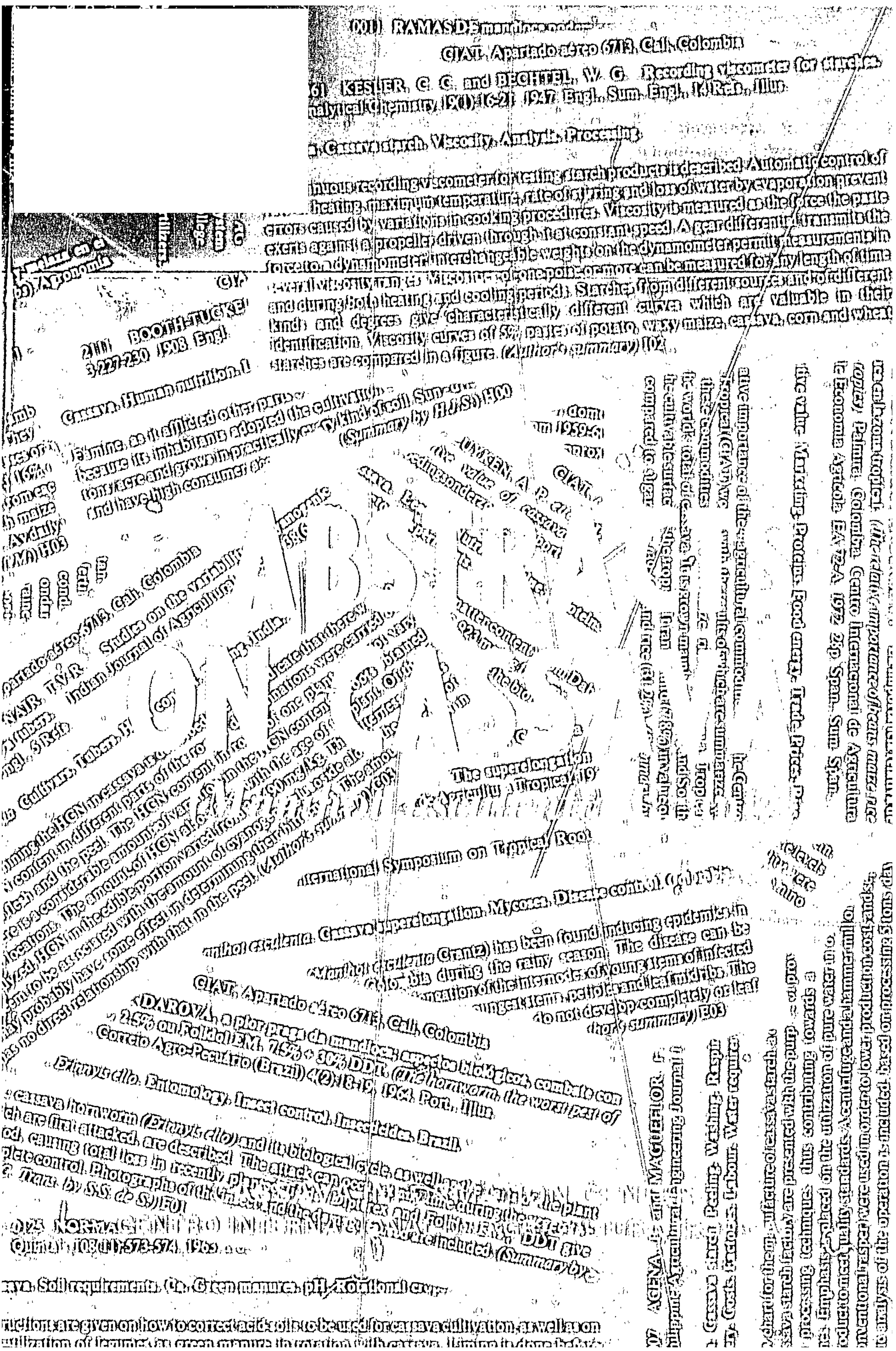
ABSTRACTS
ON CASSAVA

CIAT is a nonprofit organization devoted to the agricultural and economic development of the lowland tropics The Government of Colombia provides support as host country for CIAT and furnishes a 522-hectare farm near Cali for CIAT's headquarters Collaborative work with the Instituto Colombiano Agropecuario (ICA) is carried out mainly at its Experimental Centers at Turipana and Carimagua. CIAT is financed by a number of donors represented in the Consultative Group for International Agricultural Research During the current year these donors are the United States Agency for International Development (USAID), the Rockefeller Foundation, the Ford Foundation, the W.K Kellogg Foundation, the Canadian International Development Agency (CIDA), the International Bank for Reconstruction and Development (IBRD) through the International Development Association (IDA), the Interamerican Development Bank (IBD), the United Nations Environment Programme, the Ministry of Overseas Development of the United Kingdom and the governments of Australia, Belgium, the Federal Republic of Germany, the Netherlands and Switzerland. In addition, special project funds are supplied by various of the aforementioned entities plus the International Development Research Centre (IDRC) of Canada. Information and conclusions reported herein do not necessarily reflect the position of any of the aforementioned agencies, foundations or governments

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ABSTRACTS ON CASSAVA

(*Manihot esculenta* Crantz)

Volume II

CASSAVA INFORMATION CENTER
CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL

FOREWORD

Volume II of Cassava Abstracts is the result of efforts to complete the backlog information on this crop. Starting in 1977, semiannual supplements will be issued to maintain an up-to-date, permanent record of this collection.

The Cassava Information Center at CIAT offers a complete service on cassava documents. Monthly, subscribers receive all abstracts that have been processed through the Center during that period. In addition, by means of a mechanized system, specific searches can be made on any topic or combination of topics, and abstract cards on all documents dealing with that particular subject are provided. Users can then request photocopies of the original documents in which they are interested.

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It is our constant hope that services such as those provided by the Cassava Information Center at CIAT be used extensively by researchers throughout the world since information per se is not an end in itself but one of the major pillars supporting research activities that contribute to eliminating mankind's major concern—hunger.

Fernando Monge, Ph.D
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A00 BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

0001-5939 CROIZAT, L. *Manihot tweediana* Mueller is unacceptable. Revista Argentina de Agronomía 11(3):173-174. 1944. Engl., Sum. Span.

Manihot tweediana. **Taxonomy. Argentina.**

The complexity of the genus *Manihot* has given rise to differences in nomenclature. Although Lourteig and O'Donell deny that *M. tweediana* Muell.-Arg. and *M. flabellifolia* Pohl are synonyms of the same species, there is no doubt, however, as to the synonymy of *M. grahami* Hook. 1843 and *M. tweediana* Muell.-Arg. 1873 because both belong to the same collection Tweedie made in the woods along the river Paraná. Thirty years of difference between Hooker's and Mueller's binomial are a sound reason for botanists to use the former. *(Author's summary Trans. by S.S. de S.)* A00

0002-3026 CROIZAT, L. A study of *Manihot* in North America. Journal of the Arnold Arboretum 23:216-225. 1942. Engl., Illus.

Manihot. **Taxonomy. Plant anatomy. North America.**

A preliminary report is presented on the North American species of *Manihot* Mill., which have been confused in the herbarium and in literature with *Manihot carthagenensis* Jacq. The morphological characteristics and origin of the following species are indicated: *M. carthagenensis, M. gualanensis, M. aesculifolia, M. rhomboidea, M. ludibunda, M. colimensis, M. chlorosticta, M. rubricaulis, M. isoloba, M. angustiloba* and *M. davisiae*. *(Summary by P.G. Trans. by S.S. de S.)* A00 B00

0003-6705 DEBOER, W.R. **The archaeological evidence for manioc cultivation: a cautionary note.** American Antiquity 40(4):419-433. 1975. Engl., Sum. Engl., 68 Refs., Illus.

Cassava. History. Plant geography. Cultivation. South America. Central America.

In the humid tropics of the Americas, where preservation of plant materials is unlikely, archaelogical evidence for cassava cultivation largely consists of artifacts similar to artifacts associated with cassava cultivation in the etnographic record, which, by analogy, were similarly used in the prehistoric past. The validity of this inference by analogy is examined in terms of ceramic platters and stone grater teeth, 2 of the most commonly cited proofs for cassava cultivation. *(Author's summary)* A00

0004-0006 JOHNSTON, B.F. **Staple food crops in West Africa and the Congo.** Tropical Agriculture (Trinidad) 33(3):214-220. 1956. Engl., 18 Refs.

Cassava. Plant geography. Maps. Africa.

Several maps illustrate the distribution of the main crops in the area under study. Cassava is one of the basic tubers included in the natives' diet The calorie content of cassava is 3-4 times higher than that of cereals. This crop can be successfully grown in poor soils and does not require special agricultural techniques although harvesting is rather difficult. Because cassava contains fewer proteins and vitamins of the B complex than the cereals, the diet should be supplemented with beans, fish or meat. It would be worthwhile studying cassava leaves as they are a good source of vitamins and proteins. *(Summary by L.F.C. Trans. by S.S de S)* A00

0005-1811 KENT, E. **Note sur l'introduction et la propagation du manioc à Madagascar.** *(The introduction of cassava and its dissemination in Madagascar).* Terre Malgache no. 5:177-183. 1969 Fr., 37 Refs.

Cassava. History. Plant geography. Malagasy Republic.

Historical notes are given on the origin, introduction and dissemination of cassava in Madagascar. Some other researchers' theories on this subject are analyzed. It was concluded that (1) cassava was introduced in Madagascar by Africans.(2) Its dissemination throughout the country began on the West Coast. (3) Terminology used to designate cassava in several dialects and oral tradition show that introduction and dissemination can be traced to dates earlier than 1750 *(Summary by S.S. de S.)* A00

0006-1758 LANJOUW, J. **Two interesting species of *Manihot* L. from Suriname.** Recueil des Travaux Botaniques Néerlendais 36:543-549. 1939. Engl, Illus.

Manihot. **Taxonomy.** *Manihot saxicola*. *Manihot melanobasis*. **Surinam.**

A morphological description is given of the species *Manihot saxicola* and *M. melanobasis* from Surinam. On the basis of chemical analyses, it was determined that the former is very poisonous because of its high HCN content and that its protein content on a dry basis is approx. 10%, a relatively high value as compared to the normal content of *M. esculenta*. *(Summary by A J. Trans by S.S de S)* A00

0007-0740 LEITAO FILHO, H F **Caracterização botânica de cultivares de mandioca** (*Manihot esculenta* Crantz). *(Botanical description of cassava cultivars).* Agronômico 23:73-91. 1971. Port., 18 Refs

Cassava. Cultivars. Identification. Tubers. Stems. Leaves. Flowers. Fruit. Seed. ***Manihot esculenta*. Brazil.**

Based on a review of literature, the characters (root, stem, leaf, flower, fruit and seed) used to differentiate cassava varieties are discussed *(Summary by T.M.)* A00 B00

0008-6851 LOWE, S. B., MAHON, J. D and HUNT, L A. **A small collection of *Manihot* species.** Tropical Root and Tuber Crops Newsletter no 8:29-32 1975. Engl., 2 Refs

Cassava. *Manihot* **Taxonomy. Canada.**

As part of a 2-yr program on cassava physiology that is being carried out at the University of Guelph (Canada), a number of wild species of *Manihot* were collected to study their photosynthetic potential. The material, which was received from the USA, Puerto Rico, Colombia, Brazil and Argentina, presents a wide range of characteristics. To date, the collection has 10 species; the varieties forming the collections of the aforementioned countries are indicated. Physiological characters of interest among the wild species include tolerance to drought (*M. carthagenensis)* shade (*M. brachyloba*) and low temperatures (*M. grahami, M. anisophylla* and *M. rubricaulis*). The collection at Guelph will be transferred to the National Arboretum in Washington. The trials on vegetative propagation, using the rooting hormone IBA, showed that the wild species are easily propagated from cuttings, making it possible to collect and multiply them by means of clones at a local level. (*Summary by S. S. de S.*) A00

0009-3007 McVAUGH, R **Euphorbiaceae novae novo-galicianae.** Brittonia 13(2).145-205. 1961. Engl., Illus.

Manihot **Taxonomy. Plant geography. Plant anatomy. Mexico.**

Twenty-four previously undescribed and unidentified euphorbiaceous species from the Jalisco region were studied with the purpose of contributing to taxonomic and botanical studies Abridged keys are also given of their respective genera, nomenclature, distribution and taxonomic relationships. Five species of the genus *Manihot* are included: *M. angustiloba* (Torr.) Muell; *M. auriculata* McVaugh; *M. michaelis* McVaugh; *M. microcarpa* Muell; and *M. olfersiana* Pax. *(Summary by A.J. Trans. by S S. de S)* A00 B00

0010-5935 McVAUGH, R. **The jatrophas of Cervantes and of the Sessé & Mociño herbarium.** Bulletin of the Torrey Botanical Club 72(1):31-41. 1945. Engl , Sum. Engl., Illus.

Cassava. *Manihot.* **Taxonomy.**

On the basis of specimens in the herbarium of Sessé and Mociño, it was possible to establish the identity of *Jatropha edulis, J. ciliata, J. dioica, J. triloba* and *J. quinqueloba,* all species described by Sessé in a paper by Cervantes in 1794. The typification of *J. peltata* Sessé and *J. palmata* Sessé was not possible on the basis of the material available; but they probably belong to *Manihot* sp. The identity of *J. octandra* Sessé, of which no material was available, is unknown. *Jatropha heterophylla* Sessé & Mociño and *J moluensis* Sessé & Mociño are typified by specimens in the collection. The following new names are proposed: *Jatropha humboldtiana, J. dioica* var. *sessiliflora, J. dioica* var. *graminea.* The following are relegated to synonymy: *Jatropha peltata* H B.K., *J edulis* Sessé, *J. yucatanensis* Briq., *J. olivacea* Muell. Arg , *J. grandifrons* Johnst., *J. spathulata* (Orteg) Muell Arg , *J. quinqueloba* Sessé. *(Author's summary)* A00

0011-5365 **MANDIOQUEIRA DOCE** [*Manihot dulcis* **(Gmel.) Pax**]. **Mandioqueira amarga** (*Manihot esculenta* **Crantz).** *(Sweet and bitter cassava)* Agronomia Angolana no. 2:214-225 1949. Port.

Cassava. *Manihot esculenta.* **Cultivars. Sweet cassava. Bitter cassava. Identification. Taxonomy. Plant anatomy. Angola.**

A botanical description is given of the sweet and bitter cassava species and of some varieties of cassava planted in the regions of Icolo and Bengo and in the area of Caffeira Dos Dembos, Angola. *(Summary by A.J. Trans by S.S de S.)* A00 B00

0012-1747 **MANIHOTEAE.** Flore du Congo et de Ruanda-Burundi 8(1):121-122. 1962. Fr.

Cassava. Taxonomy. Plant anatomy. *Manihot glaziovii. Manihot esculenta. Manihot.*

A taxonomic and morphological study is made of the family Manihoteae and of the species *Manihot glaziovii* Mull., *M. esculenta* Crantz and *M. utilissima* Pohl. The origin, habitat, common names, uses and areas where these species have been introduced are also dealt with briefly. *(Summary by L.C. Trans. by T.M.) A00 B00*

0013-0619 MARAFIOTI, R. L. The meaning of generic names of important economic plants. Economic Botany 24:189-207. 1970. Engl., 21 Refs

Cassava. *Manihot.* Taxonomy.

The most probable etymology is given of generic names of some 590 economically important plants. As regards cassava, *Manihot* Adans (Euphorbiaceae), the name comes from the Brazilian name for the plant (*Summary by T.M.*) A00

0014-4543 MURRAY, D. B. Notes on the vernacular names of some Nigerian cassavas. Farm and Forest 2(1):45-46 1941. Engl.

Cassava. History. Nigeria.

This article presents translocations of some vernacular names given to local cassava varieties in Nigeria. These names are useful because they focus attention on those features that are of particular interest to the African farmer, such as color, growth habit, cooking characteristics, etc. A number of varieties have different names from one region to another. *(Summary by P.G. Trans. by S S de S.)* A00

0015-1880 PITTIER, H. Botanical notes on, and descriptions of, new and old species of Venezuelan plants. II. Old and new species of Euphorbiaceae. Journal of the Washington Academy of Sciences 19(16).351-357. 1929. Engl., Lat , 2 Refs.

Manihot. Plant anatomy. Taxonomy. Venezuela.

The botanical description and taxonomic identification are given of some new species from Venezuela. Two species of the genus *Manihot* are included: *M. remotiloba* Pittier, sp. nov. and *M. meridensis* Pittier, sp. nov (*Summary by A.J. Trans by S S. de S.*) A00 B00

0016-4473 RIVIERE, C. Le manioc en Algérie et dans le bassin méditerranéen. *(Cassava in Algeria and in the Mediterranean basin).* Bulletin de la Société Nationale d'Acclimatation. de France 1897:490-496. 1897. Fr., 1 Ref.

Cassava. Plant geography. Africa.

This article discusses the introduction of cassava into Algeria and the difficulties encountered in adapting it to the edaphic and climatic conditions there. Special mention is made of the failures experienced by France, Italy and other Mediterranean countries in their attempts to introduce cassava. A brief description is given of its cycle and storage in boxes where the roots are separated by dry sand. Because of its low nutritive value and its uneconomical production, cassava cannot compete with wheat in Algeria. It is recommended to limit cassava to botanical gardens and to grow potatoes instead *(Summary by S.S. de S.)* A00

0017-1893 ROGERS, D.J. Intraspecific categories of *Manihot esculenta.* Science 126.1234-1235. 1957. Engl.

Cassava. *Manihot esculenta.* Taxonomy.

Manihot esculenta (Euphorbiaceae), a complex of tropical food plants, has a large number of unclassified subspecific units In this study the variability of the species has been intensively examined in 2 areas where the crop is important: Jamaica and Costa Rica. The 75 cultivars found here are probably representative types of a much larger area, inasmuch as man has introduced many variants in his efforts to improve the crop. After examination of plants in the field and of specially prepared herbarium specimens, it is possible to make a few rather definitive groups and from these to judge something of the total range of variation which can be expected in other regions of the growth of cassava. The framework of taxonomic categories proposed for a classification of the subspecific entities of *Manihot esculenta* is (1) convariants, the equivalent of subspecies in wild plant taxonomy; (2) subconvariants, comparable to "series"; (3) cultivars, the cultivated counterpart of taxonomist's "variety." In *Manihot esculenta* 2 convariants exist, and below this category many subconvariants are found. In each of the convariants the characteristics which differentiate the subordinate groups are almost identical and parallel categories are established. In this classification the importance of individual cultivars is subordinate to those units designated as subconvariants Some inferences about the origin of the cultivated forms may be drawn after this classification is proposed. (*Full text*) A00

0018-2912 SCHMIDT, C. B. **A mandioca; contribuição para o conhecimento de sua origem.** *(Cassava: its origin)* Boletim de Agricultura (Brazil) 52a:73-128. 1951. Port., 69 Refs., Illus

Cassava. History. Plant geography. Maps. South America. Caribbean.

The 1st part of this article gives an account of the migration of the Indian Tribes Arauak and Caribe, who traveled from South America to the Antilles, introducing cassava in all the regions they passed through Special reference is made to the Tupi-guaraní group, who at the time of the conquest already had advanced agricultural techniques and taught the inhabitants of the Brazilian Atlantic Coast and other nearby countries how to grow cassava during their migration. The origin of cassava, ascribed to the Brazilian Amazon region, is dealt with in the 2nd part. Mythical aspects attributed to cassava by some Indian tribes are also discussed and the different areas where bitter and sweet cassava were disseminated are mentioned. The last part presents the Indian version (a series of legends) of the origin of cassava. (*Summary by W.P. Trans. by S.S. de S.)* A00

0019-1849 VALERIANO, C. **Estudo botânico da mandioca; caracteres comuns ao gênero** *Manihot. (A botanical study of cassava, characteristics of the genus Manihot).* Boletim do Instituto Biológico da Bahia 1(1):110-155. 1954. Port., Illus.

Cassava. Flowers. Leaves. Petioles. Stems. Tubers. Identification. Taxonomy. Cultivars. *Manihot.* **Brazil.**

A complete botanical description of cassava is given from a morphological point of view. This paper also includes aspects of taxonomic botany, the classification of 136 bitter and sweet varieties on the basis of leaf color, and the description of 21 groups of flowers corresponding to the same number of *Manihot* species. *(Summary by A.J. Trans. by S.S de S.)* A00 B00

See also 0403

B00 PLANT ANATOMY AND MORPHOLOGY

0020-0108 ACOSTA A., J., ESCOBAR D., J. F. and PORRAS R., F. G. **Descripción y adaptación de 20 variedades de yuca** ***Manihot esculenta*** **Crantz) a las condiciones del Valle de Medellín.** *(Description and adaptation of 20 cassava varieties to the ecological zone of Medellín).* Tesis Ing. Agr. Medellín, Universidad Nacional de Colombia, Facultad de Ciencias Agrícolas, 1972. 53p. Span., Sum. Span., 11 Refs., Illus.

Cassava. ***Manihot esculenta*** **Field experiments. Cultivars. Adaptation. Identification. Soil analysis. Stems. Leaves. Tubers. Plant height. Petioles. Flowers. Fruits. Seed. Colombia.**

The objective of this study, carried out at the Centro Nacional de Investigaciones Agropecuarias "Tulio Ospina" with the cooperation of the Instituto Colombiano Agropecuario, was to evaluate the adaptation of 20 cassava varieties from the cassava center located in Palmira (Valle) to the ecological environment of Medellín (Antioquia). The morphological characteristics of each variety were recorded during the year of the experiment. Quantitative and qualitative observations were made of the following: stem (no. of main stems/plant, color, diameter), leaves (shape, color, length, diameter, petiole and shoot color), flowers (sepal color and length, stamen and pedicel length, disk and ovarium color, ovarium diameter and length), roots (shape, size, color of peel, phellogen and pulp, peel texture, phellogenic adherence, insertion, depth, weight/plant). Evaluation of adaptation of the different varieties was based on characteristics such as plant height, stem diameter and production. During the phase of vegetative development, the crop was attacked by mites *(Tetranychus bimaculatus),* the shoot fly *(Lonchaea chalybea)* and cassava ash *(Oidium manihotis).* Varieties no. 158, 161, 165, 168, 170, 171, 172 and 176 adapted well to the ecological zone of Medellín, whereas varieties 162, 164, 166, 175 and 177 did not. *(Author's summary. Trans. by S.S. de S.)* B00 D02

0021-1646 COURS, M. **Les études scientifiques sur le manioc à la Station Agricole du Lac Alaotra.** *(Scientific studies on cassava at the Agricultural Station of Lake Alaotra). In* Congrès du Manioc et de Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institut Colonial, 1949. pp. 124-131. Fr.

Cassava. Plant development. Leaves. Stems. Flowers. Tubers. Plant breeding. Starch productivity. Malagasy Republic.

This article is divided into 2 main parts: the study of the cassava plant and its improvement. The characteristics of cassava leaves; stems, branches, flowers, roots and seeds and the changes they undergo as the plant grows are described in detail. The second part emphasizes the development of high-yielding varieties, with resistance to mosaic and rots and with a high starch content. The steps that should be followed to select promising varieties are indicated. This study concentrates on Madagascar and practical applications are mainly local *(Summary by S.S. de S.)* B00 G01

0022-4986 FONTENELLE, J.B. **A mandioca.** *(Cassava)* Campo 7(74):52-54. 1936. Port

Cassava. Cultivars. Identification. Leaves. Tubers. Water content. N. Analysis. Fat content. Fibre content. Mineral content. Brazil.

This article presents a few recommendations for growing cassava in the state of Pernambuco (Brazil) and indicates the morphological characteristics and chemical composition of several cassava varieties. *(Summary by P.G. Trans. by S S. de S.)* B00 C03

0023-2200 INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES DE MADAGASCAR. STATION AGRONOMIQUE DU L'AC ALAOTRA DIVISION AMELIORATION DES PLANTES. **Charactéristiques des principales varietés de manioc diffusées.** *(Characteristics of the most important, most widely grown cassava varieties)* Lac Alaotra, IRAT-IRAM, 1968. 12p. Fr.

Cassava. Cultivars. Identification. Plant anatomy. Resistance. Productivity. Starch content. Hybrids. Malagasy Republic.

A morphological description is given of 3 cassava varieties (Criolina, Bouquet de la Réunion and Bogor) and 21 hybrids grown at the experimental station of Lake Alaotra, specifying their resistance to rots and mosaic, probable yields and starch content. Characteristics described refer only to the region of Lake Alaotra. *(Summary by S.S de S.)* B00

0024-5357 PAINE, J. **A study and collection of the edible aroids, yams and cassavas of Trinidad, B.W.I.** St Augustine, Trinidad, Imperial College of Tropical Agriculture, 1939. 66p. Engl., Sum. Engl., 12 Refs., Illus.

Cassava. Cultivars. Identification. Stems. Leaves. Petioles. Tubers. Cultivation. Trinidad and Tobago.

A nontechnical study was made of root and tuber crops in Trinidad. Methods of collecting samples and their study (in gardens and in their natural habitats), as well as a diary of the author's trips, are described. Native farmers were also interviewed as to the influence of the moon on agricultural practices. As regards cassava, descriptions and illustrations are given of 16 different samples collected. *(Summary by T.M.)* B00

0025-0266 RODRIGUEZ S., C. **Algunas indicaciones sobre el cultivo de la yuca.** *(Cassava cultivation).* Agricultor Venezolano 4(36-37):29-30. 1939. Span.

Cassava. History. Plant anatomy. Cultivation. Venezuela.

A brief historic description is given of cassava, as well as of its morphology. Some of the most important species are discussed. General climatic data, soil requirements and land preparation for obtaining good yields are also given. *(Summary by L.C. Trans. by T.M.)* B00

0026-5580 TABORDA R., F., TONG P., F. and VILLAR, A. DEL. **Observaciones taxonómicas sobre yuca, *Manihot esculenta* Crantz.** *(Taxonomic observations on cassava).* Maracaibo, Venezuela, Universidad de Zulia, Facultad de Agronomía, n.d. 10p. Span , 3 Refs.

Cassava. *Manihot esculenta*. Clones. Identification. Leaves. Petioles. Stamens. Venezuela.

In the western part of Venezuela, there is sufficient difference among cassava plants to affirm the existence of a clone complex in this zone. The purpose of this study was to describe variations found in a collection of 81 introductions from different climatic zones in the state of Zulia, in order to differentiate among clones Characteristics of the leaf—number of lobes, characteristics of the central lobe, size of stomata, presence of panduriform leaves, and color of the petioles and buds—were determined. Identification was made of several different clones, among which there may be natural polyploids; nevertheless, this study will be continued to see whether the differences found at this stage of plant development are also observed at later stages. *(Author's summary. Trans. by T. M.)* B00

0027-5237 UPHOF, J. C. T. **Estudio botánico de la yuca** *(Manihot esculenta* **Crantz)** *(Botanical study of cassava).* Revista de Agricultura, Comercio y Trabajo (Cuba) 13:9-17. 1932. Span., 8 Refs., Illus.

Cassava. Cultivars. Identification. Leaves. Stems. Tubers. HCN content. Plant anatomy. Timing. ***Manihot esculenta.*** **Cuba.**

The characteristics and relative HCN content in different plant organs of 4 varieties of cassava grown in Cuba are set forth, together with observations on blooming and anatomy. *(Summary by Chemical Abstracts)* B00 C02

0028-0165 ZEHNTNER, L. **Estudo sôbre algumas variedades de maudiocas brasileiras.** *(Study on some Brazilian cassava varieties).* Rio de Janeiro, Brasil, Sociedad Nacional de Agricultura, 1919. 112p., Port., Illus.

Cassava. ***Manihot esculenta.*** **Cultivars. Identification. Leaves. Stems. Tubers. Petioles. Flowers. Fruits. Protein content. Starch content. HCN content. Plant height. Sweet cassava. Bitter cassava. Branching. Brazil.**

A botanical description is given of 72 sweet and bitter cassava varieties collected by the Instituto Agricola da Bahia from several Brazilian states in 1909. The aspects studied for each of the varieties are leaves, flowers, branches, stems, roots, chemical composition of roots and origin. The chemical analysis of the roots included the determination of their specific wt and density and their contents of water, starch, fatty and fibrous substances, ash, glucose, HCN, proteins, hydrocarbons and albumin. Based on these results, a comparison of the varieties is made. Some field experiments were carried out to study the possible differences in root, leaf and stem wt, starch yield and color and between branching and nonbranching varieties. Tables giving the composition of the flour from several bitter and sweet varieties are included. Finally, the use of cassava in the feed industry and some aspects of flour manufacture are discussed. *(Summary by S.S. de S.)* B00

See also 0002 0007 0009 0011 0012 0015 0019 0266

C00 PLANT PHYSIOLOGY

0029-5944 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. CASSAVA PRODUCTION SYSTEMS PROGRAM. **Cassava production systems.** Cali, Colombia, 1975. 57p Engl., 10 Refs., Illus.

Reprinted from CIAT's Annual Report, 1975. pp.B-1/B-57.

Also in Spanish.

Cassava. *Manihot esculenta.* Cassava programs. Economics. Plant physiology. Plant development. Propagation. Cassava bacterial blight. *Cercospora henningsii. Phoma.* Cassava superelongation. Injurious mites. Thrips. Thysanoptera. *Anastrepha pickeli Erinnyis ello.* Aleyrodidae. Insect control. Biological control. Insecticides. Field experiments. Tuber productivity. Plant breeding. Resistance. Fertilizers. Minerals. Planting. Spacing. Cultivars. Composition. Weeding. Colombia.

This is a report on the activities of the cassava program at the Centro Internacional de Agricultura Tropical during 1975. The areas covered are economics, physiology, propagation, plant pathology, entomology, plant breeding, agronomy, soils, weed control and training. The main achievements during this year were as follows: (1) It was determined that the most efficient varieties have a leaf area index of 3-3.5 and that the best varieties are those with a long leaf life and with branches that begin to form at 4-6 mo. (2) Cassava resistance to bacterial blight was found to be transmitted to the progeny by crossing resistant with susceptible lines; similar results were obtained with superelongation disease, Phoma and Cercospora leaf spots. (3) A new bacterial disease, bacterial stem rot, probably caused by *Erwinia* sp. and spread by fruit flies *(Anastrepha* sp.) was discovered (4) A large part of CIAT's germplasm bank was found to be resistant to thrips. (5) The lack of correlation between yields/row and population yield was overcome by using harvest index as a selection criterion. (6) Data collection was completed for the agro-economic survey carried out in 5 cassava-producing zones of Colombia, and it was found that av yields were below 8 tons/ha in 4 of these zones and 12 tons/ha in the best region. (7) High yields (18 tons/ha) can be obtained by good cultural practices, but these can be further increased (30 tons/ha) when improved varieties are used. (8) A workshop was held during which the basis for regional testing programs in 16 countries was established. *(Summary by A.J. Trans. by S.S. de S.)*
C00 D00 E01 F01 J00

0030-5577 CHEW, W.Y. and TAN, M.H. **A preliminary investigation on the leaf area of tapioca *(Manihot utilissima* Pohl*).*** Kuala Lumpur, Malaysia. Division of Agriculture. Agronomy Branch. Federal Experimental Station Jalan Kebun. Paper no. 13 1969. 12p. Engl., 5 Refs., Illus.

Cassava. Leaf area. Dry matter. Plant development. Plant assimilation. Tuber productivity. *Manihot esculenta.* Malaysia.

This study was carried out at the Federal Experimental Station Jalan Kebun to determine the best and most convenient linear dimensions for making a quick leaf area estimate of cassava (variety Jurai). The leaf area of cassava plants in a community was then determined in relation to the

accumulation of dry matter in that community. Conclusions were as follows: (1) Best dimensions were those of the leaflet rectangular area, which is the product of the length of the median lobe, its greatest breadth and the number of lobes per leaf. The next best and more convenient dimension was the length of the median lobe, as this required only one simple measurement. (2) Leaf area index (LAI) increased with time; optimum LAI had still not been obtained 7 months after planting. Two-stalk plants had the highest LAI. (3) The number of productive leaves on the plant did not exceed a certain maximum, which was obtained 2-4 months after planting The LAI, however, continued to increase beyond this point. Three-stalk plants had the most leaves. (4) Dry matter accumulation for one-, two- and three-stalk plants was similar for the first 4-5 months; thereafter, two-stalk plants gave the highest TDM accumulation. Tuber development exceeded that of stem and leaves after the first 4-5 months of growth. Mean crop growth rate (CGR) 7 months after planting was 87 lb/acre/day. The CGR and net assimilation rate were highest for two-stalk plants. *(Author's summary)* C00

0031-6745 COCK, J. H. **Characteristics of high yielding cassava varieties.** Experimental Agriculture 12(2):135-143. 1976. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. *Manihot esculenta.* Field experiments. Tuber productivity. Timing. Starch content. Sugars. Dry matter. Cultivars. Leaf area. Growth. Colombia.

Forty different cultivars of cassava were grown in unreplicated plots at a plant population of 20,000 plants/ha in fertile soil. Harvests were taken at 4, 6, 8, 10 and 12 mo after planting 18 varieties. The characteristics of the 2 highest yielding varieties, M Colombia 113(66 tons/ha) and M Colombia 22 (32 tons/ha), were compared with the other types. M Colombia 22 is an early-maturing type (25 tons/ha after 6 months) with a very high harvest index; M Colombia 113 yields little better than average 6 mo after planting. High yield is associated with a balance between leaf and root production, so that leaf area index does not decline excessively in the later growth stages. Changing canopy structure is unlikely to increase yields. *(Author's summary)* C00 D03

0032-6917 COCK, J. H. **Fisiología de la planta y desarrollo.** *(Plant physiology and development). In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp. 35-43. Span., Illus.

Cassava. Plant physiology. Plant development. Leaf area.

The results of cassava research that led to the definition of a plant ideotype are discussed briefly. High yields are a function of high total dry matter (DM) production and high DM root content (70%). To achieve this goal, leaf area index (LAI) should range from 4-5, especially during the last half of its life cycle Increasing leaf production or reducing leaf fall are used to increase LAI. The following conclusions are presented: (1) It is a better practice to increase LAI by preventing leaf fall than by increasing leaf formation. (2) The fall of old leaves (photosynthetically efficient) is controlled by both the roots and the aerial part of the plant. (3) An efficient plant is one with a relatively slow leaf production and satisfactory leaf retention. (4) A preliminary determination indicates that plants with a low no of branches have a higher harvest index (optimum 60) and that excessive or early flowering reduces leaf retention capacity and leaf size. (5) More than 70% DM passes to the roots. Although a plant ideotype has not been clearly defined yet, it should be a short type and have a sufficient no. of leaves that do not fall until a satisfactory and well-distributed root production is obtained. (*Summary by A.J. Trans. by S.S de S.*) C00

0033-5942 COCK, J. H. and ROSAS S. C. **Ecophysiology of cassava.** Cali, Colombia, Centro Internacional de Agricultura Tropical, 1975. 14p. Engl., Sum Engl , 9 Refs , Illus.

Paper presented at International Symposium on Ecophysiology of Tropical Roots, Manaus, Brazil, 1975.

Cassava. Climatic requirements. Soil fertility. Temperature. Germination. Leaves. Tuber productivity. Photoperiod. Water requirements (plant). Growth. Plant physiology. Leaf area. Ecology. Colombia.

Cassava is a high-yielding crop, well adapted to areas of the tropics with low, uncertain rainfall and mean temperatures above 20°C. It has the ability to grow on very acid soils where few other crops will grow at all; however, highest yields are obtained under more fertile conditions It will not tolerate excessive moisture in the soil, which leads to root rots and lower yields. It responds well to the high solar radiation levels likely to be found in the drier tropical regions Where long days are encountered, yields decline slightly. *(Author's summary)* C00

0034-6805 **GERMINATION AND pollination.** *In* Terry, E. R. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976 p.41. Engl.

Cassava. Germination. Pollination. Plant reproduction. Nigeria.

Cassava germination and pollination methods used by the International Institute for Tropical Agriculture are presented. As regards germination, true seed is planted in field beds during the dry season (soil temperature 30-35°C) with irrigation until the beginning of the rainy season. Especially valuable seed is pregerminated in screenhouses from where the seedlings are transplanted directly to the field. Pollen collection and pollination are done in the morning on sunny days. To obtain higher hetorozygosity, IITA uses a pollination method consisting of the following steps: (1) collection of as many flowers as possible from the desired parent into small plastic boxes, (2) cutting them in half laterally and discarding the basal part; (3) cutting away the male flowers from the inflorescence that is going to be pollinated; (4) opening the female flowers with forceps and dusting pollen onto the stigma, (5) covering the pollinated flowers with a paper bag tied at the bottom; and (6) labeling each inflorescence, indicating date, relationship and no. of flowers pollinated. *(Summary by A.J. Trans. by S. S. de S.)* C00

0035-6837 HUNT, L A. **Environmental physiology of cassava; research proposal to IDRC from the University of Guelph.** Ontario, University of Guelph, 1975. 13p. Engl

Cassava. ***Manihot esculenta.*** **Cassava programs. Plant physiology. Canada.**

In early 1973, the International Development Research Centre approved a package of 3 projects on environmental physiology of cassava to be carried out by the University of Guelph in cooperation with the Centro Internacional de Agricultura Tropical. The objectives were (1) to determine useful characteristics that plant breeders could incorporate into improved varieties and (2) to recommend the treatments that could be included in husbandry trials. Three previous projects had been designed to produce part of the information needed; this proposal covers 4 additional projects oriented to the achievement of these goals Postgraduate training for Canadian graduate students and trainees from different countries will also be included. The 4 projects are leaf photosynthesis under field conditions, adaptability to different thermal environments, adaptability to dry environments, and translocation and transpiration patterns The aspects studied are objectives, specialized equipment required, location, duration, background, significance and research plans. Finally, staff requirements and the budget are included. *(Summary by S.S. de S.)* C00 J00

0036-6819 HUNT, L. A , MAHON, J D. and LOWE, S B.**Growth rooms—tools for cassava research.** Tropical Root and Tuber Crops Newsletter no.8:15-19. 1975. Engl , 4 Refs.

Cassava. Plant physiology. Growth-chamber experiments. Leaf area. Plant assimilation. Temperature. Cassava programs. Canada.

Data are presented comparing the leaf area, total plant dry weight, net assimilation rates and rate of leaf appearance of cassava cv. Llanera grown in the field at 30/18°C (daily maximum and minimum), at CIAT, Cali (Colombia) and in growth cabinets at 29/24° at Guelph. (*Summary by Plant Breeding Abstracts*) C00

0037-7477 HUNT, L. A., WHOLEY, D. W. and COCK, J. H. **Stem and leaf parameters in some cassava (*Manihot esculenta* Crantz) cultivars.** Guelph, Canada, University of Guelph, Department of Crop Science, 1974. 16p. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. *Manihot esculenta*. Cultivars. Plant physiology. Stems. Leaves. Leaf area. Branching. Colombia.

Detailed measurements were made of some of the stem and leaf characteristics of well-established plants of a no. of cassava cultivars from the Centro Internacional de Agricultura Tropical, CIAT. The no. of nodes before the 1st fork varied from 10-15 for 2 cultivars to over 500 for 1 cultivar in which branching associated with reproductive development was not observed. The no. of nodes between branching points appeared to be less from Mar.-Sept. than from Nov.-May. Av internode length between branching increased after the 1st fork and decreased after either the 2nd or 3rd fork in the 2 cultivars examined. Individual internodes were extremely short (0.5 cm) immediately before, and long immediately after, the branching points associated with reproductive development. Leaf size and lobe no. increased for several plastochrome intervals after, and decreased before, branching points associated with reproductive development Petiole lengths and weights were linearly related to laminae lengths and weights, respectively; lamina area was linearly related to lamina wt. Mean rate of leaf appearance varied between genotypes from 6.7-7.7 leaves/10 days to 3.3-4.0 leaves/10 days. The phyllochrome age of the oldest leaf, which varied considerably among the cultivars examined, increased in the early stages of growth and decreased later. This parameter was greater at wider spacings. The results emphasize both the need for detailed cultivar descriptions in reports of agronomy and physiology studies and the potential importance of the branching characteristics in determining the pattern of leaf area increase and decrease for any given cultivar. *(Author's summary)* C00

0038-6706 LIU, M. C. **The in vitro induction of callus and regeneration of cassava plants from shoot apical meristems.** Taiwan Sugar 1975:171-177. September-October 1975. Engl., Sum. Engl., 25 Refs., Illus.

Cassava. *Manihot esculenta*. Apical meristems. Propagation. Shoots. Culture media. Plant-growth substances. Plant tissues. Rooting. Laboratory experiments. Plant physiology. Taiwan.

Small (2 x 5 mm) shoot tips of 3 cassava cultivars (White Powder, Wu-Tze and Mangi No. 4) were excised and grown on modified Murashige-Skoog medium containing various levels of benzyladenine (BA), gibberellic acid (GA_3) and naphthaleneacetic acid (NAA). Formation of calluses, shoots, roots or complete plantlets depended on the growth regulators used. Only calluses were proliferated on the medium supplemented with 2 mg/liter 2,4-D. NAA and BA combined evoked 58% of the excised meristems forming complete plants, 37% regenerating shoots only. NAA in conjunction with kinetin resulted in a similar rate of shoot regeneration but a lower frequency of complete plant emergence in comparison with the medium containing NAA and BA. BA applied jointly with GA_3 induced vigorous shoot differentiation, but very few of them developed roots. All of the differentiated shoots lacking root system could well be rooted by allowing them to grow on MS medium containing a higher level of NAA (1.0 mg/liter) or Schenk and Hildebrandt medium BA, GA_3 and NAA combined in a one-step system of plant production would not yield as good results as that of BA and NAA. Controversial reports concerning GA_3's physiological effect are discussed. *(Author's summary)* C00

0039-0691 MILTHORPE, F. L **Some physiological principles determining the yield of root crops.** *In* International Symposium on Tropical Root Crops, St Augustine, Trinidad, 1967. Proceedings. St Augustine, University of West Indies, 1969. v.2 , pp. 1-19. Engl., 48 Refs , Illus.

Cassava. Productivity. Potatoes. Plant development. Plant physiology.

Young plants of all species are more responsive than old plants to variations in environment. Exploration of the truly tropical species, both in terms of degree of response during ontogeny and with respect to the mechanisms involved, would lead to a clearer understanding and control in agricultural production and provide a more precise knowledge of the physiological bases of plant morphogenesis. These data should be combined with an increasing appreciation of the soil and aerial environment. Little is known about the response of tropical root crops (i.e., sweet potatoes, cassava, yams) to environmental factors; in this paper, plant development in potatoes, sweet potatoes and sugar beets is compared. Development of potato sprouts during storage, initiation of storage organs, interrelationships between the growth of storage organs and stems, and potato plant behavior in the tropics are discussed. (*Summary by T.M.*) C00

0040-6849 MOH, C. C **Induction of anther callus in cassava.** Tropical Root and Tuber Crops Newsletter no. 8:5-7 1975. Engl., 2 Refs.

Cassava. Anthers. Culture media. Laboratory experiments. Plant physiology.

A great deal of attention has been given recently to the induction and utilization of haploids in plant breeding. In vegetatively propagated crops, this system is very valuable because the haploid material can be kept indefinitely and can be easily propagated. In addition, haploid tissues induce somatic mutation, usually giving rise to a higher mutation rate. This article describes the method and the medium that enabled cassava anthers to produce callus Cultivar no. 68 was selected because it was not pollen sterile. The steps followed from the planting of cuttings to the cutting of male flowers are described. After sterilizing the flowers, the anthers are placed in a culture medium, essentially the same as that of Murashige and Skoog but with modified growth regulators. The composition of this medium is given in detail. Afterwards, anthers are incubated in the dark at 28°C. Four to 6 wk later, the anther wall is ruptured and the callus appears It is not certain whether the callus develops from the pollen grain or from other somatic tissue of the anther; an examination of its chromosome number may help to identify its origin. Shoot development was not obtained, probably because some other substances should be added to the culture medium. (*Summary by S. S., de S*) C00

0041-5946 NAYAR, G.G. **Neutron induced variegated mutation in tapioca.** Current Science 44(6).205. 1975. Engl., Illus.

Cassava. Mutation. Genetics. India.

This is a report on a variegated mutant obtained in the neutron irradiated population of cassava. Fresh cuttings of a promising cassava var H-97 (obtained from Dr. N. Hrishi, Director, Central Tuber Crops Research Institute, Trivandrum) were exposed to fast neutrons using Standard Neutron Irradiation Facility (SNIF) in the APSARA Reactor of the Bhabha Atomic Research Centre. The dose rate was 71 rad/min and 12 cuttings were exposed per treatment. The radiation dose ranged from 25-250 rad. The cuttings, along with the untreated control, were planted in the field immediately after treatment. One of the 2 sprouts developing from 1 cutting in the 125 rad treatment was a sectorial chimera with variegated leaves in early growth period in the MV_1 generation. After harvest, the stem with variegated leaves was made into 10 cuttings and planted. In the MV_2 generation, 2 sprouts in the population had all their leaves variegated; the lobes were light green with a white border. Three other sprouts in early stages of growth were chimeric and had variegated leaves as in the MV_1 generation. One of these sprouts later developed normal green leaves whereas in the other 2, the leaves later developed were variegated. All the other sprouts in the population were normal green. There is a garden variety of cassava (*M. esculenta* Crantz var. *variegata* Hort.), which has variegated leaves with a yellow middle region and green border. The variant obtained in the present study is conspicuously different from the existing variegated type with respect to chlorophyll distribution and its nature. On account of low chlorophyll content, the growth was less vigorous in the variegated mutant As the palisade cells did not possess chlorophyll and were mostly empty, the leaves appeared light green, especially on the ventral side. *(Full text)* C00

0042-7402 PASSAM, H. C **Cyanide-insensitive respiration in root tubers of cassava.** Plant Science Letters 7(3):211-218. 1976. Engl., Sum. Engl., 14 Refs., Illus.

Cassava. Plant physiology. Plant tissues. Tubers. Cyanides. Plant respiration. Laboratory experiment.

The respiration of tissue discs prepared from cassava roots is stimulated by 1 mM KCN. The rate of oxidation of succinate by cassava mitochondria is partially inhibited by KCN. Inhibition is increased by the further addition of salicylhydroxamic acid (SHAM), indicating the operation of a cyanide-insensitive electron transport pathway, alternative to cytochrome oxidase and similar to that described for other plant mitochondria The inhibition of succinate oxidation by KCN and SHAM is apparently dependent on the electron transport capacity of the cytochrome oxidase and alternative oxidase pathways. *(Author's summary)* C00

See also 0338 0414 0424

C01 Plant development

0043-5614 CAMPOS, H. DOS R. and SENA, Z. F. DE **Profundidade do sistema radicular do aipim "Maragopipe" (*Manihot esculenta* Crantz) aos sete e aos doze meses de ciclo.** [*The depth of cassava roots (sweet cultivar Maragopipe) at seven and twelve months of age* *In* Projeto mandioca. Cruz das Almas, Brasil Convênio U.F.B.A./BRASCAN Nordeste. Série Pesquisa v.2, no.1. 1975 pp 65-70. Port., Sum. Port., Engl , 10 Refs , Illus

Cassava *Manihot esculenta*. Roots. Plant development. Timing. Brazil.

A study of the root distribution in the sweet cultivar Maragogipe was made in an oxisol (Série sede) at the Escola de Agronomia in Cruz das Almas, Bahia (Brazil). The root system reached depths of 90 and 140 cm at 210 and 365 days of growth, respectively. In the upper layer of soil (0-30 cm deep), 95.3 and 96 4% of the roots were found, whereas 65.6 and 85.75% were in the uppermost layer (0-10 cm). *(Author's summary)* C01

0044-6831 CHAPMAN, A.L. **Cassava introduction and planting material increase; final report.** Kununurra, Australia. Kimberley Research Station, 1974. 10p. Engl.

Cassava. *Manihot esculenta*. Cuttings. Field experiments. Growth. Plant development. Shoots. Selection. Timing. Tuber development. Tuber productivity. Cultivars. Australia.

The cycle of development of 6 cassava *(Manihot esculenta)* cultivars (UQ.1, UQ.6, UQ 20, UQ.21, UQ.24 and UQ.26) from planting time (Aug 1973) to harvesting 12 mo later is described. This experiment was carried out at the Kimberley Research Station in Kununurra, Australia. Cuttings were planted at an angle at a depth of 10 cm and irrigated at 7- to 10-day intervals. Phosphorus, Zn and N were applied 1 mo later. By this time, UQ.6 had produced shoots and was growing well. Ten % of the UQ.20 cuttings failed to grow, this percentage varied from 1-2% for the other 4. At 2 mo of age, a disorder (possibly Zn deficiency) characterized by interveinal chlorosis of younger leaves that produced distortion and stunted growth was detected; older leaves were attacked by white, rounded spots. UQ. 6, the best cultivar, was not affected; but in UQ 24, only 18% of the plants were symptomless. Two mo later the symptoms disappeared. At the beginning of April, all cultivars except UQ.6 had produced flower buds. In late April, the plants had already produced roots 5-6 cm in diameter; roots of all cultivars were located within the top 15 cm of soil. At harvest, UQ.6 and UQ. 1 had the best root distribution and shape for mechanical digging A number of UQ.20 plants showed root rot. The outer skin of UQ.6 was pigmented with anthocyanin. Data on plant growth and root yields are given in tables. *Spodoptera litura, Heliothis armigera* and red spider mites attacked the shoots during the 1st months but did not cause serious damage. *(Summary by S S. de S)* C01 D03

0045-7009 CUNHA, H.M.P. DA and CONCEIÇAO, A.J. DA **Indução ao florescimento da mandioca (*Manihot esculenta* Crantz) — Nota prévia.** *(Preliminary note on flowering induction in cassava).* *In* Projeto mandioca. Cruz das Almas, Brasil Convênio U.F. Ba /BRASCAN Nordeste. Série Pesquisa v.2, no. 1. 1975.pp. 11-14. Port., Sum. Port., Engl., 4 Refs.

Cassava. *Manihot esculenta.* Plant-growth substances. Flowering. Illumination. Field experiments. Brazil.

The results are given of a preliminary experiment to induce flowering in cassava under the climatic conditions found in Cruz das Almas, Bahia (Brazil). Treatments used naphthaleneacetic acid, indoleacetic acid, Chlormequat and artificial light from tungsten bulbs (120 V x 150 W). Induction of flowering was most effective with the last treatment: 2 ½ h light, beginning at 6:30 p.m. *(Author's summary)* C01

0046-4537 FORNO, D. A., ASHER, C. J. and EDWARDS, D. G. **Mist propagation of cassava tip cuttings for nutritional studies: effects of substrate calcium concentration, temperature and shading.** Tropical Agriculture (Trinidad) 58(1).47-55. 1976. Engl., Sum. Engl., 15 Refs., Illus.

Cassava. *Manihot esculenta.* Cuttings. Shoots. Leaves. Propagation. Growth-chamber experiments. Plant physiology. Nutritional requirements. Ca. Temperature. Roots. Growth.

A method is described for the production of uniform batches of rooted tip cuttings suitable for use in nutritional studies. Use of root-promoting hormones has been found unnecessary. Acid-washed, black polyethylene beads moistened with a dilute solution of a calcium salt (150 µM) were found to provide a low-nutrient environment in which healthy root development can occur. The optimum bed temperature for the cultivars studied was in the range of 25-30°C. Heavy shading of the propagation beds (about 80% light reduction) caused substantial reductions in root growth; however, light shading (about 30% light reduction) for the first 2 or 3 days of the propagation period reduced initial wilting in some cultivars and may assist in their establishment. *(Author's summary)* C01 D02

0047-4844 GIRALDO, C.C. **Observaciones experimentales de campo como aporte al estudio del posible influjo de las fases lunares en el cultivo de la yuca.** *(Experimental field observations on the possible influence of lunar phases in cassava cultivation).* Tesis Ing. Agr. Manizales, Colombia, Universidad de Caldas, Facultad de Agronomía, 1970. 36p. Span., 14 Refs., Illus.

Cassava. *Manihot esculenta.* Plant development. Climatic requirements. Field experiments. Colombia.

In order to corroborate the popular belief that planting during different lunar phases affects cassava cultivation, an experiment was conducted on the farm "La Suiza" in Manizales (Colombia), using the variety Cascarilla. The trial was divided into two experiments using a Latin square design in which the treatments corresponded to the different phases of the moon. Four variables were considered stem thickness, height of branching, size of roots and total root weight in each plot. Harvesting was done at 14 months. It was found that there may be a possible lunar influence on both the variables and the crop in general Stem thickness, size and weight of roots tended to decrease as luminosity increased, whereas height of branching increased as lunar luminosity increased. *(Author's summary. Trans. by T.M.)* C01

0048-4414 GOPINATHAN NAIR, V. and KUMARA PILLAI, P. **Further observations on a tapioca graft-hybrid.** Agricultural Research Journal of Kerala 4(1):106. 1967. Engl., 1 Ref.

Cassava. Grafting. Branching. Hybrids. India.

Gopinathan Nair and Kumara Pillai (1964) reported the development of a green branch from a variegated scion in a cassava graft through a progressive reduction in the extent of leaf variegation. This branch was subjected to a critical study in the planting season of 1964. The stem was cut into a number of cuttings and they were planted according to the sequence. It was observed that cuttings from the variegated segment of the stem produced both variegated and green branches, whereas those from the green segment produced only green branches. This suggests that the change from the variegated to green obtained in 1963 is of a permanent nature. The green plants so obtained resemble the normal green variety (stock type) in the color of leaves, stem and fruit But for the bulk of other plant characters such as stature, duration, branching habit and fruiting habit, they resemble the variegated variety (scion type). Thus the change occurred in a segment of the scion has affected only the color of the different plant parts. The genetic relationship of the new green form to the stock and scion types can be studied by making suitable crosses. The three types are being maintained in this division through vegetative propagation. The original graft plant (normal green as stock and variegated as scion) produced a number of branches from the scion region in April 1964. Most of them were variegated and so true to the scion type. Two branches were pure green. Another branch was more interesting, in that it was a sectorial chimera for green and variegated at development and continued to be so till the very end. The two types occupy almost equal sectors in the stem. The development of pure green branches and a sectorial chimera from the variegated scion suggests that the scion segment no longer maintains its true variegated nature. (*Full text*) C01

0049-5755 LOWE, S. B., MAHON, J. D. and HUNT, L. A. **The effect of daylength on shoot growth and formation of root tubers in young plants of cassava *(Manihot esculenta* Crantz).** Plant Science Letters 6(1):57-62. 1976., Engl., Sum. Engl., 16 Refs., Illus.

Cassava. *Manihot esculenta.* Growth-chamber experiments. Photoperiod. Plant height. Stems. Shoots. Growth. Roots. Tuber development.

Plants of cassava *(Manihot esculenta* Crantz var. Llanera) were grown from stem cuttings for 16 wk under 3 day-length treatments of 8 h (short days), 14 and 20 h, using an 8-h basic period of high intensity light in all treatments, extended with weak incandescent light to give long-day treatments. Results of a harvest at 8 wk indicated that the initiation of root tubers was earlier in the 8-h day length than the 14 or 20 h, but there was no difference in the number of root tubers in the 16-wk harvest. However, the weight of root tubers was 75 g in the 8-h day length, compared with 30 and 35 g in the 14 and 20 h day lengths; this was accompanied by a reduction in stem dry weight to 18 g, compared with 47 and 41 g in the long-day treatments. It was concluded that a long photoperiod promotes shoot growth and reduces root tuber development in young cassava plants, without influencing total dry weight. *(Author's summary)* C01

0050-5203 SENAWI, M. IBN M. T. **Toward production of virus-free manioc plants *(Manihot esculenta* Crantz).** Serdang, Malaysia, Malaysian Agricultural Research and Development Institute (MARDI), 1975. 5p. Engl., Sum. Engl., 3 Refs.

Paper presented at the National Plant Tissue Culture Symposium, Kuala Lumpur, 1975.

Cassava. *Manihot esculenta.* Tissue culture. Plant development. Culture media. Rooting. Plant-growth substances. Leaves. Petioles. Stems. Malaysia.

Stem internodal sections about 2 mm long, excised from the 2nd to 5th nodes from the apex, were grown on a synthetic agar medium containing a known ratio of auxin to cytokinin. Two types of callus were observed on the explants: (1) the "surrounding callus," which originated from the epidermal or subepidermal region and developed around the sides and lower region of the explants and (2) the "central callus" which originated from the pith region and developed on the upper surface of the explants. High levels of auxin appeared to stimulate greater root formation.

It was observed that younger explants (excised nearer the apex) formed more roots. The roots appeared to originate from the cambial region of the stem; their development appeared to be arrested after a stage, probably due to the formation of an abscission layer at the base of the roots. Shoot formation was not observed even at relatively high levels of cytokinin. Gibberellic acid did not initiate organogenesis. Current work is centered on developing a hormonal treatment capable of initiating balanced organogenesis (i.e., both shoot and root initiation) from the callus. *(Author's summary)* C01

0051-7268 SHANMUGAM, A. and SHANMUGHAVELU, K. G. **Influence of ethrel on growth and yield of tapioca.** Indian Journal of Plant Physiology 17(1-2) 44-46 1974 Engl , Sum. Engl , 13 Refs.

Cassava. Plant-growth substances. Growth. Tuber productivity. Tubers. Starch content. HCN content. Sugars. Ascorbic acid. India.

The effect of ethrel on growth and yield was studied using cassava (var. Malavella). At higher concentrations (2000 mg/liter), it induced epinastic symptoms; at 250 and 500 mg, it increased root yield. Ethrel increased starch content whereas HCN content decreased. *(Author's summary)* C01 D03 C03

0052-7256 SHANMUGAM, A., THAMBURAJ, S. AND MUTHUKRISHNAN, C.R. **Effect of 2,3,5-triiodo benzoic acid (TIBA) on tapioca (*Manihot esculenta* Crantz).** Madras Agricultural Journal 61 (10/12). 1007-1008. 1974. Engl , 4 Refs.

Cassava. *Manihot esculenta*. Field experiments. Tuber productivity. Tuber development. Plant height. Plant-growth substances. India.

A trial was carried out with 3-mo-old cassava plants, varieties Malavella (ME 4) and Musri (ME 7). Triiodo benzoic acid (TIBA) was sprayed onto the leaves to run off at concentrations of 500, 1000, 1500 and 2000 ppm in order to measure its effect on yield and general performance of cassava plants Similar responses were obtained with both varieties. The reduction in foliage was proportional to the increase in the concentration employed, the maximum being recorded at 2000 ppm. The maximum yields of 30.8 and 29.8 tons/ha for ME 4 and ME 7, respectively, were obtained with the application of TIBA at 1000 ppm, giving an increase over the control of 33.45 and 37.69%, respectively. Increases in concentration reduced yields because TIBA interfered with auxin transport. The increase in yields can be attributed to a better distribution of dry matter due to the treatment. TIBA applications reduced root size but increased their number. *(Summary by A.J. Trans. by S.S. de S.)* C01 D03

0053-7393 SHANMUGAVELU, K. G. *et al.* **Effect of certain growth regulants on tapioca.** South Indian Horticulture 21(3). 119-122. 1973. Engl., Sum. Engl., 9 Refs.

Cassava. *Manihot esculenta*. Field experiments. Plant-growth substances. Tuber productivity. Growth. Shoots. Starch content. India.

Studies on the effect of several growth regulants on cassava var. Malavella indicated that Ethrel (2-chloroethylphosphonic acid) at 2000 ppm caused formative effects with maximum reduction in shoot growth and promoted lateral shoots. MH (1,2-dihydro-3,6-pyridazinedione) also reduced shoot growth. Ethrel at 250 and 500 ppm and Alar (succinic 2,2 dimethylhydrazide) at 1000 ppm increased starch content remarkably (10.5 and 11%, respectively, as compared to the control), besides increasing total soluble starch content; however, ascorbic acid content was reduced. Data on economic returns from the Alar and Ethrel treatments are given *(Summary by T.M.)* C01 D03

0054-7267 SINHA, S. K. **Further studies on the mechanism of tuberization in** *Manihot esculenta.* Indian Journal of Plant Physiology 16(1-2): 84-88. 1973. Engl., Sum. Engl., 3 Refs., Illus.

Cassava. *Manihot esculenta. Manihot glaziovii.* **Grafting. Tuber development. India.**

Reciprocal grafts were made between *Manihot esculenta* (tuber bearing) and *M. glaziovii* (nontuberous). The results showed that the scion and leaves play a significant role as tuberization occurred only when *M. esculenta* acted as the scion. *(Author's summary)* C01

0055-4558 UTTAMAN, P. **A short note on the bud sprouts of tapioca setts.** Madras Agricultural Journal 39.468-470. 1952 Engl.

Cassava. Cuttings. Shoots. Plant development. Plant height. Timing. Field experiments. Germination. Leaves. Petioles. Stems. India.

A trial was conducted with cassava cuttings taken from the basal, middle and top parts of the stem of the variety Valenca to determine differences in vigor and height. Based on the results of this experiment, another trial was carried out with equally mature cuttings taken from the same part of the stem and exhibiting the same diameter but of different lengths. For the 1st experiment, height was measured 50 and 95 days after planting. The plants from the basal portion turned out to be the highest at both 50 and 95 days (21.1 and 77.6 cm, respectively), whereas those from the middle and top portions measured 20.5 and 63.1 cm and 14.6 and 52.1 cm, respectively. In the 2nd experiment, it was found that the greater the length of the cuttings (that will have, therefore, a larger no. of buds), the greater the length and basal thickness of the main stem. In a 3rd experiment, cuttings from the same stem were planted leaving only 1 bud/cutting. It was observed that 3 buds at the top end of the stem, out of 35 buds on the entire stem, did not germinate and that the plants resulting from the basal and lower part of the middle portion were more vigorous and healthier than the others. *(Summary by A.J. Trans. by S.S. de S.)* C01

0056-5037 WHOLEY, D. W. and COCK, J. H. **Rooted shoots for physiological experiments with cassava.** Tropical Agriculture (Trinidad) 52(2).187-189. 1975. Engl., Sum. Engl., 3 Refs., Illus.

Cassava. *Manihot esculenta.* **Cuttings. Shoots. Starch content. Growth. Propagation. Rooting. Sugars. Plant physiology. Colombia.**

The early growth of cassava is influenced by both carbohydrate and mineral reserves in the planting material. Rooted shoot tips provide a convenient tool for physiological investigations into early growth and mineral nutrition. Details are given for the production of rooted shoots. *(Author's summary)* C01

0057-0402 WILLIAMS, C.N. and GHAZALI, S.M. **Growth and productivity of tapioca** *(Manihot utilissima).* **I. Leaf characteristics and yield.** Experimental Agriculture 5(3):182-194. 1969. Engl., Sum. Engl., 12 Refs., Illus.

Cassava. ***Manihot esculenta.*** **Leaves. Leaf area. Foliage. Plant physiology. Plant development. Timing. Cultivars. Malaysia.**

Shoots of high-, medium- and low-yielding cassava clones were examined to see whether yield was associated with morphological characteristics of the foliage and/or leaf area development. The lowest yielding variety had the highest leaf area per stem and vice versa, differences in leaf area being mainly due to differences in leaf size Leaves of the highest yielding variety had attenuated lobes, which tended to have a more vertical, mid-day orientation whereas the lowest yielding variety possessed large, broad-lobed leaves with a more horizontal orientation. The intermediate variety had acutely attenuated lobes and showed a much more vertical, daytime orientation. The relationship between these leaf properties and canopy efficiency is discussed. *(Author's summary)* C01

See also 0186 0187 0243 0261 0285 0390

0058-3312 ADRIAENS, L.. **Contribution a l'étude de la toxicité da manioc au Congo.** [*Contribution to the study of cassava toxicity in the Belgian Congo (Zaire)*]. Bruxelles, Institut Royal Colonial Belge, Section des Sciences Naturelles et Medicales, 1946. 140p. (Mémoires v.4.no.3). Fr., Sum. Dutch, 67 Refs.

Cassava. Toxicity. HCN content. Cyanogenic glycosides. Cyanogenesis. Detoxification. HCN. Metabolism. Hydrolysis. Analysis. Enzymes. Glucose. Cassava products. Biochemistry. Zaire.

The purpose of this study is to find chemical elements that can be used as antidotes to HCN toxicity. A description is given of the principal methods for preparing cassava as a food. Since it is difficult to obtain large quantities of natural or synthetic heterosides, the tests have been done with synthetic aglycone. An attempt has been made to measure the behavior of aglycone and dimethylcyanohydrin in emulsions found in different samples of cassava roots and cassava flour. The presence of diastases was established. The classic reaction to amygdaloside was applied, and liberation was brought about by means of Guignard's test with sodium picrate reaction. Once the presence and rate of reaction of the hydrolytic emulsions had been determined, a quantity of synthetic aglycone was added to the heteroside of the flour in a moist medium. After preliminary trials, which made it possible to determine the optimal conditions of the reaction, the samples were tested. The titration of the HCN made it possible to determine the quantity of acid liberated after a certain period of time. The effect that HCN has on acetone, benzaldehyde, the glucosides and their derivates was determined. It was found that the glucose and the HCN combine with excellent results in a medium that has 2 g of cassava flour. The other chemical components used give slower, less perfect reactions. The action of glucose was studied thoroughly to establish the optimal rates, time and temperatures. It was found that processed products such as flours or starch prepared in the laboratory and submitted to the action of synthetic aglycone, hydrolyze the glucose much better than unprocessed products. If 5.4 g of glucose is added to 1 kg of cassava, it is sufficient to neutralize the toxic effect of 100 mg HCN although products shipped to Europe never contain such a quantity. If they do contain cyanogenic compounds, there are only traces or insignificant quantities present; therefore, these feeds can be consumed at no risk. Difficulties can be avoided if exporters prepare the cassava adequately. For this reason, it is proposed that cassava be prepared in the form of chips or slices in order to export unprocessed, but perfectly conditioned products. (*Summary by C.P. Trans. by T.M.*) C02 H04

0059-1787 MENON, A.G.G., NAIR, K.P.M. and GEORGE, C.M. **Effect of Seradix-B1, B2 and B3 on the yield of tapioca** ***Manihot esculenta*** **Syn.** ***Manihot utilissima***. Agricultural Research Journal of Kerala 4(2):95-99. 1966. Engl., 8 Refs.

Cassava. ***Manihot esculenta.*** **Plant-growth substances. Field experiments. Tuber development. Tuber productivity. India.**

An experiment to study the effect of Seradix-B (3-indolebutyric acid) on cassava yields was conducted at the Agricultural College and Research Institute in Vellayani (India), using 3 concentrations that were applied to the base of the cuttings. Results indicate that although the increase in root wt/plant by treatment S1 was not significant, a 17.9% increase, as compared to the control, was observed. Treatments S2 and S3 had no significant effect on any of the characters studied except for root length. Since the most important factor is root wt/plant, the order of preference should be Seradix-B1, B2 and B3 because they increased yields 17.9, 14.7 and 12 9%, respectively, as compared to the control. *(Summary by A.J. Trans. by S.S. de S)* C02

0060-1920 NARTEY, F. **Cyanogenesis and metabolic changes associated with ultrastructural development in cassava** (*Manihot esculenta* Crantz). Denmark, University of Copenhagen Institute of Plant Physiology, 1973. 18p. Engl, Sum. Engl., Fr, 24 Refs.

Paper presented at International Symposium on Tropical Root Crops, 3rd, Ibadan, Nigeria 1973.

Cassava. *Manihot esculenta* **Cyanogenesis. Plant physiological processes. Seed. Protein content. Fat content. N. Soluble carbohydrates. Cyanogenic glycosides. Plant development. Plant physiology. Linamarin. Lotaustralin. Linamarase. Metabolism. Tubers. Leaves. Analysis. HCN. Detoxification. Cyanides. Rhodanese.**

Analyses of storage lipids (47%) and proteins (34%) show that cassava seed kernels represent nutritionally and industrially useful sources of vegetable fats and proteins Seedlings show high lipolytic and proteolytic activities, convert storage lipids to carbohydrates, and incorporate valine and isoleucine into the cyanogenic glucosides linamarin and lotaustralin, respectively. Electron microscope and tracer studies indicate that the biosynthesis and metabolism of cyanogens, cyanide, proteins and lipids are associated with specific organelles and microbodies that become well developed after 10 days active seed germination. (*Author's summary*) C02

See also 0280 0549

C03 Chemical Composition, Methodology and Analyses

0061-4436 ADRIAENS, M. L. **Note sur la toxicité des carottes de manioc.** *(Toxicity of the cassava roots).* Institut Royal Colonial Belge. Bulletin des Séances 8:796-804. 1937. Fr., 5 Refs.

Cassava. HCN. Analysis. HCN content. Tubers. Cortex. Cassava starch. Cassava flour. Zaire.

A description is given of the processes and results of trials carried out in the Belgian Congo to test the toxicity of several cassava samples from that country. Quantitative and colorimetric methods were used to determine the HCN content of nearly 15 different forms of processed and fresh cassava from several regions. The absence of free HCN and hydrolyzable cyanogens was confirmed in all cases; therefore, it can be concluded that none of the products examined was toxic. *(Summary by S.S. de S.)* C03

0062-7270 BALASUNDARAM, C.S. *et al.* **Distribution of hydrocyanic acid in different fractions during the extraction of leaf protein from cassava leaves.** Indian Journal of Nutrition and Dietetics 13(1):11-13. 1976. Engl., Sum. Engl., 9 Refs.

Cassava. Leaves. HCN content. India.

A study was made to determine the amount of HCN present in cassava leaves at different stages of leaf protein extraction. It was found that cassava leaves, which contain appreciable amounts of protein that would otherwise go to waste, can be profitably utilized for the extraction of leaf protein since it is free from toxic hazards due to HCN. *(Author's summary)* C03

0063-5399 BORDAS, M. *et al.* **Del contenido del ácido cianhídrico en las raíces de mandioca; resultados preliminares.** *(HCN content of cassava roots).* Asunción, Paraguay. Universidad Nacional de Asunción, Instituto de Ciencias Publicaciones Serie C: Investigación no.8. 1965. 14p. Span., 10 Refs., Illus.

Cassava. Tubers. HCN content. Analysis. Timing. Cultivars. Paraguay.

A study was made of variations in HCN content in the promising varieties Toledo, Caballero Guazú, San Rafael, San Quintín, Pytá and Yerutí. Samples were taken from 2 varieties/day for 3 consecutive days, from the central and apical parts of peeled roots (5 subsamples/root) The alkaline titration method was used in the quantitative analysis for HCN. Lowest values corresponded to Toledo, San Rafael and Pytá; however, all were classified as sweet varieties (less than 120 ppm of HCN). Variations in HCN content were slight, and the results serve only as a guide, being of no statistical value because of the low no. of observations It was recommended to (1) find out the seasons in which minimum and maximum HCN levels occur in order to determine the best harvesting season for roots intended for industrial purposes, and (2) correlate these results with the agronomic characteristics of the varieties studied It is concluded that the varieties studied can be used for human consumption. *(Summary by A.J. Trans. by S. S. de S.)* C03

0064-2195 BURE, J., BONN and DELAROUZEE. **Le manioc d'Indochine.** *(Cassava from Indochina)* Annales de Falsifications et des Fraudes 43(496-497):129-134. 1950. Fr., 2 Refs.

Cassava. Cassava starch. Particle size. Analysis.

In Indochina, sweet cassava varieties are the most frequently used for industrialization. The roots from *Manihot utilissima* Pohl do not present any special external features; therefore, this study focused on its internal morphology and most of all on the characteristics of starch granules. There are two types of starch granules: large, with a diameter of 15-20μm; and small, with a diameter of 3-5μm. The small ones can be confused with rice granules and the large ones with those of maize. Observations under the microscope show that a large quantity of small granules (70%) are found at the center of the root; however, they constitute only 10% of total granule weight. This percentage decreases towards the periphery. Attempts to differentiate small from large cassava granules through 4 classical methods were unsuccessful (Wood's light method, polarized light method, colorimetry and chemical reagents); therefore, direct observation is preferred. *(Summary by H.J.S.)* C03

0065-4428 **CONSIDERAÇOES SOBRE a relação do peso das raizes de mandioca com o seu teôr em fécula.** *(The relationship between the weight of cassava roots and their starch content).* *In* Banco de Nordeste do Brazil S.A., Departamento de Estudos Econômicos do Nordeste (ETENE), Divisão de Agricultura. Pesquisas tecnológicas sôbre a mandioca. Fortaleza, Brasil, 1972. pp.95-113. Port. Sum. Port.

Cassava. Tubers. Starch content. Analysis. Timing. Brazil.

It has been proved that the volumetric analysis of cassava roots makes it possible to determine their starch content by means of a table similar to that used for sweet potatoes. Further tests, however, should be continued with new series of sweet and bitter clones. The systematic analyses of the roots of many clones by groups (small, medium and large) or individually have been hindered by the lack of personnel and trial plots. Nevertheless, from these 1st trials it was concluded that small roots are low starch yielders with higher fiber content, affecting starch and flour manufacturing adversely. These small or defective roots are not suitable for industrial purposes. *(Author's summary. Trans. by S.S. de S.)* C03

0066-0543 CORREIA, F.A. and FRAGA JUNIOR, C. G. **Tecnologia da mandioca; estudo preliminar da variação da percentagem de fécula.** *(Cassava technology; preliminary study on variations in starch content).* Bragantia 5(4):213-237. 1945. Port., Illus.

Cassava. Cultivars. Starch content. Timing. Analysis. Tubers. Dry matter. Brazil.

Variations in root starch content were determined in 36 cassava varieties, taking into account plant age, locality and variety. Trials were conducted at Sorocaba, Pedeneiras and Mococa. Groups of 4 plants were harvested at 6, 6.5, 7, 8, 9, 10, 11 and 12 mo and their starch content determined using Ewers' method. The greatest starch contents were found in the same order of localities already given. The variety Rio Dourado registered the greatest content in all regions. Significant differences were not found at 8,9 and 10 mo of age, the period with the highest values. Because of the great no. of varieties under study, it was not possible to make an adequate analysis of the variable locality; therefore, further studies in this area are necessary. Based on starch content, the most outstanding varieties were Rio Dourado, Branca de Santa Catarina and 2 types of Vassourinha. Dry matter and starch content of roots, as well as the analysis of covariance, are presented in tables. *(Summary by A.J. Trans. by S.S. de S.)* C03

0067-4332 COUSINS, H.H. Cassava from Colombia. Bulletin of the Department of Agriculture. Jamaica 1:35-38. 1903. Engl.

Cassava. Cultivars. Water content. Starch content. HCN content. Tubers.

An analysis was made of 17 Colombian cassava varieties that were introduced and grown in Half Way Tree (Jamaica) in 1901. Their contents of moisture, starch, solids others than starch and HCN were determined. All the varieties had a high starch content; Governor Hemming was the highest (36.5%). The contents of moisture and solids other than starch varied from 54-72% and 3.5-19%, respectively. HCN content of the varieties was very low. *(Summary by A.J. Trans. by S.S de S.)* C03

0068-4471 CZYHRINCIW, N. **Nota sobre las variaciones químicas en productos vegetales.** *(Chemical variations in vegetable products).* Archivos Venezolanos de Nutrición 2(1):139-143. 1951. Span.

Cassava. Tubers. Starch content. Enzymes. Biochemistry. Venezuela.

The irregular distribution of chemical compounds in vegetable products was studied in certain roots and tubers. As regards cassava, it was found that the percentage of starch in one plant varied from one root to another and in different parts of the same root. The same was true of enzymatic activity in the roots. *(Summary by T.M.)* C03

0069-5587 DHAHMALINGAM, C. *et al.* **Varietal assessment of *Manihot esculenta* Crantz in relation to chemical constituents.** Madras Agricultural Journal 60(9-12):1613-1616. 1973. Engl., Sum. Engl., 8 Refs.

Cassava. Cultivars. HCN content. Sugars. *Manihot esculenta*. Tubers. Starch content. India.

An analysis was made of the starch, HCN and sugar contents in 24 varieties from the cassava germplasm bank. Based on the results, they were classified as having high, medium and low starch and HCN and as being sweet, nonbitter or bitter, according to their sugar content. No one variety satisfied all aspects; however, ME 7 and ME 3 were found to be high in starch and low in HCN. *(Author's summary)* C03

0070-7020 FAFUNSO, M. and BASSIR, O. **Effect of cooking on the vitamin C content of fresh leaves and wilted leaves.** Journal of Agricultural and Food Chemistry 24(2):354-355. 1976. Engl., Sum. Engl., 21 Refs., Illus.

Cassava. *Manihot esculenta*. Leaves. Ascorbic acid. Cooking. Nigeria.

The vitamin C content of 12 edible leaves freshly harvested from a farm in Nigeria ranged from 109-421 mg/100 g on a dry weight basis; these amounts were lowered by between 25-38% by the traditional method of cooking them. Wilting of fresh leaves for 2, 4, 6, 8 and 10 h lowered their ascorbate contents, on the average, by 11,20,36,47 and 49%, respectively. Cooking of the wilted leaves significantly decreased their ascorbate contents. *(Author's summary)* C03

0071-6910 GONDWE, A. T. D. **Studies on the hydrocyanic acid contents of some local varieties of cassava (*Manihot esculenta* Crantz) and some traditional cassava food** products. East African Agricultural and Forestry Journal 40(2):161-167. 1974. Engl., Sum. Engl., 27 Refs.

Cassava. *Manihot esculenta.* **Cultivars. Leaves. Tubers. HCN content. Cooking. Steeping. Cassava flour. Fresh products. Processed products. Kenya.**

The distribution of cyanogenic glucosides was studied in 4 varieties of cassava. Young leaves contained from 568-620 mg/kg HCN fresh weight; this concentration decreased in mature leaves (400-530 mg). The root peel had much higher concentrations than the pulp (608-950 and 45-330 mg, respectively). Analyses of roots of 4 other varieties showed that HCN content decreased from the outer root to the inner pulp Boiling of both leaves and roots greatly reduced glucoside concentration. Cassava flour made in the laboratory according to local traditional processes contained harmless levels of cyanide. (*Summary by T.M.*) C03 H04

0072-5020 GROSSMAN, J. and FREITAS, A.G. DE **Determinação do teôr de matéria sêca pelo método de pêso específico em raizes de mandioca.** *(Determination of the dry matter content of cassava roots by the specific gravity method).* Revista Agronômica (Brazil) 14:75-80. 1950. Port., Sum. Port., 7 Refs., Illus.

Cassava. Tubers. Dry matter. Analysis. Brazil.

The results are given of a study on the correlation between specific gravity and the dry matter content of cassava roots. The results are based on 14 trials that included a total of 1,366 samples from many varieties and clones grown in different soils over a 6-yr period. The coefficients of correlation ranged from + 0 3914 to + 0.8110, with a mean value of + 0.6189, indicating a close association between these 2 variables. On the other hand, the mean coefficient of correlation indicates that to each unit (gram) of weight in water corresponds an increase of 0.0564 in dry matter. A regression equation based on this relationship was formulated; this makes it possible to draw up a table that facilitates the determination of the percentage of dry matter according to root specific gravity. *(Author's summary. Trans. by S.S. de S.)* C03

0073-0012 GUIGNARD, L. **Sur l'existence et la localisation de l'émulsine dans les plantes du genre** ***Manihot.*** *(Existence and localization of emulsin in plants of the genus Manihot).* Compte Rendu de l'Association Française pour l'Avancement des Sciences 23(2):593-596. 1895. Fr.

Cassava. Cyanogenic glycosides. HCN. Analysis. *Manihot esculenta. Manihot carthagenensis. Manihot glaziovii.*

Several trials were conducted with sweet and bitter varieties of cassava in order to determine the existence of emulsin. The action exerted by emulsin on amygdalin served to verify its existence. In order to locate it in the plant, samples were taken from the roots, leaves and flowers. There was slightly more emulsin in the leaves and flowers than in the roots; it seems that the seed also has a small quantity in the embryo. Other euphorbiaceous plants not belonging to the genus *Manihot* do not contain emulsin. *(Summary by S.S. de S.)* C03

0074-4940 HAMPEL, G. **Bedeutung und mikroskopischer Nachweis von Tapiokawurzelmehl.** *(The microscopic detection of cassava meal).* Zeitschrift für Lebensmitteluntersuchung und -forschung 108:48-53. 1958. Germ., Sum. Germ.

Cassava. Cassava meal. Cyanogenic glucosides. Composition. Processing. Tubers. Laboratory experiments. Food enrichment. Composite flours. Tissue culture. Cytology. Uses.

After a histological-study of cassava roots, it was possible to detect accurately the addition of cassava flour either to raw or heat-treated material, based on the spotted tracheids and companion cells The starch granules, as well, had a characteristic appearance. *(Author's summary. Trans. by H.P.)* C03

0075-0979 INDIRA, P. and SINHA, S. K. **Colorimetric method for determination of HCN in tuber and leaves of cassava (*Manihot esculenta* Crantz).** Indian Journal of Agricultural Science 39(11):1021-1023. 1969. Engl., 6 Refs., Illus.

Cassava. HCN content. Tubers. Leaves. Analysis. Laboratory experiments. *Manihot esculenta*. India.

There are several methods for determining and extracting cyanoglucosides; however, they do not give quantitative results. Therefore, a technique, based on the use of an endogenous enzyme to release the HCN which should react with sodium picrate for a quantitative assay of cyanide, was developed. Two figures illustrate the results obtained. *(Summary by L.F.C. Trans. by S. S. de S.)* C03

0076-3296 JARDIN, C. I. **Composition des aliments et pourcentage d'humidité.** *(Composition of foodstuffs and their moisture content)* Annales de la Nutrition et de l'Alimentation 22(5).329-333. 1968. Fr ,5 Refs., Illus.

Cassava. Tubers. Water content. Food energy.

Moisture content is very important in determining the nutritive value and chemical composition of foodstuffs. A method for estimating the nutritive value of foodstuffs containing variable amounts of moisture (tubers, fresh vegetables and cereals) is detailed, and the formula used for updating tables of composition is outlined. The wide range of variations in moisture content is due to growth, storage and climatic factors; these variations affect the relative energy value. For example, the moisture content of cassava varies from 46-85%; therefore, its energetic value will vary from 58-212 calories/100 g of the edible portion. *(Summary by S.S de S.)* C03

0077-4851 KAMIL, M. *et al.* **Biflavones from *Manihot utilissima*.** Phytochemistry 13(11):2619-2620. 1974. Engl., 1 Ref.

Cassava. *Manihot esculenta*. Leaves. Analysis. Pigments.

Plant: *Manihot utilissima* Pohl *(M. esculenta* Crantz) (Euphorbiaceae). Source: Collected at Aleem Nursery, Aligarh Muslim University, Aligarh, India Previous work: Isolation of quercetin-3-rhamnosylglycoside. Present work: The phenolic extract obtained from fresh leaves and purified by usual methods gave 2 biflavones by preparative TLC. They were characterized as amentoflavone and podocarpus-flavone A (4'''-0-methyl amentoflavone) by mp, mmp and comparison of NMR spectra of their methyl and acetyl derivatives with those of authentic samples *(Full text)* C03

0078-6766 LAVOLLAY, J. and BUI, X. N. **Technique colorimétrique de contrôle rapide de la**

teneur en acide cyanhydrique des produits alimentaires d'origine végétale. *(Colorimetric technique for the rapid control of the hydrocyanic acid content of food products of vegetable origin).* Annales de Chimie Analytique 25:212-214. 1943. Fr., Sum. Fr.

Cassava. HCN. Analysis. Laboratory experiments.

The toxicity of some species of *Manihot* is due to the presence of a glucoside containing HCN. The method here proposed depends upon the evolution of HCN by diastatic fermentation in a buffered solution of pH 6, removal of the HCN after an hour's digestion at 32-34°C by a current of air, absorption of the HCN in a solution of Na picrate and colorimetric determination by comparing the reddish tint produced in the yellow picrate solution with standards. (*Summary by Chemical Abstracts*) C03

0079-4641 LEE, Y. K. and HWANG, S. L. **Further studies on the cyanogenetic compounds of cassava.** Kwangsi Agriculture 6:1-11. 1946. Chin., Sum. Engl., 9 Refs.

Cassava. Toxicity. Leaves. Stems. Tubers. HCN content. Cortex. Analysis. Detoxification.

This article gives the results of studies on the enzymolysis of cyanogenetic compounds of cassava and the HCN content of different parts of the plant. The methods to preserve samples in distilled cold water or in alcohol are also given. *(Summary by L.F.C Trans. by S.S. de S.)* C03 H04

0080-6852 MARTIN, F. W. and SPLITTSTOESSER, W. E. **A comparison of total protein and amino acids of tropical roots and tubers.** Tropical Root and Tuber Crops Newsletter no.8:7-14. 1975. Engl., 9 Refs.

Cassava. Protein content. Amino acids. Cultivars. Starch crops. Puerto Rico.

Thirty-nine cultivars of 12 tropical root and tuber species, *Manihot esculenta* among them, were planted at the Instituto de Agricultura Tropical in Mayagüez (Puerto Rico). The protein content was determined by the microkjeldahl method, and amino acid content by GLC. The relatively large amount of nonprotein N in *M. esculenta* suggests that the protein content of cassava is very low; therefore, it is unlikely that protein-rich cassava varieties can be obtained through breeding. The cultivar Fowl Fat was the only one that reached the minimum protein levels (4.1-8%) acceptable by FAO. Forastero and Treune had the lowest contents (1.88%). The minimum relative molecular percentages of amino acids accepted by FAO were compared to those found in the hydrolyzates of roots *M. esculenta* was deficient in many essencial amino acids. The determination of methionine, cysteine, lysine and sulfur-bearing amino acids showed that cassava was the poorest of all roots and tubers. All the crops analyzed should be supplemented with protein from other sources. (*Summary by S. S de S.*) C03

0081-6713 MERCIER, C. **Composition glucidique des végétaux utilisés en alimentation humaine: aspects quantitatif et qualitatif.** *(Carbohydrate composition of foods of vegetable origin: qualitative and quantitative aspects).* Revue Française de Diététique 17(66):27-40. 1973. Fr., 31 Refs.

Cassava. Tubers. Carbohydrate content. Dietary value. Human nutrition.

After describing the methods used to measure carbohydrates, mean values are given for sugars, pentosans, starch and cellulose in maize, wheat, barley, oats, rye, millet, rice, potatoes, sweet potatoes, cassava, yams , carrots, Jerusalem artichokes, beans, peas, lentils, soybeans and in flours obtained from cereals, roots and legumes. The carbohydrate compositions of the edible portions of 18 vegetables and of 40 different fruits, including nuts, are also tabulated. The effects of carbohydrate composition on the digestibility of the vegetables are discussed. *(Summary by Food Science and Technology Abstracts)* C03 H01

0082-4741 MURTHY, H. B. N., SWAMINATHAN, M. and SUBRAHMANYAN, V. **Starch-synthesizing enzymes in tapioca *(Manihot utilissima)* roots.** Journal of Scientific and Industrial Research 13B:223-224. 1954. Engl., 15 Refs.

Cassava. Cassava starch. Enzymes. Analysis. Biochemistry. Tubers. India.

Fresh cassava roots were peeled, sliced and soaked 10 min in a 0.05% sodium hydrosulfite solution. After draining off the liquid, the slices were suspended in water and mashed in a Waring blender The extract was clarified by centrifuging and preserved with toluene at 0°. Preliminary tests on the juice showed phosphorylase, Q-enzyme and pyro- and glycerophosphatases to be present. No phosphatase activity with respect to glucose-1-phosphate was demonstrated, nor was α- or β -amylase activity detected. Phosphorylase and Q-enzyme were fractionated from the extract by Bourne and Peat's method; phosphorylase activity was determined according to Hanes; inorganic phosphate by Fiske and Subba Row's method; and amylose by Hanes' photoelectric method Q-enzyme activity was determined by Barker's method, following the action of the enzyme on amylose at pH 7 in citrate buffer. Optical density of the color obtained with iodine was measured, and the quantity of reducing sugars was determined by the Somogyi micromethod. Q-enzyme causes about 70% decrease in absorption value of amylose, liberating only 2% of reducing sugars (as maltose) *(Summary by Chemical Abstracts)* C03

0083-0090 NERY, J. P. **Extração de proteína da mandioca.** (*Extracting protein from cassava*). Agronômico (Brazil) 15(7-8):4-5. 1963. Port., 3 Refs.

Cassava. Tubers. Proteins. Laboratory experiments. Analysis.

Dry cassava roots (10% humidity) contain approximately 3% protein. Because of the lack of an industrial process to extract protein, the following one, used in laboratories to isolate all kinds of flours, is suggested: wash and peel the roots, slice them finely and dry them at 40°C; grind the chips; suspend 10 g of fat-free flour in 100 ml of 10% NaCl and mix it in a blender for 5 minutes; filter the suspension and precipitate the protein by adding ammonium sulfate until it reaches a pH of 5; centrifuge to eliminate the ammonium sulfate by dialysis; wash the protein twice with 5 ml of alcohol and twice with 5 ml of ethyl ether; then, dry it in an oven at 40°C. (*Summary by L.F.C. Trans. by S.S. de S.*) C03

0084-0022 OKE, O. L **Nutritional studies on Nigerian tubers.** West African Pharmacist 7(6):109-110, 113. 1965. Engl., 6 Refs.

Cassava. Tubers. Fibre content. Ash content. Food energy. Mineral content. HCN content. Analysis. Nigeria.

This is a preliminary study on the nutritive value of cassava, cocoyams, sweet potatoes and yams The tubers were dried at 100°C and ground finely. Crude protein, crude fiber, ash, ether extract and HCN were determined according to the Association of Official Agricultural Chemists methods of analysis; K content by flame photometry; other minerals by means of a photoelectric spectrometer; oxalic acid by Dye's method and phytic acid by McCance and Widdowson's method. The results show that cassava contains the lowest amount of protein (2.58%); a fairly high P content (0.151% of DM); a 1:1 Ca:P ratio; a very low Mg content (0.04% of DM); low contents of oxalic and phytic acids (3.2% and 76%, respectively) and the highest amount of HCN (between 0.0354 and 0.1121%). (*Summary by A.J. Trans by S.S. de S.*) C03 H01

0085-4389 OLOJEDE-NELSON, S. O. **Methods of analysis of cassava used in Chemistry and Soils Division.** Nigeria, Federal Department of Agricultural Research, Memorandum no.104. 1970. 6p. Engl.,,3 Refs.

Cassava. Starch content. Analysis. Water content. Dry matter. Laboratory experiments. Tubers. HCN content. Nigeria.

This memorandum gives instructions and techniques for sampling cassava tubers. Starch content is determined by the specific gravity method or by polarimetry. HCN is determined by the alkaline titration method. Dean and Stark's method is used for determining the moisture content of the roots; a formula is also given for calculating dry matter content (*Summary by L.C. Trans. by T.M.*) C03

0086-6859 OTOUL, E. **Contribution à l'étude nutritionnelle des feuilles de manioc** ***Manihot esculenta*** **Crantz (*Manihot utilissima* Pohl).** (*Study on the amino acid content of cassava leaves*). Bulletin des Recherches agronomiques de Gembloux 8(2).117-123. 1973. Fr., 7 Refs

Cassava. Leaves. Amino acids. Zaire.

Because of the importance of cassava leaves in nutrition, a series of trials was conducted in Zaire to determine the amino acid spectra in leaves of the most promising clones in their collection. The results are given of trials carried out with only 1 clone (N'Tolili), based on samples taken from the apical bud, immature and adult leaves, as well as from the blade and the petiole The contents of nitrogenous substances and amino acids were determined in dry samples Analysis of the amino acid spectra showed that the amounts change as the leaves mature, lysine and methionine being the ones that are reduced the most There were considerable differences between the spectra of the blades and the petioles. Petioles were rich in aspartic and glutamic acids, whereas the blades had a high methionine, lysine and tyrosine content Results varied even within the samples of the same clone, due to age, ecological conditions, stem and cutting development. Clones suitable for feeding purposes are those with tender, large and well-developed leaves, with a high proportion of blade. The total content and dry weight of nitrogenous substances and the amino acid spectra are given in tables. (*Summary by S S. de S*) C03

0087-1730 OTOUL, E. **Spectres des acides aminés des feuilles de clones de manioc morphologiquement très différents** ***Manihot esculenta*** **Crantz (= *M utilissima* Pohl).** (*The leaf amino acid spectrum of morphologically very different cassava clones).* Bulletin des Recherches Agronomiques de Gembloux 9(2):159-163. 1974. Fr., Sum. Fr , Engl., 5 Refs

Cassava. *Manihot esculenta.* Leaves. Amino acids. Analysis. Clones.

The laminae of mature leaves were sampled with strictly identical methods from morphologically very different cassava clones of the same age and grown under uniform ecological conditions. The great stability found in the amino acids spectrum suggests that the variations reported in literature are not of genotypical origin They may be caused by ecological conditions but, most probably, by lack of uniformity in the sampling method. (*Author's summary*) C03

0088-5931 PAULA, R.D. DE G. and RANGEL, J.L **Dosagem de ácido cianídrico na mandioca e seus derivados.** *(Determination of HCN content in cassava and its by-products).* Revista Alimentar (Brazil) 3(29) 215-217. 1939. Port.

Cassava. HCN content. Analysis. Laboratory experiments. Brazil.

A description is given of a method for determining the HCN content of cassava and its by-products The method consists of the hydrolysis, distillation and titration of the testing material. Tartaric acid was the best agent in the hydrolytic process. The use of a long-necked matrass and the addition of paraffin prevents the formation of foam during hydrolysis, when this foam is formed, it usually overflows. *(Summary by A.J. Trans by S.S de S.)* C03

0089-2956 PAYNE, H. and WEBSTER, D.C **The toxicity of cassava varieties on two Jamaican soil types of differing potassium status.** Kingston, Jamaica, Ministry of Agriculture and Fisheries Crop Agronomy Division, 1956? 3p. Engl.

Cassava. HCN content. Soil fertility. P. Field experiments. Jamaica.

Twenty-six cassava varieties were planted in 2 localities with different ecological conditions (Lodge clay loam soil with a high to medium-high-K content and hot and dry climate; and Chudleigh clay soil with a very low K content and a cold, humid climate) in order to compare the HCN content of the root pulp and peel. Av HCN contents in the clay loam and clay soils for the pulp and the peel were 103.19 and 136.19 ppm and 416.12 and 940 65 ppm, respectively. The av HCN content was significantly higher on the K-deficient soils (clay). The difference in climate between the 2 localities is unlikely to account for the difference in HCN content since the cooler climate in the clay soil would tend to diminish HCN content. Results indicate that the peel is more toxic than the pulp and that the soil exerts a greater effect on the HCN content of the peel than on that of the pulp. *(Summary by A.J. Trans. by S.S. de S.)* C03

0090-1767 PEREIRA, A. S. **Breve comentário sôbre experimentos de competição de clones de mandiocas de mesa (Aípins), no Instituto Agronômico de Estado de São Paulo.** *(Comparative study of sweet cassava clones for culinary purposes at the Instituto Agronômico in the state of São Paulo).* Agronômico 23:21-33. 1971. Port.

Cassava. Cassava programs. Field experiments. Cultivars. Selection. HCN content. Human nutrition. Tuber productivity. Foliage. Productivity. Brazil.

HCN contents of fresh pulp of cassava cultivars ranged from 6.5 mg/100 g in 797-Auro do Vale to 14.5 mg in IAC-14-18. In variety trials highest yields were given by cv. 59-Branca de Santa Catarina (toxic), Mantiqueira and IAC-14-18 (21.1, 18.8 and 18.1 tons/ha, respectively) Highest top yields were 17.3 tons/ha from 1010-Vassourão. *(Summary by Field Crop Abstracts)* C03 D03

0091-0020 PETERS, F. E **La composition chimique des aliments du Pacifique Sud.** *(Chemical composition of South Pacific food crops).* Qualitas Plantarum et Materiae Vegetabiles 5 313-343. 1959. Fr., 31 Refs.

Cassava. *Manihot esculenta*. Water content. Ash content. Fibre content. N. Analysis. Sugars. Starch content. Tubers. Leaves. Vitamin content.

The work done by the South Pacific Commission on the nutritional status of the indigenous population is summarized for the period 1954-56. The need to establish the bases for the transition between cultivating food crops for the farmer's consumption and large-scale production was already felt at this time. The chemical composition and vitamin content of bitter and sweet varieties from different régions are analyzed. The leaves are an excellent source of carotene and an intermediate source of niacin and ascorbic acid Starch and water are the main components of the root. It was concluded that South Pacific crops can provide a balanced diet for the inhabitants. *(Summary by S S. de S.)* C03

0092-6715 PION, R. **Composition des aliments végétaux en protides et en acides aminés.** *(Protein and amino acid composition of foods of vegetable origin).* Revue Francaise de Dietetique 17(66):13-25. 1973. Fr., 22 Refs.

Cassava. Amino acids. Protein content. Tubers.

Mean values are given for individual amino acids in wheat, rice, barley, oats, rye, maize, sorghum, groundnut, soybeans, sunflower, rape, beans, peas, chickpeas, lentils, beetroot, potatoes, cassava, cabbage, spinach, yeasts and algae. The influence of genetic factors and processing treatments on the amino acid content, nutritive value and digestibility of vegetable proteins is discussed briefly *(Summary by Food Science and Technology Abstracts)* C03 H01

0093-0196 RECHERCHE SUR **la toxicité des maniocs cultivés dans la région du Lac Alaotra.** *(The toxicity of cassava varieties grown in the area of Alaotra Lake).* *In* Tananarive, Madagascar. Institut de Recherches Agronomiques de Madagascar. Rapport Annuel 1961. Tananarive, 1962. pp.23-25 Fr.

Cassava. Cultivars. Toxicity. HCN content. Tubers. Leaves. Analysis. Malagasy Republic.

The vegetative cycle of cassava presents two periods of maximum HCN concentration, which correspond to the months of greatest activity (thickening of the roots). HCN content decreases as leaves grow older. In addition to the formation of HCN in cassava, the following aspects were studied: the influence of N on root toxicity and the relationship between root toxicity and the absence of anthocyanic pigment in the plant. Coloring served to determine the degree of toxicity of different varieties *(Summary by S.S de S)* C03

0094-1834 ROCHE, P., VELLY, J. and JOLIET, B. **Essai de détermination des seuils de carence en potasse dans le sol et dans les plantes.** *(Determination of the critical level of potassium deficiency in soil and plants).* Revue de la Potasse 1957:1-5 février 1957. Fr., 1 Ref.

Cassava. Field experiments. Ammonium sulphate. Potassium chloride. Groundnuts. Tuber productivity. Leaves. Analysis. Dry matter. Stems. N. P. K. Mineral deficiencies. Soil analysis. Malagasy Republic.

The purpose of these trials was to determine the levels of interchangeable K at which marked deficiencies occur in cassava and peanuts. Different rates of mineral fertilizers were applied to a red lateritic soil with a pronounced P/K imbalance. The critical levels were found to be 0.03, 0.60 and 0.50%, respectively, for the soil, leaves and phelloderm. Analysis of the phelloderm showed the P/K imbalance more clearly than the leaves. *(Summary by S.S. de S.)* C03 D01

0095-6886 RODRIGUEZ-SOSA, E.J., PARSI-ROS, O. and GONZALEZ, M.A. **Composition of cassava (*Manihot esculenta* Crantz) and the rheological characteristics of its starch.** Journal of Agriculture of the University of Puerto Rico 60(1):93-98. 1976. Engl., Sum. Engl., Span., 23 Refs., Illus

Cassava. *Manihot esculenta* Cultivars. Ash content. Fibre content. Protein content. Mineral content. Starch content. pH. Cassava starch. Viscosity. Temperature. Analysis. Laboratory experiments. HCN content. Puerto Rico.

Proximate composition and the rheological characteristics of the starch were determined for 2 edible commercial varieties of cassava (*Manihot esculenta* Crantz) grown in Puerto Rico. The variety Pana has a light tan skin and Zenón or Yuca Negra de Moca from the Dominican Republic is a dark-skinned variety. Proximate composition was found to be about the same for both varieties. HCN content was well below the toxicity level (50-100 mg HCN/kg of fresh peeled root). Although pasting temperatures were the same for both (63°C), viscosity values of the starch of Pana were somewhat higher than those of Zenón. (*Author's summary*) C03 I01

0096-1667 SARAWAK. MINISTRY OF AGRICULTURE AND FORESTRY. DEPARTMENT OF AGRICULTURE. RESEARCH BRANCH. **Tapioca.** *In* ——— Annual Report 1966. Kichung, 1967. pp 48-49 Engl.

Cassava. Cultivars. HCN content. Starch content. Productivity. Tubers. Malaysia.

The third planting in a series of cassava variety trials was harvested in Tarat in September, 1966. The varieties Black Twig and Berat gave the highest yields (16.33 tons of fresh roots/acre), but unfortunately their palatability is poor (200 and 240 ppm of HCN, respectively). Black Twig also has a relatively low starch content (68.4%). *(Summary by A.J. Trans. by S.S. de S.)* C03

0097-7195 SHANMUGAN, A. and SELVARAJ, P. **Effect of ethrel on the cyano-glucoside content of tapioca (*Manihot esculenta* Crantz) roots.** Science and Culture 40(8):366-368. 1974. Engl., 9 Refs.

Cassava. *Manihot esculenta.* Plant-growth substances. HCN content. Tubers. India.

Two cassava cultivars were given 2 foliar sprays of 500, 1000, 2000 or 5000 ppm ethephon 30 and 60 days after planting. As compared with the unsprayed control, tuber HCN content at 70 days after planting was decreased by ethephon; decreases were highest with 500 and 5000 ppm treatments (38.9-40.0 and 43.4-44.5%, respectively). *(Summary by Plant Breeding Abstracts)* C03

0098-3464 SINHA, S. K. and NAIR, T.V.R. **Studies on the variability of cyanogenic glucoside content in cassava tubers.** Indian Journal of Agricultural Science 38(6):958-963 1968. Engl., Sum. Engl., 5 Refs.

Cassava. *Manihot esculenta.* Cultivars. Tubers. HCN content. Timing. India.

A technique for determining the HCN in cassava is described. Results indicate that there was no variation in the HCN content in different parts of the root if determinations were carried out separately on the flesh and the peel. The HCN content in roots of one plant does not vary appreciably. There is a considerable amount of variation in the HCN content of roots obtained from different locations. The amount of HCN also varies with the age of the plant. Of the 33 varieties analyzed; HCN in the edible portion varied from 35-490 mg/kg. The bitterness of roots does not seem to be associated with the amount of cyanogenic glucoside alone, the amount of sugars may probably have some effect in determining their bitterness. The amount of HCN in flesh has no direct relationship with that in the peel. (*Author's summary*) C03

0099-7196 SPLITTSTOESSER, W E and MARTIN, F.W. **The tryptophan content of tropical roots and tubers.** HortScience 10(1).23-24. 1975. Engl., Sum. Engl., 12 Refs.

Cassava. Tubers. Tryptophane.

The tryptophan content was determined in 29 cultivars of different tropical root and tuber crops including 3 for cassava. Fowl Fat, Llanera and Forastera. These cultivars contained 0 9, 0.8 and 0.1 g tryptophan/100 g protein and were below the FAO reference protein. The amount of tryptophan/g of dry tissue was also low; thus about 5 kg of fresh cassava would have to be consumed to ingest about 1 g of tryptophan. The prospect of selecting cassava cultivars high in tryptophan appears poor. *(Summary by T.M.)* C03

0100-0978 SWAMINATHAN, M. and DANIEL, V.A. **Toxicants naturally occurring in foods.** Indian Journal of Nutrition and Dietetics 7(2):105-118. 1970. Engl , 35 Refs.

Cassava. HCN content. Leaves. Tubers. India.

A brief review of the most important natural toxins usually found in foods and of the diseases or disturbances they cause is made as a warning of the danger of consuming foods containing toxic factors. Cassava *(Manihot esculenta)* is one of the food crops included because it contains cyanogenetic glucosides. The HCN contents of whole and peeled cassava roots and leaves are indicated. *(Summary by A J Trans. by S.S. de S.)* C03

0101-5091 TELES, F. F. F. **Considerações sôbre a análise do ácido cianídrico em mandioca e seus produtos manufaturados.** *(Analysis of the HCN content of cassava and its manufactured products)* *In* Banco do Nordeste do Brasil S. A. Departamento de Estudos Econômicos do Nordeste (ETENE). Divisão de Agricultura. Pesquisas tecnológicas sôbre a mandioca. Fortaleza, Brasil, 1972. pp 7-33. Port., Sum. Port., 16 Refs , Illus

Cassava. *Manihot esculenta* **HCN content. Analysis. Tubers. Brazil.**

Several traditional methods were evaluated to determine a simplified method of analysis for systematic research on the HCN content of cassava *(Manihot esculenta* Crantz). It was proven that mistakes and inaccuracies in the description of different methodologies may lead to an erroneous interpretation of results To avoid this, the author presents a new, more simplified and rapid methodology (adapted from the AOAC), the results of which are comparable to the widely used Paula and Rangel's method. Results obtained with this new method since the end of 1966 have been excellent. As suspected by Hanssen and Sturm, the level of pH has an effect on the analysis *(Author's summary. Trans by S.S. de S.)* C03

0102-5093 TELES, F.F.F. **Considerações sôbre um novo método de determinar nitrogênio em compostos orgânicos.** *(On a new method for detecting nitrogen in organic compounds). In* Banco do Nordeste do Brasil, S.A Departamento de Estudos Econômicos do Nordeste

(ETENE). Divisão de Agricultura. Pesquisas tecnológicas sôbre a mandioca. Fortaleza, Brasil, 1972. pp 35-56. Port., Sum. Port , 13 Refs.

Cassava. N. Proteins. Analysis. Laboratory experiments. Brazil.

The Kjeldahl analysis is modified so that it would serve in determining N and organic compounds, even in the case of heterocyclic compounds. Its application to insecticides (Sevin, Diazinon and the like), albumin, casein and mulch is of great interest in the agro-industrial branches of chemistry. This new methodology does not require expensive or complex facilities and equipment so it is recommended for any type of agro-industrial laboratories, especially in regions with poor economic and technological development. The technique has been used for 2 yr in the program "Integral Use of Cassava for Forage Purposes," conducted by the research team of the Universidade Federal do Ceará and the Banco do Nordeste do Brasil S.A., in order to determine the organic protein content of cassava and its nutritive value. *(Summary by S.S. de S.)* C03

0103-4442 TORRES, C. M. G. **Estudo das variações do teôr de HCN no limbo das folhas de mandioca** *(Manihot esculenta* **Crantz).** *(Variations of HCN content in the blades of cassava leaves).* Sociedade Cultural e Recreativa dos Engenheiros-Agronômos de Mossoró (Brazil). Boletim no. 1.13-17. 1971. Port., Sum Port , 4 Refs

Cassava. Leaves. HCN content. Timing. Analysis. Brazil.

The HCN content in the blade of cassava leaves *(Manihot esculenta* Crantz) was determined at harvest and at intervals of 24, 48 and 72 h of exposure to the sun; the HCN content was significantly different for each period. After 72 h of exposure, only tracers of HCN were found, There was a decrease of 70.2, 17.0 and 12.8% in HCN content at 24, 48 and 72 h, respectively. *(Author's summary. Trans. by S S. de S.)* C03

0104-0577 TOURY, J. and GIORGI, R. **Aflatoxine et fluorescence.** *(Aflatoxin and fluorescence).* Annales de la Nutrition et de l'Alimentation 20:112-118. 1966. Fr., 10 Refs., Illus

Cassava. Aflatoxin. Analysis. Laboratory experiments.

