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racts on Cassava
(*Manihot esculenta*, Crantz)

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Centro Internacional de Agricultura Tropical

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Publication of CIAT's
Cassava Information Center

Documentalist: **Francy González V.**

Abstracts on Cassava
(*Manihot esculenta* Crantz)

Vol. VIII No. 1 April, 1982

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FOREWORD

CIAT's documentation activities are focused on three research areas: cassava (*Manihot esculenta* Crantz) production and utilization, field beans (*Phaseolus vulgaris* L.) as grown under tropical conditions, and tropical pasture species and their management. The goal of the Documentation Center is to disseminate research results and report ongoing activities in these three areas.

This journal of analytical abstracts, which replaces the former combination of abstract cards and yearly cumulative volumes, is designed to provide users with both an update service and a permanent record of information that contains essential data for their research activities. The abstracts are categorized in broad disciplinary fields to facilitate rapid scanning. Additionally, abstracts are subject and author indexed to enable more comprehensive consultation. When retrospective or exhaustive coverage of a topic is desired, mechanized bibliographic searches of the entire document collection can be provided by CIAT's Documentation Center. Abstracts of all articles that match the topic of interest are provided to users of this mechanized search service. The full text of every article abstracted by the Documentation Center is available, through the Center's photocopy service.

No one publication can cover the whole range of information needs. Other CIAT publications dedicated to keeping users aware of research developments in their respective fields include:

Pages of Contents - a current awareness reference to articles published in more than 500 scientific and technical journals. Every article indexed can be ordered through the Center's photocopy service.

Cassava Newsletter (Yuca - Boletín Informativo) - a technical newsletter that provides information regarding cassava research in progress throughout the tropics.

Pastos Tropicales - Boletín Informativo - a newsletter on pasture research and on new developments in the tropical pastures network.

Hojas de Fríjol - a newsletter on bean breeding, agronomy, and cropping systems, and on the activities within the bean researchers' network.

We believe that each of these types of information plays a key role in research aimed at increasing agricultural productivity in the tropics. It is our hope that this range of publications satisfies the various information needs of our users.

A GUIDE FOR USERS

Components of a reference

Sequential number in this journal

0012

1 ← 16172 FILES, E.F.F.; SILVEIRA, A.J.; BATISTA, C.M.; FEITOSA, L.P.G.;
2 ← RESENDE, J.L.M. 1980. Açúcares solúveis em mandioca (*Manihot esculenta* → 3
Crantz). (*Soluble sugars in cassava*). Revista Ceres 27(151):325-328. Port., Sum.
7 ← Engl., 11 Refs. 4 5 6

8 ← Cassava. Laboratory experiments. Tubers. Analysis. Carbohydrate content. Clones. Brazil.

9 ← Total soluble carbohydrates, reducing and non-reducing sugars on 10 cassava clones, cultivated in the state of Minas Gerais, Brazil were analyzed. The analyses were carried out spectrophotometrically by the Teles' Reagent after extraction by mechanical shaking with ethanol 50% (v.v.). Av. obtained, in mg/g of green matter, ranged from 1.3-7.8 of reducing sugars; 6.1-21.8 of non-reducing; and 7.5-29.6 of total soluble carbohydrates. Statistical analyses showed significant differences among clones ($P < 0.05$), and a correlation coefficient ($r = + 0.8$) between reducing and non-reducing sugars. (*Author's summary*) C03
10 11

1- Accession number
2- Author(s)
3- Original title
4- Title translation
5- Source
6- Pages
7- Additional notes
8- Descriptors
9- Summary
10- Abstractor and/or translator
11- Subject categories

Note: The use of abbreviations in the abstracts has been standardized by the Information Center. A complete list of these abbreviations is included at the end of this journal.

Use of indexes

The author and subject indexes at the end of this journal were elaborated in collaboration with CIAT's Data Services Unit*. These indexes serve as guides for the user to carry out his own information searches.

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* Special acknowledgments to María del Rosario Henao, Systems Eng.

Author index

Here you will find the complete list in alphabetical order of the authors of the documents summarized in this issue. The four-digit numbers at the right hand side of each author correspond to the sequential numbers of appearance of the documents herein (the number centered above the abstract).

Subject index

This index presents a list of terms in alphabetical order to which the user can translate his information needs on specific topics. To facilitate his search, most of these terms or general topics cover other subjects, and thus the user will find up to two more levels of specificity. The four-digit numbers under the terms correspond to the sequential number of the documents within this issue.

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In some cases, the information contained in the abstract satisfies the needs of the user. However, if there is an interest in having the complete document, photocopies can be requested by indicating the access number that appears at the upper left corner of the reference. Send your request to:

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A00 BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

0001

15749 EVANGELIO, F.A. 1980. Getting to know more about the cassava plant. The Radix 2(1):8-10. Engl., Illus.

Cassava. Plant anatomy. Roots. Stems. Flowers. Fruits. Seed. Climatic requirements. Philippines.

A general discussion on cassava is presented. It includes information on the origin and botany of the cassava plant, root, stem, leaf, flower, fruit, and seed and environmental conditions for cassava growth. *(Summary by Abstracts on Tropical Agriculture)* A00

0002

16531 ARORA, R.K.; MEHRA, K.L. 1980. Genetic resources of wild and cultivated tropical tuber and root crops in India: their diversity and collection. Sabrao Journal 12(1):15-20. Engl., Sum. Engl., 6 Refs.

Cassava. Germplasm. Energy productivity. Plant geography. India.

Starchy tubers and roots are an important food for native communities in the humid tropical and subtropical regions of India. Tuber crop diversity is concentrated in the W. Ghats, E. Ghats, and the NE tract. In these areas approx. 70 species of native wild edible tuberous types exist which are eaten raw or boiled. The nature, extent, and geographic distribution of the variability is described, together with trends in domestication. The areas from which further collections are required are listed. *(Author's summary)* A00

0003

16534 HUQ, S.; PALMER, J.M. 1978. The involvement and possible role of quinone in cyanide resistant respiration. *In* Ducet, G. and Lance, C., eds. International Symposium on Plant Mitochondria, Marseille, France, 1978. Proceedings. New York, Elsevier/North Holland Biomedical Press. pp.225-232. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. Mitochondria. Cyanides.

Mitochondria from different cyanide resistant tissues such as *Arum maculatum*, cassava, and sweet potato were studied regarding their relative rates of oxidation of different substrates. It was found that external NADH had complete access to the cyanide resistant pathway only in thermogenic tissue such as *A. maculatum*. This is difficult to explain on the basis of a single homogenous, mobile quinone pool being common to both pathways. Lyophilized mitochondria were, therefore, treated with pentane which removed the quinone and rendered the mitochondria incapable of oxidizing substrates. It was possible to reconstitute the quinone-depleted mitochondria with both its own extracted natural quinone and with other quinones, in order to restore respiration. Evidence is presented to show that both the cyanide resistant and cyanide sensitive pathways can be stopped by depleting the mitochondria of quinone and restored by reconstituting with quinone. It was found that quinone-depleted mitochondrial particles reconstituted with ubiquinone 50 caused faster oxidation of substrate than reconstitution with natural quinone. Evidence is provided that partially

depleting *A. maculatum* spadix mitochondria of quinone causes the loss of the alternative pathway while not affecting the cyanide sensitive pathway. Results are consistent with the operation of 2 pools of quinone in mitochondria possessing both the cytochrome and the alternative pathway. *(Author's summary)* A00

When requesting photocopies, do not forget to cite the five-digit number appearing at the upper left-hand corner of each reference.

B00 PLANT ANATOMY AND MORPHOLOGY

0004

15767 SILVA, S. DE O.E. 1981. **Instalação e caracterização botânico-agronômica de coleções de mandioca.** *(Establishment and agro-botanical characterization of cassava collections).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos, 7. 51p. Port., 13 Refs., Illus.

Cassava. Germplasm. Technology evaluation. Cultivation. Germination. Leaves. Stems. Tubers. Flowering. Fruits. Pests. Agronomic characters. Brazil.

The object of this study was to provide information on the establishment and evaluation of cassava cv. collections. The aspects that should be taken into account when establishing a cv. collection are described: choice of area, land preparation, selection and preparation of planting material, planting, spacing, plot size and distribution, cv., harvesting, weed, pest, and disease control. Each one of the describers or characteristics recommended for the agro-botanical characterization of a cassava cv. collection are also analyzed: initial vigor, leaves, stems, flowering, fructification, ease of harvest and HI, roots, pests, and diseases. Annexes are included on: methods of qualitatively determining HCN and DM contents based on specific root wt. and scales to evaluate the damage caused by pests and diseases in the field. *(Summary by F.G. Trans. by L.M.F.)* B00

C00 PLANT PHYSIOLOGY

0005

16505 ELLIS, R.H.; HONG, T.D.; ROBERTS, E.H. 1981. **The influence of desiccation on cassava seed germination and longevity.** Annals of Botany 47(1): 173-175. Engl., 7 Refs., Illus.

Cassava. Seed. Water content. Drying. Storage. Germination.

Cassava seed with MC of 7.9% were dried at 20°C by air passed through silica gel for 5, 9, 22, 33, or 51 h, giving MC of 5.9, 5.5, 4.6, 3.8, and 3.2% , resp.; seeds were then stored at 70° for 0, 1.5, 3, 6, 12, 24, 48, or 96 h and then germinated at 25/35°C. Loss in viability occurred during storage at the 3 highest MC; the higher the MC the more rapid was the loss, with complete loss within 12 h at 7.9% MC, 48 h at 5.9% , and 96 h at 5.5% MC. It was concluded that cassava seed was orthodox and could be stored safely at 5% MC. *(Summary by Field Crop Abstracts)* C00

C01 Plant Development

0006

16555 HOLMES, E.B., WILSON, L.A. 1977. **The relationship between yield and quantitative shoot morphology and the development of individual leaves in six Trinidad cassava (*Manihot esculenta* Crantz) cultivars.** Nouvelles Agronomiques des Antilles et de la Guyane 3(3/4):360-376. Engl., Sum. Engl., 17 Refs., Illus.

Cassava. Field experiments. Cultivars. Leaves. Plant development. Branching. Dry matter. Harvest index. Trinidad and Tobago.

A study was made of the quantitative shoot morphology, development of individual leaves, and their relationship to biological and economic yield in 6 Trinidad cassava cv. Two cv. types were identified on the basis of leaf production and retention characteristics. These cv. differences were related to the no. of apical meristems produced and only became evident after the onset of branch production. There were no cv. differences either in the pattern of leaf production/branch or in % leaf loss during development, but there was evidence of genetic differences in the pattern of leaf development, particularly leaf size and leaf duration. These parameters showed variations which could be ascribed either to plant ontogeny or the prevailing environmental conditions. Reasons for low DM production and low HI in the 6 cv. are discussed in relation to the differences in shoot and leaf development outlined. *(Author's summary)* C01 C03

0007

16581 BALDOS, D.P. 1979. **Testing procedures and association of some characters with yield in cassava (*Manihot esculenta* Crantz).** Ph.D. Thesis. Guelph, Ontario, University of Guelph. 136p. Engl., Sum. Engl., 154 Refs., Illus.

Cassava. Field experiments. Cultivars. Experiment design. Agronomic characters. Harvest index. Tuber productivity. Planting. Spacing. Plant height.

Uniformity trials involving 2 cassava cv. grown at 2 locations were conducted to obtain information pertinent to yield testing in the Philippines. Using Smith's soil heterogeneity index "b" and relative cost method, the optimum plot size was estimated to be 42 plants (borders excluded). Taking into account plot shape, a plot size consisting of 2 rows, each having 21 plants/row is suggested as optimum. The estimates of the soil heterogeneity index "b" for locations, cv., and characters considered ranged from 0.63-0.93. In the case of root yield, the magnitude of the estimates indicated an apparent cv. effect. Higher estimates for "b" were obtained for the characters HI and av. root wt. Consequently, larger plot size will be required to adequately evaluate these characters. Eight cassava cv. were evaluated in a yield test at 2 locations and 2 planting densities, to provide information on variance components, response to planting density and location, and association of some characters with root yield. There were no significant cv. x location interaction components for root yield and Ø, residual leaf area/plant, and HI. Cv. x location interaction components, however, were significant for the characters no. of roots/plant, av. root wt., plant height, no. of nodes/dm of stem, no. of apices/plant, and no. of forked branches/plant. At the higher planting density (10,000 plants/ha), mean character expression of the cv. on a per plant basis, as measured by 11 characters was significantly reduced compared to the lower planting density (2500 plants/ha). However, root yields/ha at higher planting density were

significantly higher despite reduced character expression. The interrelationship of some characters with root yield in cassava were examined using correlation coefficient analysis in conjunction with path coefficient and factor analysis methods. Root yield/plot was positively correlated with roots/plant, av. root wt. and ϕ, HI, and no. of nodes/dm of stem. A negative correlation was observed between root yield/plant and most of the characters associated with top growth. These relationships should be seriously considered in breeding for high yields. *(Author's summary)* C01 D03

0008

16137 FUKAI, S.; BAKER, G. 1981. **Growth of four cultivars for two seasons.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland, Department of Agriculture. p.90. Engl.

Cassava. Field experiments. Cultivars. Growth. Planting. Timing. Australia.

An expt. was designed to determine from chosen cv. whether growth rates can be sustained for the 2nd season's growth. From cv. studies under favorable growing conditions M AUS 7, M AUS 10, M AUS 19, and SM 1-150 were selected for tuber yield, total DM production, carbohydrate distribution, leaf morphology, and genetic diversity. Measurements will be made in 1982 on plant DM production, carbohydrate distribution, leaf appearance rate, and leaf senescent rate for the 4 cv. Three treatments are crops in the 1st growing season, in the 2nd season, and in the 2nd season following pruning of stems at the beginning of the 2nd growing season. *(Full text)* C01

0009

16174 SPALDING, R.D.; WILSON, G.L. 1981. **The effect of tuber removal on yield in cassava (M AUS 7).** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. p.49. Engl.

Cassava. Laboratory experiments. Tuber productivity. Dry matter. Plant physiological processes. Australia.

At the age of 17 wk., cassava plants (cv. M AUS 7) grown in pots were subjected to tuber removal treatments. Removals were expressed as the intended % of tuberous roots removed: 0 (control), 30, 50, 75, and 100%. Removal of up to and including 75% did not influence total DM production, and 75% tuber removal treatment did not influence the wt. of tubers present 11 wk. after treatments were imposed. The results of this short duration expt. showed that reduction in storage root no. was compensated by increase in size of remaining storage roots, even when storage root no. were reduced to less than 4/plant in the 75% treatment. *(Complete text)* C01

See also *0021* *0023* *0024* *0029* *0032* *0037* *0043* *0048* *0053* *0127* *0194*

C02 Cyanogenesis

0010

16544 RAO, P.N.; RAO, D.S. 1976. Embryology of cassava. Proceedings of the Indian National Science (Part B) 42(2/3):111-116. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Morphogenesis. Anthers. Pollen. Pollination. India.

Aspects of the pre-pollination embryology of cassava cv. H97 were studied in flower buds produced in Nov.-Dec. 1975, from plants cultivated in Waltair, India. Degeneration of the secretory anther tapetum, pollen mother cells, and pollen tetrads observed at varying stages indicated embryo sac development of the *Polygonum* type. In the absence of pollination, healthy embryo sacs were formed but no seeds were set. Continuous asexual propagation appeared to have upset sexual phase balance in reproduction, resulting in genetically blind stock. Published data on embryology of the crop is discussed. *(Summary by Crop Physiology Abstracts)* C02

C03 Chemical Composition, Methodology and Analyses

0011

15794 KODIA, A.A.; IRIGARAY, J.L.; DEJOU, J. 1979. **Recherche analytique d'éléments majeurs et d'oligoéléments dans la banane, l'avocat, l'igname et l'attiéké de Côte d'Ivoire, par radioactivation avec des neutrons de 14 MeV.** *(Analytical study of major and minor elements in banana, avocado pear, yam, and cassava meal in the Ivory Coast by 14 MeV neutron activation analysis).* Fruits 34(12):743-749. Fr., Sum. Fr., 8 Refs.

Cassava. Laboratory experiments. Cassava flour. Analysis. Mineral content. K. P. Ca. Mg. Mn. Cu. Ivory Coast.

The concn. of K, P, Ca, Mg, Cl and Mn, and Cu were determined in dessert bananas from Ivory Coast and Cameroon, plantains from Guadeloupe and Ivory Coast, avocado pears from Israel and Ivory Coast, and yam tubers and cassava meal, also from Ivory Coast. Results are compared with those obtained elsewhere, and discussed in terms of their nutritional importance. *(Summary by Abstracts on Tropical Agriculture)* C03

0012

16172 TELES, F.F.F.; SILVEIRA, A.J.; BATISTA, C.M.; FEITOSA, E.P.G.; RESENDE, J.L.M. 1980. **Açúcares solúveis em mandioca (*Manihot esculenta* Crantz).** *(Soluble sugars in cassava).* Revista Ceres 27(151):325-328. Port., Sum. Engl., 11 Refs.

Cassava. Laboratory experiments. Tubers. Analysis. Carbohydrate content. Clones. Brazil.

Total soluble carbohydrates, reducing and non-reducing sugars on 10 cassava clones, cultivated in the state of Minas Gerais, Brazil were analyzed. The analyses were carried out spectrophotometrically by the Teles' Reagent after extraction by mechanical shaking with ethanol 50% (v/v). Av. obtained, in mg/g of green matter, ranged from 1.3-7.8 of reducing sugars; 6.1-21.8 of non-reducing; and 7.5-29.6 of total soluble carbohydrates. Statistical analyses showed significant differences among clones ($P < 0.05$), and a correlation coefficient ($r = + 0.8$) between reducing and non-reducing sugars. *(Author's summary)* C03

0013

16120 KHOR, H.T.; TAN, H.L. 1981. **The lipids of young cassava (*Manihot esculenta*, Crantz) leaves.** Journal of the Science of Food and Agriculture 32(4):399-402. Engl., Sum. Engl., 35 Refs.

Cassava. Leaves. Laboratory experiments. Fat content. Analysis.

Lipids were extracted quantitatively from young cassava leaves with a chloroform-methanol mixture. Total lipids were purified by the Folch procedure and separated into non-polar lipid, glycolipid, and phospholipid fractions by column chromatography. Lipids of each fraction were further subjected to thin layer and gas-liquid chromatography. Young cassava leaves were found to have low content of lipids (3.02) of which 22.4, 25.1, and 48.2 were non-polar lipids, glycolipids and phospholipids, resp. Pigments (11.5%), wax and hydrocarbons (1.2%), steryl esters (2.9%), methyl esters of fatty acids (2.0%), triglycerides (1.5%),

fatty acids (2.1%), diglycerides (1.1%), and sterols (0.1%) constituted the leaf non-polar lipids. The leaf glycolipids were made up of esterified steryl glycosides (2.1%), monogalactosyl diglycerides (12.5%), steryl glycosides (1.1%), cerebrosides (4.2%), and digalactosyl diglycerides (5.2%). The leaf phospholipids were found to include cardiolipin (3.6%), phosphatidylglycerol (21.5%), phosphatidylethanolamine (16.4%), phosphatidylserine (0.7%), phosphatidylinositol (4.0%), and other unidentified phospholipids (2.5%). Phosphatidylcholine was present only in trace quantity. Analysis of the fatty acid composition of each of the leaf lipids revealed that, with the exception of steryl esters, all leaf lipids have high content of polyunsaturated fatty acids. *(Author's summary)* C03

0014

15713 CORPUZ, L.M.; DJA'FAR, Z.R. 1975. **Sugar content of thirteen cultivars of** *Manihot esculenta* Crantz. Bogor, Indonesia, SEAMEO Regional Center for Tropical Biology. pp.89-95. Engl., 5 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Stems. Analysis. Sugar content. Indonesia.

At the SEAMEO Regional Center for Tropical Biology, Bogor (Indonesia), 13 cassava cv. were assessed to compare their starch contents. Cv. evaluated were: no. 4, 27, 423, 527, 396, 35, 573, 256/A/AV (1/20), 15, 256/A/AV (1/29), Penduduk, Kembang, and Gading. Some morphological observations were made on the basis of the materials collected. The bark of mature stems of the different cv. was analyzed qualitatively and quantitatively for sugar content. TLC was used to identify sugars. Tables are included on the morphological characteristics observed and the glucose contents of the 13 cv. The sugars found to be common among all cv. were saccharose, glucose, fructose, and rhamnose. Variance analysis indicated the presence of significant differences in glucose content among cv. *(Summary by F.G. Trans. by L.M.F.)* C03 G01

0015

16517 OBEN, D.H.; MENZ, K.M. 1981. **Viewpoint. Prospects for low cyanide cassava in Nigeria.** Food Policy 6(3):197-200. Engl., Sum. Engl., 11 Refs.