Aflatoxin is one of the factors responsible for poultry and cattle mortality. Four aflatoxins have been distinguised so far. B_1 and B_2, which emit a blue fluorescence; G_1 and G_2, which emit a green one. Fluorescent capacity is inversely proportional to the degree of toxicity. A study is made of the methods used for estimating aflatoxin based on the fluorescence of the product and on the relationship existing between the fluorescence and the toxicity of the product given to 1-day-old ducklings. A physicochemical method was used, based on the intensity of the fluorescence emitted by the extract prepared from the product under study. The aflatoxin from the extract is isolated by means of paper chromatography and a developing liquid composed of benzene, toluene, cyclohexane, ethanol, water and acetic acid. All cassava samples (fermented and dry) analyzed by chromatography over Kiesegel G films, showed a bright blue fluorescent spot with a retardation factor (R*f*) of approximately 0.40 for the aflatoxin B_1. After concentrating the extract, some other fluorescent spots with lower R*f*s were observed. Extracts administered to one-day-old ducklings did not produce histological modifications in the liver. Emphasis was placed on the convenience of studying whether the fluorescences observed were due to normal food constitutents or to the metabolites secreted by microorganisms. *(Summary by S.S. de S.)* C03

0105-0928 TOURY, J., GIORGI, R. and JACQUESSON, M. **Analyse de quelques plantes entrant dans l'alimentation des populations de l'A.O.F.** *(Some plants used as food by Africans).* Qualitas Plantarum et Materiae Vegetabiles no. 3/4 256-261. 1958. Fr., Sum. Fr., Engl., Germ., 6 refs.

Cassava. Leaves. Water content. Ash content. Protein content. Fat content. Mineral content. Ascorbic acid.

Some leaves commonly used as food by Africans are very rich in protids, i.e., cassava leaves with 7.7 to 9%. Cassava leaves are also remarkably rich in ascorbic acid. *(Summary by T.M.)* C03

0006-0479 VAN BIEMA, G., and CABRAL, F. B. **Método rápido para estimar el contenido de almidón de la yuca.** *(Quick method for determining the starch content of cassava).* Hacienda 46: 50, 55, 76. 1951. Span., Illus.

Cassava. Tubers. Starch content. Analysis.

A method was devised whereby the starch content of cassava roots could be determined quickly. Three different procedures are given for determining the density and specific weight of the root, using a scale, a graduated cylinder, or a special recipient with an outlet. A table to convert specific weight to percentage of starch is included. The method is advantageous for controlling factory efficiency and buying roots with higher starch content. *(Summary by L.C. Trans. by T.M.)* C03

0107-5373. VELAZQUEZ, G. and POSADAS, D. A. **Dosaje de calcio en algunos alimentos que consume la población de Corrientes.** *(The calcium content of some foods consumed by the people of Corrientes)* Revista de la Asociación Bioquímica Argentina 13:179-182. 1946. Span., 12 Refs.

Cassava. Ca. Mineral content. Argentina.

The tendency of the people from Corrientes (Argentina) to suffer from decalcification and dental cavities was the reason for determining the Ca content of different foods they consume. Among the foods analyzed was cassava; the drinkable water of the city, as well as that of 5 wells, was also analyzed. A 100-g sample of the food was ground, dried at 105°C and reduced to ashes by calcination. The ashes were then treated with HCl in order to extract the Ca The Ca content of cassava (0.366%) was higher than that of the other foods studied. It was concluded that the population's Ca intake was normal and balanced and that it satisfied the organism's requirements; therefore, decalcification must be attributed to other causes. *(Summary by A.J. Trans. by S.S. de S.)* C03

0108-0296 VOISIN, J. C. **Teneurs en fécule et matières azotées et toxicité des racines de manioc de la collection d'Adiopodoumé (Cote d'Ivoire).** [*Starch content, nitrogen substances and toxicity of cassava roots from the Adiopodoumé collection (Ivory Coast)*]. Bulletin Trimestriel du Centre Technique d'Agriculture Tropicale no. 2:42-53. 1956 Fr.

Cassava. Tubers. Leaves. HCN content. Starch content. N. Analysis. Cultivars. Ivory Coast.

The HCN content of roots of 16 cassava varieties and of leaves of 15 varieties were analyzed in order to determine their toxicity. Results obtained with leaf samples show that the differences are highly significant (P=0.01); it was not possible to reach a definite statistical conclusion for data on roots although the differences seem to be significant. No significant differences were found in the starch content of the varieties from the Ivory Coast and Boukoko. The traditional belief that bitter varieties have a higher starch content than sweet varieties was found to be erroneous. The comparative study of fat and nitrogenous substances in several types of tubers showed that cassava occupies an intermediate position; however, among the 17 cassava varieties analyzed, significant differences were found that are very important in nutrition. This aspect could be greatly improved by means of selection. On the other hand, there is no correlation whatsoever between toxicity and N content. *(Summary by S.S. de S.)* C03

See also ... 0022 0027 0051 00157 0186 0192 0193 0199 0211 0249 0261 0265 0274 0278 0281 0338 0339 0345 0413 0419 0447 0451 0467 0474 0492 0550 0586

D00 CULTIVATION

0109-4843 ALVAREZ, C. A. and DUQUE, C. E. **Cultivo e industrialización de la yuca** *(Manihot utilissima* **Pohl).** *(Cassava cultivation and industrialization)* Tesis Ing. Agr. Manizales, Colombia, Universidad de Caldas, Facultad de Agronomía, 1967. 184p. Span., Sum. Span., 60 Refs., Illus.

Cassava. ***Manihot esculenta.*** **Cultivars. Planting. Spacing. Weeding. Injurious insects. Diseases and pathogens. Production. Productivity. Marketing. Costs. Cassava starch. Peeling. Washing. Rasping. Silting. Steeping. Screening. Packaging. Factories. Colombia.**

This study was carried out with the purpose of obtaining information on the principal aspects of cassava cultivation and the current status of its industrialization in the state of Caldas (Colombia). Data on production zones in the municipalities of Quinchía-Riosucio, Anserma, Filadelfia, Chinchiná-Palestina and Victoria were obtained by means of direct surveys of 91 farmers. It was found that most cassava cultivation was on a very small scale; 68% of the plantations were 1 hectare or smaller. Yields ranged from 4.4 to 15.1 tons/ha. Production costs are given. The varieties cultivated most were Amarilla (more than 50% of the total), Blanca, Cascarilla and Paimuna Negra. Agricultural practices were very inadequate, and no fertilizers were used. Pests reported were *Atta cephalotes, Trialeurodes* sp and *Rhyzormina fuhrmani.* Diseases included roots rots, bacterial blight, stem rots, anthracnose, cassava ash, Cercospora leaf spots and rust. For the second part of this work, 15 processors were visited; average capacity was 125 kg of cassava/h. Cassava by-products included starch and tapioca and the resulting screenings and liquid fraction containing fat and protein from the roots (sold for feeding swine) Production costs and profits are given for the different processors. The products are sold principally to the Medellín, Bogotá, Manizales and Cali markets. *(Summary by T.M.)* D00 I02

0110-3729 ANTIOQUIA, COLOMBIA. SECRETARIA DE AGRICULTURA. **Cultivo de la yuca.** *(Cassava cultivation).* Boletín Agrícola (Colombia) no. 376/381:3229-3320. 1950/1951. Span.

Cassava. Cultivation. Colombia.

General aspects of cassava growing are presented: climatic and edaphic requirements, seed, planting seasons and distances, weeding, fertilization and harvesting. In Colombia, in addition to using cassava for human consumption, the starch extracted is used in the textile industry. Several by-products obtained from cassava, such as glucose, alcohol, explosives and glue, are also mentioned. *(Summary by A J. Trans. by S S. de S)* D00 .

0011-4437 BERTONI, M. S. **Le manioc au Paraguay.** *(Cassava in Paraguay).* Journal d'Agriculture Tropicale 72:168-170. 1907 Fr.

Cassava. Cultivation. Paraguay.

The following aspects of the cultivation and uses of cassava are described in general terms: sweet and bitter varieties, stems used for forage, harvesting, storage, by-products and resistance to drought. *(Summary by R.T. Trans. by T.M.)* D00

0112-0077 BLANCO M., G. **La yuca o guacamote, planta alimenticia e industrial.** *(Cassava; its alimentary and industrial uses).* Tierra (Mexico) 2(1):25-28, 63. 1947. Span., Illus.

Cassava. Cultivation. Cassava flour. Cassava starch. Tapiocas. Alcohol. Uses. Processing. Mexico.

Cassava growing in Mexico should receive more attention because in addition to its industrial uses, it is a very important source of food. It is a vigorous plant that is resistant to pests and diseases and can be cultivated in a wide variety of climates and soils. The following aspects are briefly discussed: classification and synonyms; general cultural practices; the manufacture of flour, starch, tapioca and alcohol; industrial uses; chemical composition of the root and the building of a pilot plant for manufacturing cassava starch in the state of Chiapas *(Summary by L. C. Trans. by T.M.)* D00 I02

0113-4541 BOTHA, W. A. R. **The cultivation and utilization of cassava.** South African Journal of Industries 8:371-377. 1925. Engl.

Cassava. Cultivation. Processing. Cassava products. Uses.

The following agronomic practices of cassava cultivation are presented: soil and climatic requirements of the plant, land preparation, planting, fertilization, harvesting and crop rotation. *Atta* sp. and *Lonchaea* sp. are among the most important cassava pests. The processes for obtaining flour, starch, tapioca, dried cassava, chips, alcohol, glucose and some of their industrial applications are described. Some aspects of cassava utilization for livestock feeding are also included. *(Summary by A.J. Trans. by S.S. de S.)* D00 I02

0114-4884 CELLO, C. E. **La mandioca.** *(Cassava)* Boletín Agrícola y Ganadero (Argentina) no. 184/187:57-60. 1943. Span.

Cassava. Cultivation. Argentina.

The following aspects regarding cassava are presented: a brief historical review, botanical data, edaphic and climatic requirements, planting, agronomic practices, diseases (caused by *Cercospora henningsii* and *Gloeosporium manihot);* pests *(Lonchaea chalybea, Erinnyis ello,* and a mite of the genus *Bryobia),* harvesting and utilization. Early-maturing varieties should be planted in the northern part of the province of Córdoba because of its climatic and soil conditions *(Summary by A.J. Trans. by S.S. de S.)* D00

0115-5283 CHAN, A.K., comp. **Growing tapioca (*Manihot esculenta* Crantz).** Malaysia. Department of Agriculture. Extension Branch. Farm Management Section. Technical Paper no. 3. 1971. 16p. Engl., 7 Refs., Illus.

Cassava. *Manihot esculenta.* Tuber productivity. Land preparation. Planting. Spacing. Fertilizers. Harvesting. Trade. Costs. Production. Cultivars. Malaysia.

A detailed description is given of the most important cultural practices of cassava in Malaysia. propagation, soil preparation, planting, fertilization, maintenance, weeding, pests and diseases, harvesting and marketing. The most injurious pests in the initial stages of growth are rats, monkeys, wild pigs and termites; as far as diseases are concerned, leaf spot caused by *Cercospora henningsii* is common but not serious; white root caused by *Fomes lignosus* is found occasionally. Finally, some figures on cassava exports and production costs are given. *(Summary by P.G. Trans. by S.S. de S.)* D00

0016-2059 CHILDS, A.H. B. **Cassava.** Tanganyika. Ministry of Agriculture. Department of Agriculture. Bulletin no.15. 1961. 5p. Engl.

Cassava. Human nutrition. Trade. Cultivars. Cultivation. Cassava mosaic virus. Injurious insects. Kenya.

The cassava plant is widely grown in Tanganyika and is considered the best way to combat famine in drought years A brief review is given of the various ways cassava roots can be used as food, including the use of young leaves as a spinach. A brief description is given of cultivation, varieties, green manuring, pests (white scales, *Aonidiomytilus albus;* stemborers, *Opogous chlorophanes;* grasshoppers, *Zonocerus elegans;* termites; and white grubs), diseases (cassava mosaic and brown streak viruses), control measures and harvesting. *(Summary by T.M.)* D00

0117-3643 CHIMPRABHA, M **Cassava, *Manihot utilissima* Pohl.** Bangkok, Nai Chaleo Chuntarasup, 1967. 9p. Engl., 3 Refs., Illus.

Cassava. Soil requirements. Climatic requirements. Land preparation. Planting. Propagation. Weeding. Fertilizers. Harvesting. Tuber productivity. Thailand.

General background data is provided on cassava cultivation in Thailand. Aspects dealt with are soils and climate, varieties, land preparation, propagation methods, fertilization, harvesting, yield, pests and diseases. *(Summary by L.C. Trans. by T.M.)* D00

0118-5597 CONÇEICAO, A.J. DA **Instruções para o cultivo da mandioca.** *(Instructions for cultivating cassava).* Cruz das Almas, Brasil Universidade Federal da Bahia. Escola de Agronomia/BRASCAN Nordeste. Série Extensão v.1 no. 2. 1975. 22p. Port., Sum. Engl.

Cassava. Planting. Cuttings. Spacing. Fertilizers. Irrigation. Land preparation. Harvesting. Injurious insects. Mycoses. Bacterioses. Viroses. Insect control. Injurious mites. Mite control. Disease control. Rotational crops. Agricultural equipment. Brazil.

Technical recommendations are given on cultivating cassava *(Manihot esculenta* Crantz*)* in the state of Bahia (Brazil). Aspects dealt with include recommended cultivars, soils, planting, material, density, fertilization, agronomic practices, irrigation, pruning, harvesting cycle, root storage, rotation with legumes, intercropping with citric fruits, cassava as a forage, and technical coefficients for small- and industrial-scale plants. A brief description and control measures are given for the following pests and diseases: ants *(Atta* spp., *Acromyrmex* spp.), the cassava hornworm *(Erinnyis ello, E. alope),* the shoot fly *(Silba pendula),* stemborers *(Coelosternus),* mites *(Mononychellus tanajoa);* leaf spots *(Cercospora henningsii, C. caribaea),* rust *(Uromyces manihotis)* anthracnose *(Colletotrichum manihotis),* root rot *(Phytophthora drechsleri),* bacteriosis *(Xanthomonas manihotis),* witches'-broom and mosaic. *(Summary by T.M.)* D00

0119-3907 CONGO (BRAZZAVILLE). MINISTERE DE L'AGRICULTURE. **Rapport d'exécution 1972-1973.** *(Performance report 1972-1973).* Brazzaville, Bureau pour le

Développement de la Production Agricole, 1974? 62p. Fr., Illus

Cassava. Cassava programs. Field experiments. Fertilizers. Weeding. Mechanization. Productivity. Weeds. Harvesting. Timing. Planting. Spacing. Cultivars. Identification. Consumption. Labour. Costs. Maps. Congo.

In 1972 the Ministry of Agriculture of the Democratic Republic of the Congo and the Bureau for the Development of Agricultural Production (BDPA) approved the creation of a technical cell that would be in charge of verifying technical and economic information concerning the problems found in the experimental production of cassava before proceeding with its industrial production. The cell was composed of 2 experts: one in agriculture and the other in economics. This report presents the results of the 1st year of activities in the state of Mantsoumba The following trials were carried out: relationship between planting date and harvesting; response to N, P, K and Ca fertilization; harvesting seasons according to variety; varietal response with and without fertilization; study of the development of the production curve, and maintenance and planting distances. A list is included of foreign and native varieties, giving the characteristics of the aerial part of the plant. The technical cell made recommendations on markets, administrative and operational structures, norms regarding agricultural work and different production costs. As of June, 1973 the main cassava-consuming markets were Jacob (44% of total production), the swine-raising regions (22%) and Le Briz (12%); of the remaining 22%, 7% was used for manufacturing foofoo and 15% was consumed in different markets. In relation to administrative and operational structures, a series of factors that should be taken into account are indicated regarding land selection, preparation and planting, maintenance, harvesting, crop utilization and rotation. Regulations were established for the following services: administration, supplies, general maintenance, mechanical work and transportation. The times at which each job should be done were also fixed. The different jobs were classified into 3 groups: those related to the field, those regarding transportation facilities and machinery (tractors, vehicles), and those belonging to other departments. Costs generated by each of these services are analyzed. Annexes present in detail the different agronomic trials. *(Summary by S.S. de S.)* D00 J00

0120-3667 CULTURA DA **mandioca.** *(Cassava cultivation).* São Paulo Secretaria da Agricultura. Cordenação de Assistência Técnica Integral Instrução Prática no. 141. n. d. 19p. Port., Illus.

Cassava. Land preparation. Fertilizers. Cultivars. Cuttings. Planting. Timing. Pruning. Disease control. Bacterioses. Insect control. Insecticides. Rotational crops. Harvesting. Brazil.

A series of practical recommendations are given for farmers who want to plant cassava in the state of São Paulo. They include selection of adequate soils, land preparation and fertilization, varietal selection (describing the main Brazilian varieties and their performance in relation to pests and diseases), length and form of cuttings, planting season, agronomic practices, harvesting, crop rotation (with rice, wheat and soybeans), pest and disease control. The kind of damage caused by bacterial blight, the hornworm, white grubs, shoot flies and leaf-cutter ants are presented with illustrations; and methods to eliminate them are indicated. *(Summary by L.F.C. Trans. by S.S. de S.)* D00

0121-5675 CUNLIFFE, R. S. **Yuca: su cultivo, variedades, contenido en almidón y fabricación.** *(Cassava: its cultivation, varieties, starch content and processing).* Santiago de las Vegas, Cuba. Secretaría de Agricultura Comercio y Trabajo. Estación Experimental Agronómica. Boletín no. 34. 1916 66p. Span., Illus.

Cassava. Soil requirements. Land preparation. Fertilizers. Planting . Harvesting. Productivity. Uses. Cassava starch. Factories. Costs. Industrial machinery. Processing. Cultivars. Identifica-

tion. Water content. Starch content. Sugars. Protein content. Fat content. Fibre content. Ash content. Cuba.

This monograph on cassava *(Manihot utilissima* and *M. aipi)* covers a series of agronomic and industrial aspects in Cuba. As regards agronomic aspects, the subjects discussed are soil requirements, land preparation and fertilization, planting systems, cultural practices, harvesting season according to use, yields and conservation. The preparation of cassava by-products for human consumption, such as flour, tapioca flakes and pearls, etc. is explained; uses of fresh and cooked tubers and starch by-products in poultry, cattle and swine feeding are included. The methods for producing starch, glucose and dextrin, as well as the machinery required for manufacturing starch and the description of some starch factories, are presented. Some aspects of the collection and selection of introduced and native varieties based on their commercial value are dealt with; a list of 54 materials and their morphological description are given. The information on chemical composition of the varieties and possible causes of variations found are discussed. Damage caused by pests and diseases are described. Pests mentioned are *Delophonota ello, Microgastor flaveventris, Lagochiros oboletus, Cryptorhynchus* sp., *Lonchaea chalybea, Leptostylus binstus, Pachnaeus litus,* and the leaf-cutter ant. Fungi included are *Cercospora* spp., *Gloeosporium manihot, Fusarium* sp. and *Rosellinia* sp., as well as the bacteria *Bacillus manihot. (Summary by A.J. Trans. by S.S. de S.)* D00 I02

0122-3734 CURTISS, A H. **Sweet cassava in Florida.** Garden and Forest 2:99. 1899. Engl.

Cassava. *Manihot esculenta.* **Cultivation. USA.**

A brief description is given of the importance of sweet cassava *(Manihot aipi)* in the southern part of the United States (1885). In Florida, in addition to being used for human and animal consumption, it is processed into starch, tapioca and glucose The difference between sweet cassava and *M utilissima* is discussed Agronomic practices are given for the ecological conditions of this region, taking into consideration damage caused by frosts. *(Summary by P.G. Trans. by S.S. de S.)* D00

0123-5398 DIZES, J. **Aperçus sur le manioc et sa culture.** *(Cassava and its cultivation).* Abidjan, Côte d'Ivoire, Office de la Recherche Scientifique et Technique Outre-Mer, Centre D'Adiopodoumé, Service d'Experimentation Biologique, 1975. 48p. Fr., Sum. Fr., 28 Refs

Cassava. Plant anatomy. Climatic requirements. Land preparation. Planting. Harvesting. Tuber productivity. Mechanization. Rotational crops. Inter-cropping. Fertilizers. Irrigation. Diseases and pathogens. Production. Starch productivity. Cultivars. Dry matter. N. HCN content. Starch content. Ivory Coast.

This is an overview of cassava and its cultivation in the Ivory Coast; technological aspects, its utilization and economic importance are not taken into account. Historical aspects, botanical names, classification, varieties, plant description and ecological conditions are discussed briefly. Traditional cultivation systems are described, as well as more technical methods. Improved agronomic practices discussed are mechanization, rotation, intercropping, fertilization, grafting and irrigation. Cassava is kept in field clamps covered with straw and soil; but the best system, although expensive, is to refrigerate it at 2°C. Crops are attacked by small mammals (monkeys, rats, pigs, etc.) and several diseases. Insects are not of economic importance. Main diseases are mosaic (transmitted by the whitefly), *Cercospora* leaf spots, root rots, anthracnose and bacterial blight. The potential of cassava in industry and animal feeding has not been exploited It is necessary to improve yields and increase the area dedicated to intensive production systems. Total mechanization will not be possible until adequate varieties are available. Several tables and annexes as well as an ample bibliography, are included. *(Summary by S.S. de S.)* D00

0124-4755 DUFOURNET, R. and GOADRIN, P. **Mandioca.** *(Cassava).* Hacienda (USA) 53:39-41, 83-85 1958 Span , Illus.

Cassava. Rotational crops. Clones. Resistance. HCN content. Tubers. Hybridizing. Weeding. Harvesting. Herbicides. Diseases and pathogens. Injurious insects. Malagasy Republic.

This article summarizes studies carried out at the Experimental Agricultural Station of Lake Alaotra (Madagascar). It describes the requirements for cassava growing and analyzes the following aspects of 5 crosses obtained from introduced material: resistance to mosaic and rots, probable yield and starch content. It includes an outline of a 10-yr breeding program. With regard to cassava-growing problems, it analyzes weed control and the products used. Finally, it describes damage caused by the insects *Euproctis proeucta, Opatrum micans, Heteronychus plebejus* and the mite *Tetranychus bimaculatus,* and mosaic and root rot diseases *(Phaseolus manihotis, Armillaria mellea, Clytocibe tebescens* and *Gloeosporium manihotis)* giving preventive and control measures used. *(Summary by L.F.C. Trans. by S.S de S.)* D00

0125-4916 EHLERS, R.F. **Considerações sôbre a cultura da mandioca.** *(Cassava cultivation).* Granja (Brazil) 10(81):44-46; 10(82):34-37. 1954. Port.

Cassava. Use. Land preparation. Climatic requirements. Nutritional requirements. Soil requirements. Fertilizers. Propagation. Planting. Spacing. Productivity. Harvesting. Brazil.

A brief description is given of the following aspects of cassava growing in Brazil: origin; economic value and uses, climate; types of soil, their preparation and fertilization; different varieties; methods of propagation; planting systems and other agronomic practices; yields; storage. *(Summary by L.C. Trans. by S.S. de S.)* D00

0126-0427 ESTRADA R., N. *et al.* **El cultivo de la yuca en Colombia.** *(Cassava cultivation in Colombia).* Revista Esso Agricola 16(5):28-31; 16(6):22-24. 1970. Span., Illus.

Cassava. Cultivation. Weeding. Herbicides. Injurious insects. Diseases and pathogens. Cultivars. Identification. Productivity. Colombia.

Data are given on the area planted to cassava, average yields (8 tons/ha), prices, cultivation, weed control, varieties tuber quality, storage and future prospects. Important cassava diseases are CBB, Cercospora leaf spots, anthracnose and root rot (*Rosellinia* sp., *Phytophthora* sp. and *Pectobacterium* sp.). Chemical controls are given for the shoot fly (*Lonchaea chalybea*) the hornworm (*Erinnyis ello*), the mite (*Mononychus planki*) and the caterpillar (*Cecidomya cecropia*) *(Summary by T M.)* D00

0127-0064 **ESTUDIOS DE costos de producción de yuca. Centro Agrícola Regional de la Zona Norte. Zona de San Francisco de la Palmera. 29 fincas. Año 1973.** *(Cassava production cost studies. Agricultural Center-North Zone. San Francisco de la Palmera. 29 farms. 1973)* Costa Rica. Ministerio de Agricultura y Ganadería. Dirección de Planeamiento y Coordinación. Departamento de Economía y Estadísticas Agropecuarias. Boletín Técnico no. 21. 1974. 40p. Span , Illus.

Cassava. Cassava programs. Cultivation. Costs. Production. Land preparation. Planting. Fertilizers. Weeding. Harvesting. Distribution. Income. Prices. Trade. Costa Rica.

An agro-economic survey on cassava was conducted in San Francisco de la Palmera (Costa Rica) with 29 farmers who were interviewed with the purpose of (1) determining the technological level used, cassava production costs, the importance of this crop and future perspectives; (2) obtaining data needed by public and private institutions and enterprises; and (3) achieving the goals of the Agricultural and Livestock National Development Plan. Land use, production costs (labor, materials, transportation, etc.), income, profits and measures to determine production efficiency were studied. The results indicated that (1) the ecological conditions were adequate for cassava growing, (2) labor is the highest production cost; (3) av yield is 20 tons/ha; (4) fertilization is an uncommon practice; (5) farmers usually use the insecticide dieldrin; (6) credit service is adequate; (7) the variety Algodón is most commonly planted; and (8) at the time of the experiments, market prices for cassava were good because of the increase in exports to the USA. The results are given in tables and figures. *(Summary by A.J. Trans. by S.S. de S.)* D00 J00

0128-0215 **EXPERIMENTS PRODUCE** more cassava. Quarterly Bulletin Department of Agriculture, Zanzibar. 1961:5-12 Oct.-Dec. 1961. Engl.

Cassava. ***Manihot esculenta.*** **Field experiments. Cultivars. Selection. Tuber productivity. Dung. Ammonium sulphate. Potash. Planting. Spacing. Harvesting. Timing.**

The results are given of cassava varietal trials and experiments on fertilization, planting distances and harvesting season conducted in the region of Kizimbani (Zanzibar, Tanzania). Of the varieties studied, the most promising as regards yields (14 65 tons/acre), resistance to mosaic and palatability is 46106/27 *(Manihot esculenta* x *M. glaziovii* F_1 x *M. esculenta)* Experiments with different organic and inorganic fertilizers showed that the highest yields (17.75 tons/acre) were obtained applying 20 tons of farmyard manure (FYM)/acre, whereas the control produced only 8.43 tons. With the application of 10 tons FYM/acre, a marginal yield of 16.14 tons/acre was achieved. The treatments with sulfate of ammonia and muriate of potash did not increase yields significantly. Root collection at 16-20 mo gave higher yields (8.2-9.9 tons/acre) than harvesting at 12 mo (7 2 tons/acre). The conclusion drawn is that the variety 46106/27 should be planted at 3-4 ft between plants and 5 ft between ridges; it should be harvested at 18 mo and the application of FYM should not exceed 10 tons/acre. *(Summary by A.J. Trans. by S.S. de S.)* D00

0129-0076 FELLER, M **Cultura da mandioca.** *(Cassava cultivation)* Recife, Brasil, Grupo Executivo da Integração da Política dos Transportes, 1968. 9p., Port.

Cassava. Climatic requirements. Soil requirements. Cultivars. Planting. Fertilizers. Harvesting. Tuber productivity. Costs. Production. Processing. Cassava flour. Brazil.

The following aspects of cassava growing were studied from 1960-64 in norhern Brazil, where large amounts of cassava are produced the position of cassava in the gross agricultural income, ecological requirements of the crop (climate, rainfall), temperature, soils (physicochemical properties), most commonly grown varieties, planting systems (spacings, densities, seasons), agronomic practices (weeding, fertilization), sanitary treatments, harvesting and transportation, yields and processing. A diagram showing the steps for manufacturing flour and production tables for the years 1955-66 are also included *(Summary by L N.A Trans. by S S. de S.)* D00

0130-4933 FERNANDEZ A., E. **Frutos menores: boniato, yuca, ñame, malanga.** *(Minor crops: sweet potatoes, cassava, yams and taro).* Agronomia (Cuba) 4 302-312. 1944. Span.

Cassava. Cultivation. Mycoses. Injurious insects. Cuba.

A description is made of the agronomic aspects of cassava, sweet potato, yam and taro cultivation in Cuba. As regards cassava, the varieties, soil preparation, planting season and spacing, cultural practices, harvesting and intercropping (maize and beans) are dealt with. Cassava pests are *Erinnyis ello* (biologically controlled by *Microgaster flaviventris*), *Lagochirus obsoletus, Lonchaea chalybea, Lepidosaphes alba, Leptostylus brinstus, Pachnaeus litus* and *Atta* sp. *Cercospora* spp. and *Gloeosporium manihot* are mentioned as the most important pathogens *(Summary by A J. Trans by S.S de S.)* D00

0131-3122 FERREIRA FILHO, J C *et al.* **Manual da mandioca, a mais brasileira das plantas uteis; cultura, pragas e doenças, indústria.** (*Manual on cassava: its cultivation, pests and diseases, industry*) São Paulo, Edicão da Chácaras e Quintaes, 1942 299p Port , 95 Refs , Illus.

Cassava. History. Taxonomy. Plant anatomy. Cultivars. Composition. Toxicity. Cassava flour. Cassava starch. Tapiocas. Alcohol. Glucose. Forage. Climatic requirements. Soil requirements. Land preparation. Fertilizers. Propagation. Cuttings. Planting. Harvesting. Cultivation systems. Productivity. *Coelosternus granicollis. Erinnyis ello. Erinnyis alope. Bemisia. Scirtothrips manihotis. Anastrepha pickeli* **Lima.** *Carpolonchaea chalybea* **Wied. Pest control. Insect control.** *Xanthomonas manihotis. Pseudomonas.* **Resistance. Foliage. Cereals. Industrialization. Breads. Fermentation. Industrial machinery. Drying. Factories. Brazil.**

In this study on cassava, the following areas are dealt with (1) Cultivation - history, botanic description and classification, chemical composition and toxicity, uses, climate and soil, fertilization, selection of cuttings, planting, agronomic practices, harvesting and yields (2) A biological description and methods of control are given for the following pests: Coleoptera - *Coelosternus rugicollis, C granicollis, C. manihoti, C. notaticeps, Eulechriops manihoti;* Lepidoptera - *Erinnyis ello, E. alope, Setomorpha insectella, Rothschildia aurota;* Hemiptera - *Gargaphia lunulata, Leptopharsa manihotae, L. illudens;* Coccidae - *Saissetia oleae, Monophlebus niveus, Pseudaulacaspis pentagona, Pinnaspis aspidistrae, Aleurothrixus aepin; Bemisia tuberculata;* Thysanoptera - *Scirtothrips manihoti, Retithrips aegyptiacus;* Diptera - *Autodiplosis brasiliensis, Schizomyia manihoti, Atherigona excisa, Lonchaea pendula, L. chalybea, Anastrepha montei, A. manihoti, A. pickeli.* (3) The geographic distribution, importance, history, symptoms, etiology, study of the organism in different media, bacteriophage, transmissibility, control and resistant varieties are discussed for bacteriosis, (*Bacillus manihotis*), black root rot (*Diplodia* spp.) soft root rot (*Rhizopus nigricans*), leaf spots (*Cercospora henningsii, C. caribaea, Oidium manihotis, Colletotrichum manihotis*). (4) The cassava industry: production of raw material, types of energy available for industry, by-products, socioeconomic importance, comparative studies of cassava, sugar cane, maize and rice industries and their by-products, machinery for the cassava industry. The appendix includes a thesis on the influence of fuels on transportation costs and one on small-scale "aguardente" (distilled spirits) industries that could be converted to manufacture alcohol. (*Summary by T.M.*) D00 I02

0132-4434 FLACOURT, M. DE **Compte-rendu des experiénces culturales faites a la Station Expérimentale de Thanh-Ba (Tonkin) (2 août - fin janvier 1906).** *(Results of crop trials carried out at the Thanh-Ba Experimental Station).* Bulletin Economique de l'Indochine 1906:450-463. Fr.

Cassava. Cultivars. Identification. Tubers. Harvesting. Timing. Starch content. Tuber productivity. Cassava chips. Animal nutrition. Indochina.

A trial was carried out with several cassava varieties in different plots. This crop and tuber classification are described in detail; tables give data on starch content and yields. Diseases and pests most commonly found are also reported. *(Summary by H P. Trans by S S. de S)* D00

0133-2944 GAVIRIA M., H. **Cultivo de la yuca.** (*Cassava cultivation*). Agricultura Tropical (Colombia) 13:429. 1957. Span.

Cassava. Cultivation. Colombia.

This article gives a brief description of natural conditions and agronomic practices required for growing cassava, including aspects sush as climate and soil requirements, land preparation, planting season and density, fertilization, weeding, harvesting and production. The following pests and their control measures are mentioned: the cassava hornworm, whiteflies, a stemborer and leaf-cutting ants. (*Summary by A.J. Trans. by S. S. de S.*) D00

0134-0099 GRANER, E. A. and ABRAHAO, J. T. M. **Cultura da mandioca.** *(Cassava cultivation).* Piracicaba, Brasil, Escola Superior de Agricultura "Luiz de Queiroz", Departamento de Agricultura e Horticultura, 1970. 24p. Port , 8 Refs.

Cassava. Cultivars. Cuttings. Planting. Spacing. Climatic requirements. Soil requirements. Land preparation. Harvesting. Fertilizers. *Silba pendula. Erinnyis ello. Xanthomonas manihotis. Rosellinia*· **Insect control. Disease control. Animal nutrition. Plant breeding. Costs. Production. Trade. Brazil.**

A study was conducted on cassava growing in Brazil with the purpose of gathering data on the present state of the agro-economic aspects of this crop. Its position in the world, foreign trade and domestic situation are analyzed in table form; special emphasis is placed on the agro-industrial situation of cassava in São Paulo. The classification and botanical description of the plant and varieties used for fresh consumption and industrial purposes are dealt with first. Edaphic and climatic requirements and agronomic practices (soil preparation, planting, cultural practices and harvesting) are included. Other aspects discussed are fertilization and crop rotation. Main pests and diseases, their description and methods of control are presented. The main pests mentioned are *Silba pendula, Erinnyis ello* and *Coelosternus* spp ; the most important pathogens are *Xanthomonas manihotis* and *Rosellinia* spp. Cassava in animal feeding, plant breeding methods normally used, and the program's objectives are also discussed. *(Summary by A.J. Trans. by S.S de S.)* D00

0135-1660 INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES ET DES CULTURES VIVRIERES. **Manioc.** *(Cassava) In*_____. Compte rendu des activités de l'IRAT aux Antilles, 1963-1964 Fort de France, Martinique, 1965 pp. 224-248. Fr.

Cassava. *Manihot esculenta.* **Cultivars. Identification. Field experiments. Spacing. Fertilizers.** *Carpolonchaea chalybea.* **Resistance. Cassava mosaic virus. Cassava programs. Caribbean.**

A report is given on the results of studies carried out by the Institut de Recherches Agronomiques Tropicales in Guadeloupe and Martinique from 1963-64. Its objectives were to classify the main varieties in Guadeloupe and nearby islands and to conduct several regional trials, especially on the northern part of the island. Thirteen cassava species were classified into 3 main groups: the camanioc group (a sweet cassava variety), sweet and bitter. Aspects considered for each of the species are common and botanical name, cycle, origin, plant characteristics, average yield/plant, and susceptibility to *Lonchaea chalybaea* and to mosaic. Several density and fertilization trials were carried out, and the parasites and diseases most frequently found in these regions were studied. Some viruses, bacteria and the parasites *Lonchaea chalybaea,* tingids and thrips were found. *(Summary by S.S de S.)*D00

0136-6858 IRVINE, F. R. Cassava (*Manihot utilissima*) *In*____ West African Agriculture 3rd ed Oxford, Oxford University, 1969. v.2, pp.153-159. Engl, Illus.

Cassava. Cultivation. Africa.

General aspects of cassava cultivation in West Africa are discussed. The differentiation between sweet and bitter varieties is made. Sierra Leone is the only region producing bitter cassava on a large scale; the varieties used are Black and White Kandah and Shenge. The most appropriate climatic and edaphic conditions are mentioned. Cassava is propagated from cuttings planted at a distance varying from 90 x 90 to 1.50 x 1.50 m. Weeding and fertilization practices are needed. Cassava responds better to K than to N. Good results have been obtained leaving the debris from the previous crop in the field. Cassava can be grown alone or in association with other crops. In general, roots mature from 12-18 mo, but they are harvested as required because of the lack of storage systems. Human and animal feeding is the most important use of cassava leaves and roots. The preparation of gari, starch and tapioca is described. Main diseases mentioned are mosaic, *Fomes lignosus*, anthracnose and *Cercospora* spp. Pests devastating cassava fields include rodents, pigs and monkeys; grasshoppers, beetles, bugs and *Aonidomytilus albus* (a scale insect) also damage cassava. (*Summary by S S. de S.*) D00

0037-0167 KIDAVU, M G. Note on tapioca cultivation. Mysore Economic Journal 6.459-461. 1920. Engl.

Cassava. Cultivation. India.

Although the climatic conditions prevalent in South Kanara (Madras) are unsuitable for some crops, they are adequate for cassava. A brief description is given of different agronomic practices types of soils, drainage, planting season and systems, land preparation, fertilization and harvesting. *(Summary by P.G. Trans. by S S. de S.)* D00

0138-1617 KUNJU, U. M. Tapioca a food cum industrial crop. Farmer Parliament 7(10):9-10, 29. 1972. Engl.

Cassava. Land preparation. Planting. Spacing. Fertilizers. Harvesting. India.

Cassava, although unknown in some regions of India, ranks 2nd in importance after rice in the state of Kerala. Cassava starch yields/unit of area can double those of maize. The following aspects concerning cassava growing are discussed. origen, distribution, area planted, yields and agronomic practices *(Summary by P.G. Trans. by S.S. de S.)* D00

0139-7269 LEAO, A C. and GRAMACHO, I. DA C. P. **Aplicação da fotografia aérea em planejamento agrícola na região cacaneira da Bahia.** *(Application of aerial photography in the agricultural planning of the cacao region of Bahia).* Cacau Atualidades 11(4) 8-17. 1974. Port., Illus

Cassava. Cultivation. Developmental research. Maps. Brazil.

The principles of aerial photography are explained in this article, which shows how photointerpretation can be used for agricultural planning with reference to the cassava growing and processing industry in the state of Bahia, Brazil. *(Summary by Royal Tropical Institute)* D00

0140-0316 LOPEZ J., L.E. and ESTRADA R., N. **Taxonomía de la yuca, su origen, valor nutritivo y prácticas agronómicas.** (*Cassava: its taxonomy, origin, nutritive value and agronomic practices*). Bogotá, Instituto Colombiano Agropecuario, 1969. 18p. Span. Sum. Span., 12 Refs., Illus

Paper presented at the Simposio y Foro de Biología Tropical Amazónica, 2o., 1969.

Cassava. Taxonomy. Climatic requirements. Soil requirements. Planting. Herbicides. Harvesting. Nutritive value. Composition. Tubers. Leaves. Plant geography. Colombia.

The different scientific and common names of cassava (*Manihot esculenta* Crantz) are discussed. Cassava originates in the tropics of America from 0 to 1,700 m; it may have been cultivated first in the Amazon region. In Colombia 128 varieties have been collected so far Optimal adaptation of varieties occurs at temperatures between 18-30°C, in areas with a yearly rainfall of 600-1,500 mm. Soils should be light and fertile, either loam or clay loam. Because of its digestibility and high content of numerous amino acids, cassava is valuable in balancing diets; it should not be discarded for its low protein content. Hay from cassava leaves is of equal, if not superior, value to alfalfa (*Medicago sativa* L) (*Summary by T.M*) D00 H01

0141-2726 LOPEZ N., J.T. **Algo sobre el cultivo de la yuca en Venezuela.** (*Cassava growing in Venezuela*). Agricultor Venezolano 15(154):14-16. 1952. Span., Illus.

Cassava. Cultivars. Identification. Cultivation. Venezuela.

After giving a morphological description of cassava and emphasizing its importance both as a food and in industry, some agronomic aspects of its cultivation are described (soil preparation, rotation, planting material, agronomic practices, irrigation, harvesting and storage). Symptoms of the main diseases and pests and control measures are given. The elimination of diseased plants and the use of certified "seed" are the best practices to control mosaic and witches'-broom. Chemical control is recommended for mites, leaf-cutting ants and gall midges. Of the 200 or more Venezuelan varieties, some are recommended for being (1) early maturing (Carolina, Tempranita, Santa Ana and Amarilla); (2) resistant to postharvest deterioration (Cubana, Pajarita and Valenciana), and (3) high yielding (Carolina, Paja de Paloma and Caribe). These and other varieties with desirable characteristics constitute an excellent collection that should be multiplied in order to make cassava a crop of economic importance within the Venezuelan agricultural sector. (*Summary by A.J. Trans. by S. S. de S*) D00

0142-2948 MALLARD, R P. **A mandioca e sua cultura.** (*Cassava cultivation*). Boletim Agricola 11(1/6):89-96. 1962. Port.

Cassava. Land preparation. Fertilizers. Planting. Timing. Harvesting. *Erinnyis ello*. Bacterioses. Cassava flour. Cassava starch. Processing. Brazil.

General aspects of cassava cultivation and processing are presented: climatic and edaphic requirements, edible, industrial and forage varieties, cutting selection, soil preparation, fertilization, liming, crop rotation, planting methods and seasons, cultural practices, harvesting, crop association, conservation, diseases and pests. Among the pests, emphasis is placed on *Erinnyis ello;* among diseases, bacteriosis. The processes for obtaining cassava flour and starch are described. (*Summary by A.J. Trans. by S S. de S.*) D00 I02

0143-5733 MANDAL, R. C., SINGH, K. D. and MAINI, S. B. **Effect of plant density, fertility level and shoot number on tuber yield and quality of tapioca hybrids.** Indian Journal of Agronomy 18(4) 498-503 1973. Engl., Sum. Engl., 8 Refs.

Cassava. *Manihot esculenta*. Field experiments. Fertilizers. N. P. K. Dung. Spacing. Tuber productivity. Dry matter. Carbohydrate content. Shoots. Tubers. India.

The Central Tuber Crops Research Institute at Trivandrum conducted experiments from 1968-70 to determine the effect of plant density, shoots/plant, plants/hill and fertility level on root yield and quality in branched (H-97) and nonbranched (H-165) types of cassava. It was found that a spacing of 90 x 90 cm was best for the branched type and 75 x 75 cm for the nonbranched type. Two shoots/plant gave the best results. In the nonbranched type, 2 plants/hill gave encouraging results as compared to the normal practice of 1 plant/hill. Increased fertility levels increased root yield significantly. The combination of 12.5 metric tons of manure and 100 kg each NPK/ha produced the highest yield in both types. To obtain good-sized, better-quality roots, it is better to have 1 plant/hill with 2 shoots/plant under high fertility conditions. *(Author's summary)* D00

0144-3178 MARTIN, M. **Le manioc.** *(Cassava).* Engrais no. 53:17-20. 1952. Fr.

Cassava. Cultivation. Africa.

Brief notes are given on cassava. Data deal with botanical description, climates and soil, cultivation, fertilizers and the status of cassava cultivation in the French territories of Africa in 1948. *(Summary by H.J.S.)* D00

0145-6826 MATTOS, P L P. DE, GOMES, J DE C. and MATOS, A. P. DE **Cultura da mandioca.** *(Cassava cultivation)* Cruz das Almas, Brasil. Instituto de Pesquisas Agropecuáruas do Leste. Circular no. 27. 1973. 13p. Port., Illus.

Cassava. Soil requirements. Fertilizers. Minerals. Planting. Cuttings. Selection. Spacing. Harvesting. Costs. Production. Insect control. Disease control. Maps. Brazil.

The following aspects of cassava growing in the states of Sergipe and Bahia (Brazil) are dealt with briefly. recommended cultivars, soils, liming, planting systems, spacing, selection of cuttings, cultural practices, fertilization, economic study on the per hectare costs of land preparation, hand labor and fertilization, pests (*Silba pendula, Erinnyis ello, Mononychellus tanajoa*), diseases (bacterial blight, viroses, *Cercospora* sp.) and harvesting. *(Summary by S.S. de S.)* D00

0146-0600 MENDES, C. T. **Culture du manioc au Brésil.** (*Cassava cultivation in Brazil*). Revue de Botanique Appliquée 13(145).655-658 1933. Fr.

Cassava. Cultivars. Identification. Cultivation. Brazil

This article gives a brief description of the 3 main varieties used for human consumption (Mandioca Rosa, Mandioca Palma, Vassourinha) and the 3 used for forage and industrial purposes (Vassourinha Grande, Grêlo Roxo, Cubatas). The composition of forage roots and comments on aspects that should be taken into account when growing cassava are also included. (*Summary by S.S de S.*) D00

0147-5038 MONTEIRO, T. **Como cultivar a mandioca.** *(Cassava cultivation)* São Paulo; Edições Melhoramentos, 1956. 29p. Port., Sum. Port., Illus.

Cassava. Climatic requirements. Soil requirements. Fertilizers. Planting. Cuttings. Timing. Spacing. Weeding. Cassava common mosaic virus. *Xanthomonas manihotis* Disease control. Rotational crops. Cassava products. Uses. Brazil.

This article highlights the importance of cassava. It includes the chemical analysis of the roots and the steps followed to manufacture bread, flour and chips. A description is given of cassava varieties grown in Brazil and the following aspects are discussed climate, soils, land preparation, cutting selection and preparation, planting season, K, P and lime fertilization, agronomic practices, harvesting and production. Rotation with cotton, maize and legumes is recommended. Symptoms presented by plants attacked by several pests *(Diplonota ello, Erinnyis ello, Eudiplosis brasilensis)* and diseases (witches'-broom and cassava bacterial blight) are described and illustrated; prevention and control measures are given. The precautions that should be taken when using chemicals are enumerated. *(Summary by L.F.C. Trans. by S.S. de S.)* D00

0148-4932 MUELLO, A C. **Cultivo y explotación de la mandioca en la Argentina.** *(Cassava cultivation in Argentina).* Hacienda 31(6) 204-205. 1936. Span., Illus.

Cassava. Cultivation. Argentina.

A description is given of agronomic practices, soil selection, varieties, planting, harvesting and storage. The purpose of this description is to promote the expansion of cassava in Argentina because of its importance in human and animal feeding and as a raw material for industrial products. *(Summary by A.J. Trans. by S.S. de S.)* D00

0149-2941 OSPINA L., A **La yuca, valioso recurso agrícola del Meta.** *(Cassava, a valuable agricultural resource in Meta).* Arroz no. 106:19-20. 1960. Span.

Cassava. Cultivation. Costs. Colombia.

The present state of the cassava crop in Meta (Colombia) is described. Some factors contributing to its expansion within this region are its importance in the diet of the rural population, land availability and the crop's marketability. Some agronomic aspects from planting to harvesting and production costs are included. Also mentioned are its uses for both human and animal consumption and industrial purposes, especially as a raw material for manufacturing starch. However, it is mentioned that the starch industry has failed because of marketing problems. *(Summary by A.J Trans. by S.S. de S.)* D00

0150-4935 PAIVA, D. V. **El cultivo e industrialización de la mandioca.** *(Cassava growing and industrialization)* Boletín Informativo (Uruguay) no. 401:4-5. 1952. Span.

Cassava. Cultivation. Processing. Paraguay.

Aspects are presented of cassava growing and industrialization in Paraguay. Agronomic practices from planting to harvesting are discussed and different varieties for consumption and industrial purposes are recommended. The rudimentary processes for manufacturing cassava starch and flour and methods for selecting and storing planting material are given. There are no pests or diseases of economic importance Yields vary between 10,000-15,000 kg/ha. *(Summary by A J. Trans. by S.S. de S.)* D00 102

0151-1739 PEIXOTO, A. R. **Mandioca.** (*Cassava*). Rio de Jâneiro, Brasil, Ministério da Agricultura, Serviço de Informação Agrícola. Productos Rurais no. 5. 1963. 36p. Port.

Cassava. Cultivars. Identification. Production. Climatic requirements. Cuttings. Planting. Land preparation. Fertilizers. Harvesting. Processing. Cassava products. Uses. Brazil.

This article presents in detail the following agronomic practices of cassava cultivation: soil and climate, cutting propagation, soil preparation, planting, fertilization, irrigation, harvesting and storage. The basic steps followed to obtain several cassava by-products are indicated: washing, peeling, pressing and drying. A description is given of the production of cassava flour, starch, taquiri (a spirituous liquor), tapioca, tucupi, alcohol, dextrins and glucose. The uses of this crop in human and animal feeding are also indicated. *(Summary by P G. Trans. by S S.de S.)* D00 I00

0152-5349 PORRAS M., E. **Las rodajas de yuca, una nueva agroindustria.** *(Cassava chips: a new agricultural enterprise).* Surco Latinoamericano (Colombia) no 1:6-7. 1975. Span

Cassava. Productivity. Harvesting. Rooting. Cassava chips. Prices. Industrial machinery. Soil requirements. Drying. Factories. Nicaragua.

In the region of Cerro Negro (Nicaragua), good cassava yields (28 tons/ha) are obtained. A mechanical harvester of local design is used, reducing costs considerably. The roots are sliced and dried in the sun These chips are sold for feedstuffs and to starch factories. *(Summary by T.M.)* D00 I02

0153-3733 PUIG Y NATTINO, J. **La mandioca.** *(Cassava).* Revista del Ministerio de Industrias (Uruguay) 8(52):81-85. 1920. Span.

Cassava. Cultivation. Uruguay.

A description is made of the agronomic practices of cassava growing and its climatic and edaphic requirements The chemical composition of cassava pulp is also given. The purpose is to disseminate information on this plant to promote its cultivation in Uruguay. *(Summary by A.J. Trans. by S.S. de S.)* D00

0154-4931 PYNAERT, L. **Cassava: its cultivation and utilization.** Bulletin of the Imperial Institute 12:581-611. 1915. Engl.

Cassava. Cultivars. Climatic requirements. Planting. Soil requirements. Propagation. Land preparation. Harvesting. Rotational crops. Tuber productivity. Tubers. HCN content. Toxicity. Uses. Cassava meal. Cassava flour. Casave. Cassava starch. Tapiocas. Glucose. Cassava chips. Alcohol. Processing. Wastes. Trade.

A general description is given of the origin of cassava, varieties, cultivation (climate, adequate sites, soil, propagation and planting of cuttings, preparation of soil and manuring, maintenance, intercropping, rotation, harvesting and yields). Pests include *Atta* spp., *Lonchaea* sp., *Erinnyis ello, Prodenia litura, Mytilaspis dispar* and *Lagochirus obsoletus.* Mention is also made of bacterial diseases, Cercospora leaf spots and *Gloeosporium manihoti.* The composition of the roots is analyzed, together with the HCN content in sweet and bitter varieties. The preparation of cassava meal and flour, farine, starch and tapioca, dried cassava and cassava chips, alcohol, glucose, etc. is explained. Uses of fresh cassava and factory waste products for livestock are also included. Import and export data for the United Kingdom, Dutch and French possessions are given for 1914. *(Summary by L.C Trans. by T M.)* D00 I02

0155-0011 RAMAS DE mandioca podem ser conservadas durante meses para plantio. *(Cassava stalks to be used for cuttings can be stored for months).* Agricultura e Pecuária (Brazil) 37(500) 52. 1965. Port.

Cassava. Stems. Storage. Brazil.

A simple method is given for storing cassava stalks during the winter. Furrows 2 m long x 0.30 m deep are made, and the stalks are piled to form a cone, at the vertex of which a stick is placed. The stalks are then covered with straw and soil, and ventilation is provided. Instructions are also given for building a simple field clamp for storing the stalks to be used for cuttings. Since this area is liked by mice, poison should be applied periodically. *(Summary by T.M.)* D00

0156-4753 RIBEIRO FILHO, J. **Cultura da mandioca.** *(Cassava cultivation).* Viçosa, Brasil Universidade Rural do Estado de Minas Gerais, Escola Superior de Agricultura, 1966. 80p. Port., 52 Refs.

Cassava. *Manihot esculenta.* Cultivars. Identification. Flowers. Petioles. Climatic requirements. Soil requirements. Fertilizers. Planting. Timing. Spacing. Cuttings. Weeding. Pruning. Harvesting. Starch productivity. Tuber productivity. Storage. Tubers. Cultivation systems. Costs. Production. Brazil.

This manual of the Escola Superior de Agricultura of the Universidade Rural do Estado de Minas Gerais (Viçosa) deals with the following subjects: (1) history; (2) importance - uses, chemical composition, roots, branches, leaves, different flours, economic situation; (3) botany - *M. utilissima,* origin, description, toxicity, varieties, classification according to use and characters (key) for recognition; (4) climate; (5) soils - preparation, liming, fertilization, absorption of main elements; (6) planting - season, density, cuttings, systems; (7) manual and mechanical agricultural practices, herbicides, pruning; (8) harvesting; (9) storage and root rot; (10) yields; (11) intercropping; (12) crop rotation; (13) prices and economic prospects. *(Summary by L.F.C. Trans. by S.S. de S.)* D00

0157-0552 RIOS R., M., PATERNINA H., O. and ESTRADA R., N. **Informe sobre las investigaciones de yuca (*Manihot esculenta* Crantz) en Colombia.** [*Cassava research (Manihot esculenta Crantz) in Colombia*]. Bogotá, Instituto Colombiano Agropecuario, 1970. 10p. Span.

Paper presented at the Reunión de Investigadores en Yuca de los Países Andinos del Estado de São Paulo, Campinas, Brasil. 1970.

Cassava. *Manihot esculenta.* Cassava programs. Cultivars. Selection. Protein content. Starch content. Animal nutrition. Weeding. Pest control. Colombia.

A report is given on the cassava research conducted by the Instituto Colombiano Agropecuario in different zones and environments in Colombia since 1967. The main objectives were the collection and evaluation of varieties, improvement of agronomic practices, high yields, improvement of cassava quality (protein and starch), pest and disease control, and adequate storing conditions. Some varieties are recommended for their high yields, quality, starch content and precocity; the most outstanding variety was CMC-9 (Llanera), which reached experimental yields of up to 60 tons/ha. Agronomic practices recommended were the use of 30-cm high ridges, the planting of 25- to 30-cm-long cuttings at a 45° slant and spacings of 1 x 2 m and 1 x 1 m, according to branching habit. In animal feeding trials, the increase in liveweight of pigs fed 2.48 kg/day of a balanced diet based on 69% cassava was 0.708 kg/day. In the case of fattening broilers, the proportion of cassava meal should not exceed 15% as a higher amount decreases weight gain and feed efficiency. As regards pests and diseases, chemical control is recommended for the hornworm, *Erinnyis ello;* the shoot fly, *Carpolonchaea chalybea;* and the thrips *Mononychus planki.* Resistance to *Cercospora* spp and *Xanthomonas* sp. has apparently been found. *(Summary by A.J. Trans. by S.S de S.)* D00 C03

0158-7386 ROSENTHAL, F. R. T. **A cultura da mandioca.** *(Cassava cultivation).* Informativo do INT 9(10).27-36 1976. Port., Sum. Engl.,Port., 27 Refs.

Cassava. Cultivars. Production. Prices. Tuber productivity. Stems. Leaves. Protein content. Carbohydrate content. N. P. K. Ca. Mg. Fertilizers. Harvesting. Timing. Brazil.

A general overview on cassava growing in Brazil is given. Statistical data and projections related to world and national production are quoted Results of agronomic studies made by Brazilian institutions on cassava physiology, planting and harvesting dates, early- and late-maturing varieties, root and leaf composition, etc are presented General aspects of its cultivation, favorable ecological conditions, and response to fertilizers and management are also discussed. Pests of importance are *Silba pendula, Coelosternus* sp , *Erinnyis ello, Mononychellus tanajoa* and *Atta* spp. Principal diseases are bacterial blight, Cercospora leaf spots, cassava ash, rust and several root rots. *(Summary by T M)* D00

0159-0040 SAGOT, P. **Du manioc.** *(Cassava).* Bulletin de la Société Botanique de France 18:341-354. 1871. Fr

Cassava. Cultivation. Harvesting. Cultivars. Toxicity.

A general description is given of several aspects of cassava growing presented to the French Botanical Society in 1871. The main subjects dealt with are names and origin of cassava, planting, agricultural practices, stages of vegetative development, harvesting, preparation of roots, toxin content, wild varieties, its use as a feed and for green manure, utilization of waste products and cassava growing outside French Guiana in areas such as the Antilles, Brazil and Angola. *(Summary by R.T Trans. by S.S. de S.)* D00

0160-0028 SAWYER, A. M. **Tapioca cultivation in Travancore.** (*Cassava cultivation in Travancore)* Indian Forester 21:290-296. 1895. Engl

Cassava. Cultivation. Plant development. Cultivars. Identification. India.

A general description is given of native methods used for growing cassava in both flat and hilly areas Cassava is boiled several times to eliminate the HCN. Coconuts and tamarind juice are used as antidotes in case of intoxication. Seventeen varieties are classified into two groups: the "Avians" or "easily boilable" and the "Maravans" or "dark races " (*Summary by L F.C. Trans. by T.M*) D00

0161-1765 SILVA, J.R. DA **O programa de investigação sôbre mandioca no Brasil.** *(Cassava research in Brazil). In* Encontro de Engenheiros-Agronômos Pesquisadores de Mandioca dos Países Andinos e do Estado de São Paulo, 1º, Campinas, Brasil, 1970. Trabalhos. Campinas, Brasil, Instituto Agronômico do Estado de São Paulo, 1970. pp.59-72. Port.

Cassava. Cassava programs. Plant breeding. Bacterioses Resistance. Cultivars. Selection. Fertilizers. Cuttings. Spacing. Tuber productivity. Timing. Brazil.

With the purpose of improving relationships among professionals working on cassava research, a meeting was carried out to analyze the situation of the crop in the following states: (1) Rio Grande do Sul. Areas planted, production, crop problems (bacterial blight, frosts, and poor soils) and their solutions through breeding, varietal selection and fertilization are given in detail (2) Santa Catarina. Problems found were cassava bacterial blight (*Xanthomonas manihotis*), soil conservation, P-deficient soils and frosts. To solve them, research was conducted on varieties resistant to CBB (Branca de Santa Catarina, Guaxo and Mico), mineral fertilization, adequate planting distances and length of cuttings. (3) Guanabara and Rio de Janeiro. The main handicaps were the low degree of technology and the few experimental results available on the region. Work was done to identify agronomic problems and to determine research priorities. (4) Minas Gerais. Research has been done on the use of preemergence herbicides, competition among varieties, planting seasons (yields are given in a table), cassava as a livestock feed, conservation of stems for propagation material, planting distances and mineral fertilization. (5) Bahia. Research was conducted on weed competition, planting seasons, collection of varieties, mineral fertilization, soil conditioning, planting systems and breeding. (6) Amazonas. Although it is not one of the largest cassava-producing areas, cassava is a basic staple in the diet of this region; therefore, trials were carried out to enrich its protein and vitamin content adding soybean flour to the two types of cassava flour consumed in the region. Fertilization trials were also conducted. (*Summary by L.F.C. Trans. by S.S. de S.*) D00 G01

0162-1763 SILVA, J. R. DA **O programa de mandioca no Instituto Agronômico do Estado de São Paulo.** *(The cassava program of the Instituto Agronômico do Estado de São Paulo).* Agronômico 23:49-71. 1971. Port.

Cassava. Cultivars. Adaptation. Tuber productivity. Planting. Spacing. Cuttings. Timing. Fertilizers. Germination. Plant breeding. Resistance. Pruning. Selection. Brazil.

Because of the great economic importance of cassava and the high susceptibility of Vassourinha (90% of the plants are of this variety) to *Xanthomonas manihotis*, a series of experiments were carried out. Results were as follows: (1) New high-yielding clones were developed and tested in Vale do Paraíba; (2) planting from May to August (before the rainy season) is more advantageous; (3) long cuttings (60 cm) planted vertically or slanted are recommended; (4) cuttings should be planted from 20 to 30 cm deep; (5) planting distances of 1.00 x 0.50 or x 0.60 m are recommended for infertile soil and 1.20 x 0.60 m for fertile soil; (6) fertilization with NPK is summarized in tables; (7) indices of productivity are also given. The rest of the report outlines the present program and analyzes different varieties from Bolivia and Paraguay. *(Summary by T.M.)* D00 G01

0163-1709 SILVA, R F. E. **Notas sôbre a cultura da mandioca.** *(Cultivation of cassava)* Brasil. Ministério da Agricultura, Secção de Publicidade, 1942. 11p. Port., 15 Refs.

Cassava. Cultivars. Composition. Soil requirements. Land preparation. Fertilizers. Cuttings. Planting. Timing. Pests. Harvesting. Uses. Brazil.

A description is given of the origin, taxonomic classification and different varieties of cassava grown in the states of Rio de Janeiro, Bahia and São Paulo. A chemical analysis of these varieties is given in a table Other factors discussed are climate, soils, land preparation, fertilization, planting times and methods, intercropping, agronomic practices, diseases and pests, crop rotation, harvesting, storage, yield and the different uses of cassava as a food for humans and animals, as well as for various industrial products *(Summary by L.C. Trans. by T.M.)* D00

0164-5579 **SISTEMA DE produção para mandioca.** *(Cassava production systems).* Rio Prêto, Brasil. Empresa Brasileira de Pesquisa Agropecuária. Série Circular no. 48. 1975. 12p. Port.

Cassava. Productivity. Land preparation. Planting. Harvesting. Soil requirements. Cuttings. Fermentation. Rasping. Washing. Pressing. Screening. Cassava flour. Composite flours. Trade. Brazil.

This booklet is directed to farmers who use family labor or mutual help, especially in the state of Amazonas. It enumerates the practices and technical recommendations that constitute the production system: soil selection and preparation, the selection and preparation of cuttings, cultural practices, harvesting and processing (flour) and commercialization. A table shows production costs per hectare. *(Summary by L.F.C. Trans. by S.S. de S.)* D00 J00

0165-5371 SOCIETE D'AIDE TECHNIQUE ET DE COOPERATION, PARIS. Manioc. *(Cassava)* *In* ______. Projet PNUD-FAO de développement de la plaine de Morondava (Madagascar) Paris, 1970. pp. 75-79. Fr

Cassava. Cultivation. Fertilizers. Costs. Industrialization. Malagasy Republic.

Data are given on the varieties, cropping cycle, different agronomic practices, planting density, water requirements, fertilization, yields and by-products of cassava in Morondava (Malagasy Republic). The importance of multiplying high-yielding varieties for cattle feeding is indicated. A deeper preparation of the soil is required to facilitate water retention and root penetration. Crop rotation could be used to reach yields as high as 40 tons/ha. The costs of operating 1 hectare with traditional and improved cultivation methods are given in tables. *(Summary by S.S. de S.)* D00 J00

0166-5736 STEPHENS, J. M. **Growing cassava in Florida.** Gainsville. University of Florida. Agricultural Extension Service. Extension Vegetable Crops. Mimeo Report 65-1. 1965. 3p. Engl., 7 Refs.

Cassava. Cultivation. Uses. USA.

This booklet of the Florida Agricultural Extension Service gives a general description of the variety Aipi, the most commonly grown in that region; soil and climatic requirements; cultural practices (propagation of cuttings and their conservation during the winter); planting systems; fertilization and harvesting. Cassava is not apparently affected by diseases and pests in Florida. It is used as starch, tapioca, gaplek, cassareep and for animal feedstuffs. *(Summary by L.F.C Trans. by T.M.)* D00

0167-4941 THOMSON, R. **Report on cassava.** Bulletin. Botanical Department, Jamaica, 9(6):81-87. 1902. Engl.

Cassava. Cultivation. Processing. Cassava products. Uses. Jamaica.

A brief description is given of several aspects of cassava growing in Jamaica, including soil preparation, planting season and methods, harvesting, industrial uses (starch, glucose and alcohol) and animal feedstuffs. *(Summary by A.J. Trans. by S.S. de S.)* D00 I02

0168-4536 TORRES H., J. M. **La yuca: cultivo, rendimiento y productos.** *(Cassava: cultivation, yield and products)* Revista Agrícola y Ganadera (Colombia) no. 2 5-7. 1942. Span.

Cassava. Cultivation. Uses. Colombia.

The agronomic practices (from planting to harvesting) used in Colombia for growing cassava are described. Several by-products obtained from cassava for human and animal feeding and industrial purposes, such as flour, starch, tapioca, bread, forage, beer, explosives, glue, textiles, etc., are mentioned. *(Summary by A.J. Trans. by S.S. de S.)* D00

0169-0071 TRIBUZI, H.S. **Trabalho completo sôbre a cultura racional da mandioca.** *(Cassava cultivation).* Sitios e Fazendas 29(12):22-24. 1963. Port., Illus.

Cassava. Land preparation. Fertilizers. Planting. Cuttings. Cultivars. Selection. Harvesting. Productivity. Brazil.

A brief description is given of the following agronomic aspects used in cassava cultivation in Brazil: edaphic and climatic requirements, soil preparation, fertilization, cutting selection and conservation, planting, selection of the varieties, cultural practices, harvesting, storage and yields. *(Summary by A.J. Trans. by S.S. de S.)* D00

0170-4560 VARON C., L. A. and GARTNER G., J. J. **Cultivo de la yuca.** *(Cassava cultivation).* Palmira, Colombia, Instituto Colombiano Agropecuario, Centro Nacional de Investigaciones Agropecuarias, n. d. 8p. Span.

Cassava. Climatic requirements. Soil requirements. Land preparation. Planting. Spacing. Insect control. Disease control. Weeding. Irrigation. Cultivars. Productivity. Starch content. Protein content. Colombia.

Agronomic aspects of cassava growing are dealth with in order to provide farmers with techniques and varieties recommended to increase present yields (7 tons/ha). One of the basic steps designed to achieve this goal was the establishment of a germplasm collection, the evaluation of which has made it possible to identify superior varieties. Control measures are given for the following pests and diseases the cassava hornworm *(Erinnyis ello)*, shoot flies *(Lonchaea chalybea)*, leaf galls *(Cecidomyia cecropias)* and mites *(Mononychus planki)*. Root rot due to *Phytophthora parasitica* causes the greatest economic damage. Some foliage diseases caused by *Cercospora caribaea, Ascochyta* sp. and *Colletotrichum* sp. are also mentioned. A list of recommended varieties is included, specifying yields, protein and starch content, vegetative period, climatic and edaphic requirements and utilization. *(Summary by A.J. Trans. by S.S. de S.)* D00

0171-0204 VARON C., L. A. and GARTNER G., J. J. **Yuca: generalidades y técnicas de cultivo.** *(Cassava cultivation). In* Instituto Colombiano Agropecuario. Curso intensivo del cultivo de yuca. Palmira, Colombia, Centro Nacional de Investigaciones Agricolas. 1972. pp.3-13. Span.

Cassava. Cassava programs. Land preparation. Planting. Timing. Weeding. Herbicides. Harvesting. Cultivars. Composition. Cassava products. Uses. Marketing. Colombia.

A description is given of the present state of cassava growing in Colombia, the Government's objectives for increasing its production, and the methods for accomplishing these objectives Agronomic systems are also described in regard to soils, preparation of the land, seed, planting distances and seasons, fertilization and cultural practices. *(Summary by L. C. Trans. by T.M.)* D00

See also 0029 0424 0604 0676 0712 0736 0741 0747 0749 0757 0765-0767 0768 0772 0788

D01 Soil, Water, Climate, and Fertilization

0172-6756 AMON, B O.E. and ADETUNJI, S. A. **The response of maize, yam and cassava to fertilizers in a rotation experiment in the savannah zone of western Nigeria.** Nigerian Agricultural Journal 10(1):91-98 1973. Engl , Sum. Engl , 3 Refs

Cassava. *Manihot esculenta*. Rotational crops. Field experiments. N. P. K. Tuber productivity. Fertilizers. Maize. Yams. Nigeria.

This paper describes responses to major nutrients by the staple food crops—maize, yams and cassava—in the savanna of western Nigeria. The crops were grown in rotation: sunn hemp, maize, yam and cassava as the final crop before fallow (sunn hemp). High increases in maize, yam and cassava yields were obtained; the system was good for maize and cassava but not quite suitable for yams. Recommended fertilizer rates are presented for this rotational pattern; as regards cassava, they are 25 lb N + 0 lb P_2O_5 + 60 lb K_2O/acre as 120 lb ammonium sulfate and 100 lb muriate of potash (KCl). *(Summary by T M.)* D01 K01

0173-6800 ASHER, C. J., comp. **Symptoms of nutritional disorders in cassava.** Santa Lucia, Australia, University of Queensland, 1975. 18p. Engl., 10 Refs., Illus.

Cassava. Mineral deficiencies. N. P. K. Magnesium. Boron. Ca. S. Iron. Zn. Copper.

A description is given of the symptoms of various nutritional disorders (deficiencies and toxicities) found in cassava in 1970 by the cassava research program conducted at the University of Queensland. Plants were propagated under mist from small tip cuttings (5 cm long) with the purpose of minimizing initial nutrient reserves; afterwards, they were grown in solution cultures under partially controlled glasshouse conditions. The nutritional disorders that produce symptoms in older and younger leaves are described. As regards older leaves, N, P, K and Mg deficiencies, as well as K-induced Mg deficiency and B toxicity, are discussed. The disorders producing deficiency symptoms in younger leaves dealt with are Ca, B, S, Fe, Mn, Zn and Cu. In many of these experiments, it was observed that cassava presented visible symptoms of deficiency only when it was very severe (i.e., P deficiency); this may have contributed to the generalized idea that this crop is well adapted to poor soils Absence of symptoms cannot be taken as evidence that the nutrient supply in a particular situation is completely adequate for the growth and development of cassava. *(Summary by A.J. Trans. by S. S. de S.)* D01

0174-6934 CAMPBELL, L. G. **Mechanising tropical root crop production.** Span 17(3) 118-120. 1974. Engl , Illus.

Cassava. Mechanization. Starch crops. Cultivation. Harvesting.

The development of mechanized systems of production for edible starchy root crops such as yams, sweet potatoes, taro (*Colocasia* spp.), tania (*Xanthosoma* spp.) and cassava are discussed with reference to land preparation, planting, weed and pest control, secondary tillage, foliage support, soil fertility and harvesting. (*Summary by Field Crops Abstracts*) D02

0175-0172 CHEW, W.Y. **The performance of tapioca, sweet potato and ginger on peat at the Federal Experiment Station, Jalan Kebun, Selangor.** Kuala Lumpur, Agronomy Branch, Division of Agriculture, 1971?. 7p. Engl., Sum. Engl., 12 Refs.

Cassava. *Manihot esculenta.* **Land preparation. Planting. Spacing. Cultivars. Tuber productivity. N.P. Potash. Fertilizers. Field experiments. Malaysisa.**

Large areas of Malaysia have acid peat soils with low mineral content, high water table and coarse woody texture. Drainage, liming and manuring with major and trace elements are necessary for growing short-term crops. The soil management, varieties, liming, manuring and cultural requirements of cassava, sweet potatoes and ginger are discussed. As for cassava, it was found that cuttings should be planted flat to avoid lodging. Good drainage is important. Of the 14 varieties tested, Black Twig yielded best (14.1 tons/ha at 9 1/2 mo). The best NPK treatment on virgin peat was 180 lb N, 50 lb P and 110-160 lb potash/acre. The most important trace element is Cu; 15 lb/acre of copper sulfate should be applied as a basal fertilizer. *(Summary by T.M.)* D01 D03

0176-5617 CONCEIÇAO, A. J. DA, SAMPAIO, C V. and BORGES, I O. **Competição de cultivares de mandioca** ***(Manihot esculenta*** **Crantz)** **para a produção de ramas e raízes forrageiras.** ***(Evaluation of cassava cultivars as to production of aerial parts and roots for forage).*** *In* Cruz das Almas, Brasil. Universidade Federal da Bahía. Escola de Agronomia/BRASCAN Nordeste Série Pesquisa v.1. no. 1. 1975. pp.87-97. Port., Sum. Port., Engl., 22 Refs.

Cassava. Cultivars. Field experiments. Tuber productivity. Foliage. Production. Forage. Timing. Rainfall data. Temperature. Soil analysis. Brazil.

From 1969-72 an experiment was carried out on a colonial latosol, tertiary sediment (Série Barreiras) at the Universidade Federal da Bahia in Cruz das Almas, Bahia (Brazil) to study the production of both the aerial part (leaves and stems) and roots of cassava for forage Plants in some plots were cut every 4 months during the first year (3 cuts), others were cut every 4 months during the first 8 months (2 cuts), and a third set was not cut at all Final harvesting was done at 18 months for all treatments. The cultivars Sutinga, Platina, Graveto and Salangor Preta, cut twice during the first 8 months, proved to be the best for this purpose. *(Author's summary. Trans. by T.M.)* D01 D03

0177-5382 DOOP, J. E. A. DEN **Factors influencing the availability of the indigenous phosphorus in an acid tropical soil.** Soil Science 52:101-120 1941 Engl , 5 Refs., Illus.

Cassava. Field experiments. Soil fertility. P. Analysis. N, K. Fertilizers. Productivity. Java.

Experiments were made on a deep red loam clay soil of volcanic origin in Java Its Al_2O_3 content is 25% and Fe_2O_3 15%. The base-exchange capacity is 30 meq/100 g and the pH of the soil, when forested, about 6-7. After clearing and cropping, the pH falls to a nearly constant level of approx. 4.5-5 5. Annual rainfall is 2,000 mm. Cassava yields are used to evaluate the availability status of P The status of indigenous P can be improved by additions of K fertilizer and by N in the presence of K. These effects become more apparent after several years than at first. The 1st evidences were noted 1½ yr earlier with cassava than with sisal. The effect lasted about 3 yr longer with sisal than with cassava. It is thought that utilization of the sun's energy stored in the form of organic matter is later at the disposal of soil microoganisms to better advantage when K fertilizers are added to facilitate their activity. (*Summary by Chemical Abstracts*) D01 D03

0178-2433 GODFREY-SAM-AGGREY, W. and BUNDU, H. S. **Growing and fertilizing cassava in three cropping systems on upland soils of Sierra Leone.** University of Sierra Leone. Njala University College. Circular no.6. 1972. 19p. Engl.

Cassava. *Manihot esculenta.* **Fertilizers. N. P. K. Ca. Magnesium. Costs. Cultivation. Tuber productivity. Sierra Leone.**

After giving background data on the status of cassava, which is the 2nd most important staple food crop (after rice) in Sierra Leone, 3 cropping systems are studied: (1) planting and fertilizing cassava after a 6-year bush fallow; (2) planting pineapples (1 crop only) after clearing secondary bush; then cassava was planted and fertilized; and (3) planting maize after clearing secondary bush; then cassava was planted but not fertilized Experiments were conducted on well-drained Njala upland soils (pH 4 to 4.8), highly weathered, low in available plant nutrients and poor in productivity. Agronomic practices are recommended and fertilizer recommendations are summarized in tables. Methods of combating bush fowls, squirrels, subterranean termites and grasshoppers (*Zonocerus variegatus*) are given. Mosaic (transmitted by the whitefly *Bemisia* sp.) and white thread (a root rot caused by *Fomes lignosus*) are important diseases; other diseases of no economic importance are *Cercospora* leaf spots and anthracnose. (*Summary by T.M.*) D01

0179-4985 GROSSMAN, J. and ASSIS, J.A DE **Ensaios de adubação.** *(Fertilization trials).* Revista Agronômica 15:169-173. 1951. 15p. Port., Sum. Port , 5 Refs.

Cassava. Field experiments. N. P. K. Fertilizers. Tuber productivity. Plant development. Statistical analysis. Brazil.

Several fertilization trials were carried out on a sandy soil with cassava, sweet potatoes, maize, rye and peanuts at the EstaçãoExperimentalde Mandioca in Cai (Brazil). Each trial consisted of 27 different combinations of NPK applied in a proportion of 100-200 kg/ha split into 3 blocks of 9 balanced plots each, according to a confounded experimental design. As far as cassava is concerned, N fertilizer was applied as blood meal, P as superphosphate and K as KCl. Variance analysis was employed to study the linear effect and curvature of each fertilizer, as well as the possible interactions resulting from the application of 2 fertilizers. P fertilizers proved to be efficient in all cases because of the P deficiency of the soil under study; however, yield increase was not proportional to the quantity of P fertilizer used. K reserves contained in the soil did not satisfy the needs of cassava, which responded satisfactorily to only 1 application of 100 kg of KCl/ha. N fertilizers accounted for a considerable increase in cassava. There was an interaction of P and K in cassava when they were applied simultaneously to the soil The vegetative development and yields of the different crops were poor, therefore, it is necessary to improve the physical and biological conditions of the soil before planting *(Author's summary. Trans. by S.S. de S.)* D01

0180-3338 HESELTINE, N. **The ecological basis of agriculture in Madagascar.** World Crops 25(1):34-40 1973. Engl., Sum. Engl., Fr., Span., 12 Refs., Illus

Cassava. Ecology. Climatic requirements. Soil requirements. Rainfall data. Maps. Malagasy Republic.

The highly diversified patterns of agricultural production in Madagascar show a marked difference from those of countries relying on 1 or 2 export crops; about 15 products make up more than 70% of total exports by value. This diversity is due mainly to geographical factors but also to favorable resource endowment The mountainous relief and the influence of prevailing winds blowing from the Indian Ocean give rise to 5 ecological regions, each with its own production pattern. Cassava is cultivated on a small scale on latosols of the Central Highlands and in the semiarid south. The leaves are eaten as greens *(Author's summary)* D01

0181-7434 HOWELER, R. H. **Requerimiento de elementos secundarios y elementos menores en yuca.** *(Minor element requirements of cassava). In* Curso sobre producción de yuca. Cali, Colombia, Centro Internacional de Agricultura Tropical, 1976. pp 163-170 Span., Sum Span , 8 Refs., Illus.

Cassava. Nutritional requirements. Ca. Magnesium. Boron. Zn. Copper. Mineral deficiencies. Mineral content. Stems. Tubers. Leaves. Analysis. Iron. Colombia.

Although cassava has a high degree of tolerance to soil acidity, it responds to small applications of lime in very acid soils. In alkaline soils or acid soils to which high levels of lime have been applied, cassava can present deficiencies of minor elements and possibly of K. Zinc requirements of cassava are very high. Normal concentrations of minor elements in young leaves range from approx. 20-40 ppm Zn, 8-15 ppm Cu, 15-40 ppm B, 100-200 ppm Fe and 50-150 ppm Mn. *(Author's summary. Trans. by S.S. de S.)* D01

0182-6891 KANAPATHY, K. **Fertilizer experiments on shallow peat under continuous cropping with tapioca.** Malaysian Agricultural Journal 49(4):403-412. 1974. Engl., Sum. Engl., 2 Refs.

Cassava. Soil analysis. N. P. K. Fertilizers. Tuber productivity. Analysis. Nutrient absorption. Tubers. Stems. Leaves. Field experiments. Malaysia.

Fertilizer trials carried out on shallow peat showed that continuous growing of cassava, an exhaustive crop, was possible if fertilizer at a rate of 120 lb N and 90 lb K_2O/acre/crop was added. Distribution and percentage of nutrients in roots, stems, leaves and branches are given for the different treatments Nutrient content of roots with the N + P treatment was 0.27% N, 0.11% P, 0.59% K, 0.10% Ca, 0.13% Mg, 18 ppm Fe and 10 ppm Mn; yield was 10.34 tons/acre. *(Summary by Food Science and Technology Abstracts)* D01 D03

0183-5007 MALAVOLTA, E *et al.* **Estudos sôbre a alimentação mineral da mandioca** *(Manihot utilissima* **Pohl).** [*Mineral nutrients of cassava (Manihot utilissima Pohl)*] Anais da Escola Superior de Agricultura "Luiz de Queiroz" (Brazil) 11 21-40. 1954. Port., Sum Port , Engl , 11Refs.

Cassava. Fertilizers. P. N. K. Starch productivity. Tuber productivity. Analysis. Dry matter. Mineral content. Biochemistry. Carbohydrate content. Plant physiology. Absorption. Brazil.

The effects of mineral nutrients on yield, as well as on root composition, were studied in cassava, using the variety Branca de Santa Catarina, grown in a sand culture. Details of the different treatments are given. The omission of P gave the poorest yields; this is explained by the fact that P is needed for the phosphorylation of starchy reserves. P and N were the most important nutrients. In the absence of K, root yield decreased, whereas foliage increased (K is essential for the translocation of carbohydrates). Chemical analyses revealed that lack of P reduced starch content the most; this decrease was associated with the drop in yield when P was omitted. Treatment N2

P1 K1 gave the highest yields but did not produce any industrial gain (only 24% starch), whereas N1 P1 K1 gave 32% starch. Similar results have been obtained in sugar beets and sugar cane, as a result of the interaction between N and the sugar produced. The biochemical aspect is interesting: by increasing the amount of assimilable N, the carbohydrates do not polymerize to starch but combine with the amino groups to form proteinaceous materials. Protein content did, in fact, increase from 2.91 to 5.14%. *(Summary by T.M.)* D01 D03

0184-2946 MEJIA F., R. **El cultivo de la yuca y su explotación industrial. II. Variedades, clima, terrenos y siembra.** *(Cassava cultivation and industrialization. II. Varieties, climate, soils and planting).* Agricultura Tropical (Colombia) 2(2):14-16, 18-19 1946. Span.

Cassava. Cultivars. Climatic requirements. Soil requirements. Land preparation. Planting. Colombia.

This article presents several aspects of cassava cultivation in Antioquia (Colombia), including edaphic and climatic requirements, soil preparation and planting systems The varieties Caramanteña, Cargamanta, Yuca Remediana, Sietecueros and Caucana are described. *(Summary by A.J. Trans. by S.S. de S.)* D01 D02

0185-1950 NAIR, P.G. and VARGHESE, T. **Effect of liming on the yield and quality of cassava in laterite soil.** Agricultural Resarch Journal of Kerala 8(1):14-16. 1970. Engl., Sum. Engl., 5 Refs.

Cassava. Ca. Soil requirements. pH. Tuber productivity. Starch content. HCN content. Timing. N. P. K. Fertilizers. India.

In field experiments conducted to study the effect of liming on the yield and quality of cassava tubers in a laterite soil in Trivandrum (Kerala), an increase of soil pH from 4.55 to 6.5 was recorded with applications of calcium and magnesium carbonates. Starch content of tubers increased from 29 to 30.8% whereas the HCN content decreased from 140 to 117 mg/kg when calcium carbonate was added in combination with NPK. *(Author's summary)* D01

0186-6994 NGONGI, A.G.N. **Influence of some mineral nutrients on growth, composition and yield of cassava (*Manihot esculenta* Crantz).** Ph. D. Thesis. Ithaca, N.Y., Cornell University, 1976. 215p. Engl., Sum. Engl., 197 Refs., Illus.

Cassava. *Manihot esculenta*. N. P. K. Mg. Molybdenum. Leaf area. Plant height. Analysis. Leaves. Petioles. Stems. Tubers. Mineral content. Minerals. Plant development. Timing. Fertilizers. Dry matter. Ca. Tuber productivity. Tuber development. S. Field experiments. Analysis.

Three experiments were conducted on an oxisol at Tranquero in the Llanos Orientales of Colombia, to study the effects of N, K, Mg, and S fertilization on the gross physiology of cassava (*Manihot esculenta* Crantz cv. Llanera). An attempt was made to relate root yield of cassava to measurable growth parameters The composition of leaf blades, petioles and storage roots was investigated. The 5th leaf opening from the top was the sample leaf. The 1st experiment was a 3 x 3 factorial of N and K, using 0, 100 and 200 kg N and 0, 150 and 300 kg K_2O/ha Experiment II studied the effects of K sources KCl, K_2SO_4 and KCl + S, applied at rates of 0, 60, 120 and 240 kg K_2O/ha. Elemental S was applied in amounts equivalent to the S content of each rate of K applied at K_2SO_4. The experiment was repeated at Pance, near Cali (Valle del Cauca). Experiment III had as variables magnesium oxide and magnesium sulfate, applied at rates of 0,25,50,75 and 100 kg Mg/ha. Growth parameters studied included plant height, leaf number, leaf area, leaf area duration, leaf size and leaf retention. Total dry matter (TDM) production, relative growth rate, bulking rate and harvest index, as well as root yield, were also investigated. Plant height, leaf number, leaf area, leaf area duration and leaf size were increased by N, K, Mg and S. Plant fresh wt and TDM produced/ha were increased by the low rate of N and moderate rates of K and Mg. High rates of fertilization depressed TDM production at Tranquero, apparently by inducing Mg and Ca deficiencies. High rates of K applied as potassium chloride accentuated S deficiency. The composition of leaf blades, petioles and storage roots was changed by fertilization. The av N content of leaf blades was 4.7-5.0%. Peeled roots had an av N content of 0.39-0.43%. K, Ca and Mg contents of leaf blades and petioles were markedly altered by fertilization, but the sum of cations was stable over a wide range of fertilization. Maximum root yields at 40 wk were obtained at Pance (44 tons/ha) in plots receiving 240 kg K_2O/ha, in addition to a basal application of 100-75-100 kg of NPK/ha. At Tranquero, the highest yield of 25.4 tons at 38 wk was produced by plots receiving 50 kg Mg/ha as magnesium sulfate. The plots also received a basal application of NPK at a rate of 100-100-100 and lime at a rate of 0.5 tons/ha. Root yields were highly correlated to leaf area index, leaf area duration, total plant fresh wt and TDM produced/ha. Correlations between root yields and TDM produced/ha were high because the percentage of DM of roots and tops was only slightly affected by fertilization, and harvest index remained relatively stable. Yield depressions were noted at high rates of fertilization and these yield depressions were directly related to depressions in TDM or total fresh wt production. *(Author's summary)* D01 D03 C01 C03

0187-6719 NITIS, I. M. and SUMATRA, I. G. N. **The effect of fertilizers on the growth and yield of cassava *(Manihot esculenta* var. Gading) undersown with stylo *(Stylosanthes guyanensis* cv. Schofield) at Penebel, Bali.** Denpasar, Bali. Universitas Udayana. Fakultas Kedokteran Heivan dan Peternakan Bulletin no. 048. 1976. 13p. Engl., Sum. Engl.

Cassava. *Manihot esculenta.* Field experiments. N. P. K. Plant height. Growth. Tuber development. Productivity. Dry matter. Foliage. Tubers. Timing. Inter-cropping. Indonesia.

A 33-wk experiment was conducted to study the effect of NPK fertilization and stylo on cassava growth and yield. Cassava cuttings were planted at 70 x 70 cm and stylo was sown at the diagonal crossing of 4 cassava plants. Root length of cassava intersown with stylo was 16.08% ($P < 0.05$) longer than that of cassava planted alone; but root no. and circumference were not significantly affected. In the cassava and stylo treatment, root dry matter (DM) was 16.8% heavier than that of cassava alone. With PK applications, the increase was 17%. Cassava treated with N fertilizer produced 21.09% more root DM than in the cassava + stylo treatment. Top DM yield of stylo sown with cassava was 20.8% ($P < 0.05$) lower than stylo sown alone. Cassava + stylo combined produced 180% more top DM than cassava alone; PK applications raised this 108.9% more. In terms of livestock feed supply, undersowing cassava with stylo could produce 5-6 tons more feed (DM)/ha/yr even though stylo growth and yield were depressed by the more competitive cassava. *(Summary by T.M.)* D01 D03 C01

0188-4635 NORMANHA, E.S. **Adubação da mandioca.** *(Fertilization of cassava)* FIR 3(8):18-19. 1961. Port.

Cassava. Ca. P. K. N. Fertilizers. Brazil.

Since fertilization of highly acid soils seldom produces the desired results, soils with a pH of 6-7 are the best for cassava. Liming is necessary; applications should be made before plowing or between plowing and harrowing. The lime should be well incorporated; i.e., approx. 15 cm deep. Plants used as green manure in the crop rotation plan also benefit from the Ca in the soil. P and K fertilizers should be incorporated in the rows, whereas N should be applied as a soil cover 3-5 mo after planting, depending on the stage of plant development. *(Summary by P.G. Trans. by S.S. de S.)* D01

0189-0125 NORMANHA, E.S. **Adubação do mandiocal.** *(Cassava manuring)* Chácaras e Quintais 108(11):573-574 1963. Port.

Cassava. Soil requirements. Ca. Green manures. pH. Rotational crops. Brazil.

Instructions are given on how to correct acid soils to be used for cassava cultivation, as well as on the utilization of legumes as green manure in rotation with cassava. Liming is done before planting the legumes to obtain better yields. Rates of application and equipment needed are also included *(Summary by L.C. Trans. by T.M.)* D01

0190-2395 NORMANHA, E. S. **Adubação do mandiocal e mamoneiras em terras fracas.** *(Manuring of cassava and castor-oil plantations in sterile soils).* Chácaras e Quintaes 101(2).162. 1960. Engl.

Cassava. Nutritional requirements. Fertilizers. Brazil.

In answer to a consultation regarding the fertilization of cassava and castor oil plantations with bone meal in sterile soils in Goías, the Instituto Agronômico do São Paulo recommends using 300 kg/ha bone meal, together with 50 kg/ha potassium chloride and 100 kg/ha ammonium sulfate for cassava *(Summary by T.M.)* D01

0191-6893 NUNES, DA O. *et al.* **Resposta da mandioca à adubação mineral e a métodos de aplicação do potássio en solos de baixa fertilidade.** *(Cassava responses to mineral fertilizing and methods of potassium application in low fertility soils).* Pesquisa Agropecuária Brasileira (Série Agronomia) 9(9):1-9. 1974. Port , Sum. Port , Engl 14 Refs., Illus

Cassava. *Manihot esculenta.* Field experiments. N. P. K. Minerals. Tuber productivity. Fertilizers. Soil fertility. Brazil.

In the state of Rio de Janeiro (Brazil), 7 trials were conducted to determine the effect of NPK fertilization and different methods of K application on cassava yields. Yield responses at 2 sites were not statistically significant. At the remaining 5, P was the major factor limiting yields. Application of 40 kg/ha of P_2O_5 increased yields an av of 86%; with an additional 40 kg/ha of P_2O_5, the av yield increase was only 8%. Quadratic production functions computed for 3 sites indicated that 67 kg/ha P_2O_5 was the most economic level of application and resulted in an av yield of 29,746 kg/ha Av yields of cassava in the state are approx. 12,000 kg/ha Yield responses to up to 30 kg/ha of N and up to 40 kg/ha K_2O were not statistically significant. Split application of K had no influence on yields (*Summary by Abstracts on Tropical Agriculture*) D01 D03

0192-7497 OBIGBESAN, G. O. **The influence of potassium nutrition on the yield and chemical composition of some tropical root and tuber crops.** *In* International Potash Institute, Coloquium, 10th, Abidjan, Ivory Coast, 1973 pp.439-451 Engl., Sum. Engl , Fr., 53 Refs , Illus.

Cassava. Nutritional requirements. P. Absorption. Tuber productivity. Soil analysis. Dry matter. Timing. Starch content. HCN content. Tubers. Nigeria.

Information on the influence of mineral fertilizers on the quality of tropical root and tuber crops, with the exception of the sweet potato, is scanty. Fertilizer recommendations made on a crop response basis often result in poor-quality products. Response of 2 major crops of socioeconomic importance—yams and cassava—to K fertilization is discussed and varietal differences pointed out. Besides increasing overall yield, high K applications considerably improved the dry matter and starch content and reduced appreciably the HCN content of the cassava root, whereas increasing N applications above a certain level increased the HCN content. Research on optimum K levels for the varieties requires more attention. (*Author's summary*) D01 D03 C03

0193-6734 OBIGBESAN, G.O. and FAYEMI, A.A.A. **Investigations on Nigerian root and tuber crops. Influence of nitrogen fertilization on the yield and chemical composition of two cassava cultivars** *(Manihot esculenta)*. Journal of Agricultural Science 86 (2) 401-406. 1976. Engl., Sum. Engl., 22 Refs., Illus.

Cassava. ***Manihot esculenta.*** **N. Fertilizers. Field experiments. Soil analysis. Tuber productivity. Starch productivity. HCN content. Cultivars. Timing. Nigeria.**

Results are given of field experiments on the influence of N fertilization on the yield components, starch and HCN content of 2 cassava cultivars recommended for cultivation in Nigeria. The 2 cultivars 53101(local) and 60506 (improved) were harvested at 9, 12 and 15 mo. In general, the improved cultivars appeared to respond better to N fertilization, but high rates of N (150 kg N/ha) tended to reduce the yield performance of both. The local cultivar produced maximum yields of 31.5, 37.5 and 55.7 tons/ha fresh roots with 60 kg N/ha at 9, 12 and 15 mo, respectively, when the improved cultivar gave maximum yields of 31.5 and 48.4 tons/ha with 120 kg N/ha at 9 and 12 mo, respectively, and 64.1 tons/ha with 90 kg N/ha at 15 mo. By allowing the crop to grow up to 15 mo, the starch yield more than doubled and yields were about 3 times higher than those obtained at 9 mo The 53101 strain seemed to produce maximum starch yields with 60 kg N/ha while the 60506 type tended to give maximum starch yields with 90 kg N/ha. Influence of N treatments was significant up to 12 mo of age but not at 15. The HCN content of both cultivars diminished considerably with the age of the plant, dropping at 15 mo to about half the level at 9 mo. While the HCN concentration of the local cultivar tended to increase with higher N fertilization, that of the improved cultivar diminished, particularly at 12 mo. At 15 mo, however, the HCN content of both cultivars rose with increasing N fertilization. *(Author's summary)* D01 D03 C03

0194-6919 RODRIGUEZ J., M. **Fertilización de la yuca.** *(Fertilization of cassava).* *In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp.119-123. Span , 5 Refs.

Cassava. Nutritional requirements. N. P. K. Manures. Field experiments. Productivity. Colombia.

Some criteria and experimental results of fertilization trials with cassava in Colombia, method of application and recommended crop rotations are presented. Adequate fertilization should be based on (1) the amount of nutrients absorbed by the plant, (2) the vegetative cycle, and (3) soil analysis and field experimentation. Several fertilization trials conducted in Palestina (state of Caldas) showed that maximum yields were reached applying 145 kg N, 194 kg P_2O_5 and 46 kg K_2O/ha. Yields were greater when the applications were made at planting time than when split. Other experiments conducted in 5 localities of Antioquia showed that there was no response to fertilizers in Chigorodó and La Pintada due to high soil fertility; whereas in Bello, Urrao and San José del Nus, the best results were obtained with 100 kg N, 200 kg P_2O_5 and 100 kg K_2O/ha. For each meq of exchangeable Al, 1 1/2 tons lime/ha should be added, soils with less than 4.6 meq of lime responded to liming In different planting system trials carried out in Lloró (Chocó), best yields were obtained with the application of 1,000 kg/ha of 10-30-10 and planting on ridges (10-15 cm high). Band applications in a circle or semicircle under the cutting were the best methods. N and K can be applied under the soil surface and P should be placed 10-15 cm deep. The following crop rotations are recommended: maize/beans, soybeans, cowpeas, etc./cassava; maize/legume to be incorporated/cassava; legume pastures (3 yr)/ cassava; and sorghum or rice/legume/cassava. *(Summary by A.J. Trans. by S.S. de S.)* D01

0195-6856 ROJO B., C. **Consideraciones agrológicas relacionadas con el cultivo de la yuca.** (*Agrologic aspects of cassava cultivation).* Pensamiento Agrario 1(2):14-17. 1976. Span.

Cassava. Soil requirements. Soil analysis. Cassava program. Venezuela.

The purpose of this agrologic classification of Venezuelan soils is to recommend the most adequate ones for cassava growing. The factors studied were physical characteristics (texture, structure, consistency); chemical characteristics (pH, cation exchange capacity, organic matter content); topography; external and internal drainage, and effective soil depth. On the basis of these factors, 8 categories were established, ranging from soils that did not present any limitation whatsoever and were adequate for any kind of crop (Class I) to those that as a result of their severe limitations could only be used for wild life and recreation (Class VIII). Cassava can be planted in soils IV, V and even VI, producing acceptable yields when adequate management practices are used. The regions recommended are (1) the basin of Lake Maracaibo: the Villa del Rosario sector, between Rio Negro and Rio Zulia, the southern part of the lake; (2) the northeastern region: the plateau of La Mesa in the eastern and central eastern plains, some valleys of La Mesa, and the eastern part of Margarita Island; (3) the high western plains: region located between the Andean piedmont and the alluvial plain; (4) Amazonia: San Juan de Manapiare and the communities of La Reforma, Gavilán, Pintao, Provincial, Galipero and Parhueña. The scarcity of farming lands and the hardiness of the crop were taken into account when selecting the areas. As regards the Amazonian region, it was recommended to make an inventory of native varieties, to carry out varietal trials for the different edaphic conditions, and to study the problems resulting from the type of soil and cultural practices used. (*Summary by S.S. de S.*) D01

0196-7277 SANTANA, A. M. **Fertilização da mandioca no nordeste brasileiro.** *(Fertilization of cassava in northeastern Brazil)* *In* Projeto mandioca; subprojetos de pesquisas para o nordeste do Brasil. Cruz das Almas, Brasil, Universidade Federal da Bahia. Escola de Agronomia. Convenio U.F.Ba./BRASCAN Nordeste, 1974. pp. 51-75. Port., 43 Refs.

Cassava. *Manihot esculenta.* Cassava programs. Fertilizers. Experiment design. Minerals. Brazil.

The subproject presented here is denominated Cassava Fertilization in Northeastern Brazil and forms part of the cassava project for this area (under the agreement Universidade Federal da Bahia/BRASCAN Nordeste, in cooperation with the Centro International de Agricultura Tropical). A comprehensive bibliographic revision, background and bases are included The objectives of this subproject are (1) to measure cassava responses to fertilizers and amendments (quantity, methods and times of application); (2) to correlate soil nutrient content and cassava yields; (3) to correlate nutrient action and the chemical composition of roots and leaves; (4) to determine the efficiency of fertilization in relation to other cultural practices; (5) to establish the most economical levels of fertilization, and (6) to cooperate with the breeding program. Based on the climatic and edaphic conditions, the region will be divided into zones, and each zone will be divided into 9 localities for 9 replications. The results of these experiments will set the guidelines for future trials. Preference will be given to the fertilizers produced at a local level. The experimental model is described and information is given on kinds of treatments, rates and method of application, etc. *(Summary by A J. Trans. by S.S. de S)* D01 J00

0197-5612 SANTANA, A. M., CARVALHO, J E. B. DE and BORGES, I O. **Competição de fontes de nitrogenio em solos para mandioca.** *(Effect of different sources of nitrogen on cassava production)* *In* Cruz das Almas, Brasil. Universidad Federal da Bahia. Escola de Agronomia/BRASCAN Nordeste. Série Pesquisa v.1 no. 1. 1975. pp.39-55. Port., Sum. Port., Engl., 22 Refs.

Cassava. N. Fertilizers. Manures. Costs. Soil analysis. Tuber productivity. Starch content. Water content. Dry matter. Brazil.

The results are given of experiments carried out on a colonial latosol (Série Barreiras) to study the effect of different sources of nitrogen fertilizer on cassava production The trials were conducted at Cruz das Almas, Bahia (Brazil) from 1971-74 The following sources of N, at the rate of 100 kg N/ha, were used cattle manure, castor seed cake, ammonium sulfate, urea, calcium nitrate and Chilean sodium nitrate. All treatments received a constant amount of P(100 kg P_2O_5/ha) and K(75 kg K_2O /ha) There were no statistical differences among the N sources tested; however, economical analysis indicates that the best source of N was urea, followed by castor seed cake, ammonium sulfate and calcium nitrate. *(Author's summary)* D01

0198-2081 SCHMITT, J. **Cultivo abundante y explotación industrial de la yuca.** *(Cassava cultivation and industrialization).* Suelo Tico 8(34).152-158, 1955. Span. 6 Refs Illus.

Cassava. Fertilizer. N. P. K. Productivity. Spacing. Costa Rica.

A description is given of some aspects of cassava cultivation, especially fertilization, with the purpose of promoting and improving agronomic practices in Costa Rica. After giving the climatic and edaphic requirements and planting season, a review is made of some papers on fertilization in different parts of the world. For higher yields, 40-cm spacings between plants and 2-3 applications (preplanting and 2-4 mo later) of NPK (7-7-13 or 6-8-13 at a rate of 900-1,100 kg/ha and 10-10-15 at a rate of 600-800 kg/ha) per harvest are recommended. Cassava can be intercropped with tobacco, maize or beans when intensive fertilization practices are used, just as it can be planted as an intermediate crop with *Hevea* or oil palms until these begin to produce. *(Summary by A.J. Trans. by S.S. de S)* D01

0199-5611 SENA, Z.F DA and CAMPOS, H. DOS R. **Frequência de irrigação no cultivo da mandioca** (*Manihot esculenta* **Crantz**). *(Frequency of irrigation in cassava). In* Cruz das Almas, Brasil, Universidade Federal da Bahia, Escola de Agronomia/BRASCAN Nordeste. Série Pesquisa v.1. no. 1. 1975. pp. 21-38. Port., Sum Port., Engl., 14 Refs., Illus

Cassava. Climatic requirements. Irrigation. Timing. Plant height. Tuber productivity. Tubers. Water content. Fibre content. Starch content. HCN content. Foliage. Production. Field experiments. Brazil.

An irrigation trial was carried out with cassava at the Universidade Federal da Bahia in Cruz das Almas, Bahia (Brazil) from Sept. 1972 to Nov. 1973. Irrigation increased yields of the cultivar Sutinga up to 42% when planted in an oxisol, tertiary sediment (Série Barreiras). Irrigated plants had less HCN in roots Irrigation would make year-round planting and harvesting possible. Under the climatic conditions prevailing in Cruz das Almas, the most economical irrigation system would be to apply 35 mm H_2O/ha every 18 days *(Author's summary. Trans by T M.)* D01 C03

0200-5930 TAKYI, S. K. **Effects of nitrogen, planting method and seed-bed type on yield of cassava** *(Manihot esculenta* **Crantz).** Ghana Journal of Agricultural Science 7(2).69-73. 1974. Engl , Sum. Engl., Fr., 3 Refs., Illus.

Cassava. Fertilizers. N. Planting. Cuttings. Tuber productivity. Land preparation. ***Manihot esculenta*** **Ghana.**

Yield of cassava *(Manihot esculenta* Crantz cv. Ankra), planted on an unplowed, fringe-forest sandy loam soil, was significantly increased with N applications. Planting of stem cuttings on the flat and mounding gave higher yields than slant planting and no mounding, respectively. On a plowed, semideciduous forest sandy loam, N gave a nonsignificant increase in yield of the same cultivar. Planting on the flat resulted in a nonsignificant yield increase over slant planting; ridging gave a substantial, but nonsignificant yield depression as compared with no ridging. *(Author's summary)* D01 D03

0201-5613 TAVARES, F. D. and AZEVEDO, M S DE **Solos do Planalto de Cruz das Almas.** *(Soils of the plateau of Cruz das Almas). In* Cruz das Almas, Brasil. Universidad Federal da Bahia. Escola de Agronomia/BRASCAN Nordeste. Série Pesquisa v. 1. no. 1. 1975. pp. 57-63. Port., Sum. Port., Engl., 13 Refs. Illus.

Cassava. Soil requirements. Soil analysis. Maps. Soil fertility. Brazil.

The main characteristics of the soil in Cruz das Almas, Bahia (Brazil) are outlined on a map. Most soils consist of well-drained plateaus; about 40% of this area is an oxisol or colonial latosol, sandy clay tertiary sediment (Série Barreiras). Mean rainfall is 1,196 mm/yr and mean temperature is 24.4°C. The land is suitable for mechanization; fertilizers are needed to give higher yields Cassava and tobacco are mainly grown in this region, and citrus production is increasing. *(Summary by T.M.)* D01

0202-6755 ZSCHERNITZ, K. **Fertilizer in the improvement of shifting cultivation.** Soils Bulletin (FAO) no. 24:203-216 1974. Engl.

Cassava. Shifting cultivation. Fertilizers. Field experiments. N. P. K. Productivity. Africa.

Results are given of 97 trials and 1245 demonstrations in Nigeria (mostly in the forest zone), in which certain combinations of N (0, 22.4 and 44.8 kg/ha), P_2O_5 (0, 11.2, 22.4 and 44.8 kg/ha) and K_2O (0, 22.4 and 44 kg/ha) were applied to maize, rice, yams, cotton, cassava and groundnuts. Results are also given from 298 sets of rice plots and 70 groundnut plots in Sierra Leone. Almost all demonstrations were carried out on farms under shifting cultivation. It was concluded that the use of fertilizers could increase yields from 25-60% in a short time, without introducing great changes in existing traditional cultivation methods. *(Summary by Field Crop Abstracts)* D01

See also 0094 0280

D02 Cultivation Practices: Propagation, Planting, Weed Control and Harvesting

0203-3805 ALBUQUERQUE, M. DE **Contribução ao estudo da mandioca. II. Ensaios experimentais de campo.** *(Contribution to studies on cassava. II. Field trials).* Norte Agronômico 4(4).107-124. 1958. Port., Sum. Port., 7 Refs.

Cassava. Field experiments. Cultivars. Productivity. Harvesting. Timing. Cuttings. Selection. Propagation. Brazil.

The results are given of 2 field trials carried out at the Instituto Agronômico do Norte in Belém (Brazil) in soils representative of the Amazonian region. The 1st trial evaluated the root production of 64 varieties. Preferred local varieties (Pecuí, Pretinha, Manivainha, Mameluca and Jurará) were intermediate in root production; Bubão, Tataruaia and Piabinha were the best at both 12 and 15 mo of age. The purpose of the 2nd trial was to study the influence of cutting size and texture (herbaceous or woody) on production and vegetative period. On the basis of the results obtained, it was impossible to reach definite conclusions; however, it was clearly shown that (1) herbaceous cuttings should not be used in this region, and (2) provided there is enough planting material, cuttings 0.30-0.45 m long should be used rather than 0.15 m long. It seems that cutting length and early maturity are correlated; therefore, longer cuttings should be used when shorter vegetative periods are required. *(Summary by S.S. de S.)* D02 D03

0204-2384 ALBUQUERQUE, M DE **Cultura da mandioca.** *(Cassava cultivation).* Belém, Brasil. Instituto de Pesqúisa Agropecuária do Norte/Associação de Crédito e Asistência Rural do Pará. Circular no. 16. 1973. 10p. Port., Sum. Port., Engl.

Cassava. Land preparation. Cuttings. Planting. Spacing. Weeding. Cultivars. Harvesting. Brazil.

Technical recommendations for growing cassava (*Manihot esculenta* Crantz) in the eastern Amazonian region are made, based on the results of the Instituto de Pesquisa Agropecuária do Norte's research work. Aspects dealt with are soil selection and preparation, propagation material and planting, spacing, agronomic practices, association and rotation, biological enemies, cultivars recommended for human and animal consumption and industrial purposes, and harvesting. An 8-yr planting program for this region is included. *(Summary by S.S. de S.)* D02

0205-3275 ALBUQUERQUE, M. DE **Estudos com mandioca.** *(Studies on cassava).* Belém, Brasil. Instituto Agronômico do Norte. Circular no. 6. 1962. pp. 14-33. Port., Sum. Port. Illus.