Cassava. Bitter cassava. Sweet cassava. HCN content. Processing. Consumption. Plant breeding.

Sweet (low HCN) and bitter (high HCN) var. of cassava are compared from the viewpoint of their production, processing, and consumption in Nigeria. With this information, the costs and benefits of breeding higher yielding sweet var. are calculated. A new processing method, currently in use in one region of Nigeria, is examined for its likelv impact on the demand for sweet cassava. *(Author's summary)* C03 G01

0016

16574 LERARIO, P.; BOTTALICO, A. 1978. **Note sul dosaggio cromatografico delle aflatossine nella farina di manioca.** *(Notes on the quantification of aflatoxins in cassava meal by thin layer chromatography).* Annali della Facolta di Agraria 30: 669-674. Ital., Sum., Engl., Ital., 14 Refs., Illus.

Cassava. Laboratory experiments. Cassava meal. Aflatoxins.

Assays carried out on the quantification of aflatoxins in CM by TLC, indicated that aflatoxins can be separated from interfering substances by 2-dimensional TLC, developed with diethyl-ether-methanol-water (94 + 4.5 + 1.5) in the 1st direction and with chloroform-acetone (88 + 12) in the 2nd direction. *(Author's summary)* C03

0017

17128 TELES, F.F.F.; SILVEIRA, A.J.; BATISTA, C.M.; FEITOSA, E.P.G.; REZENDE, J.L.M. 1980. **Toxidez cianogênica em folhas e raízes de mandioca (*Manihot esculenta* Crantz).** *(Cyanogenic toxicity in cassava leaves and roots).* Revista Ceres 27(153):557-560. Port., Sum. Engl., 10 Refs.

Cassava. Laboratory experiments. Leaves. Tubers. HCN content. Clones. Cyanogenic glycosides. Brazil.

The HCN content of leaves and roots of cassava was determined on 10 clones cultivated in the state of Minas Gerais, Brazil. The results ranged from 0.086-0.300 mg/g in the roots, and from 0.173-0.478 mg/g in the leaves. A negative correlation (r = - 0.382) was observed. *(Author's summary)* C03 G01

0018

16118 KEATING, B.A.; BREEN, A.R.; EVENSON, J.P. 1981. **Estimation of starch and total fermentables content in storage roots of cassava (*Manihot esculenta* Crantz).** Journal of the Science of Food and Agriculture 32:997-1004. Engl., Sum. Engl., 19 Refs., Illus.

Cassava. Tubers. Starch content. Sugar content. Composition. Dry matter. Australia.

The relationships between the % of DM, specific gravity, % of starch and of total fermentables in cassava storage roots have been examined in detail. The results confirm the findings of previous research that specific gravity can provide a reliable estimate of storage root DM in the absence of drying facilities. A curvilinear relationship of the form $1/y = a + bx$ was found to exist between storage root DM and % of starch or fermentables within 1 cv. over a range of ages and seasonal conditions. This relationship shows that the proportion of total DM present as starch or fermentables increases for samples of higher DM %. A similar relationship was shown to exist between specific gravity and % of starch or fermentables. A linear relationship was also developed between the % of DM and of fermentables based on 28 cv. harvested at the same age and under the same seasonal conditions. More information is required on cv. differences in these relationships over the entire range of DM and fermentable % , before widespread use is recommended. Once correctly established, relationships based on DM or specific gravity provide a simple and reliable method of estimating % of starch or total fermentables in the storage roots of cassava. Comparisons are made between these results and those reported earlier in the literature, using less precise methods of starch measurement. *(Author's summary)* C03

0019

16585 BATTISTI, C.R. DE; BATISTA, C.M.; COELHO, D.T.; TELES, F.F.F.; SILVEIRA, A.J. DA 1981. **Determinação de carboidratos solúveis, redutores e não redutores, em cultivares de mandioca (*Manihot esculenta* Crantz).** *(Determination of soluble, reducing, and non-reducing carbohydrates in cassava cultivars).* Revista Ceres 28(157):312-317. Port., Sum. Port., Engl., 13 Refs.

Cassava. Cultivars. Tubers. Carbohydrate content. Sugar content. Soluble carbohydrates. Brazil.

Levels of soluble, reducing, and non-reducing sugars (mono and disaccharides) were determined in the roots of 10 cassava cv. The highest levels of soluble reducing sugars were found in cv. Sabará Entre Rios and Branca de Santa Catarina; however, the greatest amounts of soluble non-reducing sugars occurred in cv. Pirassununga and Manteiga. The sugars were identified as fructose, glucose, and sucrose. *(Author's summary)* C03

0020

16570 OGUNSUA, A.O. 1980. **Changes in some chemical constituents during the fermentation of cassava tubers (*Manihot esculenta,* Crantz).** Food Chemistry 5(3):249-255. Engl., Sum. Engl., 13 Refs.

Cassava. Tubers. Composition. Cyanogenic glycosides. HCN. Gari. Cassava flour. pH. Sugar content. Nigeria.

Fresh cassava tubers contained cyanogenetic glycosides as HCN 78, CF 13.4, and from the

local market, naturally fermented cassava as gari 0.13 and 0.04 in 2 of 5 samples and as lafun (3 samples) 0.46-0.50 mg/kg. When gari was prepared in the lab. pH decreased from the initial 6.2 to 3.9 after 4 days, titratable acidity as lactic acid increased from 0.42 to 0.82%, and the reducing sugar content increased initially. This finished gari had no HCN. *(Summary by Nutrition Abstracts and Reviews)* C03 I02

See also 0006 0029 0034 0050 0054 0107 0125 0128 0140 0147 0153 0163

D01 Soil Water, Climate and Fertilization

0021

11813 AKARA-EKATALIN, U. 1966. [A study of calcium, magnesium and sulphur defficiency symtions of cassava by controlled sand culture]. *In* Thailand. Kasetsart University. Faculty of Agriculture. Thai., Sum. Engl.

Cassava. Laboratory experiments. Nutrient solution. Mineral deficiencies. Ca. Mg. S. Growth. Plant height. Thailand.

Quartz sand, leached by dilute HCl, was used in these expt. (4 treatments and 3 replications). The treatments were: (1) complete nutrients in solution; (2) complete nutrients in solution, except Ca; (3) complete nutrients in solution, except Mg; and (4) complete nutrients in solution, except S. Plants lacking S showed stunted growth; at 7.5 mo. plant height was only 78.83 cm. Ca-deficient plants were 94.5 cm tall at 7.5 mo. old which was less than that of Mg-deficient plants and of plants with no mineral deficiencies. Chlorosis of stems was not as severe as that of Mg-deficient plants. Leaves and petioles were large and long and often fell off. Leaves from the lower portion of the plants dried from the margin inwards from leaf to leaf. Young leaves curled upward, and margins wrinkled irregularly. Top growth was slow and rarely produced new leaves. Dried leaves had a dark brown color with little chlorosis. Root growth was good, but with few thickened roots, probably because of the limited space in the pot. Plants with Mg deficiency showed similar growth to that of plants with no nutrient deficiency. The av. height was 98 cm at 7.5 mo. Leaves and stems were light green with chlorotic spots between the veins. Veins were green, but petioles were light purple. In the 1st stages of growth leaves did not fall considerably, but at later stages only top leaves were left. Young leaves dried up quickly and fell; plants died quickly. The plants showed fewer thickened roots; however, these were thin and long with a whitish colored and an av. wt. of 83 g/plant. *(Complete text)* D01 C01

0022

12037 MORAIS, F.M. DE 1976. Projeto: FAO/ANDA/ABCAR/BNB/EMBRAPA/MA; relatório preliminar 1975, Estado da Paraíba. *(Project FAO/ANDA/ABCAR/BNB/EMBRAPA/MA: 1975 preliminary report, state of Paraíba)* João Pessoa, Paraíba, Brasil, Associação Nordestina de Crédito e Assistência Rural. 37p Port., Illus.

Cassava. Cassava programs. Research. Technology evaluation. Fertilizers. Brazil.

The preliminary results obtained during the development of a cooperative project in the state of Paraíba, Brazil, among the Food and Agricultural Organization of the United Nations, the Associação Nacional para Difusão de Adubos, the Associação Brasileira de Crédito e Assistência Rural, the Banco Nordeste do Brasil, the Ministry of Agriculture, and the Empresa Brasileira de Pesquisa Agropecuária are given. Objectives were to increase crop productivity by the use of fertilizers and soil amendment as well as by modern cultural practices such as adequate soil conservation and preparation, the use of selected seed, adequate planting (time, distance), and pest control. The project is conducted by means of demonstrative trials and demonstrations to farmers. Results are included regarding the following crops: arboreal cotton, herbaceous cotton, maize, beans, rice, sugar cane, cassava, sweet potato, coconut, and avocado. With regard to cassava, results of 10 trials indicate that the fertilizer

treatment 60-45-30 produced the highest yield, utility, and value/cost. Farmers showed interest in the focus given to the use of fertilizers and improved methodology. Perspectives of extracting alcohol would stimulate producers' interest in fertilizer utilization. *(Summary by I.B. Trans. by L.M.F.)* D01

0023

13794 PILLAYARSAMY, K.; FERNANDO, X.S.; MOHAMED AZAM, C.A. 1980. **Response of tapioca to azotobacter inoculation.** *In* National Seminar on Tuber Crops Production Technology, Coimbatore, India, 1980. Proceedings. Coimbatore, Tamil Nadu Agricultural University. pp.62-63. Engl., 8 Refs.

Cassava. Field experiments. Inoculation. *Azotobacter.* Plant development. Tuber productivity. India.

Treatment with *Azotobacter* sp. (family Bacteriaceae) is known to promote plant growth and increase yields of a wide range of crops. In a field trial, cassava cuttings were dipped in *Azotobacter* slurry for 15 min. and planted in an *Azotobacter* enriched soil. The tuber yield from almost all the treatments having *Azotobacter* inoculation (16.69-22.82 t/ha) was higher than the resp. control (14.49-18.96 t/ha). *Azotobacter* soil application in all treatments recorded an increased yield ranging from 5.7-30.7%. *Azotobacter* treatment indicated the possibility of reducing fertilizer N by some 37.5 kg N/ha. *(Summary by Abstracts on Tropical Agriculture)* D01 C01 D03

0024

15244 ISLAM, A.K.M.S.; EDWARDS, D.G.; ASHER, C.J. 1980. **pH Optima for crop growth. Results of a flowing solution culture experiment with six species.** Plant and Soil 54(3):339-357. Engl., Sum. Engl., 67 Refs., Illus.

Cassava. Laboratory experiments. Nutrient solution. pH. Growth. Ca. Cu. N. Mg. Mineral deficiencies.

Ginger, cassava, maize, wheat, french beans, and tomato were grown for periods up to 6 wk. in continuously flowing nutrient solutions at 7 constant pH values ranging from 3.3-8.5. All species achieved max. or near-max. growth in the pH range 5.5-6.5. However, there were substantial differences in the ability of species to grow outside this range. Ginger and cassava were the most tolerant species to low solution pH, while ginger and tomato were the only species to show no yield depression at the highest solution pH. Roots of all species at pH 3.3 and some species at pH 4.0 exhibited symptoms of H ion injury. In addition, the concn. of Mg in the tops of all 6 species, of N in the tops of tomato and cassava, and of Mn in the tops of maize at these pH values were inadequate for optimal growth. Growth depression at high solution pH was associated with Fe deficiency in maize and wheat and with N and/or Cu deficiency in cassava. The relevance of the present results to crop growth under field conditions is discussed. The complex interplay of plant and soil characteristics militates against precise definition of an optimum pH range for the growth of a particular crop unless the soil is also specified. *(Author's summary)* D01 C01

0025

15792 FERTILIZER RESPONSE of major food crops in Bangladesh and Indonesia. 1980. News in Brief 3(2):9-16. Engl.

Cassava. Field experiments. Fertilizers. N. P. K. Costs. Income. Tuber productivity. Indonesia.

Results of fertilizer trials with applications of NPK conducted in Bangladesh with rice are given. In Indonesia fertilizer trials on maize, cassava, and soybeans showed significant responses usually to N and P, and in some areas to K. Cost-benefit ratio for maize varied from 1.7-2.9, for cassava from 2.9-12.9 and for soybeans from 1.2-12.9. Variations were associated inter alia with type and levels of fertilizer. Tables are included on each crop. *(Summary by Abstracts on Tropical Agriculture)* D01 D03

0026

16128 HAQUE, I.; WALKER, W.M. 1980. **Effect of nitrogen sources on cassava yields in Sierra Leone.** Communications in Soil Science and Plant Analysis 11(12): 1167-1173. Engl., Sum. Engl., 12 Refs.

Cassava. Field experiments. Fertilizers. N. Tuber productivity. Sierra Leone.

Two expt. were conducted on cuttings of cassava cv. Cocoa planted in upland soils low in nutrients in Sierra Leone. Highest N utilization was observed when ammonium sulphate and urea were applied in 3 split applications, but tuber yield was low. Various N applications and sources did not increase fresh tuber yield and indicated the low N requirement of the local cassava cv. *(Summary by Field Crop Abstracts)* D01 D03

0027

16129 HAQUE, I.; WALKER, W.M. 1980. **Direct and residual effects of P sources on cassava in Sierra Leone.** Communications in Soil Science and Plant Analysis 11 (12):1175-1180. Engl., Sum. Engl., 9 Refs.

Cassava. Field experiments. Fertilizers. P. Urea. Tuber productivity. Sierra Leone.

Direct, residual, and cumulative effects of various sources and rates of P were studied on upland soils (Sierra Leone) using cassava cv. Cocoa as an indicator crop. Source and rate of P did not affect utilization, and yield was not increased by initial applications when compared to the control. Increasing rates of P resulted in an increase in soil available P. There was a fresh tuber yield response to residual effects of triple superphosphate and urea ammonium phosphate. *(Summary by Field Crop Abstracts)* D01 D03

0028

16186 MAGALHAES, P.C.; BEGAZO, J.C.E.O.; PAULA, J.F. DE; DEFELIPO, B V. 1980. **Efeitos de níveis, de épocas e de localização do cloreto de potássio em alguns caracteres das raízes de mandioca.** *(Effects of levels, time, and localization of potassium chloride on some cassava root characteristics).* Revista Ceres 27(151): 215-223. Port., Sum. Port., Engl., 16 Refs.

Cassava. Field experiments. Fertilizers. K. Tuber productivity. Starch content. Brazil.

The objective of this work was to evaluate the effects of levels, methods, and time of potash fertilization on cassava yield. The cassava var. Cacau was used and the expt. carried out on a red-yellow cambic Podzolic soil, terrace phase. The crop was harvested 10 mo. after planting, and the following root characters were analyzed: no., length, ϕ, wt., and starch content. The no. of roots and root wt. were not significantly affected by the different levels of K_2O applied. This result was obtained because the soil utilized was high in available K, and because of the short period of time that the culture stayed in the field. The time of fertilization did not have any effect on the characters studied. The potash application in the planting furrow resulted in a greater density of the root, while broadcast application contributed to a greater root length. *(Author's summary)* D01 D03

0029

16200 OKEKE, J.D.; OBIGBESAN, G.C.; KANG, B.T. 1979. **Effect of fertilizer application on nutrient concentration and growth relationships in cassava** *Manihot* **spp.** Journal of Root Crops 5(1/2):1-7. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Field experiments. Fertilizers. Bitter cassava. Sweet cassava. N. P. Dry matter. Mineral content. Leaves. Petioles. Stems. Growth. Tuber productivity. Nigeria.

The relationship between applied fertilizer, nutrient concn. and DM production in cassava was studied. A fertilizer combination of NP was most favorable for DM accumulation and nutrient uptake on a loamy sand soil in Nigeria. Percent N in the various plant parts increased with increasing rates of applied N; P and K in blade and stem appeared to decrease

with increasing amounts of added N, but petiole K showed a linear positive response to applied N. Blade N at 3 mo. was well correlated with whole plant dry wt. at 3 mo. and tuber yield at 12 mo. *(Extracted from author's summary)* D01 C03 C01

0030

16511 WHOLEY, D.W. 1980. **Fertilize cassava to produce better quality planting material?.** Tropical Root and Tuber Crops Newsletter 11:17-20. Engl.

Cassava. Field experiments. Soil fertility. Cuttings. Fertilizers. K. Colombia.

In a field expt. in Colombia the nutritional status of the soil was reflected not only in the total growth and root yield of fertilized cassava crops but also in the nutrient content and wt. of the individual stem cuttings. Comparing cuttings of same length but different Ø and, therefore, different DM contents, showed that the largest Ø cuttings regenerated with the most rapid shoot growth in the 1st few wk. after emergence. K fertilizer increased the DM content and the Ø of the stem. Thus, giving additional K fertilizer to those plants "earmarked" to give stem cuttings for planting will result in obtaining elite planting material. *(Summary by Abstracts on Tropical Agriculture)* D01 D02

0031

16530 DUANGPATRA, P. 1980. **Fertilizations and soil managements for maintaining and increasing the productivity of cassava cultivated soils.** *In* Kasetsart University. Department of Plant Pathology. Research reports 1977-1978. Bangkok, Thailand. pp.91-92. Thai., Engl.

Cassava. Field experiments. Soil fertility. Cultivation. Thailand.

A preliminary survey on the soil condition and cassava production was carried out in major cassava-growing areas in the SE and NE provinces of Thailand (Cholburi, Rayong, Chantaburi, Nakhon Ratsima, Chaiyapum, and Khon Khaen). The results and information obtained revealed that most of the soils under study were low in fertility and often susceptible to erosion, especially those on slopes and inclined fields. Most of the farmers in the SE regions fertilized their land while the majority of farmers in the NE did not. Among the problems faced by those using fertilizers was the determination of their most effective use, especially regarding sources, rates, methods, and time of application for specific soil types and environments. The information gathered from this study lead to a field trial at the student training farm at Sriracha, Cholburi to investigate the response of a local cassava var. to fertilizers N, P, and K as well as their combination ratio. This expt. is in progress and results will be reported later. *(Full text)* D01

0032

16136 BAKER, G.; FUKAI, S.; WILSON, G.L. 1981. **Response of four cultivars to water stress.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. p.88. Engl.

Cassava. Field experiments. Water stress. Cultivars. Selection. Tuber productivity. Dry matter. Growth. Carbohydrate content. Australia.

An expt. was conducted to determine from chosen cv. whether growth rates can be sustained with a limited water supply and to investigate drought tolerance mechanisms. From cv. studies under favorable growing conditions M AUS 7, M AUS 10, M AUS 19, and CMC 84 were selected for tuber yield, total DM production, carbohydrate distribution, and genetic diversity. Mild water stress was established using plastic ground sheets to exclude rain. Exclusion of water took place at different growth stages. Growth during and after water stress periods was compared to cv. having no exclusion of rainfall. Patterns of carbohydrate distribution, root depth, rooting density, and leaf diffusive resistance were measured. These factors were analyzed in relation to total tuber production under limited available soil moisture. *(Full text)* D01 C01

0033

16165 ANGULO G., R.E. 1980. **Fertilización con nitrógeno y potasio de la asociación yuca y maíz en un inceptisol de Turrialba.** *(Fertilization with nitrogen and potassium of the association cassava and maize in an inceptisol of Turrialba).* Tesis Mag. Sc. Turrialba, Universidad de Costa Rica. Centro Agronómico Tropical de Investigación y Enseñanza. 159p. Span., Sum. Span., Engl., 98 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Maize. Fertilizers. N. K. Tuber productivity. Plant development. Costa Rica.