Cassava. Field experiments. Planting. Spacing. Productivity. Labour. Costs. Harvesting. Cultivars. Cassava flour. Tuber productivity. Brazil.

Results are given of 2 studies on cassava, carried out by the Instituto Agronômico do Norte in the Brazilian Amazonia, where it is widely grown. It was found that the most appropriate planting distance for cassava grown on a commercial scale was 1.50 x 1.50 m; small farmers should use shorter distances. There was a significant interaction between soil types and density. The interactions spacing x plant type and spacing x yields were significant in most trials As regards flour yields, 49% of the 67 cultivars yielded more than 25% flour; Itaúba (35%) was the best and Teiú (14%) the worst. As far as root production is concerned, the best cultivars were Bubão a Pixuna, Bacuri, Mameluca, Jurará, Pretinha, Pecuí, Tataruaia, Tapiona and Cachimbo *(Summary by S.S. de S.)* D02 D03

0206-6742 ARISMENDI, L. G. **Epocas de siembra y tiempos de cosecha del cultivo de la yuca (*Manihot esculenta* Crantz) en la sabana de Jusepín.** *(Times for planting and harvesting cassava in the savanna of Jusepín).* Monagas, Venezuela. Universidad de Oriente. Instituto de Investigaciones Agropecuarias. Boletín Informativo. Serie Agronomía no. 7. 1973. 7 p. Span., Sum. Span., Engl., 2 Refs., Illus.

Cassava. Field experiments. Planting. Harvesting. Timing. Tuber productivity. Rainfall data. Venezuela.

In an experiment on savanna soil, cassava cv. Pata e'Negro was planted on May 24, June 24, July 24 or Aug. 24, 1971 and harvested at 9, 10, 11 or 12 mo. Highest yields (28.8 tons/ha) resulted from planting in May and harvesting at 12 mo. Yields for the 4 planting dates, respectively, were 24.3, 16, 15.2 and 15.9 tons/ha (mean of all harvesting dates). *(Summary by Abstracts on Tropical Agriculture)* D02 D03

0207-6803 BELLOTTI, A. *et al.* **Suggested guidelines relating to the international movement of cassava planting materials.** *In* Terry, E. R. and Mac Intyre, R., eds The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976 pp. 51-52. Engl.

Cassava. Propagation materials. Distribution. Cassava programs.

This article presents some recommendations complementary to existing quarantine regulations for vegetative and sexual planting material, imposed by the recipient countries. The smallest possible amount of planting material should be imported. No cassava from countries where African mosaic and brown streak virus exist should be imported. In addition, the measures that should be taken by both the importing and exporting countries are given. *(Summary by A.J. Trans. by S.S. de S.)* D02

0208-4881 BHUTIANI, R C. **Cultivation of tapioca (Cassava).** Mysore, India. Central Food Technological Research Institute. Project Circular no. 11. n.d. 4p Engl.

Cassava. Soil requirements. Planting. Timing. Land preparation. Harvesting. India.

Cassava was first introduced into India by the Portuguese explorers in the 17th century. It is extensively cultivated in the state of Kerala. Its high content of carbohydrates, minerals, Ca, Fe and vitamins makes cassava a valuable food. A brief description is given of soil and climate requirements, planting season, land preparation, varieties, harvesting and uses. *(Summary by P.G. Trans. by S.S. de S.)* D02

0209-1533 BIEHL, E. G. **Conservação da rama da mandioca para plantio.** *(Storage of cassava branches to be used for propagation material).* Campo 5(4):58-60. 1934. Port., Illus.

Cassava. Stems. Storage. Propagation materials. Brazil.

A detailed description is given of the system used to keep cassava in good condition until the next planting season. Enough branches for supplying 100,000 cuttings can be stored in a rectangular excavation 1 m deep x 3 m long x 2 m wide. Technical considerations that should be taken into account if the system is to work properly are also included. *(Summary by P.G Trans by S.S. de S)* D02

0210-6750 BRAWIJAYA UNIVERSITY. FACULTY OF AGRICULTURE. CASSAVA RESEARCH PROJECT. **Progress report III (November 1974-October 1975).** Malang, Indonesia, 1975. 35p. Engl., Illus.

Cassava. Cassava programs. Field experiments. Planting. Fertilizers. Grafting. Propagation. Cultivation systems. Spacing. Harvesting. Timing. Intercropping. Tuber productivity. Indonesia.

This report covers the activities of the Cassava Research Project at the School of Agriculture of the University of Brawijaya (Indonesia) from Nov. 1974-Oct. 1975. The localities and conditions of the 1st and 2nd yr are presented, as well as the findings that served as a basis for the experiments of the 2nd yr. It was found that (1) in certain localities it is not necessary to apply large quantities of organic matter to Mukibat (a graft), a common local practice; (2) making holes before planting is not necessary; and (3) production of low-yielding varieties of good quality can be increased without affecting their quality. The plan for the 3rd yr of experiments is presented; these cover the measurement and comparison of normal and grafted cassava as regards planting methods and distances, yields, crop association and varieties adequate for this system, vegetative period, fertilization, grafting of species of the genus *Manihot (M. glaziovii)*, harvesting season, etc. *(Summary by A.J. Trans. by S.S de S.)* D02 D03

0211-0025 CALDERON A., H. **Ensayo de distancias de siembra con dos variedades de yuca (*Manihot esculenta* Crantz) en la región de Santágueda.** *(Evaluation of planting distances with two varieties of cassava in the region of Santágueda).* Tesis. Ing. Agr. Manizales, Colombia, Universidad de Caldas, Facultad de Agronomía, 1972. 55p. Span., Sum. Span., 17 Refs , Illus.

Cassava. *Manihot esculenta*. Field experiments. Planting. Spacing. Soil analysis. Tuber productivity. Starch content. Water content. Starch productivity. Plant height. Plant anatomy. Cultivars. Colombia.

The effect of planting density on cassava production was studied on the farm Montelindo in the region of Santágueda (Colombia). The varieties used were Llanera CMC 9 and Pantanera CMC 63, which had good yields and adapted well under the local environmental conditions. Two rows (0 80 and 1.60 m) and plant spacings (0.40,0.80,1.20,1.60 and 2m) were used. Densities ranged from 3,155 to 31,250 plants/ha A randomized block design with 9 treatments and 3 replications/variety was used. All plots measured 10 m x 3.20 and 6.40 m and had 4 rows. The soil was acid (Serie 10 or Serie Chinchiná), clay loam texture, granular structure, moderate permeability and average organic matter, P and K content. Optimum planting densities and maximum production for Llanera and Pantanera were estimated on the basis of Carmer and Jackobs' and Holliday's equations, respectively; data are given in a table. Llanera surpassed Pantanera in production, percentages of thick and medium-sized roots, starch content and disease resistance. At the same planting density, higher yields were obtained when the place occupied by each plant was square. The greater the population density, the higher the production/unit of area but the lower the production/plant. Based on the results obtained, densities of more than 10,000 plants/ha are recommended. Similar studies should be conducted in other regions of the country, using 6 planting densities and square and rectangular individual plots. With spacings of 0.80 x 1.20 m, both varieties yielded better and cultural practices such as planting, hilling, weeding, fumigation and harvesting were easier. This would also be an adequate distance for intercropping with maize or beans *(Author's summary. Trans. by S.S. de S.)* D02 D03 C03

0212-2942 CARDEÑOSO B , R. **Nueva y prometedora máquina sembradora de caña, papa, yuca y similares.** *(A new planter for sugar cane, potatoes, cassava and similar crops)* Agricultura Tropical (Colombia) 4 33-38 1948. Span., Illus.

Cassava. Planting. Mechanization. Agricultural equipment. Colombia.

The different parts and the functioning of a planter requiring at least a 30-hp tractor are described. The planter consists of a furrower and a seeder; it covers 3.89 ha/8 h A comparative analysis is made of mechanical and manual planting *(Summary by L.F.C. Trans. by S.S. de S)* D02

0213-6929 CHEING, B.N. **Evaluation of harvesting systems of tapioca of leaf forage production.** B. Agr. Sc Thesis Kuala Lumpur, University of Malaya, Faculty of Agriculture, 1973. 88p. Engl , Sum. Engl., 37 Refs., Illus.

Cassava. Field experiments. Pruning. Foliage. Leaves. Forage. Productivity. Fertilizers. Timing. Soil analysis. Agricultural machinery. Mechanization. Malaysia.

Harvesting systems for cassava leaf forage production were studied in order to (1) determine the most suitable cutting height, harvesting intervals and level of fertilizer needed and (2) assess the New Holland Double-Chop Flail Harvester as a cassava leaf harvester. A complete randomized block design was used with 3 cutting heights (12, 16, 20 in.), 3 harvesting frequencies (3, 5, 7 wk) and 3 levels (0, 500, 1000 lb/acre) of N, P, K, Mg (15-7-18-2) fertilizer. Evaluation was based on yield (fresh weight, dry matter and crude protein level). Results were submitted to analyses of variance. The combination of 20-in. cutting height, 3-wk frequency of cutting and 1000 lb fertilizer/acre gave best yields of dry matter (17.31 tons/acre/yr) and protein (3.84 tons/acre/yr) Experimental results showed that the stubble left after harvesting was relatively neat, and there was little loss of material. Particle size distribution was uneven; there was no dust contamination in harvested material The "no load" hp requirement was relatively low, and the actual cutting of forage required only a small portion of energy supplied to the cutting devices. From 3-9 tons/h was obtained with a power consumption of 8-15 hp The harvester was very efficient in utilizing tractor power by giving high specific output (0 3-0.7 tons/hp hour). (*Summary by T.M.*) D02 D03 H03

0214-6883 COCK, J. H., WHOLEY, D. and LOZANO, J. C. **A rapid propagation system for cassava.** Cali, Colombia, Centro Internacional de Agricultura Tropical, Series EE-20. 1976. Engl , Illus

Cassava. Propagation. Cuttings. Shoots. Colombia.

Cassava has a slow rate of propagation; a mature plant will produce about 10-30 normal-sized (25 cm) cuttings/yr. With the purpose of obtaining short-term increases in planting material from new varieties and producing disease-free stock for commercial plantings, a simple and rapid propagation method can provide approx. 36,000 cuttings/yr/mature plant. The kind of facilities and materials required, as well as the methodology used, are described and illustrated Finally, a description is given of the method recommended to obtain clean material when it has to be taken from CBB-infected fields, indicating the steps that should be followed to eliminate CBB from the soil. (*Summary by S. S. de S.*) D02

0215-5616 CONCEIÇAO, A.J. DA and SAMPAIO, C.V **Influência da posição da maniva na produção da mandioca.** *(Effect of cutting position on cassava yields). In* Cruz das Almas.

Brasil. Universidade Federal da Bahia. Escola de Agronomia/BRASCAN Nordeste. Serie Pesquisa v.1 no 1. 1975. pp.79-85 Port., Sum. Port., Engl., 22 Refs.

Cassava. Planting. Cuttings. Soil analysis. Tuber productivity. Field experiments. Rainfall data. Brazil.

An experiment was carried out to study the effect of cutting position on cassava yields. A random block design with 15 replicates was used in the trials conducted during 3 crop seasons (1969-72) at Cruz das Almas, Bahia (Brazil) on a colonial latosol, tertiary sediment (Série Barreiras), with an annual rainfall of 1,196 mm and a mean temperature of 24.4°C Statistical analyses did not reveal any significant differences among the tested positions (vertical, slanted, or horizontal) *(Author's summary. Trans. by T.M.)* D02

0216-7010 CONCEICAO, A.J. DA and SAMPAIO, C.V. **Sistemas de plantío de mandioca.** *(Planting systems for cassava)* *In* Projeto mandioca. Cruz das Almas, Brasil. Convênio U.F. Ba./BRASCAN Nordeste. Série Pesquisa v. 2, no.1.1975. pp. 119-127. Port., Sum. Port , Engl., 9 Refs , Illus.

Cassava. *Manihot esculenta.* **Field experiments. Planting. Cuttings. Land preparation. Soil analysis. Costs. Brazil.**

An experiment on planting systems for cassava was carried out at the Universidade Federal da Bahia in Cruz das Almas, Bahia (Brazil) Four systems (2 different hilling systems, on the flat and on ridges) and 4 regional cultivars (Sutinga Branca, Cigana, Salangorzinha and Vassoura Branca) were evaluated. The effect of planting systems was not statistically significant; therefore, planting on the flat (20-cm cuttings, planted horizontally, 10-20 cm deep) is recommended because it involves the lowest cost/ha. Vassoura Branca was best at the 5% level of probability. *(Author's summary. Trans. by T.M.)* D02

0217-7283. **CONTROL DE maleza en yuca.** *(Weed control in cassava)* Noticias Agrícolas 5(17):1-3. 1969. Span., Illus.

Cassava. Weeding. Herbicides. Venezuela.

Several aspects of cassava weed control in Venezuela are discussed. Three methods of weed control are applied in this country: (1) small weeding hoe and machetes (small farmers of low resources), (2) mechanical cultivator together with machetes (some commercial farmers), and (3) chemical control Based on herbicide trials, a preemergence application of Cotoran (80% W.P.) at a rate of 2 kg/ha is recommended. The advantages of chemical control and disadvantages of mechanical control are included. *(Summary by A.J. Trans. by S.S de S.)* D02

0218-0636 CORREA, H. **Possibilidades de aproveitamento do cerrado para cultura da mandioca.** *(Possibilities of growing cassava on "cerrado" soils).* Sete Lagoas, Brasil, Instituto de Pesquisas e Experimentação Agropecuárias Centro - Oeste, 1971. 15p. Port., Sum. Port., 10 Refs

Paper presented at Reunião da Comissão Nacional da Mandioca, 5a., Sete Lagoas, Brasil, 1970?

Cassava. Soil fertility. Plant breeding. Cultivars. Selection. Planting. Spacing. Harvesting. Fertilizers. Timing. Pruning. Tuber productivity. Foliage. Production. Field experiments. Brazil.

The results are given of research conducted at the Instituto de Pesquisa e Experimentação Agropecuárias do Centro-Oeste on different aspects of cassava cultivation in Cerrado soils As regards plant improvement, several promising clones obtained by open and controlled pollination are being evaluated to select the most productive. The best varieties are Riqueza IPEACO-1 and Vassourinha SEL-514, which have a high starch content, a moderate level of resistance to cassava bacterial blight and yields of 30 tons/ha under normal conditions and without fertilization. Plant density studies showed that the smaller the distance between plants, the greater the production of roots and branches, however, branch production is greater than root production when spacing is less than 1.00 x 0.30 m. Response to the application of fertilizers and amendments was unsatisfactory, especially when P and dolimitic or calcitic lime were used. Root production decreased markedly when crop rotation was not practiced, even when soil fertility had been improved through fertilization The most important production factor was the planting season; planting should be done from the 2nd wk of Oct to the end of Dec. Pruning of branches at 6 and 12 mo of age decreased root production 21 and 40%, respectively; therefore, this practice is recommended only when green forage for animals is scarce *(Author's summary. Trans. by S.S. de S.)* D02 D03 G01

0219-4549 COSTA, A.S. **Cultivo y beneficio de la yuca.** *(Cassava cultivation and industrialization).* Hacienda 41(3):48-49. 1946. Span., Illus.

Cassava. Land preparation. Plantings. Harvesting. Timing. Processing. Productivity. Factories. Brazil.

Some agronomic practices used in cassava cultivation and its industrialization on the Hacienda Santa Cruz in São Paulo are explained because this farm is considered to be an agro-industrial model for this crop. To obtain the highest percentage of starch from the roots, they should be harvested in 2 cycles (from May-August for the local conditions). Two qualities of starch are produced on this farm. top-quality or export type, used for food and a 2nd-quality starch used for glue, textile sizing, etc. The 2 types are distinguished by means of a "sound" test: the starch bags are pressed with the fingers, the top-quality starch produces a characteristic noise whereas the other produces no noise at all. Exports to the US market could be made if Brazilian starch production costs were reduced, sea freight expenses lowered, and crop practices improved through the use of promising varieties resistant to bacterial blight, other diseases and pests. *(Summary by A.J. Trans. by S.S de S.)* D02 I02

0220-7274 CUNHA, H.M.P. DA **Competição de herbicidas no combate às invasoras da mandioca** (*Manihot esculenta* **Crantz**). *(Evaluation of herbicides for controlling weeds in cassava). In* Projeto mandioca; subprojetos de pesquisas para o nordeste do Brasil. Cruz das Almas, Brasil, Universidade Federal da Bahia. Escola de Agronomia. Convênio U.F.Ba./BRASCAN Nordeste, 1974. pp. 76-89. Port., 15 Refs., Illus.

Cassava. *Manihot esculenta*. Field experiments. Herbicides. Weeding. Cassava programs. Brazil.

The subproject presented is denominated Application of Herbicides for Weed Control of Cassava Fields and forms part of the cassava project for the northeastern part of Brazil (under agreement Universidade Federal da Bahia/Brascan Nordeste, in cooperation with the Centro Internacional de Agricultura Tropical). A bibliographic revision, background and bases for the subproject are included. The objectives are to evaluate the effect of the herbicides on the weeds found in cassava fields, to compare the efficiency and costs of manual and chemical control, and to evaluate the levels of weed competition 60 days after cassava has been planted. The variety Salangorzinha will be used and 3 herbicides (diuron, alachlor and fluometuron) at 3 different rates will be tested and compared to manual weeding. Data will be collected on weed incidence, plant height at different ages, weight of the roots and aerial part of the plant at harvesting, toxic effects of herbicides and costs of the different systems. (*Summary by A.J Trans. by S S. de S*) D01

0221-7011 CUNHA, H M.P.DA, CONCEIÇAO, A J. DA. and SAMPAIO, C.V **Observações preliminares sôbre o uso de herbicidas pré-emergentes na cultura da mandioca** (*Manihot esculenta* Crantz). *(Preliminary observations on the use of preemergent herbicides in cassava). In* Projeto mandioca. Cruz das Almas, Brasil Convênio U.F.Ba/BRASCAN Nordeste Série Pesquisa v.2, no.1. 1975. pp. 129-135.Port., Sum. Port , Engl , 8 Refs.

Cassava. *Manihot esculenta*. Weeding. Herbicides. Field experiments. Plant development. Weeds. Brazil.

Evaluations were made of 4 herbicides (atrazine, ametryn, simazine and diuron) in preemergence applications in cassava. Atrazine, ametryn and simazine (2.4 kg a.i /ha) gave weed control for 90 days only, and there was retarded plant growth in these plots. In another experiment with ametryn + simazine (1.6 kg a.i. each), similar results were obtained Diuron was considered as selective in spite of the fact that it caused light damage to cassava plants, probably because applications were made when plants had already emerged. Applications could be made preemergence or postemergence in moist soil to avoid this damage Data on selectivity will be used in future experiments *(Summary by T.M)* D02

0222-0376 **UN DESCUBRIMIENTO accidental que puede revolucionar el cultivo de la yuca.** (*An accidental discovery that could revolutionize cassava cultivation*). Agricultor Venezolano 7(83-84).10. 1943. Esp

Cassava. Cuttings. Planting. Cuba.

Long cassava stakes (5-6 ft) were used as supports for eggplant They were left in the ground to be used as propagation material; these stakes not only produced new shoots but also had harvestable roots after only 6-8 wk. The process was successfully repeated under bananas, obtaining good harvests in less time (4 ½ to 5 mo). (*Summary by T.M.*) D02

0223-0098 DIAS, C. A de C *et al* **Mandioca: plantio em nível, terraceamento, seleção de ramas para plantio, contrôle de ervas daninhas.** *(Cassava· contour and terrace planting, selection of stem cuttings and weed control).* São Paulo, Secretaria da Agricultura, Coordenadoria de Assistência Técnica Integral. 1973/1974. 14p. Port., Illus

Cassava. Cassava programs. Soil requirements. Land preparation. Planting. Cuttings. Selection. Weeding. Brazil.

The cassava program of the Department of Agriculture in São Paulo has the following specific objectives to study contour and terrace planting systems, selection of cuttings and weed control. The first part presents a series of agronomic practices for soil conservation; the second gives a general description of cassava growing in Bauru It includes the different sizes of cuttings tested and their probable yields after 1 or 2 vegetative cycles As regards pests and diseases, it gives the symptoms to recognize CBB and stemborer attack, as well as control measures Manual and chemical methods of weed control are discussed. (*Summary by L F C. Trans. by S S de S*) D02

0224-7437 DIAZ D , A. **Preparación de tierras.** *(Preparation of land). In* Curso sobre producción de yuca Cali, Colombia, Centro Internacional de Agricultura Tropical, 1976 pp. 187-196. Span., 5 Refs.

Cassava. Land preparation. Agricultural equipment. Timing. Colombia.

Several aspects of land preparation including objectives, agronomic practices (cleaning of the field, plowing, harrowing and leveling), equipment and systems of preparation are discussed. As far as cassava is concerned, 4 systems of land preparation in ridges (heavy soils) are described, indicating the time required for each operation when cassava is planted on ridges and on the flat (light soils) (*Summary by A.J. Trans. by S S de S.*) D02

0225-7436 DOLL, J D. **Ensayo demostrativo de herbicidas en yuca.** *(Herbicide trial in cassava) In* Curso sobre producción de yuca. Cali, Colombia, Centro Internacional de Agricultura Tropical, 1976 pp 183-186. Span

Cassava. Field experiments. Herbicides. Timing. Colombia.

A brief outline is given of the methodology and treatments to be used in a series of herbicide trials in cassava, forming part of a practical demonstration for an intensive training course. Herbicides will be applied pre- and postemergence (the latter applied by the participants) (*Summary by T.M.*) D02

0226-6842 DOLL, J D. and PIEDRAHITA C., W. **Methods of weed control in cassava.** Cali, Colombia. Centro Internacional de Agricultura Tropical. Series EE-21 1976. 12p. Engl., 3 Refs., Illus

Also in Spanish

Cassava. *Manihot esculenta.* **Field experiments. Weeding. Spacing. Herbicides. Tuber productivity. Timing. Plant physiology. Weeds. Germination. Colombia.**

Cassava yields can be quadrupled using an integrated package of cultural practices that includes adequate weed control measures. This article presents the results of 3 years' research on weed control conducted at the Centro Internacional de Agricultura Tropical (CIAT) and highlights the importance of a timely control and of the adoption of an appropiate program. Studies on the effect of weed competition on yields showed that 2 hand weedings (HW) 15-120 days after planting increased yields substantially. The work on the interaction planting density x weed competition indicated that when none of the control methods was used, the greater the plant population, the lower the weed competition When herbicides were applied, highest yields were obtained with approx. 15,000 plants/ha; in the case of 2 HWs, 15,000-20,000 plants/ha. In addition, the selectivity of 37 herbicides applied in preemergence or incorporated before planting was determined A table in which they are classified as highly selective, moderately selective and nonselective is included Experiments with postemergence herbicides were also carried out Diuron proved to be the most effective product in broadcast applications; amitrol, bentazon, paraquat, dalapon, MSMA, DNBP and glyphosate were totally nonselective. Chemical weed control recommendations for cassava are presented in a table, to arrive at these recommendations, the effectiveness, selectivity, availability and cost of each product were taken into account. As regards the integrated control trials, the best results were obtained with 3 HWs (31 tons/ha at 10 mo), followed by the use of diuron in preemergence complemented with 1 HW (27 tons/ha). *(Summary by S.S de S)* D02

0227-4447 ECHEVERRIA, H **Mecanización del cultivo de la yuca.** *(Mechanization of cassava cultivation). In* Primer Seminario Nacional sobre Yuca. Revista de la Facultad de Agronomía (Venezuela). Alcance no. 22-45-09. 1973 Span , 4 Refs

Cassava. Planting. Harvesting. Mechanization. Land preparation. Labour. Costs. Venezuela.

The possibility of mechanizing cassava planting and harvesting was studied The best manual planting system (on machine-made ridges) required 32 man-h/ha, as opposed to the mechanized method requiring only 0 5 h/ha (60% efficiency) Manual harvesting, packing and drying took 215 man-h/ha, whereas with a subsoil plow and potato harvester, it took 0.36 and 0 30 h/ha (80 and 55% efficiency), respectively. Mechanized harvesting is difficult because of the size and distribution of the roots. *(Summary by T.M.)* D02 J00

0228-6921 GARTNER, J. J. **Métodos de cosecha, almacenamiento y perspectiva de exportación de yuca.** (*Methods of harvesting and storing cassava and export perspectives*) *In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp.135-148. Span., 8 Refs.

Cassava. Harvesting. Mechanization. Storage. Trade. Legal aspects. Colombia.

Several methods for harvesting and storing cassava roots, as well as export perspectives for Colombia, are presented. The following harvesting methods are described: manual (by hand, pick, cinch and crowbar); manual-mechanical (trench digger and reversible plow); and mechanical Some considerations are presented in connection with the implementation of the mechanical method such as planting systems and distances, soil texture and moisture, and distribution habit of roots. Mention is made of the traditional root storage methods and their disadvantages (changes in root texture, color, taste, cost, etc) Clamp storage and the paraffin and resin methods of conservation are described, highlighting their advantages over the traditional practices. The foreign market presenting the best prospects for Colombian cassava is New York because of the high number of warehouses and the large Latin American population living in that area. Roots should comply with the following specifications in order to compete in this market: (a) dark peel and (b) 5-8 cm in diameter and 30-40 cm in length. (*Summary by A J. Trans. by S. S. de S* .) D02 I02

0229-6916 GARTNER, J.J. AND PEREZ, O. **Producción de yuca.** *(Cassava production). In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp. 19-34. Span , 4 Refs.

Cassava. Land preparation. Planting. Cuttings. Spacing. Harvesting. Cultivation systems. Cultivars. Selection. Identification. Colombia.

A brief description is given of agronomic practices recommended for producing cassava in Colombia, as well as the most outstanding varieties. Among the agronomic practices discussed are adequate soils and their preparation; planting systems (on the flat, beds and ridges), characteristics, size, treatment and storage of propagation material; position of cuttings (upright, horizontal, slanted and crossed), planting distances according to soil fertility and climate, planting seasons; hilling; irrigation; and harvesting seasons. Intercropping cassava with maize, beans or plantain is discussed as well. The varieties Llanera, ICA Palmira, ICA Montería and ICA Caribe are recommended; in addition a list of promising varieties is included. (*Summary by A J. Trans. by S.S. de S.*) D02

0230-4738 GODOY, J.M. DE **Tecnología agrícola fecularia e amidonaria.** *(Agricultural technology the starch industry).* 2 ed. São Paulo, Secretaria da Agricultura, Indústria e Comércio do Estado de São Paulo, 1940. 288p. Port., 49 Refs., Illus.

Cassava. Taxonomy. Cultivars. Composition. Toxicity. Soil requirements. Land preparation. Cultivation systems. Propagation. Cuttings. Planting. Harvesting. Productivity. Injurious insects. Insect control. Diseases and pathogens. Cereals. Industrialization. Tapioca pearls. Cassava starch. Cassava flour. Feeds and feeding. Vitamin content. Legal aspects. Food products. Starch crops. Glucose. Dextrin. Analysis. Industrial machinery. Drying. Costs. Brazil.

In addition to giving a general description of cassava cultivation, the first chapter includes chemical analyses of root dry matter at different harvest times for several varieties. Detailed descriptions and illustrations, damage and methods of control are given for the following cassava pests: *Erinnyis* spp., *Rothschildia aurota, Autodiplosis brasiliensis, Aleurothrixus aepim, Bemisia tuberculata, Thrialeurodes manihot, Scirothrips manihoti, Leptopharsa* spp., *Atta* spp., *Acromyrmex* spp. *Lonchaea* spp., *Coelosternus* spp., *Anastrepha* spp., *Saissetia oleae, Lasioderma serricorne, Stegobium paniceum, Pyralis farinalis, Setomorpha insectella, Ephestia kuehniella.* The second chapter deals with the starch industry. An analysis is made of the different starches including cassava. The manufacture of cassava flour, starch, tapioca, chips, flour from chips, glucose and dextrin is dealt with; and the different types of machinery used are illustrated. The use of cassava flour in breadmaking and government regulations in this respect are also discussed. Different rations including cassava are given for dairy cows, swine and horses. The vitamin value of cassava is analyzed. Standards for flour (acidity, moisture, starch content, color, ash) are analyzed as well. *(Summary by T.M.)* D02 I02

0231-1662 GONZALEZ, J. A. *et al.* **El cultivo de la yuca en Venezuela.** *(Cassava cultivation in Venezuela).* Maracay, Venezuela, Ministerio de Agricultura y Cría, Centro Nacional de Investigaciones Agropecuarias, Sección de Fitopatología, 1974. 18p. Span.

Cassava. Cultivars. Inter-cropping. Planting. Timing. Land preparation. Cuttings. Harvesting. Tuber productivity. Casave. Prices. Processing. Venezuela.

A study was carried out on the status of cassava cultivation in Venezuela in order to establish the bases for a research program. Direct surveys were made among farmers of the main producing zones in the East (50 properties), Barlovento (48) and the West (55). Most of the farms visited were small production units where technology was almost nonexistent. Soil preparation is limited to cleaning and burning; the land is seldom plowed. Agronomic practices such as fertilization and irrigation are scarcely used, and weeding and harvesting are done manually. Diseases and pests are not of economic importance; among those mentioned are bacterial blight, root rot, leaf-cutting ants, the hornworm, shoot flies and stemborers. A list of varieties planted in different regions is included. The East was considered to be the most suitable region for cassava industrialization in view of the land resources available and the future creation of industries that require this raw material. Barlovento is adequate for sweet cassava production because it is located near the large markets where prices are more favorable. The West is an appropriate region for industrializing cassava for swine feeding. *(Summary by A.J. Trans. by S.S. de S.)* D02

0232-0024 GROSSMAN, J. **A cultura da mandioca no Rio Grande do Sul.** *(Cassava cultivation in Rio Grande do Sul).* Revista de la Facultad de Agronomía (Uruguay) 42:43-75. 1945. Port., Illus.

Cassava. Plant physiology. Planting. Timing. Tuber productivity. Spacing. Cuttings. Harvesting. Rotational crops. N. P. K Fertilizers. Field experiments. Cultivars. Brazil.

The importance of cassava in Rio Grande do Sul is discussed, including area planted, distribution, av yield (7,000 kg/ha) and estimated value of production. Correlations between (1) the aerial part of the plant and roots and (2) specific gravity and starch percentages were studied. Yield trials were conducted with 38 sweet and bitter varieties. Aspects of agronomic practices dealt with were planting season and distances, size of cuttings, part of the plant used for propagation material, use of green or woody cuttings, planting position of cutting, harvesting season, NPK fertilization and rotation systems. Analyses of variance and covariance are made of the foregoing aspects. (*Summary by L.F.C. Trans. by S S. de S.*) D02

0233-5592 GURNAH, A.M. **Effects of method of planting and the length and types of cuttings on yield and some yield components of cassava (*Manihot esculenta* Crantz) grown in the**

forest zone of Ghana. Ghana Journal of Agricultural Science 7(2):103-108. 1974. Engl , Sum. Engl., Fr., 11 Refs , Illus.

Cassava. ***Manihot esculenta.*** **Cuttings. Planting. Tuber productivity. Field experiments. Ghana.**

In 2 experiments carried out from 1970-71 in the forest zone of Ghana, cuttings of cassava (*Manihot esculenta* Crantz cv. Ankra), with less than 5 nodes, produced lower yields per hectare and fewer and lighter roots per plant than those with 5 or more nodes The percentage take of cuttings was also lower in the shorter cuttings. In 2 other experiments during this period, 3 methods of planting (horizontal, slanting and vertical) and 3 types of cuttings (base, middle and top) were used. The type of cutting had no effect on yield or any other parameters tested. Planting methods had no effect on yield and its components, but they affected root depth and spread. Vertical planting produced deeper, but more compactly arranged roots, whereas horizontal planting produced shallower, more widespread roots A slanting position was intermediate for both depth and spread. It was concluded that cuttings from any part of the stem could be used; they must have at least 5 nodes and should be planted in a vertical or slanting position. *(Author's summary)* D02

0234-6808 HOWLAND, A. K. **A rapid multiplication technique.** *In* Terry, E. R. and Mac Intyre, R , eds. The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976. pp.41-44. Engl., Illus.

Cassava. Propagation. Cuttings. Nigeria.

A description is given of a technique developed to multiply desirable cassava clones rapidly and to produce planting material free from bacterial blight. The method consists of (1) planting 25-cm-long cuttings in an upright position in polyethylene bags filled with sterilized soil, which are placed on trays to maintain soil moisture ; (2) cutting shoots at about 15 cm (3 wk), leaving only the youngest leaves; (3) planting shoots in small polyethylene bags with washed, moist, sterilized sand; (4) placing bags in a humidity chamber or direct planting of shoots in the chamber (step 3 is avoided); and (5) transplanting rooted seedlings 2-3 wk old to the field. Lozano's humidity chamber is described. (*Summary by A. J. Trans. by S. S. de S.*) D02

0235-3908 JAMAICA AGRICULTURAL SOCIETY. **Roots and tubers: cassavas.** *In* _________. Farmer's guide Kingston, 1954. pp.433-436 Engl.

Cassava. Propagation. Cuttings. Land preparation. Planting. Spacing. Weeding. Harvesting. Productivity.

Some characteristics of sweet and bitter cassava are given. As regards its cultivation, the following aspects are referred to briefly: propagation material, preparation of the land (ridges, mounds and on the flat), planting seasons and methods, cultural practices and harvesting. *(Summary by P.G. Trans. by T.M)* D02

0236-6890 KANAPATHY, K. **Time of harvesting different varieties of tapioca on peat.** Malaysian Agricultural Journal 49(4):469-479. 1974. Engl., Sum Engl., 4 Refs., Illus.

Cassava. Field experiments. Leaves. Stems. Production. Tuber productivity. Starch productivity. Harvesting. Timing. Cultivars. Malaysia.

Two experiments were carried out on a peat soil to evaluate harvesting time of different cassava varieties. A sweet variety (Tiga Bulan) was used in the 1st; optimum harvest time on deep peat was at 9 mo (15 tons fresh roots/acre). In the 2nd experiment, 4 crops (6 varieties) were planted in shallow peat. The 1st failed because of the late application of Cu. In the other 3 crops, there was little difference in yield at 8 mo, but at 12 mo the differences were highly significant. Black Twig and Green Twig yielded best at 12 mo (22.2 and 20.2 tons/acre). Recommendations are given for varieties suitable to the monsoon areas of the East Coast of Malaysia. A great advantage of growing cassava on peat is the ease of harvesting. Yields were as good or better than those obtained at Serdang on ordinary mineral soils. (*Summary by T.M.*) D02 D03

0237-4772 KOCH, L. **Uitkomsten van een proef met het gebruik van "gedegenereerde" cassavebitit.** *(The use of degenerated cassava cuttings).* Buitenzorg, Java Department van Landbouw, Niverheid en Handel. Korte berichten uitgande van de selectie en zaadtuinen voor Rijst en andere ééjarige Inlandsche Landbouwgewassen no. 12. 1918. 5p. Dutch.

Cassava. Cuttings. Planting. Java.

It is generally observed in East Java that cassava cuttings introduced from dry areas yield less each succesive planting up to 50% in 4 generations, as compared with cuttings from wet areas. In this experiment it appeared that cuttings from dry and wet areas, planted in a wet area, gave equal yields. It is concluded that no genetic change is involved in the observed degeneration and that in wet areas origin of cuttings did not influence yield as in dry areas. *(Summary by A. van S.)* D02

0238-2449 LAGRIFFOUL. **Le manioc dans la province de Maroantsetra.** *(Cassava in the province of Maroantsetra).* Bulletin Economique de Madagascar no. 4:359-367. 1902. Fr.

Cassava. Production. Cultivars. Soil requirements. Costs. Planting. Harvesting. Starch productivity. Prices. Industrialization. Malagasy Republic.

The following aspects of cassava growing in Maroantsetra (Malagasy Republic) are discussed. varieties and area planted, soil preparation, planting seasons, maintenance and harvesting. An intensive growing system is proposed that would quadruple yields and make it possible to expand the area grown to cassava without increasing hand labor. Finally, a feasibility study is presented on the construction of a starch factory in this province. Such a factory would give excellent profits and would have a sufficient supply of raw material. Several recommendations are made regarding the most suitable site, adequate type of construction and labor required. *(Summary by S.S. de S.)* D02 I02

0239-4922 **Mandioca.** *(Cassava).* Lavoura (Brazil) 37:81-85. 1933. Port.

Cassava. Cultivars. Composition. Planting. Timing. Soil impoverishment. Harvesting. Brazil.

A botanical description is given of cassava, and mention is made of different varieties grown in Brazil High-yielding varieties with a short vegetative cycle are indicated. The following aspects are also dealt with briefly: chemical composition of the roots, soils, climatic requirements, growing and selecting species and varieties, propagation, time and method of planting, fertilizing, agronomic practices, pests and diseases, yields, production costs and uses. *(Summary by L.C. Trans. by T.M.)* D02

0240-4557 MENDES, C.T. **Algumas notas para a cultura da mandioca.** *(Cassava cultivation).* Revista de Agricultura 5:95-102. 1930. Port.

Cassava. Cultivars. Planting. Spacing. Soil requirements. Cuttings. Timing. Brazil.

A brief description is made of the characteristics of some varieties recommended for cooking and industrial and forage purposes. Agronomic practices such as distance between plants, soils, planting material and seasons and fertilization are also described. *(Summary by P.G. Trans. by S.S. de S.)* D02

0241-5756 MENDES, C. T. **Conservação da rama da mandioca.** (*Storage of cassava stems*). Granja (Brazil) 5(47-48):50. 1949. Port.

Cassava. Cuttings. Storage. Stems. Brazil.

A method of storing cassava stems was developed in view of the need to keep high-quality cuttings in good condition for the next planting season. Stems should be piled in a well-ventilated, shaded area (under trees or a straw roof) that is not exposed to direct sunlight and dampness. The no. of cuttings and linear meters of stems recommended on the basis of 3 planting distances are given in a table. With this method, cuttings can be kept for 3-5 mo without deterioration. Stems should be collected late in the season to prevent their sprouting during prolonged summers. (*Summary by L.F.C. Trans. by S. S. de S.*) D02

0242-4386 MENDES, C. T. A poda **da mandioca.** *(The pruning of cassava).* Revista de Agricultura (Brazil) 4(7-8):290-302. 1929. Port., Sum. Port.

Cassava. Pruning. Timing. Tuber productivity. Starch content. Brazil.

Several experiments were carried out with cassava to evaluate the effect of pruning in different seasons. It was found that this crop is much more economical and productive when it has been planted for 2 years. It is not advisable to prune it when it is to be left from one year to another, except in cold weather, because cutting decreases total root production and starch content. One- and two-year-old plants have the highest starch content when they are defoliated and shoots have not begun to sprout. The new shoots draw reserves from the roots until they reach 40-50 cm in height. Pruning should not be done before harvesting unless the branches are going to be used as forage or for propagation material. Several cassava varieties (pruned and not pruned) are compared with regard to the rest period and plant reaction 1 and 2 months after pruning. *(Summary by L.N.A. Trans by S.S de S.)* D02

0243-0190 MIEGE, J. **Essais culturaux sur le manioc.** (*Agronomic trials on cassava*). Journal d'Agriculture Tropicale et de Botanique Apliquée 4(9-10):402-441. 1957. Fr.

Cassava. Field experiments. Planting. Timing. Tuber productivity. Cultivars. N. P. K. Fertilizers. Cuttings. Branching. Mycoses. Tuber development. Flowering. Ivory coast.

A series of trials were carried out in the region of Abidjan (Ivory Coast) between 1951-55. Results of the 4 aspects studied were as follows. (1) the 2 planting systems used (on ridges and on the flat) did not show significant yield differences. (2) Mid-May was the best planting time. (3) As far as fertilizers and ash are concerned, the burning of the branches and the application of K gave high yield increases. (4) The 3 trials with cuttings showed that the longest cuttings (60 cm) gave the best productivity; planting position did not affect yields significantly. The productivity of basal and apical cuttings was superior to that of cuttings taken from the 1st, 2nd or 3rd branching. (*Summary by S.S. de S.*) D02 C01

0244-4486 MURILLO A., G. **Estudios sobre yuca (*Manihot utilissima* Pohl).** [*Cassava (Manihot utilissima Pohl)*]. San José; Universidad de Costa Rica, Estación Experimental Agrícola Fabio Baudrit Moreno, 1962. 105p. Span., 39 Refs.

Cassava. Cultivars. Climatic requirements. K. Soil requirements. Seed. Diseases and pathogens.

Harvesting. Starch content. Spacing. Production. Productivity. Timing. Land preparation. Planting. Leaves. Field experiments.

Experiments were carried out on lateritic soils at the experimental station of the Universidad de Costa Rica to improve cassava production and quality. General background data are given on climate, soils, agricultural practices, diseases (Cercospora leaf spot, rust, wilt, black root rot, witches'-broom, etc.) and pests (*Erinnyis ello, Coelosternus* sp., *Aleurocantrix* sp., *Cecidomyia cecropidae, Lonchaea chalybea, Tetranychus bimaculatus*) and uses. A review of literature on fertilization and planting distances was made. An experiment was carried out with K; no significant differences were found in level of fertilization, indicating that there was already sufficient K in the soil. In an experiment on planting density, differences in yield between rows were highly significant; as distances between rows decreased (2, 1.5 and 1 m), production increased (from 14.7 to 22.5 tons/ha). Distances between plants had no influence on yields. As regards foliage, greater density (2 and 1 m) also gave higher yields (21.7 and 30.9 tons/ha). Different methods for making a precise calculation of starch content were tested; the best treatment was $T_3P_1A_1$ (6.5 min of mixing in a blender, a 60-g sample of cassava, and 2,900 cc of water to wash the starch). (*Summary by T.M.*) D02

0245-0089 NORMANHA, E. S. **Clima e terra para mandioca.** (*Climate and soils for cassava*). Agronômico (Brazil) 1:77-79. 1941. Port., Illus.

Cassava. Soil requirements. Climatic requirements. Brazil.

This article deals with the ecological and edaphic conditions required for cassava growing in the state of São Paulo, together with the agronomic practices necessary to prevent cassava bacterial blight and root rots (*Rosellinia* sp.). (*Summary by L.F.C. Trans. by S. S. de S.*) D02

0246-2861 NORMANHA, E. S. A. **Pareceres técnicos; sistemas de colheita da mandioca.** *(Technical aspects of harvesting cassava).* Agronômico 10(7/8):5. 1958. Port.

Cassava. Harvesting. Brazil.

A series of recommendations to facilitate harvesting are made. A practical measure consists of removing the branches from the field before harvesting the roots, cutting them at 15-20 cm from the ground In light soils, plants should be dug, pulling them from the base; whereas in compact soils, it is necessary to remove some soil from around the plant first. A large plow can be used to mechanize harvesting in sandy soils. No matter which method is used, harvesting will always be done more rapidly and economically if the field has already been cleared *(Summary by P.G Trans. by S.S. de S.)* D02

0247-5618 SAMPAIO, C. V. and CONCEIÇAO, A.J. DA **Espaçamento na cultura da mandioca** (*Manihot esculenta* Crantz). (*Spacing trial in cassava*). *In*. Projeto mandioca. Cruz das Almas, Brasil. Convênio U. F. Ba./BRASCAN Nordeste. Série Pesquisa v.2, no. 1. 1975. pp.99-105. Port., Sum. Port., Engl., 10 Refs., Illus.

Cassava. *Manihot esculenta*. Spacing. Field experiments. Tuber productivity. Soil analysis. Rainfall data. Brazil.

The results are given of a 3-yr density trial in cassava, conducted at the Universidade Federal da Bahia in Cruz das Almas, Bahia (Brasil). Spacing ranged from 0.40 m x 0.40 m to 0.60 m x 0.60 m. The early-maturing cultivar Salangorzinha was used; harvesting was done at 12 mo. Statistical analysis of annual data showed no significance for the influence of spacing; joint analysis, however, showed that both spacing and years were significant.(*Author's summary*) D02 D03

0248-4634 SANTIAGO JUNIOR, E.C. **Informações sôbre a cultura da mandioca.** *(Cassava cultivation).* Boletim de Agricultura, Zootecnia e Veterinária 6(8):499-502. 1932. Port.

Cassava. Soil requirements. Planting. Pruning. Harvesting. Brazil.

The following aspects of cassava growing in Brazil are described briefly: varieties, soils, planting, weeding, pruning and harvesting. The sweet varieties Pão do Chile, Mata-fome, Sabará and Manteiga are recommended for human and animal feeding. Bitter varieties recommended for flour and starch processing are Assú, Saracumanipéba and Grêlo rôxo. *(Summary by P. G. Trans. by S.S. de S.)* D02

0249-1666 SARAWAK MINISTRY OF AGRICULTURE AND FORESTRY. DEPARTMENT OF AGRICULTURE. RESEARCH BRANCH **Tapioca.** *In* ______. Annual Report 1967. Sarawak, 1968. pp.54-58. Engl., 6 Refs.

Cassava. ***Manihot esculenta.*** **Field experiments. Planting. Harvesting. Timing. Cultivars. Tuber productivity. Starch productivity. HCN content. Tubers. Leaves. Selection. Malaysia.**

Ten promising varieties were selected at Tarat Experiment Station for a 4-year period of evaluation (1963-67). Six randomized blocks of 10 plots each were used. Nine-inch cuttings were planted at 1 x 1 m in a Terbat soil (recent alluvial). Aspects studied were yields, starch content of roots, HCN content in roots and leaves, and palatability. The results are given in tables. *(Summary by L.F.C Trans by S.S. de S.)* D02 D03 C03

0250-1889 SCHULTE, E.E., MAKANJUOLA, G.A. and ONOCHIE, B.E. **Mechanization of cassava production. I. Planting.** n.p., 1973, 6p Engl., 2 Refs.

Paper presented at International Symposium on Tropical Root Crops., 3rd., Ibadan, Nigeria, 1973.

Cassava. ***Manihot esculenta.*** **Planting. Mechanization. Cuttings. Agricultural equipment. Field experiments. Nigeria.**

Stem cuttings of cassava (*Manihot utilissima* var. 53101) were planted on the flat with a commercial "New Holland" transplanter. Stands were planted 0.92 m apart in 0.92 m rows. At a ground speed of 50 m/min (3 0 km/h), the machine could plant about 0 28 ha/h, not counting turn-around time at the end of the field and time required to load the planter with cuttings. Frequency of missed stands was a function of ground speed, soil tilth and operator efficiency. Preliminary results with mechanical planting on the flat indicate that it should be possible to develop a transplanter for planting on ridges and even to ridge and plant in one operation. (*Summary by D.H. and L.J.*) D02

0251-5754 SHANMUGAN, A. and SRINIVASAN, C. **Yield increasing techniques for tapioca and sweet potato.** Rural India 37(7-8):125-126. 1973. Engl.

Cassava. ***Manihot esculenta.*** **Planting. Timing. Fertilizers. Dung. Irrigation. Harvesting. Cultivars. Productivity. India.**

Cassava and sweet potatoes are the most widely grown tubers in India. In view of their importance in the national economy and human nutrition, the Indian Council of Agricultural Research has developed yield-increasing techniques. As far as cassava is concerned, a technological package is given, which includes agronomic practices whereby it is feasible to obtain yields between 30-40 metric tons/ha. It is suggested that the agricultural extension agencies conduct demonstration trials incorporating the recommended practices *(Summary by L.F.C. Trans. by S.S. de S.)* D02

0252-1709 SILVA, R. F. E. **Notas sôbre a cultura da mandioca.** *(Cassava cultivation).* Revista da Sociedade Rural Brasileira 18(220):32-37. 1938. Port., Illus.

Cassava. Climatic requirements. Cultivars. Composition. Land preparation. Fertilizers. Planting. Timing. Diseases and pathogens. Harvesting. Productivity. Uses. Brazil.

This paper deals with several agronomic aspects of cassava growing in Brazil, with the purpose of encouraging its cultivation for industrial uses, especially for breadmaking. Aspects such as climatic and edaphic requirements and varieties outstanding for their starch content are included. Agronomic practices described are varietal selection, soil preparation, fertilization, planting, harvesting, storage and rotation. In addition some aspects of its uses in industry and for human and animal consumption are discussed. *(Summary by A.J. Trans. by S.S de S.)* D02

0253-3478 SOMABHI, M. and POTHISOONTHORN, P. **Field evaluation of herbicides in some field crops in Thailand.** *In* Asian-Pacific Weed Control Interchange, 2nd, Los Baños, Philippines, 1969. Proceedings Los Baños, 1969. pp.302-315. Engl.

Cassava. Herbicides. Field experiments. Thailand.

The purpose of this work was to select promising herbicides to be used with the following crops: maize, cotton, sugar cane, sorghum and cassava The herbicides were applied in preemergence at 3 rates (low, medium and high). As regards cassava, all herbicides reduced germination of cuttings during the first 2 months. C.P. 50144 (alachlor) was the most selective herbicide Diuron provided good control but reduced plant density. With low rates of dalapon (6.16 kg/ha), linuron (1 kg) and monolinuron (1 kg), reduction in plant density was insignificant, but the control obtained was poor. *(Summary by W.P. Trans. by S S. de S.)* D02

0254-5005 TEIXEIRA, E F. **Nova época do plantio da mandioca.** *(New planting season for cassava).* Granja 5(42).23. 1949. Port.

Cassava. Planting. Timing. Brazil.

Trials carried out by the Instituto Agronômico de Campinas showed that higher yields were obtained when cassava was planted in May rather than in Oct. Planting at an earlier date has the following advantages the problem of keeping cuttings in good condition for the next planting season is avoided; root production/unit area is increased; the laborers can be used to plant other crops in Oct.; and production costs are reduced *(Summary by P.G Trans. by S.S de S.)* D02

0255-6930 TORO, J.C. **Método de propagación de yuca.** *(A method for propagating cassava).* *In* Curso sobre producción de yuca. Medellín, Instituto Colombia Agropecuario, Regional 4, 1975. pp 191-199. Span.

Cassava. Propagation. Cuttings. Propagation materials. Colombia.

In response to the need for reducing the time required to develop, test and disseminate new varieties to farmers, the Centro Internacional de Agricultura Tropical developed a new rapid propagation system for cassava. A description is given of the field propagation system and the much more advantageous rapid propagation method The latter consists of building propagation chambers, preparing 2-node cuttings, planting, cutting apices, rooting apices in pots, and transplanting them to the field. Using the commercial technique, the field propagation system and the new rapid propagation method, 30, 150 and 1500 mature plants/yr/plant, respectively, can be obtained; therefore, these systems can produce 900, 4500 and 45,000 20-cm-long cuttings/yr, respectively. *(Summary by A.J. Trans. by S.S. de S.)* D02

0256-7438 TORO, J.C., CASTRO M., A. and CELIS A., E. **Selección y preparación de material para siembra de yuca.** *(Selection and preparation of cassava planting material). In* Curso sobre producción de yuca. Cali, Colombia, Centro Internacional de Agricultura Tropical, 1976. pp. 197-204. Span., 10 Refs.

Cassava. Cuttings. Selection. Colombia.

General considerations on the selection and preparation of cassava planting material (cuttings) are given. As regards cutting selection, the following factors should be taken into account: (1) Plant age, including age of the stem and maturity of its basal, middle and apical parts. (2) Pith diameter. A cutting is sufficiently mature to endure adverse conditions when the diameter of the pith occupies 50% or less of the total diameter of the stem. (3) Sanitary conditions. The stem or part of the stem attacked by insects and from fields affected by diseases transmissible by cuttings (viroses is bacteriosis and some fungi) should be discarded when looking for a seed source. (4) Cutting viability. The presence of latex and buds in good condition are indicators of a good level of viability. As far as cutting preparation is concerned, the factors dealt with are size, ways of cutting and treatment. *(Summary by A.J. Trans. by S.S. de S.)*D02

0257-4556 TRIBUZI, H.S. **Mandioca se cultiva assim.** *(Cassava cultivation).* Granja 20(198):39-41. 1964. Port.

Cassava. Land preparation. Fertilizers. Planting. Cuttings. Planting. Harvesting. Brazil.

A brief description is given of agronomic aspects such as land preparation, fertilization, planting, selection of cuttings and varieties, harvesting, storage and yields. *(Summary by P.G. Trans. by S.S. de S.)* D02

0258-6846 **TRIPLIQUE SU producción de yuca por el método más sencillo.** *(A simple method for tripling cassava production).* Agricultura Tropical (Colombia) 4(3):15-16. 1948. Span.

Cassava. Propagation. Cuttings. Propagation materials.

The purpose of this article is to encourage farmers to use long cuttings. It shows how 120- to 150-cm-long cuttings yield 3 times more than 25- to 30-cm-long ones. This discovery was made by a farmer in Trinidad when he used 120- to 150-cm-long cassava cuttings to support eggplants When the cuttings were going to be cut for planting material 10 mo later, it was found that root yields tripled those normally obtained. This system presents the following advantages: ease of planting, harvesting can be done several months before the usual time, root quality is superior, cassava can be grown at all times of the year, all cuttings produce a large no. of roots, and higher yields are obtained no matter what variety is used. *(Summary by S.S. de S.)* D02

See also 0020 0046 0192 0471 0542 0593 0739 0754

D03 Energy Productivity and Yields

0259-6740 ARISMENDI, L. G. **Rendimiento de quince clones de yuca dulce y diez clones de yuca amarga en la sabana de Jusepín.** *(Yields of fifteen sweet and ten bitter cassava clones in the savanna of Jusepín).* Monagas, Venezuela. Universidad de Oriente. Instituto de Investigaciones Agropecuarias. Boletin Informativo. Serie Agronómica no. 2. 1973. 4 p. Span., Sum. Span., Engl., 3 Refs.

Cassava. Sweet cassava. Bitter cassava. Tuber productivity. Venezuela.

In a field experiment in the Savanna of Monagas, the highest yielding sweet cassava clones were Ceiba Llanera, Canaria and Pan de Pobre (25.3, 24.9 and 20.0 tons/ha, respectively). Of the 10 bitter cassava clones, only Querepa was significantly better, with a yield of 50.4 tons/ha. *(Author's summary)* D03

0260-1888 CHAN, S.K. **Evaluation of two cassava cultivars for starch and chip production.** Kuala Lumpur, Malaysian Agricultural Research and Development Institute, 1973. 14p. Engl..

Paper presented at International Symposium on Tropical Root Crops, 3rd, Ibadan, Nigeria, 1973.

Cassava. Cultivars. Field experiments. Tuber productivity. Starch content. Fibre content. Protein content. Costs. Fertilizers. Income. Dry matter. Spacing. Planting. Malaysia.

Two cassava cultivars capable of producing high yields of freshly harvested roots were compared at two plant populations to find which was more suitable for starch and chip production. Their production of roots, stalks and leaves is analyzed. The criteria for selection were based on the productivity of tuberous roots in terms of dry matter yield and the relative amounts of starch, crude protein and crude fiber in the tuber. Black Twig was better for starch and chip production than Bangkok. *(Summary by D H and L.J.)* D03

0261-7383 CHAN, S. K. and CHIA, J. S. **A preliminary evaluation of five cassava clones derived from open-pollinated seeds at Serdang.** MARDI Research Bulletin 2(1): 1-8. 1974. Engl., Sum. Engl , Mal., 9 Refs., Illus.

Cassava. *Manihot esculenta.* Clones. Field experiments. Growth. Tuber productivity. Stems. Leaves. Production. Timing. Tubers. Water content. Starch content. Protein content. Starch productivity. Malaysia.

Five cassava clones derived from open-pollinated seeds at Serdang were compared with a widely grown cultivar, Black Twig, at 9 1/2 mo for growth, root number, size and yield, root/tops ratio and root composition in terms of moisture, starch, crude protein and crude fiber. Although it may not have been the optimum period for yield, the following clones were found promising: C3 for root and starch yield and short-maturity period, C1 for root and starch yield, and C5 for root yield. *(Author's summary)* D03 C01-C03

0262-4756 CHATTERJI, K. N. **Age of cassava plant for maximum yield.** Science and Culture 14(12):533-534. 1949. Engl., 1 Ref.

Cassava. Productivity. Timing. Field experiments.

Samples from cassava plants of different ages were taken at random with the purpose of determining the total production (tapioca, flour and soji) of each plant. Results from 6-to 14-month-old plants are given in a table; 10.7 mo turned out to be the optimum age of production. *(Summary by L.F.C. Trans. by S.S. de S.)* D03

0263-5615 CONCEIÇÃO A. J. DA and SAMPAIO, C. V. **Competição de cultivares de mandioca e aipim (*Manihot esculenta* Crantz) para fins industriais.** *(Evaluation of sweet and bitter cassava cultivars for industrial purposes). In* Projeto mandioca. Cruz das Almas, Brasil. Convênio U.F. Ba/BRASCAN Nordeste. Série Pesquisa v.2, no.1. 1975. pp.71-78. Port., Sum. Port., Engl., 12 Refs.

Cassava. Field experiments. *Manihot esculenta*. Cultivars. Tuber productivity. Identification. Soil analysis. Sweet cassava. Bitter cassava. Brazil.

Eight bitter and sweet cassava cultivars were evaluated for root production. The sweet cultivars Mata Negro, Maragogipe and Cavalo yielded, on the av, more than 17 tons/ha, which was as good as the bitter cultivars Graveto, Cigana, Sutinga and Salangor Preta. *(Summary by T.M.)* D03

0264-5619 CONCEIÇAO, A.J. DA and SAMPAIO, C.V. **Competição de cultivares industriais precoces.** *(Evaluation of early-maturing industrial cultivars). In* Cruz das Almas, Brasil. Universidade Federal da Bahia. Escola de Agronomia/BRASCAN Nordeste. Série Pesquisa v.1, no. 1. 1975. pp.107-117. Port., Sum. Port., Engl., 22 Refs.

Cassava. Cultivars. Timing. Tuber productivity. Starch content. Fibre content. Water content. Field experiments. Rainfall data. Brazil.

From 1970-73, variety trials were conducted on a colonial latosol, tertiary sediment (Série Barreiras) at the Universidade Federal da Bahia in Cruz das Almas, Bahia (Brazil) to evaluate five early-maturing cultivars; the control was a late-maturing cultivar, Salangor Preta. The best cultivars were Mamão and Aipim Bravo, yielding an average of 27.31 and 27.95 tons/ha, respectively. *(Author's summary. Trans. by T.M.)* D03

0265-1951 CORDOBA DE LA O., J. M. **Comportamiento de veintiocho variedades de yuca (Manihot spp.) en Guanacaste.** [*Evaluation of 28 varieties of cassava (Manihot spp.) in Guanacaste*]. Tesis. Ing. Agr. San José, Universidad de Costa Rica, Facultad de Agronomía, 1969. 53p. Span., Sum. Span., 18 Refs., Illus

Cassava. Cultivars. Tuber productivity. Starch productivity. Field experiments. Starch content. Cassava starch. Analysis. Selection. Sweet cassava. Bitter cassava. Statistical analysis. Costa Rica.

In order to study cassava root yield, quality and starch content in the humid lowlands of Guanacaste (Costa Rica), an experiment was conducted at the Agricultural Experiment Station "Enrique Jiménez Núñez" in 1966. Twenty-eight improved varieties of cassava were selected from a previous experiment using 84 varieties from the collection of the Agricultural Experimental Station "Fabio Baudrit Moreno." The results were as follows: Greatest yields were obtained with

Bullet Tree (46.82 tons/ha) and Amarilla Palo Blanco (46.57 tons/ha). As regards the percentage of commercial roots; the best varieties were Mangi (45.86%) and Cubana de Atenas (44.55%). The two best varieties as regards number of roots/plot were Vagana (108.5 roots) and Amarilla Palo Blanco (101.8 roots). The best varieties in starch content (%) and yield (tons/ha) were 3039 Black Stick Ruck Ruck (35.3%) and China (33.7%); and Bullet Tree (13.53 tons/ha) and Cubana de Atenas (11.47 tons/ha). *(Author's summary. Trans. by T.M.)* D03 C03

0266-6799 EVENSON, J P. *et al.* **Tropical root crop research at the University of Queensland, Australia.** Santa Lucia, Australia, University of Queensland, 1975. 13p. Engl., 27 Refs., Illus

Cassava. Cultivation. Tuber productivity. Cultivars. Identification. Leaves. Stems. Petioles. Australia.

This paper reviews the research and publications of the Department of Agriculture at the University of Queensland from 1970, when research in tropical tubers was initiated, to 1975. The crops that have been studied in order of importance are ginger, *Manihot* sp. *Colocasia* sp, *Xanthosomona* sp. and *Dioscorea* sp. As far as cassava is concerned, the institution's germplasm comes from other countries such as Puerto Rico, Thailand, Java and Colombia. Research has covered (1) a series of laboratory and glasshouse studies focusing on the development of a rapid propagation method and on the determination of nutrient deficiencies and the optimum nutritive levels necessary for adequate growth; (2) economic studies (feasibility analyses, production systems and root consumption patterns); and (3) agronomic studies on leaf and root yields and their relationships. A list of the university's cassava accessions, giving their morphological characteristics and the yields of some selected cultivars is also included. (*Summary by A.J. Trans. by S.S. de S*) D03-B00

0267-6892 GARCIA-REYES, F. **Producción de 25 variedades de yuca en zona cafetera.** *(Production of 25 cassava varieties in the coffee zone).* Cenicafé 25(3):84-89. 1974. Span., Sum. Span., 9 Refs.

Cassava. Field experiments. Cultivars. Tuber productivity. Starch productivity. Starch content. Colombia.

An evaluation was made of 25 cassava varieties grown in Colombia at an altitude of 1,250 m with an av annual temperature of 21.2°C and an av annual rainfall of 1,977 mm. Fresh root yields, starch content and yield are given in tables. The best varieties were Santandereana (110 tons/ha fresh roots, 23 tons/ha starch), H-34 (101 tons/ha fresh roots, 24 tons/ha starch) and Blanca no. 1 (84 tons/ha fresh roots, 22 tons/ha starch). (*Summary by T.M.*) D03

0268-1982 JUAREZ G, L. **La hoja de la yuca como forraje.** (*Cassava leaves as forage*) Vida Agricola (Peru) 29(347):881-883, 885, 887-888. 1957. Span., Illus.

Also in Agricultura Tropical (Colombia) 9:7-10. 1953.

Cassava. Leaves. Production. Pruning. Tuber productivity. Cultivars. Timing. Forage. Water content. Ash content. Fibre content. Carbohydrate content. Peru.

A study was carried out with 16 cassava varieties in order to determine (1) the effects on root yields of one leaf-pruning done before harvesting; (2) double-purpose varieties (utilization of roots and leaves), (3) the way to provide forage for cattle without intoxicating them; and (4) the nutritive value of leaves. Two treatments were used· (1) two prunings, one 7 months after planting (217 days).and another just before harvesting, and (2) only one cutting at harvest time. The varieties Blanca de Chilca and Maleña gave the best root and leaf yields in both treatments. As regards HCN content, leaf analysis gave positive results; therefore, its utilization as green forage for animal feeding is dangerous. Cutting and drying whole and chopped leaves for forage eliminated HCN content 18 and 12 days later, respectively. Tests conducted with horses and cattle showed that cassava leaves were well accepted and palatable as forage; the nutritive value compared favorably with that of alfalfa. *(Summary by A.J. Trans. by S.S. de S.)* D03 H03

0269-4757 LAMBOURNE, J. **Proeven met cassave varieteiten.** *(Experiments with cassava varieties).* Indische Culturen 22(10):181-186. 1937. Dutch, 3 Refs.

Cassava. Cultivars. Tuber productivity. Field experiments. Toxicity.

Two experiments were conducted with 40 varieties at the Central Experiment Station in Serdang to determine the 10 best yielders. Large variations were found. The high-yielding varieties, which contain high amounts of HCN, are used in Java for tapioca and "ampas," which are exported to Europe for cattle feed. Cassava for human consumption should be cooked before eating as even low amounts of toxic conpounds can be damaging. *(Summary by A. van S.)* D03

0270-7400 MARREWIJK, G. A. M. VAN **Preliminary cassava yield trials on soils of the Zanderij formation.** Surinaamse Landbouw 22(2/3).52-57. 1974. Engl., Sum. Engl., 12 Refs., Illus.

Cassava. Soil requirements. Field experiments. Tuber productivity. Growth. Starch productivity. Surinam.

As a result of the interest in growing cassava in Surinam, 2 preliminary experiments were conducted with 4 selected clones on an unbleached sandy soil and on a sandy loam soil. Vegetative growth was better on the sandy loam soil. Fresh root production, as well as total starch yield, of the clone 2195 was unsatisfactory on both soils. When harvested at 15 mo, fresh root yields were higher than at 12. Clone Bitter IV combined fair root production with a starch content superior to the other clones. On the sandy soil, starch content dropped between 12 and 15 mo after planting. *(Author's summary)* D03

0271-0073 MATHEW, N. T. **Tapioca as a solution of the food problem.** Science and Culture 12(11):557-558. 1947. Engl.

Cassava. Tuber productivity. India.

In view of the scarcity of basic foodstuffs in India, the cultivation of cassava, which yields 4 times more than rice, was recommended. Although cassava has a low protein content, this can be improved by supplementing it with other protein sources. For this reason, experiments with cassava are being conducted at Baranagore, an av yield of 6,700 lb/acre is expected. *(Summary by L.F.C. Trans. by S.S. de S.)* D03

0272-5586 MUTHUKRISHNAN, C.R. *et.al.* **Relationship of certain yield components in *Manihot esculenta* Crantz.** Madras Agricultural Journal 60(9-12):1610-1612 1973. Engl., Sum. Engl., 7 Refs.

Cassava. *Manihot esculenta.* Cuttings. Plant height. Leaves. Leaf area. Stems. Tubers. Tuber productivity. India.

Studies were undertaken on cassava (variety M4) to assess the degree of association between certain plant characters and yield. It was found that yield was positively correlated with root length and girth, number of nodes per plant and plant height. Leaf area and root yield were negatively correlated, whereas leaf length and breadth were positively correlated. Node number had a positive correlation with characters other than leaf area. Plant height was positively related to root length, girth and yield, whereas leaf area showed a negative relationship. Multiple regression equations were worked out to predict root yield. *(Author's summary)* D03

0273-6743 PINCHINAT, A.M. **Rendimiento potencial de la yuca (*Manihot esculenta* Crantz) en la zona de Turrialba, Costa Rica.** *(Potential yields of cassava in the region of Turrialba, Costa Rica).* Proceedings of the Tropical Region. American Society for Horticultural Science 17:367-372. 1973. Span., Sum. Span., Engl., 9 Refs.

Cassava. *Manihot esculenta.* Field experiments. Tuber productivity. Starch productivity. Cultivars. Adaptation. Costa Rica.

The yield potential of 87 entries in a cassava collection at Turrialba was evaluated in 6 trials from 1969-71. Pata de Paloma-Cartago-S yielded 74.3 tons/ha. Characteristics of this clone and 29 entries yielding from 38-73 tons/ha are shown in table form *(Summary by T.M.)* D03

0274-1658 PUSCHENDORF, J. **Resultado de los ensayos de campo con yuca en el Valle de Sula, Honduras.** *(Cassava field trials in Valle de Sula, Honduras).* Tegucigalpa, Honduras, Ministerio de Recursos Naturales/FAO, 1972. 43p. Span., Sum. Span., Engl., 38 Refs., Illus.

Cassava. Cultivars. Adaptation. Field experiments. Tuber productivity. Timing. Water content. Protein content. Fat content. HCN content. Fibre content. Carbohydrate content. Spacing. Planting. Harvesting. N. P. K. Foliage. Production. Fertilizers. Honduras.

In the northern zone of Honduras, the UNDP/FAO Project, "Agricultural Development and Diversification," carried out several cassava *(Manihot esculenta)* variety trials to ascertain the possibilities of establishing a commercial project for cassava production. In an observation trial, 57 varieties were compared for root production; physiological characteristics; insect, disease and virus incidence. The most promising varieties were then compared in a formal replicated trial at 2 harvesting times. Root samples (minimum 4 cm in diameter) were also chemically analyzed for nutritional characteristics in relation to time of harvesting. Based on the quantitative and qualitative criteria, Criolla de Comayagua was the best variety at all times, showing high production (38.3 tons/ha at 9-10 mo and 70 tons/ha at 15-18 mo) and a chemical analysis (percentage of DM) as follows: crude protein content, 6-8%; fat content, 0.8-0.9%; HCN content, very low, and carbohydrate content, 85-90%. This variety was highly tolerant to the virus complex (witches'-broom), which greatly reduces yield in some other varieties. With the variety

Criolla de Comayagua, further trials were carried out on the effect of spacing, fertilizers and of different harvesting times The best spacings were 1.8 x 1.0 m and 1.8 x 0.5 m. The effect of fertilizers was nil. The effect of harvesting time showed maximum yield at 12-16 mo, after which yield declined. Production was strongly reduced by drought periods and slightly by wind damage. *(Summary by T.M.)* D03 C03

0275-1905. ROSANOW, M. **Field experimental check on starch yields of cassava in Indonesia. Wageningen, Holland, 1973. 10p. Engl.**

Paper presented at International Symposium on Tropical Root Crops, 3rd, Ibadan, Nigeria, 1973.

Cassava. Starch productivity. Timing. Soil fertility. Climatic requirements. Field experiments. Indonesia.

A brief review is made of experimental work done on starch accumulation in cassava roots. The process of starch accumulation depends on such factors as age of crop, variety, soil fertility and weather conditions. It is shown that substantial gains in total amount of starch produced in a given year may be obtained when the harvesting sequence is adjusted to patterns of starch accumulation established experimentally. A knowledge of this pattern (acquired through starch-yield curves) is very important in the evaluation of newly introduced cultivars. (*Summary by T. M.*) D03

0276-6736 SABAH DEPARTMENT OF AGRICULTURE. **Tapioca.** *In* ______. Annual Report 1970 Kota Kinabalee; 1972. pp. 30-31. Engl.

Cassava. Field experiments. Tuber productivity. Harvesting. Timing. Cultivars. Malaysia.

In 1969-70, 7 cultivars of cassava from W. Malaysia were compared with the local cv. Tuaran at 2 sites. Differential varietal responses to season, locality and harvesting date were apparent. Black Twig yielded 16 5 tons/acre and was disappointing when harvested after 9 mo but yielded 23 8 tons after 15 mo. Green Twig did well after 9 mo (25.6 tons/acre) but yielded poorly at 15 mo (11 tons). Medan was highly recommended in terms of yield (20.1 and 25.6 tons/acre with harvests at 15 and 9 mo, respectively) and quality. Tuaran yielded 17.4 and 28.0 tons/acre when harvested after 9 and 15 mo, respectively, and contained a relatively high amount of HCN as compared with Black Twig. In further variety trials, the local cv. Ubi Udaran, Ubi Puteh, Tonglahing, Mentika and Soronggo yielded 43.7, 25.5, 34.6, 40.8 and 27.9 tons/acre, respectively, when harvested after 9 mo Ubi Labuan, Local Ranau and Tomanggong yielded 19 2, 13.4 and 27.2 tons/acre, respectively, when harvested after 10 mo. *(Summary by Plant Breeding Abstracts)* D03

0277-1668 SARAWAK. MINISTRY OF AGRICULTURE AND FORESTRY. **Tapioca variety trial, Tarat.** *In* ______. Annual Report 1965 Kuching, 1966. pp. 52-53. Engl

Cassava. Cultivars. Tuber productivity. Malaysia.

A table is given of the different yields of 10 varieties of cassava, harvested at 12 months in Indonesia The method used was 6 randomized blocks of 10 plots each. Each plot measured 18 x 18 feet Yields ranged from 8.35-10.89 tons/acre. *(Summary by L.C. Trans. by T.M.)* D03

0278-1628 SILVA, J. R. DA *et al.* **Iracema (IAC-7-127): Nôvo cultivar de mandioca para fins industriais.** [*Iracema (IAC-7-127): a new cassava cultivar for industrial purposes*]. Ciencia e cultura 21(2):357-359. 1969. Port.

Cassava. Cultivars. Tuber productivity. Tubers. Dry matter. Brazil.

An evaluation was made of several cassava clones and cultivars for industrial use in 2 regions of Brazil Branca de Santa Catarina was used as the control. According to the data on root production, amount of root dry matter, dry matter production/ha and final stand, Iracema (IAC-7-127) was the best cultivar. *(Summary by P.G. Trans. by S.S de S)* D03 C03

0279-5023 SIMOES, R. M. A **Comentário do mapa da produção de mandioca no Estado do Bahia.** *(A map of cassava production in the state of Bahia).* Boletim Geográfico (Brazil) 11(112):84-86. 1953. Port., Illus.

Cassava. Production. Maps. Brazil.

Brief information is given, together with a map, on the distribution of cassava production in 1948 in the state of Bahia, the major producer of this crop in Brazil Intercropping with maize, beans and tobacco is mentioned. Cassava flour is also produced for local consumption *(Summary by T.M.)* D03

0280-6894 TAKYI, S. K. **Fertilizer, planting date and growth period effects on yields of cassava *(Manihot esculenta* Crantz) in three ecological zones in Ghana.** Ghana Journal of Agricultural Science 7(3):185-190. 1974 Engl., Sum. Engl, Fr., 3 Refs, Illus.

Cassava. *Manihot esculenta*. Soil analysis. Rainfall data. N. P. K. Fertilizers. Planting. Growth. Tuber productivity. Field experiments. Timing. Ghana.

In forest, forest/savanna and coastal savanna/thicket zones, the 1st planting of cassava (*Manihot esculenta* Crantz cv. Ankra) at the beginning of the rains (March 15) gave very significantly higher yields than the 2nd planting (April 15), which in turn gave very significantly higher yields than the last planting (May 15). Yields were higher with longer growth periods (harvesting was at 9, 12 and 15 mo), and there was a close relationship between yield and total rainfall in the forest and forest/savanna zones. NPK fertilizer applications increased yields to varying degrees in the 3 zones. *(Author's summary)* D03 D01 C02

0281-6875 TEMPANY, H A. **Experiments with varieties of food crops.** Mauritius. Department of Agriculture. General Series. Bulletin no. 19. 1920. 8p. Engl

Cassava. Cultivars. Tuber productivity. HCN content. Uses.

The results are given of several yield trials carried out with *Ipomoea batata, Manihot utilissima, Dioscorea sativa, Arachis hypogea* and upland rice in different regions of Mauritius As far as cassava is concerned, 51 varieties were tested at Réduit, Pamplemousses, Mahebourg and Montagne Longue Based on yield data of 42 varieties, Yellow Bell, C Bureum, White Greenaway, Blue Beard White, White Top, Pacho III, Silver Stick and Brown Stick are the most promising accessions The HCN content of 25 varieties is given in a table. The main pests attacking cassava in Mauritius are *Phytatus smithi, Saissetia hemispherica* and *Chionaspis* sp. *Gloeosporium manihotii* causes plant dieback *(Summary by A.J. Trans. by S.S de S)* D03 C03

0282-1642 TOGO. SERVICE D'AGRICULTURE. **Le manioc au Togo.** *(Cassava in Togo). In* Congrès du Manioc et des Plantes Féculentes Tropicales, Marseille, 1949 Marseille. Institut Colonial, 1949. pp. 100-106. Fr.

Cassava. Cultivars. Soil analysis. Tuber productivity. Starch productivity. Rotational crops. Tapiocas. Gari. Prices. Trade. Legal aspects. Togo.

The 5 main cassava varieties grown in Togo are Séko, Kataoli, Goula, Maliaka and Kanikouti. The objective of the plant breeding trials is to find and disseminate mosaic-resistant varieties, with a high starch content and high fresh root yield Trials on agronomic practices, crop rotation and fertilization are being carried out at present. The results from the chemical and physical (Robinson pipette) soil analyses are given in tables. Starch and tapioca manufacturing are described; the different forms in which gari and fresh roots are consumed are mentioned. Tapioca has to meet quality standards according to its classification when it is to be exported *(Summary by S.S. de S.)* D03 J00

0283-2308 **LES TUBERCULES; le manioc.** (*Tuber crops; cassava*). Agronomie Tropicale 28(4):437-438. 1973. Fr.

Cassava. Cultivars. Selection. Productivity. Ivory Coast. Togo. Malagasy Republic.

This is a summary of the work carried out by the Institut de Recherches Agronomiques Tropicales (IRAT) in 1972. Ivory Coast research is directed toward obtaining high-yielding varieties and studying behavior of varieties introduced from Madagascar. The experimental station of Lac Alaotra, Madagascar, continues its work on varietal assessment. In Togo, trials are under way with the varieties Goula and Kataoli to determine the optimum period for planting. (*Summary by J L S.*) D03

0284-2262 TULEAR, MADAGASCAR. SERVICE DE L'AGRICULTURE. Rapport annuel 1955. **Essai de maniocs doux dans la circonscription agricole d'Ambobambe.** *(Annual report 1955. Trials with sweet cassava varieties in the agricultural area of Ambobambe)* Centre Technique Agricole Tropical. Bulletin Trimestriel no.2:46-50. 1957. Fr.

Cassava. Cultivars. Sweet cassava. Field experiments. Productivity. Malagasy Republic.

The results obtained in several trials with 4 sweet cassava varieties (Australia, Aipi Valenca, H 32 and Beambony) in 3 different regions of Malagasy Republic are presented in tables Aspects studied are yields/plot and weight/plant Hybrid H 32 proved to be the best in 2 of the regions, and the variety Beambony ranked first in Behara *(Summary by S.S de S.)* D03

0285-0346 WILLIAMS, C.N. **Growth and productivity of tapioca** (*Manihot utilissima*). **III. Crop ratio, spacing and yield.** Experimental Agriculture 8(1):15-23. 1972 Engl., Sum. Engl., 10 Refs., Illus.

Cassava. ***Manihot esculenta.*** **Cultivars. Growth. Tuber development. Dry matter. Spacing. Timing. Tuber productivity. Plant assimilation. Leaf area. Plant physiology. Harvesting. Malaysia.**

High yield in the cassava varieties studied appears to be associated with sink activity of the roots and consequently with crop index Growth measurements indicate that assimilation is significantly affected by sink activity, as well as by the functioning of the assimilation apparatus The form of the crop growth curve and the effect of spacing on yield and distribution of dry matter are also considered. *(Author's summary)* D03 C01

0286-0864 ZANZIBAR. DEPARTMENT OF AGRICULTURE. **Results of field experiments, crop and stock records and other statistics. I. Hybrid cassava variety trial (Kizimbani).** *In* ________. Annual Report 1953. Zanzibar, 1953. Supplement 6(2):1 1953. Engl.

Cassava. Cultivars. Field experiments. Productivity. Viroses. Resistance. Palatability. Kenya.

A trial was carried out at Kizimbani to test productivity of 8 promising hybrid cassava varieties bred at Amani Significantly higher yields (8.7-9.1 tons/acre) were rendered by 2 varieties resulting from 3rd backcrosses with *Manihot glaziovii*. (*Summary by H.J.S.*) D03

0287-0860 ZANZIBAR. DEPARTMENT OF AGRICULTURE. **Two variety trials with cassava.** *In* ——. Agricultural Report Supplement 1956 Zanzibar, 1957. pp 7-8 Engl

Cassava: Cultivars. Field experiments. Tuber productivity. Palatability. Tanzania.

Six high-yielding, palatable varieties from Amani were further tested in Kinongo soil and compared with the local standard variety Msitu (yielding 3.2 tons/acre). Best results were obtained with T. 206 (10.8 tons/acre). Six other varieties from Amani were tested on Changa soil, but they seemed less suitable for local conditions and yields were very low (1.70-3 80 tons/acre). (*Summary by T.M.*) D03

See also *0031 0044 0051 0052 0053 0090 0175 0176 0177 0182 0183 0186 0187 0191 0193 0200 0203 0205 0206 0210 0211 0213 0218 0236 0247 0249 0411 0775 0798*

E01 General Descriptive Studies

0288-4441 ARENE, O.B. **A short epistemology of some diseases of cassava in Nigeria.** Umudike, Nigeria. Federal Agricultural Research and Training Station. Technical Bulletin 1974 36p. Engl, 8 Refs., Illus

Cassava. *Fomes lignosus.* *Cercospora caribaea.* *Cercospora henningsii* *Xanthomonas manihotis.* **Cassava mosaic virus. Disease control. Vectors. Plant pathology. Nigeria.**

The symptoms, viral pathogen, vector, control, heat treatment of cuttings and meristem tissue culture are discussed for cassava mosaic. Symptoms, pathogens, epidemiology and control are described for bacterial blight, white-thread root rot under field and storage conditions, white and brown leaf spots (*Cercospora* spp) (*Summary by L. C. Trans by T. M.*) E01

0289-5729 BAKER, C. F. **A review of some Philippine plant diseases.** Philippine Agriculturist and Forester 3(7):157-164. 1914. Engl.

Cassava. *Manihot esculenta* **Mycoses. Philippines.**

At the College of Agriculture, University of the Philippines, a study was made of the literature on fungal diseases that attack plants in that country As regards *Manihot utilissima,* a leaf spot induced by *Cercospora henningsii* Allesch was reported to defoliate the lower leaves Three new pathogens were found on dead branches: *Diplodia manihoti* Sacc., *Guignardia manihoti* Sacc. and *Colletotrichum lussoniense* Sacc. *(Summary by L.F.C. Trans by T.M.)* E01

0290-1813 BOURIQUET, G. **Les maladies du manioc.** *(Diseases of cassava)* *In* ______. Les maladies des plantes cultivées à Madagascar. Paris, Paul Chevalier, 1946. pp.198-237. Fr., 32 Refs, Illus.

Cassava. Cassava mosaic virus. Plant physiology. Vectors. *Bemisia* *Xanthomonas manihotis.* *Cercospora henningsii.* *Gloeosporium manihotis.* *Phaseolus manihotis.* *Lasiodiplodia.* **Malagasy Republic.**

A detailed description is given of some cassava diseases such as mosaic, bacterial blight *(Bacterium robici),* Cercospora leaf spots, false mosaic (caused by the mite *Tetranychus bimaculatus*) and anthracnose. Reference is made to the histological and cytological modifications and symptomatology of each disease. The incidence of *Mytilaspis dispar* and *Lecanium hemisphericum,* entomophagous fungi, is also recorded; *Lasiodiplodia theobromae* and *Phaseolus manihotis* cause root rot. Macro- and microscopic data are given of the latter. *(Summary by R.T. Trans. by T.M.)* E01

0291-0655 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL **Inactivation of viruses, mycoplasma, bacteria and other organisms by heat and other treatments in cassava cuttings.** Palmira, Colombia, 1971. 7p., Engl.

Cassava. Cassava programs. Disease control. Viroses. Mycoplasmoses. Bacterioses. Cuttings.

Movement of cassava propagation material makes the introduction of diseases and pests into any geographical area possible. A program is presented to develop a cooperative project between CIAT and the Instituto Agronômico of Campinas (Brazil). Virus and mycoplasma diseases not found in Colombia will be studied in Brazil. The effect of treatments on germination as well as methods for inactivating CBB in cutting, will be undertaken in Colombia. Cultivars and types of cuttings, methods of heat transfer, temperature range, length of treatment, effects of heat and freezing treatment and bud indexing will be studied. (*Summary by T.M.*) E01

0292-3820 CONCEIÇAO, A. J. DA. **Contribuição ao Seminário sôbre o "Establecimiento de una red de colaboración internacional para la prueba y evaluación de cultivares superiores de yuca", promovido pelo CIAT, de 4 a 6 de fevereiro de 1975.** *(Contribution to the seminar "The establishment of an international collaborative network for testing and evaluating promising cassava cultivars," sponsored by CIAT from February 4-6, 1975).* Cruz das Almas, Universidade Federal da Bahia, Escola de Agronomia, 1975. 12p. Port , 12 Refs.

Cassava. Cassava programs. *Xanthomonas manihotis. Cercospora henningsii. Cercospora caribaea. Phoma. Uromyces manihotis. Glomerella cingulata. Rosellinia. Sclerotium rolfsii. Rhizopus.* **Disease control. Developmental research. Germplasm. Brazil.**

As far as the general establishment of cassava research programs in Brazil is concerned, this report gives a brief historical review of the School of Agronomy's program at the Universidade Federal da Bahia in Cruz das Almas In addition, it indicates the places where each project will be carried out and the fields of research to be included: plant improvement, pests and diseases, soils and fertilization, climatic conditions, irrigation, agricultural practices, mechanization, animal nutrition, chemistry and technology, socioeconomic aspects and dissemination of data. It also refers to the general pathological aspects of growing cassava in Brazil, analyzing in detail the incidence of the following diseases: *Xanthomonas manihotis, Cercospora* spp., *Phoma* sp , *Uromyces manihotis, Oidium manihotis, Glomerella manihotis, Rosellinia bunodes, Phytophthora drechsleri, Sclerotium rolfsii, Rhizopus nigricans,* witches'-broom, common and leaf vein mosaic. Finally, it provides a list of the genetic resources available (germplasm bank) of the economic species of the country according to institution. *(Summary by L.F.C. Trans by S.S. de S.)* E01

0293-3039 COSTA NETO, J P DA **Relação das doenças até agora encontradas, pelo serviço de biologia agricola, nas plantas cultivadas e algumas selvagens no Rio Grande do Sul.** *(Diseases identified in some cultivated and wild plants in Rio Grande do Sul):* Revista Agronômica (Brazil) 1(6/10) 286-297. 1937. Port , Illus.

Cassava. *Xanthomonas manihotis.* **Brazil.**

The diseases attacking cultivated and wild plants in the state of Rio Grande do Sul are identified Class, order, family and species of the pathogen (bacteria or fungus), common name of the disease and susceptible plant species, visible morphological symptoms; and origin of material attacked are presented. Cassava is attacked by *Xanthomonas manihotis,* the causal agent of bacterial blight Diseased material was collected in Caí, Gravatai, Lageado, Osorio, Taquarí and Tupaceretan *(Summary by A.J Trans by S.S de S.)* E01

0294-2468 DESLANDES, J. A **Observações fitopatológicas na Amazônia.** *(Phytopathological observations in the Amazon region).* Boletim Fitosanitário 1(3/4) 198-242. 1944. Port , 14 Refs , Illus.

Cassava. *Xanthomonas manihotis. Cercospora henningsii. Cercospora caribaea.* Brazil.

This is a study on the main diseases of several tropical crops. As regards cassava, the most important disease is root rot, which presents symptoms similar to those of bacterial blight but whose causal agent is unknown. Bacterial blight *(Xanthomonas manihotis)* is found throughout the state. Of minor economic importance are the leaf spots caused by *Cercospora caribaea* and *C henningsii. (Summary by L.F.C. Trans. by S S. de S.)* E01

0295-5581 DRUMMOND, O.A **Doenças da mandioca.** *(Diseases of cassava).* Revista Ceres (Brazil) 7(37):24-33. 1946. Port., Illus

Cassava. *Xanthomonas manihotis* Mycoplasmoses. *Cercospora henningsii. Cercospora caribaea. Diplodia. Oidium.* Disease control. Brazil.

The incidence of cassava diseases has increased in the state of Minas Gerais (Brazil), being of economic importance in areas where the soils are poor and the climate harsh. The following diseases, together with their symptomatology, are described: bacterial blight or bacteriosis, witches'-broom, root rot caused by *Diplodia cacaoicola,* rotting or necrosis of the pith area of the branches, cassava ash *(Oidium* sp.), leaf spots *(Cercospora henningsii; C caribaea, Periconia* sp.) As to their control, the following practices are recommended: use disease-free propagation material and vigorous varieties; plant in adequate soils, rotating crops every two years; rogue infected plants and clean tools which can spread the disease. Where there is root rot, plant disease-free cuttings and use bitter varieties The state's Department of Agriculture has organized 3 centers for developing disease-free propagation material and evaluating 102 varieties for this purpose. *(Summary by L.F.C. Trans. by T.M.)* E01

0296-3123 FROLICH, G. *et al.* **Yuca o mandioca.** *(Cassava). In* ________. Enfermedades y plagas de las plantas tropicales; descripción y lucha. Leipzig, Alemania, Edition Leipzig, 1970. pp. 179-182. Span.

Cassava. *Fomes lignosus.* **Pseudomonas. Fusarium.** *Glomerella cingulata. Cercospora henningsii. Erwinia cassavae. Uromyces manihotis.* **Cassava mosaic virus.** *Bemisia. Carpolonchaea chalybea.. Coelosternus granicollis. Tetranychus telarius.* **Disease control. Insect control.**

As regards cassava *(Manihot esculenta* Crantz), the following diseases, their symptoms and their causal agents are briefly described: (1) white rot (causal agent, *Fomes lignosus*) which attacks swollen roots in Ghana, causing a 20% loss in yield; (2) a disease probably caused by *Pseudomonas,* which produces black spots on the roots and causes leaves to die prematurely (Brazil); (3) stem rot, caused by *Fusarium theobromae* (Brazil); (4) anthracnose or "wither-tip," caused by *Glomerella cingulata;* (5) *Xanthomonas manihotis,* which causes bacterial blight; (6) cercosporiosis, caused by the fungi *Cercospora cassavae, C. manihotis* and *C. henningsii;* (7) leaf spot in Uganda caused by the bacteria *Erwinia cassavae;* (8) *Uromyces* spp., parasites of cassava; (9) mosaic and brown streak diseases, caused by several viruses. Insects mentioned include the shoot fly, *Lonchaea chalybea* (Brazil), the stemborer, *Coelosternus* spp.; the mite *Tetranychus urticae;* and hornworms, *Dilophonota ello* L., etc. *(Summary by L.C. Trans. by T.M.)* E01 F01

0297-5741 HAHN, S. K., HOWLAND, A.K. and OKOLI, C. A. **Breeding for resistance to cassava bacterial blight at IITA.** *In* Okpala, E. U. and Glaser, H. J., eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station, 1974. pp. 11-14. Engl.

Cassava. *Xanthomonas manihotis* **Plant breeding. Resistance. Nigeria.**

IITA has been involved in the search for resistance to cassava bacterial blight in Africa This is a presentation of the results obtained during the period 1972-74. The genetic source of resistance to CBB has now been identified; the mechanism of resistance appears to be due to quantitative genes mainly with additive effects, although some present nonadditive effects. Based on the results of these trials, it seems possible to produce high-yielding varieties with a high level of resistance to CBB (*Summary by P.G Trans by S S de S*) E02 G01

0298-6963 KOCH, W. **Tropische Knollenpflanzen und ihre Krankheiten.** *(Tropical root crops and their diseases).* Nachrichtenblatt der Deutschen Pflanzenschutzdienstes 26:135 1974 Germ , Sum Germ., Engl , 52 Refs

Cassava. Viroses. Bacterioses.

Virus, mycoplasma, bacterial and fungal diseases of yams, taro *(Colocasia esculenta),* tania (*Xanthosoma* spp.), sweet potatoes, cassava and chayote *(Sechium edule)* are compiled from observations in Central America and the tropics and from published reports. *(Summary by Review of Plant Pathology)* E01

0299-6881 LOZANO, J C *et al.* **Field problems in cassava.** Cali, Colombia. Centro Internacional de Agricultura Tropical Series GE-16 1976. 127p. Engl., Illus.

Also in Spanish and Portuguese

Cassava. ***Manihot esculenta.*** **Bacterioses. Mycoses. Viroses. Mycoplasmoses. Injurious insects. Injurious mites. Disease control. Insect control. Mite control. Mineral deficiencies. Toxicity. Herbicides. Colombia.**

A description is given of the damage caused and the control measures used to eradicate the following problems of cassava: (1) Diseases (bacterial blight, bacterial stem rot, African mosaic, leaf vein mosaic, witches'-broom, brown leaf spot, blight leaf spot, white leaf spot, concentric ring leaf spot, superelongation, cassava ash, anthracnose, rust, stem rot, infected propagating material and different root rots) (2) Pests (mites, thrips, hornworms, shoot flies, whiteflies, white grubs, cutworms, stemborers, scale insects, lace bugs, termites, leaf-cutting ants, gall midges).(3) Nutritional deficiencies and toxicities (N, P, K, Mg, S, Zn, Cu, Fe, Mn, B, salinity and alkalinity) (4) Damage caused by herbicides (diuron, 2,4-D o 2,4,5-T, paraquat, butylate and atrazine). Finally, a key for identifying cassava pests and diseases is included. Color photographs illustrate each of the problems. *(Summary by S. S. de S)* E01 F01

0300-4587 MULLER, A. S. **A preliminary survey of plant diseases in Guatemala.** Plant Disease Reporter 34(6).161-164. 1950. Engl., 3 Refs.

Cassava. ***Manihot esculenta. Cercospora henningsii.*** **Guatemala.**

Based on observations made in Guatemala from 1941-50, a report was made of 60 garden crops and diseases attacking them. As regards cassava *(Manihot utilissima),* mention is made of *Cercospora henningsii,* which attacks foliage (no economic losses); and *Rhizopus nigricans,* which attacks stored roots. *(Summary by T.M.)* E01

0301-5742 NNODU, E. C. **Chemical aspects of control of bacterial blight of cassava.** *In* Okpala, E. U. and Glaser, H. J., eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station, 1974. pp.22-24. Engl., 12 Refs.

Cassava. *Xanthomonas manihotis.* Disease control. Nigeria.

Some chemical methods for controlling cassava bacterial blight are presented. These methods are based on the knowledge of mode of entry and spread of the pathogen. The following treatments are suggested spraying of foliage with dodine and Bordeaux mixture, use of paints to heal cut surfaces of cuttings; use of systemic fungicides such as benomyl and thiabendazol; application of methyl bromide and chloropicrin to the soil; use of streptomycin to prevent the dissemination of the infection, and control of insect vectors. (*Summary by P G. Trans. by S.S de S.)* E01 E02

0302-6877 PARADELA FILHO, O. **Principais doenças da mandioca.** (*Principal diseases of cassava*). Agronômico 23:116-124. 1971. Port , 5 Refs

Cassava. *Xanthomonas manihotis. Cercospora henningsii. Cercospora caribaea. Oidium. Rosellinia. Diplodia. Sclerotium rolfsii.* **Brazil.**

A description is given of different aspects of cassava diseases caused by (1) *Xanthomonas manihotis* (etiology, geographical distribution, symptomatology and control), (2) *Cercospora henningsii* and *C. caribaea* (symptomatology and control), (3) *Oidium manihotis*, (4). *Rosellinia bunodes;* (5) *Diplodia manihotis;* and (6) *Sclerotium rolfsii.* Symptomatology is the only aspect dealt with for the last 4 diseases. The economic impact of these diseases is also discussed. (*Summary by A.J. Trans by S. S. de S.*) E01

0303-1869 TOCCHETTO, A. **Doenças da mandioca no Rio Grande do Sul e contrôle.** *(Diseases of cassava in Rio Grande do Sul and their control)* Porto Alegre, Brasil, Secretaria de Estado dos Negócios da Agricultura, Indústria e Comércio. Secção de Informações e Publicidade Agrícola, 1948. 18p. Port , 7 Refs., Illus.

Cassava. *Xanthomonas manihotis.* Disease control. Mycoses. Brazil.

Several aspects of pathogenic and physiogenic diseases of cassava in Rio Grande do Sul (Brazil) are presented Cassava bacteriosis caused by *Pseudomonas manihotis* is discussed in detail, indicating symptoms, dissemination and control. In addition, the symptomatology and control of root diseases caused by *Diplodia theobromae* and *Rhizopus nigricans* are presented. The effects of frosts on cassava plants are also described General aspects of cassava fertilization with farmyard and green manures and compost are included *(Summary by A J. Trans. by S.S. de S)* E01

See also 0029 0387 0584

E02 Bacterioses

0304-5747 AGBO, F.M. **Preliminary field screening for cassava bacterial blight resistance.** *In* Okpala, E.U. and Glaser, H J , eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974 Proceedings. Umudike, Nigeria, Federal Agricultural Research Training Station, 1974 pp.52-56 Engl., Sum Engl., 9 Refs , Illus.

Cassava. *Xanthomonas manihotis* **Resistance. Cultivars. Selection. Field experiments. Nigeria.**

Cassava bacterial blight (CBB) caused by *Xanthomonas manihotis* was reported in Nigeria for the 1st time in 1971. A practical method for scoring field symptoms to select tolerant cultivars was outlined as a preamble to resistance breeding. No immunity to CBB has been found but high tolerance was exhibited by some selections and local cultivars: 60506, Nwugo, Iwa-Panya (Congo) Iwa-Bende—2, Alibobuji-Orba *(Author's summary)* E02

0305-5748 ARENE, O.B. **Preliminary evaluation of some fungicides for the control of bacterial blight diseases of cassava caused by** *Xanthomonas manihotis* **(Arthand-Berthat and Boudor) Burkholder.** *In* Okpala, E.U. and Glaser, H J., eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station, 1974 pp.57-60. Engl., 6 Refs.

Cassava. *Xanthomonas manihotis* **Disease control. Nigeria.**

Three fungicides—Dithane M-45, Bordeaux mixture (5:5.50) and copper ammonium carbonate—were analyzed to determine their effect in the control of cassava bacterial blight caused by *Xanthomonas manihotis* Six concentrations were used for each 0, 10, 100, 1000, 3000 and 6000 ppm Bordeaux mixture had no effect on the organism in vitro at any of the concentrations used. Dithane showed some bactericidal property at as low as 10 ppm. Copper ammonium demonstrated carbonate bactericidal effect in vitro. (*Summary by P G. Trans. by S S. de S*) E02

0306-7528 ARENE, O.B. **Rating system for cassava cultivars to the resistance of cassava bacterial blight caused by** *X. manihotis* **at FARTS, Umudike.** *In* Okpala, E U. and Glaser H J., eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, 1974. Proceediugs. Umudike, Nigeria, Federal Agricultural Research and Training Station, 1974. pp.70-72. Engl., 5 Refs.

Cassava. *Manihot esculenta. Xanthomonas manihotis.* **Resistance. Nigeria.**

A description is given of a rating system developed at Umudike to evaluate cassava resistance to bacterial blight *(Xanthomonas manihotis).* This system is based on 2 qualitative (wilting and defoliation) and 2 quantitative (stunting and death) factors. The 5 classes of symptoms are defined. The validity of this system is supported by yield data. *(Summary by A J. Trans. by S.S. de S.)* E02

0307-1716 AMARAL, J. F DO Caracteres bioquimicos do *Xantomonas manihotis* e *X. rubrisubalbicans* e suas posições na chave de Burkholder (Schizomycetes, Pseudomonacea). *(Biochemical characters of Xanthomonas manihotis and X rubrisubalbicans; their position in Burkholder's 1957 key for this genus).* Arquivos do Instituto Biológico 21.65-72 1958. Port , Engl , 31 Refs.

Cassava. *Xanthomonas manihotis.* Biochemistry. Brazil.

Based on Burkholder's key for *Xanthomonas* (12.154), it was verified that *Xanthomonas manihotis* (Arthaud-Berthet, 1912) Starr, 1946 and *X rubrisubalbicans* (Christopher et Edgerton, 1930) Savulescu, 1947 are not correctly placed. After biochemical studies, the author found that 3 samples of *X manihotis* hydrolyzed starch but were unable to produce nitrites from nitrates The following alterations are proposed for this key Item II. Colonies whitish to cream pigment nonwater soluble, (A) GELATIN LIQUIFIED. (1) Starch hydrolyzed. (a) Nitrites produced from nitrates. 54. *X. panici* 55. *X proteamaculans.* (aa) Nitrites not produced from nitrates 56. *X. manihotis.* (2) Starch not reported. 57 *X. cannae.* 58 *X. conjac.* 59. *X. zingiberi.* (B) GELATIN NOT LIQUIFIED (1) Starch hydrolyzed (a) Nitrites not reported 60 *X. rubrisubalbicans (Summary by T.M.)* E02

0308-4913 **BACTERIAL WILT disease of cassava.** Umudike, Umuhahia-Ibeku, Nigeria. Federal Agricultural Research and Training Station Advisory Bulletin no. 1. 1973 18p. Engl., Illus.

Cassava. *Xanthomonas manihotis.* Disease control. Nigeria.

Most high-yielding varieties of cassava in Nigeria are susceptible to bacterial blight, most serious outbreaks occur during the rainy season. The causal agent is *Xanthomonas manihotis.* Characteristic symptoms of the disease are wilting of leaves, defoliation and dieback, accompanied by a creamy yellow exudation from infected parts. Photos showing disease symptoms are included. Suggested control measures are as follows: (1) use disease-free cuttings, (2) plant at a time that will permit plants to establish well before heavy rains begin, (3) use balanced fertilizer, (4) use resistant varieties such as Nwaugo and Aburu-Asuo, which have proven to be tolerant in this area, (5) rogue and burn diseased plants, and (6) rotate crops *(Summary by A.B Trans by T M.)* E02

0309-0158 BONDAR, G. **A bacteriose da mandioca.** *(Cassava bacterial blight).* Campo 10(119).28-30. 1939. Port , Illus.

Cassava. *Xanthomonas manihotis.* Etiology. Disease control. Brazil.

A description is given of the symptoms of cassava bacterial blight caused by *Xanthomonas manihot,* with the purpose of supplying farmers with a field identification guide and some methods of control. Symptoms differ between sweet and bitter varieties, but the intensity of the attack is equally devastating Root wt and starch content of heavily affected plants are reduced considerably. The causal agent was confirmed by means of the Kock test. A description is presented of the bacterium culture in nutritive broth and agar. It was concluded that (1) disease transmission is through vector or by direct contact; (2) healthy cuttings from infected plants are susceptible to the disease; (3) sweet varieties are more susceptible than bitter varieties Preventive measures recommended are (1) plant as soon as possible cuttings from healthy plants of resistant varieties; (2) prepare the cuttings without damaging the peel in any way; (3) disinfect the cuttings; (4) avoid planting cassava in fields affected by the disease in previous seasons; (5) control pests; and (6) avoid direct contact of cuttings with manure. *(Summary by A.J. Trans. by S.S. de S.)* E02

0310-2994 BONDAR, G. **Uma nova molestia bacteriana das hastes da mandioca.** *(A new bacterial disease of cassava stems).* Chacaras e Quintaes 5(4):15-18. 1912. Port., Illus.

Cassava. *Xanthomonas manihotis.* **Brazil.**

A description is given of the symptoms found in cassava plantations attacked by the bacterium *Bacillus manihotis (=Xanthomonas manihotis).* In recently planted fields, the plants die from the attack. When infected cuttings are used, they rot before germinating. Some preventive measures recommended are planting healthy material, rotating crops and using resistant varieties *(Summary by P.G. Trans. by S.S. de S.)* E02

0311-1781 BRANDAO FILHO, J S. **Meios de contrôle e bacteriose da mandioca.** *(Cassava bacteriosis and measures for its control).* Campo (Brazil) 1940:62-63. Otubro 1940. Port.

Cassava. *Xanthomonas manihotis.* **Disease control. Brazil.**

A brief historic resumé is given of bacteriosis caused by *Bacillus manihotus* in some Brazilian states A detailed description is given of the symptoms, and the following preventive measures are indicated (1) plant only in disease-free soils and use sound cultural practices; (2) use disease-free cuttings; (3) rotate crops for some years (4-5) and avoid planting host plants of the disease *Bacterium solanacedrum;* (4) rogue and burn debris from previous crops; (5) combat vectors of the disease, such as the fly *Lonchaea pendula,* whose larvae infest the growing points of the plant. *(Summary by L.F.C. Trans. by T M.)* E02

0312-3068 CASTRO, J. B. DE **A cultura da mandioca e a bacteriose.** *(Cassava cultivation and bacterial blight)* Suplemento Agricola no. 8. 1957. 2p. Port., Illus.

Cassava. *Xanthomonas manihotis.* **Brazil.**

A brief description is given of the importance of cassava bacterial blight as a factor limiting the production of this crop. The seriousness of the disease is associated with the susceptibility of the variety and planting in poor soils. Symptoms observed in the field are explained in detail. *(Summary by P G. Trans. by S.S. de S.)* E02

0313-2481 CASTRO, J. B. DE, GONÇALVES, R. D. and NORMANHA, E S. **A bacteriose da mandioca.** *(Cassava bacterial blight).* Bahia Rural 6:225-226. 1939. Port., Illus.

Cassava. Cassava bacterial blight. Disease control. Brazil.

Cassava bacterial blight was reported for the 1st time by Gregorio Bondar in the state of São Paulo in 1911. Symptoms appear at any age of the plant. The disease is characterized by partial or total wilting of the plant and the presence of brown and bluish spots on the leaf upper and undersurface, respectively. In general, spots are located at the borders or at the tip of the leaves. Preventive control measures include the use of healthy cuttings, crop rotation for several years in infected fields, and not planting in poor soils which increase disease severity. *(Summary by P.G. Trans. by S.S. de S)* E02

0314-5739 ENE, L.S.O. and AGBO, F.M.O. **Breeding for resistance to cassava bacterial blight at Umudike.** *In* Okpala, E. U. and Glaser, H. J., eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings Umudike, Federal Agricultural Research and Training Station, 1974. pp.3-10. Engl.

Cassava. *Xanthomonas manihotis* **Plant breeding. Resistance. Nigeria.**

A crop loss of N$25 million, recorded in East Central State (Nigeria) in 1973, gives an idea of the devastating effect of cassava bacterial blight In the past, breeding was focused on selecting mosaic resistant and high-yielding varieties. The ways in which the disease can be disseminated are explained, and the 3 possible types of resistance found in cultivars are mentioned The first step in the breeding strategy at Umudike is to collect all varieties grown in Nigeria for their evaluation under greenhouse and field conditions (*Summary by P.G. Trans. by S. S. de S.*) G01

0315-5743 EZUMAH, H.C. and TERRY, E.R. **Cultural considerations in control of cassava bacterial blight (CBB).** *In* Okpala, E.U. and Glaser, H.J. eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station, 1974. pp 25-32. Engl., Sum. Engl., 7 Refs.

Cassava. *Xanthomonas manihotis.* **Planting. Timing. Pruning. Productivity. Nigeria.**

Although breeding of cassava varieties resistant to bacterial blight should be the long-term goal in CBB control, a few temporary cultural measures, based on observations made on the performance of cassava in different locations, are discussed. Other culturally oriented measures such as sanitation, crop rotation and the use of disease-free planting material have been published elsewhere. Since plants with vigorous top growth may be more likely to escape disease than those with poor growth, it will be necessary in breeding for resistant varieties to be sure that root yields are higher or at least comparable to yields from susceptible cultivars. Lower root yields may result when alternative sinks are formed in stems and leaves at the expense of the roots. Plants with vigorous top growth are more likely to exhibit this phenomenon. Considerations involving plant establishment by use of fertile soils or fertilizer application, choosing planting time to escape disease incidence, pruning of tops and effects of reduced leaf cover on yield are briefly discussed *(Author's summary)* E02

0316-2497 FREIRE, J. R. J **Considerações sôbre o problema de bacteriose da mandioca.** *(Cassava bacterial blight).* Revista Agronômica 15 103-104. 1951 Port , 2 Refs.

Cassava. *Xanthomonas manihotis* **Disease control. Brazil.**

Cassava production is greatly reduced by bacterial blight caused by *Xanthomonas manihotis.* Control of the disease should include (1) prophylactic measures such as planting healthy cuttings, crop rotation, postplanting elimination of infected plants—that guarantee the conditions necessary for the vigorous development of the plant and (2) the search for resistant varieties. The implementation of these practices requires a long and difficult educational campaign *(Summary by P.G. Trans. by S.S. de S.)* E02

0317-5746 GLASER, H J and OGBOGU, F.C. **Problems and experiences of plant protection extension in the control of cassava bacterial blight disease in East Central State of Nigeria.** *In* Okpala, E U. and Glaser, H J., eds Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station, 1974. pp.44-51. Engl

Cassava. *Xanthomonas manihotis* **Disease control. Cultivars. Resistance. Nigeria.**

Problems and experiences concerning the Nigerian plant protection extension service are examined, and some practical solutions for the control of cassava bacterial blight are suggested. Among the aspects studied are 1st symptoms of the disease, highly susceptible and disease-free local cultivars, and farmers' superstitious beliefs and practices. Problems found in the expansion of control measures were (1) the farmers' reluctance to adopt crop rotation, (2) the inadequate supply of disease-free planting material, and (3) the lack of trained extensionists. Control measures include the collection and distribution of disease-free materials to farmers, the establishment of CBB-free cassava mutiplication plots, the implementation of agrochemical control measures, the use of fertilizers, and the coordination of applied agricultural research. (*Summary by P.G. Trans. by S. S. de S.*) E02

0318-3101 LIMA, A. D. F. **Mandioca e aipim.** *(Bitter and sweet cassava).* Boletim do Ministério da Agricultura 33(12).6-18. 1944. Port.,Illus.

Cassava. *Xanthomonas manihotis. Erinnyis ello* **Disease control. Insect control. Injurious insects. Brazil.**

A detailed description is given of a bacteriosis that attacks leaves and stems of cassava plants and affects normal root development. Crop losses up to 90% were recorded in the state of Santa Catarina. The plan designed to control the disease is explained in detail. On the other hand, losses caused by the cassava hornworm *(Erinnyis ello)* amounted to 80% in the district of Rio de Vermelho. Information is given of their growth habits in the field, annual fluctuations and experimental control methods. The fly *Phoracera longiuscula,* a predator of *Erinnyis ello* larvae, serves as a biological means of control. *Coelosternum granicollis, Eulecriopsis manihoti, Lonchaea pendula, Euxesta alternans* and *Araeocerus fasciculatus* are other cassava pests that have been reported. Cassava mosaic and the diseases caused by *Cercosporella pseudoidium, Rosellinia* sp., *Polyporus sapurema* and *Uredo* sp. have been observed although none of them are of economic importance. *(Summary by P.G. Trans by S.S de S.)* E02 F01

0319-0798 LOZANO, J.C. **Bacterial blight of cassava in Central and South America: etiology, epidemiology and control.** Palmira, Colombia, Centro Internacional de Agricultura Tropical, 1973. 19p. Engl., Sum. Engl., 23 Refs., Illus.

Paper presented at International Symposium on Tropical Root Crops., 3rd, Ibadan Nigeria, 1973.

Cassava. *Manihot esculenta* **Cassava bacterial blight.** *Xanthomonas manihotis.* **Etiology. Disease control. Central America. South America.**

Bacterial blight of cassava (*Manihot esculenta*) is a serious problem in Central and South America and has been observed in parts of Africa. Symptoms include leaf spotting, wilting, dieback, gum exudation on young shoots and vascular discoloration in mature stems and roots of susceptible cultivars. Dispersal by rain splashing is the most important means of dissemination within localized areas. Dissemination from one area to another occurs through infected planting material or through the use of contaminated tools. Delay in spread of the disease has been obtained by pruning infected plants The use of resistant varieties and the production of certified bacterial-free planting material, obtained from plants propagated from shoot tip cuttings, give satisfactory control (*Author's summary*) E02

0320-5740 OKPALA, E.U. **Review of the economic importance of the bacterial blight of cassava caused by** ***Xanthomonas manihotis.*** *In* Okpala, E.U. and Glaser, H.J., eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974.

Proceedings. Umudike, Nigeria, Federal Agricultural Research and Training Station, 1974, pp.15-21. Engl.

Cassava. *Manihot esculenta. Xanthomonas manihotis.* **Nigeria.**

Classic examples of diseases in other crops that started too mildy to cause alarm and suddenly reached epiphytotic proportions are presented with the purpose of warning of the danger of cassava bacterial blight *(Xanthomonas manihotis)* for the West Africans, who depend on this staple food. Research on CBB should be coordinated and results passed on to the farmers. *(Summary by T.M.)* E02

0321-4639 REITSMA, J. and HOFF, H. A., VAN **Voorlopige mededeling omtrent een bacterie-ziekte in cassave.** *(Preliminary report on a bacterial disease of cassava).* Landbouw 20(2):94-101. 1948. Dutch, Engl., Ilus.

Cassava. *Manihot esculenta.* **Bacterioses. Java.**

A report is given on the symptoms of a disease of bacterial origin that was detected at the experimental station of Moeara (Java). It was noted that cuttings from infected plants transmitted the disease to the new plants; therefore, it was recommended not to use these materials. The varieties Mangi, R 366 and P 988 are highly resistant, whereas Valenca, Moeara, Basiorao and Betawi are highly susceptible. The symptoms of the disease are illustrated. *(Summary by A.J. Trans. by S.S. de S.)* E02

0322-4532 SHANMUGAN, N. *et al.* **A die-back disease of tapioca** *(Manihot esculenta* **Crantz) in Madras, caused by** *Glomerella manihotis* **Chevaugeon.** South Indian Horticulture 12(1):18-23. 1964. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. *Manihot esculenta. Gloeosporium manihotis.* **India.**

A heavy outbreak of anthracnose in cassava *(Manihot esculenta* Crantz) appeared in a severe form in parts of Chingleput district in 1963. It was characterized by the appearance of dark-colored lesions found mostly on the young branches and petioles. These lesions were covered by numerous erumpent acervuli scattered on them. The infected areas turn black and die; parts above them wither. The causal organism was identified as *Glomerella manihotis* Chevaugeon, with imperfect stage in *Colletotrichum (Gloeosporium) manihotis* (P. Henn) Chevaugeon. This is the first report of this fungus on cassava in India. *(Author's summary)* E03

0323-3477 **SOBRE A bacteriose da mandioca.** *(Cassava bacterial blight).* Campo 10(5):22-23. 1939. Port.

Cassava. *Xanthomonas manihotis.* **Disease control. Brazil.**

The Institute Agronômico of the state of São Paulo gives historic background on cassava bacterial blight, which was reported in Brazil for the first time in Campinas (São Paulo) in 1911. The bacteria causing the disease was identified as *Bacillus manihoti* Bondar. Since 1927 it has become of economic importance in the southern part of the country. It is recommended to prohibit the shipment of cuttings from contaminated zones to other parts of the country, especially to Bahia, where the only problem is the mite, *Tetranychus tanajoa. (Summary by T.M.)* E02

0324-7527 TAKATSU, A. and LOZANO, J.C. **Translocación del agente causal del añublo bacterial de la yuca *(Manihot esculenta* Crantz*)* en los tejidos del hospedero.** (*Translocation of the causal agent of cassava bacterial blight in host tissues*) Fitopatología (Peru) 10(1):13-22. 1975. Span., Sum. Engl., Span., 14 Refs., Illus.

Cassava. *Manihot esculenta. Xanthomonas manihotis.* **Plant physiology. Plant tissues. Colombia.**

Studies on the translocation of the causal agent of cassava bacterial blight (considered to be a biotype of *Xanthomonas manihotis*) within the host tissues showed that this pathogen moves mainly through the xylem tissue. The primary stem symptoms appear on the green portion of the stem, but their appearance depends on varietal susceptibility and the water content of the soil. Spray inoculations gave even infection; this method appears to be useful for screening for resistant varieties. A new shoot-rooting method, which shortens the rooting period as compared with other reported methods, was devised; and no failures to root occur. (*Author's summary*) E02

0325-6812 TERRY, E. R. **Cassava bacterial blight in Africa.** *In* Terry, E R. and Mac Intyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976. pp.23-25. Engl., 8 Refs., Illus.

Cassava. *Xanthomonas manihotis* **Disease control. Nigeria. Zaire.**

This article presents aspects of cassava bacterial blight (*Xanthomonas manihotis*) in Africa with the purpose of highlighting some facts that may serve as a basis for checking its spread and eventual control. Information on CBB etioglogy, symptomatology, geographic distribution, epidemiology and control is included. The most effective methods of control are the use of resistant varieties and healthy planting material; crop rotation has also been suggested although the survival potential of the pathogen in Africa is unknown. (*Summary by A.J. Trans. by S. S. de S*) E02

0326-5745 TERRY, E. R. **Some epidemiological factors affecting the survival and dissemination** of *Xanthomonas manihotis*. *In* Okpala, E. U. and Glaser, H. J., eds Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974 Proceedings Umudike, Federal Agricultural Research and Training Station, 1974. pp 39-43. Engl

Cassava. *Xanthomonas manihotis.* **Nigeria.**

This report deals with certain epidemiological factors that affect the survival and dissemination of the pathogen *Xanthomonas manihotis*. Typical symtoms of CBB are described, and data from field observations, laboratory and greenhouse experiments are included. It was found that during periods of heavy early morning dew deposits, water droplets form around the bacterial exudation on leaf surfaces. As solar radiation increases, these droplets evaporate, leaving pelleted particles containing up to 1.5 x 10^5 viable cells of *X. manihotis*. Studies are in progress to determine (1) the possibility of lateral spread of *X. manihotis* cells within pelleted bodies over long distances, eventually constituting soil inoculum, (2) the role of the grasshopper *Zonocerus variegatus* in the dissemination of the CBB pathogen, and (3) the survival of *X. manihotis* cells within the pelleted bodies under natural field conditions. (*Summary by P.G. Trans. by S S. de S.*) E02

See also 0329

E03 Mycoses

0327-2860 ALBUQUERQUE, F.C. and FIGUEIREDO, M. M **Podridão mole das raízes da mandioca (*Manihot esculenta* Crantz).** *(Soft root rot of cassava).* Anais da Sociedade Botânica do Brasil 1968:77-84. 1968. Port , Sum. Port., Engl., 4 Refs , Illus.

Cassava. *Manihot esculenta*. Tubers. *Phytophthora drechsleri* Etiology. Disease control. Brazil.

A *Phytophthora* sp. was isolated from transition-layer tissues of rotted cassava roots. Its sporangia were irregular in size and shape and were able to germinate or liberate zoospores under certain temperature and moisture conditions. Its oogonium was globose; the amphigynous antheridium adhered to its base. It also formed some oospores in tap water. Based on the characteristics of the sporangia and oospores, the species was identified as *Phytophthora dreschsleri*. Inoculation tests in small vertical incisions made on the stem proved the pathogenicity of the fungus. Inoculated plants suffered dieback due to the severe rot around the inoculated wounds; plants that were wounded but not inoculated remained healthy. When the fungus was placed in root incisions, it caused tissue deterioration and sometimes death of the plant. Drawings of the main structure of the phycomycete are presented Some control measures are suggested based primarily on physical conditions of the soil. Resistant varieties would be the most appropriate control method in areas with heavily infested soils. Since cassava types vary greatly, it would be interesting to study them in relation to the intensity of attack. *(Author's summary)* E03

0328-1835 CHEVAUGEON, J. **Enquête phytopathologique dans le bassin du Cavally.** *(Pathological survey in the Cavally basin).* Supplement Colonial à la Revue de Mycologie 21(2):57-86. 1956 Fr., 13 Refs., Illus.

Cassava. Mycoses. Ivory Coast.

Several plants (cassava among them) and the environmental conditions suitable for the development of diseases attacking each one of them were studied. Symptoms, damage caused and the part of the plant attacked are described for the following diseases of cassava: *Leptoporus lignosus, Corticium rolfsii* and *Sphaerostilbe repens* (attacking the roots); *Lasiodiplodia theobromae* and *Hendersonula toruloidea* (propagation material); *Colletotrichum gloeosporioides, Fusarium equiseti, Lasiodiplodia theobromae, Cercospora caribaea, Cercospora henningsii* (leaves and branches). Other diseases of minor importance appearing in different regions and seasons are also mentioned. *(Summary and trans. by S.S. de S.)* E03

0329-1614 FARADELA FILHO, O. **Doenças fungicas e bacterianas da mandioca.** *(Fungal and bacterial diseases of cassava). In* Encontro de Engenheiros Agrônomos Pesquisadores em Mandioca dos Paises Andinos e do Estado de São Paulo, 1st , Campinas, 1970. pp. 1-9. Port., 9 Refs.

Cassava. *Xanthomonas manihotis*. Disease control. *Cercospora henningsii*. *Cercospora caribaea*. *Sclerotium rolfsii*. Brazil.

A detailed description is given of the main diseases attacking cassava in Brazil. Bacteriosis (*Xanthomonas manihotis*) is considered the most important; the only effective control method is the use of resistant varieties Other diseases reported are Cercospora leaf spots caused by *C. caribaea* (white leaf spot) and *C. henningsii* (brown leaf spot), both are economically unimportant so the use of control methods is unnecessary. Black root rot *(Rosellinia bunodes)*, dry rot of cuttings *(Diplodia manihotis)* and neck rot or wilting caused by *Sclerotium (S. rolfsii)* are also mentioned. *(Summary by A.M. Trans. by S.S. de S)* E03 E02

0330-3124 GHESQUIERE, M. J. **Sur la "mycosphaerellose" des feuilles du manioc.** *(Mycosphaerella manihotis, a disease of cassava leaves).* Bulletin des Séances. Institut Royal Colonial Belge 3(1):160-178. 1932. Fr., 60 Refs.

Cassava. *Cercospora henningsii.* **Disease control. Leaves. Zaire.**

The purpose of this article is to prove that the disease *Mycosphaerella (Sphaerella) manihotis*, found in the Belgian Congo and described in 1924, is the same disease found in Argentina and described by H. Sydow in 1901. The author considers that the fungi are identical, both belonging to the genus *Mycosphaerella*. To support this thesis, several authors are cited. The same disease sometimes receives more than 2 names because of the form under which it can be found; for example, *Cercospora cassavae* is only the conidial form of *Mycosphaerella manihotis*. Cultural, technical and biological methods of control are proposed. *(Summary by S.S. de S.)* E03

0331-2495 GOLATO, C. **Manioca (*Manihot utilissima* Pohl = *Jatropha manihot* L.).** *(Cassava) In* ______. Mallattie delle piante coltivate in Somalia. Firenze, Istituto Agronomico per l'Oltramare, 1967. pp.20-23. (Biblioteca Agraria Tropicale) Ital., Illus.

Cassava. *Manihot esculenta. Cercospora caribaea.* **Disease control. Africa.**

In Somalia, cassava is cultivated in the region of Garas Bintó in sandy and fertile soils. The main disease attacking this crop is *Cercospora caribaea*. In addition to describing the symptoms of affected leaves and the dissemination of the disease (by wind, water, etc.), some control measures are recommended: to destroy all infected leaves as soon as the first symptoms are noticed, to destroy all dry leaves that fall because they maintain their infectivity, and to apply Cu-based products. Good results have been obtained applying zineb at 0.2-0.3%. *(Summary by S.S. de S.)* E03

0332-0565 GOLATO, C. and MEOSSI, E. **Una nuova malattia fogliare della manioca in Somalia.** (*A new cassava leaf disease in Somalia*). Rivista di Agricoltura Subtropicale e Tropicale 60:182-186. Ital., 10 Refs., Illus.

Cassava. *Cercospora henningsii. Cercospora caribaea.* **Africa.**

The disease, whose symptoms are described, has been reported in some other African countries in the Dominican Republic, Brazil and Venezuela. The fungus could be identified with *Cercospora caribaea, C. henningsii, C. cearae, Ragnhildiana manihotis,* or *Corynespora manihotis.* (*Summary by H.J.S.*) E03

0333-5578 KRAUSZ, J.P. **The superelongation disease of cassava.** Ph.D. Thesis Ithaca, New York, Cornell University, 1976. 81p. Engl., Sum. Engl., 32 Refs., Illus.

Cassava. Cassava superelongation. *Sphaceloma manihoticola.* **Laboratory experiments. Culture media. Isolation. Field experiments. Hosts. Leaves. Petioles. Cultivars. Resistance. Productivity. Colombia.**

The superelongation disease of cassava was first reported causing serious epidemics in widely scattered areas of Colombia in 1972. The causal organism is a fungus *(Sphacèloma).* The pathogen is believed to be similar to *Sphaceloma manihoticola,* previously reported on cassava by Bitancourt and Jenkins. Free moisture was necessary for conidial germination; optimun germination occurred at 28.5ºC. Light and spore concentration had little or no effect on germination whereas percentage of germination decreased with increased colony age The fungus penetrates the host directly, causing spots on leaf lamina and cankers on leaf midribs and main veins and on petioles and young stems. Leaf curl, necrosis and defoliation occur; internodes of infected plants often become greatly elongated, resulting in tall, thin, weak plants. Yields are greatly reduced in heavily infected plants. In yield trials it was found that early infection caused losses of about 80%; there was no significant loss when infection occurred late in plant development. A system was devised for inoculating cassava plants artificially in a mist chamber in order to study the time necessary for infection to occur, the possible existence of pathogenic races and the sequence of symptom development. An acetone extract from a broth culture of the pathogen was concentrated by lyophilization, diluted 1:10,000,000 and sprayed on lima bean plants. This fungal culture extract had a growth-stimulating effect on the lima beans equal to that of 100 ppm of 2 commercially prepared gibberellic acid compounds. Almost 400 cassava clones were screened in the field for resistance to superelongation disease. Sufficient sources of good levels of resistance have been found to encourage breeding for resistance. *(Author's summary)* E03

0334-2182 LOZANO, J.C. and BOOTH, R. H. **The superelongation disease of cassava.** Palmira, Colombia, Centro Internacional de Agricultura Tropical, 1973. 29p. Engl., Sum. Engl., Span., 2 Refs., Illus.

Paper presented at International Symposium on Tropical Root Crops, 3rd, Ibadan, Nigeria, 1973.

Cassava. *Manihot esculenta.* **Cassava superelongation. Mycoses. Disease control. Colombia.**

A new disease of cassava *(Manihot esculenta* Crantz) has been found inducing epidemics in several cassava-growing areas of Colombia during the rainy season. The disease can be recognized by a characteristic exaggerated elongation of the internodes of young stems of infected plants and by the distortion and deformation of the youngest stems, petioles and leaf midribs. The epidermis commonly bears cankers, and frequently leaflets do not develop completely or leaf lamina do not expand fully. The causal agent is *Taphanina* sp. *(Author's summary)* E03

0335-3053 SEYMOUR, A. B. **Euphorbiaceae.** *In* ______. Host index of the fungi of North America. Cambridge, Mass., Harvard University Press, 1929. p.459. Engl.

Cassava. *Manihot carthagenensis. Manihot esculenta.* **Mycoses. USA.**

The following fungi are listed for *Manihot carthagenensis* Müll.: *Alternaria fasciculata, Macrosporium fasciculatum, Ascochyta carthagenensis, Dothiorella botrya, Macrophoma janiphae, Phoma janiphae* and *Sphaeropsis janiphae.* For *Manihot utilissima* Pohl the following are reported: *Cercospora cassavae, C. henningsii, C. jatrophae, C. manihotis, Dimerosporium pellicula, Gloeosporium ampelophagum, G. manihot, Microsphaera euphorbiae, Rhizoctonia solani, Rosellinia bunodes, R. pepo, Nigredo janiphae, Uromyces janiphae* and *Uredo janiphae.* *(Summary by T.M.)* E03

0336-6825 VIEGAS, A.P. **Notas sôbre tres fungos brasileiros. 3.** ***Pleophragmia manihoticola* n. sp.** *(Notes on three Brazilian fungi. 3. Pleophragmia manihoticola n. sp.)* Bragantia 3(3):45-48. 1943. Port., 1 Ref., Illus.

Cassava. ***Manihot esculenta.*** **Mycoses. Brazil.**

A morphological description is given of the fungus *Pleophragmia manihoticola* n. sp. isolated from cassava *(Manihot utilissima)* leaves. This saprophytic species is considered to be a new one because its characteristics do not correspond to any of the species described up to 1940. *(Summary by A.J. Trans. by S.S. de S.)* E03

0337-6888 VYAS, S.C. and JOSHI, L.K. **Leaf blight of cassava (*Manihot utilissima*).** Indian Phytopathology 27:422-423. 1974. Engl.

Cassava. ***Manihot esculenta.*** **Mycoses. Leaves. India.**

Based on microscopic examinations, a description is given of the fungus identified as *Drechslera rostrata* (Drechsler) Richardson and Fraser; which causes a cassava disease characterized by leaf spots. Host symptoms are described. *(Summary by A.J. Trans. by S.S de S.)* E03

See also 0347

E04 Viroses

0338-7248 ALAGIANAGALINGAM, M.N. and RAMAKRISHNAN, K. **Effect of cassava mosaic virus on the nitrogen metabolism of cassava (*Manihot esculenta* Crantz).** Madras Agricultural Journal 61 (1-2):18-26. 1974. Engl., Sum. Engl., 21 Refs.

Cassava. *Manihot esculenta*. Cassava mosaic virus. N. Metabolism. Plant physiology. Leaves. Analysis. Carbohydrate content. Amino acids. India.

Studies were made of the pathophysiology of CMV-infected cassava leaves, with particular reference to N metabolism There was a reduction in the total N content in the CMV-infected leaves at all sampling periods. More total N was noted in samples collected in the early morning than in samples taken later. These diurnal fluctuations in the synthesis of various N fractions and the pattern of various N-fraction contents were found to be almost the same in both healthy and diseased leaves, but the disease exaggerated the conditions by either increasing or decreasing the content. The carbohydrate: N ratio also varied according to the time of sampling, the ratio usually being less in the diseased samples. Diseased leaves contained more bound amino acids, the maximum level being reached 15 days after grafting. Asparagine was found to accumulate more in the diseased than in the healthy leaves. *(Author's summary)* E04 C00 C03

0339-2464 ALAGIANAGALINGAM, M. N. and RAMAKRISHNAN, K. **Studies on a virus disease of tapioca (*Manihot esculenta* Crantz). II. Carbohydrate metabolism.** Madras Agricultural Journal 57(2):55-62. 1970. Engl., Sum. Engl., 25 Refs.

Cassava. *Manihot esculenta*. Cassava mosaic virus. Plant physiology. Leaves. Soluble carbohydrates. Metabolism. Enzymes. Sugars. Sucrose. Starch content. Photosynthesis. Tubers. India.

A study was made of the chlorophyll content, photosynthetic rate and fluctuation in carbohydrate content in leaves of plants infected with cassava mosaic virus (CMV), taking into account age and diurnal variations. Reduced photosynthesis in diseased plants was traced to severe chlorosis resulting from chlorophyll deficiency and the poor development of chloroplasts; the increased chlorophyllase activity would partly account for the destruction of chlorophyll. CMV-infected cassava synthesized lesser quantities of carbohydrates at all ages and times of sampling, resulting in less invert sugar, reducing sugar, nonfermentable reducing substances and starch. Diseased plants also had less starch in tubers In diseased plants, amylase activity was higher, reaching a peak at 2 p m.; this might contribute to the accumulation of sucrose observed at night. *(Summary by T.M.)* E04 C03

0340-6912 COSTA, A. S **Inactivation of viruses and mycoplasma in cassava cuttings by heat treatments.** *In* Cooperative project between the Centro Internacional de Agricultura Tropical (CIAT) and the Instituto Agronômico (IA), Campinas, Brasil. Palmira, Colombia, Centro Internacional de Agricultura Tropical, 1975. pp.34-52 Engl., Sum. Engl.

Cassava. Cassava programs. Disease control. Viroses. Mycoplasmoses. Cuttings. Colombia. Brazil.

Cassava witches'-broom mycoplasma was eliminated from diseased cuttings by heat treatment. Immersion of diseased cassava cuttings in a water bath heated at 50°C for ½ h was effective in some cases but more so after 1 h. Storage of mycoplasma-diseased cuttings in a hot air oven at 38°C for 1 and 3 wk inactived the pathogen in the infected tissues Shorter periods of treatment were not tried. There were indications that the cassava witches'-broom mycoplasma can be inactivated in diseased tissues by extremely short heat treatments with microwaves, but the results need confirmation. The cassava common mosaic virus was not inactivated when cuttings were heat treated for 1 h in a water bath held at 50°C nor at 45°C for 2 h. Similar negative results were obtained in tests with CMV-infected cuttings stores in a hot air oven at 38°C for 3 wk, the maximum time for viable cuttings at this temperature. The cassava vein mosaic virus was not inactivated in diseased cuttings treated for 1 h in a water bath held at 50°C nor for 2 h at 45°C. Infected cuttings treated in a microwave oven for periods up to 20 sec showed symptoms of the disease in all cases when sprouting occurred. *(Author's summary)* E04 E05.

0341-1762 COSTA, A.S. **Moléstias de virus e de micoplasma da mandioca em São Paulo - Riscos na introdução de material do exterior.** *(Viral and mycoplasmatic diseases of cassava in São Paulo; risks of introducing material from abroad).* Agronômico 23:125-128. 1971. Port.

Cassava. Cassava common mosaic virus. Cassava vein mosaic virus. Mycoplasmoses. Disease control. Propagation materials. Cassava programs. Brazil.

The economic importance and control of cassava mosaic, vein mosaic and witches'-broom in São Paulo, Brazil, are briefly discussed In general terms, these diseases are of minor economic importance and can be controlled easily by using healthy planting material. When introducing new materials in the germplasm collection, the following aspects should be taken into account: (1) introduce only materials that meet the objectives of the collection, (2) select and test the material in its country of origin prior to its introduction, (3) apply quarantine restrictions to imported material, (4) give preference to the introduction of seeds and flowers, (5) observe the germplasm bank of vegetative material continually since it can become contaminated easily, and (6) locate the propagation fields far from the experimental stations *(Summary by A.J. Trans. by S.S. de S.)* E04 E05

0342-3063 DADE, H. A. **Cassava mosaic.** *In* Accra, Gold Coast. Department of Agriculture. Yearbook 1930. Accra, 1931? pp.245-147. Engl.

Cassava. Cassava mosaic virus. Resistance. Cultivars. Selection. Ghana.

An evaluation was made of 18 varieties of *Manihot apii* grown in the Gold Coast (Ghana) in order to determine their degree of susceptibility to cassava mosaic and to select resistant or immune materials. This disease is beginning to spread throughout the Gold Coast and will affect cassava, which is one of the country's staple foods. Only 2 varieties (Calabar II and Bankye Sareso) were found to be resistant and appeared to be immune. However, both of them present limitations Calabar II has a long vegetative period (2 yr) and Bankye Sareso (13 mo) causes gastric disturbances and is preferred for starch manufacturing. Although these materials are not the most suitable, they do provide a good source of resistance from which short-period varieties with good cooking qualities can be obtained by means of crossing and selection The introduction of varieties from other countries for their evaluation and selection under local conditions is recommended. *(Summary by A.J. Trans. by S.S. de S.)* E04 G01

0343-0530 GOLATO, C. **Virosi della manioca in Ghana.** *(Viruses of cassava in Ghana).* Rivista di Agricoltura Subtropicale e Tropicale 65(7-9):281-286. 1971. Ital., 6 Refs., Illus.

Cassava. Cassava mosaic virus. Cassava brown streak virus. *Bemisia.* Vectors. *Manihot esculenta.* Resistance. Ghana.

Two forms of virus infection (and a 3rd resembling a mycosis) were observed in the Ashanti region of Ghana on plants of *Manihot utilissima* and *M. glaziovii.* The mosaic form induces discoloration and morphological changes; symptoms vary with the vegetative stage and ecological conditions. The infection usually starts from the leaf stem and develops into large yellowish necrotic blotches, the leaves continuing to develop asymmetrically. Relatively low temperatures favor virulence. The damage can result in an up to 50% reduction of primary and secondary starch yield. Control consists of destroying infected plants and cultivating resistant strains. Bitter varieties are generally more resistant than sweet varieties; also crosses between *M. utilissima* and *M. glaziovii* are more resistant. Brown streak, another form of virosis on cassava, is manifested by dark gray streaks near the leaf stem, leaf distortion in adult plants and bud decay. Brown streak is associated with the virosis, infests the same plant species and spreads the same way (*Summary by Biological Abstracts*) E04

0344-7463 KARTHA, K. K. and GAMBORG, O. L. **Elimination of cassava mosaic disease by meristem culture.** Phytopathology 65(7):826-828. 1975. Engl., Sum. Engl , 13 Refs., Illus

Cassava. *Manihot esculenta* **Cassava mosaic virus. Disease control. Apical meristems. Laboratory experiments.**

The cassava mosaic agent was eliminated from 2 cultivars of Indian and Nigerian origin by culturing shoot apical meristems on a Murashige and Skoog medium supplemented with benzyladenine (5×10^{-7}M), naphthaleneacetic acid (10^{-6}M) and gibberellic acid (GA_3 10^{-7}M) Plant regeneration averaged 90-95%, and 60% of the regenerated plants were mosaic symptom free when explants of up to 0 4 mm in length were cultured. Growing diseased cuttings at 35°C for 30 days resulted in the production of plants without symptoms; from such plants, meristem tips of up to 0.8 mm were cultured and mosaic disease-free plants regenerated. Results of graft transmission experiments demonstrated the absence of the causal agent in the plants regenerated by meristem culture technique. *(Author's summary)* E04

0345-5299 KARTHA, K. K. and GAMBORG, O. L. **Potential value of a tissue culture technique for producing mosaic symptom-free cassava plants.** *In* Nestel, B. and MacIntyre, R, eds. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp. 45-50. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. Tissue culture. Growth-chambers experiments. Plant development. Virus transmission. Cassava mosaic virus. Disease control.

A procedure has been developed for regenerating complete plants from shoot apical meristems of cassava. The method was used to obtain symptom-free plants from cuttings infected with the cassava mosaic disease of Indian and Nigerian origin. Meristem tips cultured on a mineral salt-sucrose-vitamin medium, supplemented with a 5×10^{-7} M benzyladenine, 10^{-6} M naphthaleneacetic acid, 10^{-7} M gibberellic acid (GA_3), regenerated complete plants within 26 days. More than 90% of the meristem tips developed into complete plants, 60% of which were free of mosaic symptoms. In diseased cuttings grown under a higher temperature (35°C) for 30 days (16 h/day at 4000 lux light intensity and 70% RH), the mosaic symptoms completely disappeared. Symptoms reappeared when plants were transferred to a lower temperature (21°C). All plants regenerated from meristems of symptom-free cassava were healthy. Graft transmission carried out monthly confirmed the absence of symptoms of the causative agent in the plants regenerated by tissue culture techniques. (*Author's summary*) E04 C03

0346-3103 KOHLER, E. **Die Kräuselkrankeiten des Maniok (Kassave).** *(Cassava mosaic). In* Soraver's Handbuch der Pflanzen-krankheit I(2) 449-500. 1934. Germ , 10 Refs., Illus.

Cassava. Cassava mosaic virus. Leaves. Disease control. Africa.

A description is given of the symptoms of cassava mosaic (wilting of plants and whitish and yellowish spots on the leaves), a viral disease identified in East Africa. It is infectious, but its transmissibility through grafts and sap has not yet been proved. Its vector is unknown. The disease has spread from East to West Africa. The control measures recommended are to eradicate and burn all diseased plants, to use cuttings from healthy plants only, and to avoid the use of material from infected fields. *(Summary by H.P. Trans. by S.S de S)* E04

0347-6749 LOZANO, J. C. **Inactivation of pathogenic organisms of cassava** *(Manihot esculenta* **Crantz) by heat and other treatments.** *In* Cooperative project between the Centro Internacional de Agricultura Tropical (CIAT) and the Instituto Agronômico (IA), Campinas, Brasil. Palmira, Colombia, Centro Internacional de Agricultura Tropical, 1975. pp.1-33. Engl., 20 Refs., Illus

Cassava. *Manihot esculenta.* **Cassava programs. Disease control. Cassava bacterial blight. Mycoses. Cuttings. Colombia. Brazil.**

CIAT's contribution to this joint research program was (1) to develop a technique for the production of bacteria-free planting stocks of cassava and (2) to study the effect of physical therapeutic agents on vegetative material used for propagation. The propagation technique developed to produce CBB-free cuttings is described. Guidelines are given for eradicating CBB from infected plantations. Hot water, microwave and ultraviolet light treatments of cuttings were evaluated It was found that hot water or microwaves can seriously reduce germination of cuttings, whereas UV light for 7 h had no effect on germination. The optimum hot water treatment for cuttings was 52ºC/30 min; the optimum microwave treatment, 75-90 sec of exposure. CBB, a vascular pathogen, was not controlled by these treatments. Its inactivatory or inhibitory point, when associated with its host, is higher than the optimum point of sensitivity of the cuttings to these treatments. *Botryodiplodia* sp , *Glomerella* sp and the causal agent of the superelongation disease (a lower ascomycete) were controlled by hot water or microwave treatments only in the case of early infection. UV light exposure did not control these pathogens. Since green cuttings are very sensitive to hot water and microwaves, these treatments are unsuitable for this type of cutting. *(Summary by T.M.)* E04 E03

0348-3651 LOZANO, J. C **Status of virus and mycoplasma-like diseases of cassava.** *In* Cassava mosaic workshop, Ibadan, Nigeria, 1972 Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture, 1972. pp 2-12. Engl., 21 Refs.

Cassava. Cassava common mosaic virus. Cassava mosaic virus. Mosaic diseases. Cassava brown streak virus. Cassava vein mosaic virus. Cassava superelongation. Mycoplasmoses.

Because of the present importance of cassava and the limited knowledge on diseases of the same, a detailed analysis is made of those caused by viruses and micoplasma. The aspects dealt with are distribution, symptoms, economic losses, form of transmission, hosts, survival of the causal agent, properties of particles and control for the following diseases: cassava common mosaic virus, cassava mosaic in Africa and Asia, cassava brown streak, cassava vein mosaic, cassava latent virus, witches'-broom and superelongation. Data are summarized in a table. *(Summary by L.F.C. Trans. by T.M.)* E04

0349-6988 TASCON, A., KITAJIMA, E. W. and COSTA, A. S. **Microscopia electrônica do virus do mosaico comum da mandioca nos tecidos foliares de diferentes plantas hospedeiras.** *(Electron microscopy of the cassava common mosaic virus in tissues of different host plant species).* Bragantia 34: V-X. 1975. Port., Sum. Engl., 12 Refs., Illus.

Cassava. Cassava common mosaic virus. Virus transmission. Plant tissues. Laboratory experiments. Brazil.

Cassava common mosaic virus (CCMV), an elongated virus placed in the morphological group of the potato virus X, infects several other plant species besides cassava under experimental conditions. Electron microscopic observations were made of thin leaf tissue sections from a symptomless host *(Euphorbia prunifolia)* and local-lesion hosts *(Chenopodium quinoa, C. amaranticolor, Malva parviflora* and *Datura stramonium).* Loose aggregates of filamentous particles of varied size and shape were consistently found in the cytoplasm of most paranchymatous and epidermal cells. These findings are consistent with those previously described in CCMV-infected cassava leaf tissues and stress the view that the elongated particles of the fibrous inclusion represent CCMV in situ *(Author's summary)* E04

0350-6811 TERRY, E. R. **Description and evaluation of cassava mosaic disease in Africa.** *In* Terry, E.R. and Mac Intyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976. pp. 53-54. Engl., Illus.

Cassava. Mosaic diseases. Identification. Africa.

A description is given of the symptoms of cassava mosaic on the basis of a tentative rating scale used to evaluate the severity of the disease and plant reaction. The scale consists of 5 classes: class 1 shows no symptoms and is considered as representative of field resistance, whereas class 5 exhibits the most severe mosaic symptoms. These 5 degrees are illustrated by means of photographs. (*Summary by A.J. Trans. by S.S. de S.*) E04

See also 0415

E05 Mycoplasmal Diseases

0351-5029 KITAJIMA, E. W., NORMANHA, E.S. and COSTA, A. S. **Corpúsculos do tipo micoplasma associados a uma forma de superbrotamento da mandioca, na região de Tapachula, Chiapas, México.** *(Mycoplasm-like bodies associated with a form of witches'-broom disease in the region of Tapachula, Chiapas, Mexico).* Ciência e Cultura (Brazil) 24(9).852-854. 1972. Port., Sum. Engl., Port , 6 refs , Illus.

Cassava. Etiology. Laboratory experiments. Leaves. Mycoplasmoses. *Manihot esculenta.* **Mexico.**

A disease causing serious problems in southern Mexico, where cassava *(Manihot esculenta* Crantz) is grown on a commercial scale, was suspected to be a form of witches'-broom To establish its etiology, samples of leaves were collected from affected plants. As the material was to be examined in the electron microscope at Campinas (Brazil), tissues were fixed on site to avoid introducing material in vivo. Pleomorphic, mycoplasma-like bodies were found consistently in the sieve tubes of all samples examined, therefore, indications are that witches'-broom is associated with an infection of mycoplasma-like organisms, as has already been established in the two forms of the disease found in Brazil. If this be the case, it is the first one of mycoplasmic etiology outside Brazil. *(Summary by T.M)* E05

0352-3054 SCHMIDT, C. B. **Superbrotamento ou envassouramento da mandioca.** *(Witches'-broom disease of cassava)* Notas Agrícolas (Brazil) 7:99-101. 1949. Port.

Cassava. Mycoplasmoses. Disease control. Brazil.

This disease causes problems in cassava plantations in some states of Brazil. Plants attacked by witches'-broom disease have low-quality roots, are poor in starch and watery, which makes them undesirable for consumption and industrial uses. The studies carried out indicate that the disease is caused by a highly infectious virus. Plants may acquire the disease at any age, roots of attacked plants are abundant, thin and intertwined. The plants are dwarfed and there is heavy budding. There may be one or more shoots per bud; these are thin, weak and from 20 to 30 cm long. There are usually many deformed, yellowed leaves; branches form bunches, giving the appearance of a broom. There is an excess of water in the stem pith. Roots are fragile and decompose easily. Measures to prevent its dissemination are indicated *(Summary by A.B. Trans. by T.M.)* E05

See also 0340 0341

E06 Nematodes

0353-3119 GUIRAN, G DE **Nématodes associés au manioc dans le sud du Togo.** *(Nematodes associated with cassava in southern Togo). In* Congres de la Protection des Cultures Tropicales, Marseille, 1965 Comptes rendus. n i. pp.677-680. Fr.

Cassava. Nematodes. Cultivars. Resistance. Productivity. Togo.

Data on the degree of dissemination and populations of *Pratylenchus brachyurus* and *Helicotylenchus* cf. *erythrinae* are given in tables for 3 different zones. Susceptibility of some cassava varieties to the former nematode was also evaluated. *(Summary by R.T. Trans. by T.M.)* E06

0354-1657 MERNY, G. **Les nematodes phytoparasites associés à quelques plantes à tubercules de l'Ouest Africain.** *(Phytoparasitic nematodes of certain tubers from West Africa).* Dakar, Senegal. Office de la Recherche Scientifique e Technique Outre Mer, 1971. 8p. Fr.

Paper presented at the Seminaire Ford-IRAT-IAAT sur les Plantes à Racines et à Tubercules, Ibadan, Nigeria, 1971.

Cassava. Nematodes. Africa.

Reference is made to yam cassava and sweet potato parasitic nematodes. Yam and cassava nematodes are almost the same, cassava is attacked by species of *Meloidogyne, Pratylenchus* and *Scutellonema bradys. Pratylenchus brachyrus* and *Halicotylenchus* spp are frequently found in southern Togo. The best control system is to develop resistant varieties and to eliminate nematodes present in planting material and in the soil. To control soil nematodes with insecticides is too expensive; therefore, rotation with crops that are not hosts is recommended. *(Summary by S.S de S.)* E06

F00 PEST CONTROL AND ENTOMOLOGY

0355-1975 ALDRICH, J. M. **A new genus and species of two-winged flies of the family Chloropidae injuring *Manihot* in Brazil.** Proceedings of the United States National Museum 65:1-2. 1924. Engl.

Cassava. *Manihot esculenta. Teleocoma crassipes.* Entomology. Brazil.

The Biological Institute for Agricultural Defense in Rio de Janeiro sent a sample of a fly to the US Bureau of Entomology, which identified it as *Teleocoma crassipes* (new genus and species). A detailed taxonomic description is given of both the genus and species (including male and female characteristics). (*Summary by L.F.C. Trans. by S. S. de S.*) F00

0356-5934 BREUNING, S and TEOCCHI, P. **Note sur *Ceroplesis quinquefasciata* T., laminaire dont la larve evolue dans les tiges de manioc en Afrique Centrale (Coleoptera Cerambycidae Lamiinae).** *(Ceroplesis quinquefasciata, a pest of cassava in central Africa).* Bulletin de la Société Linnéenne de Lyon 44(1/2):27-32,39-43 1975 Fr., Sum. Fr., 37 Refs., Illus

Cassava. Injurious insects. Entomology. Africa.

A list is given of insects belonging to the family Cerambycidae, whose larvae feed on cassava in central Africa. The origin, synonymy and description of the adult and larva of *Ceroplesis quinquefasciata* are given. Host plants and dates of emergence of adults are indicated as well. *(Author's summary Trans. by S.S. de S.)* F00

0357-1733 CHARMOY, D. D. and GEBERT, S. **Insect pests of various minor crops and fruit trees in Mauritius.** Bulletin of Entomological Research 12(2):181-190. 1921. Engl.

Cassava. Injurious insects. Entomology. Africa.

Among the numerous minor crops grown in Mauritius, cassava is a very important foodstuff which gives good yields and is not attacked by pests. Occasional pests in some regions are *Lachnosterna* (Phytalus) *smithi* and *Saissetia hemisphaerica,* a minor pest of cassava leaves *Chionaspis* spp. attacks stems frequently. *(Summary by L.C. Trans. by S.S. de S.)* F00

0358-1830 CORBETT, G. H. **On new Aleurodidae (Hem.).** Annals and Magazine of Natural History (Series 10) 16:240-252. 1935 Engl., Illus

Cassava. Entomology. *Bemisia.* Nigeria.

Bemisia nigeriensis is one of the vectors of the cassava mosaic virus in Nigeria A detailed biological description is given of the different genera of the family Aleurodidae, to which *Bemisia* belongs. (*Summary by H.P. Trans. by T.M.*) F00

0359-1735 HARRIS, W.V. **Annotated list of insects injurious to native food crops in Tanganyika.** Bulletin of Entomological Research 28:483-488. 1937. Engl.

Cassava. ***Manihot esculenta.*** **Injurious insects. Entomology. Tanzania.**

A list is presented of the main pests attacking native and introduced crops in Tanganyika. With few exceptions, their identification has been made by the Imperial Institute of Entomology. As for cassava, the main pests in this region are *Zonocerus elegans* Thnbg. (Acrididae), *Bemisia* sp. (Aleurodidae), *Ferrisia virgata* Ckll. (Coccidae), *Lepidosaphes dispar* Vayss. (Coccidae) and *Opogona chlorophanes* Meyr. (Lyonetiidae). The importance of developing pest control methods such as crop rotation, weed control, use of resistant varieties, etc. is discussed. *(Summary by A.J. Trans. by S.S. de S.)* F00

0360-4613 KORYTKOWSKI G., C. and OJEDA P., D. **Especies del género *Anastrepha* Schiner 1868 en el nor-oeste peruano.** *(Species of the genus Anastrepha Schiner 1868 in northwestern Peru)* Revista Peruana de Entomología 11(1).32-70. 1968. Span., Sum. Span., Engl., 18 Refs., Illus.

Cassava. *Manihot esculenta. Anastrepha pickeli.* **Entomology. Peru.**

This paper is a study of the genus Anastrepha Schiner 1868, over an ample area in northwestern Peru, comprising the states of Tumbes, Piura, Lambayeque, La Libertad, Cajamarca and Amazonas. Of 35 species studied, 21 constitute first records for Peru and 2 are new to science. The species recorded prior to this study are *A. fraterculus, A. distans, A. distincta, A. inca, A. chiclayae, A. striata, A. serpentina, A. lambda, A. nigripalpus, A. cryptostrepha, A. grandis* and *A. shannoni*. Species recorded for the first time in Peru are *A. rheediae, A. pseudoparallela, A. lanceola, A. bistrigata, A. ballou, A. suspensa, A. dissimilis, A. lathana, A. turicai, A. zuelaniae, A. turpiniae, A. mombinpraeoptans, A. antunesi, A. perdita, A. barbiellinii, A. bahiensis, A. extensa, A. correntina, A. manihoti, A. pickeli* and *A. triangulata*. The 2 new species are *A. barandiaranae* and *A. lambayecae*. The former is described from male and female specimens; the second, from a single male specimen that is closely related to the male of *A. fraterculus*. An extensive study is made of the ligula of the claspers. There are drawings to illustrate each species fully. *(Author's summary)* F00

0361-4565 MARSHALL, G. A. K. **On new Curculionidae from Brazil (Coleoptera).** Annals and Magazine of Natural History 15(86).282-296. 1923. Engl.

Cassava. Injurious insects. Entomology. Brazil.

A morphological description is given of new species of Curculionidae identified in Brazil, their host plants and locality where they were collected. *Coelosternus manihoti* (subfamily Cryptorrhynchinae), a cassava *(Manihot esculenta)* stemborer collected in the state of Bahia, is among the insects described. *(Summary by A.J. Trans. by S.S. de S.)* F00

0362-1734 NEWSTEAD, R. **Observations on scale-insects (Coccidae)-V.** Bulletin of Entomological Research 8(2):125-134. 1917. Engl.

Cassava. ***Manihot esculenta.*** **Ceará rubber. Injurious insects. Entomology.**

Pseudococcus viragatus Ckll. was recorded on cassava *(Manihot esculenta)* and *Aspidiotus destructor* Mask. on Ceará rubber *(Manihot glaziovii)*. *(Summary by L.C. Trans. by T.M.)* F00

0363-7266 TOYE, S. A. **Feeding and locomotory activities of *Zonocerus variegatus* (L.) (Orthoptera, Acridoidea).** Revue de Zoologie et de Botanique Africaines 88(1) 205-212. 1974 Engl, Sum. Engl, 13 Refs., Illus.

Cassava. Injurious insects. Entomology. Nigeria.

Field observations have shown that the 1st, 2nd and 3rd instar larvae of *Zonocerus variegatus* feed almost exclusively on weeds, notably *Eupatorium odoratum, Aspilia latifolia, Ageratum conyzoides* and *Lantana camara*. It is suggested that the recent widespread occurrence of *Eupatorium* in many parts of southern Nigeria (in particular Western State) probably accounts for the increasing abundance of *Z. variegatus*. The 4th, 5th and 6th instars and the adults are responsible for the considerable damage usually done to economic crops such as cassava, citrus and banana or plantain. Spontaneous flight by *Z. variegatus* adults was rare in the field; but during bright sunshine and high temperatures, about 40-50% of a large population of mature adults flew over short distances when disturbed Aktograph experiments have shown that the patterns of locomotory activity of the 6th instar larvae were essentially similar to those of the adults, although the total period of activity of the larvae was longer than that of the adults. In both larvae and adults, activity occurred only during 07.00-19.00 h with a peak during 14 00 - 16.00 h Constant artificial illumination (approx. 630 lux) and temperature (30°C) destroyed the normal rhythm of activity of the adults. *(Author's summary)* F00

0364-5348 VILLAMIZAR M, R. **Ciclo biológico y morfología de *Vatiga (Leptopharsa) manihotae* (Drake) (Hemiptera: Tingitidae), chinche de encaje en yuca (*Manihot esculenta* Crantz).** (*The biological cycle and the morphology of Vatiga manihotae, the cassava lace bug*) Tesis Ing. Agr. Palmira, Universidad Nacional de Colombia, Facultad de Ciencias Agropecuarias, 1974. 40p. Span, Sum. Span, 8 Refs., Illus.

Cassava. *Manihot esculenta. Vatiga manihotae.* Entomology. Colombia.

An insect, identified as *Vatiga* (Leptopharsa) *manihotae* (Drake) (Hemiptera Tingidae), was reported attacking cassava in the Valle del Cauca (Colombia). The members of the family Tingidae are characterized by differences in expansion of the prothorax and the reticulated wings, which resemble lace. Lace bugs—adults, but especially nymphs—are found in large quantities on the undersides of leaves, sucking the sap and causing early defoliation, which reduces crop yields. The duration of the different instars are embryo, 8 07 days; nymph, 16.57 days; male adult, 49.61 days, and female adult, 52.06 days. Females prefer to oviposit on leaves located in the middle part of the plant and sometimes on lower leaves, but never on top leaves. These data apply to the ecological conditions of the Valle del Cauca and, in particular, to the Centro Internacional de Agricultura Tropical. (*Author's summary. Trans. by S. S. de S*) F00

0365-5360 WILLIAMS, C B. **Plant diseases and pests; notes on some Trinidad thrips of economic importance.** Trinidad and Tobago, Bulletin 17(3):143-146. 1918. Engl, Illus.

Cassava. Thrips. Entomology. Trinidad and Tobago.

This is a detailed and illustrated description of the different species of thrips that attack plants in Trinidad, *Corynothrips stenopterus* being the only one attacking cassava Their anatomical characteristics, habits, place of origin, kind of damage and part of the plant affected are given *(Summary by L.F.C. Trans. by S.S. de S)* F00

F01 Injurious Insects and their Control

0366-6918 BELLOTTI, A., SCHOONHOVEN, A.V. AND PEÑA, J. **Insectos que atacan la yuca.** *(Cassava pests)* *In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp. 45-60. Span.

Cassava. Injurious insects. Injurious mites. Thrips. *Erinnyis ello. Silba pendula.* Insect control. Mite control. Entomology. Colombia.

A description is given of the main pests that attack cassava in Colombia, their biological characteristics, type of damage and control methods. The main pests are species of thrips such as *Frankliniella williamsi, Corynothrips stenopterus* and *Caliothrips masculinus;* mite species such as *Mononychellus mcgregori, M. tanajoa, Tetranychus urticae* and *Oligonychus peruvianus*; and *Erinnyis ello* larvae. Mites are biologically controlled by species of the families Phytoseiidae (mites), Coccinelidae and Staphilinidae, and *E ello* by *Trichogramma fasciatum* and *Polistes canadensis.* Other pests that can cause serious damage in highly infested fields are *Silba pendula, Anastrepha pickeli, A. manihoti*, white grubs, *Agrotis ipsilon, Saissetia miranda, Hemiberlessia diffinis, Aonidomytilus albus, Aleurotrachelus* sp., *Bemisia tuberculata, B. tabaci* and *Trialeurodes variabilis. Vatiga manihotae, Latrophobia* sp., termites, ants and grasshoppers are of minor economic importance. (*Summary by A.J. Trans. by S.S. de S.*) F01

0367-1725 BLANCHE, D. **La fourmi-manioc.** *(The cassava ant)* Phytoma 12(123):7-15. 1960 Fr., 16 Refs., Illus.

Cassava. Entomology. Injurious insects. Insect control. Guyana.

A complete entomological study of the cassava ant (*Atta* spp. and *Acromyrmex* spp.) and damages caused by it are presented. The traditional systems used for eliminating it and present control measures, which include mechanical, physical and chemical systems, are discussed. *(Summary by S S de S.)* F01

0368-0571 BONDAR, G **A cochenilha "Saissetia oleae, Bern".** *(The black scale insect Saissetia oleae Bern.).* Correio Agricola 2:142-143. 1924 Port.

Cassava. Injurious insects. Entomology. Brazil.

The female of the insect *Saissetia oleae* Bern. looks like a soft ball, 2-3 mm in diameter. Its color varies from greenish brown to bronze. It is found on the stems and leaf petioles, sucking the sap, and can cause total crop loss. Planting healthy cuttings is recommended as a control measure *(Summary by P.G. Trans. by S.S. de S.)* F01

0369-4563 BRETONI, A. DE W. **Sobre el marandová de la mandioca** *(Erinnyis ello* L.) [*The cassava hornworm (Erinnyis ello L.)*] Revista de la Sociedad Científica del Paraguay 1(6):91. 1924. Span.

Cassava. *Erinnyis ello.* **Entomology. Biological control. Insecticides. Paraguay.**

A morphological description and the habits of the cassava hornworm *(Erinnyis ello)*, a sporadic pest of cassava in Paraguay, are presented. Biological control is obtained through *Amphiochaeta angulada* Bréth., which parasitizes the pupae of this insects, and several species of birds that consume the larval instar. Some methods of chemical control are also included. *(Summary by A.J. Trans. by S.S. de S.)* F01

0370-5738 BRINHOLI, O. *et al.* **Estudo do comportamento de alguns "cultivares" da mandioca ao ataque da broca-dos-brotos (*Silba pendula*).** (*Evaluation of some cassava cultivars for resistance to the shoot fly, Silba pendula*) Revista de Agricultura 49(4) 181-183. 1974. Port., Sum. Engl., 5 Refs.

Cassava. *Silba pendula* **Cultivars. Resistance. Field experiments. Brazil.**

Trials were conducted with 10 varieties in São Paulo to evaluate their resistance to the shoot fly The most resistant were 1418 IAC and Ouro do Vale, with 7 8 and 21.2% damaged branches, respectively. Highly susceptible varieties had 100% damage (*Summary by T.M.*) F01

0371-4559 CARRASCO Z., F. **La hormiga "Cuquí"** *Atta sexdens fuscata* **Santschi (Formicidae), grave problema entomológico para los cultivos tropicales.** [*The leaf-cutter ant, Atta sexdens fuscata Santschi (Formicidae), a serious entomological problem of tropical crops*]. Revista Peruana de Entomología Agrícola 5(1):94-97. 1962 Span., 14 Refs.

Cassava. Injurious insects. Insect control. Peru.

In view of the importance of the leaf-cutter and infestation in the Valle de la Convención (Peru), a survey was conducted in this region. A list of the different crops attacked by this ant is included; cassava, which is one of them, can be totally destroyed When cassava and cacao (which is also susceptible) are intercropped, the ant prefers cassava; therefore, this method is used to protect cacao plantations. Control measures have not been effective because most of the farmers are small landholders who do not have the resources and knowledge necessary to prevent a reinfestation. The possibility of controlling this pest biologically is discussed and the practices used in the region (plugging of ant hills, boiling water, red-hot coal or wood, chemical products, etc.) are described. *(Summary by A.J. Trans. by S.S. de S.)* F01

0372-7045 COSTA, J.M DA. **O "tanajoá" da mandioca.** *(The "tanajoá" disease of cassava)* *In* Projeto mandioca. Cruz das Almas, Brasil. Convênio U.F. Ba/BRASCAN Nordeste. Série Pesquisa v.2, no. 1. 1975. pp. 15-19. Port., Sum. Port., Engl, 10 Refs., Illus.

Cassava. *Mononychellus tanajoa.* **Entomology. Mite control. Insecticides. Acaricides. Brazil.**

Symptoms of mite damage on cassava leaves are reported in this paper. The importance of the effects of this pest on plant growth and yield has been known for a long time, and the Indian name "tanajoá" is still used to describe the disease. Two mites are described. *Mononychus tanajoa* (Bondar, 1938) and *Tetranychus cinnabarinus* (Boisduval, 1867). This is the 1st time in Brazil that the latter has been observed on cassava plants. Chemical control with Zolone (100% efficient), Rhodiatox (97%) and Diazinon (97.4%) is recommended. *(Author's summary)* F01

0373-3483 DEVEZ, G. **Le fourmi-manioc** *(Oecodoma cephalotes). (The cassava ant, Oecodoma cephalotes).* Agronomie Coloniale 1:129-135; 164-174. 1913; 2:42-51. 1914. Fr., Illus.

Cassava. Injurious insects. Entomology. Insect control. Insecticides. French Guiana.

Agriculture was the first economic activity in French Guiana up to 1853;since then it has declined, partly because of the gold fever but mostly because of cassava ants that destroyed the crops. In addition to general considerations on the country's agriculture, the 1st part of this article describes the natural habitat of these ants in several regions of the world, the different names they are given, and the socioeconomic problems they cause The 2nd part focuses on the biological description of *Oecodoma cephalotes* (male, female, worker and soldier ants), its reproductive system, habits and methods of attacking crops. The 3rd part analyzes methods of control. Among the systems used with very little success up to now have been flooding, boiling water and oil, petroleum, molasses, fish oil, chloroform, P, copper sulfate, mercury, etc. In 1872, carbon disulfide was used for the first time in French Guiana with excellent results; however, since it is very inflammable, it can be applied only in rainy seasons: Trials carried out at the beginning of this century led to the adoption of liquid sulfur dioxide by decree of the Department of Agriculture in 1913. The product is sold in containers with a special device, making it possible to use it in gaseous or liquid form. The product is injected at a depth of 20-25 cm through all the openings of the ant hill. If destruction is not total, the treatment must be repeated. Sulfur dioxide is superior to carbon disulfide because it is not so inflammable and can be applied at any time of the year. The quantity of product required is much lower, it is not toxic to nearby plants, and the difference in price is insignificant. *(Summary by S.S. de S.)*

0374-4780 FENNAH, R. G **The insect pests of food-crops in the Lesser Antilles.** Grenada, British West Indies, Department of Agriculture for the Windward Island, 1947. 24p. Engl., Illus.

Cassava. Entomology. Injurious insects. Injurious mites. Insect control. Mite control. Caribbean.

A detailed description is given of the biological cycle of the different insects, type of damage caused, distribution, host plants, and chemical and biological control (parasites). As regards cassava, the principal pests in this zone are *Nezara viridula, Leptopharsa illudens, Pseudococcus citri, Saissetia hemisphaerica, Ceroplastes cirripediformis, Pseudaulacaspis pentagona, Lepidosaphes alba, Corynothrips stenopterus, Frankliniella melanommata Cryptocephalus tristiculus, Lagochirus araneiformis, Ecyrus hirtipes, Diaprepes oabbreviatus, Coelosternus* spp *Erinnyis ello, Latrophobia brasiliensis, Lonchaea chalybea, Tetranychus* sp. Drawings illustrate the morphological characteristics that help to recognize these pests more easily. *(Summary by L.F.C. Trans. by T.M.)* F01

0375-5757 KOBER, E. **Lagarta da mandioca.** *(The cassava hornworm).* Granja (Brazil) 12(106):52-54. 1956. Port., Sum. Port., Illus.

Cassava. *Erinnyis ello.* **Entomology. Insect control. Insecticides. Brazil.**

This is a detailed description of the cassava hornworm *(Erinnyis ello)* including host plants, seasons in which it appears, type of damage, biological cycle and ways to identify it in the field Pesticides such as toxaphene and isodrin are recommended to control this insect. In addition, some recommendations are made on pesticide handling and application. *(Summary by L.F.C Trans. by S.S. de S.)* F01

0376-6810 LEUSCHNER, K. **Major pests of cassava in Africa and preliminary guidelines for screening of resistance.** *In* Terry, E.R. and Mac Intyre, R , eds The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976. pp.55-56 Engl

Cassava. ***Bemisia Tetranychus telarius Zonocerus variegatus.*** **Entomology. Resistance. Insect control. Mite control. Cultivars. Nigeria.**

This article presents general aspects and possible systems for rating the degree of resistance to *Bemisia tabaci, Zonocerus variegatus* and *Tetranychus telarius,* the main pests of cassava in Nigeria. Their distribution, damage, yield losses, biology, host range and control are discussed. Since *B tabaci* is the vector of mosaic disease, screening for resistance to this insect is of primary importance. A rating system ranging from 0-5 is presented for the other 2 pests. In the case of *Z. variegatus,* screening is difficult because of the high population and mobility of this insect, but it can be done early in the morning. (*Summary by A.J. Trans. by S. S. de S*) F01

0377-3074 LEVER, R. J. A. W. **Some insect pests of local economic plants.** British Solomon Island Protectorate. Agricultural Gazette 3(4).3-5. 1935. Engl , 3 Refs.

Cassava. Injurious insects. Insect control.

As regards cassava, the only pest recorded in the British Solomon Islands is the Coreid bug *Amblypelta gallegonis* Lever *(in litt.).* It may be controlled by a homemade spray mixture of hard soap and kerosene. *(Summary by T.M.)* F01

0378-4758 **A MANDAROVA, a pior praga da mandioca; aspectos biológicos, combate com dipterex pó 2.5% ou Folidol EM. 7.5% + 30% DDT.** *(The hornworm, the worst pest of cassava).* Correio Agro-Pecuário (Brazil) 4(2):18-19. 1964. Port., Illus.

Cassava. ***Erinnyis ello.*** **Entomology. Insect control. Insecticides. Brazil.**

The cassava hornworm *(Erinnyis ello)* and its biological cycle, as well as the parts of the plant which are first attacked, are described. The attack can occur at any time during the vegetative period, causing total loss in recently planted fields. Dipterex and Folidol EM + DDT give complete control. Photographs of the insect and the damage caused are included. *(Summary by L.F.C. Trans. by S.S. de S.)* F01

0379-1627 **MANDAROVA ATACA a mandioca.** *(The cassava hornworm)* Seleções Agricolas 19(216):91. 1964. Port.

Cassava. ***Erinnyis ello.*** **Insect control. Insecticides. Brazil.**

A brief description is given of the morphology and life cycle of the cassava hornworm, which is responsible for the total destruction of crops during its larval instar Sevin (7.5%) or endrin (1.5%) at a rate of 1 kg/100 kg of water are recommended for controlling this pest *(Summary by P.G Trans. by S.S de S.)* F01

0380-2995 MONTE, O. **Os insectos daninhos. XLII. Tingitideo da mandioca** ***Lepthofarsa manihotae*** **Drake).** *(Insect pests of cassava Tingidae. Lepthofarsa manihotae Drake).* Chacras e Quintaes 56:445-446. 1937. Port.

Cassava. *Vatiga manihotae.* **Injurious insects. Brazil.**

Erinnyis ello, Leptopharsa manihotae and *Corythaica planaris* are tingids that cause serious economic damage in Brazil. Their habits and the type of damage are described. To control these pests, crop rotation is recommended. *(Summary by S.S. de S.)* F01

0381-4750 NORMANHA, E S. **O mandarová da mandioca.** *(The cassava hornworm).* Campinas, Brasil, Instituto Agronômico, 1946. 3p. Port.

Cassava. *Erinnyis ello.* **Insect control. Insecticides. Entomology. Brazil.**

A brief description is given of the biological cycle of the cassava hornworm *(Erinnyis ello)* in relation to the duration of the larval instars and its morphological characteristics. This pest can be controlled (a) mechanically, which includes the manual removal of larvae or the construction of traps, and (b) chemically, using lead arsenate. The application of adhesive substances is recommended to prevent the insecticide from being washed off the leaves by rain. Hornworm damage also affects starch and flour production because the roots become watery, which makes the processing more difficult and costly and a lower quality product is obtained. In addition, this pest is considered as one of the possible vectors of cassava bacterial blight. *(Summary by L.F.C Trans. by S S. de S.)* F01

0382-6807 NYIIRA, Z.M **Advances in research on the economic significance of the green cassava mite (*Mononychellus tanajoa*) in Uganda.** *In* Terry, E R. and MacIntyre, R., eds The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975 Ottawa, Canada, International Development Research Centre, 1976. pp.27-29. Engl., 3 Refs

Cassava. *Mononychellus tanajoa.* **Entomology. Mite control. Insect agents. Acaricides. Tuber productivity. Uganda.**

This article deals with the research conducted on the mite *M. tanajoa,* which attacks cassava in Uganda. The aspects included are symptoms, hosts, natural enemies, life cycle, dissemination, favorable seasonal conditions, effects on yields and control methods. This mite is apparently restricted to *Manihot* spp. Its most common natural enemies include insect species of the genera *Oligota, Stethorus, Syrphus, Chrysopa, Thrips, Geocoris* and *Orius,* other predators mentioned are mites of the family Phytosiidae and spiders. Water, other insects and several vertebrates contribute to its dispersion. Mite populations are higher during the dry season. Yield losses of up to 40% of fresh root wt have been recorded. Effective measures against this mite should aim at an integrated control, utilizing early-maturing, resistant or tolerant varieties and a program of biological control. (*Summary by A J. Trans. by S. S. de S*) F01

0383-5732 QUIROS L., M. and PULGAR N.R. **Evaluación de cinco acaricidas comerciales en el combate del ácaro *Mononychellus caribbeanae* McGregor en yuca, *Manihot esculenta* Crantz.** *(Evaluation of five commercial acaricides used to control Mononychellus caribbeanae McGregor in cassava, Manihot esculenta Crantz).* Revista de la Facultad de Agronomía de la Universidad del Zulia (Venezuela) 2(4).65-71. 1974. Span., Sum. Span , Engl., 6 Refs.

Cassava. *Manihot esculenta.* **Injurious mites. Acaricides. Mite control. Venezuela.**

An experiment was carried out at the Universidad de Zulia to study the effectiveness of 4 commercial acaricides in controlling mites in cassava *(Manihot esculenta* Crantz)' The products used were Akar 338, Fundal 800, Galecron, Kelthane and Top Schering (wettable sulfur), a fungicide used occasionally to control mites in cassava. Mortality of mites indicated that all products effectively controlled mites up to 7 days after application. Effectiveness decreased noticeably 14 days after application, except for Galecron, which had almost the same percentage of mortality as compared to the 7th day. *(Author's summary. Trans. by T.M.)* F01

0384-7474 SCHOONHOVEN, A. VAN and PEÑA, J. E. **Estimation of yield losses in cassava following attack from thrips.** Journal of Economic Entomology 69(4):514-516. 1976. Engl., Sum. Engl., 3 Refs.

Cassava. *Manihot esculenta.* **Injurious insects. Thrips. Tuber productivity. Insecticides. Field experiments. Colombia.**

Yield losses in cassava (*Manihot esculenta* Crantz) from thrips (*Corynothrips stenopterus* Williams and *Frankliniella williamsi* Hood) were estimated by using the difference in yield increase following insecticidal application between thrips-resistant and thrips-susceptible cultivars. In the absence of a dry season, yield loss from thrips for susceptible cultivars was estimated at 8%. When exposed to a dry season, yield losses were 11 and 15.4% for intermediate-resistant and susceptible cultivars, respectively. Losses for susceptible cultivars, with and without insecticidal protection, were estimated at 17.2%; however, this may be an overestimate as other insects than thrips may have contributed to this yield loss. *(Author's summary)* F01

0385-3739 SILVEIRA, A. DA **Pragas da mandioca; a "primavera" (Lagarta da mandioca) (*Dilophonata ello*, Linneu).** *(The cassava hornworm)* Boletim da Agricultura 17.710-724. 1916. Port., Illus.

Cassava. *Erinnyis ello.* **Entomology. Insect control. Brazil.**

A description is given of the morphology, biology, damages and control of the cassava hornworm, *Erinnyis ello* L. (= *Dilophonata ello*). The larva (including the 5 instars) and chrysalid are described. Chemical control is recommended. *(Summary by A.J. Trans. by S.S. de S.)* F01

0386-3731 UTRA, G. DE **Praga dos mandiocais (*Dilophonata ello* Lin.).** [*A pest of cassava (Dilophonata ello Lin.)*]. Boletim Agricola (Brazil) 17:39-44 1916 Port.

Cassava. *Erinnyis ello.* **Insect control. Entomology. Brazil.**

A general description is given of the cassava hornworm *Erinnyis ello (=Dilophonota ello* Lin.). Control is suggested with arsenates, especially in the months of highest populations, from October to March. A brief description is given of adults, eggs, larval and pupal stages. *(Summary by A van S.)* F01

0387-3847 WALKER, P.T., WALLER, J.M. and EVANS, A.A.F. **The insect pests, plant diseases and nematodes of crops in Antigua.** London, Ministry of Overseas Development, 1974 40p. Engl., 64 Refs.

Cassava. Injurious insects. Injurious mites. Insect control. Mite control. Mycoses. Nematodes.

General information is given on the chemical control of insects, diseases and nematodes of 33 crops from Antigua and one from the Leeward Islands. The shoot fly *Lonchaea chalybea*, whose larvae bore into the young tips of shoots, is the most important pest of cassava. Other insects attacking this crop are *Erinnyis ello, Diaprepes abbreviatus, Lagochirus araneiformis, Aonidomytilus albus, Ceroplastes cirrepediformis, Pseudaulacaspis pentagona, P. tubercularis, Saissetia coffeae, Planoccoccus citri, Nezara viridula, Leptopharsa illudens, Corynethrips stenopterus, Frankliniella melanommata* and *Tetranychus* sp. Among the diseases, leaf spot caused by *Cercospora henningsii* was observed occasionally, *Colletotrichum* has also been collected. A heavy infestation of *Meloidogyne incognita* was found in the Christian Valley. *(Summary by P.G. Trans. by S.S. de S.)* F01-E01

0388-7035 WYNIGER, R Cassava-manioc (*Manihot utilissima*) *In* ——— Appendix to pests of crops in warm climates and their control. V. Control measures. 2nd. enl. and rev. ed. Basel, Verlag für Recht Gesellschaft, 1968. 162p. (Acta Tropica. Appendix to Supplementum 7) pp. 79-80. Engl.

Cassava. *Manihot esculenta. Leucopholis rorida. Coelosternus granicollis. Lagochirus obsoletus. Carpolonchaea chalybea. Aonidomytilus albus. Erinnyis ello. Scirtothrips manihoti. Tetranychus telarius.* **Injurious insects. Insect control. Insecticides. Mite control.**

A table showing several cassava pests and their control is presented. The species included are *Pratylenchus brachyrus, Leucopholis rorida, Coelosternus granicollis, Lagochirus obsoletus, Carpolonchaea chalybea, Aonidomytilus albus, Erinnyis ello, Zonocerus elegans, Scirtothrips manihoti, Corynothrips stenopterus, Erythroneura cassavae, Bemisia nigeriensis, Planococcus citri, Saissetia coffeae, Tetranychus urticae* and *Dasynus manihotis. (Summary by A.J. Trans. by S.S. de S.)* F01

0389-6857 WYNIGER, R. **Cassava (Manioc) (*Manihot utilissima* Pohl); most important pests.** *In* ———. Pests of crops in warm climates and their control. Basel, Switzerland, Verlag für Recht und Gesellschaft, 1962. (Acta Tropica. Supplementum 7) pp 199-204 Engl., Illus.

Cassava. *Manihot esculenta.* **Injurious insects.** Entomology.

The main pests attacking cassava, the damage they cause and their distribution in the world are given briefly. The pests mentioned are *Pratylenchus brachyrus, Leucopholis rorida, Coelosternus granicollis, Lagochirus obsoletus, Carpolonchaea chalybea, Aonidomytilus albus, Erinnyis ello, Zonocerus elegans, Scirtothrips manihoti, Corynothrips stenopterus, Erythroneura cassavae, Bemisa nigeriensis, Planococcus citri, Saissetia coffeae, Tetranychus urticae* and *Dasynus manihotis (Summary by S S. de S.)* F01

See also 0029 0296 0299 0318

G00 GENETICS AND PLANT BREEDING

0390-6895 MEDARD, R. **Mise en évidence chez le manioc (*Manihot esculenta* Crantz, euphorbiacées crotorioidées) d'une mémoire de ramification transmissible par bouturage.** (*Atypical branching habits in some cassava clones, transmissible through stem cuttings*). Journal d'Agriculture Tropicale et de Botanique Appliquée 21(10/12):351-360. 1974. Fr., Sum. Fr., Engl., 3 Refs., Illus.

Cassava. *Manihot esculenta*. Genetics. Branching. Inheritance. Congo.

Branching in cassava was studied in the Niari Valley, Congo. Some clones had main stems that were abnormally short as compared with other clones or plants from seed. In these clones short branches also occurred in the branchings at later stages of growth; in 1-yr-old plants, short branches occurred more frequently towards the shoot apex. This short-shoot characteristic was transmitted in stem cuttings. (*Summary by Field Crops Abstracts*) G00 C01

0391-3872 PERRY, B A **Cytological relationships in the Euphorbiaceae.** Virginia Journal of Science 5.140-144. 1942. Engl., 12 Refs

Cassava. *Manihot*. Chromosomes.

A comparative cytological study was made of the Euphorbiaceae family, including chromosome number determinations, chromosome morphology, geographic distribution and morphology, in order to determine the correlation between these phenomena and the phylogeny of the family. *Manihot* was one of the genera studied; its species are distributed from Texas and Mexico to tropical America, especially Central America and Brazil. Five species and 40 cultivated varieties reported were tetraploid. As regards chromosome number in the Euphorbiaceae family, 23.3 and 37.1% of the annual and perennial species, respectively, were 2n. It was therefore concluded that there are a lower number of polyploid species among annuals as compared to perennials, and it seems that the evolution in the family has been from the annual to the perennial condition. *(Summary by A.J. Trans. by S.S. de S.)* G00

G01 Breeding, Germplasm, Varieties and Clones, Selection

0392-1931 ABRAHAM, A **Breeding of tuber crops in India.** Indian Journal of Genetics and Plant Breeding 17:212-217. 1957. Engl.

Cassava. *Manihot esculenta.* Hybridizing. Hybrids. Crossbreeding. Selfing. Polyploidy. Colchicine. Chromosomes. *Manihot glaziovii.* India.

This is a summary of the breeding work on cassava (*Manihot utilissima*) and other tubers in Kerala, India. A large-scale intervarietal hybridization program combining new promising cassava introductions with previously selected materials was carried out in 1950; as a result, promising hybrids were obtained. Based on the knowledge of the combining ability of these varieties, an inbreeding program for the selected varieties was started to take advantage of hybrid vigor. This breeding method proved to be the most promising for cassava. Interspecific hybridizations between *M. utilissima* and *M. glaziovii* indicated that crossing is fertile only when the former is used as female parent. The characteristics of the F_1 hybrids are different or intermediate as compared to those of the parents; therefore, successive backcrosses were carried out with *M. utilissima* to increase its proportion of genes. Some favorable traits such as high yields, greater vigor, resistance to drought and spreading habit of roots were obtained. In other experiments, the formation of tetraploids was induced, treating the axillary bud with colchicine. Their yields were lower than those of diploids, but they were more vigorous; therefore, some crosses were made between tetraploids (female) and diploids (male) to obtain triploids. Materials obtained are still being evaluated in yields trials to be selected later for release to farmers. Research was also conducted on the improvement of agronomic practices and fertilization. It was concluded that large-scale random hybridization, followed by selection, is a good method to obtain promising strains. Hybridization between inbred lines offers great possibilities for the improvement of tuber crops. Research should be planned to produce mutants by radiation. (*Summary by A.J. Trans. by S. S. de S.*) G01

0393-5302 ARIAS, C. **Venezuela[Cassava germplasm]** *In* Nestel, B. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp 29-30. Engl.

Cassava. Germplasm. Cassava programs. Venezuela.

A report is given on germplasm collected, its distribution in the country and main characteristics used for evaluating it. Ongoing and future projects, together with resources available, are mentioned. The following diseases were evaluated in nurseries: cassava bacterial blight, Brazilian common mosaic virus, vein mosaic, superelongation, *Cercospora* spp., mycoplasma and anthracnose. The country's quarantine restrictions are also given. *(Summary by L.F.C. Trans. by S.S. de S.)* G01

0394-1841 ARRAUDEAU, M **Communication sur l'amelioration variétale du manioc à Madagascar.** *(The improvement of cassava varieties in Madagascar).* Tananarive, Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières, n. d. 22p. Fr., 10 Refs.

Paper presented at the Seminaire de la Fondation Ford sur les Plantes Alimentaires à Tubercules, Ibadan, Nigeria.

Cassava. Cassava programs. Cultivars. Selection. Plant breeding. Resistance. Starch content. HCN content. Crossbreeding. Pollination. Hybridizing. Tuber productivity. Cassava mosaic virus. Genetics. Malagasy Republic.

This paper describes in detail the methodology of selection for the varietal improvement of cassava, based on certain fundamental biological characters of the plant, such as the development of the aerial and underground part, root composition, total starch content, plant toxicity and resistance to diseases such as mosaics and rots. It also includes the genetic bases for varietal improvement, parent selection, methods for obtaining hybrid clones and studies of progeny. Comparative tables show the results achieved in different trials Two priorities were established for the future: to promote collaborative activities with other institutes and research centers and to increase knowledge in the field of plant genetics. *(Summary by R T. Trans. by S.S. de S.)* G01

0395-1842 ARRAUDEAU, M **Communication sur le manioc, la patate douce et la pomme de terre.** *(Cassava, sweet potatoes and potatoes)* Tananarive, Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, n d. 11p. Fr , Illus.

Paper presented at the Seminaire de la Fondation Ford sur les Plantes Alimentaires à Tubercules, Ibadan, Nigeria.

Cassava. Cassava programs. Clones. Selection. Tuber productivity. Soil requirements. Fertilizers. Plant breeding. Viroses. Mycoses. Injurious insects. Production. Maps. Malagasy Republic.

This paper gives a brief description of traditional and modern agricultural methods used in Madagascar, as well as the present status of the following areas of research:HCN and starch content, parasitic and physiological diseases, and harmful pests. The method for varietal improvement employed at the institute is explained in detail. Present research priorities are to obtain varieties resistant to mosaic, increase starch content by hybridization and study homozygosity. A map of the main producing and exporting zones is given. *(Summary by S.S de S.)* G01

0396-4765 BECK, B. D. A. **Cassava.** *In* Lagos, Nigeria. Department of Agricultural Research. Annual Report 1958-59. 1960. pp.11-16. Engl.

Cassava. Field experiments. Cultivars. Selection. Ecology. Productivity. Spacing. Plant breeding. *Manihot esculenta. Manihot glaziovii.* Cassava mosaic virus. Resistance. Germination. Virus transmission. Grafting. Nigeria.

This document deals with the activities of the Department of Agricultural Research in Nigeria. The collection and classification of new cassava varieties are reported. Regional trials were carried out for 2 years in 8 ecologically different zones in order to compare the production of selected varieties with that of the best local variety, to study the effect of the duration of the growth period on yields, and to determine varietal and environmental interactions at the different experimental stations. Twenty native and imported selections were compared with variety 53101 on the Moor plantation; this last variety gave the best yields and was more tolerant to the environment than the others. Agronomic trials were conducted to study 3 varieties with different growth habits in order to determine optimum planting spacing in the Guinea savanna zone; no significant difference was found. In 1957, the breeding program crossed 6 varieties to study the inheritance of yield and variety characters in the progeny. In 1958, the hybridization program assessed the genetic potential of yield and mosaic resistance in 1,435 hybrids and clones and tried to combine the mosaic resistance of *M. utilissima* x *M. glaziovii* with the high yields of *M.*

utilissima hybrids. At the time of writing, 1,171 seedlings have been established and are being evaluated. A new type of male sterility was also discovered. Some varieties produce flowers whose anthers contain very little pollen and most of the grains formed are empty. The *M. utilissima* hybrid 60452 shows a different kind of sterility caused by the phenomenon known as protandry, the inheritance mechanism of which is being investigated. Leaf symptoms of cassava mosaic were classified into 5 groups. Some plants produced from infected cuttings mask the symptoms, making it difficult to determine whether they are virus free or infected. When the symptomless plants were grown under laboratory conditions at a constant temperature of 72°C, mosaic symptoms developed within 3 weeks. The virus can also be transmitted by grafts; but as the symptoms are masked, it has been impossible to identify the mosaic virus strains. *(Summary by L.F.C. Trans. by S S. de S.)* G01

0397-5293 BOONSUE, B. and SINTHUPRAMA, S **Thailand [Cassava germplasm].** *In* Nestel, B. and MacIntyre, R., eds The International Exchange and Testing of Cassava Germ Plasm; proceedings of an intesdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp. 26-28. Engl., 1 Ref

Cassava. Germplasm. Cassava programs. Thailand.

In Thailand cassava is the 4th major crop, and most of its production is exported in processed form Data include the number of introductions in the germplasm bank, whose evaluation is just beginning, the area planted to cassava; and the increment in production between 1969-73, as well as the national average yield (15 tons/ha). It enumerates ongoing and future projects and human and financial resources available. As regards pests and diseases, the country seems to be free of them. *(Summary by L.F.C. Trans. by S.S. de S.)* G01

0398-5303 CARPENA, A L. and BALDOS, D. P. **Philippines [Cassava germplasm].** *In* Nestel, B. and MacIntyre, R., eds The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp. 23-24. Engl.

Cassava. Germplasm. Philippines.

In the Philippines, cassava yields (5 6 tons/ha), as well as starch and protein content, are low due to inferior genetic make-up. The germplasm resources are limited and only variety (Balinghoy) is grown on a commercial scale In evaluating cassava germplasm, the form of the plant, yield and starch content of 3 varieties were compared to those of the variety Balinghoy Problems encountered and progress made with introduced and crossed varieties are reported; these varieties were compared to the 4 native ones. Cultivated area, future land requirements, and human and financial resources are briefly dealt with. Two diseases and one pest are mentioned: *Cercospora* sp., rust and a mite Damage was not of economic importance. *(Summary by L.F.C. Trans. by S.S. de S.)* G01

0399-5305 CHAN, S. K., TAN, S. L. and GEH, S. L. **Malaysia [Cassava germplasm]** *In* Nestel, B. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975 Ottawa, Canada, International Development Research Centre, 1975. pp. 19-20. Engl.

Cassava. Germplasm. Cassava programs. Diseases and pathogens. Malaysia.

A brief historical review is made of the germplasm collected in Malaysia The collection is divided into 4 groups on the basis of 5 morphological characteristics At present 20,000 ha are planted to cassava. An outline is made of future and ongoing projects including breeding and selection of varieties, improvement of cultural practices, identificaction of diseases and their economic importance Important diseases are CBB, Cercospora leaf spots and root rot caused by *Fomes lignosus*. Pests are of minor importance. Quarantine restrictions for materials from South America and Africa and from other countries are given. *(Summary by T.M.)* G01

0400-7276 CONCEIÇAO, A J. DA **Diretrizes gerais para o programa de melhoramento genético da mandioca (*Manihot esculenta* Crantz) no nordeste do Brasil.** *(Guidelines for a cassava breeding program in northeastern Brazil)* *In* Projeto mandioca, subprojetos de pesquisas para o nordeste do Brasil. Cruz das Almas, Brasil. Universidade Federal da Bahia. Escola de Agronomia. Convênio U.F.Ba./BRASCAN Nordeste, 1974. pp.1-28. Port , 20 Refs , Illus

Cassava. *Manihot esculenta* Cassava programs. Developmental research. Plant breeding. Brazil.

This subproject is denominated General Guidelines for the Cassava Breeding Program in northeastern Brazil and forms part of the cassava project for this area (under the agreement Universidade Federal da Bahia/Brascan Nordeste, in cooperation with the Centro International de Agricultura Tropical). General aspects on this subject, a bibliographic revision and background data are included. The purpose of this subproject is to select clones that present certain characteristics in their aerial parts (early maturity, high leaf area index, short internodes, low or medium height, resistance to diseases and pests, etc), as well as underground parts (well-developed fibrous roots without affecting storage roots, a large no. of roots, thin peel, low HCN content, white pulp, etc.). The following steps lead to the attainment of these goals: (1) the obtainment, characterization and registering of new materials for the germplasm bank, (2) controlled hybridizations, (3) special treatments of resulting seedlings, (4) the transplanting of seedlings to individual observation fields, (5) the establishment of fields for clonal propagation, (6) diallel crosses and (7) regional trials. A description is given of the hydrostatic weighing method used for determining dry matter and starch content of cassava roots. (*Summary by A J Trans by S.S. de S.*) G01-J00

0401-5296 CONCEIÇAO, A J DA **Brazil [Cassava germplasm].** *In* Nestel, B. and MacIntyre, R , eds The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975 Ottawa, Canada. International Development Research Centre, 1975 pp 34-35. Engl,

Cassava. Germplasm. Cassava programs. Diseases and pathogens. Injurious insects. Brazil.

The present state of cassava research in Brazil is described, as well as its future objectives regarding crop expansion The germplasm collection consists of 1,059 cultivars distributed among several institutions. A list of the Brazilian institutions and their present fields of research, as well as the areas covered by Priority Project I (1969) of the school of agronomy at the Universidade Federal de Bahia, is included. There is no information on economic losses caused by the different diseases attacking cassava in Brazil, among which are *Xanthomonas manihotis* (the most important), *Cercospora henningsii, C. caribaea, C viscosae, Phyllosticta* sp., *Uromyces manihotis, Oidium* sp., *Glomerella manihotis, Rosellinia bunodes, Phytophthora drechsleri, Sclerotium rolfsii* and *Rhizopus nigricans* The quarantine of materials coming from other countries is recommended as a preventive measure. *(Summary by A J Trans by S.S de S)* G01

0402-4496 COURS, G. **Les études scientifiques sur le manioc à la Station Agricole du Lac Alaotra.** *(Scientific studies on cassava at the agricultural station of Lake Alaotra).* Enterprises et Produits de Madagascar. 2:41-61. 1950. Fr , Illus.

Cassava. Leaves. Stems. Tubers. Plant breeding. Cultivars. Resistance. Selection. Cassava programs. Plant development. Malagasy Republic.

In Malaysia, cassava is planted in Oct., at the end of winter. During the 1st months, the plant uses half of its reserves for foliage formation, from Mar.-May, the stems get stronger and the amount of reserves directed to the leaves begins to decrease. Root activity begins in April and increases until it reaches a period of inactivity (Aug. to Sept.). Vegetative activity is renewed in Oct., and the plant uses almost all its reserves (from stems and roots) to produce new leaves At the beginning of the 2nd year (Jan), leaf surface decreases and stem surface increases. Starch accumulation in the roots begins once again in May, showing a marked increase from June to Sept. Different varieties grown in Malaysia are used to describe and illustrate physical characteristics of leaves (color, shape, number of lobes, petiole diameter and length); stem (type of ramification, nodes, internodes, color), flower (buds, calix, stigma, fruit) and root (shape, peel, pulp, starch grains) Breeding work has been focused on obtaining varieties resistant to mosaic and rot that will produce higher fresh root weight and starch content. Starch should have large grains and a small amount of cellulose and fat and nitrogenous substances. Also described are the different steps followed by breeders to obtain, by means of selection and hybridization, clones with desirable characteristics *(Summary by S.S. de S.)* G01

0403-1645 COURS, M. **Note sur la culture et la sélection du manioc à Madagascar.** *(Cassava growing and selection in Madagascar,* I ı Congrès du Manioc et de Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institut Colonial, 1949. pp.118-123 Fr

Cassava. Cultivars. Identification. Flowers. Leaves. Plant fertility. Tubers. Plant breeding. Cassava programs. Stems. Plant geography. Malagasy Republic.

This article gives an overall view of the varieties grown in Madagascar, genetic improvement and agronomic practices used It discusses the main characteristics used at the Alaotra Agricultural Station to classify varieties (color of stigmata, pollen content of the anthers, form and color of roots and young leaves, etc.) and gives the names of the varieties most commonly grown in several regions of the country. Genetic improvement focuses on the obtainment of rot- and mosaic-resistant varieties, with a low content of fat, albuminoids and cellulose and a high harvest index. The evolution of agricultural systems during the last 50 years is also described. *(Summary by S.S. de S.)* G01 A00

0404-5306 DHARMAPUTRA, T. S. **Indonesia [Cassava germplasm].** *In* Nestel, B. and MacIntyre, R., eds The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp. 13-14. Engl., 8 Refs

Cassava. Germplasm. Cassava programs. Indonesia.

Indonesia is 2nd to Brazil in world cassava production. The aspects to be included in every international cooperative program are set forth: germplasm exchange, standardization of evaluation procedures of cassava cultivars, comparative testing, and the promotion of international meetings on the development of cassava research. It also deals with the origin, evaluation and characteristics of germplasm collected and with ongoing and future projects, indicating work already done by the different institutions. Human and financial resources for research and extension are outlined. The only disease reported is bacterial wilt in Java; the mite *Tetranychus bimaculatus* is the most important pest The plant breeding program is working to obtain clones resistant to both. Quarantine measures established by the Directorate General of Agriculture, Jakarta are also given. *(Summary by L.F.C Trans. by S S. de S.)* G01

0405-6813 EZUMAH, H C., KABONYI, S. and BEYA, K **Guidelines for the establishment of a cassava improvement project: the Zaire model.** *In* Terry, E. R and Mac Intyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976 pp 45-48 Engl

Cassava. Cassava programs. Plant breeding. Zaire.

A series of recommendations are presented for the establishment of a joint cassava breeding program between Zaire and the International Institute of Tropical Agriculture, as a response to the wide range of phytosanitary and environmental problems affecting cassava in this country. The steps recommended are (1) to establish a germplasm bank comprising improved materials from IITA and other organizations and agencies, (2) to identify areas of maximum impact and concentrate efforts in such regions, (3) to establish nurseries at various locations to screen for desirable characters and distribute these materials to nearby areas, (4) to recruit local personnel for the program, and (5) to define responsabilities of local and foreign staff. *(Summary by A. J Trans. by S S de S)* G01

0406-5304 FUMAGALLI, A. **Guatemala [Cassava germplasm].** *In* Nestel, B and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975 pp. 21-22. Engl.

Cassava. Germplasm. Guatemala.

In Guatemala cassava is grown only in the southeast About 80% of the total production is processed into starch and 20% is used for food. The germplasm collection has just began Data on area planted to cassava, its characteristics and average national yield (22,700 kg/ha), as well as its economic prospects, are given. A study on the use of cassava for feeding swine will be carried out. Agronomic practices are rudimentary and there are no research or extension activities to increase cassava production. It is believed that the following diseases and pests could become a problem: superelongation, *Silba pendula,* thrips and mites. Guatemala follows the quarantine measures of the Central American area. *(Summary by L.F.C. Trans. by S.S. de S.)* G01

0407-6804 HAHN, S. K **Cooperative testing and selection.** *In* Terry, E.R. and Mac Intyre, R , eds The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975 Ottawa, Canada, International Development Research Centre, 1976. pp. 39-40. Engl.

Cassava. Cassava programs. Cultivation. Field experiments. Selection. Nigeria.

This article presents guidelines for the agronomic trials with cassava materials that will be conducted in Africa under the coordination of the International Institute of Tropical Agriculture and in cooperation with the Centro Internacional de Agricultura Tropical. The objectives of the cooperative testing are (1) the distribution of foundation seed to national cassava programs, (2) the identification of the most promising material with respect to quantity, quality and stability, (3) the development of national cassava breeding programs, (4) the determination of productivity levels under a wide range of growing conditions, and (5) the obtainment of information on genotype x environment interactions. To achieve these goals with maximum efficiency, some specifications are proposed regarding testing materials and sites, soil preparation, planting, experimental design, management, collection of field and harvest data, further evaluation and data reporting. (*Summary by A.J. Trans. by S.S. de S.*) G01

0408-6802 HAHN, S.K. **Improvement of cassava at the International Institute of Tropical Agriculture.** *In* Terry, E.R. and MacIntyre, R., eds The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop. Ibadan, Nigeria, 1975 Ottawa, Canada, International Development Research Centre, 1976. pp.21-22. Engl.

Cassava. Cassava programs. Plant breeding. Resistance. Viroses. Bacterioses. Nigeria.

This article presents the objectives of the cassava breeding program at IITA and the conditions that have made it possible to achieve them. Specific objectives were (1) high dry matter yields/unit of area and time in both monoculture and mixed cropping systems, (2) resistance to and control of economically important diseases (mosaic, CBB and anthracnose) and pests (mites), (3) improvement of palatability, nutritive value and processing characteristics, (4) improved plant type, and (5) adaptation to a wide range of ecological conditions In addition to having identified sources of resistance to the aforementioned diseases, a positive correlation between resistance to mosaic and CBB was found. Clones with desirable characte st n were obtained through hybridization and selection. The environmental conditions at IITA are suitable for screening for resistance because of large whitefly populations (vectors of mosaic) and high rainfall, which favors the development of CBB (*Summary by A J Trans. by S.S de S.*) G01

0409-5295 HRISHI, N. **India. [Cassava germplasm].** *In* Nestel, B. and MacIntyre, R., eds The International Exchange and Testing of Cassava Germ Plasm, proceedings of an interdisciplinary workshop, Palmira, Colombia; 1975. Ottawa, Canada, International Development Research Centre, 1975 pp.31-33. Engl.

Cassava. Germplasm. Cassava programs. Plant breeding. India.

A brief outline is given of the research activities conducted at the Central Tuber Crops Research Institute in Kerala. The no. of varieties in their germplasm bank is indicated, specifying the source. As regards taste, starch content, yield, early maturity and plant type, the best selections are 300, 2371, 2335, 2398 and 2317 Area planted to cassava and future land requirements are indicated The main objective of the breeding program is to develop varieties adequate for human consumption and industrial purposes. Other objectives of the program are to breed varieties with resistance to drought, saline and alkaline soils, and mosaic and tolerance to shade in order to intercrop cassava Three high-yielding hybrids (H-97, H-165 and H-226) have been obtained through heterosis. The most important pests and diseases and quarantine restrictions are also mentioned. (*Summary by S.S de S.*) G01

0410-2376 HSU, K. S. and VALERIO, J. **Relationship of radiation-induced chromosomal aberrations and somatic mutations in *Manihot esculenta*.** *In* Moh, C.C., ed. The application of nuclear energy to agriculture, annual report. Turrialba, Costa Rica, Instituto Interamericano de Ciencias Agrícolas,1966. pp.23-24. Engl

Cassava. Mutation. Chromosomes. Genetics. Cultivars. Microsporogenesis. Shoots. Cuttings.

An experiment was designed to determine the relationship between chromosomal aberrations and induced somatic mutations in cassava. Another objective was to test to what extent the chromosomal aberrations could be accumulated in somatic cells without producing a lethal effect Cassava cultivars, cytologically identified as free from chromosomal aberrations, were selected A total of 166 cuttings from 4 selected cultivars were irradiated with 1 to 4 kR and then planted Microsporocytes from individual shoots of the irradiated material will be examined later to determine the types and frequencies of chromosomal aberrations. *(Summary by L.C Trans by T.M.)* G01

0411-5367 INSTITUT DE RECHERCHES AGRONOMIQUES DE MADAGASCAR Manioc. *(Cassava). In* ______. Rapport Annuel 1963. Tananarive, 1964. pp. 73-78 Fr

Cassava. Hybrids. Tuber productivity. Plant breeding. Field experiments. Harvesting. Timing. Selection. Malagasy Republic.

Research conducted at the experimental station of Tananarive has focusedon hybridization with the purpose of producing high-yielding varieties, resistant to mosaic and rots. In 1963, the best clone obtained was H 56 which proved to be superior to hybrid H 54. The station has 3 collections and nearly 332 different clones. The hybrid H.54 was used as the parent for the hybridizations carried out in 1963 Almost 20 trials were conducted with these hybrids, using different plantings systems and seasons, as well as several replications Seasonal planting trials showed that the best seasons are April 1st to May 15th and all September. The best harvesting season varied between 16-20 mo The best clones for large-scale production are H.54, H.56, H.49, H.45, H.53, H.52, H.47, H 42 and H.46. *(Summary by S S. de S)* G01 D03

0412-0082 INSTITUTO AGRONOMICO. **O Instituto Agronômico e a semente seleccionada.** *(Plant breeding at the Instituto Agronômicq).* Agronômico 16(9/10):1-29 1964. Port

Cassava. Cassava programs. Plant breeding. Brazil.

This article deals with the breeding and production of foundation seed of some of the most important crops grown in the state of São Paulo. Among the crops included is cassava. The steps followed to obtain new types of cassava for human and animal nutrition and industrial purposes are presented *(Summary by P.G Trans. by S.S. de S)* G01

0413-6823 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. **Root and tuber improvement.** *In* ______. Report 1972-73. Ibadan, Nigeria, 1974. pp 21-25. Engl., Illus

Cassava. Plant breeding. Cassava mosaic virus. Cassava bacterial blight. Resistance. Planting. Spacing. Timing. Cultivars. Tuber productivity. HCN content. Leaves. Selection. Nigeria.

Genes for resistance to cassava mosaic disease have been determined. Resistance to mosaic disease appears to be related to resistance to *Xanthomonas manihotis.* Hybrids and lines with a low HCN content have been identified. (*Summary by Plant Breeding Abstracts*) G01 C03

0414-6876 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. **Root and tuber improvement program.** *In* ______. Annual Report 1974. Ibadan, Nigeria, 1975. pp.125-152. Engl., Illus.

Cassava. *Manihot esculenta.* **Cassava programs. Plant breeding. Cassava mosaic virus.** *Xanthomonas manihotis.* **Inheritance. HCN content. Cuttings. Propagation. Tuber productivity. Pruning. Spacing. Resistance. Selection. Virus transmission.** *Bemisia.* **Plant physiology. Starch content. Dry matter. Leaves. Nigeria.**

This is a progress report made by the Root and Tuber Program (cassava, sweet potatoes and yams) of the International Institute of Tropical Agriculture in the identification and solution of the major problems limiting the production of these crops. Several aspects regarding plant improvement, agronomy, entomology, pathology and physiology are discussed As far as cassava is concerned, the resistance to bacterial blight (CBB) and common mosaic (CM) was stable in a region with sandy soils and high rainfall. A positive heritable relationship between CM and CBB resistance was confirmed. The heritability of low HCN content is 43%, whereas that of resistance to both diseases and root size, form and neck length is 40%. Root yield was positively associated with canopy, leaf size, stem no., and root no. and size, but it was negatively associated with branch height, lodging, CM and CBB A positive correlation was observed between root no. and size, as well as between starch content and dry matter percentage. A yield increase that did not have an adverse effect on root quality was registered when the distance between rows was reduced from 1 m to 57-80 cm. The main cassava pests during 1974 were *Bemisia tabaci, Tetranychus telarius* and *Zonocerus variegatus* It was found that *X manihotis* cells from pellets remained viable for 14 mo after they had been collected from infected plants *(Summary by A J. Trans. by S.S. de S.)* G01 C00

0415-3647 JENNINGS, D L. **Breeding for resistance to cassava viruses in East Africa.** *In* Cassava Mosaic Workshop, Ibadan, Nigeria, 1972. Proceedings. Ibadan, Nigeria, International Institure of Tropical Agriculture, 1972 pp.40-42 Engl., Illus.

Cassava. Plant breeding. Resistance. Cassava mosaic virus. Backcrossing. *Manihot esculenta. Manihot glaziovii.* Hybrids. *Manihot melanobasis.* **Cassava brown streak virus. Tanzania. Uganda.**

Cassava yield losses due to virus infections vary between 65-95% in East Africa as compared with 14-43% in West Africa. East African losses are due to the high incidence of African mosaic and brown streak viruses, which occur together in coastal regions. Breeding was oriented to transferring high levels of resistance found in other *Manihot* species and to restore root quality by backcrossing to *M. esculenta.* The *M. glaziovii* series performed better as regards resistance to both diseases, but the *M. melanobasis* series was best for resistance to brown streak. Three backcrosses were necessary to restore root quality. Since resistance often breaks down from one region to another, detailed studies on host/virus relationships were undertaken. Factors contributing to loss of resistance are discussed, which led to the improvement of the screening techniques Varieties with a moderate level of resistance were distributed; the need of disseminating disease-free material was emphasized *(Summary by L F.C. Trans by S.S de S.)* G01 E04

0416-5297 KAWANO, K. **Cassava germplasm collection and advanced genetic material at CIAT.** *In* Nestel, B. and MacIntyre, R., eds ,The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop. Palmira, Colombia, 1975 Ottawa, Canada, International Development Research Centre, 1975. pp.63-66. Engl

Cassava. Germplasm. Plant breeding. Colombia.

Approximately 2,700 clones of cassava have been collected from Colombia, Venezuela, Ecuador, Mexico, Panama, Puerto Rico, Brazil and Peru by the Centro Internacional de Agricultura Tropical This collection is a promising source of genetic variation Agronomic evaluations of 2,000 clones have been completed The present objective of hybridization is to increase harvest index without losing heterozigosity. During 1974, 35,000 F_1 seeds were obtained by hand pollination of genotypes selected for their high-yielding capacity. Sources of resistance to CBB, superelongation, Phoma leaf spot and Cercospora leaf spot were found. Various types of genetic materials are being sent to cassava breeders outside CIAT upon request. Programs are also being carried out in cooperation with IITA (Nigeria) and some Brazilian breeders. *(Summary by P.G. Trans. by S S de S)* G01

0417-5307 LUJAN, L. Colombia [Cassava germplasm]. *In* Nestel, B. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975 Ottawa, Canada, International Development Research Centre, 1975. pp. 17-18. Engl.

Cassava. Germplasm. Cassava programs. Colombia.

Sweet cassava is grown in Colombia by small farmers; 70% is used for human consumption, 20% for industrial purposes and 10% for animal feeding. The germplasm bank is formed by 2 groups: (1) 256 clones planted at ICA's headquarters in Palmira (Valle) and (2) 74 cultivars including *Manihot carthagenensis* planted in Caribia (Magdalena). The main aspects evaluated were phenotypic and agronomic characteristics and resistance to pests and diseases, which made it possible to identify 4 promising varieties. Data on area planted to cassava, production value and costs, and possible ways to increase yields are given. Ongoing and future research projects and human and financial resource available are also mentioned. The following diseases are of economic importance: cassava bacterial blight, *Cercospora* spp., *Phyllosticta* spp., superelongation, *Phytopthora* spp. and *Rosellinia* spp. The pests mentioned are thrips, mites, the cassava hornworm, stemborers, shoot flies and ants. Colombia complies with the quarantine restrictions established in Rome in 1951. *(Summary by L.F.C. Trans by S.S de S.)* G01

0418-0517 MAGOON, M. L., MAINI, S. B. and KRISHNAN, R. **Breeding for tuber quality in cassava.** Tropical Root and Tuber Crops Newsletter no. 5:27-29. 1973. Engl., 6 Refs

Cassava. *Manihot esculenta.* **Plant breeding. India.**

Crosses were made between 1 female parent and 3 different high-yielding male parents The consolidated range values for the F_1 s were 20-47.2% root dry matter, 13.3-85.5% carbohydrate (DWB), 1.39-7.99% crude protein, and 15.398 µg/g HCN. *(Summary by T.M.)* G01

0419-4422 NICHOLS, R F W **Review of work on cassava.** *In* East African Agricultural Research Institute. Report 1947. Amani, 1948? pp. 9-11. Engl.

Cassava. Hybridizing. Crossbreeding. Backcrosses. Hybrids. *Manihot dichotoma. Manihot glaziovii Manihot saxicola Manihot melanobasis* **Tubers. HCN content. Protein content. Starch content. Fibre content. Kenya.**

This is a brief review of the results obtained after 10 years of work in cassava breeding According to the author, high productivity and susceptibility to the two main viral diseases common in East Africa are genetically linked, therefore, it is preferable to use interspecific hybridization rather than intercrossing in order to prevent susceptibility to these diseases. A progress report is made on the different crosses of *Manihot esculenta* with *M. dichotoma, M. glaziovii, M. saxicola, M. catingae* and *M. melanobasis* as regards productivity, resistance to viral diseases and root quality.

The chemical composition of fresh, peeled roots of the different *Manihot* spp. mentioned in the report is presented in a table. *(Summary by W.P. Trans. by S.S. de S.)* G01 C03

0420-1761 NORMANHA, E.S. **O trabalho de melhoramento da mandioca no Instituto Agronômico do Estado de São Paulo, Campinhas, S.P., Brasil.** *(Work on cassava breeding at the Instituto Agronomico do Estado de São Paulo). In* Encontro de Engenheiros Agrônomos, Pesquisadores de Mandioca dos Países Andinos e do Estado de São Paulo, 1º, Campinas, Brasil 1970. Trabalhos. Campinas, Brasil, Instituto Agronômico do Estado de Sao Paulo, 1970. pp.39-47. Port.

Cassava. *Manihot esculenta.* **Plant breeding. Cultivars. Selection. Crossbreeding. Pollination.** *Silba pendula. Teleocoma crassipes. Anastrepha pickeli. Xanthomonas manihotis.* **Brazil.**

Over a period of many years, more than 20 clones were developed for food and industrial purposes. As of 1969, the breeding program was intensified; the main objective was to increase the number of controlled breeding fields to obtain fertile seeds. Controlled pollination techniques, protection and periods of inflorescence, protection of fruits, seed formation and harvesting of seeds are amply discussed. Problems were encountered with larva of *Silba pendula, Teleocoma crassipes, Anastrepha pickeli* and bacterial blight caused by *Xanthomonas manihotis. (Summary by T.M.)* G01

0421-5294 PAZ B., F.R. **Ecuador [Cassava germplasm].** *In* Nestel, B. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp.25-28. Engl., 1 Ref.

Cassava. Germplasm. Cassava programs. Productivity. Ecuador.

Aspects of the present status of cassava cultivation and research in Ecuador are presented. The situation can be summarized as follows: (1) Ecuador's germplasm collection has not been kept adequately. (2) Only the varieties CADE 1, 2, 3 and 4 have been evaluated. (3) The av national yield in 1973 was 9.4 tons/ha. (4) In 98% of the area planted to cassava, intercropping was practiced. (5) A joint CIAT/INIAP agronomic study is being carried out at present (6) All research funds come from AGRIL, S.A., a private company. (7) Important diseases include those caused by *Cercospora caribaea, Rosellinia bunodes* and *C. henningsii.* (8) *Silba pendula, Erinnyis ello* and *Coleosternus* sp are pests of economic importance. (9) There are no quarantine restrictions for imported cassava materials. *(Summary by A.J. Trans by S S. de S.)* G01

0422-6920 RÍOS R., M. **Mejoramiento en yuca (*Manihot esculenta*).** *(Varietal improvement in cassava). In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp.149-156. Span.

Cassava. *Manihot esculenta.* **Plant breeding. Crossbreeding. Cultivars. Colombia.**

This article presents generalized information on improving cassava through hybridization. Varieties for human consumption and industrial purposes should have a wide range of adaptability, disease resistance, high yielding, a good no. of well-formed roots with high specific gravity, early-maturing, vigorous, nonbranching types with a sweet taste (bitter for flour manufacturing). The components of the Instituto Colombiano Agropecuario's breeding program (since 1967) are summarized: (1) the collection and evaluation of varieties, (2) the selection of material obtained from true seed, and (3) the production of early-maturing varieties. ICA is carrying out diallel crosses vith the varieties CMC 9, 40, 76, 84 and 92 in order to obtain material with the aforementioned characteristics. *(Summary by T.M.)* G01

0423-5292 ROSAS, J C. Peru [Cassava germplasm] *In* Nestel, B. and MacIntyre, R. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp. 15-16 Engl.

Cassava. Germplasm. Cassava programs. Peru.

A great variety of genetic characteristics are found in the cassava material grown in Peru The origin of the germplasm bank, its distribution in the country, and the aspects taken into account when evaluating it are dealt with. Data on the area planted to cassava and the average national yield (13,365 kg/ha) are given. As regards future programs, a list is included of priority projects and human and financial resources available. The following diseases (3) and pests (5) are mentioned: *Cercospora* spp , *Phyllosticta* sp., *Botryodiplodia* sp., *Erinnyis ello, Silba pendula, Tetranychus* sp , *Eubulus* sp. and *Meloidogyne incognita. (Summary by L.F.C. Trans. by S S. de S.)* G01

0424-6834 STATION AGRONOMIQUE DU LAC ALAOTRA. DIVISION D'AMELIORATION DES PLANTES. SECTION MANIOC. Rapport 1960. *(1960 Report).* Lac Alaotra, 1961 45p. Fr., Illus.