The effect of the nutrients N and K on agronomic performance, nutrient extraction by plants and food production in the system cassava associated with maize was studied as compared with their resp. monocultures at Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica. The soil used belongs to the Instituto series, normal phase and has been classified in the subgroup Typic Distropept with moderate drainage, pH 5.2, and medium soil fertility. The exptl. design was split-plot with 3 replications. Main treatments were: cassava + maize in association and cassava and maize in monoculture. Subtreatments consisted of N rates of 48, 80, 160, 240, and 272 kg/ha and K rates of 69, 115, 230, 345, and 391 kg/ha applied in bands at each side of the maize and cassava rows. Cassava var. Valencia and the maize Tuxpeño-1 were used; both crops were planted simultaneously in June 1978. Soil N did not decrease appreciably in the 3 systems. Exchangeable K on plots in monoculture increased with rates of K_2O > 230 kg/ha 140 days after planting; this did not occur in the plots with cassava and maize in association. At 360 days after planting, exchangeable K increases were similar in both cassava in monoculture and in association with maize. Cassava total biomass production was hardly affected by the competition of maize plants. Also, morphological changes were observed when the crops were grown in association such as less branching and a greater height of cassava plants. Yields of cassava roots were the same for cassava in monoculture and in association with maize and did not show response to the fertilizer applications. At every fertilization rate, the associated system gave LER > 1.0. The highest LER was 1.81 registered for the treatment which consisted of 240 and 115 kg of N and K_2O/ha, resp. In a similar manner, the highest Area Time Equivalent Ratio (ATER) was 1.32 and corresponded to the same treatment. The highest yields of the edible production for both crops with regard to the non-edible plant portion were obtained when the N to K_2O ratio was 0.69. This ratio may be obtained with a fertilization rate of 48 and 69 kg of N and K_2O/ha, resp. The fertilization rate of 240-120-115 kg of N, P_2O_5, and K_2O/ha, resp. is suggested when land is the limiting factor, yielding 21.14 MT of cassava/ha. Due to the similar benefit:cost ratio, the fertilization rate 80-120-115 kg of N, P_2O_5, and K_2O/ha, resp. would be another option when the limiting factor is unavailable capital for the farmer, obtaining similar yields. It is assumed that with the rate 48-120-69 N, P_2O_5, and K_2O/ha, resp. is a more economical option, yielding 20.70 MT of cassava/ha. *(Author's summary)* D01 K01

0034

17150 BAKER, G.; FUKAI, S.; WILSON, G.L. 1981. **Response of cassava to water stress.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.55-57. Engl., 2 Refs., Illus.

Cassava. Field experiments. Irrigation. Water stress. Tuber productivity. Dry matter. Growth. Plant physiological processes. Australia.

The effects of different levels of available soil moisture on growth and tuber yield and physiological response of cassava were studied. Two irrigation expt. were conducted, one at Redland Bay and the other at Dalby, Australia with cv. M AUS 7. Both expt. were planted in Sept.-Oct. 1979 and included treatments of frequent irrigation, infrequent irrigation, and no irrigation. At Redland Bay, rainfed plants experienced several water stress periods. Yields of 13 t of storage organ DM/ha were obtained after 10 mo. of growth. The relationship between storage organs and total plant DM was independent of the irrigation treatment. Total plant DM production was much less at Dalby and hence storage organ yield was much less than that at Redland Bay. Since the Dalby site had large soil water deficits in the treatment without irrigation, the relative difference of tuber yield between the irrigated and

the non-irrigated treatments was large. Results indicate that the stomatal control of water use in cassava is so effective and rapid that leaf water potential did not vary between irrigation treatments. *(Summary by F.G. Trans. by L.M.F.)* D01 C03

0035

15752 OLIVEIRA, S.L. DE; MACEDO, M.M.C.; PORTO, M.C.M. 1980. Exigências hídricas da mandioca. *(Water requirements of cassava plants).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado técnico no. 11. 5p. Port., 3 Refs., Illus.

Cassava. Field experiments. Water stress. Irrigation. Tuber productivity. Water requirements (plant). Brazil.

A random block design expt. with 6 treatments and 4 replications using cv. Aipim Bravo (12 mo. growth cycle) was conducted at the Unidade Estadual de Pesquisa (UEP) of Irecê, state of Bahia, Brazil to determine the effects of soil water stress on cassava root yield. Treatment 1 was an irrigated crop (check); treatments 2-6 included periods of water stress from 2 mo./treatment successively up to 11 mo. Irrigation by infiltration was carried out every 7 days (44 mm water/irrigation). According to the results obtained, it is concluded that the periods between 30-150 days after planting are the most critical regarding water stress; while water stress after the 6th mo. does not significantly reduce yields, irrigation during the last 3 mo. of cultivation is still necessary. *(Summary by F.G. Trans. by L.M.F.)* D01 D03

0036

15718 RAMIREZ, A. 1978. Fertilización de la yuca (*Manihot esculenta* Crantz). Fertilización de la yuca en suelos de los departamentos del Cauca y del Valle del Cauca. *(Cassava fertilization. Cassava fertilization on soils of Cauca and Valle del Cauca, Colombia). In* Instituto Colombiano Agropecuario. Programa Nacional de Suelos. Informe de Progreso 1978. Bogotá. pp.104-108. Span.

Cassava. Field experiments. Fertilizers. N. P. K. Cultivars. Tuber productivity. Colombia.

Two trials, one in Darien, Valle del Cauca and the other in Popayan, Cauca (Colombia), were established to determine the influence of the method of fertilizer application (in bands, in hills around the plant, and in furrows) and the rate of 200-4.0-150 kg N-P_2O_5-K_2O/ha, resp. on the root production of 11 cassava cv. and 3 regional cv. There were no differences due to the method of fertilizer application in Darien; likewise, there was no response to fertilization at the site in Popayan. However, a wide var. difference was observed. Another expt. was carried out at 10 sites in Cauca and Valle del Cauca using 1 regional and 1 improved var. at each site to determine the response of cassava to NPK fertilization, and more specifically, to establish the max. and min. response limits to each nutrient, to study their interactions, and to correlate soil analyses and the response to P and K. A marked response to fertilization was observed at sites in Santander, Palmira, and Caicedonia (< 1200 m in alt.) with a growth cycle < 12 mo. At sites of higher alt., Darien and Popayan, cassava showed little response to fertilization (growth cycle > 14 mo.). *(Summary by F.G. Trans. by L.M.F.)* D01 D03

0037

16152 KEATING, B.A.; HERBERT, S.; EVENSON, J.P. 1981. Cassava response to photoperiod. *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. p.50. Engl.

Cassava. Field experiments. Cultivars. Photoperiod. Growth. Shoots. Tubers. Temperature. Australia.

The effects of photoperiod on cassava growth and development were examined in a series of 4 controlled environment studies. Although tuber initiation was somewhat promoted for both M AUS 7 and M AUS 10 under a 10 h photoperiod, total no. of tubers were about the

same for plants grown under a 10 and 16 h photoperiod. However, the subsequent balance between shoot and storage root growth expressed in terms of distribution ratio, DR = Δ storage root dry wt. (DW)/Δ total DW, strongly favored shoot growth in long days (DR = 0.15 and 0.37 for M AUS 7 and M AUS 10, resp.) and storage root growth in short days (DR = 0.49 and 0.68 for M AUS 7 and M AUS 10, resp.). Distribution to storage roots was quantitatively reduced in M AUS 10 with each additional 1 h increment used in another expt. comparing 10, 11, 12, 13, 14, 15, and 16 h photoperiods although the 12-13 h period was a critical part of the response curve. A treatment consisting of a short day (10 h) plus a 1 h nightbreak in the middle of the dark period produced long day type growth. A small interaction between temp. and photoperiod was detected in a 3rd expt., in that the increase in HI under short days (10 h vs. 14 h) was greatest at lower temp. (28/22°C vs. 34/28°C). Differences in cv. response to a range of photoperiods (11, 12, 13, and 14 h) were identified in a 4th expt. Assimilate distribution was not affected by photoperiods in this range for the cv. M AUS 7 and Ceiba but longer photoperiods strongly favored shoot growth at the expense of storage root yield for cv. CMC 84. *(Full text)* D01 C01

0038

17130 CONNOR, D.J.; COCK, J.H. 1981. **Response of cassava to water shortage. 2. Canopy dynamics.** Field Crops Research 4(4):285-296. Engl., Sum. Engl., 13 Refs., Illus.

Cassava. Field experiments. Cultivars. Water stress. Leaf area. Foliage.

Crops of 2 cv. of cassava, M Col 22 and M Mex 59, were subjected to water shortage during the period 12-20 wk. of their growth cycle. The crops were then allowed to recover until a final harvest was made at 10 mo. Measurements of the components of leaf area production (i.e. rate of apex production, rate of leaf production/apex, and rate of leaf expansion) were maintained along with measurements of leaf senescence for the entire crop cycle. The loss of leaf area during water stress is shown to be dominated by restricted leaf area development and not by leaf loss. Leaf life was increased under stress. Leaf size was the most sensitive parameter of leaf area production and the most responsive following the release from stress, but apex production and the rate of leaf production/apex were also susceptible. The reliance on reduced leaf formation rather than leaf fall is an important feature of an efficient C balance under stress. *(Author's summary)* D01

0039

16148 FULTON, M.C.; ASHER, C.J.; BELL, L.C.; EVENSON, J.P. 1981. **Nutritional studies with cassava on rehabilitated land mined for bauxite at Weipa, N. Queensland.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.62-63. Engl.

Cassava. Field experiments. Fertilizers. N. P. K. Mg. S. B. Zn. Cu. Mo. Tuber productivity. Australia.

To determine the nutritional requirements of cassava on mined land at Weipa (N. Queensland, Australia), a field expt. was set up at Andoon to assess the response of cv. M AUS 7 over 2 wet seasons to various levels of each one of the elements N, P, K, Mg, S, B, Zn, Cu, and Mo. The crop was planted in Jan. 1978 and harvests were made 17 and 66 wk. after planting. At the 2nd harvest, max. yields of tubers and planting material were obtained with rates of 100, 200, 300, 20, and 16 kg of N, P, K, Mg and Zn/ha, resp. There was no significant response to the application of S, B, Cu, or Mo. *(Summary by F.G. Trans. by L.M.F.)* D01

0040

16520 HOWELER, H. 1981. **Nutrición mineral y fertilización de la yuca (*Manihot esculenta* Crantz).** *(Mineral nutrition and fertilization of cassava).* Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie 09SC-4. 55p. Span., 172 Refs., Illus.

Also in English.

Cassava. Research. Nutritional requirements. Soil requirements. Absorption. Plant development. Mineral deficiencies. Symptomatology. pH. Nutrient solution. Soil analysis. Soil amendments. Agricultural lime. Cultivars. Selection. Resistance. Pests.