Cassava. Field experiments. Cultivars. Plant physiology. Resistance. Hybridizing. Crossbreeding. Tuber productivity. Minerals. Spacing. N. P. K. Fertilizers. Cuttings. Selection. Planting. Timing. Plant fertility. Experiment design. Malagasy Republic.

This is a report on the breeding trials carried out by the experimental station at Lake Alaotra from 1958-62. A list of the varieties under study is included, indicating the following characteristics for each: rot and mosaic resistance, yields, planting density, index of recovery, growing habit, type of cassava (sweet, medium or bitter) and fertility or sterility. Hybridizations carried out in 1960 are listed. The statistical analysis of a comparative trial with cassava varieties planted in a rectangular lattice is explained in detail According to this analysis, hybrid 31,312 (recently denominated H-54) is the best. The extrapolation of yield/ha shows that H-54 yields 45 tons/ha Several fertilization trials, using all the possible combinations of N, P and K and of the minor elements Mn and Mo, were conducted in the regions of Andranomadio and Ambalade. The joint application of these 5 elements gave the best results, followed by the combination P, K, Mn and Mo. The following trials were carried out from 1959-61 and 1960-62: cutting recovery from drought stress, performance of varieties and hybrids, planting systems, optimum cutting length, cutting viability and slant, fertilization and rot resistance. The importance of clonal propagation and heterozygosity in the selection of the best cassava varieties is studied in detail. Since the transmission of characters is not yet known, hybridizations are made on the basis of a series of phenotypic characters in the hopes that the cross will give good results. As to the most appropriate season for planting cassava in the region of Lake Alaotra, it was found that it depends on the climatological conditions of each year. *(Summary by S.S de S)* G01 D00 C00

0425-5301 TERRY, E **Cassava germ plasm resources, disease incidence, and phytosanitary constraints at IITA, Nigeria.** *In* Nestel, B. and MacIntyre, R., eds The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop, Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp. 38-40. Engl

Cassava. Germplasm. Cassava programs. Viroses. Mycoses. Bacterioses. Nigeria.

This is a brief review of the cassava germplasm collection, phytosanitary constraints, diseases and the Cassava International Testing Program in Africa. Aspects of viral, bacterial and fungal diseases are dealt with (causal agent, distribution in Africa and other countries, potential risk of introduction and control). The quarantine restrictions for vegetative planting material are included. Points to be considered in the establishment of an International Testing Program are mentioned. *(Summary by A.J Trans. by S.S de S.)* G01

0426-5195 TORO, J. C and FRANKLIN, D **Consideraciones en la estructuración de una red cooperativa internacional para la evaluación de variedades promisorias de yuca.** *(The structuring of an international cooperative network for the evaluation of promising cassava varieties).* Palmira, Colombia, Centro Internacional de Agricultura Tropical, n.d. 5p. Span., Illus.

Cassava. Cultivars. Plant breeding. Cassava programs. Colombia.

Experience acquired in the first regional trials in Colombia was used as a basis for the initial structuration of an international cooperative network to evaluate cassava cultivars. Each year, the cassava breeding section at CIAT would supply the agronomy section with 5 promising cultivars, which would then be multiplied (using the rapid propagation system) for one year and tested in regional trials the following year. Regional trials of the first promising hybrids are scheduled for 1977. Once these cultivars have been widely tested, field days will be organized so that farmers may select material they would like to use. A group of collaborators, preferably CIAT-trained, will be basic in the worldwide testing and disseminating of material and technology. Two strategies for evaluating cultivars were proposed: (1) give the same opportunities to one group of cultivars for 3 consecutive years without considering their field behavior (conservative approach), or (2) select the most promising material yearly to be tested in several sites before being designated as varieties. A diagram illustrates what could happen to a promising variety. *(Summary by T.M.)* G01

0427-0857 ZANZIBAR. DEPARTMENT OF AGRICULTURE **Cassava.** *In* ——. Annual Report 1954 Zanzibar, 1955 10p Engl

Cassava. ***Manihot glaziovii.*** **Hybrids. Palatability. Cultivars. Field experiments. Tanzania.**

The hybrid varieties received from Amani in 1950 were again the subject of variety trials This year's results were of considerable interest in that the department's standard local variety Msitu was significantly outclassed by several of the hybrids Two experiments were reaped, and from both it was clear that Amani varieties Nos 4674/4, 46106/27 and 46106/26 are superior to Msitu in yield and in their degree of resistance to mosaic disease. They are apparently now quite palatable although they were classed as bitter in earlier trials All 3 are 3rd backcrosses between *M glaziovii* and cassava These 3 varieties are now being bulked for distribution to the public Full results of the variety trials are given in the experimental supplement to this report. Work continued on the 2nd batch of Amani hybrids received in 1953, these are being multiplied up to the variety trial stage. It is noteworthy that the behavior of new cassava varieties, particularly as regards palatability, is usually most variable during the 1st few years and tests made after the 1st year's harvest are not to be relied upon. A fertilizer experiment with cassava was laid down at Kizimbani *(Full text)* G01

See also 0021 0161 0162 0218 0297 0314 0342

G02 Cytogenetics

0428-1789 BOITEAU, P. **Cytologie du manioc.** *(The cytology of cassava).* Chronica Botanica 4(4/5):386-387. 1938. Fr.

Cassava. Cultivars. Chromosomes. *Manihot glaziovii.* **Hybridizing.** *Manihot esculenta.* **Cytology.**

Chromosomes from the meristems of rootlets from 20 varieties of cassava in Madagascar, Réunion, Java, etc. were studied. All the perfect varieties were diploids. Because of the number of chromosomes, their size and mitotic process, cassava seems to be one of the oldest dicotyledons. Varieties of *Manihot palmata* and *M. glaziovii*, were also studied. Hybridization between these species produced parthenocarpic fruits only, with poorly formed, sterile seeds. *(Summary by L.C. Trans. by T.M.)* G02

0429-2431 HSU, K. S. and VALERIO, J. **Preliminary observation on meiotic chromosome pairing in** *Manihot esculenta. In* Moh, C. C., ed. The application of nuclear energy to agriculture; annual report. Turrialba, Costa Rica, Instituto Interamericano de Ciencias Agrícolas, 1966. pp.20-22. Engl., 5 Refs.

Cassava. *Manihot esculenta.* **Cultivars. Chromosomes. Cytology. Costa Rica.**

Cytological examinations of meiotic chromosomes of *Manihot esculenta* were carried out to gather evidence as to whether this species is a diploid or a polyploid, to select some cultivars free from chromosomal aberrations for irradiation experiments, and to see if any cultivar had a chromosome number other than 2n= 36. The process used is fully described. Preliminary results obtained from 19 cultivars are given in a table. Four had normal meiosis, 9 had multivalent, mostly quadrivalent associations, and 6 had complex configurations in addition to recognizable multivalent associations. The nature and pairing relationship of these complex structures are not clear. *(Summary by T.M.)* G02

0430-3107 MOH, C. C and VALERIO, J. **Cytogenetics of** *Manihot. In* ______ . ed. The application of nuclear energy to agriculture. Turrialba, Costa Rica, Instituto Interamericano de Ciencias Agrícolas, 1965. pp.43-49. Engl., Illus

Cassava. *Manihot esculenta.* **Cytogenetics. Chromosomes. Plant fertility.**

The objectives of this study were to supply cytological information to the New York Botanical Garden to reinforce the taxonomical conclusions as to the relationships of the species of *Manihot* that are based only on morphological criteria and to select cytologically normal and stable lines for work on radiation-induced heterosis The study conducted on pollen sterility serves to predict the presence of cytological abnormalities. A table shows the great diversity in the level of fertility of the collected materials, ranging from 100% sterile to 100% fertile. The results so far obtained prove that there is a high percentage of chromosomal aberrations in sterile cultivars *(Summary by P.G. Trans. by S.S. de S.)* G02

H00 NUTRITION

0431-2111 BOOTH-TUCKER, F. **Cassava as famine food.** Agricultural Journal of India 3:227-230. 1908. Engl.

Cassava. Human nutrition. India.

Famine, as it afflicted other parts of India, has been unknown in Travancore for the last 30 yr because its inhabitants adopted the cultivation and use of cassava, which renders from 5-20 tons/acre and grows in practically every kind of soil. Sun-dried cassava and flour are low in cost and have high consumer acceptability. (*Summary by H.J.S.*) H00

0432-6716 FIGUEIREDO, A. DE A. **Maniok: seine Bedeutung als Nahrungs- und Futtermittel.** *(Cassava: its importance in human and animal consumption)* Deutsche Lebensmittel-Rundschau 70(9):322-325. 1974. Germ., Sum. Germ., Engl., Fr., 42 Refs., Illus

Cassava. Nutritive value. Human nutrition. Animal nutrition.

Cassava, because of its easy cultivation and quick growth, is a primary candidate as a carbohydrate source for human and animal consumption. It is a high-yielding crop that competes with other starch-bearing products in the manufacture of animal fodder, which caused the EEC to introduce import restrictions. If used as the sole basic staple in diets, it may cause malnutrition due to its low protein and vitamin content. The biological value can be increased through the admixture of essential substances It is definitely practicable to enrich cassava products with proteins since cassava flour has proved to be a good carrier for such additives. If no raw roots are eaten, the risk of HCN poisoning is very low and practically negligible *(Author's summary)* H00

0433-3202 KENSINGER, K. M. **Manioc and the Cashinahua (Peru).** Bennington, Vermont, Bennington College, 1971. 19p. Engl., 4 Refs., Illus.

Paper presented at the Symposium Manioc in Lowland South America, New York, 1971.

Cassava. Human nutrition. Cultivation. Uses. Processing. Peru.

The classification, production and usage of cassava by the Cashinahua, a group of Amerindians living along the Curanja and Alto Purus rivers of southeastern Peru, are described in detail, from the point of view of an anthropologist *(Summary by H.J.S.)* H00

0434-6987 MORAN, E. F. **Manioc deserves more recognition in tropical farming.** World Crops 28(4) 184-188. 1976. Engl, 21 Refs., Illus.

Cassava. Uses. Human nutrition. Industrialization. Processing. Brazil.

Cassava is a New World food that has become an important pantropical staple. Much of the criticism that has been made of this root crop is based on food biases and inadequate comprehension of its qualities. This article points to the economic, agronomic and cultural advantages of cassava as a tropical crop. Parts of the plant have been successfully used for fattening cattle, horses, pigs and poultry. Industrial applications have been found in the sizing, glue and particle-board industries—despite relatively inadequate funding and interest on the part of agricultural scientists. Cassava is far more productive per unit of land and per unit of labor than even the high-yielding varieties of cereals, it is productive in ecologically marginal areas; it is drought and pest resistant; and it stores well in the ground for up to 2 yr. This article suggests that cassava should be made a part of agricultural development schemes in the tropics beyond its obvious subsistence use. *(Summary by World Crops)* H00 I02

0435-0078 VON HAGEN, V.W. **The bitter cassava eaters.** Natural History 58(3):120-124. 1949. Engl., Illus.

Cassava. Human nutrition. Casave. Processing. Detoxification processes. Bitter cassava. South America.

A detailed description is given of the process followed by the Indian tribes of Central Amazonas to eliminate HCN from bitter cassava, a staple food in their diet. The objective is to highlight the perfection of such a primitive method. The procedures followed by the different tribes are basically the same, but the implements used vary. The women harvest, peel and grate the roots. The grated cassava is placed into a basket-work cylinder called tipití (1.80 m long x 7.5 cm in diameter), which is hung from a rafter and whose diameter can be increased or reduced by means of a stick that is placed at the base of the cylinder and that is used as a lever. After repeating this operation several times, a poisonous liquid is extracted; once boiled it is known as cassareep. The coarse meal left in the cylinder is ground in a mortar and sifted. Then some giant cassava "pancakes" are prepared and cooked over wood to eliminate the traces of poison; afterwards, they are sun dried until they harden. Although this is the basic food of all the tribes of the Central Amazonas, cassava is also consumed in many other forms (tapioca, for example) including spiritious liquors. *(Summary by S.S. de S.)* H00

H01 Cassava Foods and Nutritive Value

0436-7263 ARAUJO, T.M.V.C DE *et al.* **Valor biológico da farinha de mandioca enriquecida com concentrado proteico de peixe, proteína isolada da soja e caseína.** *(Biological value of cassava flour enriched with fish meal, soybean isolated protein and casein)* Revista Brasileira de Pesquisas Médicas e Biológicas 8(2) 139-142 1975. Port, Sum Port, Engl, 1 Ref, Illus

Cassava. Cassava flour. Food enrichment. Analysis. Proteins. Protein content. Carbohydrate content. Fat content. Ash content. Fibre content. Diets. Nutritive value. Brazil.

Because of the high consumption of cassava flour in Brazil and its low protein level, a study was made of processes for enriching cassava flour with fish meal and soybean isolated protein. Biological value was determined by the protein efficiency ratio in white rats, using diets with a 10% protein level, supplemented with vitamins, minerals, vegetable oil and cornstarch Best results were obtained with fish meal. *(Author's summary)* H01

0437-7264 ARAUJO, T M.V.C DE *et al.* **Valor nutritivo das misturas: feijão Macácar integral + farinha de mandioca e feijão Mulatinho integral + farinha de mandioca, suplementadas com diferentes níveis de metionina.** *[Nutritional values of diets containing beans (Macácar and Mulatinho) and cassava flour, supplemented with methionine at different levels].* Revista Brasileira de Pesquisas Médicas e Biológicas 8(2).143-147. 1975. Port., Sum Port., Engl., 5 Refs., Illus.

Cassava. Cassava flour. Methionine. Food enrichment. Diets. Protein content. Carbohydrate content. Fat content. Ash content. Fibre content. Analysis. Nutritive value. Brazil.

A study was made of the effect of methionine in diets prepared with beans and cassava flour. The biological value of the diet was determined by the protein efficiency ratio in white rats, using diets with protein levels of 10%, supplemented with 0.3 and 0 4% methionine. The results showed a significant increase in the biological value of the diet with 0.3% methionine, as compared with the control diet (no methionine); there was no significant increase at the 0.4% level *(Author's summary)* H01

0438-0916 BALU, V. and PARPIA, H. A B. **Tapioca macaroni goes to the people.** Mysore, Central Food Technological Research Institute. Food Science Extension Service. Bulletin no. 1. 1958. 47p. Engl., Illus.

Cassava. Tapioca macaroni. Human nutrition. Developmental research. Nutritive value. Processing. India.

Emphasis is placed on the role of extensionists and the method of demonstration used to introduce low-cost cassava macaroni (developed by the Central Food Technological Research Institute) in the diets of the people of Kerala (India). The macaroni product is made of cassava flour (60%), groundnut flour (15%) and wheat semolina (25%). A large-scale publicity campaign (newspapers, movies, radio, bulletins, etc) was conducted. In addition, public meetings and group discussions were held, during which audio-visual aids, illustrations, samples, methods of preparation, recipes, etc. were used to present the product. The campaign was successful in spite of the difficulties encountered by the extensionists (i.e., a psychological rejection) A historical account of cassava cultivation in India is included. Finally, some recipes using cassava macaroni as the basic ingredient are given Thanks to the work done by the team of extensionists from CFTRI and to government cooperation and mass media, it was possible to improve the people's diet through the introduction of cassava macaroni, which has double the protein content of rice. *(Summary by A J. Trans by S S de S)* H01

0439-4470 BENGOA, J. M. and JAFFE, W. **Tabla de composición de alimentos.** *(Food composition tables)* Caracas, Venezuela. Instituto Nacional de Nutrición. Cuaderno no. 1 1950. 16p. Span

Cassava. Composition. Nutritive value. Venezuela.

Analyses are made of the protids, lipids, glucides, Ca, P and Fe salts, Vitamins C, B complex and A contained in the majority of foods commonly consumed in Venezuela, including cassava and casave *(Summary by L.C. Trans by T.M.)* H01

0440-2166 BIGWOOD, E.J , CLOSE, J and ADRIAENS, E L. **Les acides aminés de la farine de manioc.** *(Amino acids in cassava)* *In* Bruxelles, Institut de Recherches Scientifiques au Congo. Cinquieme Rapport Annuel, 1952 p 181. Fr.

Cassava. Cassava flour. Amino acids. Protein content.

Cassava flour, the staple food of a large native population in Africa, is very poor in N Knowledge of its amino acid composition is of special interest for nutritionists Following the method of Moore and Stein for the isolation and determination of amino acids, a sample of flour from cassava retted according to indigenous methods was analyzed. It had a content of 1.9% protein (N quantity), which decompcsed into 18 amino acids, of which a large amount was ornithine. The 3 principal amino acids were glutamic acid (18.5%), ornithine (14 5%), and alanine (10%). Sulfur amino acid content was significantly low. This is the believed to be the 1st time that ornithine is reported as being part of a nutritonal protein *(Full text. Trans. by J.L.S.)* H01

0441-6717 BRUNS, P. **Nutritional, microbiological and physicochemical studies on chemically modified tapioca starch.** Ph. D. Thesis. New York. Cornell University. 1974 102p. Engl., 55 Refs., Illus.

Cassava. Cassava starch. Modified starches. Laboratory animals. Animal physiology. Nutritive value. pH. Analysis. Laboratory experiments. Digestibility. Metabolism. USA.

Nutritional and physicochemical studies were conducted on the modified cassava starch, hydroxypropyl distarch phosphate Rats fed unprocessed, modified starch for 30 days demonstrated increased food consumption, lowered food efficiency, increased fecal cholesterol excretion, chronic diarrhea, cecal enlargement and depression of cecal pH when compared to animals fed the unprocessed, unmodified cassava starch After 180 days, cecal enlargement and chronic diarrhea remained, but additional evidence of indigestibility was lacking. Moreover, rats fed processed, modified starch for 30 or 180 days also showed cecal enlargement and chronic diarrhea. The effect of hydroxypropyl distarch phosphate on Fe availability was studied in vivo. Modified starch enhanced Fe availability in Fe-adequate rats when Fe was allowed to react with the starch prior to ingestion. Fe availability was not affected by unmodified or modified starch in Fe-inadequate rats when Fe and starch were administered separately. Studies were conducted on the effects of processed and unprocessed, modified and unmodified cassava starch on the small intestine and cecum microflora of rats. Animals ingesting unprocessed, modified starch for 6 mo at a 35% dietary level showed significant changes in cecal populations of lactobacilli, coliforms and streptococci as compared to rats receiving unprocessed, unmodified starch. Populations of both small intestine and cecum streptococci declined to almost zero in 6 mo in animals fed unprocessed, modified cassava. Heat processing of the modified starch lessened the magnitude of the microflora shifts. The microbial data were interpreted as indicators of modified starch indigestibility. Both modified and unmodified, unprocessed cassava starch bound Cu, Fe, Zn and Mg ions in vitro. The modified starch always bound more mineral ions than the unmodified starch. The binding mechanism was not determined although several hypotheses were proposed. A possible therapeutic application was suggested. Overall, the results showed that beneficial as well as adverse effects may be associated with long-term ingestion of high levels of hydroxypropyl distarch phosphate. *(Summary by Dissertation Abstracts)* H01 I01

0442-0027 CAMPOS, F. A. DE M. **Pesquisas de alguns fatores do complexo vitaminico B em alimentos nacionales.** (*Research on some factors of the vitamin B complex in Brazilian foodstuffs*). Arquivos Brasileiros de Nutrição 1(3):179-185 1944. Port., Sum Port., Illus.

Cassava. Vitamin B. Cassava flour. Cassava starch. Tubers. Cooking. Nutrient loss. Food energy. Brazil.

The school of medicine at São Paulo studied the nutritive value of national foodstuffs as regards their energetic, chemical and vitamin content. In this paper, the results are given of work carried out on the vitamin B complex. Biological methods were used, making it possible to study dietary balance with rats. Raw and cooked cassava, as well as cassava flour and starch, are analyzed. Although the raw form is rich in riboflavin (vitamin B_2), this is lost in the flour-making process, after which only vitamin B_1 remains. (*Summary by T M*) H01

0443-6853 CHANDRA, S. and DE BOER, A.J. **Root crops and diets in two Sigatoka Valley villages.** Tropical Root and Tuber Crops Newsletter no. 8:19-22. 1975. Engl , 2 Refs

Cassava. Food energy. Energy productivity. Diets. Prices.

The diets of 2 nearby towns in the Sigatoka Valley—1 of them inhabited by Fijian villagers and the other by Indian small landholders—are compared. Both towns present the same ecological conditions. The data given in tables show the daily calorie and protein intake/adult, the proportion of food produced on the farm, daily production costs and level of sales. The Fijian villagers prefer root crops (cassava, taro, sweet potatos and yams) and the Indians, rice and vegetables. The daily food cost of an adult Indian is 50% greater than that of the adult Fijian because of the low cost of cassava in comparison with that of rice and vegetables; on the other hand, crop cash sales/family are lower in the case of the Fijians. Total caloric intake is more or less the same (natives, 1441; Indians, 1426), but total protein intake is very low for the former (14 0) as compared to the latter (42.1). *(Summary by S.S. de S.)* H01

0444-7250 DE VIZIA, B. *et al.* **Digestibility of starches in infants and children.** Journal of Pediatrics 86(1):50-55. 1975 Engl., Sum. Engl., 16 Refs.

Cassava. Cassava starch. Digestibility. Dietary value. Diets. Human nutrition. Human physiology. Italy.

The digestibility of various starches was studied in normal infants of different ages. During balance periods of 3 days, the fecal content of lactic acid, glucose, dextrins and starch was measured. At the age of 1, children were able to absorb almost completely 170 g/m² of body surface of cooked wheat starch given in the form of biscuits or macaroni A lower absorption coefficient was found for potato starch in biscuit form. Cooked wheat, tapioca, corn, rice and potato starch in amounts of 45 and 85 g/m² day, respectively, for 1- and 3-mo-old infants, were almost completely absorbed. In 1-mo-old infants larger amounts (110 g/m²/day) of cooked rice starch, were well tolerated; it should therefore be possible to provide a large part of the carbohydrate requirements of infants with cooked starches after they are 1 mo old *(Author's summary)* H01

0445-6723 DORAISWAMY, T. R *et al.* **Studies on enriched tapioca macaroni products. V. Supplementary value to the diet of weaned infants and young children.** Food Science 10(12):389-393. 1961., Engl., Sum. Engl., 14 Refs.

Cassava. Tapioca macaroni. Food enrichment. Protein content. Fat content. Carbohydrate content. Mineral content. Vitamin content. Dietary value. Diets. Human health. Human nutrition. India.

The diets of 3 groups of children who ordinarily ate milled rice with some milk and small amounts of bread, vegetables and pulses were supplemented for 6 mo with 2 oz daily of tapioca macaroni, unenriched or enriched with 15% chickpea flour or 2 5% casein. Each group had 17 girls and 16 boys (8-36 mo old). Increases in height, weight and Hb of both boys and girls were significantly greater in the groups given the blends than in the control group and were greatest in the children who got the casein Nutritional status improved in 3, 21 and 23 children in the respective groups *(Summary by Nutrition Abstracts and Reviews)* H01

0446-6722 DORAISWAMY, T. R. *et al.* **Studies on enriched tapioca macaroni products. VI. Supplementary value to the diet of school children.** Food Science 10(12) 393-397; 1961. Engl., Sum. Engl., 8 Refs.

Cassava. Tapioca macaroni. Dietary value. Human nutrition. Food enrichment. Composition. Diets. Human health. India

Two groups each of 17 boys and 20 girls aged 6-11 yr were given daily for 4 mo, as additions to their ordinary diets in a boarding home, 4 oz tapioca macaroni, unenriched or enriched with 15% chickpea flour. Mean increases in height, weight, and RBC were significantly greater and the increases in Hb was greater, although not significantly so, in the group given the enriched product. Nutritional status improved in 31 of the children in this group but in only 7 in the other group *(Summary by Nutrition Abstracts and Reviews)* H01

0447-6924 ECHEVERRY U., L. E. **La yuca en la alimentación de los colombianos.** *(Cassava in Colombian diets). In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp. 169-172. Span.

Cassava. Tubers. Leaves. Fat content. Protein content. Fibre content. Ash content. Sugars. Starch content. Ca. Iron. P. Colombia.

General comments on the nutritive and industrial value of cassava are given. Analyses of the chemical composition of peeled and unpeeled roots, of the peel and the leaves are included. Using common methods of starch extraction, up to 80% efficiency can be achieved. Since the leaves are rich in nutrients, they can be used for forage. *(Summary by A.J. Trans. by S.S. de S.)* H01 C03

0448-6989 EL-HARITH, E A., DICKERSON, J.W.T. and WALKER, R. **On the nutritive value of various starches for the albino rat.** Journal of the Science of Food and Agriculture 27(6) 521-526 1976. Engl., Sum Engl., 18 Refs.

Cassava. Cassava starch. Dietary value. Laboratory animals. Animal physiology.

The effect of raw potato starch on N retention was compared with that of maize starch when used as main sources of carbohydrate in synthetic diets. The effect of raw potato starch on food efficiency was compared with that of other starches In addition to the gastrointestinal effects previously described by El-Harith et al, raw potato starch caused serious impairment of the net protein utilization and food efficiency values when fed to growing rats The gross cecal hypertrophy, accompanied by mortality caused by diets containing 71% raw potato starch, was not encountered when using any of the cereal starches or cassava starch. *(Summary by T.M.)* H01

0449-4384 FERNANDES, E. and LIRA, M.B **Bromatologia das farinhas de mandioca produzidas no Amazonas.** *(Bromatology of cassava meals produced in the Amazonas).* Arquivos Brasileiros de Nutrição 18(1/2) 87-94. 1962. Port., Sum. Port., Engl, Fr, 5 Refs.

Cassava. Cassava flour. Water content. Food energy. Protein content. Fat content. Carbohydrate content. Fibre content. Ash content. Mineral content. Brazil.

Cassava meal is a basic staple in the Amazonians' diet. Although it is criticized for its low protein content, it greatly facilitates adequate trypic digestion because of its high starch content. This is important in view of the enormous quantity of animal and fish protein consumed in the regional diet. There are two types of cassava meal produced in the state of Amazonas: "farinha seca" and "d'agua" Because of the different market demand and prices for these products, it is not surprising that attempts are made to pass off the inferior one. Therefore, a chemical analysis was made of 9 samples of meal from Amazonas. Characterization of the two types cannot be made merely on the basis of humidity, acidity, ash and starch content. They may be more accurately defined according to their crude fiber content; above 2.5 g/100 g for farinha seca and below this figure for farinha d'agua. It is interesting to note that both meals have an appreciable quantity of Ca (up to 100 mg/100g), Fe (up to 6.5 mg/100g), and P (up to 71 mg/100g); as compared to soybeans (whole grain), which contain 20 mg/100g of Ca, 57 of P and 0.64 of Fe *(Summary by T M.)* H01

0450-6721 GOPALAKRISHNA RAO, N. *et al* **Studies on enriched tapioca macaroni products. III. Over-all growth promoting value.** Food Science 10(12).383-385. 1961. Engl., Sum Engl., 2 Refs

Cassava. Tapioca macaroni. Food enrichment. Diets. Composition. Laboratory animals. Animal physiology. Cereals. Nutritive value. India.

Four blends of enriched tapioca macaroni, containing cassava flour, groundnut flour, semolina, Ca and vitamins plus (A) 2 5% casein, (B) no casein, (C) 10% nonfat milk solids, or (D) 15% chickpea flour, were fed free choice to weanling rats as the sole diet for 8 wk. All 4 products promoted high weight gains. Product A was significantly superior in growth-promoting value to a proprietary cereal food. Supplementation with whole milk powder improved the value of the cereal but not that of the product. *(Summary by Nutrition Abstracts and Reviews)* H01

0451-0026 GRANER, E. A. *et al.* **A mandioca e o seu valor nutritivo.** *(The nutritive value of cassava).* Hospital 26(6) 879-894. 1944. Port., 23 Refs., Illus.

Cassava. Cultivars. HCN content. Timing. Nutritive value. Mineral content. Vitamin content. Protein content. Water content. Starch content. Chromosomes. Brazil.

Values for the different types of Brazilian cassava varieties range from 57-71% moisture (at 110°C), 37-82 mg/100g P, 0.44-1.49 mg/100 g Fe, 0.012-0.05 g/100 g Ca, 0.64-1 49 g/100 g proteins. Fresh cassava contains vitamins B_1 and B_2, the latter being destroyed or eliminated during the preparation of flour, thiamine (in the flour) varies from 33-100 IU / 100 g. *(Summary by Chemical Abstracts)* H01 C03

0452-6718 JOSEPH, K. *et al.* **The effect of replacing rice in the diet by tapioca macaroni on the metabolism of nitrogen, calcium and phosphorus in children.** Food Science 7(9):253-254. 1961. Engl., Sum. Engl., 2 Refs.

Cassava. Tapioca macaroni. N. P. Ca. Metabolism. Human physiology. Human nutrition. India.

Replacement of rice with tapioca-macaroni in children's diets resulted in an increase in the retention of N, Ca and P; but the difference between the experimental and control groups was not statistically significant. *(Summary by Tropical Products Institute)* H01

0453-1659 KIM, J. C and DE RUITER, D. **Bread from non-wheat flours.** Food Technology 22(7):867-878. 1968 Engl. 14 Refs., Illus.

Cassava. Cassava bread. Breads. Palatability. Cassava flour. Food energy. Bakery products. Analysis. Composite flours. Bread improvers. Nutritive value. Proteins. Cassava starch.

Bread consumption has increased in many parts of the world where previously it had not formed part of the daily diet. Nevertheless, the wheat required to satisfy this demand is grown only in a few countries inhabited by less than 1/3 of the world's population. The developing countries grow various starchy tubers (cassava, sweet potatoes, yams) or cereals (maize, millet or sorghum) that may be used as food. Flours prepared from tubers have a high starch content and therefore meet nutritional calorie requirements. The protein content, however, is very low. Palatability of nonwheat breads, their consistency, starch granule binding and comparisons of raw materials including protein and starchy components are discussed. A more detailed study is made of cassava/soybean flour and the feasibility of substituting cassava starch for cassava flour. These experiments suggest that the combination of cassava flour and cassava starch has breadmaking potential, warranting further investigation. It was also found that the finer fraction obtained by sifting cassava flour resulted in greater loaf volume. Processing variables such as the duration of final proof, the effect of sugar added, the inclusion of an intermediate fermentation and varying mixing speeds are also dealt with. As regards nutritional values of nonwheat flours, the nitrogen and protein (N x 5.7) contents were analyzed. Experiments using rats were carried out to determine net protein utilization and digestibility, the protein efficiency ration and biological value of protein. *(Summary by L.C. Trans. by T.M.)* H01 I02

0454-6965 KOCH, D E. V **Foodstuffs.** Tropical Agriculturist 87(5):296-298 1936. Engl., 2 Refs

Cassava. Cassava flour. Nutritive value. Sri Lanka.

Analyses are made of rice brans, olu seeds *(Nymphaea lotus)*, cassava flour and arrowroots. The food value of cassava flour was 88.8, it had a nutritive ratio of 1:47. *(Summary by T.M.)* H01

0455-3809 LAL, B. M., RAJAGOLAPAN and GIRI, K V. **Utilisation des graines oléagineuses pour l'alimentation humaine.** *(Utilization of oil seeds in foodstuffs)* Oléagineux 7(11):637-639. 1952. Fr., 3 Refs.

Cassava. Human nutrition. Food enrichment. India.

Famine has led India to consider the possibility of manufacturing a food rich in plant protein based on oilseeds. In the past, these plants were utilized only for oil extraction, but the Central Food Technological Research Institute (Mysore, India) is already using soybeans and peanuts for the preparation of oil cakes enriched with vitamins and minerals. One of the foods produced is a mixture of peanuts, soybeans, sesame and cassava (the carbohydrate source). Its appearance and taste are pleasant, and excellent results have been obtained with trials carried out with 5- to 15-year-old children. This protein supplement is ideal to balance their daily rice-based diet. The manufacturing process is described. India should take the necessary steps to profit from the millions of tons of peanuts and sesame produced annually that could be used for human consumption. *(Summary by S.S. de S.)* H01

0456-4392 LELONG, M *et al.* **Le tapioca dans l'alimentation du nourisson de 6 mois.** *(Tapioca in diets for children under six years of age).* Archives Françaises de Pediatrie 17(10) 1270-1281. 1960. Fr., Sum. Fr., 7 Refs., Illus.

Cassava. Dietary value. Human nutrition. Tapiocas. Food energy. Digestibility. Milk. Ash content. Protein content. Starch content. Human physiology.

Although tapioca has many good qualities and it is very inexpensive, it has not gained wide acceptance in children's diets. Cassava starch increases tryptic proteolysis and has a weak buffering capacity. Its energetic value is 359 cal/100 g. Having almost no protein, it is a food with practically no antigen capacity, making it good for children with allergies. In order to appreciate these qualities, tapioca was used in two simple preparations (1) liquid formulas with small amounts of tapioca to improve the digestive qualities of cow's milk in babies' diets during the first months and (2) a somewhat thicker preparation similar to a light porridge for older children The former proved completely satisfactory with fresh, as well as powdered cow's milk. Nursing babies could also be given this formula. Formulas used with diluted or reconstituted milk and the light porridge were introduced into diets for 1,000 babies ranging in age from a few days to a month Tolerance was perfect: there were no cases of regurgitation, vomiting, abdominal swelling, or diarrhea. Appetites were normal; weight increases were too. Equal results were obtained with premature babies weighing from 2,000 to 2,900 g. *(Author's summary. Trans. by T.M.)* H01

0457-4329 LOPEZ A., J M , SANTOS R , A. and DEAN G., M. **Oligoelementos en alimentos españoles de origen vegetal. I. Cereales y legumbres.** *(Trace elements in Spanish foods of plant origin I. Cereals and vegetables).* Anales de Física y Química 41:1358-1367. 1945. Span , Sum. Span., 4 Refs.

Cassava. Cassava starch. Composition. Analysis.

This article discusses the importance of trace elements for both plant and animal life. A study was made of the trace elements found in 29 samples (19 vegetables and 10 cereals) by means of spectrochemical methods The method is described in detail. As far as cassava is concerned, the ashes from the starch were used for analysis, the results of which are given in a table. In the last part, an analysis is made of each microelement and its possible interaction in the samples *(Summary by L.F.C. Trans. by S.S. de S.)* H01

0458-3866 LUYKEN, A. P. *et al.* **De voedingswaarde van het eiwit van cassave blad.** *(The nutritive value of cassava leaf protein).* Zeist, Holland, Central Instituut voor Voedingsonderzoek, Rapport no. R 2617. 1968 7p. Dutch, Sum Dutch

Cassava. Leaves. Nutritive value. Proteins content. Proteins. Analysis. HCN content. Laboratory experiments.

Cassava leaves (33% dry matter content) from Dahomey contained an av of 8.4% crude protein.

HCN content varied from 0-923 mg/kg fresh matter. Tryptophan, methionine and cystine levels were low. As determined with rats, the biological value of the protein and its digestibility were very low. Addition of methionine improved this; therefore, methionine is the most limiting amino acid. *(Author's summary. Trans. by A. van S.)* H01

0459-0574 MAGHUIN-ROGISTER, G. **Un disaccharide nouveau extrait de la farine de manioc. II. Synthèse du 5-0-α-D-glucopy-ranosyl D-glucofuranose.** (*A new disaccharide from cassava flour. II. Synthesis of 5-0,-α-D-glucopyranosyl D-glucofuranose*). Bulletin des Societés Chimiques Belges 77:575-578. 1968. Fr., Sum. Fr., Engl., 8 Refs., Illus.

Cassava. Cassava flour. Analysis. Sugars.

The chemical synthesis of 5-0-α-D-glucopyranosyl D-glucofuranose was conducted by 2 methods: (1) Koenigs-Knorr's synthesis based the halogenation of β-glucoside and (2) synthesis based on Brigl's anhydride. It was found that the synthetic compound had the same properties as the one found naturally in cassava (common name, maniocose). This oligosaccharide was the only disaccharide from D-glucose which had not been identified previously. (*Author's summary*) H01

0460-0953 MASSAL, E. and BARRAU, J. **Cultures vivrières du Pacifique: le manioc.** (*South Pacific crops: cassava*). Commission du Pacifique Sud. Bulletin trimestriel 5(4):23-32. 1955. Fr., 6 Refs., Illus.

Cassava. Cultivars. Cultivation. Nutritive value. Vitamin content. Protein content. Mineral content. Fat content. Tubers. Leaves. Human nutrition.

This article deals with 3 aspects of cassava growing in the South Pacific: (1) a general description of the plant, the 2 species known, soil requirements, systems of propagation, environmental characteristics affecting yield and storage; (2) chemical composition and energetic and caloric value of roots and leaves; (3) methods of preparing cassava—peeled and boiled, roasted over charcoal or in the oven—as tapioca, and sun drying the roots after which they are grated and mixed with coconut milk, etc. *(Summary by S.S. de S.)* H01

0461-5932 MORSE, R. E and URAIH, N. **Protein enriched gari.** Canadian Institute of Food Science and Technology. Journal 7(2):151-154. 1974. Engl., Sum. Engl., 9 Refs.

Cassava. Gari. Nutritive value. Composition. Proteins. Food enrichment. Nigeria.

The purpose of this study was to enrich gari, a major item in Nigerian diets, with indigenous protein sources, using rudimentary equipment to produce a food product indistinguishable from gari. Rats were fed (1) a 5% protein level supplied by a gari-coconut mixture; (2) a 5% protein level supplied by gari-orange-coconut mixture; (3) gari with protein adjusted to 5% by adding casein; and (4) unfortified gari (1.5% protein). Treatment I gave satisfactory results; but when further supplemented with 15% orange during extraction, a slightly better quality protein results and a new food suitable for children is obtained. *(Summary by T.M.)* H01

0462-6794 MOTA, T.P. and LOURENÇO, M. C. **A farinha de mandioca de Moçambique.** (*Cassava flour from Mozambique*). Agronomia Moçambicana 8(1).47-59. 1974. Port., Sum. Port., Engl., Fr., 37 Refs., Illus.

Cassava. Cassava flour. Starch content. Protein content. Fat content. Fibre content. pH. Cellulose. Aflatoxins. Analysis. Portuguese East Africa.

Samples of cassava flour were collected from different sources in Cabo Delgado, Nampula, Ilha, Zambézia and Inhambane districts; 26 of these samples were tested chemically and microbiologically. Contents of starch (75.78-86 76%), crude protein (0.95-3 36%), crude fat (0.21-1.04%), crude fiber (0.94-2.79%) and ash (1 71-3 36%) were comparable to those reported previously by several authors Moisture varied from 9.90-16 05%, the lowest values corresponding to recently produced flours Very high aflatoxin contents were detected (0.50-4.61 ppm), which exceeds the limits admissible for human consumption. Thermophilic and mesophilic sporulated bacteria, as well as some fungi, were detected in the microbiological analysis. Of particular interest is the fact that most of the samples revealed the presence of *Streptococcus fecallis* and 3 of them contained *Staphylococcus aureus.* This shows the bad quality of cassava flours consumed by approx. 50% of the rural population; consequently, a better cassava processing technology must be developed in Mozambique. (*Author's summary*) H01

0463-6760 MURTHY H.B.N., SWAMINATHAN, M. and SUBRAHMANYAN, V. **Effects of partial replacement of rice in a rice diet by tapioca flour on the metabolism of nitrogen, calcium and phosphorus in adult human beings.** British Journal of Nutrition 8(1):11-16. 1954. Engl., Sum Engl, 12 Refs.

Cassava. Cassava flour. N. Ca. P. Metabolism. Human nutrition. Human physiology. Food energy. Proteins. India.

The metabolism of N, Ca and P was studied in 6 men fed on rice-based diets and on a mixture of 75% rice and 25% cassava. The av daily intake of N on the rice diet and the rice cassava diet was 9.69 and 8.93 g, respectively. In spite of a slightly lower N intake on the latter, the av retention of N on the 2 diets was 2.65 and 2.75 g, respectively. Four of the 6 experimental subjects were in positive Ca balance and 2 in negative balance on the rice diet; all 6 subjects were in positive Ca balance on the rice/cassava diet. The av daily retention of Ca was 47 2 mg on the rice diet and 153 4 mg on the rice/cassava diet, the difference being statistically significant The av daily intake of P was nearly the same on both diets. The av absorption of P was only 43% on the rice diet as compared with 60% on the rice/cassava diet. The av daily retention of P was 196 mg on the rice diet and 470 mg on the rice/cassava diet, the difference being statistically significant. *(Author's summary)* H01

0464-5346 OKE, O. L. **A nutrition policy for Nigeria.** World Review of Nutrition and Dietetics 14:1-47. 1972. Engl, 21 Refs., Illus

Cassava. Human nutrition. Protein deficiencies. Vitamin deficiencies. Mineral deficiencies. Dietary value. Diets. Composition. Food energy. Gari. Nigeria.

An analysis is made of nutritional problems in Nigeria, due mainly to the lack of proteins and the vitamin B complex Cassava has replaced other staples such as rice and millet in spite of its low protein content. Cassava is generally consumed in fermented form (gari), this foodstuff is very low in protein, and amino acids are not balanced. A gari-based diet gives very good results when supplemented with casein and soybeans because this corrects the amino acid imbalance, as well as methionine, lysine, isoleucine and valine deficiencies The calories supplied by different diets in several regions are presented in tables. The consumption of foodstuffs with a greater protein content to supplement cassava and the industrialization of agriculture are recommended. (*Summary by L.F.C. Trans. by S. S. de S.*) H01

0465-2266 OOMEN, H A. P C **Vegetable greens, a tropical undevelopment.** Chronica Horticulturae 4(1) 3-5. 1964 Engl, Illus.

Cassava. Cassava leaves (vegetable). Food energy. Protein content. Vitamin content. Mineral content. Human nutrition.

Adequate consumption of green vegetables among the indigenous people of tropical regions is found only in a few areas where acute food shortage prevails On the whole, vegetables are consumed in insignificant quantities only, although a multitude of wild-growing plants have edible green parts and many of them can easily be grown around homes or in small plots. Special attention is drawn to the semiaquatic weed *Ipomoea reptans*, which is highly valued in Indonesia. The unfavorable consequences of substituting cassava for nutritionally more valuable crops, which is taking place in several countries, may be partly counteracted by consuming its leaves as well. More research on edible leaves and their preparation and more propaganda for their use are urgently needed since increased vegetable consumption will prevent many cases of blindness resulting from vitamin A deficiency. (*Summary by Tropical Abstracts*) H01

0466-5572 OROK, E.J. and BOWLAND, J.P. **Nigerian cocoa husks and cassava meal as sources of energy for rats fed soybean meal or peanut meal-supplemented diets.** Canadian Journal of Animal Science 54(2).229-238. 1974. Engl., Sum. Engl., 10 Refs

Cassava. Cassava meal. Diets. Dietary value. Amino acids. Fat content. HCN content. Protein content. Food energy. Laboratory experiments. Animal nutrition.

Nigerian cocoa husks (CH) and cassava meal (CM) were evaluated chemically and biologically in comparison with Canadian yellow corn (C), Canadian soybean meal (SBM) and US peanut meal (PNM) using weanling Sprague-Dawley rats. The growth experiment lasted 4 weeks. Five major dietary energy-protein combinations were employed, one of which was supplemented with DL-methionine and L-lysine Each major dietary category was subdivided into three isocaloric (3,600 kcal digestible energy/kg) subgroups containing 20, 16 and 12% crude protein, respectively. The crude fat, crude protein and amino acid contents of the foodstuffs and HCN contents of CM and cassava root peels, and the theobromine content of detoxified and undetoxified CH were determined. Energy source substantially influenced the response to protein supplementation of the diets Inclusion of CM at 30-50% of the diet gave the best overall performance. Isonitrogenous substitution of detheobrominized CH for 6.7% corn in the C-PNM diet gave growth response and energy and nitrogen digestibilities that compared favorably to C-PNM or C-PNM supplemented with DL-methionine and L-lysine, thus suggesting that detheobrominized CH could be utilized efficiently in animal diets. *(Author's summary)* H01 H04

5385 PANDITTESEKERA, D. G., and ELIKEWELA, Y. **Some indigenous feedingstuffs of Ceylon.** Tropical Agriculturist 103 176-178. 1947. Engl , 4 Refs.

Cassava. Tubers. Fresh products. Dried tubers. Water content. Protein content. Carbohydrate content. Fibre content. Mineral content. Food energy. Sri Lanka.

Since existing supplies of livestock feeds (rice straw and bran, coconut meal, etc.) presently used in Ceylon satisfy only 10% of the requirements, other possible sources of forage are presented Among these are cassava roots, breadfruit, plantain, pumpkin leaves, *Saccharum arundnacum*, *S. spontoneum*, sugar cane tops, etc Cattle should not be fed fresh cassava roots due to possible HCN poisoning; the meal is used for fattening swine. Yields of 40 tons roots/acre (13 5 tons meal/acre) are obtained in Ceylon. The chemical composition of the crops studied is given in a table. (*Summary by A J Trans. by S. S. de S*) H01 C03

0468-0094 PIRIE, N.W. **Novel protein sources for use as human food in wet tropical regions.** *In* Congrès International des Industries Alimentaires et Agricoles, Ier., Abidjan, Cote d'Ivoire, 1964 pp.237-248. Engl., Sum. Engl., Fr., Germ., 14 Refs.

Cassava. Proteins. Human nutrition.

The people living in tropical rain forests are among the least well-nourished in the world. Their main staples (cassava, yams, bananas, sugar cane, etc) are excellent sources of carbohydrate, but protein deficiency is acute. It should be possible to increase production of green vegetables quickly, but difficulties can be foreseen with protein-rich seed crops. Leaf crops and coconuts grow well in the wet tropics, but they cannot be used directly in quantity as protein concentrates in human food. Research has shown that palatable protein of good nutritional value can be extracted from them; this work should now move from the research to the development phase. At the same time, various agricultural products and by-products should be studied as carbon sources on which edible microorganisms could be grown with the addition of a source of N. Protein concentrates made from these 3 sources resemble those made from groundnuts, soybeans or fish in that they have unfamiliar appearances; their flavors are likewise unfamiliar. They will, therefore, have no immediate appeal to the consumer so care must be taken to devise suitable forms of presentation before marketing them. Work is urgently needed on the related problems of perfecting the methods for making these novel proteins, continuing the assessment of their nutritional value, and devising methods for presenting them on the table. All should be carried out at the same institute, and new institutes dedicated to producing protein concentrates from local products for local consumption are needed in wet tropical areas. (*Author's summary*) H01

0469-6936 PRADILLA, A., BRENES, F. and ALVAREZ-LUNA, E. **Analytical and biological studies of a high-yielding, high protein cassava.** Archivos Latinoamericanos de Nutrición 25(2) 175-186 1975 Engl., Sum. Engl , Span , 10 Refs

Cassava. Proteins. Analysis. Human nutriton. N. Colombia.

Cassava and plantain have been considered solely as energy sources in diets of tropical populations; however, they represent 10% of the total protein intake in Colombia. Studies on several cassava cultivars revealed one high-yielding type with a protein concentration 3 times higher than that of normal varieties Although analyses of this protein show it to be of very poor quality, it was an acceptable source of nonessential N in diets for preschool children recovering from protein-calorie malnutrition (*Author's summary*) H01

0470-4995 PUPO, L M. *et al.* **Avaliação sensorial de novos clones de mandioca.** *(Organoleptic evaluation of new cassava clones).* Coletânea do Instituto de Tecnologia de Alimentos 3:57-64. 1969/70. Port., 3 Refs

Cassava. Clones. Palatability. Organoleptic examination. Brazil.

New cassava clones were evaluated for their flavor, texture and consumer preference in both raw and cooked form. A local variety was used as the check. The sweet varieties were preferred; no great differences were observed between raw and cooked samples. The following clones were best: 454 (check), IAC 67-66, IAC 19-66, IAC 121-66, IAC 80-66 and IAC 113-66 *(Summary by T.M.)* H01

0471-5018 RANGEL, J. DE C. **A cultura da mandioca e sua industrialização.** *(Cassava cultivation and its industrialization)* Revista da Sociedade Rural Brasileira 17(204):38-43. 1937 Port

Cassava. Tubers. Cassava flour. Fat content. Protein content. Carbohydrate content. Vitamin content. Dietary value. Human nutrition. Cultivation. Brazil.

General background data are given on the uses of cassava and the chemical composition of the roots as well as the flour. Since cassava starch is easily assimilated and contains the vitamin B complex and vitamins D and E, it is good in diets for children, convalescents, nursing women, etc.

The cultivation of cassava is suggested as a substitute for coffee as an export commodity Production costs (1937) are analyzed for the cultivation and industrialization of cassava. Local problems and government policies are discussed. *(Summary by T.M.)* H01 D02

0472-5945 RODRIGUES, A DE P **Valor alimentar dos paes mixtos; farinha de mandioca e fubá de milho.** *(Nutritional value of bread made from composite flour (maize and cassava)* Revista Alimentar (Brazil) 1:56-59. 1937. Engl.

Cassava. Breads. Composite flours. Cassava flour. Water content. Protein content. Cellulose. Food energy. Fat content. Mineral content. Nutritive value. Brazil.

The chemical composition of different breads made from composite flours (wheat, cassava and maize) is given. A mixture of wheat and maize is recommended although the vitamin content is low. *(Summary by T M)* H01

3863 SCHWARTZKOPFF, E.M. and WILSEY, E. M **La yuca; modos de prepararla para la mesa.** *(Cassava as a foodstuff).* Río Piedras, Universidad de Puerto Rico, Colegio Agricultura y Artes Mecánicas. Circular de Extensión no. 1. 1935. 17p Span., Illus.

Cassava. Human nutrition. Nutritive value. Puerto Rico.

The 2 kinds of cassava, their uses and differences are described briefly. The nutritive value of cassava and other tubers are compared in a table. Some recipes and menus based on cassava are included. *(Summary by L.F.C. Trans. by S.S. de S)* H01

0474-1604 SEERLEY, R W., ROGERS, D. J. and OBIOHA, F. C. **Biochemical properties and nutritive value of cassava.** *In* Hendershott, C H. *et al* A literature review and research recommendations on cassava *(Manihot esculenta* Crantz). AID contract no. csd/2497. Athens, University of Georgia, 1972. pp. 99-130. Engl., 847 Refs.

Cassava. ***Manihot esculenta*** **Tubers. Leaves. Water content. Protein content. Fibre content. Fat content. Ash content. Amino acids. Mineral content. Vitamin content. Cassava products. HCN content. Nutritive value. Biochemistry.**

This bibliographic review of 847 documents was made with the purpose of determining the chemical composition, biochemical processes and nutritive value of cassava. Carbohydrate, lipid, protein, mineral and vitamin contents vary greatly according to the variety or line, locality, environmental conditions and method of chemical analysis. In view of the wide range of variation, emphasis was placed on the necessity of taking into account the physical (peeled, unpeeled, etc.) and moisture conditions of the product when presenting analytical data Starches represent 64-72% of root dry matter. Lipid content (0.5%) is insufficient for feeding animals with cassava-based diets Roots have a low protein content (0.7-2.6% DM), whose digestibility is only 48%, in addition, they are deficient in essential amino acids, especially methionine, lysine and tryptophan. In contrast, cassava leaves are rich in protein (20.6 to 36.4%), deficient in methionine and marginal in tryptophan. Quality and quantity of protein alter during processing but could be improved by means of bacterial fermentation; this aspect requires further study. Although cassava roots contain nutritionally significant amounts of Ca, Fe, ascorbic acid, niacin, riboflavin and thiamine, these decrease during processing. In addition to discussing variations in content, function and role in the biochemical processes of the aforementioned compounds, the different contents of cyanogenic glucosides and their role in protein synthesis were studied. Differences between sweet and bitter varieties have not been established yet. Some illnesses such as tropical atoxic neuropathy, sterility and pellagroid diseases are probably caused by HCN poisoning. *(Summary by A.J. Trans. by S S. de S.)* H01 C03

0475-0877 SUBRAHMANYAN, V. **Tapioca macaroni.** Food Science 12(5):135. 1963. Engl.

Cassava. Tapioca macaroni. Human nutrition. India.

Cassava, which has a very low protein content (about 1%), can be suitable, enriched with groundnut flour and processed into a product with the shape and size fo rice or any other product that would appeal to the consumer. Several hundred tons of a product named tapioca macaroni, containing a higher percentage of protein and more of Ca than rice were made. The extensive trials carried out by the Central Food Technological Research Institute in Kerala during the late fifties showed that the product was generally acceptable to a large section of the people. The trials carried out by the State Health authorities showed that the product promoted better growth than rice. Plans for setting up a 20-ton plant in Kerela had been approved by the Government of that state, but subsequently other difficulties, including shortage of foreign exchange, made it necessary to defer large-scale production for some time. Indian contribution in this field has attracted a great deal of attention in other parts of the world, and there are already 3 or 4 fair-sized plants operating in some of the Far Eastern countries. The UN and some leading manufacturing concerns in Europe and America are interested in this development. The concept of enriching a low-grade food with a cheap, protein-rich material and then processing it to meet the requirements of the consumer is now recognized as being not only fundamentally sound but also realistic and feasible. Such products can also be supplemented with minerals and vitamins so as to improve the quality further. Consumption of such products, even as a part of the diet, will help to reduce some of the dietary deficiencies besides reducing the pressure on the requirements of staple foods; viz., rice and wheat. *(Full text)* H01

0476-6759 SUBRAHMANYAN, V., MURTHY, H B.M. and SWAMINATHAN, M. **Effects of partial replacement of rice, wheat or ragi *(Eleusine coracana)* by tuber flours on the nutritive value of poor vegetarian diets.** British Journal of Nutrition 8(1):1-10. 1954. Engl., Sum. Engl., 12 Refs.

Cassava. Cassava flour. Nutritive value. Laboratory animals. N. Ca. Metabolism. Animal physiology. Diets. India.

Substitution of rice, wheat or ragi by cassava or sweet potato flour to the extent of 25% in a poor vegetarian diet did not lead to any deterioration in the overall growth-promoting value of the diet when fed to albino rats. In fact there was a distinct improvement in the growth response of rats on the rice/cassava diet as compared with the rice diet. The incorporation of groundnut cake flour with tuber flours (in the ratio of 1:4) as a partial substitute for rice, wheat or ragi led to further improvement in the overall nutritive value of the diet. Paired-feeding experiments showed that when food intake was equalized, the av weekly increase in body weight of rats on the rice/cassava diet was not significantly different from that observed on the rice diet. Experiments studying the supplementary value of minerals present in cassava showed that the value was mainly due to the extra Ca contributed by cassava. The N and Ca metabolism in rats fed on rice-based diets and on a mixture of rice and cassava was studied. The retention of N was of the same order in the animals fed ad libitum on both diets; but when pair fed, the retention of N was significantly lower in the rats on the rice/cassava diet. The av weekly retentions of Ca by rats on the rice/cassava diet were 6 and 4 mg more than those observed in rats on the rice diet when the animals were fed ad libitum and by the paired-feeding technique, respectively. The effect of replacing different percentages of rice by cassava flour on the nutritive value of a poor vegetarian rice diet was studied. Even when 50% of the rice was replaced by cassava flour, there was no deterioration in the overall growth-promoting value (as compared with an exclusive rice diet), provided the diet was fed ad libitum. *(Author's summary)* H01

0477-6754 SUBRAHMANYAN, V., RAMA RAO, G. and SWAMINATHAN, M. **Investigations on the preparation, properties and nutritive value of rice substitutes from** tubers and millets. Journal of Scientific and Industrial Research (Section B) 9(10):259-261. 1950. Engl., 2 Refs

Cassava. Cassava flour. Food enrichment. Human nutrition. Nutritive value. Processing. India.

Substitutes for rice can be prepared from maize and cassava flours. Products obtained from a mixture of cassava and groundnut cake flours were light brown in color but proved quite acceptable when cooked separately or with rice. *(Summary by Tropical Products Institute)* H01

0478-6768 SUBRAHMANYAN, V. *et al.* **Grain substitutes.** Bulletin. Central Food Technological Research Institute (India) 3(7):162-165. 1954. Engl., Sum. Engl., Illus.

Cassava. Food enrichment. Water content. Protein content. Fat content. Fibre content. Ash content. Carbohydrate content. Mineral content. Vitamin content. Food energy. Processing. Tapioca macaroni. India.

Rice shortages prompted investigations into "synthetic rice" in Mysore. There were already 7 commercial products of this nature on the world market, such as "mock rice" and "barley rice." A cheap and plentiful raw material (cassava flour) with an added source of protein (groundnut flour) was blended in the proportion 85:15. The process of manufacture is described, and a table shows the analytical data of some rice substitutes as compared with natural rice *(Summary by Tropical Products Institute)* H01

0479-6767 SUBRAHMANYAN, V. *et al.* **Investigations on grain substitutes. V. The nutritive value of synthetic rice.** Bulletin. Central Food Technological Resarch Institute (India) 4(3):55-57. 1954 Engl., Sum Engl , 6 Refs., Illus

Cassava. Cassava flour. Composite flours. Nutritive value. Laboratory animals. Animal physiology. India.

Rat growth was used to determine the overall nutritive value of poor vegetarian diets based on raw milled rice (A), synthetic rice (60% cassava, 15% groundnut and 25% wheat) (B), and synthetic rice grains coated with calcium caseinate (C). B and C were significantly superior to A in overall growth promotion; animals fed on A failed to reproduce whereas this was not the case with diets B and C *(Summary by Tropical Product Institute)* H01

0480-6763 SUBRAHMANYAN, V. *et al.* **Rice substitutes.** Nature 174(4422):199-201. 1954. Engl , 10 Refs

Cassava. Mysore flour. Processing. Nutritive value. Water content. Protein content. Fat content. Carbohydrate content. Fibre content. Ash content. Mineral content. Food energy. India.

A review is made of the search for cheap, abundant substitutes for rice. One satisfactory blend of cassava and groundnut flours was developed (Mysore "synthetic rice"), the properties and nutritive value of which are given. *(Summary by T.M.)* H01

0481-1930 SUBRAHMANYAN, V. *et al* **Studies on enriched tapioca macaroni products. I. Development of new formulations and pilot plant studies.** Food Science 10(12).379-381. 1961. Engl., Sum Engl , 9 Refs

Cassava. Tapioca macaroni. Food enrichment. Water content. Protein content. Fat content. Ash content. Mineral content. Vitamin content. Carbohydrate content. Processing. Costs. India.

Four blends of enriched tapioca macaroni contained cassava flour, groundnut flour and semolina with calcium and vitamins, and (A) 2.5% casein, (B) no casein, (C) 10% nonfat milk solids, or (D) 15% chickpea flour. The products had from 18 to 20.3% protein, about 0.5% Ca, and in mg per 100 g, Fe 3.2, vitamin B_1 0.7, riboflavin 0.71, nicotinic acid 5.6, calcium pantothenate 0.5; in IU, vitamin A 1050 and vitamin D 110. Blend C was superior in flavor to the others *(Summary by Nutrition Abstracts and Reviews)*H01

0482-4638 TAHALELE, E. **De cassavevoeding en het eiwitvraagstuk.** *(The cassava diet and the question of protein).* Landbouw 22(10/12).495-522. 1950. Dutch, Sum. Mal., Engl, 28 Refs

Cassava. Gaplek. Food energy. Proteins. Nutritive value. Protein content. Carbohydrate content. Fat content. Energy productivity. Diets. Human nutrition. Indonesia.

Chronic protein shortages are found in regions where cassava—usually consumed as gaplek— is the basis of the diet In the Moluccas, sago has the same function. In such regions food edema or even hunger edema are often observed Though the caloric values are the same, the protein content of gaplek (1.5%) is only 1/5 of that of cereals, apart from the lesser biological value of cassava protein. As the caloric supply determines the feeling of satiation, it is not possible to eat as much cassava (gaplek) as is necessary to satisfy the protein requirements (1 g/day/kg of body wt for adults, for children more). For the same reason the solution of the protein problem does not depend directly on the question as to whether cassava may produce more protein/yr and per ha than rice. The low percentage of protein in gaplek is the reason why even additional foodstuffs rich in protein—meat, fish, pulses, all with 20% protein—are not sufficient to neutralize the protein shortages when gaplek forms the principal food When 400 g of gaplek—giving a feeling of satiation—are eaten/day, only 6 g of protein are consumed The deficit of 45 g of protein could be made up by the addition of 225 g of meat, fish or pulses. Even in the diet of the Moluccas, rich in fish, where 75% of the proteins are animal proteins, the supply of proteins remains 40-50% below the standard since sago is the principal food. Thus the principal food determines the protein supply, and supplementary food of animal origin has no predominant influence. Moreover, this food is much too expensive for the population of the gaplek regions. All measures for an improvement of the protein consumption concern in the 1st place the principal article of food. **Agricultural measures.** Apart from some aspects of the Special Development and Extension Plan (Bijzonder Welvaartsplan, 1949), (1) soils, so far suitable only for cassava should be improved through cultural measures, so that crops rich in protein can be grown and (2) drought-resistant grains and pulses should be considered, especially those with a low commercial value, such as sorghum and millets Drought-resistant fodder crops are recommended, but it is also stated that cattle are often kept only for sale and not for consumption or for effective use in agriculture. Mixed gardening in compounds is often totally insufficient. **Nutritional measures.** Food of vegetable origin contains a smaller no. of amino acids than food of animal origin. As the protein supply depends principally on vegetable proteins, care should be taken that the diet is as varied as possible. Food customs should be changed in this direction. A mixture of pulses and gaplek (1:2-3) has about the same nutritive value as rice The same is the case with rice polishings and gaplek in a mixture of 2 2.5-3.5. Combinations of sorghum and gaplek are also commendable In regions with an abundant rice diet, a partial substitution of rice by tubers (i.e., gaplek) should be propagated so that rice can be exchanged with cassava regions. Young shoots of cassava are very rich in protein and could also be used. In promoting high vegetable consumption, the assistance of the women's welfare services should be sought. **Socio-economic measures.** Agrarian reforms, more agricultural credit, industrialization and emigration are mentioned. Regional food (export) control, road building and industrialization are proposed as direct measures. *(Author's summary)* H01

0483-6737 TAN, K. **Increasing the potential of cassava through improved processing techniques and nutritional enrichment.** *In* Mac Intyre, R., ed. Interaction of Agriculture with Food Science; proceedings of an interdisciplinary symposium, Singapore, 1974. Ottawa, Canada. International Development Research Centre. IDRC-033e. 1974. pp.121-129. Engl., Sum. Engl., Fr., 16 Refs.

Cassava. Production. Toxicity. Composition. Dietary value. Cassava programs. Cassava products. Uses. Malaysia.

The utilization of cassava is discussed from the viewpoint of its importance in subsistence economies. Cassava plays a primary role in diets of many people in the tropics, and its nutritional quality could be upgraded at relatively moderate costs using modern enrichment techniques. As a food source or as an industrial crop to generate better farm incomes, cassava offers great potential for development. *(Summary by T.M.)* H01 J00

0484-5539 TEODOSIO, N.R. and MATTOS JUNIOR, A G. DE **Coeficiente de digestibilidade e valor biológico da associação alimentar: feijão mulatinho, xarque e farinha de mandioca.** *(Coefficient of digestibility and biological value of a diet consisting of common beans, dried meat and cassava flour)* Revista Brasileira de Medicina 10(9).613-617. 1953. Port., Sum. Port., Engl., 24 Refs.

Cassava. Cassava flour. Digestibility. Nutritive value. Diets. Protein content. Proteins. Analysis. Brazil.

Using Mitchell's method, a study was made of the protein content of a diet consisting of common beans, dried meat and cassava flour, which are basic staples of the inhabitants' diet in northeastern Brazil.Rations containing 16% protein were fed ad libitum to albino rats, the control group was given industrial casein. The digestibility coefficient of the experimental diet was lower (84 96%) and the biological value identical (97 3%) to the standard protein It was found that the protein deficiency of the people in that region was due to the insufficient quantity of the basic food ration, aggravated by the scarcity of other good sources of protein such as milk and eggs. *(Author's summary)* H01

0485-5347 THOMAS, H. M. **Some aspects of food and nutrition in Sierra Leone.** World Review of Nutrition and Dietetics 14:48-58. 1972. Engl., 22 Refs.

Cassava. Human nutrition. Gari. Foofoo. Kpokpo gari. Cassava leaves (vegetable). Protein content. Vitamin content. Deficiency diseases. Cassava programs. Dietary value. Sierra Leone.

An analysis is made of nutritional problems in Sierra Leone As regards cassava, the 2nd most important crop after rice, the different typical dishes prepared with it are enumerated. The process used in their preparation includes soaking in water to reduce the HCN content. *Manihot utilissima* leaves are consumed as a vegetable; they contain only 7.3% protein but 200 mg Ca and vitamin C/100 g and 1.9 mg Fe/100 g The contents of other vitamins present in the leaves are also given. *(Summary by L.F.C. Trans. by S S. de S.)* H01

0486-1921 UTRA, G.R.P. DE **A mandioca como forragem.** *(Cassava as a forage)* Boletim do Instituto Agronômico (Brazil) 10:196-207. 1899. Port.

Cassava. Forage. Protein content. Fat content. Cellulose. Ash content. Cultivars. Dry matter. Animal nutrition. Starch content. Glucose. Brazil.

The problems involved in using an adequate forage for animals are discussed in general. The growing of cassava on a greater scale is recommended since cassava is valuable not only for human and animal consumption but also for its by-products (especially tapioca). An analysis is made of the dry matter of a "white" or sweet variety, as well as the starch, glucose, fat and dextrin content for 17 varieties Farmers are given instructions on how to use bitter varieties and waste material for forage, how to prune the plant and how to store cassava Intercropping with coffee is not recommended *(Summary by L.F.C. Trans. by T.M.)* H01

0487-4103 **VALOR DAS FOLHAS e ramas da mandioca.** *(The nutritive value of cassava leaves and stalks).* Agrominas (Brazil) 1(4):16. 1968. Port.

Cassava. Leaves. Water content. Protein content. Fat content. Fibre content. Mineral content. Nutritive value. Brazil.

Although not commonly used, the aerial part of cassava (fresh or as hay) can be used as an animal feed. Chemical analysis shows that the dry matter of leaves has up to 20% crude protein, 2% calcium and 0.5% phosphoric acid. Several experiments were carried out with laying hens in Campinas (São Paulo) in order to determine the best times to cut the forage, etc. The variety Guaxupé is recommended, and appropriate agricultural practices are given. *(Summary by L.F.C. Trans by S.S.de S.)* H01

0488-6720 VENKATA RAO, S. *et al.* **Studies on enriched tapioca-macaroni products. II. Effect of processing on the protein efficiency ratio.** Food Science 10(12):381-383. 1961. Engl., Sum. Engl., 18 Refs.

Cassava. Tapioca macaroni. Proteins. Nutritive value. Cooking. Laboratory animals. Analysis. India.

Four blends of enriched tapioca macaroni, containing cassava flour, groundnut flour, semolina, Ca and vitamins plus (A) 2.5% casein, (B) no casein, (C) 10% nonfat milk solids, or (D) 15% chickpea flour, were incorporated in a synthetic diet to provide 10 g protein/100 g. Raw and heat-processed diets were fed free choice to weaned rats for 4 wk; the protein efficiency ratios for all 4 blends were higher before than after processing. Rats given blends C and D had higher food intake and weight gains and lower fat content in the liver than those given blends A and B. *(Summary by Nutrition Abstracts and Reviews)* H01

0489-6822 VENKATA RAO, S. *et al.* **Studies on enriched tapioca macaroni products. IV. Effect of partial replacement of rice on the nutritive value of poor rice diet.** Food Science 10(12):386-389. 1961. Engl., Sum. Engl., 9 Refs.

Cassava. Tapioca macaroni. Food enrichment. Laboratory animals. Diets. Composition. Animal physiology. Food enrichment. Laboratory animals. Nutritive value. India.

A mixture of rice and enriched macaroni (36:54) promoted nearly the same rate of growth in albino rats as a blend of rice and whole milk powder (54:36). Replacement of rice by enriched macaroni at a 33.6% level in a poor rice diet made up the deficiencies in the diet and promoted good growth. Incorporation of small amounts of whole milk powder (4.2%), along with enriched macaroni (25.1%) to replace an equivalent quantity of rice in a poor rice diet, promoted nearly the same growth rate as that obtained with milk powder at a 16.8% level. The results indicate that partial replacement of rice in the poor rice diet by enriched macaroni improves the nutritive value of the diet. There was no significant difference in the mean N contents of livers of rats fed on diets containing enriched macaroni or milk powder. *(Author's summary)* H01

0490-6958 VIDAL, B.A.S. **Farinha de raspa de mandioca.** *(Flour from cassava chips)* Boletim da Associação Commercial do Amazonas 6(72):52-53. 1947. Port.

Cassava. Cassava flour. Nutritive value. Uses. Brazil.

A campaign against cassava was carried out in Brazil during World War II. Some arguments concerning the nutritional value of cassava are given with the purpose of justifying the expansion of cassava growing and the production of the flour made from cassava chips It is recommended to use this flour mixed with wheat (80%) in breadmaking in order to obtain a tasty and highly nutritional product. *(Summary by A.J. Trans by S.S de S.)* H01

0491-6704 VIERA, C. A **A mandioca** *"Manihot utilissima"* **Link.** [*Cassava (Manihot utilissima)*]. Revista de Química Pura e Aplicada 4(1/2):19-94. 1953. Port., 46 Refs., Illus

Cassava. Cassava products. Analysis. Water content. pH. Ash content. N. Fat content. Starch content. Dextrins. Cassava flour. HCN content. Glucose. Organoleptic examination. Laboratory experiments. Cellulose.

A review is made of cassava, extraction of cassava flour, physicochemical properties and analysis. In the determination of HCN in cassava flour, it is found that steeping in H_20 for 2-4 h is not sufficient to liberate HCN completely. The flour (20 g) is steeped in 100 cc distilled H_20 for 24 h (minimum time 12 h) to liberate HCN from the glucoside, another 100 cc of H_20 is added, and HCN is distilled with steam into a solution of 10-15 cc ammonia in 20 cc H_20 until the volume reaches 100-125 cc. Completeness of distillation is tested by adding 1 drop of 0.2% I_2 in H_20 to a few drops of distillate; distillation is complete when this mixture remains light yellow. *(Summary by Chemical Abstracts)* H01

0492-6700 VITTI, P., FIGUEIREDO, I. B. and ANGELUCCI, E. **Folhas de mandioca desidratadas para fins de alimentação humana.** *(Dehydrated cassava leaves for human consumption).* Coletânea do Instituto de Tecnologia de Alimentos (Brazil) 4:117-125. 1971-1972 Port., Sum. Port., Engl., 8 Refs.

Cassava. Leaves. Water content. HCN content. Protein content. Vitamin content. Amino acids. Cultivars. Brazil.

Six 8-mo samples of cassava leaves were analyzed for their HCN, protein, vitamin A and amino acid content. All samples were high in protein. Vassourinha and IAC-14-18 were highest in vitamin A. Only Guaxupé (leaves from 1- and 2-yr branches) had a low HCN content; however, dehydration lowered HCN to permitted levels of toxicity. Amino acid content was reasonably good for all samples. *(Author's summary. Trans. by T.M.)* H01 C03

0493-6820 WIE HAN KWEE *et al* **Quality and nutritive value of pasta made from rice, corn, soya and tapioca enriched with fish protein concentrate.** Cereal Chemistry 47(1):78-84. 1969. Engl., Sum. Engl , 7 Refs , Illus

Cassava. Cassava flour. Composite flours. Organoleptic examination. Cooking. Protein content. Water content. Ash content. Fat content. Analysis. Nutritive value. Laboratory animals. Nutrient loss. Food enrichment. Indonesia.

Fish protein concentrate (FPC) supplemented to rice, maize, soybean and cassava flours could contribute significantly to the protein intake of the populations of developing countries. As pasta is a universal food, it was chosen as a carrier for FPC. Pasta was evaluated organoleptically (in animal feeding studies) and objectively. Both 10 and 20% FPC additions were efficient in increasing the protein content and nutritional value of pasta From sensory and objective evaluations, rice pasta appeared to be the most acceptable. Of maize, soybean and cassava pasta, cassava seemed most promising for further investigation; it promoted a more attractive color and counteracted grittiness in the FPC, but its texture became too soft during cooking *(Author's summary)* H01

0494-4633 XAVIER, L. P. **A civilização da mandioca.** *(Cassava cultivation).* Chácaras e Quintaes 89(2):171-172. 1954. Port

Cassava. Nutritive value. Brazil.

This article highlights the importance of cassava as a food staple within the socioeconomic process of development in Brazil and points out the nutritive value of cassava leaves and flour. *(Summary by P.G. Trans. by S.S. de S.)* H01

See also 0081 0084 0092 0140 0586 0621 0708 0764

0495-6909 HOUSTON, R.G. **Dietary nitriloside and sickle cell anemia in Africa.** American Journal of Clinical Nutrition 27(8):766-769. 1974 Engl., 34 Refs.

Cassava. Anaemia. Etiology. Africa.

The author of this letter refutes the thesis of another who asserted that sickle cell anemia (SCA) is rare in African adults, stating that there should be a moderating factor causing the cases to go undetected. Such a factor could be the cyanates and thiocyanates from dietary nitrilosides (beta-cyanogenetic glucosides, called vitamin B_{17}) that protect the individuals when there is an adequate protein supply. In West Africa, where kwashiorkor is prevalent, SCA is most severe It has been proved that hybridization lowers the nitriloside content of foods, and the increase of SCA cases is directly proportional to the increase in hybridization Prolonged soaking and fermentation of cassava also decreases the nitriloside and thiocyanate contents. He proposes that cyanates induce an electrophoretic mobility in hemoglobin S molecules identical to that of hemoglobin A, thus masking the symptoms of SCA and producing a heterozygous pattern SCA crises have been treated successfully with doses of nitriloside much lower than the clinical doses of cyanates. The generation of cyanate from thiocyanate in the red blood cells induces the formation of methemoglobin, which inhibits the appearance of the symptoms in SCA patients. The probability that vitamin B_{17} is a protective factor for bearers of the SCA gene is very high. On the other hand, mild cases of SCA reported in Jamaica are intensified when the people affected emigrate to other countries and disappear on their return to Jamaica, where the diet contains sources (such as cassava) rich in nitrilosides *(Summary by S.S. de S.)* H02

0496-5760 HOUSTON, R G. **Sickle cell anemia and dietary precursors of cyanate.** American Journal of Clinical Nutrition 26.1261-1264. 1973 Engl., 47 Refs.

Cassava. Anaemia. Thiocyanates.

It has been proven that many chronic anemias are due to nutritional deficiencies. It has been reported that the genetic disease of sickle cell anemia is associated with a high folic acid requirement. It was recently discovered that cyanate inhibits this anemia. The purpose of this work was to establish the reciprocal correlation between the incidence of sickle cell anemia and the thiocyanate yield in African and American diets This correlation suggests that it is a genetically determined nutritional deficiency anemia involving dependency on thiocyanate formed from nitrilosides (beta-cyanogenetic glucosides). Cyanate is formed as a product of the oxidation of thiocyanate. It was found that 80% of the tropical African diet may consist of thiocyanate-yielding foods: this fact is associated with the rarity of sickle cell anemia there in comparison to its incidence in the United States. Clinical use of cyanate and thiocyanate ameliorates sickle cell anemia *(Summary by L F.C. Trans by T.M.)* H02

0497-6829 LAMBOTTE, C. **Sickle cell anemia and dietary precursors of cyanate.** American Journal of Clinical Nutrition 27(8):765-766. 1974. Engl., 16 Refs.

Cassava. Anaemia. Etiology. Africa.

The author of this letter refutes the thesis of another regarding the possible effect of cyanates and precursors of dietary origin on the evolution of sickle cell anemia (SCA). The traditional African diet contains several foods (especially cassava) that are rich in thiocyanates and their precursors. He denies that SCA symptoms are camouflaged by the cyanate derivatives in the diet. In addition, he proves that thousands of cases of SCA have been reported in Africa since 1951 and that the rate of mortality is very high especially from the 1st months to 3 yr of age. To the hypothesis that the hemoglobin S electrophoresis could bring about a special zone with the mobility of the hemoglobin A that could lead to the erroneous identification of the individuals affected by the disease as heterozygotes, he responds that he ignores whether this zone can be produced by a therapeutic dosis of cyanates but that among the thousands of cases studied in Africa, it was never found, whatever the quantity of cassava contained in the diet. He explains that both in the Congo and in Uganda the incidence of SCA is the same, even though the staple food in the former is cassava and in the latter, plantain Finally, he says that the influence of dietary thiocyanates and precursors on SCA is unknown but that it is a subject meriting further study *(Summary by S S. de S.)* H02

0498-7405 RIVERA L., P. H. and WASSERMAN L., M. **Influencia de la ingestión de yuca en una zona con bocio endémico.** *(The influence of cassava consumption in a zone with endemic goiter).* Tesis Quím Bogotá, Universidad Nacional de Colombia, Facultad de Ciencias, 1969. 98, 15p. Span., Sum. Span., 52 Refs., Illus

Cassava. Endemic goitre. Etiology. Laboratory experiments. Laboratory animals. Diets. Iodine. Composition. Analysis. Absorption. Animal health. Colombia.

Goiter has been endemic in Colombia for a long time The simple intake of iodized salt has failed to eradicate it in certain regions. The purpose of this work was to study the hypothesis that the combined action of iodine deficiency and the presence of a goitrogen element in the diet cause goiter. Cassava was selected as the most probable cause of goiter, the study was conducted in Villeta, a large cassava-producing region with a high incidence of endemic goiter. The group of guinea pigs selected for the trial were fed a nongoitrogen diet, deficient in iodine but with satisfactory nutritional value, which consisted of wheat flour and maize gluten enriched with vitamins, minerals and fats. To prove that the diet met these 3 requirements, these tests were made: daily iodine analysis (by activation) of the urine of 20 guinea pigs fed with this diet for 1 mo; the percentage of uptake of a dosis of I^{131} injected 24 h before slaughter; preparation of growth curves, chromatographic determination of iodide, monoiodotyrosine, diiodotyrosine and thyroxine taken from thyroid extracts of these animals. The 2nd step was to verify the effects of cassava on the following parameters of the thyroid function: body weight, I^{131} uptake, and content of I^-, monoiodotyrosine, diiodotyrosine and $T_3 + T_4$ in the thyroid gland. Guinea pigs were fed a ration composed of 50% of this diet + 50% cassava. The effects were observed at 7, 21 and 28 days and compared to the rations received by 3 different groups of animals. (1) diet without iodine, (2) diet without iodine + a known goitrogen element (thyourea), and (3) diet with iodine. The results show that cassava has an inhibiting effect on thyroid metabolism, apparently in the process of the synthesis of diiodotyrosine from monoiodotyrosine *(Author's summary. Trans. by S.S. de S.)* H02

0499-6885 AHMED, F. A. and KAY, M. **A note on the value of molasses and tapioca as energy supplements to forage for growing steers.** Animal Production 21:191-194. 1975. Engl., Sum. Engl., 2 Refs.

Cassava. Molasses. Dietary value. Cattle. Diets. Composition. Digestibility. Animal nutrition. Food energy.

The intake and digestibility of diets containing dried grass supplemented with either molasses or cassava was studied with 12 Friesian steers in 2 experiments, using a Latin square design. Three periods were used, each containing 3 weeks preliminary followed by a 10-day collection period. In both experiments long, artificially-dried grass was fed free choice (treatment A). The other treatments in Experiment 1 were 25% molasses + 75% dried grass (B) and 50% molasses + 50% dried grass (C). In Experiment 2 the treatments were 21% cassava + 79% dried grass (D) and 42% cassava + 58% dried grass (E). There was no significant difference in dry matter or organic matter intake and digestibility between the diets, though intake in both experiments tended to be lower when the dried grass was supplemented with either molasses or cassava than when it was given alone. In both experiments the digestibility of crude fiber was significantly lower ($P < 0.05$) when either molasses or cassava was given with the dried grass than when the grass was offered alone. (*Author's summary*) H03

0500-1991 ALQUIER, J. **Valeurs nutritives comparées, pour les bovins, des gros sons de blé, des issues roses de riz et de la mouture de manioc.** *(Nutritional values of wheat and rice brans and cassava meal in cattle feeding).* Bulletin de la Société Scientifique d'Hygiene Alimentaire et d'Alimentation Rationnelle de l'Homme 15:294-314. 1927. Fr.

Cassava. Cassava meal. Cattle. Rice bran. Fattening. Diets. Composition. Nutritive value. Animal nutrition. Wheat bran.

A trial was carried out with Breton cattle in order to evaluate their performance (wt gains) on 4 different combinations of wheat and rice brans and cassava meal, given with a basic ration of hay and straw with molasses. Liveweight increases on rice and wheat were normal and parallel (a graph illustrates the results); on cassava meal, growth stopped abruptly and weight remained stationary. Because of its chemical composition (poor in ashes and vitamins and rich in hydrocarbons), cassava destroys the food balance, affecting the normal growth of cattle when it is a basic staple in their diet. Another trial with Charolais steers was carried out at the zootechnical center of Clos-Ry with the purpose of comparing the nutritional values of cassava and barley meals. Again it was found that the yields obtained with cassava meal depends on the ration of which it forms a part. Tables including the components of each of the rations and their content of ashes, sugars, pure cellulose, digestible nitrogenous materials, caloric value, nutritional relations, Ca:P and ashes: sugar relationships are presented for both trials (*Summary by S.S. de S.*) H03

0501-5232 ALVAREZ G., R. and ALVARADO R., L. **La yuca (*Manihot esculenta* Crantz) como fuente energética en la alimentación de los cerdos. II. Sustitución del maíz por cuatro niveles de harina de yuca deshidratada en raciones para cerdos en crecimiento.** *(Cassava as a* *source of energy in swine feeding II. Substitution of maize by four levels of dehydrated cassava meal in rations for growing pigs)* Ganagringo 10(40) 42-45, 1975. Span., Sum Span., 8 Refs

Cassava. Cassava meal. Swine. Fattening. Nutritive value. Feed constituents. Animal nutrition. Maize. Venezuela.

An experiment was conducted with 15 crossbred pigs (Duroc x Yorkshire) to evaluate the possibility of substituting maize with dehydrated cassava meal in rations for growing pigs (av initial wt of 36.8 kg). The treatments [0 (control), 12, 24 5, 36 5 and 48% cassava meal] were distributed according to a randomized block design with 3 replications. Statistical analyses of daily wt gains, feed consumption, conversion and efficiency did not reveal significant differences ($P<0.05$) among treatments However, the 18 and 48% cassava rations produced highest wt gains As regards feed costs, diets containing 12 and 48% cassava cost less (10.2 and 16 3%, respectively) than the control. *(Author's summary Trans. by S.S. de S.)* H03

0502-7390 ARAMBAWELA, W J. *et al.* **Effect of replacing barley with tapioca meal at two different levels of feeding on the growth and health of early weaned pigs.** Livestock Production Science 2.281-288 1975. Engl., Sum Engl., Fr , Germ , 13 Refs

Cassava. Cassava meal. Swine. Feed constituents. Dietary value. Food energy. Digestibility. Animal health. Animal nutrition.

The effects of barley and cassava meal as the main source of carbohydrate—at 2 levels of feeding— on the growth and health of early weaned piglets were compared. The effects of the 2 carbohydrate sources on growth were not significantly different, but the cassava ration caused a significantly higher incidence of digestive disturbances, even though it showed a better digestible energy in experiments with rats Ad libitum feeding resulted in a significantly higher rate of growth than restricted feeding, but at the same time there was a significantly higher incidence of digestive disturbances and a lower utilization of energy Restriction of feed was thus found to be an effective way of reducing the incidence of digestive disturbances and diarrhea and the utilization of energy was better. Cassava meal appears to be a suitable source of carbohydrate when balanced with other essential nutrients. *(Author's summary)* H03

0503-5728 ARMAS, A. E and CHICCO, C F. **Evaluación de la harina de yuca (*Manihot esculenta*) en raciones para pollos de engorde.** [*Cassava meal (Manihot esculenta) in rations for fattening chicks*]. Agronomía Tropical (Venezuela) 23(6):593-599. 1973. Span., Sum Span , Engl., 9 Refs.

Cassava. Cassava meal. Chicks. Feed constituents. Fattening. Feed mixtures. Amino acids. Lysine. Methionine. Proteins. Diets: Dietary value. Animal nutrition. Venezuela.

The effect of replacing maize with 18, 36 and 54% cassava meal was studied in a random block design with 2 replications. Groups of 36 three-day-old Vantress x Arbor Acres chicks were fed free choice; they were weighed at 6 and 8 weeks. Rations contained 8 or 16% animal protein (with or without 0.23% methionine and 0.3 lysine), soybean meal, alfalfa, sesame, meat meal, fish meal, vitamins, minerals, salt, bone meal and (except with 54% cassava) maize and lipid. All treatments were made roughly equivalent in protein and metabolizable energy by adjusting the level of soybean meal and vegetable lipid. Although rations with 54% cassava meal gave lower body weights, differences were not significant The different amounts of animal protein or extra amino acids had no significant effect on results. Feed conversion was not affected by any of the experimental variables. *(Summary by T M.)* H03

0504-1532 ATHANASSOF, N. A mandioca na engorda dos suinos. *(Cassava in swine fattening).* Chácaras e Quintaes 56 203-206. 1937. Port , Illus

Cassava. Swine. Fattening. Dietary value. Feed constituents. Brazil.

This article shows the good results obtained in swine fattening when the animals are fed a mixture of cassava and maize enriched with foods having a high protein and fat content, such as rice cakes, cottonseed and rice bran, skim milk, etc The food components used for each of the diets and their nutritive ratios are presented. *(Summary by P.G. Trans by S.S de S)* H03

0505-2379 ATINKPAHOUN, H. **Contribution a l'étude de la valeur nutritionelle pour le poulet de trois plantes tropicales:** *Manihot utilissima, Hypomea batatas* **et** *Dioscorea cayenensis. (The nutritional value of three tropical crops—Manihot utilissima, Ipomoea batatas and Dioscorea cayenensis—for chickens)* These Docteur de 3ème Cycle. Paris, Université de Paris, 1973. 53p Fr., 57 Refs., Illus

Cassava. ***Manihot esculenta.*** **Cassava starch. Digestibility. Analysis. Chicks. Animal physiology. Amino acids. Feeds and feeding. Animal nutrition. Sweet-potatoes. Yams. Dahomey.**

The project of intensifying vegetable production to improve human and animal nutrition in Dahomey required a deeper understanding of the physicochemical characteristics of tropical roots and tubers. Therefore, a study was conducted on the digestibility of cassava, yams and sweet potatoes in chicken's diets. The following aspects were considered: botanical and physiological characteristics, chemical composition, utilization in human and poultry nutrition, glucoside composition and starch characteristics, in vivo digestion within the chicken's crop, the effect of hydrothermic treatments on starch structure and on the growth of poultry fed raw or processed tubers. The study of the physicochemical characteristics of the starches confirmed that cassava starch belongs to type A (the same as cereals). Hydrothermic treatment in vitro made the starches more susceptible to bacterial amylases. The in vivo study of digestibility within the bird's crop showed that cassava and sweet potato starches break down more easily than that of yams. Although cassava is an unbalanced feed, it has a positive effect on growth and favors weight gains Varieties should be carefully selected in order to develop a feed with greater nutritive value. (*Summary by S. S. de S.*) H03

0506-1779 BRAGA, J. F. **O cozimento da batata doce e da mandioca na engorda de porcos.** *(Cooked sweet potatoes and cassava in rations for fattening pigs).* Ceres 3:366-370. 1942. Port., Sum. Port , 3 Refs , Illus.

Cassava. Swine. Cooking. Nutritive value. Fattening. Costs. Sweet-potatoes. Animal nutrition. Brazil.

The purpose of these trials was to study the economic advantages of fattening pigs with cooked sweet potatoes and cassava Although the animals preferred the cooked roots, they should—from an economical standpoint—be supplied raw because of the high labor and fuel costs. *(Summary by S S. de S.)* H03

0507-6874 BUITRAGO A., J. **Utilización de la yuca en dietas para crecimiento y ceba de cerdos.** (*Cassava in diets for growing-finishing pigs).* Tesis Med Vet. Bogotá, Universidad Nacional de Colombia, 1964. 114p Span., Sum Span , 34 Refs , Illus

Cassava. Swine. Fattening. Finishing. Tubers. Fresh products. Feed constituents. Diets. Composition. Dietary value. Animal nutrition. Colombia.

Three trials were conducted at the Centro Nacional de Investigaciones Agrícolas in Palmira (Colombia) to evaluate raw cassava as the carbohydrate source in diets for growing-finishing pigs (Duroc x Jersey). In the 1st trial (28 days), Group 1 (control) received yellow maize supplemented with soybean and cottonseed meals, bone meal, minerals and vitamins; Group 2, fresh cassava (free choice) + protein supplement (free choice); Group 3, fresh cassava (free choice) + protein supplement; and Group 4, fresh cassava + protein supplement Group 2 had the best av daily wt gain (718 g), whereas Group 1 had the best feed efficiency ratio (3.74:1) as compared with 5.59:1, 5.65:1 and 5.85.1 for groups 2, 4 and 3, respectively. This marked difference may be due to the short experimental period, which did not give the animals time to adjust to the cassava-based diet. In the 2nd trial (112 days; i.e., weaning to 100 kg), there were 3 groups. (1) control, (2) fresh cassava (free choice) + protein supplement (free choice), and (3) cassava (free choice) + protein supplement Group 2 had the best av daily gain (774 g). Feed efficiency ratios were 3.53.1, 2.80.1 and 2 83.1, respectively, for the 3 groups. The 3rd trial (98 days) had the same 3 diets. The control group (1) had the best av daily gain (843 g), but feed efficiency was better for the cassava groups Economic analyses also show that the use of cassava is advantageous. *(Summary by T.M.)* H03

0508-6923 CASTRO, E and QUINTERO Q., S. **La yuca en la alimentación animal.** (*Cassava as a feedstuff*) *In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975 pp 173-186 Span , 5 Refs.

Cassava. Swine. Fattening. Finishing. Feed constituents. Concentrates. Proteins. Dietary value. Cultivars. Compositions. Animal nutrition. Colombia.

The results are presented of swine feeding experiments with cassava-based diets and protein supplement A bromatologic analysis (made by the Instituto Colombiano Agropecuario) of 15 cassava varieties is included Carbohydrate content on a fresh basis was 30 8% Although av protein content was low, varieties with protein levels up to 15.4% on a dry basis were reported This is an indication of the great selection potential that could be used to raise cassava protein content. HCN toxicity is discussed summarily. A description is given of several ways of supplying cassava to pigs cassava + supplement ad libitum; cassava ad libitum + controlled supplement, a mixture of chopped cassava and protein supplement ad libitum, and dry cassava (flour) incorporated in diets for growing pigs In addition, the results are given of trials using fresh and dry cassava ad libitum + controlled supplement during the growing, fattening, lactating and gestating periods, under grazing and feed-lot conditions It is important to remember that animals on a cassava-based diet require more Zn. (*Summary by A J Trans by S S de S*) H03

0509-7444 CASTRO, M. E. D and SILVA, J F.C DA **Substituição do milho desintegrado com palha e sabugo pela raspa de mandioca integral. I. Valor nutritivo.** *(Cassava meal as a replacement for ground ear maize I. Nutritive value).* Experientae 20(7) 184-203 1975. Port., Sum. Port., Engl., 40 Refs , Illus.

Cassava. Cassava meal. Maize. Cottonseed meal. Digestibility. Feeds and feeding. Diets. Proteins. Sheep. Animal nutrition. Animal health. Nutritive value. Brazil.

Sheep in metabolism cages were used to test the effects of the replacement of ground ear maize by cassava meal supplemented with urea and cottonseed meal. In the 5 rations studied, the ground ear maize was replaced by 0, 25, 50, 75 or 100% cassava meal. The rations were isoenergetic and isonitrogenous, using urea and cottonseed meal to make up for the difference in protein content. The results showed that intake of dry matter, crude protein and digestible protein decreased linearly ($P < 0.01$) when the level of cassava increased in the rations The apparent digestibility of dry matter and of gross energy increased linearly ($P < 0.01$) when the maize was replaced by cassava but the apparent digestibility of crude protein was not affected. Nitrogen retention decreased linearly ($P < 0.01$) with increased levels of cassava. *(Author's summary)* H03

0510-7443 CASTRO, M E. D. and SILVA, J. F. C DA **Substitução do milho desintegrado com palha e sabugo pela raspa de mandioca integral em rações para ruminantes. II. Confinamento de bovinos.** *(Cassava meal as a replacement for ground ear maize. II. Steers in feed lot)* Experientiae 20(7) 204-216 1975. Port , Sum Port , Engl., 23 Refs , Illus

Cassava. Cattle. Cassava meal. Feed constituents. Nutritive value. Fattening. Animal nutrition. Brazil.

In a feed-lot experiment at the Universidade Federal de Viçosa, 45 Zebu crossbred steers (av wt 310 kg) were confined for 105 days. A randomized block design with 5 treatments and 9 replications was used Sorghum silage was administered on the basis of 1 5 kg/100 kg liveweight and concentrate, ad libitum The concentrate consisted of ground ear maize replaced by 0, 25, 50, 75 or 100% cassava meal supplemented with urea and cottonseed meal The av daily gains were 1 16, 1.13, 1.05, 1 01 and 0 85 kg, respectively, for the rations with 0, 25, 50, 75 and 100% cassava meal. There were statistically significant differences (P <0 05) among treatments. Although feed conversion improved, daily and carcass weights decreased linearly (P <0 01) with increased cassava meal in the ration *(Author's summary)* H03

0511-3512 CHICCO, C. F *et al.* **Evaluación de la yuca, pulpa de cítrico y melaza en el engorde de corderos.** (*Cassava, citrus pulp and molasses for fattening lambs*). Agronomía Tropical (Venezuela)23(6):587-592. 1973. Span , Sum Span., Engl , 9 Refs.

Cassava. Cassava meal. Lambs. Animal nutrition. Fattening. Digestibility. Feed constituents. Venezuela.

A trial was conducted in Venezuela with 4 groups of 10 West African lambs (22 kg av wt) fed sorghum forage (7.1% crude protein in DM) free choice for 112 days. They were also given 0.5 kg/day of a supplement containing 60% maize cobs, citrus pulp, molasses or cassava meal; 30% sesame; 9% molasses; and 1% minerals. The supplement contained 16% crude protein after adjustment of N by addition of urea. At the end of the trial, 4 lambs from each group were tested for N balance and digestibility. Feed conversion was poorest with maize cobs and best with cassava. Digestibility of cellulose was lower (P < 0.05) with cassava. Av daily wt gains were 78, 99, 99 and 130 g, respectively, for the 4 treatments (*Summary by T.M.*) H03

0512-7046 COSTA, B M. DA, LIMA, J. OA. DE A and GRAMACHO, D D. **Substituição do milho moído por farinha de raspa de mandioca na alimentação de suinos em período de crescimento e engorda.** *(Cassava chips as a substitute for maize in rations for growing-finishings pigs)* *In* Projeto mandioca. Cruz das Almas, Brasil. Convênio U.F. Ba./BRASCAN Nordeste. Série Pesquisa v.2, no 1. 1975 pp. 145-157. Port., Sum. Port , Engl , 11 Refs , Illus

Cassava. Cassava chips. Swine. Finishing. Fattening. Feed constituents. Diets. Composition. Costs. Animal nutrition. Brazil.

A trial was carried out at the Universidade Federal da Bahia in Cruz das Almas, Bahia (Brazil) to (1) test 3 rations in which maize was totally or partially substituted by cassava meal made from dried cassava chips as a source of carbohydrate in rations for growing-fattening pigs (Duroc Jersey x Wessex x Landrace crossbreeds) and (2) to utilize sources of protein produced or easily found in the state. A completely randomized block design with 3 treatments and 10 replications was used. The 3 treatments were as follows A (64.75% ground maize), B (63 45% cassava meal) and C (35.25% ground maize + 33 20% cassava meal). Rations also contained cottonseed cake, wheat bran, blood and meat meal, animal fat, vitamin and mineral concentrates; percentage of crude protein ranged from 16.4-19.2. There was no significant difference (at the 5% level) with reference to av wt gains and daily wt gains The following av feed conversions were registered A= 1:4.70, B = 1:4.32, and C= 1:4 34 Treatment B was the most economical, with a capital return of 61% as compared with 46 and 25%, respectively, for C and A The economic analysis was based on ration cost. *(Summary by T.M)* H03

0513-5233 EDIN, H , KIHLEN, G. and GUSTAFSSON, A. **Angående smältbarheten och fodervärten av tapioka och fiskfodermjöl.** *(Digestibility and food value of cassava and fish fodder meal)* Kungliga Landbruksakademiens Handligar och Tidskrift 69 882-904. 1930. Swed., Sum. Swed., Germ

Cassava. Cassava meal. Digestibility. Swine. Feed constituents. Animal nutrition. Diets. Composition.

The digestibility coefficient of the organic substance of finely ground cassava meal was 94.5, crude protein content, -26; crude fat, 80, crude fiber, 47; N-free extract, 99. The negative value for crude protein shows that the digestible crude protein of cassava is much too low. Food value was 126 fodder units and 95 kg starch value/100 kg organic substance. Feeding with cassava decreased the available supply of digestible albumin 0 5% in swine tested. The digestibility of coarse cassava meal was 2% less and was not eaten as readily. The av digestibility coefficient of fish meal was 78 for organic substance and 85 for crude protein Utilization was not so good on forced feeding An av of 99% crude content was digested; N-free extract was -170 *(Summary by Chemical Abstracts)* H03

0514-7254 FARSTAD, L., *et al.* **Effects of feeding "Pekilo" single cell protein in various concentrations to growing pigs.** Acta Agriculturae Scandinavica 25:291-300. 1975 Engl., Sum Engl , 15 Refs., Illus.

Cassava. Cassava meal. Swine. Proteins. Dietary value. Animal nutrition. Animal health. Fattening. Feed constituents.

A study was made of the possible side effects of Pekilo protein on growing pigs (Norwegian Landrace) when given in relatively high concentrations as a substitute for soybean protein. There were no significant negative effects on wt gain and carcass quality at the 50% level of substitution, at the 100% level, however, wt gain and feed efficiency were significantly lower Animals in this group also displayed inferior carcass quality There were no significant differences as regards glucose and acetoacetate levels or leucocyte differential count. There were some minor differences in other blood factors, however. Macroscopic and histological examination of different parenchymatous organs of the pigs showed no marked differences between the groups Bacteriological and enzymological studies of intestinal content revealed no marked significant differences between the groups as regards the quantitative and qualitative distribution of microorganisms and the amount of proteinase, amylase and lipase. *(Author's summary)* H03

0515-1962 FERRER D , A **La yuca como alimento para ganado vacuno.** *(Cassava as a feed for cattle).* Agricultor Venezolano 30(230).57-61 1966 Span.

Cassava. Cassava programs. Animal nutrition. Nutritive value. Venezuela.

Because of livestock nutritional problems in Venezuela, the partial substitution of wheat and maize by cassava in concentrates for dairy and beef cattle was studied The analysis of the total digestible nutrients (TDN) of cassava gave an index of 27 5% Cassava was chosen as the best possible solution because high TDN production/ha is more economical and it is easily adapted to poor savanna soils where the cattle are usually more affected. It is recommended that digestibility and palatability tests be conducted, supplying cassava in different forms and quantities to animals of different ages *(Summary by A J Trans. by S S. de S)* H03

0516-0264 FRATEUR, J. L **Etude sur l'emploi du manioc dans l'engraissement du porc.** *(The use of cassava for fattening swine). In* Belgium Ministère de l'Agriculture et des Travaux Publiques Rapports et Comunications Ruraux Bruxelles, 1913. v 5, pp 87-118 Fr.

Cassava. Animal nutrition. Swine. Fattening. Cassava meal. Fat content. Protein content. Dry matter. Water content. Feed constituents. Tubers. Dietary value.

The objectives were to determine (1) the capacity of swine to transform rations based on cassava and other ingredients and (2) weight gains. Three groups of 5 pigs each were selected for the experiment; the 1st was formed by native adult pigs; the 2nd, by crossed pigs (native race x Yorkshire) and the 3rd, by improved native pigs. Different methods of chemical analysis were used to determine contents of moisture, protein, cellulose, fat and nitrogen-free extract in cassava The rations used for the 3 groups were basically the same, but the 1st one received meat meal and beets instead of skim milk. Daily liveweight gains/head for the 3 groups were 529.2 g, 671.8 g and 624 5 g, respectively; coefficients of conversion were 0 09094, 0 08456 and 0 08374, respectively Animals from the 3 groups were well fattened, and the quality of the meat and the color and consistency of the bacon were excellent *(Summary by S S de S)* H03,

0517-3251 FRENCH, M. H **The nutritive value of cassava roots.** *In* ———. Tanganyika, Tanzania Department of Veterinary Science. Annual Report 1937. Tanganyika, 1938. pp.81-82 Engl.

Cassava. Tubers. Composition. Digestibility. Sheep. Animal nutrition. Tanzania.

An experiment was carried out with Majani and Chali sheep to determine the nutritive value of dried cassava root (as flour) for fattening purposes. The composition and digestibility of cassava roots and a basal ration of hay are compared in tables. The organic and dry matter were highly digestible, but as abnormal figures were obtained for other constituents, a further trial was considered necessary; however, correlated coefficients were still not found for protein, fat and fiber This fact may be explained by the large amount of starch added to the hay ration Another table shows the composition, digestible nutrients and starch equivalent values for cassava roots. It is concluded that maize and cassava have the same nutritive value, but that the former should be fed with other mineral and protein sources *(Summary by L.F.C. Trans. by S.S. de S.)* H03

0518-6848 GONZALEZ, A DE J **Cultivo y utilización de la yuca como alimento del ganado.** *(Cassava cultivation and its use in livestock feeding).* Revista de Agricultura, Comercio y Trabajo (Cuba) 14(10) 98-103. 1933 Span., 3 Refs.

Cassava. Cassava meal. Animal nutrition. Dietary value. Cultivation. Cuba

A description is given of the cassava varieties grown in Cuba, their application in livestock feeding, and the way in which this feed is supplied. The most appropriate soils and their preparation, as well as the selection of cuttings, planting systems and agronomic practices, are indicated The functions of N-P-K fertilizer in the plant are explained. The nutritive value of cassava is analyzed The chemical composition and digestibility of fresh and dried cassava and "catibia," a waste by-product of cassava are given in tables. *(Summary by L F.C Trans. by S S de S)* H03

0519-1892 GOUIN R L'utilisation du manioc dans l'allaitement artificiel des veaux. *(Utilization of cassava for bottle-fed calves)* Journal d'Agriculture Pratique 66:281-283. 1936 Fr.

Cassava. Cassava meal. Calves. Swine. Dietary value. Animal nutrition.

The main objective was to find an economic and nutritive formula for bottle-fed calves Having studied the composition of other products used in swine and cattle feeding, it was concluded that the ideal formula would be 86 g of cassava meal/liter of skim milk plus diastase, which makes the starch more soluble, thereby facilitating its digestion. This diet and whole milk have the same nutritive and caloric value *(Summary by S S. de S)* H03

0520-7500 HUTAGALUNG, R.I. *et al* **Evaluation of agricultural products and by-products as animal feeds. IV. The value of processed oil palm sludge for chicks.** Malaysian Agricultural Research Bulletin 4(1) 53-60 1975 Engl , Sum. Engl , Mal , 14 Refs

Cassava. Waste utilization. Chicks. Animal nutrition. Tubers. Cassava meal. Malaysia.

Centrifugal solids recovery (censor) materials obtained from various processing methods and combination mixtures of oil palm sludge, palm kernel cake and cassava roots were evaluated in diets for broiler chicks In general, replacement of 50% maize by censor tended to affect wt gain and feed efficiency similarly, but it did not affect feed intake significantly. Total substitution of maize with censor resulted in increased feed intake, growth depression and poorer feed conversion Metabolizable energy values were between 3206 and 3432 kcal/kg (dry matter basis) for the censor materials used *(Author's summary)* H03

0521-5759 INFANGER, C. **Obtenga mayor utilidad alimentando sus cerdos con yuca.** *(Advantages of cassava in swine feeding).* n.i 4p. Span

Cassava. Swine. Diets. Composition Feed constituents. Animal nutrition. Costs. Colombia.

A brief analysis is made of some swine feeding experiments in which cassava was used instead of maize. On the basis of the results obtained, it was concluded that (1) 1.17 kg of cassava replace 1.0 kg of maize as the energy source (2) The economic substitution of maize by cassava depends on the relationship between the price of the crop and the price of the additional protein supplement required to balance the ration. (3) In general terms, the cost of cassava should be about 1/3 of that of maize. In other experiments in which 7 different rations were used, it was found that the profitability of a given crop depends more on its price than on its feed efficiency *(Summary by A.J. Trans. by S.S de S)* H03

0522-5937 ISLABAO, N. and PEIXOTO, R. R. **Mandioca como sucedâneo do milho em ração inicial para frangos de corte.** *(Cassava as a replacement for maize in starter feeds for chicks)* Pelotas, Brasil, Universidade Federal de Pelotas. Faculdade de Agronomia. Departamento de Zootecnia. Boletim Técnico no. 6. 1971. 15p. Port , Sum. Engl , Port., 8 Refs

Cassava. Cassava meal. Chicks. Diets. Feed constituents. Fattening. Animal nutrition. Food energy. Brazil.

The effect of different levels of cassava meal as a replacement for maize in rations for one-day-old chicks was studied in 3 different 4-week trials at the Universidade Federal de Pelotas. The results were as follows (1) At a 30% level of substitution, cassava meal had no adverse effect on growth and intake, provided that there was methionine supplementation Weight gain and feed efficiency were significantly lower with 60% cassava meal (2) At a 100% level of substitution, the value was estimated to be 67% of maize There was a significantly slower rate of gain, and intake was affected even when rations were supplemented with maize oil. (3) When this same ration (100% cassava) was supplemented with 2 12% maize oil and 0 34% methionine, there were no significant differences between this ration and the control. *(Summary by T.M.)* H03

0523-6733 JALALUDIN, S. and LEONG, S K. **Response of laying hens to low and high levels of tapioca meal.** Malaysian Agricultural Research 2(1) 47-51, 1973. Engl., Sum. Engl., Mal., 6 Refs.

Cassava. Cassava meal. Poultry. Eggs. Production. Feed constituents. Animal nutrition. Diets. Composition. Malaysia.

Two completely randomized experiments were conducted to study the effects on egg production of feeding 2 low (5,10%) and 2 high (50,60%) levels of cassava meal in diets containing maize, soybean and fish meals Low levels of cassava meal had no depressing effect on egg production or on gross efficiency. At high levels, protein uptake was marginal and feed intake was high. Fish meal at 13% tended to overcome the depressing effect of high levels of cassava No symptoms of toxicity were observed *(Summary by T M.)* H03

0524-6840 LABRE, S. *et al* **Utilización de la suplementación con melaza, úrea y yuca en el crecimiento de becerros criollos limoneros.** *(Supplementation of rations for native calves with molasses, urea and cassava).* Agronomía Tropical (Venezuela) 25(3).201-205 1975 Span , Sum Span., Engl., 12 Refs.

Cassava. Cassava meal. Calves. Animal nutrition. Concentrates. Feed constituents Dietary value. Venezuela.

A trial was conducted at the El Laral experimental station in Carrasquero, state of Zulia (Venezuela) to determine the effect of substituting commercial concentrates containing 14% protein with supplements based on molasses, molasses-urea and molasses-urea-cassava in rations for native calves Water and chopped grass *(Echinochloa polystachya)* were fed free choice Significant differences ($P < 0.01$) among all treatments were observed for body weight gains Best gains were obtained with the control, followed by molasses-urea-cassava, molasses-urea and molasses. Av daily gains were 217, 169.4, 131.5 and 56 8 g, respectively Feed intake was similar. No differences were observed in the consumption of the green forage. *(Summary by T.M.)* H03

0525-1534 LANG, J R, *et al.* **Engorde de cerdos con diferentes fuentes de carbohidratos.** *(Swine fattening with different sources of carbohydrates)* Costa Rica. Ministerio de Agricultura y Ganadería Boletín Técnico no 50. 1965 14p. Span., 6 Refs.

Cassava. *Manihot esculenta* **Animal nutrition. Swine. Fattening. Feed constituents. Costs. Nutritive value. Costa Rica.**

As a result of the costly high-energy foods such as maize, sorghum, etc and therefore the high percentage of costs that correspond to feedstuffs for fattening swine (75-80%) in Costa Rica, 2 trials were conducted at the experimental station "Los Diamantes" to determine the nutritional value of cassava *(Manihot esculenta)*, bananas *(Musa sapientum)* and taro *(Colocasia esculenta)* and to establish their cost in relation to other foods. For the first trial (55 days), 3 groups of 4-month-old Duroc Jerseys (27 in total) were given the following treatments (1) a balanced ration (control), (2) a concentrate rich in protein with pieces of unpeeled cassava, and (3) a concentrate rich in protein with unpeeled bananas. Daily weight gains for the treatments were 0.76, 0.66 and 0.61 kg, respectively. In the 2nd trial, 28 animals were divided into 4 equal groups, which received the following treatments: (1) a balanced ration with 13% crude protein and grazing on pangola *(Digitaria decumbens)*, (2) a balanced ration with 16% crude protein, given in confinement; and (4) a concentrate with 16% crude protein and pieces of unpeeled taro, given in confinement. Av daily gains were 0.95, 0.92, 0.84 and 0.77 kg, respectively. Animals from treatment 1 needed more feed to gain 1 kg than those from treatment 2. Differences in daily weight gains were not significant for the cassava treatment. It was concluded that cassava, banana and taro are economically feasible for swine feeding, provided that they are properly supplemented with proteins, vitamins and minerals. The use of cassava and taro to provide only part of the energy required gives best economical results and weight gains. *(Summary by A.J. Trans. by S.S. de S.)* H03

0526-6941 HOSTE, P. **Embouche de taurillons: essai de substitution du mais par du manioc enrichi à l'urée.** *(Fattening of young bulls: substitution of maize by cassava enriched with urea).* *In* L'embouche intensive des bovins en pays tropicaux, Dakar, Institut d'Elevage et de Médecine Veterinaire des Pays Tropicaux, 1973. Actes du Colloque. Maisons-Alfort, France, 1974. pp 79-81. Fr., Sum Fr., Engl., 1 Ref

Cassava. Cattle. Fattening. Feed constituents. Dietary value. Animal nutrition. Cameroon.

A 3-mo experiment was conducted with 18 Brahman x Foulbe crossbred bulls of approx. 30 mo age, av initial wt 370 kg. The use of a maize-based (70%) concentrated feed was compared to a feed in which this cereal was replaced by 70% cassava enriched with 2% urea. Both treatments received hay ad libitum and approx. 3 feed units/day/head of these 2 concentrates. Results were comparable. In the 1st phase, wt gains were 1,094 and 1,061 g/day for maize and cassava, respectively (feed conversion index, CI 6.9 and 6.7, respectively). In the 2nd phase, wt gains were 530 and 556 g/day, with a CI of 13.9 and 13.6, respectively. For the total experiment, wt gains were 813 and 808 g/day, respectively with a CI of 10.1 for both treatments. The young bulls were excellent feed converters in the 1st phase; at the end of the test, feed conversion indices doubled. It was concluded that the substitution of maize by cassava and urea (to offset the shortage of N) is quite possible. *(Author's summary)* H03

0527-1968 LUCAS, J. E. **Expérience sur l'emploi de la farine de manioc dans l'alimentation de vaches laitieres.** *(The evaluation of cassava meal as a feed for dairy cows).* Annales de Science Agronomique (4e Série) 3:337-342. 1914. Fr.

Cassava. Cassava meal. Dietary value. Dairy cattle. Feeds and feeding. Feed constituents. Costs. Milk. Production. France.

A trial was carried out to study the nutritive value of cassava as an inexpensive feed for dairy cows in Gournay-sur-Marne (France). A comparison is made in table form of the quality and quantity of milk produced according to the feed used. The addition of cassava and peanut meals to maize gluten increased milk production 0.17%; butterfat, 2.43%/liter; total butterfat, 2.59%; and weight gain, 11%. *(Summary by R.T. Trans. by T.M.)* H03

0528-4426 LUCAS, J. E. **Expérience sur l'emploi de la farine de manioc dans l'alimentation de vaches laitieres faite a la ferme agronomique de Gournay-sur-Marne.** *(The use of cassava as a feed for dairy cows)* Bulletin Economique de Madagascar 15:67-71. 1915. Fr.

Cassava. Nutritive value. Forage. Groundnut cake. Cassava meal. Maize meal. Dairy cattle. Malagasy Republic.

Successful results obtained with cassava as a calf feed set the bases for other trials with dairy cows in an effort to find a balanced ration cheaper than maize gluten. Two groups of 6 cows each were selected for a 30-day trial at the experimental farm in Gourney-sur-Marne. They received the same ration during the first and last 10 days of the trial, during the 2nd phase, one of the groups was given cassava starch and groundnut cake. The contents of total digestible N and starch in maize gluten, groundnut cake and cassava flour were analyzed. Milk production, content of butter fat/liter and weight gain/animal were compared. It was concluded that in addition to its lower cost, the mixture of groundnut cake and cassava flour had a nutritive value equal to that of maize gluten *(Summary by S S de S)* H03

0529-5234 MACIEL, E **Contribução ao estudo da mandioca na alimentação dos animales; valor comparativo da raiz e farinha de mandioca como alimentos para porcos em crescimiento e engorda.** *(Contribution to the study of cassava in animal feeding, comparative value of fresh cassava roots and cassava meal as a feed for growing-fattening pigs).* Dipan 11(119/120):23-40. 1958. Port., Sum Port., Engl, 28 Refs., Illus

Cassava. Cassava tubers (vegetable). Cassava meal. Swine. Nutritive value. Feed mixtures. Finishing. Fattening. Digestibility. Palatability. Food energy. Animal nutrition. Brazil.

In a study comparing the use of cassava meal and fresh roots in dry-lot rations for Berkshire pigs (38 kg initial weight) in Rio Grande do Sul, 4 lots of 5 pigs each were fed the following rations: lots I and IV, cassava meal + a concentrate mixture containing 32% digestible protein, lots II and III, fresh cassava roots and the same supplement The pigs were slaughtered at 100 kg Lots I and IV reached 100 kg 8 weeks before lots II and III. Cassava meal consumption, as well as its palatability, was good. Cassava meal total digestible nutrient (TDN) was 21% more efficient than fresh root TDN. From a technical and practical viewpoint, cassava meal was better *(Author's summary)* H03

0530-6839 MONTILLA, J., CASTILLO, P. P. and WIEDENHOFER, H. **Efecto de la incorporación de harina de yuca amarga en raciones para pollos de engorde.** *(Bitter cassava meal in rations for broilers).* Agronomía Tropical (Venezuela) 25(3):259-266. 1975. Span., Sum. Span., Engl., 14 Refs.

Cassava. Bitter cassava. Cassava meal. Chicks. Fattening. Feed constituents. Diets. Composition. HCN content. Animal nutrition. Dietary value. Venezuela.

Two experiments were conducted with 1-day-old Vantress x White chicks using a completely randomized design with 8 replicates of 10 chicks each In the 1st experiment (4 wk), the following starter rations were compared. (1) YA-0 basal ration with yellow maize as the main source of energy, (2) YA-30. the same as YA-0, but with 30% maize substituted by bitter cassava meal (785 mg HCN/kg fresh matter) and 9% substituted by molasses plus 2% animal fat to correct its powdery texture; (3) YA-37: the same as YA-30 but with 37% substitution Highly significant differences ($P<0.01$) were observed for wt gains with rations YA-0 and YA-30. As regards feed efficiency, highly significant differences ($P<0.01$) were also found for the rations with lower amounts of cassava In the 2nd experiment (8 wk), 3 starter and finishing rations were used (1) YA-0, (2) YA-30, and (3) YD-30, where 30% yellow maize was substituted by sweet cassava (220 mg HCN/kg fresh matter). Highly significant differences were observed ($P<0.01$); YA-0 gave better wt gains at 6 and 8 wk than the other treatments In both experiments, rations with lower amounts of cassava were significantly better; nevertheless, from a practical point of view, these differences are minor. The results indicate that cassava meal (both bitter and sweet) are excellent sources of energy for broiler rations; its utilization will depend on its cost. *(Author's summary)* H03

0531-7396 MONTILLA, S., J. J. **Utilization of the whole cassava plant in animal feed.** Maracay, Universidad Central de Venezuela, Facultad de Ciencias Veterinarias, 1976. 17p. Engl., Sum. Engl., 40 Refs

Cassava. Tubers. Foliage. Forage. Animal nutrition. Nutritive value. Food energy. Cortex. Pulp. Cassava meal. Toxicity. Poultry. Swine. Cattle. Venezuela.

The low yields of most cereals and soybean crops in the tropics constitute one of the main obstacles to obtain efficient animal production in these areas Cassava is one tropical crop that possesses the potential for contributing to the solution of this problem. This crop can produce energy yields several times greater than cereal crops harvested in the tropics. It is also possible to obtain more than 6 tons/ha/yr of protein from cassava when the proper agronomic practices are aimed toward foliage harvest. Both products—roots and foliage—are easily processed to dry material with acceptable storage capability. It is evident from the literature reviewed that cassava meal can substitute up to more than half of the cereals in broiler rations and the whole cereal grain fraction in laying hen rations with no detrimental effect on productivity. In swine nutrition, there are various reports indicating that cereals can be safely substituted by cassava meal at levels higher than 75% without adverse effects. No deleterious effects have been reported in ruminant nutrition by partial or total substitution of cereal grains with cassava meal. Limited information suggests that cassava leaf meal can be safely used as a partial substitute for the traditional protein sources in most animal species. It should be noted that methionine supplementation and careful control of energy. protein ratios are necessary for satisfactory results with cassava leaf meal, particularly in nonruminants. *(Author's summary)* H03

0532-4852 MULLER, Z., CHOU, K.C. and NAH, K.C. **Cassava as a total substitute for cereals in livestock and poultry rations.** World Animal Review no. 12.19-24. 1974. Engl., 18 Refs., Illus

Cassava. Nutritive value. Tubers. Leaves. Stems. Swine. Poultry. Cattle. Animal nutrition. Proteins. Food energy. Cassava meal. Pellets.

Cassava in diets for pigs may fully replace cereals without any negative effect when the diets are properly balanced. In poultry diets, up to 50% cassava meal in the rations did not affect performance or egg quality, if fortified by xanthophylls. In diets for cattle, a concentrate of 85% cassava root meal, 6% molasses, 8% urea and 1% minerals could effectively supplement tropical forages, in dry-lot, a combination of cassava pellets and grass-meal pellets may totally substitute cereals. *(Summary by Abstracts on Tropical Agriculture)* H03

0533-6701 MULLER, Z. *et al.* **Study of nutritive value of tapioca in economic rations for growing/finishing pigs in the tropics.** Singapore. United Nations Development Programme. UNDP/SF Project Sin 67/505. 1972. 35p. Engl., Sum. Engl., 31 Refs, Illus.

Cassava. Tubers. Leaves. Cassava meal. Swine. Fattening. Finishing. Composition. Diets. Nutritive value. Animal health. Food energy. Animal nutrition. Singapore.

Historical and etiological data are given on cassava cultivation and utilization in Asia and elsewhere. Chemical analyses showing the amino acid, mineral, vitamin and HCN contents in cassava roots and the plant as a whole are included. Literature on experiments conducted with swine, mainly in developing countries, is reviewed. Nine feeding experiments were conducted with Sembawang crossbreeds to evaluate growing-finishing performance on cassava meal at 38, 40, 60 and 75% levels of substitution in maize-based diets. Four trials used cassava mash and 5 pelleted rations. It was concluded that cassava may replace maize on a much higher level (40-60%) than is generally recognized in present literature; however such diets must be pelleted since bulkiness and the powdery texture of the meal are limiting factors. Higher levels of cassava do not influence carcass quality, except that fat is firmer than in maize-fed pigs. In terms of energy, the price of cassava rations is more advantageous than maize; however, critical nutritional factors such as excess of crude fiber and ash and deficiency of essential fatty acids, essential amino acids, macro- and microminerals and vitamins (mainly riboflavin, nicotinic acid and pantothenic acid) must be balanced. Composition and analysis of diets based on different cassava products are included. *(Summary by T.M.)* H03

0534 6735 NG, B.S and HUTAGALUNG, R. I **Evaluation of agricultural products and by-products as animal feeds. III. Influence of dehydrated poultry excreta supplementation in cassava diets on growth rate and feed utilization of chickens.** Malaysian Agricultural Research 3:242-253. 1974. Engl., Sum. Engl , Mal.,45 Refs.

Cassava. Cassava meal. Chicks. Fattening. Proteins. Feed constituents. Diets. Composition. Costs. Animal nutrition. Animal health. Dietary value. Malaysia.

Graded levels (5,10,15%) of a commercially available sample of dehydrated poultry excreta (DPE) in combination with 2 levels of (15,30%) cassava diets containing either low (17-19%) or high (20-22%) protein levels were fed to broiler chicks from 3-11 weeks of age to evaluate performance and protein (N x 6.25) as well as metabolizable energy (ME) utilization The proximate and amino acid composition of DPE was also determined. Energy utilization of DPE was found to be low (1043 kcal ME/kg on a dry wt basis) at a constant level of ME consumed No detrimental effects and significant differences in performance were noted between chicks fed cassava diets containing 5 or 10% DPE and chicks fed conventional diets, however, growth and feed efficiency steadily declined as the level of DPE was increased beyond the 10% level. The feeding of graded levels of DPE had no significant effect on the plasma uric acid content. Regardless of protein and DPE levels, birds fed cassava diets tended to be lighter than birds fed on control diets. Increasing the concentration of protein, irrespective of cassava and DPE levels, improved growth rate of chicks but not the efficiency of feed utilization The inclusion of DPE in the diet lowered the cost of feed/kg gain compared with the control diets; but in order for the weight of broilers fed 15% DPE to be equal to that of those fed conventional diets, they must remain on 15% DPE 1 wk longer. It is concluded that the supplementation of 15% DPE and 30% cassava in the diet to substitute other protein and energy sources produced no adverse effect on performance and could contribute a substantial feed cost saving. *(Author's summary)* H03

0535-6703 PALISSE, M. and BARATOU, J. **Le manioc et les patates douces, matières premières glucidiques pour le poulet de chair.** *(Cassava and sweet potatoes, first carbohydrates for broilers)* *In* Journées de Recherches Avicoles et Cunicoles, Paris, 1973. Institut Technique de l'Aviculture, Paris, 1973. pp. 165-167. Fr., Sum. Engl.

Cassava. Chicks. Fattening. Feed contituents. Diets. Composition. Animal nutrition.

Cassava and sweet potatoes replaced maize or wheat in broiler diets as follows: 23 kg maize or wheat was replaced by 20 kg cassava or sweet potatoes and 2 kg tallow, 1 kg soybean meal and 60 g methionine Hybro chicks were grouped into 12 lots of 144 (72 males and 72 females) From 1-26 days of age the control diet was based on maize and from 26-70 days on wheat. Each diet was given to 4 lots of chicks and the birds were weighed at 26 and 56 days. Feed intake was measured from 0-26 days and 26-56 days. There was little difference in weight, feed intake or feed efficiency among the lots of chicks on all 3 diets at either age. It is concluded that cassava and sweet potatoes can be used in broiler diets, provided that they are pelleted. This overcomes problems of palatability and gumming up of the birds' beaks. It is suggested that the energy value assumed for these products may be underestimated. *(Summary by Nutrition Abstracts and Reviews)* H03

0536-5730 POLIMANTI, O **Influenza dell' alimentazione con gelatina, tapioca e glutine sull' accrescimento dei girini di rana.** *(Effect of feeding gelatin, tapioca and glutin on the development of tadpoles).* Rivista di Biologia 13:423-432. 1931. Ital., 1 Ref., Illus.

Cassava. Tapiocas. Animal physiology. Animal nutrition. Italy.

Feeding always produces acceleration of metamorphosis, particularly as regards disappearance of the tail. Tapioca clearly retards metamorphosis, as compared with glutin because it is lower in protein and amino acids. Gelatin is not at all suitable for the development and metamorphosis of tadpoles. The mortality rate is higher with tapioca than with glutin *(Summary by Biological Abstracts)* H03

0537-1700 PFEFFER, E., HARTMANN, D. and MOHME, H **Einflüsse der Trocknungstemperatur und -dauer bei der Unterdachtrocknung von Halmfutter auf den Futterwert.** *(The effect of temperature and length of drying time under cover on the nutritive value of forages)* Zeitschrift für Tierphysiologie Tierernährung und Futtermittelkunde 30.212-221. 1972 Germ., Sum. Germ., Engl., 18 Refs.

Cassava. Forage. Cassava chips. Pellets. Animal nutrition. Lambs.

When comparing storage systems for forage, loss in dry matter as well as costs of different methods must be considered. The effect of storage on the nutritive value of the forage should also be taken into account. The present study was carried out to determine the effect of temperature and drying time on the nutritive value of forages. Grass of uniform origin was either frozen or dried at 40, 90 or 120°C. One batch was ventilated with the two higher temperatures until the grass was dry, whereas the second batch was ventilated twice the necessary drying time. Ten wether lambs were used to test the dietary value of the forage. In addition to the grass, the animals received 150 g of cassava/day. Daily DM intake ranged from 895 to 938 g. Organic matter digestibility was 72% for frozen grass and 66% for hay ventilated at 120°C. Digestibility of crude protein was 68% in frozen grass; it was highest in hay dried at 40° (72%) and lowest when ventilated at 120°C (61%). N balances were lowest in frozen grass (+1.0 g/day), increasing with higher drying temperatures; the best was +3.6 g/day for hay dried at 120°C. Higher temperatures produced lower concentrations of ammonia in the rumen after feeding. Metabolizable energy plus energy in methane (as percentage of gross energy) amounted to 62% for frozen grass, 57% for hay ventilated at 120°C, and 59 to 60% for the other four types of hay *(Author's summary)* H03

0538-7384 PFEFFER, E., KLAPSING, J and BESECKE, C **Untersuchungen über den Einfluss steigender Tapiokazulagen auf den Stichstoffumsatz von Hammeln.** *(The effect of increasing dietary cassava supplements on the nitrogen metabolism of wethers).* Zeitschrift für Tierphysiologie, Tierernährung und Futtermittelkunde 35:101-112. 1975. Germ., Sum. Germ., Engl., 32 Refs.

Cassava. Sheep. Cassava chips. Diets. Compositon. Animal physiology. Animal nutrition. Dietary value.

Two wethers were fed "continuously" from an automatic feeder. The basal ration of 400 g lucerne cubes was supplemented by between 100 and 600 g cassava chips. In one trial 800 g lucerne cubes were fed. The addition of 100g cassava chips increased the excretion of N in the feces by an av of 309 mg, whereas it decreased the excretion of total N in the urine by 753 mg/day. The decrease in the urine was greater with N in urea + ammonia, whereas the excretion of allantoin was even increased to 3 times the initial value. With creatin + creatinin no change could be observed. *(Author's summary)* H03

0539-0128 ROCHA, G. L DA Mandioca, batata doce... e leite no inverno. *(Cassava and sweet potatoes· winter supplements for dairy cows)* São Paulo, Brasil, Departamento da Produçao Animal, 1968. 4p. Port

Cassava. Cassava chips. Cassava meal. Dairy cattle. Animal nutrition. Sweet-potatoes. Brazil.

Crops such as cassava, sweet potatoes, sugar cane and rye are easily grown in the state of São Paulo. Cassava and sweet potatoes are excellent winter supplements for dairy cows The av yield of cassava per alqueire (2 2 ha) is 30-40 tons This is more than enough to feed 50 cows for 3 mo. at a rate of 5 kg/day. Leftovers are sun dried to make a concentrate rich in carbohydrates. Cassava and sweet potato meals can be used to prepare balanced mixtures for swine and poultry feeding. In addition, yields can be increased by supplying animals with the whole plant—including stems and leaves—chopped *(Summary by P.G. Trans. by S S de S)* H03

0540-5092 SCHOLZ, H. K. B W. **Possibilidades de aproveitamento de partes aéreas da mandioca como forrageira.** *(Possibilities of using the aerial parts of cassava for forage). In* Banco del Nordeste do Brasil S A Departamento de Estudos Econômicos do Nordeste (ETENE). Divisão de Agricultura Pesquisas tecnológicas sôbre a mandioca Fortaleza, Brasil, 1972. pp. 181-195. Port., Sum Port

Cassava. Forage. Production. Field experiments. Cultivation. Productivity. Brazil.

The possibility of the systematic use of cassava leaves and branches was studied in 3 field trials in order to obtain good-quality forage with a high protein content (10-12%, air dried). This project is of special interest in this area (northeastern part of Ceará), where there is a good market for this product Results of yields under different pruning conditions are summarized in a table In general it was found that root yields decreased considerably when plants were pruned twice or more, especially in sandy soil. Mulching with caranday (a palm) straw and/or manure gave very good results and was economically viable. Delayed pruning (210-270 days) produced more green matter and affected root yields less (10% at 270 days). It seems economically viable to obtain yields of 3 tons/ha of dry forage, pruning in the ninth month and harvesting roots at 12 or 13 months. *(Summary by T.M)* H03

0541-5943 SEBASTIA, J. M. *et al.* **Farinha de mandioca como substituto parcial do milho, na alimentação de frangos de corte.** *(Cassava meal as a partial replacement for maize in broiler rations)* Pesquisa Agropecuária Brasileira (Série Zootecnia) 8(2) 61-64. 1973. Port , Sum. Port , Engl., 10 Refs.

Cassava. Cassava meal. Diets. Composition. Fattening. Animal nutrition. Chicks. Brazil.

A trial evaluating cassava meal as a replacement for maize at 0, 10, 20, 30, 40 and 50% level in broiler rations was conducted at the Montenegro Experimental Station, Rio Grande do Sul (Brazil) Feed consumption was not affected at any level. Nine-week broilers were significantly heavier in the groups receiving rations in which cassava meal replaced up to 30% of the maize There were no significant differences ($P < 0.05$) in feed conversion among treatment groups *(Author's summary)* H03

0542-5718 SILVA, J. R DA **Farelo de ramas e fôlhas de mandioca na alimentação animal.** *(Bran made of cassava leaves and branches as a feedstuff).* Chácaras e Quintaes (Brazil) 114(6):663-6. 1966 Port.

Cassava. Cassava meal. Animal nutrition. Domestic animals. Dairy cows. Swine. Poultry. Forage. Leaves. Composition. Planting. Cuttings. Fertilizers. Spacing. Solar drying. Timing. Brazil.

Both fresh roots and the aerial part of cassava can be used in animal nutrition. The dry matter of leaves contains 20% raw protein, 2% calcium and 0.5% phosphoric acid. Data are given on trials carried out with laying hens in Campinas (São Paulo). Agronomic practices the farmers should use to improve their plantations and methods of drying cassava—with or without drying equipment—before preparing the bran are explained in detail. *(Summary by L.F.C. Trans. by S.S de S)* H03 D02

0543-6738 SIRIWARDENE, J. A. DE S. and RANAWEERA, K.N.P. **Manioc leaf meal in poultry diets.** Ceylon Veterinary Journal 22(3-4) 52-57. 1974. Engl., Sum. Engl, 15 Refs

Cassava. Cassava meal. Leaves. Poultry. Diets. Protein content. Food energy. Detoxification. processes. Animal nutrition. Amino acids. Sri Lanka.

Cassava leaf meal, derived from the leaves, petioles and tender stems of *Manihot utilissima*, was used as a substitute for coconut meal in feeding experiments with chickens. There were no significant differences in growth rates and feed conversion up to a 10% level of substitution. A technique was developed for drying the leaves so as to reduce the HCN content of the meal to safe levels The metabolizable energy value of the meal is estimated as 1,923 kcal/kg for material containing 22.28% crude protein and 16 84% crude fiber. *(Summary by T.M.)* H03

0544-1729 YOSHIDA, M. *et al.* **[Nutritive value of various energy sources for poultry feed. IV. Estimations of available energy of cassava meal].** Japanese Poultry Science 3.29-34 1966. Jap., Sum Engl., 22 Refs

Cassava. Cassava meal. Poultry. Food energy. Animal nutrition. Animal physiology. Analysis.

The available energy content of cassava meal was determined using chicks fed rations with different energy levels The energy content was estimated by means of a computer, based on the chicks' rate of growth and expresed as a percentage of total digestible nutrients. Rations with 32% cassava meal had a growth-retarding effect on one-day-old White Leghorn Chicks Cassava meal, soaked overnight or autoclaved at 120°C for 1 h, improved rate of growth The rate of growth of 4-week-old chicks receiving diets containing 10% raw cassava meal was normal, whereas with 15 and 20% it was abnormal. The possible growth-inhibiting factor is the HCN content of cassava meal, whose effect can not be detected when the diet contains 10% raw meal or when it has been previously heated or soaked in water. Under these conditions, the available energy content of cassava meal is 70% Therefore, it is recommended to use diets for poultry with less than 10% cassava meal. *(Summary by A.J Trans by S. S de S)* H03

See also 0213 0268 0762

H04 HCN Toxicity and Detoxification (For HCN content, see C03)

0545-5375 DETRICK, L. E. *et al* **Tolerance, toxicity, and calorie availability of intravenously injected tapioca dextrin solution in rabbits.** Journal of the American Pharmaceutical Association 41(11) 614-617. 1952 Engl., Sum. Engl , 15 Refs., Illus.

Cassava. Dextrins. Toxicity. Food energy. Animal physiology.

Complete parenteral nutrition is limited by the lack of suitable means for providing an adequate calorie intake. The effect of the continuous intravenous administration of tapioca dextrin on the body weight curve, in addition to acute and chronic toxic effects, was studied in Dutch rabbits. Daily injections (11 in total) of tapioca dextrin solution containing amino acid hydrolysate, B-complex vitamins and sufficient, potentially available calories for complete parenteral nutrition were administered Although tapioca dextrin was not a source of high caloric intake, the body weight curve was maintained well above the starvation level. The intravenous regime was well tolerated by most animals, those developing symptoms of toxicity recovered if the infusions were not continued too long afterwards. Hydropic degeneration found in the epithelium of the proximal convoluted tubules of the kidney at the end of the injections was reversible during an oral-feeding recovery period. Hyaline degeneration was not observed in the glomeruli of the kidney or the blood vessel in the lungs, and foam cells were absent in the reticulo-endothelial system *(Summary by T.M.)* H04

0546-5940 GUZMAN R., V.H **Intoxicación crónica por ácido cianhídrico en ratas y su interacción con la proteína y el tiosulfato de sodio de la dieta.** *(Chronic HCN toxicity in rats and its interaction with dietary protein and sodium thiosulfate).* Tesis. Mag Sc Bogotá, Colombia, Universidad Nacional - Instituto Colombiano Agropecuario, 1975. 175p. Span , Sum. Span , 133 Refs , Illus

Cassava. HCN. Toxicity. Diets. Composition. Laboratory animals. Bitter cassava. Animal health. Animal physiology. Analysis. Thiocyanates. Cyanides. Cassava meal. Proteins. Colombia.

An experiment was conducted at the Instituto Colombiano Agropecuario (Colombia) to study the effect on rats of sublethal doses of HCN contained in bitter cassava diets supplied for 6 mo. The relationship between HCN and protein quality, represented by its S-containing amino acid content, was established, as well as the role played by sodium thiosulfate in preventing lesions and in the detoxification of HCN. Six experimental diets and 1 control diet were given to 121 white rats distributed at random. The rats were slaughtered at 3 different times at regular 2-mo intervals, and the following histopathologic analyses were made: whole blood and serum, thiocyanate (the main product from HCN excretion in the urine and blood serum); thyroid gland intake and urinary excretion of I^{131} and determination of protein bound I^{131}. The bitter cassava variety CMC-74 or UCV-2078 (in the form of flour) had a high HCN content (572-584 ppm) The addition of 2400 ppm of cyanide in the form of KCN to diets containing bitter cassava raised their cyanide content to 2972-2984 ppm, which exceeds the sublethal dosis for rats (2400 ppm) An inverse proportion between food intake and wt gains was observed in diets with different protein quality With a lower food intake, the diets with good protein quality showed a better feed conversion than those with poor protein quality The urinary excretion of thiocyanate was closely related to the protein quality, food intake and wt gain of each diet Sodium thiosulfate—an additional detoxicator used with rats for the 1st time—was very useful in the detoxication of poor protein quality diets. Diet composition and food intake had a direct influence on the urinary excretion of thiocyanate. The urinary excretion of thiocyanate in all diets used for more than half the experimental time reflected a mechanism of renal adaptation, which accounted for a considerable decrease in the level of plasma thiocyanate. This phenomenon requires more study. Statistical analysis showed that female rats given the most toxic diet presented a natural resistance or tolerance to cyanide. Based on the hematology, blood chemistry, microscopic study of the tissues and the study of thyroid functioning, it is possible to affirm that the diets did not produce lesions in rats. In this experiment bitter cassava exerted no antithyroid action. It might be necessary to combine other factors, such as iodine deficiency and a relatively unbalanced diet, with a high bitter cassava consumption for a longer period of time. The same experiment should be conducted with livestock to see whether sodium thiosulfate exerts the same detoxicant action in cattle as it did in rats. *(Author's summary. Trans. by S S. de S.)* H04

0547-4850 HENRY, M.O. **Notes sur le manioc amer et essais analytiques sur le suc de sa racine.** *(Notes on bitter cassava and analyses of the juice extracted from its roots).* Journal de Pharmacie 20 622-630. 1834. Fr.

Cassava. Toxicity. HCN. Analysis.

A description is given of sweet and bitter cassava varieties and several products prepared from them (casave, tapioca, flour and starch). Several chemical analyses were made of the juice obtained after pressing the fresh pulp of bitter cassava; it was concluded that this liquid was made up of HCN, acetic acid, a magnesium organic salt; a bitter subtance highly soluble in water and alcohol; a dark substance of a complex nature, with traces of fermentable sugar; and starch and gluten residue. *(Summary by S S. de S.)* H04

0548-0009 LACERDA, M. DE **Sur l'action toxique du suc de manioc.** (*Study on the toxic action of cassava extract*). Comptes Rendues de l'Academie Scientifique. Série 5 92·1116-1118. 1881 Fr.

Cassava. Toxicology. Animal physiology. HCN.

Several trials were carried out with dogs to determine the toxicity of cassava. The animals were injected intravenously, intramuscularly or in the belly with different doses of a cassava root extract With the application of 15-20 cc, the symptons were similar to those of drunkenness, in addition to bowel malfunction Larger doses produced convulsions, paralysis and death due to respiratory failure. Intensity of symptoms depended both on the animal and the place of application, therefore, it was impossible to determine its chemical reaction and its effects Due to the high quantities required, it can be concluded that the cassava extract is not very toxic, but further research on its mechanism, nature and the variation in response is necessary. (*Summary by S. S. de S.)* H04

0549-0644 MONTGOMERY, R.D. **Cyanogens.** *In* Liener, I.E., ed. Toxic constituents of plant foodstuffs. New York, Academic Press, 1969. pp.143-157. Engl., 75 Refs., Illus

Cassava. Cyanogen. HCN content. Toxicity. Toxicology. Detoxification. Cyanogenesis. Cyanogenic glycosides. Analysis. Metabolism.

As regards cyanogens, 3 different glucosides have been identified: amygdalin, dhurrin and linamarin; the latter is found in cassava. Although the cyanogen is found in all parts of the plant, the greatest concentration is in the root cortex. Autohydrolysis: the spontaneous release of HCN from the plant depends upon the presence of a specific glucosidase and water. The enzymes are extracellular and gain access to the glucoside after physical disruption of the cell. They act in the cold and are readily destroyed by heat. Hydrolysis occurs when the plant is macerated in water. The boiling point of HCN is 26ºC. To avoid problems of intoxication, only fresh, well-washed roots should be consumed, discarding all bruised roots. Cooked cassava should not be mixed with fresh vegatables since contact with fresh glucosidase can lead to the decomposition of the glucoside, which is stable in heat. It seems probable that under certain nutritional conditions, the consumption of trace amounts of cyanogen can lead to chronic diseases in man (amblyopia, tropical ataxic syndrome and the elevation of plasma thiocyanate levels). *(Summary by L.F.C. Trans. by T. M.)* H04 C02

0550-3263 NORMANHA, E. S. **Estudos sôbre mandioca brava.** *(Studies on bitter cassava).* Ciencia e Cultura (Brazil) 17(2):196. 1965. Port., 1 Ref.

Cassava. Toxicity. HCN content. Pulp. Cooking. Human nutrition. Bitter cassava. Brazil.

Research was carried out with the variety Branca de Santa Catarina in order to find out whether the HCN content of bitter cassava was toxic to humans. The pulp was cooked for 30, 40, 50 and 60 min, after which the HCN content was determined using Liebig's method. Conclusions were as follows: (1) Human intoxications are due to insufficient cooking time, which prevents the hydrolysis of the cyanogenic glucoside that liberates the HCN. (2) The almost total liberation of HCN does not totally inactivate the enzymes responsible for the hydrolysis or autolysis of the glycoside. (3) Cases of intoxication with cooked bitter cassava could be due to the liberation of HCN within the digestive tract and/or to the enzymatic activity of the cooked root. (4) When the enzymes (of the types linase and emulsin) are totally destroyed by heat, intoxication is due to the hydrolysis of the glycosides by some acids like HCl or to that of other components of foods ingested simultaneously. *(Summary by L.F.C. Trans. by S.S. de S.)* H04 C03

0551-0801 OKE, O.L. **Toxic chemicals in Nigerian foodstuffs.** Indian Journal of Nutrition and Dietetics 7.119-129 1970. Engl., 54 Refs

Cassava. Toxicity. Detoxification. HCN. Nigeria.

This paper studies some toxic substances found in Nigerian foodstuffs, such as HCN, oxalates, phytic acid, chemical substances (organic acids, phenols, ketones, aldehydes, terpenes, alkaloids, resins, cleoresins, cholesterol, oxalic acid, selenium and chromium) and toxins produced when food is contaminated by bacteria and fungi. HCN does not occur free in plants but in the form of cyanogenetic glucosides. These glucosides have been found in over 300 plant species, especially in lima beans, sweet potatoes, cassava and pear and apple seeds The chief factors in the variation of HCN content are variety and environment. Some methods are presented to reduce HCN content in tubers: drying, the addition of glucose and cooking. *(Summary by A.J Trans by S.S de S.)* H04

0552-5268 PEREIRA, A.S. and PINTO, M.G. **Determinação da toxicidade da mandioca pelo paladar das raízes "in natura".** *(Determination of toxicity in cassava by tasting fresh roots).* Bragantia 21: CXLV-CV. 1962 Port., Sum. Engl.

Cassava. Tubers. Toxicity. HCN content. Palatability. Organoleptic examination. Cultivars. Sweet cassava. Bitter cassava. Brazil.

Samples of bitter and sweet cassava roots were analyzed for their HCN content and at the same time given to a panel to be tasted. Results from chemical analyses and organoleptic tests indicated that there was a strong correlation between the bitter flavor of the roots and their HCN content Very bitter-tasting roots have a high HCN content and should not be used for human or animal consumption. Fresh sweet cassava roots had from 0.003 to 0.011% HCN; the industrial variety Branca de Santa Catarina had 0.039% under the same conditions. *(Author's summary)* H04

0553-2954 POHATH-KEHELPANNALA, T. B. **Poison in food plants, especially cassava.** Tropical Agriculturist 2.161-164. 1907. Engl

Cassava. Toxicity. Detoxification. Human nutrition. Sri Lanka.

A description is given of the symptoms of intoxication and poisoning resulting from cassava consumption and some of the preventive methods and treatments used in Ceylon. In addition to fainting, vomiting and diarrhea, death may occur in a few hours; however, the seriousness of the intoxication varies according to each organism. One of the preventive methods used by the people of this country is to add leaves of *Moringa pterygosperma or Piper nigrum* to cassava while it is being cooked, to counteract the effects of HCN. Treatments include decocting leaves of *Pera* sp. *Evariya* sp and *Batata* sp. *(Summary by A.J. Trans. by S S. de S.)* H04

0554-3364 REKO, V.A **Der "Camotillo", ein gehimnisvolles Indianergift.** [*"Camotillo" (cassava), a toxic plant used by the Indians*]. Phermazeutische Monatshefte 13 177-178. 1932. Germ.

Cassava. Toxicity. HCN. HCN absorption. Detoxification. Clinical manifestations. Antidotes. Fermentation. Mexico.

Cassava, known also by the names "camótillo" and "guacamote," was used as a poison and as a food (eliminating its toxicity by a special process) by the Mexican Indians It is attributed to have therapeutic effects as an astringent and as a medicine against tapeworms. A description is given of the symptoms of HCN poisoning, which are similar to those of cerebrospinal meningitis, and of the several phases of its physiological action. HCN poisoning produces acute asthma, paraplegia, blindness, deafness and finally death The fact that cassava can be consumed for long periods of time without producing deadly effects is explained by the chemical reactions that take place within the organism, counteracting the action of the poison. *(Summary by H.P. Trans by S S de S.)* H04

0555-4082 SPATH, C. D **The toxicity of manioc as a factor in the settlement patterns of lowland South America.** n.i. 26p. Engl Sum , Engl. 34 Refs.

Paper presented at American Anthropological Association. Annual Meeting, 70th, New York, 1971. Manioc in lowland South America.

Cassava. HCN. Toxicity. Human health. Detoxification. Detoxification processes. South America.

Written from an anthropological point of view, this article studies HCN toxicity in cassava *(Manihot esculenta)* Techniques of processing tubers and the removal of toxins are also discussed The wide range in the toxicity of cassava tubers reflects to some degree the genetic tendencies of the strains, but it can vary in response to edaphic and other factors. Medical literature from Africa indicates that the cyanogenic glucosides contained in a cassava-based diet produce an above-normal nutritional need for certain sulfur-bearing amino acids. Methionine and cystine in particular appear to be sources of sulfur for thiosulfates used by the body in the detoxification of cyanides, thus populations depending primarily on cassava must have reliable sources of sulfur-bearing protein, such as fish. Implications in the distribution of major cassava-based settlements are also discussed at length. *(Summary by T.M.)* H04

See also: 0058 0071 0079 0466 0619

0556-5574 BERGAMIN, F. **A polução dos cursos d'agua pelos resíduos da mandioca.** *(Water pollution due to cassava waste products).* Boletim de Indústria Animal (Brazil) 6(4).129-134. 1943. Port.

Cassava. Cassava starch. Factories. Wastes. Brazil.

The Division for the Protection and Production of Fish and Wild Animals decided to carry out a study in two cassava starch factories at Araras and Taquaritinga as a result of complaints that cassava waste products were polluting the water and killing a great number of fish. Since the effluent was found to have a high reducing capacity, two treatments were recommended: (1) a biological filter followed by a secondary decantation chamber, which retains the sediment formed in the filter, or (2) an apparatus based on activated sludge, which is ideal because it has 3 adjustable devices, making this system more flexible than the biological filter. This apparatus consists of a reservoir which has a small duct on the bottom covered by porous rock, into which a determined quantity of air is injected. The next step is a secondary decantation which lasts 1 1/2 to 2 hours, followed by a pump used to return the sludge from the secondary decantation In the presence of oxygen from the air, all the organic matter is destroyed as a result of the intense organic activity The sludge obtained by this process is channeled through a digestor, where it remains for 60 days, after which time it is completely mineralized *(Summary by L.F.C. Trans. by S.S de S.)* 100

101 Cassava Starch and its Properties

0557-6748 CHABOT, J. F., HOOD, L F. and ALLEN, J. E **Effect of chemical modifications on the ultrastructure of corn, waxy maize, and tapioca starches.** Cereal Chemistry 53(1).85-91. 1975. Engl, Sum Engl, 7 Refs, Illus

Cassava. Cassava starch Modified starches. Analysis. Laboratory experiments. USA.

Unmodified and modified cassava, corn, and waxy maize starches were examined with light and electron (scanning and transmission) microscopy. Modified starches investigated included those cross-linked with POCl or epichlorohydrin, and/or derivatized with propylene oxide or acetic anhydride Only slight differences were noted in the structure of granules cross-linked with different reagents Some samples of uncooked modified starches showed granule breakage and partial gelatinization Gelatinized preparations of unmodified cassava consisted of few granules and a mass of interconnected fibrils of variable dimension Hydroxypropyl distarch phosphate and acetylated distarch glycerol from cassava had intact granules containing a diffuse material as well as intergranular fibrils. Unmodified waxy maize and all modified waxy maize starches had little or no extragranular fibrillar material Unmodified and modified corn had small granules embedded in a fine fibrillar matrix Some of the modified granules also had diffuse fibrillar material in the central cavity of the granule Chemical modification of corn and cassava starch caused a reduction in the amount of extragranular starch, with the maintenance during cooking of an intact envelope around a fibrillar-filled cavity. (*Author's summary*) 101

0558-5381 CLEVELAND, F. C and KERR, R W. **Osmotic pressure studies on corn amylose.** Journal of the American Chemical Society 71·16-20. 1949. Engl, 23 Refs., Illus.

Cassava. Cassava starch. Analysis. .

The apparent DP*n* values for the acetates of corn amylose and its subfractions were calculated from osmotic pressure determinations with selected solvents Of those used, chloroform gave the lowest DP*n* values; the acetate of one sample prepared by Pentasol precipitation was found to have a DP*n* of 455 and another 495. The acetate of a butanol-precipitated corn amylose had a DP*n* of 435. Subfractions of the latter varied in DP*n* between 250 and 675 Higher DP*n* values were found in other solvents, which can be explained by association of the acetate in these solvents Starch acetate samples tend to become visibly insoluble or partly insoluble in organic solvents as the DP exceeds that of corn amylose. Cassava amylose acetate appeared to be very nearly the limit in respect to molecular size for solubility in chloroform and showed a DP*n* of 1050 in this solvent (*Summary by Chemical Abstracts*) 101

0559-5426 **CONDUTO-VISCOSIMETRIA em produtos amiláceos.** *(Measuring viscosity in starchy products by conductometrics). In* Banco do Nordeste do Brasil, S.A Departamento de Estudos Econômicos do Nordeste (ETENE). Divisão de Agricultura. Pesquisas Tecnológicas sôbre a mandioca. Fortaleza, Brasil, 1972 pp 59-77 Port., Sum. Port., 4 Refs., Illus

Cassava. Cassava starch. Viscosity. Gelatinization. Analysis. Temperature. Laboratory experiments. Brazil.

The possiblity of applying a new conductometric method to determine the consistency of starch viscosity by means of the respective curves formed by the coordinates temperature and time during 2 stages—heating and cooling—is discussed. These curves are characteristic for each type of starch and for the different qualities, making it possible to identify the type of starch as well After some improvements have been made in the equipment, a new criterion can be used in the qualitative analyses of starchy products. *(Author's summary. Trans by T.M.)* 101

0560-5589 ELLIS, H The microscopy of starch. Textile Recorder 1931 23-25 May 1931. Engl

Cassava. Cassava starch. Textiles. Industrial starches. Wheat flour. Cytology. Analysis. Laboratory experiments. Starch crops.

Because of the importance of starches in the textile industry, different agglutinants available were examined under the microscope in order to maintain the uniformity of the final product (textile materials, etc). The method used is described in detail. Four aspects were studied. (1) average size of the granules, (2) their shape and nature, (3) the position of the hilum or organic center, (4) the appearance in polarized light. A table comparing the main characteristics of cassava starch and tapioca to 5 other starches is included *(Summary by L.F C Trans by S S. de S)* 101

0561-5358 FOSTER, J. F and SMITH, R. L Potentiometric iodine titration of branched starch fractions. Iowa State Journal of Science 27:467-477. 1953 Engl., Sum Engl , 7 Refs , Illus.

Cassava. Cassava starch. Analysis.

The binding of I by amylose and amylopectin was studied by a differential null-point procedure The carbohydrate (40-500 mg) was dissolved in 5 ml of 0.1 N potassium hydroxide at room temperature and brought to pH 6 3 with HCl Potassium iodide was added to produce the desired concentration, the solution was diluted to 100 ml and put into an electric cell. A reference cell (no carbohydrate) was connected to the cell. Increments of I were added to the cell containing the sample, and a solution of I in KCl+KI, having the same concentrations as the solutions in the cells, was added to the reference cell until the emf was zero. The excess of I in the sample cell was considered to be bound by the carbohydrate Data are reported by plotting mg of I bound/100 mg of sample against moles of free I/liter. The relations shown are (1) effect of concentration of I^- on apparent I bound by potato amylopectin and amylose, (2) effect of sample size on apparent I bound by potato amylopectin, (3) I binding by potato starch, its amylose and amylopectin fractions and limit dextrin, (4) and (5) the same as (3) for constarch and cassava starch, and (6) I binding on waxy maize starch, limit dextrin and by glycogen. The results are in substantial agreement with those obtained by Higginbotham (1949) by a more cumbersome but more precise method I binding for the 1st half of the titration is as great or greater for limit dextrin than for amylopectin In the case of waxy maize, the I binding of limit dextrin is as great as for the starch *(Summary by Chemical Abstracts)* 101

0562-5388 HOFSTEE, J Die Unterschiede in den Eigenschaften verschiedener Stärken und ihre Deutung. *(Differences in the properties of different starches and their interpretation).* Starke no. 4/5 83-86. 1953. Germ., Sum. Engl., Germ., 23 Refs., Illus.

Cassava. Cassava starch. Analysis. Viscosity. Laboratory experiments.

The shapes of viscosigram curves for potato, cassava, sago, arrowroot, wheat, maize and rice starches are correlated with their x-ray diagrams, water uptake of the starch granules at 23ºC and 10-86% RH, 75ºC sedimentation volumes, heats of gelatinization and av granule sizes. Starch treated with heat and moisture or starch in 50% aqueous glycerol suspension does not show the rapid initial increase in viscosity on heating, which is characteristic for untreated starch. The extent of increase in viscosity during gelatinization is related to the water-absorbing power of the starch granules. *(Summary by Chemical Abstracts)* 101

0563-6887 HOOD, L F. and ARNESON, V.G. **In vitro digestibility of hydroxypropyl distarch phosphate and unmodified tapioca starch.** Cereal Chemistry 53(2).282-290. 1976. Engl., Sum Engl.; 18 Refs., Illus.

Cassava. Cassava starch. Modified starches. Processing. Enzymes. Laboratory experiments. Hydrolysis. pH. Temperature. Biochemistry. Analysis. Digestibility. USA.

Unmodified and modified (hydroxypropyl distarch phosphate) cassava starches were treated with fungal or pancreatic amylase under experimental conditions designed to simulate *in vivo* digestion conditions. The effects of gelatinization and retrogradation on enzyme susceptibility were investigated. Hydrolysis and alterations in granule structure were evaluated by quantitative reduction of ferricyanide and scanning electron microscopy, respectively. Ungelatinized starches were hydrolyzed to a greater extent by pancreatic than by fungal amylase; the reverse was true for gelatinized starches. Modification of starch increased the enzyme susceptibility of the ungelatinized starch but decreased the susceptibility of the gelatinized form. Acid pretreatment and retrogradation had little effect on enzyme susceptibility. The relative degree of hydrolysis of the gelatinized, modified to the unmodified starch was similar for the 2 enzyme preparations, suggesting that either enzyme preparation would be suitable for the estimation of the digestibility of modified starches *in vitro*. Most of the gelatinized granules were destroyed by pancreatic amylase. Pores were evident in the few granules that remained *(Author's summary)* 101 102

0564-5938 LONKHUYSEN, H. *et al* **Interaction of monoglycerides with starches.** Stärke 26(10):337-342. 1974. Engl, Sum. Engl., Fr., Russ., 13 Refs, Illus

Cassava. Cassava starch. Bread improvers. Analysis. Laboratory experiments. Particle size.

In breadmaking, the emulsifier glycerol monostearate is commonly used as an improving agent although the mechanism of its action has not been fully elucidated. The present investigation deals with interactions of the emulsifier (a mixture of glycerol monostearate and -palmitate) and starches in suspension, at temperatures ranging from 30-90ºC. The quantity of monoglycerides bound by the starch was determined by sampling the reaction vessel at time intervals and reextracting the monoglycerides that were left free in the suspension. Quantitative determination was achieved with the aid of gas chromatography. At 30ºC, part of the monoglycerides is irreversibly bound by the starch granules; during gelatinization, the quantity of emulsifier bound shows a considerable increase to reach, at 90ºC, an equilibrium at a higher level. The monoglyceride molecules probably penetrate into the swollen starch granules to form an insoluble complex with amylose. Various starches included in the study showed essentially similar behavior but were quantitatively different in their capacity to bind monoglyceride. At 30ºC, wheat starch binds a greater part of added monoglycerides than does cassava starch; at 90ºC, the reverse is true. *(Author's summary)* 101

0565-7323 LOZANO, A., CABRERA, I. and SALAZAR, T. **Susceptibilidad del almidón presente en harinas crudas y modificadas al ataque enzimático con α - amilasa.** *(Susceptibility of starch in raw and modified flours to enzymatic attack by α - amylase).* Revista Colombiana de Química 3(1):43-63. 1974. Span., Sum. Span, Engl., 10 Refs, Illus.

Cassava. Cassava starch. Enzymes. Biochemistry. Analysis. Flours. Hydrolysis. Colombia.

The rates of hydrolysis were determined for several types of starch from maize, cassava and plantain flours. The influence of rudimentary and industrial processes on the rates was also studied. Results are presented in tables and figures. *(Author's summary. Trans. by T.M.)* I01

0566-2936 **MORPHOLOGIE COMPAREE des amidons de maïs et de manioc.** *(Comparative morphology of maize and cassava starches)* Annales de Falsification et des Fraudes 42(481/483):6-8. 1929. Fr.

Cassava. Cassava starch. Analysis. Particle size. HCN.

The degradation of starch grains during processing makes it difficult to differentiate between maize and cassava in the finished product. This subject was discussed at a conference during which the participants commented on the adequacy of the following methods: Guignard's method, the presence of carotenoids, ultraviolet light, the fluorescent microscope, and decomposition of the glucoside to isolate the HCN. *(Summary and trans by S.S. de S.)* I01

0567-7255 NAKAMURA, I. M. and PARK, Y. K. **Some physico-chemical properties of fermented cassava starch. (polvilho azêdo).** Stärke 27(9):295-297. 1975. Engl., Sum. Engl., Germ., Fr., Port., 10 Refs., Illus

Cassava. Cassava starch. Analysis.

An explanation is given of how "polvilho azêdo," a typical Brazilian product, is made. Cassava starch is fermented by a rudimentary, empirical process. The fermentation—in addition to giving the product its characteristic flavor—causes some changes in its physicochemical properties. The fermented starch is more soluble and swells easily in water. When this aqueous suspension is heated, the paste formed is less viscous than that of nonfermented cassava starch. *(Author's summary)* I01

0568-6714 ODIGBOH, E.U. and MOHSENIN, N.N. **Effects of concentration on the viscosity profile of cassava starch pastes during the cooking-cooling process.** Journal of Texture Studies 5(4):441-457. 1975. Engl., Sum. Engl., 14 Refs., Illus

Cassava. Cassava starch. Viscosity. Analysis. Laboratory experiments. USA.

Raw cassava starch, dried at 50°C, was cooked at 4 concentrations in a Stormer viscometer, modified in such a way that the viscosity measurements were made under conditions satisfying the requirements of theoretical viscometry. The measurements provided rheological data usable in engineering design problems involving mixing, heat transfer or transport of the pastes. Viscosity and yield stress of the pastes were measured at 5°C-intervals throughout the cooking-cooling process. Plots of viscosity values versus cooking-cooling temperatures and time yielded viscosity profiles for different paste concentrations. The results showed that paste concentrations have pronounced effects on the magnitude of viscosity values, the rate of viscosity rise to the peak value, the time and temperature of this peak, the paste shear-thinning tendency and the extent of retrogradation on cooling. *(Author's summary)* I01

0569-5032 REGNAUDIN, A. **Méthode d'analyse proposée pour le classement des fécules et des amidons.** *(Proposed analytical method for classifying starches).* Bulletin de l'Association des Chimistes. 53:477-479. 1936. Fr., Sum. Fr., Engl., Germ.

Cassava. Cassava starch. Analysis.

The advantages of obtaining the commercial classification of starch by an analytical determination of the ratio R = Chemical starch x 100. optic starch. The chemical starch is obtained by Rossing's method and the optic starch by Baudry's method. *(Author's summary)* 101

0570-6931 SCHMIDT, S. and STEENBERG, E. **Comparaison entre l'effet stimulant du tapioca et de l'hydroxyde d'aluminium additionnés a l'anatoxine télanique destinée a l'immunisation du cheval.** (*Comparison of the stimulating effect of tapioca and aluminum hydroxide added to tetanus anatoxin used in the immunization of horses*). Acta Pathologica et Microbiologica Scandinavica 13:401-403. 1936. Fr

Cassava. Tapiocas. Therapeutants.

The production of tetanus antitoxin in horses was greatly stimulated by treating the anatoxin injected with Al $(OH)_3$ in a concentration of 10%. The addition of tapioca in a concentration of 3% did not increase antibody production. (*Summary by Chemical Abstracts*) 102

See also 0095 0441 0666 0687

0571-7019 ACENA, B. **The status and future of the Philippine cassava industry.** Plant Industry Digest 15(11) 3-14 1952. Engl., Illus

Cassava. Cassava starch. Factories. Industrialization. Costs. Production. Composition. Trade. Marketing. Philippines.

A description is given of the Phillipine Government's policy aimed at increasing cassava flour production in order to maintain dollar exchange, to prevent the scarcity of wheat flour and to regulate its importation. For the purpose of carrying out this policy, the Price Stabilization Corporation issues licenses for importing wheat flour on the condition that the importer will buy cassava flour in a proportion no greater than 30% of the wheat flour and will sell both flours in the same proportions. A comparison is made of the nutritive value of several wheat and cassava flours and of the bread based on cassava (10-15%) and wheat. Other aspects dealt with are production costs, yields, industrial machinery and equipment, product specifications, processing, impact of this policy and foreign market prospects. *(Summary by A. J. Trans. by S S. de S)* 102 J00

0572-0007 ACENA, B. and MAGUEFLOR, F. **Manufacture of starch from cassava.** Philippine Agricultural Engineering Journal 1 147-150. 1950. Engl , 3 Refs , Illus

Cassava. Cassava starch. Peeling. Washing. Rasping. Silting. Screening. Drying. Industrial machinery. Costs. Factories. Labour. Water requirements (processing). Philippines.

The flow chart for the manufacture of cassava starch, a drawing of a sieve rack, and a plant layout for a cassava starch factory are presented with the purpose of providing the manufacturers with modern processing techniques, thus contributing towards a more stable economy in the Phillipines Emphasis is placed on the utilization of pure water in order to obtain a uniformly white product to meet quality standards A centrifuge and a hammer mill or disintegrator (instead of the conventional rasper) were used in order to lower production costs and separating time An economic analysis of the operation is included, based on processing 5 tons/day; i e , 682 kg of starch and 445 kg of cassava flour (made from waste products) for animal feed Under these conditions, the company's profit would be 13%. *(Summary by A J. Trans by S S de S.)* 102

0573-3077 AGUILAR, F. *et al.* **Productos de yuca; estudio de factibilidad.** (*Cassava products· a feasibility study*).San Salvador, E. S., 1969. 121p Span.

Cassava. Cassava products. Factories. Bakery products. Cassava flour. Feed mixtures. Productivity. Economics. Processing. Industrial machinery. Dextrins. Adhesives. Glucose industry. El Salvador.

This project studies the feasibility of installing a factory in El Salvador to manufacture cassava products to be used in breadmaking (as a substitute for wheat flour) and in feedstuffs for cattle (as a substitute for cereal grains). This substitution is of great importance in countries that have a deficiency in food production and that are faced with problems of foreign exchange On an industrial scale, these products would also serve as a basis for the manufacture of starch, dextrin and glucose. The enterprise should be financed jointly by government and private capital. Included are a marketing study, data on plant size and location, engineering aspects (raw materials, machinery, inputs, manufacturing process), investments required, budget of income and expenditures according to plant capacity used, financing, a sensitivity analysis and a macroeconomic evaluation. (*Summary by L.C. Trans. by T.M.*) 102

0574-3868 ANDERSON, G. W. **Notes on cassava preparation in North Kavirondo and Samia.** East African Agricultural Journal 10:111-112. 1944. Engl.

Cassava. Processing. Bitter cassava. Sweet cassava. Kenya.

Traditional procedures for preparing cassava for culinary purposes are briefly described, together with 6 outstanding sweet varieties used in this area. Dried cassava in the form of chips is used to make flour. Better flour is obtained when using a power mill; an explanation is given of problems involved with the use of this mill. A 4,000 rpm hammer mill will produce eight 150-lb bags of flour an hour. *(Summary by T.M.)* 102

0575-0203 **ATRASO NAO dá vez à mandioca.** *(Problems faced by cassava producers and industrialists).* Coopercotia 22(193):18-21. 1965. Port., Illus

Cassava. Factories. Industrialization Developmental research. Brazil.

Emphasis is placed on the importance of cassava as a food and industrial product in the economy of Brazil In industry, it is used mainly as an adhesive, for laundry purposes, and for manufacturing paper, starch, cakes, bread, ferments, alcohol and acetone. The index of mechanization of this crop is low (5%). In spite of the development of cassava processing industries, several phases of operation are still rudimentary. In the state of São Paulo, there are about 60 factories with capacity of 62.5 tons of meal/day. The problems faced by cassava producers and industrialists are discussed and possible solutions are suggested. *(Summary by P.G. Trans. by S.S. de S.)* 102

0576-0085 BARBA G., E. **La industrialización de la yuca.** *(Cassava industrialization).* Revista de Agricultura (Dominican Republic) 34:558-563; 607-613. 1943. Span., Illus.

Cassava. Cassava starch. Factories. Industrial machinery. Drying. Cassava meal. Dextrins. Alcohol. Production. Dominican Republic.

Cassava industrialization is of primary importance for the Dominican Republic, emphasis is placed on the country's advantages for becoming one of the main starch exporters to the United States The differences between starch obtained from cereals and that from tubers are indicated. Both manual and mechanical industrial processes are used. The production of the following products and by-products is described: (1) dry cassava chips; (2) bran, a milling by-product used for manufacturing alcohol, butanol, acetone, dextrin, tapioca and starch, (3) dry cassava flour. It includes data on the composition of cassava flour and the possibility of using it in breadmaking to replace wheat flour partially; (4) starch; (5) tapioca. Cassava starch is also used in making glue, explosives, adhesive tape, textile sizing, paper, envelopes, etc. The processes for manufacturing cassava foodstuffs for human and animal consumption are also described. *(Summary by A.J. Trans. by S.S. de S.)* 102

0577-4918 BARRETO, A. **O aproveitamento da mandioca no fabrico do álcool-motor.** *(Motor alcohol made from cassava)* Lavoura 46:51-52 1942. Port.

Cassava. Uses. Alcohol. Production. Brazil.

A brief description is given of the problems involved in producing cassava alcohol; this low-cost fuel would permit Brazil to stop petroleum imports. Cassava yields 14% of alcohol/root, whereas sugar cane gives a maximum of 4.5% Since cassava yields twice as much starch as potatoes, it is possible to obtain 18-20 liters of alcohol from 100 kg of cassava, using varieties with a 30-40% starch content. *(Summary by P.G. Trans. by S.S de S.)* I02

0578-0898 BECK, H. **Fécula de mandioca.** *(Cassava starch).* Revista de Química Industrial (Brazil) 1951:17-18 Março 1951. 1951:14-16. Abril 1951. 1951:14-17. Maio 1951. Port.

Cassava. Cassava starch. Rasping. Washing. Drying. Centrifuging. Productivity. Analysis. Legal aspects. Composition. Factories. Economics. Silting. pH. Brazil.

After a series of economic considerations concerning cassava production in Brazil from 1946-47, the steps in the manufacturing of cassava starch are given weighing, determination of the starch content, storage, washing and drying, screening, expelling, shaking screen, decanting tubes, washing tanks, centrifugation, grinding, driers, silk screens and yield. Uses of cassava starch include by products for the paper, fermenting, food and textile industries. A complementary economic analysis was made of the various stages in the process at a starch factory in Santa Catarina. Also included are methods used to make the analysis, legislation, specifications and tables for the classification and control of the export of amylaceous products *(Summary by L.C. Trans by T M)* I02

0579-4761 BECKER, K **Non-grain adjuncts.** Brewers Digest 1946 45-48. Aug. 1946 Engl.

Cassava. Cassava beer. Uses. Food products. Composition.

Because of restrictions on the use of grains for the brewing industry, it was necessary to study other carbohydrate sources as possible adjuncts for beer manufacturing Cassava is very satisfactory, provided the necessary sanitary regulations are kept. Cassava meal, boiled for about 10-30 minutes, gives best results. It does not affect the taste of the beer although a slight decrease in the hop action has occasionally been observed when the percentage of cassava is too high A syrup with good brewing properties is also made from cassava with a fermentable extract. The use of cassava is affected negatively by the uncertainty in the supply and quality of the product. *(Summary by L.F.C Trans. by S.S. de S.)* I02

0580-4547 BIANCHI, J. A. **Almidón de mandioca.** *(Cassava starch).* Industria y Química 7:212-216. 1966 Span., 16 Refs., Illus.

Cassava. Cassava starch. Processing. Industrial machinery.

The industrial process for the production of cassava starch is presented. Cassava used for this purpose should have more than 22% starch content in fresh roots. The aspects described are equipment and machinery required for the cleaning processes; steps of starch production (grinding, screening, purification, centrifuging, drying, milling, final screening and elimination of waste material), packing, storing and transportation. *(Summary by A.J. Trans. by S.S. de S.)* I02

0581-7387 BIANCO, V. DEL *et al* Alcool de mandioca por fermentação contínua. *(Alcohol from cassava by continuous fermentation).* Informativo do INT 9(10):20-26. 1976. Port., Sum Engl., Port., 22 Refs., Illus.

Cassava. Alcohol. Fermentation. Enzymes. Biochemistry. Production. Analysis. Brazil.

Cassava, an easily cultivated plant rich in starch, has excellent prospects as a raw material for ethyl alcohol production, provided processing economies (i.e., reduced manpower and maintenance costs) can be achieved. Continuous fermentation would be a technique that could provide such economies. Therefore, research along these lines was conducted at the Instituto Nacional de Tecnologia to develop a technique whereby a theoretically sound fermentation procedure would become economically competitive with modern industries using sugar cane as a raw material. Glucose syrup production from cassava was achieved using dry ground meal in an enzyme-enzyme system, employing for liquefaction a thermostable bacterial amylase and for subsequent saccharification a fungal amyloglucosidase. For production of *Bacillus subtilis* amylase and *Aspergillus awamori* amyloglucosidase, media consisting mainly of cassava flour were used For fermentation, *Saccharomyces cerevisiae* no. 1133 ATCC was succesively transferred to larger and larger volumes of cassava medium until sufficient cell mass for inoculum was obtained. A no. of batch fermentation experiments were made to evaluate glucose syrup performance as a fermentation substrate and to see whether addition of nutrient salts was needed. Cell development was also studied in order to plot a growth curve of yeast in cassava medium and to calculate specific growth rate. Continuous processes were controlled daily by a no. of precise determinations of glucose, alcohol and cell mass. *(Author's summary)* I02

0582-1728 BILURBINA A., L. La glucosa a partir del almidón de tapioca *(Glucose from cassava starch)* Quimia no. 181:7-13. 1969. Span., 6 Refs., Illus

Cassava. Cassava starch. Glucose industry. Production. Processing.

Glucose can be obtained from cassava starch extracted from *Manihot esculenta.* Fresh roots (older than 24 h) are better than dried roots, yielding a whiter, purer starch. The kinetics of hydrolysis of α-amylase is reported: 100 mg of maltose/g of starch is obtained after 3 4 h from cornstarch and after 14.3 h from cassava starch After 25 h the amount obtained from potato starch and other tubers is <50 mg. Comparing fresh roots and dried cassava, the former takes 13.5 h to yield 100 mg of maltose/g of starch, the latter takes 27 5-29.0 h The manufacturing procedure includes dilution to 10°Bé., pressure saccharification with dilute HCl at pH 2 3 for 45 min, neutralization with a 20% solution of soda ash to pH 2 3; decolorization with charcoal (95-96% C, 3-5% ash); concentration 18-42°Bé. and total solids content 75%, using a triple-effect evaporator starting at 3 kg/cm^2 and finishing at 680 mm Hg, crystallization, centrifugation and drying. Optimum conditions for decolorization were 0.2% charcoal based on sugar, 50°C and 15 min. Crystallization time with and without seeding is compared. The mother liquor from centrifugation can be recrystallized. Several alternative procedures are feasible, the best being to dilute the liquor to 10°Bé., adjust to pH 5, and circulate through a cation-exchange system The recovered fraction is concentrated up to 75% dry solids and a 2nd-grade glucose. *(Summary by Chemical Abstracts)* I02

0583-5241 BOOTH, R. H. **Cassava storage; post-harvest deterioration and storage of fresh cassava roots.** Cali, Colombia. Centro Internacional de Agricultura Tropical. Series EE-16. 1975. 18p. Engl., 11 Refs., Illus. Also in Spanish.

Cassava. *Manihot esculenta.* Deterioration. Storage. Tubers. Colombia.

As cassava could not be stored for any length of time without suffering postharvest deterioration, studies were carried out to develop simple, inexpensive storage techniques. First postharvest deterioration was studied, identifying two types: primary and secondary. The effects of mechanical damage, varietal reaction and curing were analyzed. A description is given of the field clamp and box storage techniques developed. Using these techniques, it was possible to store cassava roots for at least two months; roots remained of acceptable quality and had a longer shelf life than freshly harvested roots. *(Summary by T.M.)* 102

0584-4388 BOOTH, R.H. **First year report on TPI/CIAT research programme on the storage of fresh cassava, September 1972 - August 1973.** London, Tropical Products Institute, 1973. 45p. Engl., Illus.

Cassava. Storage. Development. Harvesting. Cassava superelongation. ***Phytophthora drechsleri.*** **Deterioration. Cassava programs.**

The objective of this program is to study problems of storing fresh cassava in an effort to develop easy, inexpensive methods that can be used even by small farmers This report includes data on the project itself, activities carried out at CIAT, and organizations and persons visited and consulted. There are appendices of abstracts on the following subjects program proposal on postharvest pathology, storage and deterioration of fresh cassava roots, a progress report on the research program on fresh root storage, diseases (superelongation, *Phytophthora* root rot in Colombia), postharvest root rot (losses and control) *(Summary by L C Trans. by T.M)* 102 E00

0585-6744 BOOTH, R. H. **Storage of fresh cassava (*Manihot esculenta*). I. Post-harvest deterioration and its control.** Experimental Agriculture 12(2):103-111. 1976. Engl., Sum. Engl., 14 Refs., Illus

Cassava. Tubers. Storage. Deterioration. Timing. Field experiments. Colombia.

The rapid postharvest deterioration of cassava roots, which usually prevents their storage in the fresh state for more than a few days, is poorly understood. Two types of deterioration are defined; namely, primary, shown by internal root discoloration, and secondary, caused largely by wound pathogens. Information is presented on the influence of such factors as mechanical damage and plant cultivar upon the development of the 2 types. Control of primary and a reduction in secondary deterioration is achieved during a curing process, but none of the chemical treatments examined gave consistent practical control of deterioration *(Author's summary)* 102

0586 6889. BOOTH, R. H. *et al.* **Changes in quality of cassava roots during storage.** Journal of Food Technology 11(3):245-264. 1976. Engl., Sum Engl., 24 Refs.

Cassava. Tubers. Storage. Water content. Soluble carbohydrates. Starch content. Organoleptic examination. Nutrient loss. Nutritive value. Cassava tubers (vegetable). Timing. HCN content. Biochemistry. Cassava flour. Cassava meal. Colombia.

Changes that occurred during the storage of fresh cassava roots and their effect upon acceptability of the roots both for human consumption as a fresh vegetable and for animal feed purposes are reported During storage there was a rapid accumulation of total sugars accompanied by a small decline in starch content In those roots showing internal discoloration and deterioration, the percentage of sucrose declined very dramatically. Although roots softened during storage, they required a longer cooking time for human consumption. In most cases roots remained of acceptable eating quality over an 8-wk period although none of the stored roots were as good as freshly harvested ones. All stored roots had a sweet flavor and frequently an uneven texture, not present in fresh roots. Cassava intake by pigs was lower for stored than for freshly harvested roots: this reduction was more marked for sweet than for bitter varieties, which suggests that HCN content is not the only factor limiting consumption; texture and organoleptic changes may also be important. Despite all these changes that occurred during storage, the feeding quality of cassava meal in rat feeding trials was not noticeably affected; thus for practical purposes, the preparation of cassava meal for diets for domestic animals, notably chicken and pigs, might eliminate the limitations observed in texture and eating quality of stored roots. (*Author's summary*) I02 C03 H01

0587-4925 BRANDAO, B.T. **A farinha de mandioca e o seu emprego na panificação.** *(The use of cassava flour in breadmaking)* Lavoura 40(3):117-119. 1936 Port.

Cassava. Cassava flour. Breads. Composite flours. Brazil.

This study of the role of cassava flour in breadmaking was presented to the National Society of Agriculture (Brazil) in 1936. On the basis of the high cassava yields, its facility to grow, economic advantages, and the need to promote its cultivation to meet industrial demands, it was suggested that the Government create a flour institute and establish a tax on all imported ground and whole wheat This tax would cover the costs of constructing the institute and the cassava flour factories The bread would be made with a mixture of cassava (20%) and wheat (80%) flours *(Summary by P G. Trans. by S.S. de S)* I02

0588-5368 BROWN, F. *et al* **The structure of starch. The ratio of non-terminal to terminal groups.** Journal of the Chemical Society, 1948:27-32 1948. Engl., Sum Engl., 3 Refs

Cassava. Cassava starch. Analysis.

An assay of the proportion of terminal groups present in various starches has been made by measuring the amount of formic acid liberated on oxidation of the polysaccharide by potassium periodate. The results obtained are in good agreement with those derived by measurement of the amount of tetramethyl methylglucoside resulting from the methanolysis of the corresponding methylated starch derivatives. Few, if any, glucose residues linked solely through carbon atoms 1 and 6 can therefore be present in starch. The amylose component of certain starches including tapioca has been examined and shown to contain approximately one nonreducing end group for every 250 glucose residues The yield of formic acid produced on oxidation of the whole starch with potassium periodate, combined with an estimate of the amylopectin content of the starch obtained iodometrically, has made it possible to calculate the ratio of terminal to nonterminal groups in the amylopectin component For many varieties of amylopectin, this ratio is 20.1, but there are exceptions, for example, the amylopectin component of potato, sweet potato and arrowroot starches, where the ratio is higher.*(Author's summary)* I02

0589-4427 BUFFON, A. **Farine et fécule de manioc.** *(Cassava flour and starch)* Revue Agricole (Guadeloupe) no 9.222-225. 1929. Fr.

Cassava. Cassava flour. Cassava starch. Processing.

This article describes the manufacturing of cassava flour and starch in Guadeloupe The method is explained in detail, indicating the rather primitive implements used for each step Roots are washed, peeled and grated; they are then pressed to extract the water and left to dry on a hot metal sheet. The powdered, dried cassava pulp constitutes the flour; the extracted water is decanted and the residue is sun dried to obtain the starch Waste products resulting from this process can be used for feeding animals. *(Summary by S.S. de S.)* I02

0590-6821 CALDWELL, C. G. **Free-flowing starch esters.** United States Patent 2,613,206. 1952. 5p. Engl., 3 Refs

Cassava. Industrial starches. Patents. USA.

Bi- or multivalent metal salts of ungelatinized starch acid-esters of substituted dicarboxylic acid are free flowing, resistant to wetting by water, but easily wetted by organic solvents. These compounds are useful as a no-offset dry spray in printing, a carrier for insecticides, delustering cellulose acetate rayons and lacquers, for rubber finishing and textile sizing. Decenyl succinic anhydride (5) is added to a suspension of cornstarch (100) in H_2O (150) containing sodium carbonate (5) parts. The mixture is stirred for 14 h, the pH adjusted to 7, the mixture filtered and slurried. The resulting starch acid ester treated with 100 parts H_2O containing 2 parts aluminum sulfate gives, after 4 h agitation, a free-flowing starch acid ester derivative. Similar preparations from cassava, rice, potato starch and substituted glutaric anhydrides are given. C_6H_6 solvent and pyridine are used as solvents. (*Summary by Chemical Abstracts*) 102

0591-6753 CALDWELL, C. G. and WURZBURG, O. B. **Unsaturated starch compounds and insoluble derivatives thereof.** United States Patent 2,668,156. 1954. 5p. Engl., 13 Refs

Cassava. Industrial starches. Paper industry. Patents. Textiles. USA.

Starch compounds containing unsaturated, polymerizable olefinic groups are treated to render them relatively nondispersible in water. Starch derivatives cannot be treated if they are soluble in an organic solvent and are nondispersible in water. The starch derivative containing more than 1 unsaturated olefinic radical/15 anhydroglucose units is also excluded from treatment. The starch derivative is mixed with a vinyl-type polymerization catalyst and, if desired, a catalyst activator. The resultant product is soluble in the common organic solvents, such as alcohol, benzene, or acetone. The resulting product can vary from a paste with increased viscosity to a product which forms a gel nondispersible in water. In an example, 100 parts cornstarch was suspended in 150 parts H_2O at room temperature, and the pH raised to approximately 9 by the addition of 3% aqueous NaOH solution. Then 10 parts methacrylic anhydride was added to the suspension while maintaining the pH at 8-9 by additions of 3% NaOH solution. Agitation was continued for 1 h. The pH was then adjusted to 6.5-7.0 by the addition of HCl. The ungelatinized starch was filtered, washed twice with H_2O and dried. Upon cooking 1 part of the product in 12 parts water, the resulting dispersion was clear, stable and nongelling. Cassava potato and waxy maize starches can also be treated by this method. *(Summary by Chemical Abstracts)* 102

0592-4762 CALVINO, M. **La harina de yuca para hacer pan.** *(Breadmaking with cassava flour)* Boletín de Agricultura (Colombia), no. 9:118-126. 1932. Span.

Cassava. Cassava flour. Processing. Uses. Cuba.

This article gives a historical review of cassava growing in Cuba and describes the making of flour from the roots and its chemical composition. Milling and breadmaking are briefly discussed. It also gives production costs and planting recommendations, especially for varieties introduced from Brazil. (*Summary by L.F.C. Trans. by S.S. de S.*) 102

0593-3514 CASSAVA: **ITS cultivation and manufacture.** Tropical Agriculturist 1907 126-132. August 1907. Engl

Cassava. Cassava starch. Processing. Cultivation. Harvesting. Factories.

The present trend is to replace maize and potato starches with cassava starch. This article presents a description of the machinery and process used in the manufacturing of cassava starch for the textile industry. Agronomic practices, harvesting and yields obtained in Hawaii are discussed. The systems and implements for harvesting the roots are mentioned. The costs of producing glucose made from cassava are lower than those of starch. In addition, cassava starch yields/unit of surface are 50% higher than those of maize. Since the textile industry requires basic or acid starch, Hawaii should produce this kind of starch from cassava in order to expand its market *(Summary by A.J. Trans. by S.S. de S.)* I02 D02

0594-5366 CASSAVA CULTIVATION; tapioca production in the Netherlands East Indies. Netherlands Indies Review 3.380-381. 1923. Engl , Illus

Cassava. Tapiocas. Industrialization. Production. Indonesia.

A brief description is given of the present situation of cassava production and tapioca preparation in Indonesia in relation to its uses and economic value. Most of the starch, gaplek and waste material is exported. (*Summary by A.J. Trans by S. S. de S*) I02

0595-0909 CASSAVA STARCH *In* Five industries in the Central African Republic Washington, Continental Allied Co., 1965 pp 1-53. (AID/afr-288). Engl.

Cassava. Starch productivity. Production. Cassava starch. Industrialization. HCN. Peeling. Washing. Silting. Drying. Centrifuging. Costs. Labour. Marketing. Industrial starches. Packaging. Distribution. Factories. Glucose. Dextrins. Central African Republic.

This study surveys private investment opportunities for industries in the Central African Republic, describing projects likely to be most effective in the development of the private sector and in the growth of the C.A.R 's national economy. The following possibilities are studied. storage batteries, asbestos cement roofing, cassava starch, ice cream and reconstituted milk, and tomato puree. The chapter on cassava starch deals with the following aspects. demand (use for foodstuffs, textiles, paper sizing, adhesives, etc.) agricultural aspects, production technology, investment and production costs, and market expansion. *(Summary by J.L.S.)* I02 J00

0596-1695 CENTRO DE DESARROLLO, QUITO Almidón - Glucosa. *(Starch - Glucose).* Quito, Ecuador, 1968 103p. Span., 16 Refs , Illus.

Cassava. Cassava starch. Glucose. Industrialization. Factories. Cultivation. Processing. Production. Costs. Prices. Trade. Consumption. Cassava programs. Developmental research. Income. Industrial machinery. Uses. Pulp. Development costs. Ecuador.

The feasibility of establishing a plant in Ecuador for manufacturing cassava starch and glucose to meet the domestic demand was studied Technical specifications are given and an economical analysis of the agro-industrial sector is made. In order to obtain 33,190 tons of cassava to manufacture 4,400 tons of starch and 2,350 tons of glucose/yr, it would be necessary to have 960 ha in permanent production. The textile and cardboard manufacturing industries are the principal uses of starch, and the glucose is almost totally consumed by the candy industry. The pulp is used for animal feeding Because of its climatic and ecological conditions and its proximity to Guayaquil (the main consumer center), which minimizes transportation costs, the region of Quevedo is considered to be the most adequate site for cultivating this crop and setting up the plant Income return on total investment is 24%. Layout plans for the machinery are included. *(Summary by A.J. Trans by S.S. de S.)* I02 J00

0597-5236 CERVINKA, V. **Tractor-mounted cassava grater developed in Ghana.** World Crops 24(1):45. 1972. Engl., Illus

Cassava. Rasping. Mechanization. Ghana.

A tractor-mounted cassava grater was developed by the Agricultural Engineering Division, University of Ghana (Legon). At the present time the processing of cassava is done in tropical villages, usually by grating roots on a simple hand grater (kitchen type) or on a stationary-type power grater The latter is satisfactory, but it does mean cassava has to be carried to it from the fields. After studying the problems of cassava processing on farms in Ghana, the tractor-driven cassava grater was produced to permit the operation to be undertaken in the fields. The grater is mounted on the tractor 3-point hitch, and its drum is driven from the PTO shaft The length of the grating drum is 30 in, the diameter 10 in and the revolutions are in the range of 800-1200 rpm The capacity of the hopper is 120-140 lb (i e, 2 large baskets). This amount of cassava roots is processed in 1-2 min. The "Legon" grater was tested on farms near the University of Ghana for a 5- to 6-month period. Its main advantages are (1) A cassava grater driven by tractor can work on different cassava farms; it is more economical to transport this equipment than to carry large quantities of roots or grated cassava (after processing) to/from the stationary grater. (2) The capacity of the grater is high. (3) The grater is of a simple design and easy to operate. (4) The grater will assist in the maximum utilization of tractor power, which for too long stands idle *(Full text)* I02

0598-1808 CHATELANAT, R. P. **The use of cassava starch in the development of "composite flour" bakery products:** *In* International Symposium on Tropical Root and Tuber Crops, 2nd, Honolulu and Kapaa, Hawaii, 1970. Tropical roots and tuber crops tomorrow Honolulu, University of Hawaii, 1970 v.2, pp.14-19. Engl., 5 Refs., Illus

Cassava. Cassava starch. Bakery products. Composite flours. Breads. Biscuits. Cassava bread. Confectioneries. Wheat flour. Developmental research.

Since continually rising imports of wheat have created a serious balance of payments situation in developing countries, many experiments have been carried out during the last 50 years to mix cereal and noncereal flours with wheat flour. Serious problems have been encountered because loaf volume, quality and texture can be affected adversely, and nutritive value becomes poorer when the "extender" is used in larger proportions. Advances have been made possible only through the development of new emulsifiers and other additives that have been found to perform some of the functions of gluten. In products containing no cereal flour, the emulsifier glyceryl monostearate is employed. The Institute for Cereals, Flour and Bread (TNO) has developed a special nonwheat mix of cassava starch, soybean flour and an additive. In close cooperation with the FAO Composite Flour Program, the Tropical Products Institute (TPI) has also set up a test bakery, which has developed mixtures containing approximately 70% wheat flour, 25% cassava starch and 5% soy flour. In 1971, an agreement was made between TNO and the Industrial Research Institute, (IIT) to establish an experimental baking unit in Bogotá (Colombia). It is expected that valuable experience in production, promotion and marketing, and in determining consumer attitudes will be gained during this project. Potential benefit depends, among other things, upon the feasibility of economically producing and processing sufficient quantities of raw material for the composite flour mixture. *(Summary by L.C. Trans. by T.M.)* I02

0599-6770 CHAVES, J. M. and ATUCH, S. A. **Sedimentação de grãos de amido de raspa de mandioca.** (*Sedimentation of starch grains from ground cassava chips*). Revista de Química Industrial (Brazil) 13(148):18-19. 1944. Port., Sum Port., 2 Refs., Illus.

Cassava. Cassava starch. Silting. Water requirements (processing). pH. Analysis. Timing. Cassava chips. Brazil.

The sedimentation of cassava starch grains is determined as a function of the pH of their suspensions by finely pulverizing the cassava chips (acidity 1.5%) in a hammer mill and passing the powder through a 0.5-mm screen. Five g powder is suspended in a graduated Gilson separatory funnel in H_2O, the pH ranging from 7.5 to 1. Maximum sedimentation is obtained at pH 2 82, decreasing rapidly above this value. (*Summary by Chemical Abstracts*) 102

0600-6818 CHONG POH KIEW. **Tapioca pelleting studies.** Thesis B Sc. Agr. Kuala Lumpur, University of Malaya, 1974. 183p. Engl., Sum. Engl., 31 Refs., Illus

Cassava. Cassava meal. Pellets. Water content. Processing. Industrial machinery. Industrialization. Costs. Malaysia.

A series of trial showed that cassava meal is not suitable for pelleting when the moisture content is less than 14% dry basis, using a 7.5 hp Lister farm pelleting press fitted with an 11-mm grass die ring; however, incorporating stearine at 3% by weight overcame this problem. Pelleting of cassava meal without stearine was possible when the moisture content of the meal was close to 17%. Pelleting studies using a complete randomized block design with 2 grade levels of cassava meal (fineness modulus 1 72 and 3.44), 3 levels of stearine (3,6 and 9%) and 3 levels of moisture (< 14%, 14-17% and > 17%) showed that (1) with a higher fineness modulus, pellet strength, durability and bulk density decreased. Press efficiency and capacity also decreased, but power consumption increased. (2) With a higher stearine level, pellet strength, durability and bulk density decreased. Press efficiency and power consumption also decreased, but capacity increased. (3) Judging from the quality of the pellets produced, moisture at 14-17% gave the best pellets with comparatively maximum strength, durability and bulk density. Increasing moisture levels increased capacity but decreased efficiency and power consumption (*Author's summary*) 102

0601-7498 CHONG, P. K. AND WEBB, B. H. **Tapioca pelleting studies.** Malaysian Agricultural Research Bulletin 4(1):77-89. 1975. Engl., Sum. Engl., Mal , 4 Refs , Illus.

Cassava. ***Manihot esculenta.*** **Processing. Pellets. Analysis. Pressing. Water content. Industrialization. Malaysia.**

A series of trial runs showed that cassava meal is not suitable for pelletizing when the meal has less than 14% moisture content (dry basis) using a 7.5 hp Lister farm pelletizing press fitted with an 11-mm grass die ring; it was suitable only when 3% stearine by wt was included with the meal For the meal to be pelletized without stearine, it has to have about 17% moisture content Generally higher fineness modulus decreases pellet strength, durability, bulk density, press efficiency and capacity while power consumption is increased. Higher stearine levels follow the same trend, but power consumption is decreased and capacity increased. Meal at 14-17% moisture content gave the best pellets. (*Author's summary*) 102

0602-5731 CHRISTIE & NORRIS LTD. **Briton high speed grinders.** Chelmsford, England, n.d 3p. Engl , Illus

Cassava. Grinding. Industrial machinery. England.

This booklet includes designs and specifications for a 40-hp grinder used for processing peeled, dried and sliced cassava. Hourly output according to screen diameter is given. (*Summary by L.F.C. Trans. by T.M.*) 102

0603-5024 COIMBRA, A L *et al.* **Estudo sôbre um processo de fermentação em laboratorio; aplicação à mandioca.** *(A process for fermenting cassava in the laboratory)* Quimica (Brazil) 3:47-56. 1947. Port , 14 Refs , Illus

Cassava. Fermentation. Alcohol. Cassava chips. Laboratory experiments. Analysis. Industrialization. Brazil.

A mixture of 2 33 g of malt flour of known sugar value and 20.95 g of dried cassava chips is saccharified as usual to obtain 1500 ml of a 10 1 Balling wort. A sample is reserved for analysis, and triplicate aliquots of the wort are acidified with H_2SO_4 to pH 4.8 and fermented with yeast in closed vessels equipped to wash the CO_2 involved in fermentation. The fermented wort is centrifuged and the alcohol content determined by refractometer. Results are calculated to the moisture-free basis Efficiency of fermentation is 97%. *(Summary by Chemical Abstracts)* I02

0604-2225 COLSON, L.and CHATEL, L. **Culture et industrie du manioc, étude faite à La Réunion.** *(Cassava cultivation and its industrialization in Réunion)* Paris, Challamel, 1906. 95p. Fr., Illus.

Cassava. Toxicity. HCN content. Starch content. Cultivation. Washing. Rasping. Silting. Screening. Cassava starch. Water requirements (processing). Factories. Costs. Tapiocas. Drying. Prices. Industrial machinery. Trade. Legal aspects. Uses. Africa.

An extensive study on cassava was carried out for farmers in Réunion. Principal topics dealt with are toxicity, habitat, climatology, soils, general chemical analyses, agronomic practices, diseases, fertilization, industrialization (starch and tapioca) and economic aspects (illustrated in tables) including data on imports and exports in France, Germany, England and Brazil. *(Summary by R T. Trans by T.M)* I02 D00

0605- 1993 **CONSIDERATIONS AND contemplations regarding flour and starch processing.** Hamburg, Merkur-Druck, n.d. 48p. Engl , Illus.

Cassava. Cassava starch. Cassava flour. Processing. Factories. Industrial machinery. Uses.

This fully illustrated pamphlet gives a basic outline of the processing of starch and flour from cassava and maize. As regards cassava, general background information is given on its cultivation, starch content, harvesting, native processing methods, etc. Advice concerning the installation of modern factories, including the drawbacks and lack of trained personnel in developing areas, is also given. In East Asia wheat flour is more than 3 times as expensive as cassava flour; the addition of up to 20% cassava flour is recommended in breadmaking. The advantages of pure tapioca are also given A plant producing 40 tons/day is the most economical, giving yields of 10-12 tons daily and reducing production costs by about 50%. *(Summary by T.M.)* I02

0606-3796 CUZNER, A. T. **Arrow-root, cassava and koonti.** Journal of the American Medical Association 30.366-369. 1898. Engl., Illus.

Cassava. Processing. Uses. Brazil.

The origin and taxonomic classification of arrowroot, cassava and koonti (a breadroot) are given, in addition to their method of preparation by South American and Caribbean Indians As regards cassava, mention is made of the native methods for making meal, cassava's medicinal qualities, the preparation of tapioca, and the process for recovering starch from the liquor that remains after making cassava cakes. *(Summary by L.C. Trans by T.M.)* I02

0607-4574 DE RUITER, D. **Breadmaking with non-wheat flour.** *In* Symposium on the Use of Non-wheat Flour in Bread and Baked Goods Manufacture, London, 1970. Proceedings. London, Tropical Products Institute, 1970. pp. 7-9. Engl.

Cassava. Cassava bread. Cassava starch. Composite flour. Breads. Biscuits.

This is a brief survey of the work on breadmaking with nonwheat flour carried out by the Institute for Cereals, Flour and Bread in Wageningen (Holland). Cassava was one of the products tested. The best results were obtained with cassava starch combined with soybean or groundnut flours, using a GMS-emulsion as an improving agent. Recipes are given for making bread and biscuits using a composite flour (70% wheat, 25% maize or cassava flour or starch, and 5% soybean flour). Reference is made to a consumers' acceptability test and a marketing study that will be carried out in Colombia to reduce wheat utilization. *(Summary by L F C Trans by S S. de S.)* 102

0608-7022 DENDY, D.A.V., JAMES, A.W. and CLARKE, P. A. **Work of the Tropical Products Institute on the use of non-wheat flours in breadmaking.** *In* Symposium on the Use of Non-wheat Flour in Bread and Baked Goods Manufacture, London, 1970. Proceedings. London, Tropical Products Institure. G62. 1970 pp 1-5. Engl

Cassava. Cassava starch. Wheat flour. Breads. Flours. Uses. England.

Different wheat flours were diluted with various proportions of cassava starch and the blends processed by 3 different breadmaking systems. Mechanical dough development gave the best bread and allowed incorporation of 10% more nonwheat material than other methods. More nutritious blends were also tested. soybean, cottonseed and groundnut flours, leaf and fish protein concentrates, and coconut protein isolate with wheat flour Tropical cereals such as sorghum, millet, rice and maize were also tried in wheat blends It was found that 20% yam flour could be used without serious adverse effects. *(Summary by Tropical Products Institute)* 102

0609-2945 DIAZ DE C., D. **Utilización industrial de la yuca.** *(Industrial uses of cassava)* Boletín Agrícola (Colombia) no 528:9558-9564. 1964. Span.

Cassava. Casave. Cassava starch. Tapiocas. Processing. Uses.

The increasing importance of cassava by-products—especially starch, alcohol and feedstuffs—is mentioned. The ecological conditions required for its cultivation are given. The processes for manufacturing farinha, flour, starch and tapioca are described in detail. The system for drying cassava for exportation purposes and the way in which glucose is made are also explained. *(Summary by L.F.C. Trans. by S.S. de S.)* 102

0610-0003 DOSTAL, L. **Laboratoriumsversuche zur Gewinnung von Stärkesirup unmittelbar aus Mais-, Milo- und Maniokmehl.** *(Laboratory studies on the obtainment of starch syrup from maize, sorghum and cassava flour)* Starke no 6.122-124. 1954. Germ , Sum Germ., Engl., 3 Refs

Cassava. Laboratory experiments. Cassava flour. Confectioneries. pH.

A study was made of the saccharification of ground grains and cassava flour at different acidic concentrations and periods of degradation. It was found that hydrolysis takes place only at acidic concentrations higher than those required for starch. The speed of saccharification depends on the protein content of the material used and the acid concentration Best results were obtained with cassava flour, followed by ground sorghum and maize. Under normal production condtions, no utilizable syrup is produced This process is suitable only for cassava flour since all the by-products usually resulting from starch manufacture are lost in this method unless a cation and anion exchanger is used. *(Author's summary. Trans by H P.)* I02

0611-5752 FEDERACION NACIONAL DE CAFETEROS DE COLOMBIA. DEPARTAMENTO DE MERCADEO. OFICINA DE PLANEACION. **Analisis de factibilidad para el establecimiento de una planta procesadora de harina de yuca panificable.** *(Feasibility study for establishing a plant to process cassava flour for breadmaking)* Bogotá, 1975. 32p. Span.

Cassava. Cassava flour. Prices. Production. Industrialization. Costs. Labour. Developmental research. Cassava programs. Productivity. Income, Factories. Marketing. Colombia.

Because of the constant price rises of imported wheat, a cheaper substitute was sought to make bread and other products that require this raw material Cassava, rice and maize flours can be used A study was carried out to determine the feasibility of setting up a pilot plant in Colombia to process cassava flour for breadmaking Its initial capacity was estimated at 630 tons of flour/yr (70% of its total capacity) to compete for the 28,500 tons of wheat flour that could be replaced (10% level of substitution) Caicedonia was considered to be the best place for building the plant since it has the highest productivity and the largest area planted to cassava. A financial analysis of this industrial enterprise showed that the project is technically and economically feasible at a 45% rate of extraction. Two recommendations were made (1) to get in contact with the farmers of the region in order to promote the project and let them know the established purchase price, and (2) to seek the participation of financial entities and corporations in this enterprise *(Summary by A J. Trans. by S.S. de S.)* I02 J00

0612-6746 FRANK, A. **Mandioca, a materia prima amilácea do Brasil; a indústria de amido, das matérias amiláceas e seus produtos.** *(Cassava, a source of starch products in Brazil).* Revista Brasileira de Química 10 (56):120-123. 1940. Port.

Cassava. Cassava starch. Industrial starches. Uses. Food products. Brazil.

The following starch products are briefly discussed soluble starch, dextrins, gelatinized starches, glucose, starch for foodstuffs (tapioca, etc.) and industrial purposes, and bread flour from cassava chips. *(Summary by T.M.)* I02

0613-6815 GAVER, K. M., LASURE, E. P. and THOMAS, L. M. **Reaction of glucopyranose polymers with substituted ammonium hydroxides.** United States Patent 2, 563, 526. 1951. 4p. Engl., 2 Refs.

Cassava. Cassava starch. Patents. USA.

New compositions are prepared by the reaction of primary, secondary, tertiary or quaternary substituted NH_4 hydroxides with carbohydrates and similar materials. The carbohydrate may be any aldehyde or ketone derivative of a polyhydric alcohol. Such materials can be starches derived from maize, sweet potatoes, waxy rice, cassava, sago, arrowroot, potato, wheat and amioca. Also adaptable are various thin-boiling starches; potato, tapioca and maize dextrins; dextran, sugars, such as sucrose; glucosides, such as α-methylglucoside, cellulose, such as cotton, linen, jute and ramie, inulin, and gums, such as locust bean gum, tragacanth and gum arabic. A nonaqueous solvent is preferred, such as higher boiling alcohols (preferably toluene). Ketones, ethers and other hydrocarbons are useful. A temperature of 80-81°C appears to be critical although temperatures up to 115°, with or without the removal of H_2O, give no evidence of formation of other than mono derivatives. Water should be removed as formed; azeotropic distillation is simple if the proper solvent is used. The substituted, hence the low reduced glutathione values were not due to conversion to the oxidized form (*Summary by Chemical Abstracts*) I02

0614-6832 GONÇALVES, J.C. Aspectos industriais da mandioca. *(Cassava industrialization).* Cruz das Almas, Brasil, Centro Nacional de Pesquisa de Mandioca e Fructicultura, 1976 13p. Port , 10 Refs , Illus.

Cassava. Cassava chips. Cassava flour. Cassava starch. Prices. Glucose. Alcohol. Processing. Uses. Industrialization. Brazil.

Several economic aspects of cassava industrialization in Brazil are discussed. A brief description is given of the processing and marketing of cassava flour, chips, starch, glucose and alcohol. Cassava yields vary according to each by-product. Some uses of cassava in human and animal feeding, ceramics, castings, soaps, textiles, fuels, etc. are mentioned A comparative table gives the advantages and disadvantages of cassava and sugar cane in the production of alcohol. *(Summary by A.J. Trans by S.S. de S.)* I02

0615-6824 GOTO, F. [**Study on gelatinization of highly concentrated starch suspensions by Brabender plastograph. V. On the heat inflation of gelatinized and dried starch paste**] Journal of the Japanese Society of Starch Science 19(2) 100-105. 1972. Jap., Sum. Engl , Jap., 4 Refs., Illus.

Cassava. Cassava starch. Gelatinization. Viscosity. Analysis.

Heat inflation of various starch pastes that were gelatinized at 100°C in a highly concentrated starch suspension by plastograph and dried at room temperature was studied. The effects of gelatinization temperature on the volume of heat inflation of starch were also tested. Potato starch had the highest heat inflation; i.e., 7.7 times its initial volume It was followed by tapioca, sago, waxy maize, sweet potato, rice, maize and wheat starches, respectively. The order of heat inflation was similar to that of peak viscosity measured by amylograph but not by plastograph. Next, the volume of heat inflation of starch paste gelatinized at various temperatures was examined. Potato starch had two peaks of inflation volume at 70 and 90°C gelatinized temperature; however, the other starches had only one peak, such as sweet potato at 90°, waxy maize at 95° and corn starch at 100°C, respectively. *(Author's summary)* I02

0616-7008 GRAMACHO, D. D **Ensaios sôbre a utilização de matéria prima de mandioca** (*Manihot Esculenta* **Crantz) na obtenção de "Carimã" e "polvilho azêdo" - Nota previa.** [*(Preliminary study on the use of cassava roots for the production of "Carimã" and "polvilho azêdo" (fermented starch)*] . *In* Projeto mandioca. Cruz das Almas, Brasil. Convênio U.F Ba./BRASCAN Nordeste. Série Pesquisa v.2, no 1. 1975. pp.137-143. Port.. Sum. Port., Engl., 9 Refs.

Cassava. Processing. Fermented products. Water content. Starch content. Fat content. Protein content. Sugars. Brazil.

Results are given of tests in which cassava roots were macerated to produce the local typical foods "carmã" or "mandioca puba" and "polvilho azêdo" (fermented starch) The most suitable raw materials were fresh roots from 8- to 12-mo-old plants. To obtain good-quality products, it was necessary to remove the outer layer of the roots *(Author's summary)* I02

0617-0088 GRUNWALD, O. **Algunos datos sobre la industrialización de la yuca.** *(Cassava processing)* Agro 8(27):35-38. 1953. Span.

Cassava. Cassava starch. Processing. Tubers. Composition. Venezuela.

A description is given of the steps for manufacturing cassava starch: root storage, cleaning and grating, preparation of starch "milk," purification and drying The chemical composition of whole roots from 9 sweet cassava varieties and bitter cassava flour are included. Starch and cassave can be consumed safely because their HCN contents are eliminated in the processing *(Summary by A.J. Trans by S.S de S.)* I02

0618-1773 GUANZON, G. A. **The possibilities of cassava production in the Philippines.** Philippine Agriculturist 16:433-440. 1927. Engl., 11 Refs.

Cassava. Cassava starch. Cassava flour. Tubers. Starch content. Timing. Harvesting. Costs. Processing. Production. Philippines.

As a result of the large importations of starch from China, the British and Dutch East Indies, and the United States, the Philippines has become interested in growing cassava. The greater part of the starch (gaw-gaw) is used by laundries. The advantages of producing cassava rather than sugar cane or maize as a source of carbohydrates and inexpensive starch are given. The following aspects are also dealt with: planting and weed control, processing and production costs of cassava starch and flour. Tables and estimates are also given on the relation between plant age and the starch content of the roots and on the effect harvesting time has on yield per hectare. *(Summary by L.C. Trans by T M)* I02 J00

0619-4430 HAMILTON, W. **On the genus *Jatropha*, and the *Janipha manihot*, and *loeflingii*.** Pharmaceutical Journal and Transactions 5:27-33 1846. Engl

Cassava. Toxicity. Therapeutants. Fermented products. Cassareep. Uses.

The toxic and medicinal properties of bitter cassava are described. The primitive methods used for preparing some cassava by-products in the West Indies are explained; the liquor cassiri, which has diuretic properties, tapioca and cassareep are some of the products included. *(Summary by A J. Trans. by S S. de S)* I02 H04

0620-6847 HELTNE, L.P. **Improved process and apparatus for the treatment of dried cassava roots to obtain starch.** British Patent 468,926. 1937. 4p. Engl., Illus.

Cassava. Cassava starch. Patents. Industrial machinery. Rasping. Dried tubers. England.

Cassava roots are coarsely subdivided and converted to a crushed, long-fibered mass by repeated pressure treatment between rollers that rotate with equal peripheral speed so that little powder is produced and the mass is then soaked in H_2O and further treated to extract starch. *(Summary by Chemical Abstracts)* I02

0621-4883 HEYNE, K. *Manihot utilissima;* **trabajo sobre la yuca y sus industrias.** *(Manihot utilissima: cassava and its industries).* Boletín de Agricultura (Colombia) 1932:127-146. 1932 Span.

Cassava. *Manihot esculenta.* Cassava flour. Gaplek. Tapiocas. Processing. Waste utilization. Cassava leaves (vegetable). Cassava starch. Factories. Industrial machinery. Prices. Human nutrition. Java.

After mentioning some aspects on the origin of cassava and agronomic practices in Java, a detailed description is given of the processes for manufacturing several products for native (gaplek, etc.) and animal consumption and industrial purposes (slices and tapioca). It also discusses its toxicity. Estimated costs of the machinery used for manufacturing starch, flour, etc. in Brazil are included. *(Summary by A.J. Trans. by S.S. de S.)* I02 H01

0622-5590 HOLLEMAN, L. and VOS, L DE **Kleurmeting en kleurspecificatie, in het bijzonder van tapiocameel.** (*Color measurement and color specification, especially of cassava flour*). Ingenieur in Nederlandsch - indië 8(4):33-48 1941. Dutch, Sum. Engl., 11 Refs, Illus.

Cassava. Cassava flour. Analysis. Legal aspects. Indonesia.

A survey is given of modern methods of color specification (tri- and monochromatic) and applications to grading cassava flour on the basis of total brightness and color as compared to a $BaSO_4$ standard. For exact color measurement, the König-Martens spectrophotometer gives excellent results. The authors have constructed an apparatus called the Selenophoot and claim that it is very exact and easy to manipulate It is adapted to the determination of the reflection of flours and other opaque materials, as well as the determination of the transmission of liquids and other transparent media The apparatus, including a reproduction, is described. It has been used by the authors for the determination of the whiteness of several thousand samples of cassava flour and has given excellent results. (*Summary by Chemical Abstracts*) I02

0623-0107 **HOME-MADE machine grater.** Pacific Islands Monthly 1936:62-63. July 1936 Engl., Illus.

Cassava. Rasping. Cottage machinery.

A practical and efficient machine for grating all kinds of starch-bearing tubers can be made inexpensively at home When operated manually, it has a 600-lb capacity. All tubers need to be cleaned, washed and peeled before they are placed in the grater Designs and specifications for building it are included. *(Summary by P.G Trans. by S.S. de S)* I02

0624-5378 HORIE, S. **[Acetone-butyl alcohol fermentation. III. Utilization of various protein-rich raw materials as the source of nitrogen].** Journal of the Agricultural Chemical Society of Japan 16:321-330 1940. Jap., 1 Ref.

Cassava. Waste utilization. Alcohol. Fermentation. Production.

Nitrogen compounds must be added for the acetone-butyl alcohol fermentation of dried sweet potato and sweet potato starch waste. Gluten meal is usually a suitable source of N If this is inadequate, it is fortified by the addition of peptone. Beer waste is also a useful source of N. Acetone (8-9%) was produced from dried sweet potato starch waste by adding a mixture of 0.5% soy waste and 0 3% gluten meal. Wheat bran is useful as an N source for cassava whereas rice bran is suitable for dried sweet potato; both are effective for sweet potato starch waste Fresh and dried sweet potato were fermented without adding a source of N. *(Summary by Chemical Abstracts)* I02

0625-1993 HUBRICH, A. **Considerations and contemplations regarding flour and starch processing.** Hamburg, Merkur-Druck, n d 48p Engl., Illus

Cassava. Cassava starch. Cassava flour. Processing. Factories. Industrial machinery. Uses.

This fully illustrated pamphlet gives a basic outline of the processing of starch and flour from cassava and maize. As regards cassava, general background information is given on its cultivation, starch content, harvesting, native processing methods, etc. Advice concerning the installation of modern factories, including the drawbacks and lack of trained personnel in developing areas, is also given. In East Asia wheat flour is more than 3 times as expensive as cassava flour, the addition of up to 20% cassava flour is recommended in breadmaking The advantages of pure tapioca are also given A plant producing 40 tons/day is the most economical, giving yields of 10-12 tons daily and reducing production costs by about 50%. *(Summary by T.M.)* 102

0626-6751 HUDSON, B J.F. and OGUNSUA, A.O. **The effects of fibre, starch damage and surfactants on the baking quality of wheat/cassava composite flours.** Journal of Food Technology 11(2) 129-136. 1976. Engl , Sum. Engl., 9 Refs , Illus.

Cassava. Cassava flour. Wheat flour. Screening. Composite flours. Breads. Bread improvers. Analysis.

Sieving of cassava flour yielded a fraction suitable for use in wheat/cassava bread. The degree of starch damage of the cassava flour had no effect on baking quality. Cassava flour did not exhibit diastatic activity, nor did its presence affect the diastatic activity of wheat flour. However, the addition of 0.25% of malt to the composite flour caused an increase in loaf volume. Partial replacement of wheat flour by cassava flour, therefore, is limited mainly by the consequent deficiency of diastatic enzymes. Calcium stearyl lactylate, as a replacement for 2/7 of the fat in the formula caused a significant increase in loaf volume, but the addition of glyceryl monostearate had no effect on loaf volume. *(Author's summary)* 102

0627-6711 INGRAM, J. S. **Standards, specifications and quality requirements for processed cassava products.** London, Tropical Products Institute. G 102. 1975. 26p. Engl., Sum Engl., Fr., Span., 58 Refs.

Cassava. Cassava chips. Pellets. Wastes. Cassava starch. Cassava flour. Gari. Tapiocas. Industrial starches. Human nutrition. Animal nutrition. Legal aspects.

There is a growing awareness of the need for national and international standardization of processed cassava products for the international trade. This report summarizes information currently available on existing standards, both official and otherwise, for cassava products and discusses the related quality parameters. There are variations between standards for the different cassava products and different countries; but the quality parameters that are consistently emphasized are moisture, fiber, ash and starch contents plus general cleanliness of the product. Producer countries should therefore aim to achieve and maintain the desired good quality in these products. *(Author's summary)* 102

0628-5610 INSTITUT DE RECHERCHES AGRONOMIQUES DE MADAGASCAR. DIVISION DE CHIMIE ET DE TECHNOLOGIE AGRICOLE. **Note technologique concernant la féculerie de Marovitsika.** *(Technological report on the starch factory at Marovitsika).* Tananarive, 1959. 29p. Fr., Illus

Cassava. Roots. Cassava starch. Washing. Screening. Cassava milk. Silting. Drying. Dry matter. Viscosity. Factories. Malagasy Republic.