A literature review is given on the nutritional requirements of cassava on the basis of the following aspects: nutrient removal, accumulation, and concn. in the plant; diagnosis of nutritional problems (deficiencies and toxicities) through symptoms, soil and plant analyses, and the application of various nutrients and the observation of plant response; response to fertilization (macro and micronutrients); liming; methods and the time of fertilizer application; selection of cv. tolerant to soil problems; and the nutritional status and pest and disease tolerance. Research priorities on nutrition and soil fertility requirements in areas with marginal soils are described. Tables on nutrient concn. and color photos on deficiency and toxicity symptoms are included. *(Summary by F.G. Trans. by L.M.F.)* D01

0041

16578 SELVARAJ, K.V.; KALIAPPA, R.; RAMASWAMI, P.P. 1977. **Response of tapioca (*Manihot esculenta* Crantz) to water and nutrient levels.** South Indian Horticulture 25(2):62-64. Engl., Sum. Engl., 8 Refs.

Cassava. Field experiments. Irrigation. Fertilizers. N. P. K. Tuber productivity. Water requirements (plant). India.

An expt. was conducted at the Tamil Nadu Agricultural U., Coimbatore (India), in a well-drained sandy clay loam soil to study the effect of different moisture regimes in combination with different levels of fertilizers. A split-plot design was used. Cassava cv. Malavella was subjected to 7 irrigation treatments: irrigation at 60, 40, 20, and 0% available water and irrigation at 5, 10, and 15 days after reaching 0% available water. Three fertilizer levels were applied: 50-50-100 kg NPK/ha, 50-100 kg NK/ha, and 50 kg N/ha. Plant yield and water use efficiency were determined. *(Summary by Current Annotated Bibliography of Irrigation)* D01 D03

0042

16571 IKEDIUGWU, F.E.O.; EJALE, A.U. 1980. **Root-surface mycoflora of cassava (*Manihot esculenta*) and post harvest rot of the tubers.** Mycopathologia 71(2):67-71. Engl., Sum. Engl., 19 Refs., Illus.

Cassava. Laboratory experiments. Tubers. *Aspergillus. Fusarium.* Isolation. Deterioration. Post-harvest losses.

Rhizoplane fungi were isolated from roots washed in serial changes of sterile distilled water and plated out on potato-dextrose agar. A small group which included *Aspergillus niger, Botryodiplodia theobromae, Fusarium solani, Penicillium javanicum, Penicillium* sp.,and *Trichoderma* sp. were consistently associated with the root surface. While *B. theobromae* and *F. solani* were strongly pathogenic on freshly harvested tubers, causing extensive rot, *A. niger* was only mildly so. The removal of the rhizoplane mycoflora by surface sterilization using calcium hypochlorite and subsequent incubation in loosely tied polyethylene bags extended the storage life of the tubers considerably. *(Author's summary)* D01 E03 D04

0043

16576 CONNOR, D.J.; COCK, J.H.; PARRA, G.E. 1981. **Response of cassava to water shortage. I. Growth and yield.** Field Crops Research 4(3):181-200. Engl., Sum. Engl., 30 Refs., Illus.

Cassava. Field experiments. Cultivars. Water stress. Growth. Harvesting. Soil moisture. Dry matter. Colombia.

Rainfall was withheld from crops of 2 cassava cv. M Col 22 and M Mex 59, for 10 wk.

commencing 12 wk. after planting. The recuperation phase continued until the crops were 10 mo. old. Sequential harvests were made to define the effect of water shortage on rates of crop growth and the distribution of the biomass in the various component organs. Measurements were also made of the soil water content, fine root distribution, and sugar and starch contents of stems and storage roots. Biomass production was substantially reduced especially during the 2nd half of the stress period. M Mex 59 maintained the higher LAI during the stress and was least affected in total biomass production. The proportion of biomass in storage roots increased under stress, particularly in M Mex 59, and the modified distribution pattern persisted during the recovery. At 10 mo. the M Col 22 control at 11.2 t/ha outyielded the stress plots of M Col 22 (7.6 t/ha) and the M Mex 59 control (7.3 t/ha). The previously stressed M Mex 59 (10.7 t/ha) outyielded the M Mex 59 control and was not significantly different from the M Col 22 control. Results are discussed in terms of 2 published models of assimilate allocation in cassava. *(Author's summary)* D01 C01

See also 0120 0190

D02 Cultivation Practices: Propagation, Planting Weed Control and Harvesting

0044

13470 VILLANUEVA, M.R.; LABRA, J.S. 1979. **Planting methods for optimization of cassava yield.** Radix 1(1):5-6. Engl., Illus.

Cassava. Field experiments. Planting. Germination. Tuber productivity. Timing. Philippines.

Three planting methods of cassava var. Golden Yellow were assessed in the Philippines. Cuttings were planted vertically, horizontally, and inclined, spaced 1 m between rows and 75 cm between plants. The % germination, height, vol., no. and wt. of marketable and non-marketable tubers, and easiness of harvest were registered. Two planting seasons, March and July 1977 (corresponding to the dry and wet seasons, resp.), were considered. The no. and wt. of marketable tubers were high for the July planting and there was no variation between planting methods within the same growing season; nor were there differences in the % emergence between methods in both seasons although there were some differences in height. *(Summary by W.M.S. Trans. by L.M.F.)* D02 D03

0045

14682 PRCRTC RECOMMENDS selection and preparation of cassava seedpieces. 1979. Radix 2(2):10-11. Engl., Illus.

Cassava. Cuttings. Planting. Germination. Storage. Philippines.

The Philippine Root Crop Research and Training Center (PRCRTC) gives several recommendations for the selection and preparation of cassava cuttings for planting. Among the factors that should be taken into consideration are the maturity of the cutting, which sometimes depends on the var. or on the relative size of the pith (> 50% of the total ϕ); the length of the cutting will depend on the availability of the planting material and the ease of handling; and planting depth (not greater than 30 cm in vertical planting). Cuttings should be prepared only when the field is ready for planting; if it is necessary to store the cuttings, they should be tied in bundles and places with high RH should be chosen, such as areas near creeks or canals. Stems should not be stored for more than 1 mo. and the end portions should be discarded; the time of latex appearance will determine the length of the portion. The cut should be transverse and made in the air, not against a hard surface, or a saw may be used to cut several at a time. *(Summary by I.B. Trans. by L.M.F.)* D02

0046

15791 DAPHNE, P. 1980. Cassava: a South African venture. Optima 29(1):61-68. Engl., Illus.

Cassava. Field experiments. Harvesting. Timing. Tuber productivity. Uses. Cultivation. Africa.

From many trials conducted in S. Africa it is concluded that the min. annual av. temp. for successful cassava production is 20°C, which restricts cultivation to eastern areas of the country up to 31°S lat. and an alt. of up to 800 m. In Transvaal and Natal about 1 million ha could be planted to cassava. Trials showed that extension of the harvest period from 1-2 yr increased yield by 94%. Of the cassava var. M. Saf 2 after 2 yr under commercial cultiva-

tion in the less fertile soils of the proposed production areas, a yield of 48 t/ha can be expected. As well as food, alcohol and starch, cassava also produces cheap fresh feed for cattle: leaves provide protein; roots, carbohydrates; and stems, roughage at a cost of approx. 1 cent/kg as compared to 15 cents for maize composite feed. In 1979 a center for cassava research was established at Mtunzini on the north coast of Natal. *(Summary by Abstracts on Tropical Agriculture)* D02 I02

0047

15797 MOHAMED SENAWI bin MOHAMED TAMIN; DEBERGH, P. 1979. **Regeneration of cassava plants from axillary meristems: a short communication.** Mededelingen van de Faculteit Landbouwwetenschappen 44(3/4):1109-1112. Engl., Sum. Engl., 9 Refs., Illus.

Cassava. Laboratory experiments. Tissue culture. Cuttings. Culture media. Germination. Apical meristems. Shoots.

Multiple axillary shoots were regenerated from stem-node tissues cultured in vitro. Hormonal combinations of benzyladenine (BA) at concn. between 0.5-1.0 mg/*l* with either 0.1 mg/*l* NAA 0.1 mg/*l* 2-naphthyloxyacetic acid (NOA) or 2.0 mg/*l* 3-IAA induced the shoots regeneration during the initial culture and the subsequent subculture phases. Rockwool was found to be a good intermediary substrate for rooting and plantlet establishment. Over 70% of the plantlets survived to be finally transplanted into pots. *(Author's summary)* D02

0048

16167 MOHARANA, T.; MOHANTY, S.; LENKA, P.C. 1980. **Effect of type of cuttings and methods of planting on rooting in cassava.** Madras Agricultural Journal 67(10):655-657. Engl., Sum. Engl., 2 Refs.

Cassava. Field experiments. Cuttings. Planting. Rooting. Germination. Growth. Tuber productivity.

Terminal, middle, and basal cassava cuttings were planted vertically, inclined (60 and 30°), and horizontally to study their effect on rooting and early growth. The vertical method of planting of basal cuttings was found to be superior to inclined and horizontal planting. *(Author's summary)* D02 C01

0049

16509 CHANDRA, S.; SHARMA, A.P. 1981. **Experiments on cassava production technologies in Fiji.** Agricultural Mechanization in Asia, Africa and Latin America 12(1):19-21. Engl., Sum. Engl., 7 Refs., Illus.

Cassava. Field experiments. Technology evaluation. Cultivation systems. Fiji.

The traditional, animal, and tractor-based systems of cassava production were assessed under field conditions in Fiji. These production systems are evaluated in terms of biological, economic, and energy measures. It is concluded that the traditional and animal production systems are extremely labor intensive and incur the highest production costs. The highest gross margin/ha from cassava was obtained in the tractor production system. However, the tractor production system is very inefficient in terms of energy use/unit of food produced. *(Summary by Abstracts on Tropical Agriculture)* D02

0050

16514 MEYRELES, L.; MACLEOD, N.A.; PRESTON, T.R. 1977. **Forraje de yuca como fuente proteica: efecto de la densidad de población y edad al corte.** *(Cassava as a source of protein: effect of population density and age at cutting).* Producción Animal Tropical 2:18-26. Span., Sum. Span., 6 Refs., Illus.

Cassava. Field experiments. Laboratory experiments. Planting. Spacing. Harvesting. Timing. Productivity. Forage. Dry matter. Protein content. Dominican Republic.