The Marovitsika factory (Madagascar) was one of 7 visited during the 1957 campaign, which was carried out to study raw materials (cassava and water), manufacturing systems, and the commercial quality of the final product. Starch manufacturing and recommendations for its improvement are included. The main recommendations are (1) to double the quantity of water (1 5 m^3/ton) that is being used for root washing; (2) to improve the grating system and dilute scrapings to reduce the high starch content left in the residues, (3) to change the meshes used to another kind, suitable for cassava; and (4) to improve the operating of decanters and dryers. The report includes tables and figures showing the results of the 10 starch quality tests of the US General Foods, to which the samples were submitted. *(Summary and trans by S S. de S.)* 102

0629-4444 INSTITUTO DE INVESTIGACIONES TECNOLOGICAS. **Evaluación de calidad de yuca almacenada en silos de campo y en cajas con aserrín húmedo, fase analítica.** *(Evaluation of the quality of cassava stored in field clamps and in boxes with moist sawdust)* Bogotá, 1975. 31p. Span.; 8 Refs.

Cassava. Tubers. Storage. Organoleptic examination. Palatability. Analysis. Starch content. Water content. Sugars. Timing. Colombia.

A report is given on the Instituto de Investigaciones Tecnológica's collaboration in the analytical phase of the study carried out by CIAT on the storage and conservation of cassava in field clamps and boxes filled with moist sawdust. The quality of the stored cassava was evaluated weekly, changes occurring in the physicochemical properties and in the organoleptic characteristics of cassava during storage were studied during the 8-week period. This evaluation was carried out with the variety Llanera, grown and stored at CIAT. The methodology used included three processes: organoleptic analysis, measurement of hardness, and determination of starch and sugar content. Results are summarized in tables. *(Summary by L.C Trans. by T M.)* I02

0630-1990 JAVA. LANDBOUW, NIJVERHEID EN HANDEL DEPARTEMENT VAN AFDEELING HANDEL **Products of the cassava.** Buitenzorg, Java, 1921. 38p. Engl., Illus.

Also in Dutch.

Cassava. Tubers. Composition. Cassava flour. Rasping. Grinding. Silting. Drying. Wastes. Tapiocas. Gaplek. Uses. Marketing. Prices. Java.

A brief botanical description is given of cassava and the cultivation system used in Indonesia (Java). The chemical composition of fresh and dry roots of sweet and bitter cassava varieties are given in tables. The industrial processes are outlined for manufacturing flour, starch, tapioca and gaplek. Reference is made to the utilization of fresh cassava or its by-products for making alcohol, glucose, etc. and livestock feeds. Data are included on the production and exports of cassava by-products to the USA and some European countries during the period 1912-20 Finally, the causes of price flucturations in the international market are analyzed. *(Summary by A.J. Trans by S.S. de S)* I02 J00

0631-5364 JOHNSON, I.M. **A proposal for work on the processing of yucca for starch and flour production.** Lima, Universidad Nacional Agraria La Molina. Proyecto 80. 1970. 21p. Span , Illus.

Cassava. Cassava starch. Cassava flour. Factories. Water requirements (processing). Costs. Processing. Peru.

A study was carried out at the Universidad Nacional Agraria La Molina (Peru) to develop a plant that would produce cassava starch or flour with a capacity of 10-20 kg roots/min. The use of hydrocyclones would greatly improve starch quality, and processing time would also be reduced. Since there is no decantation, the build-up of bacterial and enzymic activity would be minimized. Recirculation of water increases extraction efficiency, reduces the volume of clean water needed for the process, and reduces the pollution problem The study includes a flow chart of the process, a critical analysis of the same, and methods for estimating costs. *(Summary by T.M.)* 102

0632-6765 JONGH, G., SLIM, T. and GREVE, H. **Bread without gluten.** Bakers' Digest 42(3):24-29. 1967. Engl , 8 Refs., Illus.

Cassava. Cassava flour. Composite flours. Breads. Bread improvers. Soybean flour. Groundnut flour. Analysis.

Results are given of breadmaking trials using a starch/water dough (wheat starch with 60% H_2O. The effect of adding glyceryl monostearate (GMS), polyoxyethylene stearate and proteins (egg albumen and gliadin) on dough structure, bread crumbs and texture was studied. A cassava starch dough (80% cassava + 20% soybean flour or peanut flour) with 70-80% H_2O and 1% GMS also gave good results. *(Summary by T.M.)* 102

0633-4551 KAUFMAN, C. W. **Cooperación en la producción de tapioca.** *(Cooperation in the production of tapioca).* Hacienda 44(7):38-40. 1949. Span., Illus.

Cassava. Tapiocas. Production. Cassava programs. Industrialization. Developmental research. Brazil.

A description is given of the historical conditions that made it possible to increase tapioca exports from Brazil to the United States in cooperation with the General Foods Corporation. The company studied the potential of Brazilian tapioca and helped in the improvement of starch quality. The following results were obtained in the states of São Paulo and Santa Catarina: (1) improvement of available machinery, (2) improvement of sanitary conditions, and (3) treatment of the water. Emphasis is placed on the fact that the significant increase in exports of high-quality tapioca was possible thanks to this joint effort. *(Summary by A.J. Trans. by S.S. de S.)* 102 J00

0634-4748 KENYON, W. O. and UNRUH, C. C. **Oxidation of starch with nitrogen dioxide.** United States Patent 2,472,590. 1949. 3p. Engl., 6 Refs

Cassava. Cassava starch. Patents. USA.

The oxidation of various types of starch with nitrogen dioxide (or the dimeric N_2O_4) to give a water-insoluble, alkali-soluble product containing at least 12% CO_2 equivalent as uronic carboxyl (COOH) is described For example, a mixture of 200 g cornstarch, 400 ml carbon tetrachloride and 400 ml liquid N_2O_4 was allowed to stand 6 h at room temperature, the product was filtered, washed with methyl alcohol (MeOH) and H_2O, then dried with MeOH followed by ethyl ether. The oxidized starch contained 22.4% COOH and 0.14% N. Similar products containing varying COOH and N contents are prepared by variations in temperature and time of reaction, reaction solvent, or by passage of N_2O_4 vapors over cornstarch. The oxidized starches may be useful when applied to gauze to prevent its adherence to body tissues, as a textile size thickening agent, as an additive for varying the viscosity of emulsions and in photographic film backing; the heavy metal salts are used as dye mordants. *(Summary by Chemical Abstracts)* 102

0635-3871 KERR, R.W **Manufacture of tapioca and arrowroot starches.** *In* ______, Chemistry and industry of starch. New York, Academic Press, 1950 pp. 87-97. Engl., 9 Refs., Illus.

Cassava. Cassava starch. Trade. Linamarin. HCN. Peeling. Grinding. Drying. Water requirements (plant). Cassava meal. Composition. Washing. Rasping. Fermentation. Distribution. Centrifuging. Pulping. Pulp. Starch productivity. Industrial machinery. Factories. Costs. Plant height. Starch crops. United States.

This is mainly a historical summary of the manufacture of cassava starch or tapioca with emphasis on Java (Indonesia). The following subjects are discussed: the importance of tapioca in the United States, the raw material, production methods (biochemical action and mechanical means) and American production (Florida, Brazil, the Dominican Republic). (*Summary by L.F.C. Trans. by S.S. de S.*) 102

0636-6724 KERR, R. W. **Process for modifying starch with aluminum chloride and enzyme and applications of such modified starch.** United States Patent 2,619,428. 1952 14p. Engl., 2 Refs

Cassava. Industrial starches. Patents. Modified starches. Paper industry. Uses. USA.

Slurries of corn, cassava, rice, or potato starch were prepared by using 100 parts by wt starch and 163 parts H_2O. To the mixture was added 0.2-0.3% $AlCl_3.6H_2O$ based on the dry wt of the starch, and the pH was adjusted to 3 1 with HCl. The slurries were filtered by suction; moisture content of the cake was 43 7-47.7%. The cakes were broken into squares about 1 in by 1 in by ¼ in thick. They were then dried on a belt drier with the air temperature maintained at 55-135°F. The drying procedure is described in detail The moisture content of the dried product was 4.4-6.6%. The material was ground and adjusted to a pH of 6 with NH_4OH and liquefied with an enzyme, such as Vanzyme, for about 30 min. The resulting coating contained 59% solids and was found to be relatively fluid and suitable for transfer by roll equipment to the sheet of paper on a conventional paper machine The enzyme-converted starch had a Dudley viscosity of 60 sec at 90° and the final coating, a Brookfield viscosity of 450 centipoises at 40° and 60 rpm. *(Summary by Chemical Abstracts)* 102

0637-4927 KERR, R. W. and SCHINK, N. F. **Process for modifying starch.** United States Patent 2,438,855. 1948 6p. Engl., 10 Refs.

Cassava. Cassava starch. Modified starches. Patents. USA.

An explanation is given of the treatment to which cassava and other tuber starches are submitted in order to produce gelatinizable pastes that are used as ingredients for certain food products (pie fillings or puddings) The objective of this treatment is to reduce the Scott and Stomer indexes and convert the natural stringiness of cassava starch gel to a desirable degree of shortness without adversely affecting its natural good qualities, that is, its clarity, smoothness and tastelessness It also makes it more resistant to acids The desired effects can be obtained by treating a water suspension of the starch with formaldehyde or acetaldehyde, in the presence of small amounts of an inorganic acid (dilute H_2SO_4, dilute HCl, etc.) The pH of the suspension should range between 1 6-2 5, and the quantity of aldehyde should be 0 075-0.5% of the dry matter weight of the starch. After allowing the aldehyde and starch to react, the acid is neutralized with soda ash (caustic soda, ammonia or potash), the aldehyde is neutralized with sodium bisulfate, which forms a water-soluble compound, thus being removable by filtering, washing and drying *(Summary by A.J. Trans. by S S de S.)* 102

0638-5361 KESLER, C. C. and BECHTEL, W. G. **Recording viscometer for starches.** Analytical Chemistry 19(1):16-21. 1947. Engl., Sum. Engl., 14 Refs., Illus.

Cassava. Cassava starch. Viscosity. Analysis. Processing.

A continuous recording viscometer for testing starch products is described. Automatic control of rate of heating, maximum temperature, rate of stirring and loss of water by evaporation prevent errors caused by variations in cooking procedures. Viscosity is measured as the force the paste exerts against a propeller driven through it at constant speed. A gear differential transmits the force to a dynamometer, interchangeable weights on the dynamometer permit measurements in several viscosity ranges Viscosities of one poise or more can be measured for any length of time and during both heating and cooling periods. Starches from different sources and of different kinds and degrees give characteristically different curves which are valuable in their identification. Viscosity curves of 5% pastes of potato, waxy maize, cassava, corn and wheat starches are compared in a figure. *(Author's summary)* I02

0639-6761 KIM, J C **Bakprodukten uit meel van tropische landbouwgewasen.** *(Bakery products from flour from tropical plants)* Voedingsmiddelentechnologie 2(52):1-5. 1971. Dutch, Illus.

Cassava. Cassava flour. Breads. Biscuits. Bread improvers. Composite flours. Netherlands.

In the baking of bread from a blend of 80% cassava and 20% defatted soybean flour, the addition of glyceryl monostearate (GMS) was required to improve crumb structure. Flours from maize, millet, sorghum and rice were submitted to baking trials, which proved unsatisfactory The addition of calcium or sodium stearoyl lactylate or of acetylated tartaric esters of mono- and diglycerides resulted in satisfactory bread from a mix of wheat flour and 30% nonwheat flours prepared from cassava, millet and maize, with soybeans or caseinate. Biscuits were made from 2 parts cassava flour or cassava starch meal and 1 part defatted soybean or groundnut flour. *(Summary by Tropical Products Institute)* I02

0640-1701 KIM, J C and DE RUITER, D. **Bakery products with non-wheat flours; a review.** Bakers Digest 43(3) 58-63 1969. Engl., 2 Refs., Illus.

Cassava. Cassava flour. Cassava bread. Breads. Biscuits. Food enrichment. Palatability. Calcium stearyl lactylate. Industrial machinery. Maize flour. Soybean flour. Wheat flour. Groundnut flour. Composite flours.

Studies were conducted to explore the potentials offered by various nonwheat flours for making bread and related bakery products. A number of tuber flours including those derived from cassava, yams, sago and arrowroot were tested for their suitability in breadmaking when combined with protein concentrates obtained from soybean, peanut, cottonseed and fish meal. Formulas and procedures using a stabilizing agent (calcium stearyl lactylate and hydroxypropylmethylcellulose) and glyceryl monostearate were developed for the production of a well-aerated bread under widely varying climatic and environmental conditions. Pilot-scale cakemaking equipment used for these processes is described. Best results were obtained with a cassava-soy flour mixture; a corn-cassava-soy mixture also gave good results *(Summary by J.L.S.)* I02

0641-4943 KROCHMAL, A. Summary of trip to Tapichula, Mexico. n.i 4p. Engl

Cassava. Factories. Distribution. Mexico.

The practices for growing cassava used at Tapichula farm, which belongs to a company that produces paints, plastics, etc., are described. Cassava is processed into starch, which serves as a raw material for the production of mucilages and glues used for assembling cardboard cartons; a small part is converted into dextrins, The use of technology, mechanization, herbicides, insecticides (thrips is the most common pest), fertilizers, etc. characterizes this farm. Harvesting is the only manual operation. In addition to the cassava produced on the farm, contracts are made with farmers who receive a predetermined amount of money periodically to guarantee a permanent supply of raw material At the end of the harvest, the farmers are paid a fair price per ton. This new industry has contributed to the progress of the region, and its example should be followed by other regions for large-scale production *(Summary by A J. Trans S.S de S)* 102

0642-4477 KUIZON, P.G. **The modern method of manufacture of cassava flour and starch.** Agricultural and Industrial Life 18 10.1956. Engl.

Cassava. Cassava flour. Cassava starch. Processing. Philippines.

The industrial process for manufacturing flour and starch is described, together with the different modern machines recommended for their speed, quality and efficiency. During the peeling operation, the tuber loses approx. 20% of its weight; this waste product is pulverized and used for animal feed. *(Summary by P.G. Trans by S.S. de S.) I02*

0643-6731 LANGFELD, E **Process for the production of a sugar solution.** United States Patent 1,834,788. 1931. 2p. Engl.

Cassava. Fermented products. Patents. USA.

A substantially dry material containing the entire starch, cellulose and other solid constituents of *Manihot* roots (with the exception of a substantial proportion of the dissolved constituents of the root juice) is subjected to saccharification by heating with dilute acid. The product may be used in yeast and alcohol production. *(Summary by Chemical Abastracts)* I02

0644-6844 LANGFELDT, E. **Verfahern zur Vorbehandlung von Maniokawurzelknollen für Garüngszwecke.** (*Fermeting cassava roots for yeast production*). German Patent 543,774. 1932. 2p. Germ.

Cassava. Tubers. Yeast production. Fermentation. Patents.

The roots are washed, dried, saccharified and acidified for yeast manufacture. (*Summary by Chemical Abstracts*) I02

0645-5389 LECLERC, H. **Le couac (Farine de *Manihot edulis* Plum).** [*Couac (flour from Manihot edulis Plum.)*]. Presse Médicale 42(78):1522. 1934 Fr.

Cassava. Cassava bread. Processing. Human nutrition.

The preparation of couac is described briefly, and other ways in which it can be consumed are indicated Cassava pulp is dried, pulverized and sifted. The resulting flour is placed on metal sheets that are heated slowly in order to dry the flour without it, finally, some salt is added. This product, similar to semolina and formed by white or yellow grains, is called couac Its caloric value is very high. *(Summary by S.S. de S.)* 102

0646-4478 LEONOR, M **Why not go into cassava starch manufacture?** Agricultural and Industrial Life 13(11) 7. 1951 Engl.

Cassava. Industrial starches. Trade. Cassava flour. Legal aspects. Industrialization. Starch productivity. Cassava bread. Philippines.

Philippine cassava starch production does not meet local demands, the prospects for cassava flour are also excellent because the Government compels its use in breadmaking A simple device for making starch on a small scale is described. (*Summary by T.M.*) 102

0647-4476 LEOPOLDO, F T. **Cassava for post and fence.** Agricultural and Industrial Life 16(3):32 1954. Engl., Illus.

Cassava. Stems. Uses. Philippines.

The use of cassava stems for fence posts is illustrated in 3 different designs for poultry and swine. Principal corner posts are made of wood. The cassava posts should be pruned occasionally; otherwise, the stems will grow too tall and slender. (*Summary by T. M.*) 102

0648-0176 LEVEY, R P **La yuca: pan de la selva.** *(Cassava bredd)* Hacienda 47:64,76,78 1952. Span., Illus.

Cassava. Cassava bread. Nutritive value. Processing. Industrial machinery. Prices. Peru.

A report is made on the utilization of cassava flour to replace starch. In breadmaking, 20% cassava flour is added to the wheat flour; 22-35% is added for cakes; 15% is used for macaroni and noodles These products not only are of good quality but also can be kept fresh longer. Cassava has more P and Ca than wheat, some vitamin B_1 and riboflavin, twice the amount of niacin and ascorbic acid, and a low fat content. Although cassava is less rich in protein than wheat, it has a greater amount of carbohydrates, which results in a better balance. The procedure for obtaining cassava flour and equipment costs are given in detail. *(Summary by L.F.C. Trans. by S.S. de S)* 102

0649-4481 LIEBERMAN, J. **La industrialización de la mandioca resulta una valiosa fuente económica para Misiones.** *(Cassava industrialization: a valuable economic activity for Misiones).* Mundo Agrícola 6(66):45-47. 1954. Span.

Cassava. Processing. Industrialization. Argentina.

The agronomic practices and processes used at an agro-industrial farm in Misiones (Argentina) for producing starch and several by-products for animal feeding is described with the purpose of promoting cassava growing and industrialization in this country. The production of motor alcohol from cassava is projected at this farm because of the economic advantages it represents as compared to that produced from maize. *(Summary by A.J. Trans. by S.S. de S.)* 102

0650-6725 LOLKEMA, J and MEER, W. A. VANDER. **Preparation of cold swelling starch-aldehyde compositions.** United States Patent 2,510,748 1950. 3p Engl., 6 Refs.

Cassava. Modified starches. Patents. USA.

Potato starch (1000 by wt) is suspended in a mixture of a 40% solution of formaldehyde (500) and H_2O (1000 parts by volume). Dilute NaOH solution is added to a pH of 6 and then the mixture is converted into cold-swelling starch on a heated, rotating cylinder at a temperature of 120-130°C. The cold-swelling starch thus obtained dissolves completely in 8-10 parts of cold H_2O to a viscous, smooth and transparent solution. An insoluble product that swells in H_2O to a limited extent when the process is carried out at 170-180°C, other conditions being constant. Other starch products, such as cassava flour, may be employed *(Summary by Chemical Abstracts)* 102

0651-4555 LUNA DE LA F., R. and OVIEDO A., M. **Ensayo de panificación con mezclas de harinas de trigo y de tres variedades de yuca.** [*Breadmaking trials using mixtures of wheat flour and cassava (3 varieties) flours*] PCEA. Boletín Trimestral de Experimentación Agropecuaria (Peru) 8(3).9-14. 1954 Span., 9 Refs.

Cassava. Cassava flour. Composite flours. Breads. Composition. Analysis. Cultivars. Costs. Peru.

Several breadmaking trials were conducted using mixtures of wheat flour with 5, 10, 15 and 20% cassava flour from the varieties Amarilla, Blanca Huacho and Maleña. The objective was to study the possibility of reducing the amount of wheat, thus decreasing wheat imports in Peru. Santa Rosa, and imported wheat flour, was used as control, following the official method of the Association of Cereal Specialist Chemists. With a 10% level of substitution, physical characteristics of the bread were acceptable As the proportion of cassava increased, bread volume dimished, texture values were inferior and the crumbs took a deeper color. Chemical analyses showed that up to a 15% level of substitution, the bread had an acceptable nutritive value; however, as this level increased, protein and vitamin B_1 contents decreased. At the 5 and 10% levels of substitution, bread prices would be reduced in the same proportion The best economical results would be achieved in the states of San Martin, Loreto and Amazonas (the greatest cassava production centers), where wheat flour prices are higher because these regions are far from the industrial zones and transportation costs are very high. *(Summary by A J. Trans. by S.S. de S)* 102

0652-6797 Mc CLOY, J. **Artificial drying in remote territories and the fuel problem.** World Crops 7(3):109-113. 1955 Engl., 69 Refs., Illus.

Cassava. Drying. Power sources. Cassava flour. Tapiocas.

This article discusses problems likely to arise in connection with the drying of agricultural products in developing countries Among the crops that are artificially dried are maize, sorghum, rice, coffee, peanuts, cassava and cocoa A description is given of the traditional methods in smoke, hot table and flue kilns, all of which contaminate the product. The introduction of artificial drying methods from Europe, using fans to obtain a controlled air flow and based on both mechanical and thermal energy, should be considered. The selection of the most appropriate fuel (oil, alcohol, wood, charcoal, methane, etc.) and the equipment—in accordance with what is available in each region—is considered. *(Summary by A.J. Trans. by S. S de S)* 102

0653-3237 MacMASTERS, M. M. and HILBERT, G. E. **Glutinous corn and sorghum** starches. Industrial and Engineering Chemistry 36(10):958-963 1944 Engl., Sum: Engl., 16 Refs., Illus

Cassava. Cassava starch. Gelatinization. Viscosity. Silting. Analysis. Temperature.

Prior to World War II, the USA imported 300-400 million lb of cassava starch annually. At present relatively small amounts are being imported, but there are some users who are willing to pay a premium price over that of any other currently available starch. This is an indication of the quantity of substitute starch with cassava-like properties that might be expected to find a commercial market. In this paper the composition of various glutinous and nonglutinous varieties of maize and sorghum have been determined. In general, the glutinous varieties have less starch and more oil and protein than the nonglutinous types The glutinous maize types can be easily processed for high-quality starch by a method similar to that used for making cornstarch The adaptation of this method to glutinous sorghums containing a nucellar layer yields off-color starches. This difficulty can be overcome by pearling the grain to remove the pigmented layer. Varieties lacking the nucellar layer yield white starch without pearling Compared to nonglutinous starch, the glutinous type is more sensitive to processing conditions. Excessive grinding and increasing the sulfur dioxide concentration in the steeping operation tend to lower the viscosity of the glutinous starch. The gelatinization temperatures of starch from glutinous varieties are about the same as those of starch from the nonglutinous types Glutinous starch granules swell to a greater extent and exhibit a different structure from the nonglutinous granules The viscosity of glutinous starch pastes is much higher than that of the ordinary type starch paste and is comparable to that of tapioca. Glutinous starch pastes are translucent, flavorless and "long." Factors involved in the industrial utilization of glutinous starch as a replacement for tapioca starch are discussed. *(Author's summary)* I02

0654-6884 MAIA, R Tiquirá, aguardente de mandioca. *(Tiquira, a liquor made from cassava)* Revista de Tecnologia (Brazil) 2(3) 9-10. 1949. Port., Illus

Cassava. Beverages. Brazil.

A description is given of the different phases of preparation of tiquira (a liquor made from cassava) in the region of Maranhão (Brazil). The process consists of the following steps (1) root washing, (2) grating, (3) pressing, (4) cooking of the paste formed (this product is called beiju), (5) saccharification (by means of the fungi *Monilia citophila, Aspergillus niger* and *Penicillium* sp). (6) beiju dilution, (7) alcoholic fermentation (in addition to the fungi mentioned, *Saccharomyces selvagens* takes part in this process), and (8) distillation The beverage obtained has a high percentage of alcohol (54-56%). *(Summary by A J. Trans by S S de S)* I02

0655-0166 MANDIOCA NO sal dura todo o ano. *(Conservation of cassava in salt)*. Dirigente Rural 2(9) 53 1963 Port.

Cassava. Tubers. Storage. Brazil.

A brief description is given of the method used by the farmers of Rincão da Porta, Cachoeira do Sul (Brazil) who keep 90 tons of cassava/yr in good condition by salting 100 kg of cassava roots with 2-3 kg of salt. In this way, livestock feed is kept in optimum conditions, and the land is left free to grow other crops Cassava is chopped and stored in wooden boxes with a 10-ton capacity *(Summary by P G Trans by S S de S)* I02

0656-2943 MEJIA F., R **El cultivo de la yuca y su explotación industrial. IV. Consideraciones económicas del cultivo. Industrialización: almidón o fécula y sus métodos de extracción.**

(Cassava cultivation and its industrialization. IV. Economic consideration. Industrialization starch and methods of extraction). Agricultura Tropical (Colombia) 2(4) 16-19 1946 Span.

Cassava. Peeling. Washing. Rasping. Screening. Silting. Drying. Cassava starch. Colombia.

The small- and large-scale methods for obtaining cassava starch are outlined with the purpose of industrializing this crop in Antioquia, Colombia, where it is used for food only. *(Summary by A J. Trans. by S.S de S.)* I02

0657-6854 MEJIA F., R. **El cultivo de la yuca y su explotación industrial. V.** (*Cassava cultivation and industrialization V.*). Agricultura Tropical (Colombia) 2(6) 13-18. 1946. Span

Cassava. Tapiocas. Glucose. Dextrins. Alcohol. Cassava flour. Processing. Production. Uses. Composition. Industrialization. Colombia.

The following subjects are dealt with briefly:(1) the preparation of tapioca and its uses, (2) industrial production and chemical properties of glucose; (3) production and uses of dextrins; (4) manufacture of motor alcohol; and (5) cassava roots and leaves as cattle feed. The chemical composition of fresh cassava and its ashes is included. Mention is made of a tannin found in cassava in a proportion of 0.010-0.003%. *(Summary by S. S. de S.)* I02

0658-3172 MELAN, C **Premiers essais d'usinage mécanisé du manioc à Yangambi.** *(Preliminary trials on the mechanized processing of cassava at Yangambi)* Bulletin d' Information de l' Institut National d' Etudes Agronomiques 10(4):263-282 1961 Fr, 3 Refs, Illus

Cassava. Cassava flour. Factories. Peeling. Steeping. Pressing. Centrifuging. Drying. Distribution. Tubers. Prices. Costs. Industrial machinery. Mechanization. Zaire.

The first part of this study describes the method developed in Leopoldville (Congo) for the mechanized processing of cassava roots into flour Peeled roots are soaked in water for 4 days, then disintegrated and partly dehydrated by pressure The product is then dried by centrifuging and hot air The second part contains a detailed cost analysis for a pilot plant at Yangambi with a capacity of 154 kg flour h Since processing costs do not exceed 47% of the total cost of the product, the outlook for introducing cassava flour manufacture into the Congo is promising *(Summary by Tropical Abstracts)* I02

0659-5594 MELLO, A. T. DE **Mingaus de café.** *(Coffee porridge).* Lavoura e Criação (Brazil) 1963:20-21 Fevereiro 1963 Port

Cassava. Cassava flour. Uses. Composition. Brazil.

A porridge made of coffee and cassava flour is prepared in some regions of Brazil To test the nutritive value of this food, a chemical analysis is given of coffee, sweet and bitter cassava, and of the flours made out of them The way to prepare the porridge is also explained. *(Summary by L.F C. Trans by T M)* I02

0660-6782 MELO, M' S **O problema do pão mixto.** (*The problem of mixed breads*). Arquivos de Higiene e Saúde Pública (Brazil) 4(6).31-45 1939 Port

Cassava. Composite flours. Cassava flour. Breads. Wheat flour. Gluten. Analysis. Brazil.

Wheat flours (analyses given) from 17 sources were used in baking tests with additions of cassava flour (I), cornstarch (II) and rice starch (III) in various proportions, singly and together Bread made from wheat flour and I was satisfactory in every respect up to a content of 12% of I Increase of I to 15% induced a slight change of flavor that was perceptible to fastidious persons; but for the working classes, increasing the proportion of I to 30 or 40% evoked no complaints. Additions of II were optimum up to 8% and good up to 12%, beyond that the flavor disqualified the bread for fastidious consumers but the working class made no objection to 25% Additions of III were good up to 10%, beyond that breadmaking was difficult Breads made from 70% of wheat flour and 10% each of I, II and III were satisfactory in all respects The loaves in all outward aspects were similar to bread from 100% wheat flour and the flavor was not affected by the combined additions. (*Summary by Chemical Abstracts*) 102

0661-0136 MENDES, C T Alcool motor. *(Power alcohol)* Revista Agricola 9(1 2) 23-31 1934. Port

Cassava. Alcohol. Production. Costs. Brazil.

A comparison is made of the production of absolute alcohol from sugar cane and cassava in Brazil, as a partial substitute for fuel An average yield of 180 liters of absolute alcohol, ton of fresh cassava, triple that of sugar cane, was obtained Production costs for both raw materials are included. It is concluded that cassava industrialization for producing absolute alcohol is definitely feasible. *(Summary by A J. Trans. by S S. de S)* 102

0662-6878 MERCADO, T. **Construction and improvement of cassava graters in the College of Agriculture.** Philippine Agriculturist 39(2) 158-162. 1939 Engl , 4 Refs , Illus

Cassava. Rasping. Cottage machinery. Philippines.

A report is made of the results obtained so far by the College of Agriculture in the Philippines in constructing a more efficient cassava grater. This "College grater no 3" is illustrated; its main parts include a stand, cover, blade, funnel-like attachment and handle The grater has a capacity of 12 kg of roots/h, thus being 200% more efficient than the native graters On the other hand, up to 76 kg of roots/h could be grated by increasing the gear ratio to 4 1 and the blade diameter to 31 cm. This machine can extract as much as 20% of the starch in the roots (*Summary by A J Trans. by S. S. de S.*) 102

0663-0952 **METHODES ET procédés spéciaux pour déterminer la qualité des farines de tapioca.** (*Special methods and procedures used to determine the quality of cassava flours*) Etudes d' Outre Mer 38:106. 1955. Fr.

Cassava. Cassava flour. Legal aspects. USA.

A brief description is given of 4 laboratory methods used to determine the quality of cassava flours. (1) Sifting flours through standard screens (140, 80 and 60) gives qualities. A, B and C, respectively. (2) The same categories are used to classify cassava according to its aspect, which is determined under natural light (direct, unshaded light) (3) Purity is determined by means of a crystallizer, (4) The starch content of cassava pulp is determined by using a 100-cc graduated cylinder. (*Summary by S. S. de S.*) 102

0664-1624 MICHE, C. **Les usages possibles des plantes à racines ou à tubercules.** *(Uses of root and tuber plants).* Nogent-sur-Maine, France, Institut de Recherches Agronomiques Tropicales, 1971. 35p. Fr, 43 Refs, Illus

Paper presented at Séminaire sur les Plantes à Racines ou à Tubercules, Ibadan, 1971.

Cassava. Cassava starch. Tapiocas. Production. Marketing. Trade. Consumption. Factories. Uses. Maps. Starch crops. Africa.

Uses of different roots and tubers, including cassava, are discussed. Economic aspects of consumption and industrialization in Africa are presented Tables include comparative data on production, area under cultivation and yields for the period 1948-68. *(Summary by R.T. Trans by T M)* I02

0665-3664 NOVELO F., E **El *Manihot utilissima* (yuca amarga); su plantación, cultivo y elaboración del almidón.** *[Manihot utilissima (bitter cassava); its planting and cultivation and the starch processing]* . Fomento (Ecuador) 2(20) 10,12 1945 Span.

Cassava. Cassava starch. Processing. Ecuador.

This article describes the rudimentary and modern methods used for manufacturing cassava starch *(Manihot esculenta* Crantz) on several private farms and enterprises in Ecuador *(Summary by A.J. Trans. by S S de S)* I02

0666-7252 ODIGBOH, E. V. and MOHSENIN, N. N. **Viscosity characterization of unmodified cassava starch paste.** Journal of Texture Studies 6(3) 363-377. 1975. Engl. Sum Engl, 18 Refs., Illus

Cassava. Cassava starch. Analysis. Viscosity. Drying. Cooking. Temperature. Laboratory experiments.

Unmodified cassava starch paste was characterized on the basis of its paste viscosity as affected by drying, cooking and paste temperatures at different paste concentrations The paste exhibited plastic fluid flow with high hot-paste peak viscosity. The temperature of the peak viscosity decreased with increasing concentrations. Drying temperature had statistically significant effects on the paste viscosity, the higher the temperature at which the starch was dried, the lower was the paste viscosity over the levels of concentration and cooking temperature. Starch drying temperature and paste concentration significantly affected the paste stability as measured by freeze-thaw tests and paste retrogradation tendencies. *(Author's summary)* I02 I01

0667-6816 OLSEN, A. G. **Tapioca process.** United States Patent 2,508,533. 1950 4p Engl, 7 Refs

Cassava. Tapiocas. Patents. Food products. USA.

Dried gelatinized tapioca and waxy starches are ground to particles small enough to pass through a 14-mesh screen The powder is then agglomerated by adding 20-35% H_2O at ordinary temperature and controlling the rate of addition. The dried, agglomerated particles are used in the making of puddings *(Summary by Chemical Abstracts)* I02

0668-6741 OHPOF, A. J **Over de verstijfseling van cassave-zetmeel.** *(Swelling of cassava starch)* Chemisch Weekblad 33:91-93. 1936. Dutch, Illus

Cassava. Cassava starch. Analysis. Particle size. Temperature. Processing.

The Samec method for determining the swelling of starch indicates that the transparency of starch suspensions depends on grain size as well as on concentration and that the temperature of swelling depends on the concentration A better method was used by Arzichowski; namely, microscopic observation of the swelling at definite temperatures A graph shows the no. of swollen grains with temperature (57° to 65°C) and with time, at different temperatures, for cassava starch The temperature curve is of a typical S shape and almost symmetrical, it represents the distribution curve of individual differences in the grains For cassava starch the typical swelling temperature is taken as the 50% point of the curve; i.e., 61.07°C. *(Summary by Chemical Abstracts)* I02

0669-5282 ONG, H.H. **Investigation into pelleting of tapioca (*Manihot utilissima* Pohl) as a single product.** Malaysian Agricultural Journal 49(4):442-454 1974. Engl., Sum. Engl., 8 Refs., Illus

Cassava. Pellets. Processing. Trade. Prices. Industrial machinery. Cassava chips. Water content. Protein content. Starch content. Fibre content. Ash content. Legal aspects. Malaysia.

A study was made of the feasibility of producing cassava pellets from chips as a rural industry in Malaysia. Factors affecting pelletability, pelleting capacity and pellet quality are reviewed. Diagrams are given of the 10-hp Lister pelleting press used in the trials. The capacity of the press with various die rings, as well as a quality analysis of the pellets produced, is given in tables. Proper pelleting can be achieved with fairly dry chips (10-14% moisture) at fairly high heat in spite of the belief that water or steam conditioning is necessary. Bursting of pellets can be reduced by sufficient compression of pellets through the selection of correct die rings. This principle of the pelleting machine is relatively simple and could be manufactured locally at a reasonably low cost. *(Summary by T.M.)* I02

0670-1810 PAEZ S., C and QUINTANILLA A., H **Factibilidad técnico-económica del montaje de una planta productora de almidón y glucosa a partir de la yuca, en San Vicente de Chucurí.** *(Feasibility study for a plant producing starch and glucose from cassava in San Vicente de Chucuri).* Bucaramanga, Colombia, Universidad Industrial de Santander, División de Investigaciones Científicas, 1972. 145p. Span., 19 Refs., Illus.

Cassava. Cassava starch. Glucose. Production. Marketing. Distribution. Packaging. Factories. Industrial machinery. Boiling. Centrifuging. Drying. Grinding. Peeling. Pressing. Pulping. Rasping. Screening. Silting. Washing. Labour. Consumption. Costs. Power sources. Cassava programs. Colombia.

The importance of cassava in the state of Santander (Colombia) is brought out from an economic, as well as an industrial, viewpoint Aspects dealt with in detail are (1) the production and marketing of cassava at the national, state and municipal level; (2) a marketing study including uses and specifications, statistics on production, importations and apparent consumption, analysis of consumption in the zone, estimated sales for the plant, (3) the plant's location in San Vicente de Chucurí, where cassava is grown intensively and socioeconomic development is being promoted; (4) a detailed description of the plant including flow charts, equipment, raw material, etc., (5) a budget for the flow of materials during each step of the processing; (6) the design, recommendations and specifications of equipment. The report is fully illustrated with tables and figures, and conclusions and recommendations are given for each of the topics dealt with. *(Summary by L.C. Trans. by T.M.)* I02 J00

0671-6702 PARK, Y. K and LIMA, D C. **Conversão contínua do amido em glicose pelo complexo amiloglicosídase-resina.** *(Continuous conversion of starch into glucose by an amyloglucosidase-resin complex)* Coletánea do Instituto de Tecnologia de Alimentos (Brazil) 4:147-154. 1971-72. Port., Sum. Port., Engl., 7 Refs , Illus.

Cassava. Cassava starch. Glucose. Enzymes. Laboratory experiment. Biochemistry. Brazil.

The use of insolubilized enzymes is a fairly recent innovation The object of this work was to study the conversion of starch to glucose using insolubilized glucoamylase The insolubilized enzyme maintained its activity for a long period of time and could be used repeatedly, thus making its use more viable economically. The enzyme was bound to Amberlite IR-45 resin (OH-form) and placed in a column. Starch solutions of varying concentrations were passed through the column, the amounts of reducing sugars present before and after passage being determined It was found that a liquefied cassava starch solution with an initial dextrose equivalent (DE) of 10 had a DE of 46 after passage through the column. In the same way, the DE of a corn syrup was raised from 26 to 63. The column remained active for 15 days with an overall loss of 40% activity *(Summary by Food Science and Technology Abstracts)* 102

0672-4344 PERALTA, M.F. **Rumbos industriales de la yuca.** (*Trends of cassava industrialization*). Agricultura y Ganadería (Venezuela) 1(2).25-27 1961. Span , Illus.

Cassava. Industrialization. Cassava products. Uses. Venezuela.

This article describes the industrial processes used in Brazil for manufacturing cassava starch. flour,chips, alcohol, dextrin and glucose, with the purpose of encouraging its industrialization in Venezuela, where there is a great deal of land available for its cultivation At present cassava production surpasses that of legumes, potatoes, textiles, oleaginous plants, vegetables, coffee, cacao and cereals, with the exception of maize. Recommendations include the carrying out of agro-economic studies to promote cassava growing and its utilization for industrial purposes (*Summary by A J. Trans. by S.S de S.*) 102

0673-6747 PERTEN, H. **Study of making French-type bread by mechanical dough development mixing wheat flour with cassava starch and millet flour.** *In* Composite flour programme Food and Agricultural Organization of the United Nations AGS:SN/SEN 5 Report of Consultant no. 1. 1969. pp 43-67 Engl , Sum Engl , Fr , Span , 8 Refs , Illus

Cassava. Cassava starch. Composite flours. Breads. Bread improvers. Processing. Cassava bread. Organoleptic examination. Analysis. Senegal.

The purpose of this study was to investigate the possibilities of making French-type bread from mixtures of wheat flours and materials available in Africa (cereals, root crops, oilseeds) Findings were as follows Acceptable French-type bread can be made by mechanical dough development with Tweedy 10 and 35 equipment when wheat flour is mixed with cassava starch and protein supplements or with millet flour Hearth-baked bread is more suitable for diluted wheat flour than large tin bread Weak wheat flours tolerate a dilution with cassava starch and millet flour of up to 30% and strong flours up to 40-50%. Dough consistency plays a vital role and must be kept as soft as possible. The presence of GMS and oxidizing agents is essential for wheat flour dilution with cassava starch but less important in a mixture with 30-40% millet flour High-speed mixing is essential for wheat flour dilution with cassava starch Millet flour may be mixed with wheat flour in conventional mixers with good results when using chemical dough development The conventional method normally gives poorer quality Full-fat soybean flours give technically good results if used at a 5% level. Unprocessed soybean flour with full enzymatic activity gives a softer bread crumb and a lighter color but may be unacceptable because of its odor The flavor of millet bread is acknowledged by many as superior to cassava bread Cassava bread is lighter in color than millet bread The keeping quality of both cassava and millet breads is satisfactory Trials were made with only 1 type of cassava starch and millet flour, more data and specifications are needed to find the most suitable quality for baking purposes *(Author's summary)* 102

0674-6739 PESCOD, M.B. and TAN, N C **Characteristics and treatment of tapioca starch industry wastewaters.** Bangkok, Thailand, Asian Institute of Technology, Environmental Engineering Division, 1975. 29p. Engl., Sum Engl., 13 Refs., Illus.

Paper presented at the Workshop Study on Agro-Industrial Wastes, Kuala Lumpur, Malaysia, 1975?

Cassava. Cassava starch. Wastes. Analysis. Biochemistry. Developmental research. Malaysia.

The paper reviews cassava starch production processes, sources of wastes, wastewater characteristics and treatment alternatives for these wastes Cassava root wash water and the starch extraction wastes, called separator waste in large factories and sedimentation supernatant in small plants, are identified as 2 sources from which the wastewaters should be segregated The characteristics and production of these wastewaters and the combined wastewater are presented Sedimentation is considered to be the only treatment necessary for wash water under normal circumstances Separator or sedimentation supernatant wastewaters require biological treatment because of their high biochemical and chemical oxygen-demand levels (BOD_5 and COD) and anaerobic treatment is suggested by this high organic strength. The results of experimental and pilot plant studies on combined cassava starch wastewater, separator wastewater and sedimentation supernatant are presented for biological treatability (respirometer), anaerobic pond treatment, facultative oxidation pond and aerated lagoon treatment, rotating biological filtration treatment and, finally, treatment using Torula yeast with the possibility of reclaiming this form of single cell protein. Economic and environmental circumstances in this industry influence the recommendation of anaerobic ponds followed by facultative oxidation ponds as treatment for these wastewaters, except where land costs are high. In that case, aerated lagoons or rotating biological filtration will provide simple and effective 2nd-stage treatment which will be less land intensive. *(Author's summary)* 102

0675-4989 PHILIPPINES. DEPARTMENT OF AGRICULTURE AND COMMERCE. **The cassava industry in the Philippines.** Manila, 1939. 10p. Engl., Illus

Cassava. Factories. Cassava starch. Philippines.

Native and introduced varieties and cultural practices used in the Philippines are indicated By-products mentioned are starch for laundry use (gaogao), flour and gaplek Tables present the av chemical composition of some cassava varieties, on a fresh root basis, of the flours obtained from cassava and some cereals, and of starch. Area planted to cassava, production, starch factories and human resources are the aspects dealt with in relation to its economic importance. Starch and flour production will be increased to satisfy domestic demand and to replace wheat flour in breadmaking The cassava industry is still very young; its problems will be solved by increasing production through the use of improved or high-yielding varieties and expanding the area planted to regions with suitable edaphic and climatic conditions Gaplek should be produced at a lower cost if it is to compete in the foreign market *(Summary by L.F.C. Trans by S S. de S)* 102

0676-4845 PIAZZA, W F **A mandioca e a sua farinha. (Aspectos culturais na Ilha de Santa Catarina).** *(Cassava and its flour).* Florianópolis, Faculdade Catarinense de Filosofia, 1956. 40p Port., 33 Refs., Illus.

Cassava. History. Plant geography. Maps. Production. Cultivation. Cassava flour. Processing. Brazil.

This article presents historical considerations, including several legends, on the origin and dissemination of cassava in Brazil. The aspects of cassava growing on the island of Santa Catarina dealt with are soil preparation, planting seasons and systems, agronomic practices, harvesting and intercropping In addition, the processes for producing flour and the preparation of some typical dishes made from cassava are described. *(Summary by A.J. Trans. by S.S. de S)* I02 D00

0677-6727 PIERSON, G. G. **Adhesive composition and process for making same.** United States Patent 2,030,073. 1936. 3p. Engl.

Cassava. Industrial starches. Adhesives. Patents. USA.

Dry raw cassava starch, having a viscosity greater than 48,000 poises when tested as described, is mixed with a small amount of dry copper sulfate and with water about 2 12 times the wt of the starch and NaOH about 3% the wt of the starch. The mixture is heated to about 65°F and stirred for 1-2.5 h to produce a glue having a viscosity of about 44,000 to 48,000 poises. *(Summary by Chemical Abstracts)* I02

0678-6730 PIERSON, G G. **Vegetable glue.** United States Patent 2,413,866 1947 4p. Engl

Cassava. Industrial starches. Adhesives. Patents. USA.

A vegetable glue suitable for wood was made from a mixture of cassava and white potato starches in a ratio of between 70-30 and 30-70, caustic alkali (3), hydrated lime (0 3) and/or Cu salts (0.03), and H_2O in about 200-250 parts *(Summary by Chemical Abstracts)* I02

0679-6726 PIERSON, G. G. **Vegetable glue.** United States Patent 2,419,160 1947. 3p. Engl, 13 Refs.

Cassava. Industrial starches. Adhesives. Patents. USA.

A vegetable glue with improved working properties is prepared from cassava starch (I) and wheat flour (II). I 35-75 and II 65-25 are suspended in H_2O (100-450 parts), 2-10% of NaOH (based on I + II) are added The mixture is heated to 140-150°F, with or without (1) a peroxide such as Ba, Ca, H, Na (to provide a lower water ratio) and (2) 0.1-1 0% Ca ion based on I + II (lowers viscosity and retards thickening). The glue thus obtained has better working properties than the usual cassava glue and is greatly superior to a wheat flour glue *(Summary by Chemical Abstracts)* I02

0680-6817 PIERSON, G G. **Vegetable glue and method of making the same.** United States Patent 2,413,885. 1947. 3p Engl

Cassava. Adhesives. Patents. USA.

A fluid and stable vegetable glue comprised of burst cassava, potato, wheat, corn and/or rye starches having a low water content (a ratio of less than 4 water to 1 starch) has been prepared by the addition of small quantities of Ca compounds [0.3-0.5% as $Ca(OH)_2$] and caustic soda (3-8%) to the unmodified starch or mixture of starches One example of a glue based on cassava is cassava starch 100, lime 0.2, water 200, and caustic soda 3 parts at 150°F. *(Summary by Chemical Abstracts)* I02

0681-6926 PINO, C J. AND VILLA V. L G Industrialización de la yuca. *(Cassava processing)* *In* Curso sobre producción de yuca Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp. 201-217 Span., 8 Refs.

Cassava. Cassava meal. Cassava starch. Washing. Rasping. Silting. Drying. Screening. Centrifuging. Solar drying.

A description is given of the processes used to obtain cassava meal and starch The rudimentary techniques for their production as a home industry and the more elaborate equipment and procedures for their large-scale manufacturing are included. The most efficient method for drying rectangular cassava chips (the most convenient form) is the vertical dryer because the drying process continues even when it is raining The different steps for manufacturing cassava starch are described washing and peeling, grating (manual, mechanical), screening (manual, revolving, vibratory), sedimentation (in tanks, canals, centrifuge), drying (natural and artificial ovens or with chamber, drum, band or centrifugal dryers) and sifting. *(Summary by A.J Trans by S S de S.)* 102

0682-1760 **O PROBLEMA** internacional do pellet da mandioca. *(The cassava pelletizing industry in Brazil and its marketing perspectives)* São Paulo, Brasil, Pavan Engenharia e Indústria, 1973 233p. Port., Illus

Cassava. Pellets. Industrialization. Processing. Factories Industrial machinery. Developmental research. Development costs. Marketing. Trade. Consumption. Cassava chips. Cassava programs. Brazil.

The firm Pavan Engenharia e Indústria Ltda conducted a feasibility study for creating an agro-industry for producing cassava pellets in Brazil The agricultural, technological, production, infrastructure, marketing and location requirements that should be met for establishing a successful pelletizing industry are discussed. The study is divided into 7 main parts (1) Cassava growing (2) Cassava products and by-products and their applications, as well as their proccessing, with emphasis on pellets (3) The market for cassava pellets. This is a quantitative and qualitative description of potential Brazilian and foreign markets for pellets (4) The pellets and their technology A profound comparative study of the processes used for producing pellets First of all, cassava chips are manufactured by 1 of the following processes. the indirect process (manual and mechanized), the D'Andrea process (with dehydration) and the Hubrich process (without dehydration). Then the chips are transformed into pellets Four pelletizing processes (illustrated by means of diagrams), used by 4 different Dutch and German companies, are analyzed and compared to the PAVAN process (direct and with dehydration) Based on the analysis of the qualitative (chemical composition of the pellets obtained in the different processes) and quantitative aspects (pellet yields in relation to roots and direct production inputs) of the processes studied, it was concluded that the PAVAN process is the only one that satisfies the quality and cost requirements of the European Common Market (5) A government policy for a cassava agro-industry This is an analysis of the Government's policies during the last 40 years, with emphasis on the aspects (and needs) that should be taken into account for promoting the establishment of agro-industries in Brazil (6) Feasibility of establishing a pelletizing plant This is an economic analysis of the costs, investments, profitability, etc of a PAVAN pelletizing plant with an installed capacity of 25,000 tons of pellets/yr. It is concluded that the investor should have a thorough knowledge of the variables involved in the establishment of a pelletizing agro-industry—from the selection of the varieties to the problems of transportation, storage and marketing of the final product It is stressed that he will be a pioneer and would depend on the Government's support, therefore, the success of this enterprise is subject to the close cooperation of both public and private sectors *(Summary by S S de S)* 102 J00

0683-1759 **PROCESSO PAVAN para forragem e mandioca pelletizada.** *(The PAVAN process for cassava forage and pellets)* São Paulo, Brasil, Pavan Engenharia e Indústria, 1973. 133p. Port., Illus

Cassava. Pellets. Forage. Processing. Industrialization. Factories. Industrial machinery. Costs. Production. Brazil.

A detailed description is given of the Flash or PAVAN process (with dehydratation), developed by the Brazilian company PAVAN Engenharia e Indústria Ltda. for manufacturing cassava forage and pellets The type of facilities required, the equipment, electric and hydraulic systems are explained and the respective plans included. The cost of this project amounts to Cr$7,300,000 This plant would have an installed capacity of 300 tons roots/day or 25,000 tons pellets/yr. Two alternatives are considered: a self-supplying agro-industrial project and an industrial project requiring raw material suppliers. Adding the facilities required for forage production increases the cost of the project slightly; however, the possibility of diversifying production makes this an attractive alternative. *(Summary by S.S de S.)* 102

0684-0023 **A PRODUÇAO do álcool industrial.** *(Production of industrial alcohol)* Química e Indústria 11:22-23. 1943. Port.

Cassava. Alcohol. Production. Brazil.

This article deals with the legal dispositions for establishing distilleries in Brazilian industries that use alcohol as a raw material. It discusses the advantages and disadvantages of using cassava or sugar cane for producing alcohol and gives the reasons for preferring the latter. *(Summary by L.F C Trans. by S..S. de S.)* 102

0685-6932 ARMON, G. *et al.* **Les anavenins spécifiques et les substances adjuvantes et stimulantes de l'immunité dans la production des sérum antivenimeux respectivement dirigés contre les venins de *Cerastes cornutus* et de *Najahaje*.** *(Anavenenes and adjuvants stimulating immunity against the venoms of Cerastes cornutus and Najahaje).* Annales de l'Institut Pasteur 67 355-358 1941. Fr.

Cassava. Tapiocas Therapeutants.

The use of anatoxins of diphtheria and tetanus, mixed before injection with tapioca, effects a reduction in the time required for the production of high titer antitoxins. Tapioca apparently acts as a stimulant in the production of immune bodies. This method is now used in the preparation of antivenes against the poisons of *C cornutus* and *N haje*. The respective antivenes prepared by the well-known method, were divided before each injection into 2 parts, to one of which was added tapioca and to the other tannin, but in proportions not detailed The injections were made every few days in horses, and the titers of the serums were estimated at intervals, In this way potent antivenes were obtained in 4-5 wk, whereas by using the old method of injecting crude venom, immunization for 8-10 mo was necessary. *(Summary by Chemical Abstracts)* 102

0686-5204 RASPER, V and MacGregor, D. **Starchy "root" crops in the Ghanaian diet and aspects of their industrial utilisation.** Gordian no. 2 47-50. 1969. Engl

Cassava. Industrialization. Foofoo. Dried tubers. Starch crops. Ghana.

—Starch-bearing crops such as roots, tubers, corms, etc. play a very important part in the Ghanaian diet as they provide about 2/3 of their daily calorie intake. A brief description is given of the difficulties arising from the high cost of transporting, storing and producing wheat and soybean flour, as compared to roots and corms. Yam is gradually being replaced by cassava as the latter is a more productive, easily adapted crop, requiring few agronomic practices. Finally, the processes used to prepare fufu and kokonte, 2 foodstuffs based on cassava flour, are described. *(Summary by P.G. Trans. by S.S. de S.)* I02

0687-7249 RASPER, V., RASPER, J. and MABEY, G.L. **Functional properties of non-wheat flour substitutes in composite flours. I. The effect of non-wheat starches in composite doughs.** Canadian Institute of Food Science and Technology Journal 7(2):86-97. 1974. Engl., Sum. Engl., Fr., 37 Refs., Illus.

Cassava. Cassava starch. Breads. Analysis. Canada.

Some functional properties relative to breadmaking of starches and flours prepared from tubers of yam (*Dioscorea rotundata* Poir., *Dioscorea alata* L., *Dioscorea cayenensis* Lam.), cormels of cocoyam (*Xanthosoma sagittifolium* Schott.), roots of cassava (*Manihot utilissima* Pohl), fuits of plantain (*Musa paradisiaca* L.), and grains of sorghum and millet were studied and compared with those of a starch and a typical bread flour of Canadian HRS wheat origin. All materials were tested for gelatinization temperature, pasting characteristics and diastatic activity, and an attempt was made to correlate these properties with the results of baking tests performed with mixtures in which 15% of wheat flour was replaced by the tested material. Though considerable differences were found between the starches, the results indicate that in the replacement of wheat flour by any nonwheat flour, the functionalities of other components than starch may play a more significant role than the variations in starch properties. When wheat flour was partially replaced by pure starches, the best baking performance was achieved with blends containing cassava starch. When nonwheat flours were used instead of pure starches, the best loaf volumes were obtained with blends containing yam flours. *(Author's summary)* I02 I01

0688-1752 A RESEARCH **proposal for developing solar dryers for drying cassava in Colombia.** n.p., Cassava/Swine Advisory Comittee Paper no. 5-2. 1973. 11p. Engl., Sum. Engl., Illus.

Cassava. Solar drying. Colombia.

Solar energy can be effectively used for drying agricultural products in specially designed solar dryers. The pioneering work in the development of solar dryers has been done at Brace Research Institute, McGill University (Canada) and Michigan University (USA). The main objective of this proposal is to design 2 or 3 different types of inexpensive solar dryers, develop prototypes and test them in Colombia for drying cassava. The design will then be adapted to meet the conditions in Colombia in particular and cassava-growing developing countries located between ±23° latitude. Drawing and specifications will be prepared for building solar dryers so that they can be locally built. The project will be undertaken at McGill University, will take approx. 1 yr to complete and is expected to cost about $16,000 Can. (*Author's summary*) I02

0689-3857 LES RESSOURCES **naturelles et leur transformation.** *(Natural resources and their processing).* Marchés Tropicaux et Méditerranéens no. 1308:3487-3493. 1970. Fr., Illus.

Cassava. Cassava starch. Tapiocas. Factories. Prices. Trade. Distribution. Togo.

A brief explanation is given of the production zones and problems faced by farmers in Togo. Coffee, cacao, some oil-bearing plants, textile fibers and cassava and its by-products are dealt with in detail. Cassava is grown everywhere in Africa, but Togo stands out because of its processing systems. The well-known gari comes from this country; this food is easily digested because the cellulose and starch remain together The activities of the Bénin Company in Ganavé are also described; it is internationally known for being the most modern plant for manufacturing cassava starch and tapioca. Its production will reach 10.000 tons/yr in 1969; 3,400 of which is tapioca. *(Summary by S.S. de S)* 102

0690-5004 RODRIGUEZ FILHO, A. J **A superioridade da cana sôbre a mandioca para a produção de álcool.** *(Sugar cane is better for manufacturing alcohol than cassava).* Brasil Açucareiro 22: 61-62. 1943 Port.

Cassava. Alcohol. Production. Costs. Productivity. Brazil.

A transcription is given of an official resolution permitting Brazilian industries to mount their own distilleries for producing industrial alcohol It was found that sugar cane was more profitable for manufacturing alcohol than cassava, therefore, cultivation of the former is recommended One "alqueire" (24,200 m²) produces 50 tons of cassava and 150 tons of sugar cane, that is, 11,000 and 9,000 liters of alcohol, respectively. Since the cane produces ratoons rapidly from the roots left in the ground, it will produce 36,000 liters in 4½ years, cassava, with a longer growing period, can equal this figure only under very favorable conditions *(Summary by L C Trans. by T M)* 102

0691-6843 ROHM and HAAS COMPANY. **Water-soluble carboxyethyl starch ethers.** British Patent 546, 585. 1944 2p Engl.

Cassava. Industrial starches. Patents. England.

A water-soluble β-carboxyethyl ether of starch is obtained by mixing starch such as cassava or maize, a 1-10% aqueous solution of a water-soluble, strongly basic hydroxide, and acrylonitrile and maintaining the mixture between 0º and 60ºC until the starch has been converted to a water-soluble product. (*Summary by Chemical Abstracts*) 102

0692-7388 ROSENTHAL, F R. T. **Indústria de amido de mandioca no Brasil.** *(The cassava starch industry in Brazil).* Informativo do INT 9(10) 3-16 1976 Port, Sum Engl, Port, 15 Refs, Illus

Cassava. Cassava starch. Factories. Production. Costs. Industrialization. Prices. Consumption. Legal aspects. Trade. Composition. Cassava programs. Brazil.

This is an overview of the cassava starch industry in Brazil, comprehending agro-industrial production and domestic and foreign trade The results are given of agro-industrial research done in Brazil Comparisons are made between national and Thailandese starch industries since Thailand is the largest exporter of cassava by-products. Emphasis is placed on the quality of the products made in Brazil; an analysis is made, based on standards adopted in different parts of the world, including those issued by the Conselho de Comércio Exterior do Brasil, governing the export of cassava products. *(Author's summary)* 102 J00

0693-6771 RUITER, D. DE **Einsatz von Nichtweizenmehlen in der Backwarenherstellung.** *(Use of nonwheat flours in bakery products).* Getreide, Mehl und Brot. 27(5) 170-176. 1973. Germ, Illus

Cassava. Cassava flour. Cassava starch. Composite flours. Breads. Biscuits.

The following aspects are discussed: basis for using nonwheat flours; centers of study; early work; studies at the Institute for Cereals, Flour and Bread TNO (Wageningen, Netherlands) on production of bread and biscuits from nonwheat flours and mixtures of wheat and nonwheat flours; acceptability study of nonwheat flour bakery products in Colombia; and equipment in experimental bakeries. Flours used include cassava (flour and starch), soybean (including defatted flour), maize (flour and starch), sorghum, groundnut, millet and rice. Several formulas incorporating these products are presented. (*Summary by Food Science and Tecnology Abstracts*) I02

0694-6798 SALAZAR DE B., T. *et al.* **Preservación de yuca fesca por el método de parafinado.** (*Conservation of fresh cassava by waxing*). IIT Tecnología (Colombia) 15(86):33-47. 1973. Span., Illus.

Cassava. Tubers. Fresh products. Storage. Packaging. Deterioration. Costs. Trade. Colombia.

One of the main problems with cassava is its short postharvest life (2-3 days). The methods of conservation studied were (1) immersion in water at 50-80°C for 10-15 sec, (2) use of antifungal agents, (3) refrigeration at 6°C and 80%RH, and (4) paraffin. Emphasis is placed on the last one, and the possibilities of adopting it in Colombia are discussed. Cassava maintained good organoleptic quality for 8, 7, 13 and 20-30 days, respectively. With the paraffin method, cassava stored at 20°C and 60%RH had a 100% index of conservation, in addition to having the best organoleptic properties and the lowest wt losses and microbiological count. To cope with the domestic market demand, a paraffin plant with a ½ ton/day capacity would be necessary; 10 tons/day would satisfy the foreign market. High-quality cassava (no bruises, cuts, etc.), harvested less than 24 h before, should be used. The following steps are involved in the paraffin process. collection of roots, transportation to the plant, selection, washing, drying, paraffining, cooling and packing. When the roots are packed in wooden boxes, a 100% index of conservation is obtained. Also included are the costs of running the plants, export possibilities and the conditions established by the Instituto de Investigaciones Tecnológicas in order to obtain the license for using the process. *(Summary by A.J. Trans by S S. de S.)* I02

0695-7034 SALDAÑA D., F. **La fabricación de harina de yuca y sus posibilidades en Puerto Rico.** *(The manufacture of cassava flour and its perspectives in Puerto Rico)* Revista de Agricultura, Industria y Comercio (Puerto Rico) 34 60-66 1942 Span , Illus.

Cassava. Cassava flour. Washing. Rasping. Peeling. Silting. Centrifuging. Drying. Grinding. Screening. Industrialization. Puerto Rico.

A description is given of the centrifugal method for manufacturing cassava flour adopted by the Puerto Rican Dept of Agriculture The phases of the process are root selection and washing, peel scraping, washing, grating, dilution and maceration, centrifugation, chopping, drying, grinding, sifting and packing Comparative trials were carried out with the variety Brazil no. 1, using 2 methods: centrifuging and cassava slicing and press extraction. The water extracted amounted to 42 and 14% for the 1st and 2nd methods, respectively. Not only did the 1st method require less fuel, but also flour losses were lower (2 6%) as compared to the 2nd (5%) The flour had to be protected during storage against the attack of *Rhiropeatha dominica* and *Tribolium confussum*, stored grains pests in this country. Other aspects discussed are the nutritive value of cassava flour, its uses (especially in bread and pastry making) and the importance of promoting cassava growing and processing in Puerto Rico. (*Summary by A.J. Trans. by S.S de S.*) I02

0696-3663 SALDAÑA D., F. **Industrialización de la yuca.** *(Cassava industrialization)* Almanaque Agrícola de Puerto Rico 1942 123-125. 1942 Span.

Cassava. Industrialization. Uses. Cassava flour. Puerto Rico.

This article presents some of the objectives of the Department of Agriculture and Trade of Puerto Rico, which were based on research carried out by the Estación Experimental Agrícola de Rio Piedras on methods of obtaining cassava flour *(Manihot esculenta* Crantz) and its utilization in the breadmaking industry. The substitution of 15% of the annual consumption (40,000 tons) of wheat flour by cassava flour can be done without affecting bread quality. The necessity to promote cassava growing and erect a pilot plant for manufacturing cassava flour and starch was indicated. *(Summary by A.J. Trans. by S.S. de S.)* 102

0697-4860 SANSORES M., A. **Almidón de yuca.** *(Cassava starch)* Fomento (Ecuador) no. 19:14-15 1945. Span., Illus.

Cassava. Cassava starch. Processing. Ecuador.

A general review is made of the cassava starch industry in Ecuador. To promote industrial development in this area, a more technical process is described and fully illustrated with photographs. *(Summary by T.M.)* 102

0698-6841 SCHOLTEN'S (W.A.) CHEMISCHE FABRIEKEN. **Werkwijze voor het bereiden van een voedingsmiddel in den vorm van vlokken uit aardappelmeel, tapiocameel of sagomeel.** *(Food products from starch).* Dutch Patent 52875. 1942. 3p. Dutch.

Cassava. Food products. Patents. Netherlands.

Starch from potatoes, sago, or cassava is mixed with at least 5% protein (milk powder) and 100% H_2O at most and converted into cold-water paste. *(Summary by Chemical Abstracts)* 102

0699-1866 SCHOLZ, H. K. B. W. **Aspectos industriais da mandioca no nordeste.** *(Industrialization of cassava in northeastern Brazil).* Fortaleza, Banco de Nordeste do Brasil, 1971 203p. Port., 77 Refs., Illus.

Cassava. Cassava chips. Pellets. Productivity. Cassava. flour. Costs. Industrial machinery. Cassava starch. Tapiocas. Factories. Consumption. Marketing. Industrial starches. Food products. Analysis. Washing. Rasping. Pulping. Peeling. Pressing. Silting. Steeping. Drying. Screening. Packaging. Legal aspects. Uses. Labour. Brazil.

A technical and economical study on the industrial possibilities of cassava is being carried out in northeastern Brazil, updating reports on new products and processes. This book is divided into 3 parts (1) Traditional products; i.e., dry root processing, production of cassava flour, small- and large-scale processes for obtaining several kinds of flour (farinha de mesa and farinha d'agua) and by-products such as glue. Figures on the no. of flour factories and their capacity are given. (2) New products. This category includes improved flours for human consumption, enriched flours, cassava meal, precooked flour (crystallized), starch, tapioca, pellets and forage products obtained from the aerial part of the plant (3) General technical and economic considerations. The following aspects are dealt with. multipurpose factories, equipment needed, increased industrial production capacity, types of packing for different products, starch production and consumption in Brazil, markets and terminology used for several by-products. Several annexes on cassava by-products, as well as flow diagrams, tables and illustrations are included. In addition, 18 abstracts and articles on tapioca, starch, manufacturing processes of several chemical products, etc. and a bibliography with 80 citations are presented. *(Summary by L.F.C. Trans. by S.S. de S.)* 102

0700-5094 SCHOLZ, H K B W. **Testes sôbre armazenagem de raízes integrais em estado natural.** *(Storage test of whole fresh cassava roots)* *In* Banco do Nordeste do Brasil S. A. Departamento de Estudos Econômicos do Nordeste (ETENE), Divisão de Agricultura. Pesquisas tecnológicas sôbre a mandioca Fortaleza, Brasil, 1972 pp. 79-92 Port., Illus.

Cassava. Storage. Tubers. Timing. Brazil.

Once harvested, cassava roots tend to rot easily, which is a serious problem for industry. A series of tests were carried out to store cassava roots for 23 days without significant alterations. Three varieties of sweet cassava (more susceptible) and one of bitter cassava were used Different-sized roots were placed in unsterilized, 20-liter lard tins filled with course and fine sand. Afterwards, parallel trials were carried out using clay soil and soil containing some humus Roots were examined every four days as regards weight loss volume loss, and feasibility of extracting good-quality flour; longitudinal and transversal cuts were made to observe discoloration and other signs of deterioration including rot. Positive results were obtained in both humid and dry seasons. It is advisable not to prolong the storage period for more than one month in order to obtain about 2/3 of the roots in normal conditions. *(Summary by L.C. Trans by T.M.)* I02

0701-3352 SERRES, H. and TILLON, J. P. **L'ensilage des racines de manioc.** (*Silage of* cassava roots). Revue d'Elevage et de Médicine Veterinaire des Pays Tropicaux 25(3):455-456. 1972. Fr

Cassava. Tubers. Storage. Silage. Dry matter. Fat content. N. Cellulose. Mineral content. Animal nutrition.

Silage was made in a cylindrical cement vat, in a ditch covered with a plastic sheet, and in a metal vat Sweet cassava varieties, containing 100 mg HCN/kg, largely cultivated in Madagascar were used. Of the 3 methods, silage prepared in the cylindrical cement vat was most readily accepted when fed to cattle and swine. *(Summary by J.L.S.)* I02 H03

0702-7260 SEYAM, A M. and KIDMAN, F.C. **Starches of non-wheat origin; their effect on bread quality.** Bakers' Digest 49(2) 25-26,28-29,31 1975. Engl., Sum. Engl , 14 Refs., Illus

Cassava. Cassava starch. Breads. Analysis. Composite flours.

Rice, corn and cassava starches were added to wheat flour to form 3 different composite flours, which yielded loaves of acceptable quality. The activated dough development (ADD) method was used to produce the doughs. The rheological characteristics of the different composite flours showed a decrease in farinograph absorption from 68 0 to 63 2% and an increase in the mechanical tolerance index from zero to 10, 40 and 40 Brabender units (B U) for flour containing rice, corn or cassava starch, respectively Dough stability, dough development time, arrival time and overall farinograph profile scores were decreased by the addition of the different starches Extensograph data showed an increase in dough deadness and a considerable drop in dough extensibility when the different starches were added to wheat flour The temperature of initial pasting and the peak height of composite flours ranged from 57-61°C and 330-800 B.U., respectively. The baked bread exhibited a range in loaf volume from 1,688 to 1,463 cc. These studies suggest that different starches found in developing countries could be used in the production of bread, thereby increasing the food productivity of these countries. *(Author's summary)* I02

0703-4736 SILVEIRA, A. H. DA **Polvilho.** *(Cassava starch)* Boletim Agrícola (Brazil) 5:55-56. 1956. Port.

Cassava. Processing. Cassava starch. Brazil.

The most important product obtained from cassava is its starch. Two kinds are produced in Brazil: (1) sweet or common, obtained by large-scale industrial process, and (2) bitter or fermented, made primarily by a rudimentary process. The modern industrial process includes these steps: washing, peeling, grating, drying, sedimentation, sifting and packing Fermented starch is produced using basically the same process, but the product is left to ferment for 15-20 days. *(Summary by L F.C. Trans. by S.S de S)* I02

0704-6764 SKROTZKY, E.W. **Ueber die bei Immunisation der Pferde mit Diphtherietoxin die Antikörperproduktion stimulierende Wirkung des Tapioka.** *(The stimulating action of tapioca on antibody production in animals immunized with diphtheria toxin).* Zeitschrift fuer Immunitatsforschung 77.443-448. 1932. Germ., Sum. Germ., 7 Refs.

Cassava. Tapiocas. Theraupetants. Animal physiology.

Besides acting as a depot, tapioca, injected subcutaneously mixed with toxin, may enhance antibody formation through its physicochemical effects, such as its action on surface tension, dispersity and electric charge. *(Summary by Chemical Abstracts)* I02

0705-6845 SOCIETE DES LABORATOIRES DE RECHERCHES POUR APPLICATIONS INDUSTRIELLES, SEINE-ET-OISE, FRANCE. **Noveau procédé de récupération industrielle de protéines, notamment dans la fabrication de la fécule ou de l'amidon.** *(A new process for the industrial recovery of proteins, especially from waste waters resulting from the manufacture of flour and starch).* French Patent 978 001 1951. 2p. Fr., Sum Fr.

Cassava. Waste utilization. Proteins. Patents.

Potatoes are mashed and mixed with twice their weight of water. After centrifuging, the liquid obtained is mixed with H_2SO_4 or any other mineral acid to give a pH of 3.8-4.0, i e , the isoelectric point of tuberin, the protein in potatoes. The mixture is then heated to 50-52°C and then for 6 min at 70°C On cooling, the flocculated protein is filtered By choosing the pH to correspond to the isoelectric point of the relevant protein, tapioca, wheat flour, starch, maize, or rice may replace the potatoes. (*Summary by Chemical Abstracts*) I02

0706-1647 SPOON, W. **La cassave comme matière première des dissolvants techniques.** *(Cassava as a raw material for industrial dissolvents)* *In* Congrès du Manioc et des Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institute Colonial, 1949. pp. 132-133, Fr., 5 Refs

Cassava. Industrial starches. Uses.

The purpose of this article is to highlight the industrial uses of gaplek (dried, sliced cassava). produced mainly in Java (Indonesia). The chemical composition of gaplek is 12% water, 2 5% ashes, 2.5% crude fiber, 1.5% proteins, 0 5% fats and 74% starch In Europe, it is used in animal feeds. The production of several by-products is mentioned, i e , ethyl alcohol, special dissolvents for making paints and varnishes, butyl alcohol, acetone and ethyl and butyl acetates *(Summary by T.M.)* I02

0707-5019 STEINEMANN, F. G., **A cultura intensiva da mandioca; o aproveitamento racional, integral e a conservação dos produtos pelo processo de desidratação.** (Intensive cassava cultivation, by-products and dehydration). Seleções Agrícolas (Brazil) 9(103):53-63. 1954 Port

Cassava. Forage. Production. Nutritive value. Industrialization. Brazil.

The dehydration process is pointed out as an alternative solution for problems of feeding, prices, storage, transportation and total utilization of agricultural commodities. Dehydrators have been installed in Costa Rica to utilize cassava, from its roots to its leaves. One hectare of cassava produces 30 tons of green forage per year in 4 cuttings, which is equivalent to 6 tons of tillers and stalks and 10 tons of dehydrated roots/ha/yr. The advantages of adopting this process in Brazil are given, in addition to statistics on handling other products. Tables give work estimates for the dehydrated and nutritive values of dehydrated and balanced forage. Tables are also given on cassava production for starch, flour and cassava meal. *(Summary by L.C. Trans. by T.M.)* I02

0708-0008 TASTEVIN, R. P. C. **Préparation et utilisation du manioc dans la région du moyen Amazone et de ses affluents.** *(The preparation and uses of cassava in the middle Amazon region).* Ethnographie 1954 53-59. 1954 Fr

Cassava. Cassava flour. Processing. Human nutrition. South America.

The purpose of this article is to prove the importance of cassava in the diet of the Brazilian Indians. The preparation of "farinha d'agua" and "farinha sêca" is described in detail. Cassava is also consumed in the form of couac, shibe, casave, tukupi, tapioca and many other typical dishes made from the fresh roots or their starch. *(Summary by S.S. de S.)* I02 H01

0709-4751 TEIXEIRA, C G **Aguardente de mandioca.** *(A liquor distilled from cassava)* Agronômico 16(5/6):9-10. 1964. Port

Cassava. Beverages. Brazil.

A brief description is given of the process for producing "aguardente," a spirituous liquor made from cassava. One ton of cassava yields approx. 400 liters of liquor. *(Summary by P.G. Trans. by S.S. de S.)* I02

0710-7271 THANH, N C. and WU, J S. **Treatment of tapioca starch wastewaters by Torula yeast.** Canadian Institute of Food Science and Technology Journal 8(4) 202-205 1975 Engl., Sum. Engl., Fr., 18 Refs., Illus.

Cassava. Wastes. Analysis. Biochemistry. Thailand.

The physical, chemical and biological properties of wastewater from the extraction operation of a cassava starch refinery were assessed, and the biological treatability of the settled separator waste using Torula yeast was investigated. The applicability of the yeast system was evaluated on the basis of the following criteria: capability of the yeast to be acclimatized to compounds in the waste, maximum extent to which all compounds in the waste were assimilated, and the yield of biomass. It was found that Torula yeast could be acclimatized and grown predominantly in the waste, reducing sugars and volatile acids being readily removed. The overall chemical oxygen demand (COD) reduction was around 73%, and the yeast mass contained about 50% protein with a yield of 0.5 lb yeast suspended solids/lb COD removed. The protein content of the yeast decreased significantly when grown in nonenriched waste. Only nitrogen was required as supplementary nutrient at a level of 1 lb N/50 lb COD removed. Supplementation of phosphorus and other trace elements was not critical. *(Author's summary)* I02

0711-7526 THANH, N.C. PESCOD, M.B and MUTTAMARA, S. **Final report on technological improvement of tapioca chips and pellets produced in Thailand.** Bangkok, Thailand, Asian Institute of Technology. Research Report no. 57. 1976. 41p Engl., Illus.

Cassava. Cassava chips. Pellets. Drying. Solar drying. Pressing. Water content. Industrial machinery. Timing. Temperature. Cassava programs. Industrialization. Thailand.

A study was made of the parameters affecting the drying and pelletizing of cassava chips in order to obtain a product of optimal quality under conditions typical of rural areas in Thailand and similar agro-economic regions of Southeast Asia. The study focused on the shape and size of chips, drying, pelletizing and cooling systems and field demonstrations. The roots were cut manually and mechanically in different forms (circular, rectangular, cubic, strips, slices) and sizes. Drying efficiency was measured on plain and black concrete floors, on a 3-shelf tray drier and on a hot plate (artificial drying). The moisture content of the chips was determined at regular intervals of 1-2 h. The pelletizing process was carried out using a CPM Master Model Pellet Mill operated by a 20-hp motor; steam served as a conditioning agent of the chips. Two cooling systems were used: natural and artificial ventilation. Five cassava chip and pellet factories were selected for field testing. The results indicate that the most adequate chips are those in the form of strips and slices (0.5 and 0 1-0 2 cm thick, respectively) and that the total drying period required to obtain an optimal moisture content (approx. 14%) is 4-5, 10, 12 and 14 h for the artificial method, black concrete, tray drier and plain concrete, respectively. It was found that 0 152 kg of steam at 70°C/kg of chips before pressing produced hard, shiny and strong pellets. The drying systems did not affect pellet quality Fan cooling was the best system for bringing pellets to ambient temperature. Field testing of the 3 drying systems showed that the tray drier was the most efficient, but because of its high cost, low margin of profits for the factories and difficult operation, the black-painted concrete floor was preferred. On the other hand, decreasing drying time by using strips and slices increases the margin of profits. Results are given in tables and figures; the equipment and final products are illustrated. *(Summary by A.J. Trans. by S S. de S.)* I02

0712-3349 TKATCHENKO, B. **Rapport de la mission d'etudes aux Etats-Unis, au Brésil, au Togo et en France sur la technologie et la culture du manioc.** *(Report of the study commission on cassava technology and cultivation in the United States, Togo, Brazil and France).* Tananarive, Institut de Recherches Agronomiques de Madagascar Division de Chimie et de Technologie Agricoles, 1959 200p Fr., 96 Refs., Illus.

Cassava. Cultivation. Production. Cassava starch. Tapiocas. Gari. Factories. Industrialization. Processing. Trade. Marketing. Legal aspects. Analysis. Composition. Prices. Developmental research. Malagasy Republic. USA. Togo. France. Brazil.

This study—conducted in several flour-importing countries from April-June 1958, as a response to the importers' demand (especially from the USA) for high-quality flour—was undertaken to protect the future of the cassava industry in Madagascar. The study focused on cassava technology, standardization of products, genetic aspects, industrialization and the nutritive value of cassava and other tropical and subtropical starch plants. A comprehensive description is given of the cassava industry and cultivation in Brazil and other territories of West Equatorial Africa (especially in Togo), of the cassava starch industry in France, and the tapioca industry in the USA. A comparative study is made of the quality of foreign and domestic cassava starches, according to the analytical norms and methods used by Morningstar, General Foods

Corporation and other institutes. As regards agronomic aspects, it was concluded that cassava production in Madagascar could be improved by means of (1) crop rotation, (2) increased organic fertilization, (3) the use of mineral fertilizers, and (4) the use of selected varieties developed at the experimental station at Lake Alaotra, so as to offer industry as homogeneous a raw material as possible Marketing of products, especially in the USA, is hindered by the low yields obtained by the flour factories; the insufficient extraction rates, which increase production costs, and processing deficiencies, which affect product quality adversely. It is recommended that 6 of the 8 factories be replaced by 2 modern plants with a capacity of 180 tons of roots/day, the other 2 could increase their rates of extraction by introducing certain changes on their premises In relation to commercial factors, those that influence starch production most directly are high transportation and processing costs and the lack of official norms to control exports. All these factors have contributed to the marked decrease in exports and the area planted to cassava, therefore, it is important to establish measures that will promote the cultivation of this crop Lists of the people interviewed and of the cassava plantations and factories visited are included *(Summary by S.S de S.)* 102 J00 D00

0713-6925 TORO, J C **Alta proteína en yuca.** *(High protein in cassava) In* Curso sobre producción de yuca Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp. 189-190. Span

Cassava. Proteins. Food enrichment. Colombia.

A brief description is given of the process used to increase the protein content of cassava. The steps are (1) root washing; (2) chopping (with peel); (3) fermentation of the pulp by the addition of 3 g urea/100 g pulp, minerals, sulfuric acid and water, followed by the inoculation of this mixture with the fungus *Aspergillus fumigatus* at a pH and fermenter temperature of 3.5 and 50°C, respectively; and (4) filtering after 22 h of fermentation A mass with 30% protein is obtained by means of this process, which is at present being experimented with for swine feeding at CIAT. (*Summary by A.J Trans. by S.S. de S.*) 102

0714-6922 TORO, J.C. **Secamiento de la yuca.** *(Methods of drying cassava) In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp. 157-167 Span.

Cassava. Cassava chips. Solar drying. Colombia.

A description is given of conventional and modified conventional methods that use natural means (sun and wind) for drying cassava roots. Drying cassava chips is faster with the modified conventional method because wire baskets, placed at 30 cm from the ground are used, facilitating air circulation. On the other hand, drying is even faster if the floor is painted black, the basket is placed in a vertical position and RH is lower than 75% The experiments proved that the best drying rate was obtained with rectangular pieces 5-cm long and 1 cm^2 across A worldwide list of companies manufacturing machinery for cassava processing is included *(Summary by A J Trans by S.S. de S.)* 102

0715-0318 TORRICO A., R. A. **El cazabe.** (*Casave*). Agricultor Venezolano 16(155):40-41. 1951 Span., Illus

Cassava. Casave. Processing. Venezuela.

Casave, which is a by-product of cassava, is generally made from the bitter type, *Manihot* *utilissima* Pohl. Since bitter cassava contains HCN (0.024%), it is submitted to a special process to eliminate the toxin. The following rudimentary steps are described: grating, drying the mass by squeezing out the bitter liquid in a special long and narrow basket, sifting, spreading the flour out to dry and sun drying. Emphasis is placed on improving the sanitary aspects and the need to mechanize the process. (*Summary by L.F.C. Trans. by S. S. de S.*) I02

0716-3160 TROPICAL PRODUCTS INSTITUTE **Report on an investigation into the relationship between atmospheric humidity, temperature and the equilibrium water content of cassava chips.** London, 1965. 4p. Engl., 2 Refs., Illus.

Cassava. Cassava chips. Drying. Temperature. Water content. Laboratory experiments. Cassava starch. Storage.

The purpose of this research was to establish the relationship between the equilibrium moisture content of cassava and ambient humidity and temperature in order to calculate the final moisture content that would be obtained under given drying conditions. Dried cassava chips, prepared from a bitter variety, were ground coarsely; and the resulting flour was used in all experiments. Saturated solutions of inorganic compounds giving an atmosphere of known relative humidity were prepared and then placed in small vacuum desiccators. About 5 g of cassava in a weighing bottle were placed in each desiccator, which was then evacuated and left in a thermostatically controlled oven until the cassava reached a constant weight (about 3 weeks' time). The equilibrated cassava was then heated to constant weight at 110°C, and the loss in weight was assumed to be the equilibrium water content of the sample. Results are given in tables and a graph. Desiccation of starches produces a permanent decrease in their ability to retain moisture, especially when dehydrated at high temperatures. Therefore, when fresh cassava is dried, the dry material will contain more moisture than would be indicated by the graphs, but if it is stored in a moist atmosphere, its final moisture content will be similar to that predicted by the curves. *(Summary by L.C. Trans. by T.M.)* I02

0717-2187 VESEY-FITZGERALD, D. **Brazilian methods of preparing cassava.** East African Agricultural Journal 15:165. 1950. Engl.

Cassava. Cassava products. Processing. Brazil.

Since Europeans find cassava—as prepared in Africa—unacceptable to their taste, the South American methods of making farinha, cassava bread, tapioca and cassareep are described briefly. (*Summary by T.M.*) I02

0718-4425 VIGNOLI, L., CRISTAU, B. and CARBONI. **A sujet de l'expertise des "tapioca".** *(Standards for tapioca).* Annales des Falsifications et des Fraudes 42. 291-293. 1949. Fr.

Cassava. Tapiocas. Analysis. Ash content. Water content. Particle size. Legal aspects.

Tapioca should have small polygonal starch grains somewhat swollen and deformed by hydrolysis, give a positive reaction for amylodextrin, have less than 0.30% ash and less than 14% water. *(Summary by Chemical Abstracts)* I02

0719-4999 VITTI, P. **Obtenção de produto de mandioca substituto da raspa.** *(A substitute for cassava chips).* Coletânea do Instituto de Tecnologia de Alimentos 3:201-215. 1970. Port., Sum. Port., Engl., 2 Refs.

Cassava. Processed products. Cassava chips. Drying. Analysis. Composition. Brazil.

The aim of this work was to improve cassava processing in order to obtain a dehydrated cube with better density and no variation in its physical or chemical properties. Cassava roots were cut into cubes, which were then submitted to acid solution treatments using ascorbic acid, benzoic acid or both. One sample was not treated; in another treatment, the sample was processed. The best products were obtained from cubes receiving no treatment, as well as from cubes that had been pressed. In the latter case, dehydration time was shorter than in the former. *(Author's summary)* I02

0720-6838 WEBB, B H. **Potential processess for utilization of agro-industrial wastes for production of food.** Kuala Lumpur, University of Malaya, 1975. 17p. Engl., Sum Engl., 13 Refs., Illus.

Paper presented at the Umaga/Faum Food Conference, 1975.

Cassava. Waste utilization. Human nutrition. Animal nutrition. Cassava meal. Malaysia.

With the rapid expansion of agro-based industries in Malaysia, wastes are becoming a pollution problem of crisis proportions, i e., palm oil sludge discharge into streams will reach 3 million tons in 1975. Wastes occur as liquids, solids in liquid suspension, solids and gaseous forms. Many wastes can be used to produce animal feedstuffs; others can provide a basis for producing mushrooms and vegetables. The CENSOR process for palm oil sludge, which uses a mixture of MECRO cassava meal and palm oil kernel meal, could produce 300,000 tons of meal that could replace maize. Conversion processes include mechanical, chemical, thermal and biological systems; however, extraction processes must be integrated (i.e., the CENSOR process) to achieve the desired results at economic cost. *(Summary by T.M.)* I02

0721-5584 WEBB, B. H. and GILL, K. S. **Artificial heat drying of tapioca chips.** Malaysian Agricultural Research 3:67-76. 1974. Engl, Sum. Engl, Mal, 2 Refs, Illus

Cassava. Cassava chips. Drying. Temperature. Industrial machinery. Water content.

The drying characteristics of cassava chips were studied using artificial heat. Variables studied were air temperatures (55, 66 and 77°C), air velocity (31, 61 and 84 m/min) and bed depth (5, 8 and 10 cm). Under most conditions, the drying process was found to be diffusional in nature, Phase II being slower than Phase I. Towards the end of drying, internal resistance to water movement rather than external factors controlled the rate. Some suggestions for drying cassava chips are given *(Author's summary)* I02

0722-6728 YELLAND, W E.C. **Oxidized starch and method of preparing the same.** United States Patent 2,606,188. 1952 5p. Engl., 5 Refs.

Cassava. Industrial starches. Textiles. Patents. USA.

Starch is oxidized by HIO_4 at pH 4.5-7 to increase the alkali solubility and render it especially useful for warp sizing of textile yarns. Corn, cassava, wheat, or waxy maize starch is slurried in H_2O containing NaOAc-HOAc buffer and oxidized at room temperature with 0.05%-0.5% $HIO_4 2H_2O$ until the reaction is complete. The product is recovered by filtering, washing and drying. The oxidized starch has a greatly increased alkali fluidity and alkali solubility, with little loss of film strength or viscosity. *(Summary by Chemical Abstracts)* I02

0723-5362 YENKO, F. M. and UMALI, P Starch hydrolysis by *Neurospora*. Philippine Journal of Science 81(2):121-125. 1952. Engl , Sum. Engl , Illus.

Cassava. Cassava starch. Hydrolysis. Philippines.

Studies were conducted on the amylolytic properties of 3 strains of *Neurospora*. Percentages of moisture, starch, sucrose and reducing sugars are given for 4 starchy crops at different times after inoculation; the best percentage of starch hydrolyzed was obtained with rice, followed by cassava, maize and sweet potatoes In the same substratum, it was found that as an organism produced more dextrin, the amount of reducing sugars decreased. *(Summary by T.M.)* 102

0724-5369 YUKAWA, M. and HORIE, S. [**Acetone-butyl alcohol fermentation. I. Bacteriological properties of** ***Bacillus butanolo-acetoni Yukawa-Horie nov. sp. and the fermentation of cassava by this organism.***] . Journal of the Agricultural Chemical Society of Japan 15:609-623. 1939. Jap., 23 Refs.

Cassava. Cassava starch. Alcohol. Fermentation. Production.

A new strain of *Clostridium acetobutylicum* (Weizmann) was isolated from maize. It was different in the fermentability of rhamnose and trehalose, the form of sporangia and fermentability at low temperature from *Bacillus granulobacter pectinovorum* Hence it was named *B. buanolo-acetoni* Yukawa-Horie nov. sp. About 7 kg of acetone, 14 kg of butyl alcohol and 2 kg of ethyl alcohol were produced by the fermentation of 100 kg of cassava within 72 h In the fermentation of cassava, the addition of rice as a source of N gave a good yield, but rice bran was unsuitable. The maximum limit for the concentration of the mash was 6-8% In large-scale fermentation, the viscosity of the starchy mash should be lowered by the addition of a small amount of acid before cooking. To prevent putrefaction by lactic acid bacteria, local heating in the sterilization of mash should be avoided; the use of vigorous stock of acetone bacteria and shortening of the fermentation are recommended. *(Summary by Chemical Abstracts)* 102

See also *0109 0112,0113 0121 0131 0142 0150 0152 0154 0167 0219 0230 0238 0434 0453 0573 0736 0743 0747 0760 0761 0765 0767 0771 0780 0784 0785 0786 0788 0792 0793 0794*

0725-7265 BASSIR,.O. and BABABUNMI, E. A. **Effect of soya flour on the production of aflatoxin by species of *Aspergillus* cultured on *Manihot* flour (Gari).** West African Journal of Biological and Applied Chemistry 14(3):16-19 1971 Engl., Sum. Engl., 10 Refs

Cassava. Gari. *Aspergillus.* Industrial microbiology. Biochemistry. Aflatoxin. Soybean flour. Nigeria.

When 2 *Aspergillus* spp. were cultured on a soybean-gari diet, aflaxtoxin yield increased at least 10-fold over the largest amount produced when either gari or soybeans alone were used as substrate for the growth of the fungus. *(Author's summary)* I03

0726-7478 GREGORY, K. F. **Enrichment of cassava with single-cell protein; progress report no. 5, December, 1974.** Guelph, Canada, University of Guelph, Department of Microbiology, 1974. 17p. Engl., Sum. Engl

Cassava. Cassava programs. Food enrichment. Proteins. Industrial microbiology. *Aspergillus.* Culture media. Cassava starch. Toxicology.

Studies continued on a low-cost method for producing microbial protein from cassava by submerged fermentation, employing thermophilic or thermotolerant fungi capable of hydrolyzing starch and growing at a low pH (ca 3 5). The economic advantages of this method are given. The following activities are reported: (1) Rats fed culture I21 at 0,20, 30 and 40% of the diet for 90 days were examined histologically; no significant lesions were found. In the absence of gross lesions and adverse clinical symptoms, it was concluded that the experimental diets were not injurious to the rats when fed to them for 90 days (2) *Aspergillus* I21, the best culture from the 1st extensive group of isolates was identified as a strain of *A fumigatus,* a species often incriminated as a cause of aspergillosis. A temporary hold was placed on pilot plant construction until the safety of the process could be assured. (3) An asporogenous mutant of I21, designated I21a, was isolated following gamma irradiation. Since the mutant could not be induced to form spores under a variety of conditions nor induced to revert to sporogeny by further irradiation mutagenesis, it is assumed to be a deletion mutation and nonrevertible. Since aspergillosis appears to occur only following massive spore inhalation, the asporogenous mutant is believed to be safe. "Cold-sensitive" mutants, able to grow at high temperatures but not at body temperature, were also sought. Mutants of I21 unable to grow at temperatures up to 30ºC were isolated, but thus far no mutant has been found that cannot grow at 37ºC but still grow vigorously at higher temperatures. (4) It was found that whole cassava mash can be used for the fermentation. Culture I21 and its mutant I21a grow well in it; thus the cassava extraction step originally planned for the process can be omitted. The percentage of protein in the product is lower (because of the unfermentable cassava residue present), but the total protein yield/liter is not reduced. (5) An initial heating of the cassava mash to 70ºC to gelatinize the starch prior to inoculation was found to be essential for high yield. If the cassava mash is heated at twice the final desired concentration, the subsequent addition of water brings the temperature to the desired incubation temperature (ca 47ºC), and subsequent culture growth maintains that temperature. (6) The ranges of pH and temperature over which I21 grows and produces protein well were determined The maintenance of temperature within a fairly narrow range appears necessary for this nonaseptic system since some potential yeast contaminants can grow at temperatures up to 46°C, but if I21 is grown much above 46°, yield is reduced. A wider latitude in pH is permissible (7) The minimal mineral nutrient supplements required by I21 were determined, as well as the proportions of urea to ammonium sulfate required to maintain autogenous pH control in the fermentation. (8) The practical limit of cassava concentration in a 50-liter fermentor was about 16% fresh cassava (4% carbohydrate). Higher concentrations were too viscous for efficient agitation and aeration, and fermentation runs could not be completed on a 1-day schedule (9) Experiments are under way to determine to what extent animal wastes such as chicken feces could be used to replace urea as an N source for this fermentation. (10) The process of narrowing down the 2nd large group of high-temperature, low pH fungal isolates continued. Eight isolates were selected for rat feeding experiments based on (a) amino-N content, (b) methionine content, (c) amylase production, (d) taxonomic identification Many have protein and methionine contents that exceed those of I21. At least 1 strain will grow at temperatures up to 61°C, a temperature that gelatinizes some starch granules. The possibility exists that conditions can be established so that the culture's growth will generate enough heat, obviating the heat input required to gelatinize the starch granules in cassava. (11) A 4,500-liter fermentor is being constructed and should be ready by 1975. Although stainless steel has risen sharply in cost, all parts are being designed and built as economically as possible. A 300-liter fermentor for use in producing a large inoculum is also being built. (12) Preliminary tests were made of 3 possible methods of harvesting the biomass. The rotary vacuum filters used elsewhere (Tate and Lyle's Cyprus process) were much too expensive. A commercial auger press was inefficient and costly A centrifugal filtration device was built but is not yet fully satisfactory. A roller-filtration system was tested on a small scale and also shows promise; a larger prototype is under construction. (13) Detailed specifications for the pilot plant system and necessary laboratory support facilities were sent to the Centro Internacional de Agricultura Tropical, CIAT. The 3,000- and 200-liter fermentors and a low-cost harvesting device should be ready for shipment to CIAT at the end of Jan. 1975. *(Summary by T M.)* I03

0727-7258 GREGORY, K. F *et al.* **Conversion of carbohydrates to protein by high temperature fungi.** Food Technology 30(3) 30, 32, 35. 1976. Engl , 11 Refs.

Cassava. Food enrichment. Proteins. Industrial microbiology. Productivity. Analysis. Fermentation. Temperature.

The progress made with the research undertaken to develop a cheap, low-technology method for the conversion of cassava into microbial protein for use as an animal feed is reported. A strain of *Aspergillus fumigatus* (I-21) that does not produce spores was used; research is also being conducted with *Cephalosporium* spp. and *Rhizopus* spp. The studies were concentrated on amylolytic, thermotolerant, filamentous fungi because their use obviates the necessity of hydrolyzing starchy substrates prior to fermentation, permits the use of a nonaseptic fermentation system because of the selective conditions of the medium (pH, 3.6 and temperature, 45-50°C), decreases the cost of cooling and fermentation and permits low-cost harvesting by filtration. Fungal biomass was produced both from cassava extract and from the cassava mash present in the fermentation medium. The nutritional value of the diets was proved by feeding rats for 90 days and were not harmful to the test animals. The equipment and process for producing the biomass are described. *(Summary by A.J. Trans. by S.S. de S)* I03 H01

0728-5377 MUTA, K. and TANAKA, S. **[Amylo process. III.].** Journal of the Agricultural Chemical Society of Japan 12 129-138. 1936. Jap.

Cassava. Alcohol. Production. Industrial microbiology. Fermentation. Rhizopus.

Rhizopus delmar, R. pëka I and 2 other species proved to be best for alcohol fermentation by the amylo process on a small industrial scale. The optimum concentration of the wort was 12-13% for kaoliang, 12-15% for dry sweet potato and 16-17% for cassava The boiling of these materials was favorable under 2.5 atm pressure for 30 min. The fermentation ratio by these materials was inferior to that of rice *(Summary by Chemical Abstracts)* I03

0729-5735 READE, A. E. and GREGORY, K. F. **High-temperature production of protein-enriched feed from cassava by fungi.** Applied Microbiology 30(6):897-904. 1975. Engl., Sum. Engl., 29 Refs., Illus.

Cassava. Cassava starch. Culture media. Fermentation. Industrial microbiology. ***Aspergillus.*** **Proteins. Analysis. Food enrichment. Animal nutrition. Nutritive value. pH. Temperature. Canada.**

A simple, nonaseptic, low-cost process for the conversion of cassava into microbial protein for use as animal feed was sought. Screening tests culminated in the isolation of a thermotolerant, amylase-producing mold, designated I-21, and identified as *Aspergillus fumigatus*. Optimum pH for protein synthesis was 3.5, but the optimum temperature was less than desired temperature ($\geq$ 45°C) required for a nonaseptic fermentation. *A. fumigatus* I-21 and its asporogenous mutant I-21A grew equally well in a medium prepared from whole cassava roots with a mean protein doubling time at 45°C and pH 3.5 of 3.5 h. In batch culture, approximately 4% carbohydrate, supplied as whole cassava, could be fermented in 20 h, givin a final yield of 24 g of dry product, containing 36.9% crude protein/liter. The conversion of carbohydrate used to crude protein was 22.1% When determined as amino acids, the protein content of the product, which contained cassava peal and other unfermented residues, was 27.1%. With urea as the N source, no pH control was necessary. Preliminary data indicated that medium prepared from whole cassava roots was inhibitory to the mold unless the cassava pulp was heated to 70°C immediately after being ground in order to gelatinize the starch and permit its complete utilization. *(Author's summary)* I03

J00 ECONOMICS AND DEVELOPMENT

0730-7018 AMAYA P., S. **Centro mundial de documentación sobre yuca en Colombia.** *(Cassava Information Center - Colombia)* CIID Informa 4(4):6-9 1976 Span., Illus.

Cassava. Cassava programs. Development. Colombia.

This is a brief look at the origin and development of the documentation center at the Centro Internacional de Agricultural Tropical, with emphasis on the cassava information services. This integrated documentation service is based on the bibliographic compilation, permanent supply of information to subscribers and specific searches for material. The information is handled by means of a mechanical system that includes cataloguing, the preparation of bibliographic citations and the search for authors' summaries or abstracts. The assignment of key words is the critical aspect of this process. A description is given of the way in which the search is conducted, equipment used and the services offered to the subscribers. The importance of improving the information systems at a world level is discussed. (*Summary by A. J. Trans. by S. S. de S.*) J00

0731-5021 BARREIRA, M. **A mandioca na economia pública e privada.** *(Cassava in the private and public economy)* Revista da Sociedade Rural Brasileira 18(215):20-21. 1938. Port., Illus.

Cassava. Cassava flour. Cassava meal. Production. Factories. Brazil.

Reductions in foreign exchange due to wheat imports led the Brazilian Government to decree in 1937 the addition of up to 30% domestic-produced starch to imported wheat flour. This resolution served as an incentive for cassava growers. It was estimated that with an increase of only 16% in area planted to cassava, the country's requirements would be met. Cassava flour industries in Campinas, Limeira and Araras (São Paulo) were studied. A brief study of costs of cassava cultivation and flour production is included. *(Summary by L. C. Trans. by S.S. de S.)* J00

0732-1653 BARRIOS, J. R. **Metas nacionales de producción de yuca en 1975 y 1980; recursos necesarios para lograrlas.** *(National goals for cassava production in 1975 and 1980, the resources required to accomplish them).* *In* Seminario Nacional sobre Yuca, Tacarigua, Venezuela, 1973. Revista de la Facultad de Agronomía. Alcance no. 22:51-68. 1973. Span., 6 Refs., Illus.

Cassava. Cassava programs. Production. Cultivars. Selection. Cultivation. Venezuela.

The deficit in cereal production in Venezuela, together with the resultant importation and drain of foreign exchange, points out the necessity of increasing the cultivation of crops that are easy and efficient to produce. For tropical conditions, cassava is a good substitute for cereals as long as proteins are added. Data and estimates for expanding cassava cultivation for the period 1975-80 are given. The most promising varieties for human and animal consumption were selected from the "Samán Mocho" germplasm bank, which has 380 clones. Recommendations are also given concerning cultural practices required to accomplish the proposed objectives. *(Summary by L. C. Trans. by T.M.)* J00 D00

0733-7275 BORGES, I.O. **Análise de grupo de experimentos com tratamentos regulares e comuns.** *(Group analysis of experiments with regular and common treatments).* *In* Projeto mandioca, subprojetos de pesquisas para o nordeste do Brasil Cruz das Almas, Brasil Universidade Federal da Bahia. Escola de Agronomia Convênio U.F.Ba /BRASCAN Nordeste, 1974. pp. 103-110 Port., 5 Refs

Cassava. Cassava programs. Developmental research. Experiment design. Brazil.

The subproject presented is Group Analysis of Experiments with Regular and Common Treatments and forms part of the cassava project for the northeastern area of Brazil (under the agreement Universidade Federal da Bahia/Brascan Nordeste, in cooperation with the Centro International de Agricultura Tropical) The methodology used to plan and analyze the performance of a large no. of annual and perennial clones and varieties (with emphasis on cassava) is described, on the basis of the experimental data obtained. (*Summary by A.J Trans. by S S. de S*) J00

0734-1607 , BRANNEN, S J. **Economics of cassava production and marketing.** *In* Hendershott, C.E *et al.* A literature review and research recommendations on cassava (*Manihot esculenta* Crantz). AID contract no csd/2497. Athens, University of Georgia, 1972 pp 222-254 Engl , 66 Refs

Cassava. Production. Costs. Income. Marketing. Consumption. Trade. Prices. Cassava chips. Cassava meal. Cassava starch. Tapiocas. Legal aspects. Developmental research.

The purpose of this study was to make a bibliographic review and an analysis of the scarce and controversial documentation on several economic aspects of cassava (*Manihot esculenta* Crantz) cultivation and marketing in order to provide researchers with a solid background for their economic studies on this crop and to make suggestions regarding its economic prospects. The main aspects considered were production costs, the supply-price relationship and marketing systems. Since cassava is a subsistence crop and the methods used to grow it are primitive, research programs and agricultural development plans of tropical countries have not taken an interest in it. In spite of the fact that world production is increasing, a decrease in yields has been recorded, with the exception of Brazil, Paraguay, Togo and Thailand There is a tendency for yields to rise more slowly than output, which reveals the more general characteristic of the cassava production system; i e , largely noncommercial and based mainly on small farms and family labor. Most of the small-farm production is for home use, the excess is sold or exchanged in local markets. Production costs vary according to the system of cultivation used, just as income depends on market conditions. The commercial marketing systems depend on the type of product made from cassava and the stage of development of the market economy. The possible causes for import-export price fluctuations are discussed. Emphasis is placed on competitive starches, quality and transportation. Cassava represents a still unexplored, low-cost source of food energy that could contribute to the economic development of tropical countries, however, national and international institutions need to make greater research efforts in the economic field and government policies should promote this crop. *(Summary by A J· Trans. by S S. de S.)* J00

0735-3662 BRENES, R **Fomento de la siembra de yuca a través de uniones agrarias.** *(Stimulating cassava cultivation through agrarian unions)* *In* ________, Almanaque Agrícola de Puerto Rico 1942:119-122. 1942. Span

Cassava. Cassava programs. Cultivation. Production. Puerto Rico.

A brief outline is given of the campaign that the Puerto Rican Government is carrying out through agrarian unions to stimulate cassava cultivation. A high-yielding variety (Brasil No 1) was distributed by the experimental station at Rio Piedras to farmers in 7 different regions

Cuttings produced during the first year were further distributed to members of the unions, together with instructions for fertilization, adequate soils, etc *(Summary by T.M.)* J00

0736-6774 CALDEIRA, A.F. and CORREA, H. **Integração, agricultura, indústria na produção de álcool carburante de mandioca.** *(Agro-industrial integration in cassava motor alcohol production).* Belo Horizonte, Instituto de Desenvolvimento Industrial de Minas Gerais, 1976 24p. Port., 9-Refs., Illus.

Cassava. Developmental research. Alcohol. Production. Development costs. Cultivation. Land preparation. Planting. Fertilizers. Harvesting. Distribution. Starch productivity. Cassava programs. Brazil.

General considerations and parameters are presented for integrating the agricultural and industrial components of motor alcohol production from cassava in Brazil. The factors to be taken into account when selecting the region for producing alcohol are site, transportation, area available for the crop, available labor and water, infrastructure, fuels, inputs and technical assistance. The characteristics of the industrial plant (installed capacity, distance from the fields, production, etc.) are studied, taking into account land available for planting. Cassava production costs and a planting and harvesting schedule designed for maintaining a permanent supply of raw material are included. Maintaining a stable production of cassava during the year and the use of only 1 crop as raw material are the 2 main problems. *(Summary by A. J. Trans by S.S. de S.)* J00 D00 102

0737-4495 CASENAVE, G. **Le manioc et les productions féculières de Madagascar; les exportations.** *(Cassava and starch production in the Malagasy Republic).* Entreprises et Produits de Madagascar 2:11-28. 1950. Fr., Illus.

Cassava. Cassava starch. Cassava flour. Tapiocas. Trade. Malagasy Republic.

A description is given of the cassava plant, its importance, appearance and chemical composition, and a distinction is made between sweet and bitter cassava. Cassava products and their uses for feeding and industrial purposes are mentioned. Most of the production is exported in the form of flour, slices, starch and tapioca. Starch exports from 1910-48 are given in a table. At present, the Malagasy Republic has 11 starch factories with a 20,000-ton production capacity. Finally, the development of the country's exports of cassava and its by-products is reviewed from the beginning of this century to 1949. *(Summary by S.S. de S.)* J00

0738-0157 **CASSAVA PRODUCTS: an important industry.** Netherlands Industrial Review 7:278-279 1927 Engl., Illus.

Cassava. Cassava meal. Tapioca pearls. Tapioca seeds. Trade. Prices. Java.

Java is the main cassava producer in Indonesia. The main products made from cassava are tapioca (two kinds), flour, cattle feeds, alcohol and paper. Cassava has replaced rice in many areas because of its ability to grow successfully in regions with a low water supply. A table on exports made to different countries is included. *(Summary by T.M.)* J00

0739-1719 CATAMBAY, A. **Cost of producing cassava in the College of Agriculture at Los Baños.** Philippine Agriculturist 27:584-589. 1938 Engl., Sum. Engl., 2 Refs

Cassava. Production. Labour. Costs. Land preparation. Planting. Weeding. Harvesting. Agricultural equipment. Philippines.

A study was undertaken of cassava cultivation to determine labor requirements, production costs, yields and cost of production/kg of roots It was found that harvesting required most labor, followed by weeding, land preparation, preparation of cuttings, planting and cultivation. The most expensive operation was harvesting and the least expensive, cultivation Average yield was 22,073 kg/ha Production costs and profit percentages are given. *(Summary by T M)* J00 D02

0740-3867 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. **A proposal for the improvement and development of cassava, a tropical root crop.** Cali, Colombia, 1971. 32p Engl

Cassava. Cassava programs. Colombia.

The 1st part of this study focuses on the origin and distribution of cassava, production, economic importance, utilization, limitations, yields, nutritional value and potential for future expansion Upon analyzing 3 fields of research, it was found that (1) more research is required in the area of agronomic practices to develop production systems that will increase yields in the tropics. (2) Relatively little work has been done on varietal improvement. There is a need to establish a sound basis for improving cassava by studying the cultivated and related wild species. (3) Research on utilization has focused on producing food- and feedstuffs, starch, flour, protein-enriched products, adhesives and glucose. The objectives of the cassava program at the Centro Internacional de Agricultura Tropical (CIAT) are then presented, using a multidisciplinary team approach. Possible export markets in Europe and the USA are discussed. CIAT has begun to collect the world's cassava literature. Highlights of the following CIAT research areas in cassava are presented: agronomy, soils, plant protection (diseases, pests and weeds), agricultural engineering, breeding, physiology, local and international trials, biometrics, utilization and training A schedule of research activities and a 5-yr budget are included. *(Summary by W.P. Trans. by S S de S.)* J00

0741-5593 CHAEWSAMOOT, S. **Cassava production and its future in Thailand.** Khon Kaen, Thailand, Northeast Agricultural Center, 1974. Engl

Paper presented at International Expert Consultation on the Use of Improved Technology for Food Production in Rainfed Areas of Tropical Asia, Hydesabad (Pakistan), Khon Kaen (Thailand) and Kuala Lumpur (Malaysia), 1974.

Cassava. Production. Cultivation. Soil impoverishment. Tuber productivity. Costs. Cassava starch. Factories. Cassava meal. Cassava chips. Pellets. Tapiocas. Trade. Marketing. Legal aspects. Consumption. Thailand.

The possible origin of cassava, its distribution and present importance are discussed, emphasizing its advantages in comparison to other crops. Tables give data on area planted to cassava, production and yields in Thailand from 1956-73, and the causes for variations in yields are analyzed The two types of cassava grown in Thailand (sweet and bitter) are described from the point of view of consumption and by-products obtainable from them. Other aspects mentioned briefly are types of soils required and their preparation, planting methods, fertilizers, weedings, pest and disease control *(Tetranychus urticae, T cinnabarinus, Cercospora* sp , *Sclerotium rolfsii)* and harvesting. Another table gives the dry matter content and nutrients removed by cassava 350 days after planting at different levels of soil fertility. The economics of cassava production, including export markets and perspectives for the different by-products (starch, meal, chips and pellets), is also analyzed. Regional production costs for different areas planted to cassava are shown in a table. *(Summary by L.F.C. Trans. by S.S. de S.)* J00 D00

0742-1606 CHAIRMAN, C.H.H. Summary and recommended research programs. *In* Hendershott, C E *et al* A literature review and research recommendations on cassava

(*Manihot esculenta* Crantz) AID Contract no. cds/2497. Athens, University of Georgia, 1972. pp.255-268. Engl., 847 Refs.

Cassava. *Manihot esculenta.* Cassava programs. **Developmental research. Processing. Cultivation. Plant breeding. Human nutrition. Animal nutrition. Marketing.**

This is a comprehensive bibliographic revision of the research on cassava conducted at a world level. The present status of the crop and research needs are indicated. Agronomic, socioeconomic, feeding and industrial aspects of cassava are discussed. Limited agronomic technology and market instability are the major factors restricting cassava expansion at present. A broad outline is made of the areas needing attention, including production research, breeding, animal feedstuffs, physiology, pests and disease losses, processing, human nutrition, marketing and inputs. *(Summary by A.J. Trans. by S.S. de S.)* J00

0743-4535 CHYE, K. O. and LOH, W. Y. **The tapioca processing industry in Perak.** Malaysia, Ministry of Agriculture and Lands, Federal Agricultural Marketing Authority, 1974. 41p Engl., Illus.

Cassava. Factories. Cassava starch. Cassava chips. Tapioca pearls. Tapioca flakes. Production. Prices. Trade. Marketing. Wastes. Maps. Malaysia.

In early 1969, a study was conducted on the cassava processing industry in Perak; based on data obtained from interviews with 46 processing factories. The main objective was to determine its characteristics and problems affecting expansion. The industry is characterized by small production units and a low technology. The cassava chip industry increased production since 1960, due mainly to the local development of the feed industry. The majority (85%) of the new factories turned to chip manufacturing because, in addition to the opportunities they were offered at the moment, it required lower capital inputs than starch factories. The slow growth and low level of technology of the industry was due to the uncertainty in the supply of raw material caused, in turn, by the generalized, illegal growing of cassava in this state. However, the industry enjoyed a high degree of stability between 1945-68 as evidenced by the few changes in ownership. Tapioca flakes and pearls and starch were the products exported between 1965-68; the domestic market consumed most of the chip (100%) and starch (86%) production. The amount of starch exported was small, as a result of the low premium existing in this sector; however, the introduction of new technology would increase the extraction rate and quality of the product, making it possible to export a greater amount in spite of the low premium. It was also determined that the domestic market for cassava products is very competitive and that the policy of some processing plants of cutting prices would in the long run have an adverse effect on the present rate of expansion. *(Summary by A.J. Trans. by S.S. de S.)* J00 I02

0744-6966 COLOMBIA. MINISTERIO DE AGRICULTURA. OFICINA DE PLANEAMIENTO DEL SECTOR AGROPECUARIO. Yuca. (*Cassava*). *In* Programas agrícolas. Bogotá, 1975. pp.191-197. Span.

Cassava. Cassava programs. Production. Costs. Colombia.

An analysis is made of the status of cassava cultivation in Colombia from 1974-75. Aspects covered are area under cultivation, yields, credit, technical assistance, labor, production costs and value, and marketing. The programming of the aforemetioned factors is presented for 1976; 1977 projections are included as well *(Summary by A J. Trans. by S. S. de S.)* J00

0745-5372 CONGRES DU MANIOC ET DES PLANTES FECULENTES TROPICALES, MARSEILLE, 1949. **Séances du congrès.** *(Congress discussions).* Marseille, Institute Colonial 1949. 56p Fr.

Cassava. Cassava programs. Trade. Cassava products. Uses. Industrialization. France.

A complete report is given on the subjects dealt with during the 4 sessions of the Congress. As regards cassava, the main aspects discussed were imports: decree on standards for cassava products; statistics on imports and utilization; local consumption; exports to France and foreign countries; industrialization, the situation of cassava in Madagascar, Indochina and several African countries; utilization of cassava and its by-products in Europe (for human and animal consumption, as well as several industrial applications), agronomic aspects including the comparison by countries of the native and European systems of cultivation; varieties and their selection; European industrialization in French territories and problems it causes; and the scientific and technical study of fresh cassava and its by-products. It was concluded that research efforts should be coordinated in order to obtain more fruitful results *(Summary by S.S. de S.)* J00

0746-3730 **CULTURA DA mandioca.** *(Cassava cultivation).* Belém, Instituto de Desenvolvimento Econômico-social de Pará. Estudos Paraenses no. 4. 1966. 9p. Port.

Cassava. Production. Cassava programs. Plant geography. Productivity. Marketing. Industrialization. Costs. Brazil.

Cassava is grown from northern to southern Brazil; the largest producers are the states of Santa Catarina, São Paulo, Pernambuco and Minas Gerais. An analysis is made of the distribution of cassava production in Brazil by states, giving an explanation of the different situations, with the purpose of promoting total industrial exploitation of the crop. Some of the situations discussed are the ecology, nearby markets, access to production and marketing zones, principally in the state of Pará. Costs and profitability of intercropping with maize and rice and expenses to transform cassava into flour are indicated. A table on cassava production (1959-64), according to geographical zones in the state of Pará, is included. *(Summary by L.F.C. Trans. by S.S. de S.)* J00

0747-4856 DALTON, G. F. and AKWETEY, F. **Cassava production and processing in southeast Ghana.** Legon, University of Ghana, 1971. 21p. Engl., 2 Refs.

Cassava. Developmental research. Cassava programs. Land preparation. Income. Labour. Planting. Weeding. Timing. Harvesting. Mechanization. Fertilizers. Productivity. Gari. Industrialization. Costs. Prices. Trade. Drying. Cottage machinery. Production. Ghana.

A study was conducted to see whether current expansion could continue in cassava production and processing and to offer a basis for development for southeast Ghana. Since this depends on its relative profitability in terms of its use of scarce resources such as labor and to some extent land, the returns to the labor required to produce cassava and cassava products were estimated. Possible future developments were also examined in the context of returns/unit of limiting resources; i.e., at particular times of the year and capital in the case of new drying plants Data were collected for the months of July and Aug. 1971 from 32 farmers and 47 women producing gari in Mafi Kumasi and surrounding villages. Estimates were made of gross returns from the 3 main crops grown in the area and of the labor requirements for land preparation, planting, weeding and harvesting. Information was also obtained on the seasonality of work, the area under cultivation and the amount of seed used. Estimates were also made of the returns from and the labor and capital requirements of gari production. It was found that the industry is healthy. The major technical improvement required to raise farmer income is to raise yields. Inputs such as fertilizer and tractor services are not available; in addition, little research is being done on finding improved varieties and cultural practices. Farmers fear a fall in prices due to increased production; however, production for export is impossible under present price conditions, and lower cassava prices could stimulate the domestic livestock industry. Mechanization of the gari industry is also necessary to reduce labor input and improve the conversion rate of fresh cassava into gari. *(Summary by T.M.)* J00 D00 I02

0748-6709 DE BOER, A. J. and FORNO, D. A **Cassava: a potential agro-industrial crop for tropical Australia.** Journal of the Australian Institute of Agricultural Science 41(4):241-252. 1975. Engl., Sum. Engl., 39 Refs., Illus.

Cassava. Cassava programs. Cultivation. Costs. Development costs. Pellets. Cassava starch. Food enrichment. Proteins. Developmental research. Processing. Uses. Maps. Australia.

Cassava seems ideally suited to serve a variety of purposes in the Australian agro-industrial scene. Production on a small to medium scale should present few problems if modifications of existing arrowroot harvesters are successful. Production on a very large scale, either by a number of specialized farmers or by a corporate farming organizational structure, could present problems in finding large enough areas of suitable land in a locality where low transport costs could be achieved. Areas where suitable land exists for growing cassava are often lacking in infrastructure development, and this could raise the costs of enterprises based on cassava to uneconomic levels. Providing further feasibility studies are encouraging, it would appear that a joint public-private initiative would be most appropriate for large-scale development of cassava growing and processing in tropical Australia. *(Author's summary)* J00

0749-7439 DIAZ, R.O , PINSTRUP-ANDERSEN, P. AND ESTRADA, R.D. *Costos y utilización de insumos en la producción de yuca. (Costs and use of inputs in producing cassava)* *In* Curso sobre producción de yuca. Cali, Colombia, Centro Internacional de Agricultura Tropical, 1976 pp 399-422. Span., Sum. Span., Illus.

Cassava. Production. Land preparation. Planting. Spacing. Harvesting. Labour. Packaging. Costs. Productivity. Fertilizers. Developmental research. Colombia.

This report describes briefly the cassava production processes in Colombia, with emphasis on the agronomic practices and input use and costs. The results of this study have set the pattern for a more comprehensive and detailed analysis of the factors limiting cassava production and productivity that is being conducted at present. Data were obtained on 300 farms in 17 states of Colombia. The agronomic practices on almost all the farms sampled were soil preparation (rudimentary in many cases); planting; weeding and harvesting. The use of insecticides and fertilizers was limited and herbicides were not applied. Cassava was intercropped with maize, plantain, coffee, yams or beans on 1/3 of the farms. Cassava production in Colombia is based on traditional methods; and land and labor represent the majority of the resources used. It is estimated that 8 and 10 man-days for manual and mechanical preparation of the soil, respectively, are employed for producing 1 ton of cassava. The av cassava yield was 11 tons/ha although there were marked fluctuations among farms. No distinct relationship was found between level of yields and farm size. Prices received by the farmers varied considerably. Small farmers received much lower prices than the large ones There is a marked relationship between price level and farm size on the North Coast, where the farmers having less than 2 ha received approx. 60% of the price paid to growers having 10 or more ha. As regards economies of scale of cassava production in Colombia, price differences seem to be more important than cost and yield differences; nevertheless, further study is necessary to prove the validity of this assertion. Additional research should be conducted on the (1) factors accounting for yield differences between farms and regions, (2) the role of intercropping, and (3) the relationship between farm size and the price received by the growers. The results also indicate the need to conduct research on the relationship between the level of weed infestation and cassava yields; the identification of low-cost methods to control weeds; and the impact of different land preparation systems on yields. *(Author's summary Trans. by S.S. de S.)* J00 D00

0750-4573 EDMONDS, M.,J. **A preliminary economic evaluation of the use of non-wheat flours in breadmaking.** *In* Symposium on the Use of Non-wheat Flour in Bread and Baked Goods Manufacture, London, 1970. Proceedings. London, Tropical Products Institute, 1970. pp. 19-25. Engl., 26 Refs.

Cassava. Cassava starch. Cassava bread. Breads. Costs.

This article gives the economic background for developing countries concerning importations of wheat and flour, patterns of consumption and the structure of related industries. It includes a method for evaluating the data already given and a cost-benefit analysis detailed in an appendix The greatest benefit was derived from the manufacture of a composite flour made of wheat, cassava starch and soybean flour *(Summary by, L F.C Trans. by S.S. de S)* J00

0751-7394 EZEILO, W. N. O., FLINN, J. C. and WILLIAMS, L. B. **Cassava producers and cassava production in the East Central State of Nigeria.** Ibadan, Nigeria. National Accelerated Food Production Project. Cassava Benchmark Survey, East Central State. 1975. 27p. Engl , Sum. Engl., 3 Refs., Illus.

Cassava. Production. Cassava programs. Developmental research. Cultivation. Productivity. Labour. Land preparation. Planting. Weeding. Harvesting. Cassava products. Prices. Timing. Nigeria.

In the East Central State of Nigeria, 200 cassava farmers were randomly sampled to provide baseline data on cassava production so that a quantitative assessment of the cassava component of the National Accelerated Food Production Project (NAFPP) could be made later. The model farmer was younger in age (40) than normally reported for the rest of the country. The typical farm labor force consisted of the farmer, 1-3 adult females and possibly some of his children although 1/3 did not regard their children as being part of the farm labor force. Outside labor was hired by 82% of the farmers, but there was no evidence that the amount of labor hired was related to the size of the on-farm labor force. Over half the farmers cultivated less than 0.2 ha/yr. As regards source of land, 44% stated that their land was family land (form of tenure) and 18% had purchased it. For the 1974 crop, 73% used credit; the most important source was other family members while banks were the least important. Only 9 of the 200 farmers purchased inputs other than labor with their credit. Although 86% knew about fertilizers, only 45% claimed to have used it on some occasion. Of these, 15 farmers had found no difference in yield. Newspapers, opinion leaders and radio were the media cited least as a source of learning about fertilizers; most had heard about it from extension officers Only 8% of the farmers had ever used plant protection chemicals. The 4 main factors limiting to yield were —in the farmers' opinions— lack of funds, lack of land, insects and diseases, and the high cost of labor. Av yield was 6 tons/ha; yields were lower in the heavily populated areas. Typical crop rotation is cassava 1-2 yr after fallow and intercropped with maize or yams when cassava is young The women are responsible for cassava production except for land preparation, which is considered a man's job. Only 17% claimed to grow new, improved varieties. Cassava was grown on lighter soils with 77% on hills, 11% on ridges and 11% on the flat. Weeding was done 3 times by 47% and twice by 43% of the farmers. Cassava was processed manually by 73% of the farmers, 24% by village gari graters and 4 farmers had their own graters. Almost 90% of the farmers thought that 50% or more of the cassava produced was consumed at home. The implications for the NAFPP are discussed in detail. The program will involve varietal improvement, multiplication and distribution of planting material, a team of trained personnel in cassava production, and the establishment of both input and marketing infrastructures conducive to increased production. *(Summary by T.M.)* J00 D00 I02

0752-1644 FAURIE, M. **Etude de divers problèmes concernant le manioc à Madagascar.** *(Problems concerning cassava in Madagascar). In* Congrès du Manioc et de Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institut Colonial, 1949. pp 111-117. Fr.

Cassava. Storage. Insect control. Cassava products. Trade. Legal aspects. Packaging. Distribution. Prices. Malagasy Republic.

In 1948 the Government of Madagascar passed a series of decrees on aspects such as disinfestation, processing, packing, quality control and shipping of cassava products; an analysis is made of these dispositions. The way in which domestic producers are affected by the fall in cassava prices, the increase in input costs and cassava imports (especially from Angola) is also discussed It is suggested that the Government should cut imports that hurt the economy and should take the necessary steps to encourage producers to continue growing cassava. *(Summary by S.S. de S.)* J00

0753-6806 FLINN, J. C. **Possibilities for economic research into cassava production systems in Africa.** *In* Terry, E.R. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976. pp.15-19. Engl., Sum. Engl., 22 Refs.

Cassava. Cassava programs. Developmental research. Production. Processing. Marketing. Africa.

When considering cassava improvement in Africa, it is vital that the components of cassava production, processing, marketing and policy be studied as an integrated system The ramifications of a possible change at one point in the system may be magnified, dampened or wiped out by a reaction or bottleneck in another. To understand the true consequences of an objective to increase production at the farm-level requires an understanding of the linkages between the various subsystems, a task that requires the cooperation of the biologist, social scientist and planner. Cassava systems in many parts of Africa are generally not well understood or documented. Cooperative research projects should be initiated to reduce this gap. (*Author's summary*) J00

0754-0141 FONSECA G., J. **Comentario a las encuestas sobre variedades de yuca producidas en Colombia, para consumo humano, animal e industrial, épocas y distancias de siembra, mercados, precio y costos de producción. 1966.** *(Surveys on cassava varieties produced in Colombia for human, animal and industrial consumption; planting seasons and distances; markets, prices and production costs).* Bogotá, Ministerio de Agricultura, 1968. 15p. Span

Cassava. Production. Marketing. Costs. Prices. Industrialization. Human nutrition. Animal nutrition. Planting. Spacing. Timing. Colombia.

A series of surveys on cassava cultivation were conducted in 8 states of Colombia (Antioquia, Meta, Nariño, Huila, Caldas, Atlántico,Tolima and Cundinamarca). Data are given on the following aspects: potential production areas, new varieties and their common names, yields, production costs, marketing, local market prices and uses. In 1967, the total production of cassava in Colombia exceeded 900,000 tons; 70% of the total output was used for human consumption, 15% for animal feeding and the remaining 15% for industrial purposes. *(Summary by L.E R.G. Trans. by S.S. de S.)* J00 D02

0755-3732 **FOOD BALANCES for 12 countries in the Far East and Oceania, 1959-61.** United States Department of Agriculture. Economic Research Service ERS Foreign 88. 1964. 14p. Engl.

Cassava. Production. Trade. Human nutrition . Uses. Animal nutrition. Asia. Oceania.

A food balance summarizes in statistical form the food supply of a country. An average of 2,120 calories/person/day, which es very low even for developing countries, has been calculated for this area. Data on cassava refer to its fresh form and include production, imports and exports and per capita consumption for the following countries: Burma, Ceylon, India, Indonesia, Japan, Malay States, Pakistan, Philippines, Taiwan, Thailand, Australia and New Zealand. (*Summary by L.F.C. Trans. by T.M.*) J00

0756-1791 FRANCE, LAWS, STATUTES, ETC Conditionnement des maniocs séchés. *(Dry cassava conditioning).* Agronomie Tropicale 3(5/6) 332-336. 1948. Fr.

Cassava. Dried tubers. Pellets. Cassava flour. Legal aspects. Trade. Water content. HCN content. Starch content. Africa.

This decree of February, 1948 regulates exports and imports made by the French colonies. It includes a series of specifications on cassava classification according to quality, product presentation, packing, labeling, quality control at the port of shipment and penalties. Systems used to verify that water, HCN and starch contents are within the limits established for export products are also described. *(Summary by S.S. de S.)* J00

0757-3421 FRANCE. SECRETARIAT D'ETAT AUX COLONIES. SECTION TECHNIQUE D'AGRICULTURE TROPICALE. **Le manioc: statistiques: considerations culturales et économiques.** *(Cassava: statistics and agro-economic considerations).* Nogent-sur-Marne, 1943. 88p. Fr., Illus

Cassava. Production. Cassava starch. Cassava flour. Tapiocas. Trade. Prices. Industrialization. Costs. Consumption. Dried tubers. Fresh products. Cultivation. Processing. Legal aspects.

This manual, divided into 3 main parts, deals with cassava growing in the French colonies up to 1943. The first part presents tables on cassava production at a world level; fresh cassava, flour, tapioca and starch imports made by France from 1913-38; and exports of the same products made by the French colonies during the same period; the position of cassava in the colonies in relation to other export products; and the evolution of average prices in France for cassava and its by-products The second part discusses cassava growing, fertilizing trials carried out in Madagascar and on the island of Réunion, soil preparation, propagation and planting, harvesting, the 2 main enemies of cassava (ants and mosaic), the preparation of couac and gari from cassava flour and the production of starch, tapioca, alcohol, dextrins and glucose. In addition, cassava and its processing are reviewed in the following countries. Indonesia (Java), Malaysia, Brazil, Belgium Congo, Madagascar, Réunion, Indochina, Cameroon, French Equatorial Africa (Gabon, Congo, Central African Republic and Chad) and Martinique. The last part includes considerations on French policies in relation to its colonies and its role regarding production and export regulations. *(Summary by S S. de S.)* J00 D00

0758-6708 GARCIA B., J. *et al* **Zonificación agroecológica para el cultivo de la yuca en el Valle del Aroa.** *(Agro-ecological zonification for cassava cultivation in the Valle del Aroa).* Barquisimeto, Venezuela, Fundación para el Desarrollo de la Región Centro Occidental, 1975. 54p. Span., Sum. Span., Engl , 35 Refs., Illus.

Cassava. Cassava programs. Developmental research. Ecology. Maps. Production. Venezuela.

An agro-ecological zonification is presented for cassava *(Manihot esculenta)* cultivation in the Valle del Aroa (Venezuela). The units of zonification are defined by combining 3 indexes or variables: potential yield, percentage of negative years and class of land. The units are classified by means of an optimal marginal gradient (from best to worst). Yield is calculated by the function of production (precipitation vs. yield) and the continuous distribution of the probability of occurrence of the different levels of precipitation for each locality. The percentage of negative years is based on the knowledge of the occurrence of precipitation levels at which no minimum yield, preestablished with economic criteria (i.e., installation and maintenance costs of the crop) is exceeded. The final map is conceived in such a way that it can be used by planners with no knowledge of ecological planning. The methodology used is explained. *(Author's summary)* J00

0759-1634 GARROS, M. **Standardisation et conditionnement des maniocs sechés et note sur le conditionnement du tapioca.** (*Standardization and processing of dry cassava and regulations regarding tapioca*). *In* Congres du Manioc et de Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institut Colonial, 1949. pp.68-72. Fr.

Cassava. Cassava chips. Cassava flour. Tapiocas. Legal aspects. Trade. Starch content. HCN content. Malagasy Republic.

Given the importance of cassava in human and animal nutrition, the French Government decreed the standardization and processing of dry cassava in 1938. For exporting purposes, the following forms were established: slices, semolina, chips, ground and pelletized cassava. Several kinds of flour were classified according to their color and granule size. Regulations were adopted for water, starch and HCN content. The method chosen to measure starch content was the transformation into glucose by means of hydrolysis. Maximum HCN content was fixed at 0.02%, using two methods: calorimetric and volumetric. As for tapioca, several norms were established regarding quality control, penalties, packing and labeling of the product. (*Summary by S.S. de S.*) J00

0760-6913 GEH, S H. and AZHAR, A. K. **Feasibility study of the planting of tapioca and production of pellets in the state of Kelantan.** Malaysia, Federal Industrial Development Authority, Industrial Studies and Surveys Unit, 1972. 147p Engl., Sum. Engl , Illus

Cassava. Cassava programs. Developmental research. Cultivation. Production. Pellets. Industrialization. Factories. Industrial machinery. Cassava chips. Costs. Developmental costs. Processing. Malaysia.

General background data is given on world cassava production in 1968. Utilization of cassava in Malaysia is confined to the production of starch, flour, tapioca pearls and dried chips. A factory for the production of pellets was installed recently but is not yet in full production About 60% of the country's total production is concentrated in the state of Perak. The potential market for pellets in the EEC is excellent (approx. 1.5 million tons); and pellets from Thailand, the main competitor, are often irregular in quality. The study proposes a large-scale operation (100 tons pellets/day, 300 days/yr) in the state of Kelantan that would include the mechanized cultivation of cassava as well. Land, labor and other agricultural inputs, presses, and other requirements are outlined. A large rotating drum dryer would be used to permit low drying temperatures. Estimated costs, sales and profits are included. Appendices give data on large-scale cassava producers, importers, analyses of plant and equipment bids, comparative performance efficiency and suggested pro forma for inviting tenders. (*Summary by T.M.*) J00 I02

0761-1384 GONZALEZ, C.E.E. *et al.* **Industrialización de la yuca; proyecto.** *(Project for cassava industrialization).* Santo Domingo, República Dominicana, Administración de Cooperación Técnica, O.E.A , 1970. 184p. Span , Sum Span., Illus.

Cassava. Cassava programs. Industrialization. Cassava starch. Trade. Marketing. Forage. Pellets. Factories. Processing. Industrial machinery. Labour. Development costs. Dominican Republic.

The enormous potential of cassava in the Dominican Republic led to a series of studies on the feasibility of creating an agro-industrial unit devoted to the manufacture of cassava starch and forage. The following aspects were analyzed domestic and foreign consumption and demand of starch and forage, raw material and equipment required; size and location of the project, level of investment, sales and overhead budget, financing systems, evaluation of the project for private industry, sensitivity analyses and feasibility of creating an agricultural subproject. The enterprise would be agro-industrial in order to be self-supplying. At present, the unsatisfied demand for industrial starch alone is 3,000 tons/yr; the demand for forage is 15,000 tons/yr. The equipment would be manufactured in Germany and Brazil. The starch and forage plants would have an installed capacity of 10 and 30 tons/day, respectively, and would operate 24 h daily. The project would be located in Guayabín, province of Monte Cristi, in the northeast. Flow diagrams for the starch and forage plants are included, as well as tables in which types of investment, costs and systems of amortization are specified. *(Summary by S.S. de S.)* J00 I02

0762-7273 GRAMACHO, D. D. **Contribução para o estudo químico -tecnológico das ramas da mandioca** *(Manihot esculenta* **Crantz) como forragem.** *(Chemical- technological study of cassava branches used for forage). In* Projeto mandioca; subprojetos de pesquisas para o nordeste do Brasil. Cruz das Almas, Brasil. Universidade Federal da Bahia. Escola de Agronomia Convênio U.F. Ba/BRASCAN Nordeste, 1974. pp. 90-102. Port., 25 Refs.

Cassava. Cassava programs. Foliage. Production. Forage. Animal nutrition. ***Manihot esculenta.*** **Brazil.**

This subproject is denominated Contribution to the Chemical-Tecnological Study of Cassava Branches Used as Forage and forms part of the cassava project for northeastern Brazil (under agreement Universidade Federal da Bahia/Brascan Nordeste, in cooperation with the Centro Internacional de Agricultura Tropical). A bibliographic revision, background and bases for the project are included. The objectives are to measure the production of fresh cassava leaves and hay and to determine the harvesting seasons and chemical composition of this material. The varieties Mamão, Caicana, Aipim Brabo, Jacomóa, Milagrosa and Abismo will be harvested at 8, 9, 10, 11 and 12 mo for the chemical analysis of fresh leaves and branches and hay in order to determine their nutritional value in animal feeding. *(Summary by A.J. Trans. by S S. de S.)* J00 H03

0763-6992 GUSSMAN, L and FRIEDEN, A **Production of tapioca flour.** *In* Bingham, R.T , ed. Starch for paper coating. New York. Technical Association of the Pulp and Paper Industry. Tappi Monograph Series no 3. 1947. pp.88-91. Engl

Cassava. Cassava starch. Paper industry. Prices. Trade. USA.

Data are given on cassava starch exports from Indonesia, Brazil and Santo Domingo to the USA. Comments are made about future supply and causes of price fluctuations from 1930-45 (increase in area planted to cassava and improvements in manufacturing and marketing techniques. *(Summary by A J. Trans. by S S. de S.*) J00

0764-3496 GUTIERREZ A., N and PINSTRUP-ANDERSEN, P **La importancia relativa de frijol, maíz, arroz y yuca en la zona tropical.** *(The relative importance of beans, maize, rice and cassava in the tropics)* Palmira, Colombia Centro Internacional de Agricultura Tropical Programa de Economía Agrícola. EA 72-A 1972. 28p Span., Sum. Span.

Cassava. Production. Nutritive value. Marketing. Proteins. Food energy. Trade. Prices. Rice. Beans. Maize.

A study was made of the relative importance of the 4 agricultural commodities that the Centro Internacional de Agricultura Tropical (CIAT) works with, the results of which are summarized in tables. In descending order, these commodities are beans, maize, rice and cassava. Tropical countries produce 97.4% of the world's total of cassava. It is grown mainly in Africa and South America, occupying 1.5% of the cultivable surface of the tropics. It ranks third (7.8%) in value of production in the tropics, as compared to sugar cane (39.4%) and rice (31.2%) *(Summary by TM)* J00 H01

0765-1631 HENDERSHOTT, C.H. *et al.* **A feasibility study on manioc production in northeast Brazil.** Athens. University of Georgia. AID Contract no. AID/LA-681(Brazil). 1971. 118p. Engl., Sum. Engl., 46 Refs., Illus.

Cassava. Developmental research. Production. Marketing. Processing. Human nutrition. Animal nutrition. Uses. Costs. Trade. Productivity. Prices. Labour. Cultivation. Factories. Cassava flour. Cassava chips. Cassava starch. Tapiocas. Brazil.

The objectives of this agro-economic study, conducted from June-Aug., 1971, were to determine if it was feasible to produce cassava in northeastern Brazil and, if so, make recommendations as to research and training programs required. Aspects covered in the study are the current status and diagnosis of key problems limiting cassava production, processing, utilization and marketing in this region. The scarcity or prices of land and labor are not obstacles to cassava production. Limited agronomic technology, market instability and the high prices of chemicals and machinery are the major factors restricting cassava expansion. There are good prospects for improving yields, nutritional value and disease and insect resistance One of the main uses of fresh cassava and its residues (obtained from the manufacture of by-products) is in animal feeding. On the other hand, poor root quality and the lack of technology needed to develop processing plants are 2 of the greatest limitations in this area. The potential of cassava starch should be explored instead of trying to compete with the cereal starches for the same markets. There is a need for research in the following areas: agronomic practices, plant improvement, insect and disease control, processing, human nutrition and economics The importance of establishing graduate programs in the 3 main universities in this region is indicated. An exchange program with the USA should also be promoted. Until yields/ha are increased or until cost/kg of roots is decreased, cassava will not be able to compete in the export market. There are, however, several activities that could be initiated without awaiting further research results: (1) the development of extension programs throughout northeastern Brazil, (2) the creation of a group in charge of disseminating information, (3) the establishment of demonstration plots, (4) the allocation of more funds for research publication, (5) the establishment of a cooperative for cassava producers, (6) the development of a credit program just for cassava producers and processors, (7) the initiation of an educational and technological program, and (8) the importation and field evaluation of high-protein cassava varieties for adaptability to local environmental conditions. The staff required to initiate a training and research program in one of the main universities is indicated. *(Summary by S.S. de S.)* J00 I02 D00

0766-6796 HOOPES, R. W. **Cassava as a food resource in Brazil.** Ithaca, N.Y. Cornell University. New York State College of Agriculture and Life Sciences. Cornell University Agricultural Experiment Station. Cornell Agricultural Economics Staff Paper no. 76-18. 1976. 37p. Engl , 35 Refs., Illus.

Cassava. Cassava program. Productivity. Production. Developmental research. Uses. Human nutrition. Animal nutrition. Maps. Consumption. Trade. Storage. Brazil.

An analysis was made of the situation of cassava in Brazil from an agro-industrial point of view, which included aspects of production, distribution, marketing and consumption, as well as its potential and some recommendations. The most important facts shown by the analysis are: (1) The av fresh root yield is 50 tons/ha. (2) The best crop-producing regions in Brazil are, in order of importance, Northeast, South, Southeast, Central-West and North. (3) Small subsistence farms using traditional methods account for most of the production; however, the southeast and southern regions are characterized by commercial farms whose production is used for starch or for livestock feed. (4) Among the most serious diseases are angular leaf spot, brown leaf spot, leaf and stem rust, common mosaic, root rot and bacterial wilt. The main pests of cassava are stemborers, hornworms, leaf-cutter ants and mites (5) Cassava consumption is higher in the rural sector, and income does not, in general, affect consumption. Differences in caloric intake range from 1-36% for the urban and rural sectors, respectively. As incomes rise, consumption of other foods (grains, meat, etc.) increases, but cassava consumption remains the same. (6) A significant part of cassava production (46-63%) is used for livestock feed. Other industrial uses are the manufacture of starch and ethyl alcohol. Exports to the USA and Western Europe are unstable because of the higher domestic prices and the less demanding quality requirements within the country. Future perspectives in relation to the improvement of growing conditions, storage, utilization and exports are also discussed It is concluded that there is a great potential for expanding production in Brazil, both in terms of area cultivated and yields. Cassava will continue to be a staple in the diets. Exports of feed concentrates based on cassava is the most promising area for this crop Finally, if the large-scale use of cassava for the production of ethyl alcohol becomes a reality, the pattern of cassava utilization as a food resource will be substantially altered. *(Summary by A J. Trans. by S.S. de S.)* J00

0767-1826 INSTITUTO DE INVESTIGACIONES TECNOLOGICAS. **Posibilidades del cultivo de la yuca y su aprovechamiento industrial en zonas cafeteras.** *(Possibilities of cultivating cassava in coffee-growing regions and its industrial uses)* Bogotá, 1962. 42p. Span., Sum. Span., 13 Refs.

Cassava. Climatic requirements. Soil requirements. Productivity. Cassava starch. Factories. Production. Costs. Consumption. Marketing. Trade. Cassava programs. Prices. Colombia.

National statistics on the production and consumption of cassava and its by-products are insufficient for estimating market capacity. Prices paid to farmers and wholesalers vary greatly, but the averages exceed production costs, leaving fairly good profits for both groups. Marketing prices and production costs for starch are given in detail. Based on these data (for 1962), it would be necessary to lower production costs to competitive export levels, taking into account the following points· (1) Commercial cassava prices eliminate Colombian starch from the international market. (2) To lower production costs for cassava and starch, it is necessary to improve agricultural practices, using high-yielding varieties with high starch content. (3) The farmers themselves (individually or cooperatively) should produce the starch based on a price for cassava similar to production costs. (4) For the production of starch intended for exports, the coastal region is in an advantageous position with regard to transportation facilities. (5) Starch production in small plants is not advisable because of the need for producing uniform, good-quality products for the export market. Annexes present information on (a) cassava production by states in 1960; (b) wholesale prices for cassava in Bogotá; (c) wholesale prices for cassava starch; (d) production costs for cassava starch in Colombia; (e) composition of cassava leaf hay and alfalfa hay; (f) production cost estimates for manufacturing cassava starch on an industrial scale; (g) production cost estimates for small-scale starch production, and (h) production costs for starch manufactured from sliced, dried cassava. *(Author's summary. Trans. by S.S. de S.)* J00 I02 D00

0768-1625 JUNQUEIRA, A A.B. *et al.* **Custos agrícolas em São Paulo. Safras 1964/65 e 1965/66; algodão, amendoim, arroz, cana de açucar, feijão, mamona, mandioca, milho, soja, trigo.** *(Agricultural costs in São Paulo. Safras 1964/65 and 1965/66; cotton, peanuts, rice, sugar cane, beans, castor oil, maize, soybeans and wheat).* Agricultura em São Paulo 13(5/6).25-44. 1966 Port

Cassava. Costs. Cultivation. Production. Land preparation. Planting. Weeding. Insect control. Harvesting. Distribution. Labour. Brazil.

This article presents the production costs of the main crops grown in São Paulo (Brazil) from 1965-66. Cassava, cotton, peanuts, rice, coffee, sugar cane, beans, millet, soybeans and wheat are included. As regards cassava, data are based on 50 tons/alqueire *(Summary by A.J. Trans. by S.S. de S.)* J00 D00

0769-6830 KROCHMAL, A **Cassava in Brazil.** n. 1 8p Engl.

Cassava. Production. Costs. Brazil.

A description is given of the cassava production systems used at the cooperative farm at Holanbra, São Paulo, and the research conducted by the agricultural station in Campinas. A short review is made of the farm's creation, form of financing, and administrative policies and systems. The most widely grown variety is Branca de Santa Catarina. Frosts are the greatest problem affecting production; costs of production/acre are included *(Summary by A.J. Trans. by S S. de S.*) J00

0770-0424 KROCHMAL, A. **Cassava in the New World.** World Crops 19(1) 74-75. 1967. Engl., Illus.

Cassava. Cassava programs. Production. Trade. Dominican Republic.

This is a very brief article on some aspects of domestic cassava consumption and international marketing in the Dominican Republic from 1959-66 Cassava growers are in a difficult economic position for several reasons: low production (approx. 3 tons/acre); transportation facilities from the field to the factory are not owned by farmers; and there is only one inefficient processing plant. Starch production in Surinam and Jamaica is described briefly and illustrated with photographs. *(Summary by A.J. Trans. by S S. de S.)* J00

0771-2013 LLANO, A **La yuca.** (*Cassava*) Boletín Agrícola (Colombia) no 504:8629-8634. 1962 Span

Cassava. Cassava programs. Costs. Production. Cultivation. Animal nutrition. Drying. Colombia.

Information is presented on cassava growing and its uses with the purpose of encouraging its production in Colombia. Emphasis is placed on concentrates for the feed industry, which makes it possible to utilize all the roots harvested, including those that are small, broken or damaged The process for drying cassava is described. A simple, economical chopping machine is used in the process. (*Summary by A.J. Trans. by S. S. de S.*) J00 I02

0772-0154 LYRA, J.M. DE. **Questionario agricola, industrial e econômico da mandioca no Estado de Parahyba.** (*Agricultural, industrial and economic aspects of cassava in the State of Paraiba*) Boletim do Ministerio da Agricultura, Indústria e Comercio (Brazil) 1·164-183. 1926. Port

Cassava. Cultivars. Soil requirements. Climatic requirements. Land preparation. Planting. Harvesting. Production. Factories. Cassava starch. Tapiocas. Cassava meal. Trade. Prices. Costs. Brazil.

Three important aspects of cassava production are discussed: (1) agricultural, which includes topics such as varieties, climatology, soils, land preparation, fertilization, agronomics practices, harvesting, production and pests; (2) industrial; (3) economic, which gives tables on production and consumer preferences of several kind of flours throughout the state. Estimates on crop costs are also given (*Summary by L.N.A., Trans. by S. S. de S.*) J00 D00

0773-5353 MALBERTI, F **Harina de yuca como sustituto de harina de trigo.** *(Cassava flour as a substitute for wheat flour).* Revista de la Sociedad Cubana de Ingenieros 23(3).187-199. 1931. Span.

Cassava. Cassava flour. Breads. Wheat flour. Trade. Consumption. Marketing. Cuba.

In order to comply with a recently passed law, all bread in Cuba must contain at least 10% cassava flour after July 2, 1932 The proportion of this flour to wheat may be as high as 40-60. The economics of manufacturing starch, tapioca, alcohol, vinegar, etc., is briefly described. *(Summary by Chemical Abstracts)* J00

0774-3816 **LE MANIOC.** *(Cassava)* Buitenzorg, Java, Division de Commerce du Departement de l'Agriculture, de l'Industrie et du Commerce, 1927. 8p. (Produits des Indes Néerlandaises) Fr., Illus.

Cassava. Production. Processing. Cassava flour. Gaplek. Tapiocas. Trade. Uses. Java.

The following aspects of cassava cultivation and uses in the Dutch East Indies are briefly discussed harvesting and production, preparation of cassava flour, tapioca and gaplek; exportations (1921-25) and industrial applications *(Summary by R.T. Trans. by T.M.)* J00

0775-1638 MIEGES, J. **Le manioc en Côte d'Ivoire.** (*Cassava in the Ivory Coast*). *In* Congrès du Manioc et de Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institut Colonial, 1949. pp.86-90. Fr.

Cassava. Production. Productivity. Cultivars. Identification. Cassava programs. Yams. Ivory Coast.

Cassava is a staple food in the Ivory Coast, but it is not an export commodity. The area planted to cassava is approximately 130,000 ha; and its production amounted to 598,000 tons in 1948 The number of varieties grown is low; and several names are given for each according to the region. Emphasis was placed on genetic improvement. The main trials that were being carried out were on starch quality, the content of cyanogenic compounds and the obtainment of new hybrid, high-yielding varieties, resistant to diseases (especially mosaic) and pests. *(Summary by S.S. de S.)* J00 D03

0776-4919 MOREIRA, N. **A cultura da mandioca em S. Paulo e as possibilidades de mercado para seus sub-productos.** *(Cassava cultivation in São Paulo and marketing perspectives for its by-products).* Lavoura 42:6-7. 1938. Port.

Cassava. Cassava products. Marketing. Uses. Brazil.

The aspects that justify the expansion of cassava growing in Brazil and perspectives for marketing its by-products abroad are discussed. The main obstacle hindering its expansion is the drying process because natural drying (by sun, wind, etc.) is uncertain, and artificial drying is still too expensive. Several cassava by-products and their uses—such as flour for breadmaking and chips for manufacturing feeds and industrial products (alcohol, dextrin, glucose, etc.)—are mentioned. The advantages of cassava chips as an export product are given, indicating at the same time that the USA is the main potential market for this product. *(Summary by A.J. Trans. by S.S. de S.)* J00

0777-0409 MORI, Y. **For manioc a future in feed.** International Trade Forum 4(2):9-13. 1968. Engl., Illus.

Cassava. Broken roots. Cassava chips. Pellets. Trade. Europe.

The future possibilities of cassava, which has had a substantial and rapidly growing export volume lately, are discussed. Most cassava is used as animal feed in West Germany, the Netherlands and Belgium. The roles these 3 countries play in the trade of this product are explained. There is a trend to use cassava pellets instead of chips in the animal feed industry. The main exporters of cassava are Thailand, Brazil, Indonesia and Nigeria. *(Summary by Tropical Abstracts)* J00

0778-4423 MUÑOZ T., M. and CAMARGO, J. A. **Producción, comercialización e industrialización de la yuca.** *(The production, marketing and industrialization of cassava).* Tesis Econ. Bogotá, Universidad La Gran Colombia, Facultad de Economía, 1973. 211p. Span., 63 Refs , Illus.

Cassava. History. Taxonomy. Composition. Animal nutrition. Human nutrition. Production. Trade. Industrialization. Marketing. Distribution. Prices. Deterioration. Starch productivity. Colombia.

The general objectives of this study were to unify, analyze and update statistics on cassava cultivation and industrialization since data often differ greatly from one entity to another; to correct errors more effectively by means of formulas suitable for each case; and to contribute to the socioeconomic improvement of the agricultural sector. The work was divided into 3 parts: (1) Figures are given on world and national production, in addition to factors influencing yields. (2) Marketing problems are discussed in relation to the producer, middleman and consumer; distribution channels; factors causing rot; and buying and selling prices. (3) Industrial evolution is described, together with the processing and marketing of starch, both nationally and internationally. It was found that cassava growing is in its initial phase of technological development in Colombia. Demographic, educational, sanitary and nutritional problems all affect production adversely. Of 160,000 ha cultivated in 1972, 90,000 are small farms; operations larger than 50 ha are rare. In the state of Valle del Cauca, there are some 100-ha plantations that produce up to 25 or 30 tons/ha. The national average was 10 tons/ha in 1972; that is, a total of 1,600,000 tons, which barely satisfied domestic needs. As cassava is a perishable product, it is difficult to market. About 90% of domestic production is used for human and animal consumption and 10% for the manufacture of starch. As regards foreign trade, Colombia needs to diversify exports; and fresh cassava and starch would be a good line. Therefore, internal production problems should be solved soon. (*Summary by S.S. de S. Trans. by T.M.*) J00

0779-6795 NESTEL, B. and COCK, J. **Cassava; the development of an international research network.** Ottawa, Canada, International Development Research Centre, 1976. 69p. Engl., Illus.

Cassava. *Manihot esculenta.* Cassava programs. Developmental research. Development.

This is a historical review of the origin, development and objectives of the International Cassava

Research Network. Emphasis is placed on the interdisciplinary approach, which contributes both to the development of research and the economy, especially in the Third World countries. Three features of the program are stressed:(1) The linkage between the basic research done in donor countries (that finance the research in developing countries), the research on genetic improvement carried out at the Centro Internacional de Agricultura Tropical (CIAT) and the International Institute of Tropical Agriculture (IITA) and in national agricultural research programs, as well as electronmicroscopic work (McGill and Rothamstead) and tissue culture techniques (Saskatoon).(2) The international nature of research, which transcends institutional boundaries. The 1st research effort was based on the importance of cassava as a staple food crop; however, other aspects are basic at present, such as the potential of cassava in the manufacturing of ethyl alcohol and the production of microbiological protein.(3) These projects can be grouped into 3 categories: those leading to the development of international testing programs; those designed to create and strengthen national cassava programs; and those oriented to improve the utilization of cassava. A comprehensive analysis is made of the development, objectives and achievements of the cassava programs at CIAT (Colombia) and IITA (Nigeria), indicating that the basic difference between these institutions is the emphasis placed by IITA on the search for solutions to bacterial blight and mosaic diseases, which are limiting to cassava production in Africa. The role played by IDRC as a coordinator of the international network is explained. Since cassava is produced and consumed all over the world and there are many institutions working on it, it is almost certain that research activities on cassava carried out by national and international entities will be integrated in the future. (*Summary by A.J Trans. by S S. de S.*) J00

0780-1809 NUSBAUM, S. J. **The applications of modern technology to the multiple uses of cassava.** *In* International Symposium on Tropical Root and Tuber Crops, 2nd , Honolulu and Kapaa, Hawaii, 1970 Tropical root and tuber crops tomorrow. Honolulu, University of Hawaii, 1970. v. 2, pp. 11-13. Engl.

Cassava. Cassava programs. Industrialization. Uses. Africa.

At present cassava is underutilized in Africa since its high carbohydrate yield is considered to be a negative factor by experts preoccupied with the protein deficiency in the African diet. For this reason many starch-rich countries have to import starch for use in food products and industry. A multipurpose approach to maximize Africanization of the cassava industry is proposed, adapting technology and capital to African know-how. A study is made of problems involved in establishing starch operations in Africa, including the cooperative organization of small-scale operations, the transport of raw material and factory location, the scale of production needed to compete on international markets, etc. A list is given of the multiple uses of cassava *(Summary by T.M.)* J00 I02

0781-7262 OLATUNJI, A. and ADEYOKUNNU, T. O. **The changing patterns of African diets in relation to income.** Nigerian Agricultural Journal 10(1):27-42. 1973. Engl., Sum. Engl., 18 Refs , Illus.

Cassava. Human nutrition. Consumption. Income. Economics. Developmental research.

The pattern of food consumption in Africa was examined in relation to observable changes in the demand for food associated with income increases. An important feature is the concentration on starchy staples such as cassava, yams, maize, millet and sorghum, which still contribute over 70% of total calorie intake; this is accompanied by protein deficiency. South of the Sahara, estimated per capita protein intake averages 59 g/day; this represents only 95% of requirements. Of greater concern is the quality of protein supplied; protein from animal sources averages only 9 g/day. This protein-calorie malnutrition results in nutritional diseases such as kwashiokor and marasmic kwashiokor in children, high child mortality, loss of strength in adults and poor overall human efficiency. Income affects both the quantity and quality of food consumed. Since the demand for food is inelastic, an increase in income causes a less than proportional increase in the quantity demanded. However, the relationship of income to food expenditure on different types of food is puzzling because per capita expenditure on staples increases with income. An explanation for this is that while per capita expenditure increases with increases in income, per capita calorie intake actually decreases. As a result, the bulkier and preferred staples like yams are substituted for the "inferior" staples like gari. At present, food distribution and processing are wasteful. Eliminating waste will have results similar to those of income increases; the quantity demanded, in absolute terms, will rise and the more expensive and "preferred" staples will be substituted for the relatively cheaper and "inferior" foods. These conclusions are vital for both the short- and long-run policy orientation as regards feeding, health and agricultural development. *(Author's summary)* J00 H00

0782-5298 PINSTRUP-ANDERSEN, P. and DIAZ, R.O **A suggested method for improving the information base for establishing priorities in cassava research.** *In* Nestel, B. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm; proceedings of an interdisciplinary workshop. Palmira, Colombia, 1975. Ottawa, Canada, International Development Research Centre, 1975. pp.51-60. Engl., Illus.

Cassava. Cassava programs. Developmental research. Production. Colombia.

This paper presents the methodology used by CIAT to carry out agro-economic analyses and discusses the experience gained from the empirical testing of the methodology for cassava in Colombia, with illustrations of the kind of information obtained. The objective of the agro-economic analysis is to transmit the farmers' demand for applied agricultural research to the group that determines research priorities through the establishment of a direct link The analysis focuses on 4 aspects: (1) describing the production process, (2) identifying factors limiting production and productivity, (3) estimating the relative importance of each of these factors, and (4) obtaining indications of the technological characteristics preferred by the farmer Emphasis is placed on identifying the principal factors limiting production and productivity and estimating the implications of removing these factors. The following aspects of the process are discussed: structure, conducts, performance, farmers' objectives, data-gathering mechanisms, agrobiological experiments, data analysis, empirical results and benefits. These farm surveys were designed to gather information needed to establish research priorities, other applications are considered secondary. CIAT is already providing technical assistance on these matters. *(Summary by P.G. Trans. by S S. de S.)* J00

0783-2953 PUVIS, J. **Le manioc et dérivés.** *(Cassava and its by-products).* Marchés Coloniaux du Monde no. 245:1667-1668. 1950. Fr.

Cassava. Factories. Cassava starch. Tapiocas. Production. Trade. Malagasy Republic.

Several aspects of cassava growing in Madagascar are treated summarily. After making a brief historical review, the cassava-producing regions and the agronomic practices used are discussed Flour, tapioca starch and dry cassava exports from 1931-48 are compared. Cassava uses in feeding and industry are mentioned. *(Summary by S S. de S.)* J00

0784-6914 RAHMAH, B. A. **Some aspects of the tapioca industry in west Malaysia including a case study of the Sharikat Ubiyu Sendirian Berhad Kuantan.** B. Agr. Sc. Thesis. Kuala Lumpur, University of Malaya, Faculty of Agriculture, 1974 72p. Engl., Sum Engl., 7 Refs., Illus.

Cassava. Cassava flour. Cassava starch. Pellets. Tapiocas, Factories. Trade. Wastes. Prices. Cassava chips. Costs. Legal aspects. Developmental costs. Cassava programs. Malaysia.

Some aspects of the cassava industry in peninsular Malaysia are reviewed, including discussions on exports and imports of cassava products. A case study of the Sharikat Ubiyu cassava starch factory, set up in Kuantan by MARA to alleviate the low incomes of subsistance farmers, is included. The economic viability of the factory was assessed, using break-even and internal rate of return criteria. The factory had been underutilizing its plant due to acute shortages of raw material. Although the factory now has its own plantation, the cassava root supply is not expected to meet the maximum requirements of the starch plant at least until 1976. Cassava cultivation can be profitable if proper cultural practices are adopted; however, subsistance farmers around Kuantan have not been able to produce the expected yield and the outlook for future increases is doubtful. *(Author's summary)* J00 I02

0785-7012 RAMOS, E.L. and LINS, E.R. DE **Aspectos da produção e comercialição de mandioca no Estado da Bahia.** *(Aspects of cassava production and marketing in the state of Bahia). In* Projeto mandioca. Cruz das Almas, Brazil, Convênio U.F. Ba./BRASCAN Nordeste. Série Pesquisa v.2, no. 1. 1975. pp. 159-187. Port., Sum. Port., Engl., 10 Refs., Illus.

Cassava. Production. Cultivars. Productivity. Cassava flour. Cassava chips. Prices. Factories. Mechanization. Marketing. Consumption. Brazil.

A survey was made of cassava production and marketing systems existing in the 2 main producing regions of the state of Bahia (Brazil). Emphasis was placed on a general description of the agricultural production systems, the cassava processing industry (utilization of resources, production and marketing), and prices. Both subsistence and commercial levels of production were found. *(Author's summary)* J00 I02

0786-1609 ROSE, R.E **Cassava growing and starch making in Florida.** n.i. 4p. Engl.

Cassava. Factories. Industrialization. Costs. Production. USA.

The estimated costs and profits of cassava growing based on a yield of 10 tons of roots/acre and the costs of erecting a starch factory to handle 50 tons of roots/day (24 h) are presented. The value of waste products used in livestock feed is not included. A starch factory can also be used as a flour mill with little additional expense. *(Summary by A.J. Trans. by S.S. de S.)* J00 I02

0787-7288 SPURGEON, D. **Avances de la investigación mundial sobre yuca.** *(Advances in cassava research).* CIID Informa 4(4):1-6. 1976. Span., Illus.

Cassava. *Manihot esculenta.* Cassava programs. Development.

This is a general review of progress made by cassava research at a world level since 1970 when research on cassava started as a result of the Canadian International Development Agency/Centro Internacional de Agricultura Tropical agreement. The research has been coordinated by the International Development Research Centre since its creation. The achievements of the 1st 4 yr of activities include (1) the identification of high-yielding Colombian cassava varieties; (2) control of cassava bacterial blight and identification of pest- and disease-resistant varieties; (3) establishment of a breeding program; (4) development of rapid propagation methods and cultural techniques to produce disease-free materials; and (5) development of improved storage methods. The cassava symposiums that have taken place up to 1975 are listed

Emphasis is placed on the classification of the characteristics of the germplasm collection at CIAT The most important goal is to develop an ideotype by incorporating 20-30 desirable characters into 1 variety (*Summary by A.J. Trans. by S.S. de S.*) J00

0788-6879 STROBOSCH, P. **A socio-economic study of cassava and cassava starch production in an Andean village in Colombia.** Palmira, Colombia. Centro Internacional de Agricultura Tropical. 1976 90p. Engl., Illus.

Cassava. Cultivation. Marketing. Costs. Production. Cassava starch. Processing. Prices. Income. Developmental research. Colombia.

A socioeconomic study on the production of cassava and its starch was conducted in Cuatro Esquinas, Cauca (Colombia) from Aug. 1975 to Jan. 1976. This region was chosen because a great deal of cassava is cultivated in this area, and there are several small starch factories. Informal interviews were held with 27 farmers and 8 factory owners. First, the historical and present situation of the physical and socioeconomic structures of the town and its agricultural activities are presented Sugar cane growers shifted to cassava as a result of the introduction of small starch factories in the region, the construction of the road Tambo-Cuatro Esquinas, and the increase in population and area planted. Cassava is cultivated under small-scale, traditional production conditions. Part of the production is utilized to meet individual family needs and part for industrial purposes; it is also used for animal feed. Cassava is planted in monoculture or intercropped with plantain, maize and/or beans. The starch manufacturing process and estimated production costs are given. Cassava production faces 3 main problems: the gradual decrease in yields (loss of soil fertility and frog skin disease), land scarcity and unemployment. Since the farmer' decision-making process in unknown, it is difficult to introduce an agricultural extension service. Therefore, more socioeconomic studies should be conducted at the farm level. The development of cassava production in the region will depend on credit facilities, technical assistance and field demonstrations, especially regarding the use of fertilizers and new varieties. *(Summary by A.J. Trans. by S.S. de S.)* J00 D00 I02

0789-4882 SUBRAMAHNYAN, V. **Industrial crops as food during times of emergency.** Bulletin. Central Food Technological Research Institute (India) 2:7-9. 1952. Engl.

Cassava. Cassava programs. Human nutrition. India.

Because of the rapid population increase in Mysore, it was proposed that cassava be cultivated since there is a great demand for starch products and it can be used as a food in times of necessity. Brief comments are given on the uses of cassava in different areas and its low cost. *(Summary by T.M.)* J00

0790-7392 **TAPIOCA:A new industry for the Ord?** University of Sydney News 7(15) 121-122. 1975. Engl., Illus.

Cassava. Cassava programs. Australia.

Aspects that should be taken into account for cultivating and processing cassava in the region of the River Ord (Australia) are outlined. Emphasis is placed on the hardiness and ease of cultivation of this crop, on the variety of by-products that can be obtained from it such as starch, dextrose and ethyl alcohol, and on the possibility of using cassava leaves for animal forage *(Summary by A.J. Trans. by S.S. de S.)* J00

0791-4562 TAPIOCA CULTIVATION in West Malaysia and its export potential. *In* The cultivation of maize, banana and tapioca in West Malaysia and their export potential. Kuala Lumpur, Ministry of Agriculture and Cooperative, Federal Agricultural Marketing Authority, 1969. pp i-v, 10-18. Engl.

Cassava. Cassava starch. Cassava chips. Production. Cassava meal. Cassava flour. Wastes. Tapiocas. Trade. Malaysia.

The Malaysian Government is placing heavy emphasis on agricultural development, expanding land under cultivation to satisfy output, income and employment targets, as well as broadening the base of the agricultural sector in order to strengthen the country's economic development and decrease its dependence on rubber. To date, it has successfully adopted oil palm; the search for a third crop includes maize, cassava and bananas. Comprehensive marketing studies are included for each of these commodities. The potential market for cassava is essentially export (starch and chips). The high cost of freight is one of the main limiting factors for West Malaysia; this problem could be solved by pelletizing the chips, thereby reducing freight costs 45%. The study includes data on area planted to cassava, industrial production, overseas markets (principally the USA and Europe). Tables give data on cassava by-products for human consumption exported by West Malaysia (1962-66) and Thailand (1965-66) and on cassava chips and meal exported by the latter during the first quarter of 1968. As regards starch, an analysis is made of its uses in the USA and production in Brazil (Thailand's main competitor). *(Summary by L.C. Trans. by T.M.)* J00

0792-3903 TITAPIWATANAKUN, B. **Cassava industry in Thailand.** Thesis Master of Economics. Bangkok, Thammasat University, Faculty of Economics, 1974. 152p Engl., Sum. Engl., 29 Refs., Illus.

Cassava. Developmental research. Factories. Pellets. Cassava chips. Cassava flour. Distribution. Cassava starch. Consumption. Trade. Marketing. Cassava meal. Legal aspects. Production. Prices. Cassava programs. Cultivation. Industrialization. Processing. Thailand.

The development of the cassava industry in Thailand is studied, with special reference made to expansion resulting from the advent of the pelleting process in the late 1960's. The major external force affecting the industry's structure is the strong demand for cassava as an animal feed in the EEC countries. At present more than 90% of the total production is exported. Government control is mainly of the exporters and the quality of the exported products Problems arising from the rapid expansion include changing rainfall patterns (more frequent drought) caused by irrational land clearance; lack of roads and rising fuel costs, which affect domestic transportation, no local cargo vessels and poor port facilities which force the processors to sell to agents at Bangkok; and high fertilizer prices. A number of policy recommendations are made. *(Summary by T.M.)* J00 I02

0793-1724 TRAVANCORE-COCHIN. TAPIOCA ENQUIRY COMMITTEE. **Final report.** Ernakulam, S. G. P. at the Government Press, 1952 125p. Engl.

Cassava. Cassava programs. Developmental research. Production. Prices. Cassava chips. Casava flour. Consumption. Cassava starch. Industrialization. Tapiocas. Tapioca macaroni. Marketing. Trade. Factories. India.

Cassava has been under strict governmental control since 1942 in view of its economic importance in the state of Travancore. Three previous reports (up to 1952) are summarized. Then the following aspects are discussed: (1) Cassava cultivation· historical data, production costs, area planted to cassava, intercropping, planting seasons, varieties, crop management (damage caused by rodents—up to 30%— is mentioned), sliced cassava (dried and boiled), cassava flour, storage and transportation. (2) Statistical data on production (1-12 tons/acre) by districts and retail prices. (3) Economic significance: As a substitute for rice, cassava is an important foodstuff in the state of Travancore-Cochin. Cassava is supplemented with protein in the form of fish, legumes and coconut. Consumer trends were studied, based on the family budget. (4) Production: economic consequences of the low prices of cassava, small farmers and consumers' interests, and future price policies. (5) Industrial possibilities: starch and its uses, flour, tapioca (sago), synthetic grains, glucose and alcohol. Recommendations are made to improve the production of the Lakshmi starch and flour factory and to establish a cassava research institute. (6) Future policies: (1) eliminate restrictions on exports and on the transformation of cassava into industrial products; (2) increase production without affecting domestic prices; (3) promote cassava cultivation outside the state and permit its industrialization only when the domestic market has been satisfied; (4) create an official board to control this crop permanently. The appendices give the conclusions and recommendations for each of the chapters and previous reports. *(Summary by L.F.C. Trans. by S.S. de S.)* J00 I02

0794-4494 URIBE E., C. **La yuca y sus posibilidades económicas e industriales en Colombia.** *(Cassava: its economic and industrial possibilities in Colombia).* Boletín de Agricultura 1932:705-726. Julio 1932. Span.

Cassava. Cassava programs. Industrialization. Trade. Marketing. Cultivation. Processing. Uses. Colombia.

It is recommended that the industrialization of cassava should be developed for exportation purposes in order to stabilize the balance of payments. Cassava is presently consumed in cooked form and the only product made from it is flour; whereas in Brazil, a great no. of by-products that could also be made in Colombia are obtained: tapioca, dried chips, flour, starch, motor alcohol and bread. The aerial part of the plant is also used for animal feed. The program proposed for Colombia includes the following steps. (1) to classify varieties, (2) to carry out agronomic trials with these materials, (3) to set up machinery for processing starch, flour, tapioca and chips at an experimental level, (4) to develop cassava cultivation near seaports, (5) to present price quotations to foreign seaports, (6) to control exports, and (7) to keep records on activities such as production, area planted to cassava, exports, etc. The production of dried cassava chips should be industrialized because of the export demand, and technical information should be disseminated to promote cassava cultivation and industrialization. *(Summary by A.J. Trans. by S.S. de S.)* J00 I02

0795-6915 YEPES Y., E. **La yuca en Colombia y el mundo. Situación actual de la producción.** *(Cassava in Colombia and in the world. The present status of production). In* Curso sobre producción de yuca. Medellín, Instituto Colombiano Agropecuario, Regional 4, 1975. pp.1-17. Span., 18 Refs.

Cassava. Cassava programs. Production. Consumption. Prices. Productivity. Economics. Colombia.

An analysis is made of the socioeconomic importance of cassava (*Manihot esculenta* Crantz) in Colombia and other countries. In Colombia, cassava is still cultivated on plots of less than 5 ha, but there are farms of more than 50 ha that are applying the most advanced techniques recommended by the Instituto Colombiano Agropecuario and the Centro Internacional de Agricultura Tropical. The main problem affecting this crop is the scarcity of planting material. Based on technical assistance and credit facilities, an increase in yields of 11.1% has been projected for 1976, maintaining the same area cultivated in 1975 and increasing the national av yield to 10 tons/ha. The lack of adequate drying and storage methods is a basic problem. Cassava yields, production and area cultivated by all producing countries in the world from 1961-72 are presented in a table. In 1972, the largest producers were Brazil, Zaire, Portuguese Guinea and

Thailand The highest import volume corresponds to by-products for feed concentrates. As a result of the increase in industrialization and the scarcity of grains, future perspectives for cassava are promising. *(Summary by A.J. Trans. by S S. de S.)* J00

See also – *0029 0035 0119 0127 0164 0165 0196 0227 0282 0400 0483 0571 0595 0596 0610 0611 0630 0633 0670 0682 0712*

K00 OTHER ASSOCIATED COMMODITIES

0796-5374 CLARK, G. L., GROSS, S. T. and SMITH, W. H. **X-ray diffraction patterns of *Hevea, Manihot,* and other rubbers.** Journal of Research of the National Bureau of Standards 23:1-5. 1939. Engl., Sum. Engl., 12 Refs., Illus.

Manihot glaziovii. **Ceará rubber. Analysis. Laboratory experiments.**

When rubber from *Hevea brasiliensis* is stretched quickly and exposed to a beam of x-rays, a crystal fiber diffraction pattern is obtained. During previous work on sol and gel fractions of this rubber, done jointly by the National Bureau of Standards and the University of Illinois, no pattern was produced by the stretched sol fraction. With the stretched gel fraction, however, the pattern was sharp and intense. Rubber from *Manihot glaziovii* may also be separated into sol and gel fractions; and in recent work they, too, have been stretched and examined by x-rays. With the stretched *Manihot* sol, a few interferences were obtained; but many more resulted with the stretched gel. When crystallized by "freezing" at low temperatures for 24 h, the interferences from the gel again outnumbered those from the sol The x-ray measurements of *Manihot* rubber agree with those of *Hevea* rubber, indicating that the same structure exists in each. *(Author's summary)* K00

0797-4431 VINCENS, F. **Une maladie cryptogramique du *Manihot glaziovii,* arbre à caoutchouc du Céara.** *(A fungus disease of the Ceará rubber tree, Manihot glaziovii).* Bulletin de la Société de Pathologie Végétale 3 22-25. 1916. Fr., Illus.

Manihot glaziovii. **Mycoses. Brazil.**

A disease of the Ceará rubber tree *(Manihot glaziovii),* observed in 1913, in the vicinity of Rio de Janeiro is described. Its characteristics are round leaf spots formed by brown, necrosed tissues and surrounded by a light green halo; dark conidiosphores, measuring 250-300 μ, are topped by a black granular head; 4-5 conidiosphores give origin to globed- or oval-shaped spores with a 25-38 μ diameter, which are grouped on top of each conidiosphore; and evanescent mycelium. This fungus was reported only once in an almost inaccessible place and for this reason is not considered dangerous. It could be classified within the genus *Haplographium* Berk and Br.; the suggested name is *Haplographium manihoticola. (Summary by S.S. de S.)* K00

K01 Rotational Schemes and Intercropping

0798-2126 LAMBOURNE, J. **A preliminary report on tapioca as a catch-crop with oil palms.** Malayan Agricultural Journal 15:104-113. 1927. Engl., Sum. Engl.

Cassava. Inter-cropping. Fertilizers. Field experiments. Tuber productivity. Potash. N. Nutritional requirements. Cultivars. Malaysia.

An intercropping experiment was conducted to determine the effect of cassava on oil palms and at the same time to produce an income until the latter bore fruit Four Philippine varieties were used, the yields of which are given in tables. Data on constituents removed from the soil by the cassava plant are also given in tables. Although the growth of the palms was not so good in the cassava plots during the time the latter was in the ground, they increased in size much faster than in the control, once the first crop was harvested and are therefore now slightly larger than in the control. This is no doubt due to the cultivation received by those plots during the harvesting of the cassava crop and the second planting. Figures given are for the 1st crop only; it remains to be seen how many cassava crops can be taken from these plots without detriment to the palms. (*Summary by T.M.*) K01 D03

See also 0172

Z00 GENERAL

0799-3117 ALBUQUERQUE, M. DE A mandioca na Amazonia. *(Cassava in the Amazonian region).* Belém, Pará, Brasil, Superintendencia do Desenvolvimento da Amazonia, 1969. 277p Port , 118 Refs., Illus

Cassava. *Manihot esculenta.* Plant anatomy. Plant physiology. Planting. Cuttings. Spacing. Fertilizers. Harvesting. Cultivation systems. Diseases and pathogens. Injurious insects. Processing. Cassava products. Uses. Human nutrition. Nutritive value. Toxicity. Productivity. Cassava flour. Cassava starch. Production. Plant breeding. Cassava programs. Brazil.

The purpose of this study is to show what has been, is and will be the exploitation of cassava in Brazil, giving at the same time a general idea of the place this crop occupies in other countries of the world. It highlights several agro-industrial and socioeconomic aspects of cassava growing in the Amazonian region. The aspects dealt with are origin, dissemination, importance in the world and in Brazil, plant morphology and physiology, environmental conditions, planting material and density, fertilization, agronomic practices, crop association and rotation, harvesting, labor requirements, pests and diseases, human consumption, industrial uses, plant improvement, nutritive value, toxicity, productivity and a detailed review of the research work conducted by the Instituto de Pesquisas e Experimentação Agropecuária do Norte. *(Summary by S.S. de S.)* Z00

0800-0672 ALBUQUERQUE, M. DE **Mandioca.** *(Cassava).* Belém, Brasil. Instituto de Pesquisas e Experimentação Agropecuarias do Norte. Série Fitotecnia v.1, no.1. 1970. 65p. Port , 10 Refs., Illus.

Cassava. Cassava programs. Cultivation. Plant breeding. Productivity. Cultivars. Starch content. Selection. Plant physiology. Production. Cassava flour. Uses. Food enrichment. Plant geography. Maps. Brazil.

IPEAN's objectives in cassava research are to determine the best cultivars for the different areas and forms of utilization; to establish the best agronomic practices and industrialization processes; and to obtain the ideal clone. The results are given of trials carried out on planting seasons and spacings, intercropping and rotation with maize, rice and beans, phytosanitary practices and harvesting Genetic activities include evaluation of cultivars and clones, controlled pollination, selection for use and screening in propagation fields. Technological activities focus on studies such as HCN content, protein and starch percentages, fermentation, nutritive additives and aflatoxin. Research was also conducted on botanical and economic aspects, nutritive value and toxicity, pests and diseases. An overview is given of the zones Bragantina and Guajarina (state of Amazonas). Emphasis is placed on cultural practices, forms of utilization and socioeconomic aspects. These zones are important for the large-scale production of cassava. Three methods to increase the protein level of cassava flour are presented: the addition of soy flour (52% protein), soy milk residues, and whole beans. *(Summary by W.P. Trans. by S.S. de S.)* Z00

0801-1649 ANGLADETTE, M. **Note sur la production du manioc.** *(Cassava production). In*

Congrès du Manioc et de Plantes Féculentes Tropicales, Marseille 1949. Marseille, Institut Colonial, 1949. pp. 142-163. Fr.

Cassava. Production. Cultivars. Plant geograply. Tuber productivity. Starch productivity. Land preparation. Planting. Spacing. Cuttings. N. P. K. Fertilizers. Composition. HCN content. Detoxification. Prices. Cassava chips. Cassava flour. Cassava starch. Trade. Legal aspects. Nutritive value. Indochina.

Although cassava growing has a secondary place in Indochina, some research was carried out on this crop during the first 40 years of this century up to World War II Data refers only to these years. A very superficial study is made of aspects such as varieties grown in several regions, starch and fresh root yields, agronomic practices, crop upkeep, harvesting and storage, industrial methods for cassava processing and preservation, HCN content, the food value of cassava and its by-products, and foreign trade. *(Summary by S S. de S.)* Z00

0802-0745 AR'AQUE, R. La yuca. (*Cassava*) Espiga (Venezuela) Jul-Ag :7-11; Sep-Oct :7-11 1962. Span , 5 Refs , Illus.

Cassava. Cultivars. Identification. Cultivation. Injurions insects. Costs. Cassava products. Uses. Venezuela.

The objective of this paper on cassava is to provide the Venezuelan farmers with data concerning its cultivation and industrialization. It discusses its importance, origin, morphological description, types and varieties and describes agronomic practices. In addition, it includes some pests of economic importance and their control. the cassava hornworm (*Erinnyis ello*), shoot flies, stemborers, leaf galls, ants (*Acromyrmex octospinosus*) and whiteflies (*Aleurocantrix* sp.). Important diseases are not reported. Production and marketing costs of cassava, as well as other economic aspects, are also included. Lastly, it discusses some aspects of cassava utilization for swine feeding and industrial uses with emphasis on starch manufacture *(Summary by A J. Trans. by S. S. de S)* Z00

0803-4984 BARREIRA, M. Mandioca; aspectos agrícolas y económicos. *(Agro-economic aspects of cassava).* Brasil Ministerio da Agricultura. Serviço de Informação Agricola. Série Tubérculos e Raízes Alimenticias. Publicacão no. 1. 1940. 19p. Port.

Cassava. Production. Productivity. Cassava meal. Animal nutrition. Human nutrition. Industrialization. Cultivation. Brazil.

Some agro-economic aspects of cassava cultivation are presented with the purpose of promoting its cultivation and industrialization in Brazil. Special emphasis is placed on breadmaking with cassava and wheat flour so that wheat imports can be reduced. There is a need for combining agronomic research (production of high-yielding varieties with a greater protein content, improvement of cultural practices, etc.) with industrial research in order to obtain by-products in addition to starch (i é., dextrins, glucose and alcohol). The importance of alcohol as a fuel and its possibilities in Brazil are pointed out. Cassava could also be used better in human and animal nutrition. *(Summary by A.J Trans. by S.S. de S)* Z00

0804-1641 BEDU, P. Note sur le manioc au Cameroun. *(Cassava in Cameroon). In* Congrès du Manioc et des Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institut Colonial, 1949. pp. 93-99. Fr.

Cassava. Cultivars. Cultivation. Cassava products. Uses. HCN content. Analysis. Marketing. Industrialization. Cameroon.

Until 1948 cassava was used mainly for human consumption in Cameroon, from this date onwards, its industrialization began. Cassava varieties, their nutritive value and agronomic practices are dealt with summarily. Industrialization projects include the erection of a cassava processing factory in the region of Yaoundé and the setting up of a distillery to produce alcohol in Tombo. Instructions for determining and eliminating HCN are included. Cameroon has never exported cassava to France and will not be able to until the necessary steps to promote its industrialization are taken. *(Summary by S.S de S.)* Z00

0805-0021 BROOKS, G.B. **Cassava as a stock food.** Queensland Agricultural Journal 25:515-516 1926. Engl.

Cassava. Cultivation. Cultivars. Uses. Australia.

The toxicity of several cassava varieties introduced into Queensland from Java with the purpose of producing motor alcohol is discussed summarily since these varieties were later used for human and animal consumption as well. Sao Pedro Preto, Creolinha and, to a certain extent, Itaparica, Tapicuru and Basiorao are poisonous, whereas Mangi and Valenca can be eaten raw. *(Summary by A.J. Trans. by S.S. de S.)* Z00

0806-3475 BRUNO, E. S. **Brasil nasceu com a mandioca.** *(Historical aspects of cassava in Brazil).* Coopercotia 22(193):21-22. 1965. Port., Illus.

Cassava. History. Brazil.

This is a historical review of the colonial period in Brazil and the importance of the sugar cane industry in comparison to cassava during the 16th-18th centuries. Some provisions taken by the Government at that time to prevent cassava from being wiped out are mentioned. *(Summary by P.G. Trans. by S.S. de S.)* Z00

0807-4628 CARIBBEAN COMMISSION. **Root crops and legumes in the Caribbean.** Washington. Caribbean Research Council. Committee on Agriculture, Nutrition, Fisheries and Forestry. Crop Inquiry Series no. 4. 1947. 129p. Engl., Illus.

Cassava. Cultivation. Diseases and pathogens. Injurious insects. Caribbean.

Root crops and legumes play an important role in the Caribbean diet, but they are cultivated only by small farmers. Storage facilities are practically nonexistant. Processing is rudimentary; principal products are arrowroot starch, cassava starch, meal, flour, cassareep, bread and cakes. Main limitations are political, not technical: most of the good land is dedicated to sugar cane. The following aspects of cassava cultivation are dealt with: ecological considerations, propagation methods, yields, extension services, toxicity, cooking qualities, wartime promotion, etc. Pests include thrips, the red spider mite, the cassava hornworm, leaf-cutter ants and shoot flies. Diseases mentioned are black rot (*Rosellinia* sp.), Cercospora leaf spots and anthracnose. *(Summary by T.M.)* Z00

0808-3860 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. **Programa de sistemas de producción de yuca.** *(Cassava production systems program).* Cali, Colombia, 1974. 16p. Span., Illus.

Cassava. *Manihot esculenta.* Cassava programs. Plant physiology. Entomology. Plant breeding. Cultivation. Storage. Colombia.

This article discusses the importance of cassava as a food and analyzes the present state of the crop, as well as optimum areas for its establishment. CIAT's cassava program objectives and advances made up to 1974 are discussed in detail for the following units: plant physiology, plant pathology, entomology, weed control, plant improvement, agronomy, agricultural economics. Studies on storage and processing methods and the abstracting services lent by CIAT's library through the Cassava Information Center are also dealt with. (*Summary by L.F.C. Trans. by S.S. de S.*) Z00

0809-0597 CERIGHELLI, R. **Manioc.** *(Cassava). In*_____. Cultures tropicales. I. Plantes vivrières. Paris, Librairie, J. B. Baillière, 1955. pp 289-378. (Nouvelle Encyclopédie Agricole). Fr., 43 Refs., Illus.

Cassava. Stems. Leaves. Flowers. Tubers. Cultivars. Identification. Plant development. Nutritional requirements. Climatic requirements. Cassava mosaic virus. ***Xanthomonas manihotis.*** **Injurious insects. Fertilizers. Planting. Spacing. Harvesting. Timing. Productivity. Composition. Cassava flour. Pulp. Casave. Gari. Cassava starch. Tapiocas. HCN content. Processing. Uses.**

This is a comprehensive, illustrated study of cassava in the world. It is divided into different sections that discuss in detail the following aspects: general description of the plant, species and varieties, main stages of development, ecological conditions, pests and diseases, agronomic practices, cropping systems, yields, chemical composition of fresh roots under different conditions, processing (sliced dry cassava, flour, couac, casave and tapioca), main chemical components of cassava (HCN, vitamins, minerals), and uses as a food and in industry. *(Summary by S.S de S.)* Z00

0810-5025 COLOM, J. L. **Cassava: an economic plant native to Latin America.** Bulletin of the Panamerican Union 66:639-650. 1932. Engl., Illus.

Cassava. Cultivation. Tubers. Composition. Cassava products. Food products. Uses. Trade.

An analysis is given of the economic importance of cassava. A general description is included of the following aspects: nomenclature, botanic description, chemical analysis, history, agronomic practices, uses and products, importance in Latin America and the United States, and exports. *(Summary by L.N.A. Trans. by S.S. de S)* Z00

0811-3737 COLOM, J. L. **La yuca.** *(Cassava).* Almanaque Agrícola de la República Dominicana 1948:72,75-76. 1948. Span.

Cassava. Cassava flour. Composition. Uses. Dominican Republic.

An analysis is made of the chemical composition of cassava tubers and flour with the purpose of establishing the bases for the partial substitution of wheat by cassava flour in breadmaking. A botanical description of the species and some notes on its origin are included. *(Summary by A.J. Trans. by S.S. de S.)* Z00

0812-6801 **COUNTRY PRESENTATIONS; summary of information on cassava production in Africa and Sri Lanka.** *In* Terry, E.R. and MacIntyre, R., eds. The International Exchange and Testing of Cassava Germ Plasm in Africa, proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre, 1976. pp.31-34. Engl.

Cassava. Cassava programs. Productivity. Diseases and pathogens. Injurious insects. Cultivation systems. Africa. Sri Lanka.

General information on cassava in African countries is summarized in a table. The countries included are Cameroon, Ghana, Liberia, Malagasy Republic, Malawi, Sierra Leone, Sri Lanka, Tanzania, Togo, Uganda and Zaire. Data given for each country are germplasm collected and evaluated, yields (tons/ha), area planted to cassava, type of culture (mono- or poly-) diseases, pests, quarantine, personnel, financing and projects. *(Summary by A.J. Trans. by S.S. de S.)* Z00

0813-3735 COURS, G. **Le manioc à Madagascar.** (*Cassava in Madagascar*). Mémoires de l'Institut Scientifique de Madagascar (Série B. Biologie Végétale) 3(2):203-416. 1951. Fr.; 318 Refs., Illus.

Cassava. *Manihot esculenta*. Clones. Cultivars. Identification. Selection. Stems. Shoots. Plant development. Plant height. Leaves. Petioles. Flowers. Fruits. Plant fertility. Tubers. Composition. Tuber development. Cassava starch. Particle size. Metabolism. Nutrient loss. Processing. Resistance. Deterioration. Cassava mosaic virus. Starch content. Plant breeding. Propagation. *Manihot glaziovii*. Cultivation. Plant physiology. Hybrids. Malagasy Republic.

This a very comprehensive manual on cassava growing in Madagascar. The first part describes in detail *Manihot* species and their characteristics, classifies the varieties found in the country, and studies the development of the plant. The second part focuses on the starch—from the moment it starts to form in the root until it is processed—and on the factors affecting yields. It also describes the work on genetic improvement that is being carried out at the Alaotra Agricultural Station, where almost all trials included in this manual took place. Finally, a series of recommendations are made to producers It includes an extensive bibliography in addition to numerous tables and illustrations. (*Summary by S.S. de S.*) Z00

0814-1853 **EL CULTIVO e industrialización de la yuca y sus grandes posibilidades para la economía nacional.** *(Cassava cultivation: great possibilities for the Costa Rican economy)* Revista de Agricultura (Costa Rica) 29(9):386-389. 1974. Span.

Cassava. Cultivation. Nutritive value. Uses. Costa Rica.

After giving a brief background of the origin and development of cassava in Costa Rica, a review is made of several articles dealing with its cultivation, HCN content and good agronomic practices. Because of the scarcity of wheat flour, the Government decreed the use of 10% cassava flour in breadmaking; however, this decree was never put into effect. The formation of cooperatives should foment the production and industrial applications of cassava. *(Summary by L.C. Trans. by T.M.)* Z00

0815-4740 DEVEZA, M. C. **A mandioca; sua importancia cultural.** *(Cassava; its importance as a food crop).* Gazeta do Agricultor (Mozambique) 4.15-16. 1952. Port.

Cassava. Uses. Human nutrition. Animal nutrition. Cassava products. Portuguese East Africa.

The importance of cassava as a food crop, both for man and animals, is indicated. In addition, this article includes very brief information on cassava toxicity, detoxification, by-products and export data. *(Summary by L.F.C. Trans. by S.S. de S.)* Z00

0816-0179 DIAS, C.A.C. **Mandioca: utilização determina variedade.** *(Cassava: characteristics and uses of different varieties).* n.i. 1963? pp.56-59. Port.

Cassava. Cultivars. Uses. Brazil.

An analysis is made of root quality, starch content, resistance to pests and diseases, HCN content, yields/ha, etc of several cassava varieties recommended for industrial purposes and human or animal feeding in Brazil. *(Summary by P.G. Trans. by S.S. de S.)* Z00

0817-4338 DRESSLER, R.L. **The pre-Columbian cultivated plants of Mexico.** Botanical Museum Leaflets 16(6):115-171 1953. Engl., Sum. Engl., 213 Refs.

Cassava. *Manihot esculenta*. History. Mexico.

Mexico was one of the two great agricultural centers of the New World. The problems involved in studying pre-Columbian plants cultivated in this country are discussed, together with the criteria used for determining their geographical origin. Ethnobotanical and archaeological literature are reviewed. Over 80 species were selected on the basis of the changes undergone in their biology and patterns of distribution because of their association with man. Two *Manihot* species were included: *M. esculenta* Crantz and *M. dulcis* (J.F. Gmel.) Pax Sweet or less poisonous forms of cassava were grown in Mexico as vegetables; in-depth studies are required to determine whether *M. dulcis* is a sweet variety of *M. esculenta*. It is generally believed that cassava is of Brazilian origin, but here again further study is necessary. (*Summary by A.J. Trans. by S. S. de S.*) Z00

0818-5238 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. REPRESENTAÇÃO ESTADUAL NO PARA. **Mandioca; informe anual.** *(Cassava; annual report).* Belém, Brasil, 1975, 21p. Port.

Cassava. Plant geography. Injurious insects. Cultivation. Diseases and pathogens. HCN content. Food products. Soluble carbohydrates. Thiamin. Human health. Cultivars. Resistance. Inheritance. Nutritive value. Food products. Brazil.

A report is given on the status of cassava cultivation at the end of 1974 in the eastern Amazonian region under the supervision of IPEAN/EMBRAPA. The following aspects are dealt with briefly: control of pests *(Silba pendula, Atherigona excelsa, Jatrophorbia brasiliensis, Anastrepha pickeli, Atta* spp., *Acromyrmex* spp., *Acridium latreillei, Erinnyis ello, Tetranychus bimaculatus, Meloidogyne* sp.) and diseases caused by *Xanthomonas manihotis, Phytophthora drechsleri, Cercospora* spp. Cassava by-products and how their consumption affects health are also discussed. Plant improvement includes breeding for yield, early-maturing varieties, resistance, etc. Research is also being carried out in 3 different types of soil in the Transamazonian area (Altamira and Ataituba). Research in Belém and Tracuateua includes pollination between domestic and wild material *(M. quinquepartita, M. pentaphylla* and *M. glaziovii).* Other general aspects of a nutritional nature are also included. *(Summary by T.M.)* Z00

0819-0183 GOTTSCHALK, A.L.M. **The mandioca of Brazil.** Simmons' Spice Mill 41:689-699. 1918. Engl.

Cassava. Cultivars. Cultivation. Processing. Trade. Brazil.

A classification of varieties is made according to their toxicity, and the most important ones in the different states of Brazil are cited. Some planting dates and systems to obtain high yields are recommended. Crop rotation is seldom practiced, and empirical methods of fertilizing are used. The best-quality flour ("polvilho") is used in pastry making. Data on cassava flour exports from Brazil are given for 1910-14. (*Summary by P.G. Trans. by S.S. de S.*) Z00

0820-4934 GUNNING, E.H. and THOMSON, R. **The tapioca plant considered as an alternative food-stuff in seasons of scarcity and famine.** Agricultural Ledger 4(4):87-106. 1897. Engl

Cassava. Cultivation. Human nutrition. India.

This paper presents a series of letters dealing with a proposal made by R.H. Gunning to the Government of India to introduce and expand cassava cultivation in that country in order to use it as an alternative foodstuff during the periods of scarcity of cereals (especially rice) and famine Aspects of cassava growing in Travancore are included. *(Summary by A.J. Trans. by S.S. de S.)* Z00

0821-6935 HAYNES, P H. **Tropical root crops; a modern perspective.** Span 17(3):116-118. 1974 Engl, 15 Refs., Illus

Cassava. Starch crops. Uses. Processing.

Root crops have high development potential because they provide a substantial carbohydrate source for diets in areas where the level of technology is low. Major crops are cassava (more than ½ total root crop production), yams, edible aroids and sweet potatoes. Attitudes towards the different crops and their prospects are discussed summarily. The processing of composite root crop flours for bakery products and the possibilities of fungal protein production using root preparations as substrates are also discussed *(Summary by T.M.)* Z00

0822-1864 HENAIN, A.E. y CENOZ, H.M. **La mandioca (*Manihot esculenta* Crantz); segunda parte.** (*Cassava, Manihot esculenta Crantz. Part II*). Corrientes, Argentina. Universidad Nacional del Nordeste, Facultad de Agronomía y Veterinaria. Publicación no.14. 1972. 100p. Span., 21 Refs., Illus.

Cassava. *Manihot esculenta.* Cultivars. Plant breeding. Cultivation. Uses. Productivity. Nutritive value. Tubers. Storage. Factories. Argentina.

Aspects dealt with are harvesting, cultivars, breeding and industrial applications of cassava. Yields in poor soils range from 7-10 tons/ha; 15 tons/ha in good soils and with improved agronomic practices; and up to 40 tons/ha in fertile or well-fertilized soils with good cultural techniques. Methods for storing fresh roots 24 h after harvest are given. Reference is made to previous studies on improved clones; illustrations are given of leaf characters, pieces of main stem and roots. An outline is given of the different points to be considered in a breeding program, and the main characteristics of the ideal cassava plant are given in detail for each part of the plant. Formation of a clone collection, the acquiring of new clones, self-pollination, intervarietal crosses (random and controlled pollination), bases for a selection plan, interspecific crosses, as well as utilization of polyploidy, breeding for resistance, increased fertility and increased protein content are amply discussed. As regards industrial applications of cassava, the aerial part is valued for its high protein content and richness in vitamins A and C The leaves and branches are used mainly for forage. The roots are used for animal feedstuffs. The procedures for processing flour, starch, the many by-products made from the waste products of these processes, farinha, dextrin, glucose and alcohol are explained. *(Summary by T.M.)* Z00

0823-3797 KRISHNAMURTHY, R. **A note on the cultivation of tapioca and derivative food products from it.** Madras Agricultural Journal 36:523-526 1949. Engl.

Cassava. Planting. Land preparation. Timing. Harvesting. Productivity. Tapiocas. Processing. Cassava chips. Cassava flour. Uses. India.

Because of its high carbohydrate content, cassava plays an important role in the Indian economy. Through an intensive campaign on the use of cassava as a vegetable, dehydrated or sun-dried chips, flour, or sago, it is possible to supplement the cereal shortage. The following aspects are briefly discussed: planting material, cultural practices, yield, manufacture of tapioca on a small scale, sun-dried chips and flour. *(Summary by L.C. Trans. by T.M.)* Z00

0824-1740 LEMAIRE, M. E. Manioc. Journal of Geography 49(9):376-385. 1950. Engl., Illus.

Cassava. History. Toxicity. Climatic requirements. Productivity. Cassava products. Uses. Trade.

The economic importance of cassava in tropical and subtropical countries is emphasized, together with the need for paying more attention to its value as a foodstuff and its industrial and commercial potential. The following aspects are discussed: origin, different common names, morphological characteristics, growth conditions and requirements, regions where it grows, yield, cassava as a foodstuff, industrial uses and trade. *(Summary by L.C. Trans. by T.M.)* Z00

0825-2409 **LA MANDIOCA, su agricultura y su industria.** *(Cassava, its agriculture and industry).* Revista de Agricultura, Comercio y Trabajo 11:18-29. 1929. Span.

Cassava. Carbohydrate content. Fat content. Protein content. Starch content. Soil fertility. Rainfall data. Rotational crops. Inter-cropping. Factories. Processing. Costs. Production. Brazil.

A description is given of cassava in Brazil Data refer to best varieties grown in Brazil, chemical composition, soil and climatic requirements, cultivation, intercropping, costs of cultivation, industrial processing, starch, yields, uses and the role that cassava flour could play in bakery products *(Summary by H.J.S.)* Z00

0826-2393 **LA MANDIOCA puede constituir la base de grandes industrias.** *(Large industries could be based on cassava).* Chacra (Argentina) 15(180):35,47. 1947. Span., Illus.

Cassava. Cultivation. Processing. Uses. Argentina.

In Argentina, cassava is grown mainly in Misiones, Chaco, Corrientes and Tucuman. In order to promote its cultivation, its diverse nutritional and industrial applications are given. In addition to the processes for obtaining alcohol and starch, mention is made of some aspects of its utilization as a forage for cattle and swine feeding. (*Summary by A.J. Trans by S. S. de S.*) Z00

0827-6752 **MANIHOT MILL. (Euphorbiaceae).** *In* The wealth of India; a dictionary of India raw materials and industrial products. New Delhi, Council of Scientific and Industrial Research, 1962. v.6, pp.286-298. Engl., Illus.

Cassava. Cultivation. Production. Harvesting. Productivity. Composition. Cassava flour. Cassava starch. Cassava meals. Cassava chips. Tapioca macaroni. Plant breeding. Processing. Legal aspects. India.

A presentation is made of agronomic and industrial aspects of cassava growing in India, where it is considered a staple food. The cassava breeding program has focused on the production of hybrids between pures lines (promising hybrids 105, 96, 9/49 and 20/50 have been obtained) and on interspecific hybridization of *M. esculenta* with *M. glaziovii* and *M. saxicola.* Promising materials with desirable characteristics (high yields, greater vigor, resistance to drought and spreading habit of roots) have been obtained backcrossing *M. glaziovii* with *M. esculenta* for 4 generations. The bulk of the national cassava production comes from the state of Kerala, which is divided into very small holdings where this crop is grown for local consumption. A description is given of some widely grown varieties and their soil and climate requirements, as well as of the following aspects: crop association (with bananas, coconut, rubber, etc.), soil preparation, planting, fertilizing, harvesting, yields (an av of 5 tons/acre) and storage. Diseases caused by *Cercospora henningsii, C. cassavae, Fomes lignosus, Phytomonas* sp. and mosaic are important, but they do not limit production. The main pests are *Aonidomytilus albus, Tetranychus telarius* and *Lepidosaphes* sp. The chemical composition of the roots is given, and the production of chips, flour, suji, starch, sago, macaroni and waste by-products is described. Foreign trade is done on a limited scale. Finally, 2 other species grown in the country are described: *M. glaziovii* and *M. dichotoma* (*Summary by A.J. Trans. by S.S de S.*) Z00

0828-2360 MANIOC, THE **Congolese manna.** Belgian Congo Today 1(2):85-86. 1952. Engl.

Cassava. Production. Human nutrition. Zaire.

Cassava flour is the principal food of the rural population of the Belgian Congo. An area of 1750 acres was planted to cassava in 1950, yielding 6,149,754 tons. About 20 years before, a better variety was imported from Brazil; it became popular because of its high nutritive value and high yield. (*Summary by Tropical Abstracts*) Z00

0829-0116 MONTALDO, A. **Yuca o mandioca** *Manihot esculenta* **Euphorbiaceae.** *(Cassava).* *In* ______. Cultivo de raíces y tubérculos tropicales. Lima, Perú, Instituto Interamericano de Ciencias Agrícolas, 1972. pp.51-136 Span., 89 Refs., Illus.

Cassava. Taxonomy. Plant anatomy. Cultivation. Tuber productivity. Fertilizers. Plant breeding. Plant fertility. Toxicity. Cultivars. Identification. Diseases and pathogens. Injurious insects. Composition. Cassava products. Processing. Uses. Composition. Nutritive value.

This bibliographic revision on cassava (*Manihot esculenta* Crantz) was made on the basis of publications from cassava-producing countries. The main objective was to make a general and systematic compilation of the information regarding this Euphorbiaceae from a descriptive, scientific and technical point of view, in order to provide researchers with an updated document on the status and problems of this crop worldwide. The aspects dealt with are different names given to cassava, its history, geographical distribution, origin, taxonomic, morphologic and physiologic description of the plant, requirements and agronomic practices in several countries. As regards plant breeding, its objectives and achievements are indicated, and a descriptive list of the varieties grown in several countries is included. The symptoms of the main diseases (bacteria, fungi and viruses) and pests (*Erinnyis ello, Silba pendula, Coelosternus* spp., *Leptopharsa illudens, Atta sexdens,* etc.) are described. Finally, storage, chemical analysis, uses, nutritive value, production and marketing at a world level are discussed. *(Summary by A.J. Trans. by S.S. de S.)* Z00

0830-1643 MOUTON, M. J. **Le manioc en Afrique Équatoriale Française.** *(Cassava in French Equatorial Africa).* *In* Congrès du Manioc et des Plantes Féculentes Tropicales, Marseille, 1949. Marseille, Institut Colonial, 1949. pp.107-110. Fr.

Cassava. History. Cultivars. Plant breeding. Cultivation. Africa.

A general overview is given of the varieties, genetic improvement, agronomic practices and economic future of cassava in French Equatorial Africa. An account is given of the introduction of cassava in F.E.A. and the origin of the names given to the varieties The main objectives of the plant improvement program are to obtain high yields and resistance to mosaic. Agronomic practices dealt with are crop rotation, planting distances, optimum lengh of cuttings, and harvesting. Although large-scale plantations have been established, cassava has not yet been able to compete on the international market because of its low tonnage. *(Summary by S.S. de S.)* Z00

0831-1790 NICHOLLS, H.A. Cassava. *Manihot utilissima*. *In* ______. Textbook of Tropical Agriculture. London, Macmillan, 1929. pp.426-434. Engl., Illus.

Cassava. Cultivation. Cassava flour. Cassava starch. Processing. Cassareep.

The following aspects of cassava cultivation are discussed: climatic and edaphic requirements, fertilization, planting, agronomic practices, harvesting and washing of roots A description is also given of the steps involved in the processing of cassava flour, starch, tapioca and cassareep. *(Summary by A.J. Trans. by S.S. de S.)* Z00

0832-3929 PYNAERT, L. Le manioc. *(Cassava)* Bulletin Agricole du Congo Belge 19(2):163-241. 1928. Fr., 8 Refs , Illus.

Cassava. Taxonomy. Cultivars. Identification. Plant anatomy. Cultivation. Tuber productivity. Cassava starch. Cassava flour. Tapiocas. Processing. Food products. Trade. Zaire. Javá.

This is a general historical review of different aspects of cassava growing and industrialization in the world. Emphasis is placed on the varieties grown in Java, Malagasy Republic and the Belgian Congo. *(Summary by S.S. de S.)* Z00

0833-4760 READ, B. E. **Tapioca root in South China.** China Journal 35:25-27. 1941. Engl.

Cassava. History. China.

This is a historical review of cassava in Asia and its introduction to China It includes the names for cassava and its products in Chinese and its curative properties. *(Summary by L.F.C. Trans. by S.S. de S.)* Z00

0834-1872 SANTANA, A M Pesquisas e experimentação com mandioca. *(Cassava research and experiments).* Bahia, Universidade Federal da Bahia Escola Agronómica, 1968. 14p. Port., 88 Refs.

Cassava. Cassava programs. Cultivation. Animal nutrition. Industrialization. Brazil.

This report discusses a series of objectives of a research project on cassava that will be carried out by the Universidade Federal da Bahia: the collection and description of varieties; the study of pests and diseases; plant improvement, mechanization and irrigation, soils, climatic conditions and the comparison of chemical characteristics of known varieties, their toxicity, and industrialization. A table shows a detailed budget that includes resources available, researchers who will work on the project, and the methodology to be used. *(Summary by L.F.C. Trans. by S.S. de S.)* Z00

0835-4531 THOMSON, R. **The tapioca plant considered as an alternative foodstuff in seasons of scarcity and famine.** Agricultural Ledger 7(15):161-168. 1900. Engl.

Cassava. Cultivation. Human nutrition. India.

The correspondence between Mr. Robert Thomson and the Government of India during the years 1899 and 1900, in which the former recommends the introduction of Colombian cassava varieties into India, is presented. Aspects of cassava cultivation in India are mentioned. *(Summary by A.J. Trans. by S.S. de S.)* Z00

0836-3821 UNIVERSIDADE FEDERAL DA BAHIA. ESCOLA DE AGRONOMIA. **Projeto mandioca; relatório semestral de pesquisas, no. 5, jul/dez 1974.** *(Project on cassava).* Cruz das Almas, Bahia, Brasil, U.F. Ba/BRASCAN Nordeste, 1974. 91p. Port., 3 Refs.

Cassava. Cassava programs. Insect control. Mycoses. Bacterioses. Irrigation. Fertilizers. Field experiments. Climatic requirements. Planting. Timing. Tuber productivity. Spacing. Production. Cultivars. Selection. Plant breeding. Water content. Fibre content. Starch content. Pruning. Animal nutrition. Human nutrition. Marketing. Trade. Cassava starch. Consumption. Legal aspects. Brazil.

This document contains the cassava research activities carried out between June and Dec. 1974, under the agreement Universidade Federal da Bahia/BRASCAN Nordeste. Technical aid (graduate course) and genetic material were received from the Centro Internacional de Agricultura Tropical (CIAT). The subprojects are (1) genetic improvement: germplasm bank, controlled crosses, seedling fields, clone multiplication, induction of flowering; (2) pests: mite control, pest incidence in different planting seasons, screening of resistant cultivars, biology of the hornworm; (3) diseases: quarantine field, *Xanthomonas manihotis, Cercospora* spp., *Phyllosticta manihotae, Uromyces manihotis, Colletotrichum* and *Gloeosporium;* (4) irrigation; (5) soils and fertilization: efficiency of different N sources, P and K levels and methods of application, minor elements, foliar fertilization with urea, N/S interaction, effects of dolomitic lime applied to coastal plateau oxisols; (6) climatic influences: phenological studies of late- and early-maturing cultivars and potential evapotranspiration; (7) cultural pratices: planting seasons and distances, screening of late- and early-maturing cultivars (sweet varieties for human consumption, bitter ones for industrial purposes) at different harvesting times, evaluation of clones and standard varieties, herbicides, study of the factors spacing x cultivars x fertilization with irrigation; (8) chemistry and technology: raw material for sweet and bitter tapioca, analytic data (tables); (9) toxicity of sweet and bitter cassava; (10) forage: cassava meal in rations for fattening chicks, cassava meal and residues as substitutes for growing and fattening pigs, cassava hay in sheep feeding; (11) socioeconomic studies: average regional production and productivity of cultivated land (tables), the international market for cassava starch (table), main exporting countries; (12) dissemination of results (six reports dealing with these subprojects will be published soon). *(Summary by L.F.C. Trans. by S.S. de S.)* Z00

0837-4497 VAN DEN ABEELE, M. and VANDENPUT, R. **Manioc** *(Manihot esculenta* **Crantz;** *Manihot utilissima* **Pohl).** *(Cassava). In* ______. Les principales cultures du Congo Belge 3a ed. Bruxelles, Ministère des Colonies Direction de l'Agriculture, des Forêts et de l'Elevage, 1956 pp. 97-112 Fr., Illus

Cassava. Plant anatomy. Climatic requirements. Cultivation. Viroses. Mycoses. Productivity. Processing. Production. Zaire.

At present, cassava is the main source of hydrocarbons in the Congo and more land is planted to this crop than to any other. Its origin, description and ecological conditions are dealt with briefly. It describes the natives' agronomic practices from planting to harvesting; yields vary from 20-25 tons/ha As no storage methods are used, the crop is either planted at different times or processed immediately. Main diseases mentioned are mosaic, brown streak, *Armillaria mellea, Fomes lignosus* and *Sclerotium rolfsii.* Two systems for eliminating HCN are explained. Cassava is exported dried and sliced or already transformed into starch Of vital importance for the Congo would be the utilization of cassava alcohol to transform palm oil into motor fuel. *(Summary by S.S de S.)* Z00

AUTHOR INDEX

SUBJECT INDEX

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0204 VARON C., L. A. and GAR... Yuca: generalidades y técnicas de cultivo. (Cassava cultivation ... gropecuario. Curso intensivo cultivo de yu... nvestigaciones Agrícolas. 19... pp.3-13. Sp...

5349 PORRAS M., E. CIAT, Apartado aéreo 6713, Cali, Colombia. Las rodajas de yuca, una nueva agroindustria. (Cassava chips: a new agricultural enterprise). Surco Latinoamericano (Colombia) no. 1:6-7. 1975. Span.

Cassava. Productivity. Harvesting. Rooting. Cassava chips. Prices. Industrial machinery. Soil requirements. Drying. Factories. Nicaragua.

In the region of Cerro Negro (Nicaragua), good cassava yields (28 tons/ha) are obtained. A mechanical harvester of local design is used, reducing costs considerably. The roots are sliced and dried in the sun. These chips are sold for feedstuffs and to starch factories. (Summary by T.M.) D00 102

...do aéreo 6713, Cali, Colom... ...onesia [Cassava germplasm ... and testing of cassava ... Colombia. 1975. Ottawa, ...14. Engl., 8 Refs.

...assava production. The aspects to b... are set forth: germplasm exchange, ... cassava cultivars, comparative testing, and ... the development of cassava research. It also deal... characteristics of germplasm collected and with ongoing ... already done by the different institutions. Human and financ... extension are outlined. The only disease reported is bacterial wilt in... ...ychus bimaculatus is the most important pest. The plant breeding program... obtain clones resistant to both. Quarantine measures established by the Director... Agriculture, Jakarta are also given. (Summary by L.F.C. Trans. by S.S. de S.)

5304 FUMAGALLI, A. CIAT, Ap... Guatemala ... Macintyre, R. The international exchange of an interdisciplinary workshop, Palmira, C... Development Research Centre, 1975. pp. 21...

Cassava. Germplasm. Guatemala.

In Guatemala cassava is grown only in the southeast. About ... processed into starch and ... used for food. The germplasm ... are planned to cassava ... characteristics and average national yie... economic prospects ... A study on the use of cassava for feed... Agronomic practices are rudimentary; there are no research or exte... cassava production. It is believed that ... the following diseases and pests c... superelongation, Silba pendula ... Guatemala follows the q... the Central American area. (Summary ... Trans. by S.S. de S.) G0...

A trial was conducted in ... sorghum forage (7.4% crude pr... g/day of a supplement containing ... sesame, 9% molasses, and 1% minerals. ... adjustment of N by addition of urea. At th... for N balance and digestibility. Feed co... cassava. Digestibility of cellulose was low... 99 and 130 g, respectively, for the 4 t...

The ... cassava germ... and testing of ... interdi... workshop, Palmira, Colombia ... Develop... Research Centre, 1975. pp. 29-30.

Cassava. Germplasm. Cassava programs. Venezuela.

A report is given on germplasm collected, its ... used for evaluating it. Ongoing and fu... mentioned. The following diseases were eva... common mosaic virus, vein mosaic, supe... anthracnose. The country's quarantine restrictio... S.S. de S.) G01

...atu... from chromosome number ... chromosome ... obtained from 19 cult... mostly quadrivalent ... multivalent as... clear. (Su...

This a very comprehensive manual on cassava growing at Madagascar. The first part describes in detail Manihot species and their characteristics, classifies the varieties found in the country, and studies the development of the plant. The second part focuses on the starch—from the moment it starts to form in the root until it is processed—and on the factors affecting yields. It also describes the work on genetic improvement that is being carried out at the Alaotra Agricultural Station, where almost all trials included in this manual took place. Finally, a series of recommendations are made to producers. It includes an extensive bibliography in addition to numerous tables and illustrations. (Summary by S.S. de S.)

...ones. Cultivars. Identification. Selection. Stems. Shoots. Plant ...aves. Petioles. Flowers. Fruits. Plant fertility. Tubers. ...ant. Cassava starch. Particle size. Metabolism. Nutrient loss. ...tation. Cassava mosaic virus. Starch content. Plant breeding. Cultivation. Plant physiology. Hybrids. Malagasy Republic.

...Cass... ...ologie ...adagascar). Mémoires de ...étale) 2(2):203-416. 1951. Fr.

0077 BLANCO ... alimentary and indu... ...ssava ... exico.

Cassava. Cultivation. Cas...

...ssava growing in Mexico ... is very important sou... seases and can be cultivated in ...ally discussed; classification a... ...ur, starch, tapioca and alcohol ...lding of a pilot plant for manufacturing cassava starch in the state of ...

...neral cultural ... ...ral uses; chemical compos... ...and soils ...

Simmons' Spice Mill

... of Brazil

0183 GOTTSCHALK, A.L.V. 41:689-699. 1918. Engl.

Cassava. Cultivars. Cultivar...

A classification of vari... different states of ... recommended ... The best-qua... Brazil are ...

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... JOHNSTON, B.F. Staple food... Agriculture (Trinidad) 33(3):214-220. 195...

Cassava. Plant geography. Maps. Africa.

Several maps illustrate the distribution of the main crops i... Cassava is one of the basic tubers included in the natives' diet. The calorie co... is 3-4 times higher than that of cereals. This crop can be successfully grown in poor ... does not require special agricultural techniques although harvesting is rather difficult. Be... se cassava contains fewer

different glucosides have been identified: amygdalin, dhu... d in cassava. Although the cyanogen is found in all parts of t... in the root cortex. Autohydrolysis, the spontaneous release ... in the presence of a specific glucosidase and water. The enzy... s to the glucoside after physical disruption of the cell. They ... ed by heat. Hydrolysis occurs when the plant is macerated ... is 20°C. To avoid problems of intoxication, only fresh, wel... ... cooked cassava should not be m... ...sidase can lead to the decompositio... ... that under certain nutritional condi... ...d to chronic diseases in man (an... ...ciocyanate levels) (Summary ...