Forage production, the no. of leaves, petioles, and stems, and the composition of these fractions were studied on a series of plots planted to cassava var. Zenón with different spacings. Plant population was negatively correlated to their fresh wt. and positively with the production of forage/ha, both on fresh and dry basis. With the highest population 53,000 plants/ha, wt./plant was 0.99 ± 0.35 kg and production on a fresh and dry basis was 52,470 and 10,861 kg/ha, resp. There were indications that the same age and at high population densities there was a lower no. of stems and that these were less lignified. Increased age at the 1st cutting (from 3 to 5 mo.) increased the % of stems while the no. of leaves decreased as well as that of petioles. These relations were similar on both fresh and dry basis. DM content (29%) and CP content in DM (21%) in leaves did not vary with the age at the 1st cutting, but DM in petioles and stems increased while protein content in these rations decreased with age. In the plant canopy, DM content increased from 20 to 23% and CP in DM decreased from 18 to 13% as age at the 1st cutting increased from 3 to 5 mo. *(Author's summary. Trans. by L.M.F.)* D02 C03

0051

16510 CHANDRA, S. 1980. **Root crop production systems studies in Fiji.** Tropical Root and Tuber Crops Newsletter 11:21-23. Engl., 4 Refs.

Cassava. Research. Cultivation. Fiji.

Current and recent research into root crop production systems is summarized, concentrating on taro, cassava, and yams. The annual production of 35,000 t of cassava is practically all consumed locally. Very little is traded in the local markets. The types of research done on these crops are listed and discussed. They include: accessions and germplasm collection, var. selection, planting material, storage ability, fertilizer responses, plant populations, and harvesting. *(Summary by Abstracts on Tropical Agriculture)* D02

0052

16535 FUKUDA, W.M.G. 1980. **Técnica de polinização manual de mandioca.** *(Hand pollination technique for cassava).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Miscelánea no. 01. 3p. Port., 4 Refs.

Cassava. Pollination. Pollen. Flowering. Brazil.

A hand pollination technique for cassava is described in detail. If it is done with care, it is possible to obtain 80% germination. A well-trained technician can pollinize up to 60 flowers/day. *(Summary by F.G. Trans. by L.M.F.)* D02

0053

16173 BURGESS, D.J.W.; WILSON, G.L. 1981. **Yield response of three cassava cultivars to changes in crop density.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.41-43. Engl., 3 Refs.

Cassava. Field experiments. Cultivars. Spacing. Planting. Tuber productivity. Dry matter. Plant height. Harvest index. Australia.

The Department of Agriculture, U. of Queensland, Australia, conducted an expt. with 3 cassava cv., M AUS 15 and M AUS 19 (high HI) and M AUS 10 (low HI) to determine the effect of 3 plant populations (10,000, 16,000, and 28,000 plants/ha) on yield. Total DM yield for each cv. was not affected by plant density. Storage organ (roots + planting material) yields for M AUS 10 and M AUS 15 decreased with a population > 10,000 plants/ha but the yield of M AUS 19 was not affected. Light interception measurements indicated that increasing plant density of M AUS 19 from 10,000 to 28,000 plants/ha reduced the

time to attainment of full canopy cover by approx. 1 mo. Height of M AUS 10 and M AUS 15 plants was greatly increased at the high population of 28,000 plants/ha; as a result, approx. 50 and 12% of the M AUS 10 and M AUS 15 plants, resp., lodged. M AUS 19 was the only cv. able to maintain a high HI at all populations; however, storage organ yield at high population was similar to that at low population. *(Summary by F.G. Trans. by L.M.F.)* D02 D03 C01

0054

16182 ROJANARIDPICHED, C. 1980. **Improvement of cassava cultural practice.** *In* Kasetsart University. Department of Plant Pathology. Research reports 1977-1978. Bangkok, Thailand. pp.89-90. Thai., Engl.

Cassava. Field experiments. Cultivation. Productivity. Starch content. Tubers. Thailand.

Cassava was planted in 2 zones of Thailand: one in the east and the other in the NE in order to study the different problems regarding production. In the east, farmers planted cassava cuttings in an inclined position in well-organized rows. Planting was mostly done on the slopes, which resulted in serious erosion during the rainy season; animal traction was used. Weed control was the most serious problem since cassava plants could not compete well with weeds due to poor soil fertility. The postemergence herbicide, paraquat, was widely used along with fertilizers 13-13-21 and 15-15-15 at the rate of 16 and 100 kg/rai, resp. (6.25 rai = 1 ha). Cercospora leaf spot and red spider mites were common; scale insects and mealybugs were also found in some areas. In the NE, most of the farmers burnt down the stems after harvesting. Planting was not done in organized rows and neither animal traction nor fertilizers and herbicides were used. Cercospora leaf spot was common and in some areas spider mites and termites attacked cassava. The price of cassava roots depended on the % of starch in the roots; the higher the %, the higher the price. Studies showed that medium-sized roots had a higher % of starch than larger roots; there was no difference in the % of starch in different parts of the root (apical, central, and basal); and no correlation was found between the amount of weeds in the plot and the % of starch in the roots. *(Full text)* D02 C03

0055

15748 VILLAMAYOR JUNIOR, F.G. 1980. **Harvest cassava the farmer's way.** The Radix 2(1):21. Engl., Illus.

Cassava. Field experiments. Harvesting. Tuber productivity.

Three advantages of selective or stagger harvesting are discussed: (1) the labor requirement for harvesting is more evenly dispersed; (2) an oversupply in the market is avoided; (3) in hilly areas where root crops are generally grown, soil erosion is minimized by the presence of some foliar cover at all times. Results of a preliminary study indicated that there was no difference between selective and single harvesting either in terms of marketable or total yield. Thus, selective harvesting is efficient in terms of productivity. Furthermore, the harvesting period is extended by 2.5 mo. With the present finding, harvesting the farmer's way seems to be practical and therefore recommendable. *(Summary by Abstracts on Tropical Agriculture)* D02

0056

16121 HICKS, L.N.; FUKAI, S.; BAKER, G. 1981. **An evaluation of four weedicides for weed control in cassava.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.45-47. Engl.

Cassava. Field experiments. Cultivars. Weeding. Herbicides. Australia.

An expt. was conducted at the Mt. Cotton U. Research Farm, Queensland, Australia with 4 herbicides in order to compare their effectiveness in terms of weed control or, in the case of preemergent herbicides, the reduction in weed emergence, by each herbicide and herbicide combination and to find and evaluate any toxicity effects which occur when treat-

ments are applied to cassava freshly cut at 30 cm at the beginning of the 2nd growing season. Herbicides applied were one selective preemergence spray (alachlor), 2 contact-knockdown sprays (paraquat, diquat), and one contact-translocated spray (glyphosate) in 10 treatments: (1) paraquat; (2) paraquat + alachlor; (3) diquat; (4) diquat + alachlor; (5) glyphosate; (6) glyphosate + alachlor; (7) paraquat + diquat; (8) paraquat + diquat + alachlor; (9) alachlor; and (10) paraquat + diquat + glyphosate. Treatments 1-9 were applied in Sept. to each of 4 areas: cassava cv. M AUS 10 and M AUS 7, each cut at 30 cm height; both cv. uncut with new shoots on the stem apices, and a weed infested section of headland. All contact herbicides gave complete weed kills. The performance of alachlor was a little below that expected. Diquat and paraquat damaged cassava foliage; however, recovery was complete after 6 wk.; glyphosate caused extensive deformity in leaves over the whole plant, which was persistent after 6 wk. Alachlor did not visibly damage the leaves. *(Summary by F.G. Trans. by L.M.F.)* D02

0057

16138 CRISP, D.L; EVENSON, J.P. 1981. **Effect of temperature and scarification treatment on the germination of cassava seed.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. p.90. Engl.

Cassava. Field experiments. Cuttings. Seed. Germination. Australia.

Investigation of the effects of various pretreatments and germination procedures for cassava seed are under way at the U. of Queensland, St. Lucia, Australia. The seed has a hard testa and is frequently slow to germinate. Scarification at the micropylar end of the seed has promoted rapid germination and the 1st temp. range trial (18-42°C) has indicated an optimum range between 26-32°C for rapid germination for cv. M AUS 1. *(Full text)* D02

0058

16163 TOLEDO, F.F. DE 1961. **Mandioca; estudo de produção de fôlhas, ramas e raízes visando o aproveitamento integral da planta.** *(Cassava: study of leaf, branch, and root production aiming at the utilization of the whole plant).* Piracicaba-SP, Brasil, Escola Superior de Agricultura Luiz de Queiroz da Universidade de São Paulo. 51p. Port., Sum. Port., 28 Refs., Illus.

Cassava. Field experiments. Cultivars. Harvesting. Timing. Leaves. Foliage. Tubers. Brazil.

The possibilities of using cassava foliage during root harvesting were studied in the state of São Paulo, Brazil. The performance of 4 cassava var. (IAC-5/82, IAC-5/127, IAC-5/133, and IAC-5/165) was studied during 4 different harvest times (the 1st 10 days of each month from May-Aug. successively) for 2 growth cycles in fields of the Plant Breeding Division of the Escola Superior de Agricultura Luiz de Queiroz. A random block split-split plot design was used with 4 treatments and 4 replications. Root, branch, leaf, and total plant wt. were determined During the 1st growth cycle plant wt. was affected by harvest time, during the 2nd cycle it was not. Root wt. did not vary significantly due to the different harvest times for the 2 growth cycles studied. However, the differences among var. were considerable. In general, analysis indicated that harvest times did not affect branch wt. of the var.; leaf wt. decreased sharply from May-Aug. in both growth cycles. Branch + leaf production was similar to root production for both growth cycles. It is concluded that the use of branches and leaves, except those set aside for planting, could improve the economic conditions of cassava cultivation. *(Summary by F.G. Trans. by L.M.F.)* D02

0059

15753 MATTOS, P.L.P. DE; CALDAS, R.C.; RIBEIRO, J.V. 1980. **Competição de épocas de corte em mandioca (*Manihot esculenta* Crantz).** *(Comparison of harvest times in cassava crops).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado técnico no. 14. 4p. Port., 1 Ref.

Cassava. Field experiments. Harvesting. Timing. Foliage. Brazil.

Between 1971 74, three expt were conducted at the Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)/Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF), Brazil to assess 3 harvest times at different intervals (all beginning 4 mo. after planting) and determine which one has the highest yield of green material/unit of area. A random block design was used with 3 treatments and 6 replications; cv. Milagrosa was used and treatments were distributed as follows: (A) cut at 4, 8, and 12 mo.; (B) cut at 4, 7, 10, and 13 mo.; and (C) cut at 4, 7, and 12 mo. According to the results of the 3 expt. branch production (t/ha) was not significant for the factors expt. and treatments independently; however, branch production in the interaction expt. x treatment was significant at a 5% level of significance, indicating an increase in branch production caused by the simultaneous effect expt. x treatment. It is concluded that in 3 yr the productivity of the treatments did not differ among themselves in spite of the fact that treatment A had a greater increase in productivity. *(Summary by F.G. Trans. by L.M.F.)* D02 D03

0060

16538 MATTOS, P.L.P. DE; SOUZA, A. DA S.; GOMES, J. DE C.; SOUZA, J. DA S.; CALDAS, R.C.; ALMEIDA, P.A. DE; MACEDO, M.M.C.; MENDES, R.A.; SANTOS, P.F. DOS; FERREIRA, J.R. 1980. **Fileiras duplas comprovam superioridade também a nível de produtor.** *(Advantages of double rows shown in on-farm trials).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado técnico no. 10. 9p. Port., 6 Refs.

Cassava. Field experiments. Planting. Spacing. Fertilizers. Propagation materials. Technology evaluation. Tuber productivity. Brazil.

In order to study the effect of adapting planting in double rows on on-farm cassava productivity, field trials using technology were conducted during 1979-80 in the localities of Petim and Sitio de Meio, municipality of Castro Alves, state of Bahia (Brazil). The following treatments were used: (1) cassava planting using the producer's technique + organic manure; (2) cassava planting using selection, recommended cutting size and spacing (1.0 x 0.6 m); (3) cassava planting using selection, recommended cutting size, spacing and fertilization; and (4) cassava planting in double rows (2.0 x 0.6 x 0.6 m) using selection, recommended cutting size and fertilization. Results obtained showed that the adaptation of spacing in double rows, in addition to being superior to all treatments, increases cassava root productivity 45 and 58% with regard to the check. In Sitio de Meio, roots were processed to obtain CF and yield response varied from 34.20-35.59% with a CF production of 4655-7650 kg/ha. Tables specifying the results obtained are included. *(Summary by F.G. Trans. by L.M.F.)* D02

0061

16536 CARVALHO, J.E.B. DE 1978. **Herbicidas pré-emergentes em mandiocais recém-podados.** *(Preemergent herbicides in recently pruned cassava crops).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado técnico no. 01.21.11. 3p. Port., 1 Ref.

Cassava. Field experiments. Pruning. Weeding. Herbicides. Germination. Brazil.

A preliminary trial was conducted at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF), Brazil, with preemergent herbicides on a sandy clay loam soil. The no. of existing weeds/m^2 was counted before herbicide application. The following herbicides were applied immediately after pruning cassava crops: diuron + alachlor at rates of 1 + 1.5 kg a.i./ha, resp. Toxicity in cassava plants and the influence of herbicides on their sprouting were determined. A new count of the no. of weeds/m^2 was made 120 days after application, registering 78% weed control with regard to the initial count. Symptoms of toxicity were slight and no suppression in sprouting was registered. According to economic analysis, it

is concluded that chemical weed control in recently pruned cassava crops is fairly promissory. *(Summary by F.G. Trans. by L.M.F.)* D02

0062

16519 TORO, J.C.; ATLEE, C.B. 1981. Prácticas agronómicas para la producción de yuca: (una revisión de la literatura). [*Agronomic practices for cassava production: (a literature review)*]. Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie no. 09SC-5. 44p. Span., 149 Refs., Illus.

Cassava. Research. Propagation materials. Cuttings. Storage. Planting. Land preparation. Timing. Spacing. Mechanization. Weeding. Irrigation. Pruning. Herbicides. Harvesting. Rotational crops.

A literature review is given of the results obtained in research conducted on agronomic practices for cassava production: propagation material (size, no. of nodes/stem age, and storage of cuttings); planting (land preparation, ridges vs. beds vs. rows, time, position, depth, distance, mechanization, and resowing); weed control; irrigation; pruning; harvesting; and rotational crops. It is concluded that it is impossible to generalize on agronomic practices of cassava cultivation in a specific country since each area is characterized by edaphic, climatic, and environmental factors that affect the yield response of a specific var. in different ways. *(Summary by F.G. Trans. by L.M.F.)* D02

0063

15765 DANTAS, J.L.L.; CUNHA, M.A.P. DA 1981. A colheita e a pós-colheita de mandioca no Brasil: estudo de caso. *(Harvest and post-harvest of cassava in Brazil: a case study).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos,1. 23p. Port., 9 Refs., Illus.

Also in English.

Cassava. Harvesting. Planting. Timing. Mechanization. Tuber productivity. Starch content. Cuttings. Storage. Cassava chips. Processing. Brazil.

The current harvest and post-harvest conditions in Brazil, research advances, and guidelines on how to achieve max. efficiency in these phases of cultivation are reviewed. Some aspects regarding harvesting are analyzed: growth period; HI; planting system; harvesting time (that also depends on economical factors such as market, prices, and availability of hand labor); harvesting methods (manual, semimechanized, and mechanized); and transportation. The possibilities of cassava cultivation for industrial purposes are described and aspects of the storage of stem planting material (place, position, and period) and root storage under field conditions and as cassava chips included. Cassava processing into flour is described in detail. It is concluded that further research is needed on these aspects. *(Summary by F.G. Trans. by L.M.F.)* D02 D04

0064

16582 PATEÑA, L.F.; BARBA, R.C. 1979. Rapid propagation of cassava by leaf-bud cuttings. Philippine Journal of Crop Science 4(2/3):53-62. Engl., Sum. Engl., 4 Refs., Illus.

Cassava. Field experiments. Propagation materials. Plant-growth substances. Propagation. Shoots. Rooting. Leaves. Philippines.

A new method of propagation of cassava consisting of the rooting of leaf-bud cuttings under mist is described. If done every 3 mo. and every leaf-bud produced is utilized, it has a potential yield of 4 million plants from an initial mature stock plant with 500 healthy leaves. Leaf-bud cuttings are prepared with a sharp knife and the basal ends are dipped in a solution of 10 g/*l* captan and 50 mg/*l* IBA, inserted in a sand bed with a 1" x 1" wire mesh as support, and allowed to root for 2 wk. Rooted cuttings are transferred in plastic con-

tainers with soil and allowed to harden for 2 wk. before transplanting in the ground. The plants are grown until each produces the desired no. of leaves for further propagation. The remaining stub also produces new leaves for propagation. Frequent propagation will result in faster turnover. *(Author's summary)* D02

16513 CALDEIRA, A.F. 1976. **A primeira unidade produtora de álcool de mandioca, do programa nacional do álcool, em implantação no Estado de Minas Gerais.** *(The first plant producing alcohol from cassava of the National Alcohol Program, established in the state of Minas Gerais).* Belo Horizonte, Instituto de Desenvolvimento Industrial de Minas Gerais. 53p. Port., 11 Refs., Illus.

Cassava. Alcohol. Cassava programs. Cultivation. Industrialization. Factories. Brazil.

The background, research and programs carried out in Minas Gerais, Brazil in order to establish the 1st plant producing alcohol from cassava, are given. An integration of agriculture and industry to obtain the final product is sought. A description is given of the current situation of cassava crops, the production system used in cerrado areas of the north central region of the state, requirements and models of introducing cassava cultivation in order to obtain planting material, testing of the planned production system, costs, budgets, and planting and harvest chronogram to supply raw material. Two main points of the industrial project are highlighted: (1) continuous industrial operation system maintaining daily, stable production throughout the yr; (2) the use of fresh cassava as the basis raw material in production. *(Summary by I.B. Trans. by L.M.F.)* D02 I02

See also 0030 0080 0109 0115 0189 0193 0194 0198

D03 Energy Productivity and Yields

0066

13254 TRINDADE, S.C. 1978?. **Avaliação de alternativas de conversão de energia: aplicação da análise de rentabilidade energética-REN ao álcool de mandioca.** *(Evaluation of alternatives of energy conversion: application of energy profitability-REN to cassava alcohol).* n.p., Instituto Brasileiro de Petróleo. 9p. Port., 12 Refs., Illus.

Paper presented at Congresso Brasileiro de Petróleo, 1o.

Cassava. Ethanol. Energy productivity. Brazil.

The application of the analysis of the profitability of cassava alcohol production reveals the need to establish less-intensive energy distilleries, utilization of domestic fuels in the system to generate energy and when it is economically feasible, generate electricity within the system. As an illustration, both an agricultural and an industrial subsystem are analyzed since the model and definition of frontiers for the system are crucial for the analysis of energy profitability REN. Some advantages are given along with the results of energy analysis. *(Summary by I.B. Trans. by L.M.F.)* D03

0067

16512 ARAUJO, J.E.G.; AGUIRRE, J.A.; BAZAN, R.; VERAS, A. 1980. **Perspectivas agroenergéticas de América Latina.** *(Agro-energy perspectives in Latin America).* Desarrollo Rural en las Américas 12(3):181-197. Span., Sum. Engl., Span., 14 Refs.

Cassava. Energy productivity. Technology. Latin America.

Four basic areas are covered: (a) energy problems; (b) the rationality and advantages of the agro-energy option; (c) sources of agro-energy and competition with food production; and (d) the basis for national agro-energy policies in L.A. countries. The most common sources of agro-energy are sugar cane, sweet sorghum, cassava, roots and tubers, vegetable residues, wood, oils and sugar beets. Several suggestions for policy guidelines to guarantee consistency on national, sectorial, and regional levels are given. *(Extracted from author's summary)* D03

0068

16508 UHL, C.; MURPHY, P. 1981. **A comparison of productivities and energy values between slash and burn agriculture and secondary succession in the upper Rio Negro region of the Amazon Basin.** Agro-Ecosystems 7(1):63-83. Engl., Sum. Engl., 43 Refs., Illus.

Cassava. Field experiments. Shifting cultivation. Productivity. Venezuela.

An analysis of the energy inputs and outputs for conuco agriculture (shifting cultivation) and a comparison of productivity between conuco crops and successional vegetation was undertaken near the town of San Carlos de Rio Negro in s. Venezuela. The main crop, cassava, yielded 4.31 t/ha wet wt. in yr 1; production declined to 2.81 t/ha in the 2nd yr. The infertile soils of the region are the major cause of these low yields. Although relatively

unproductive, conuco agriculture is much more energy-efficient than mechanized agriculture. The ratio of energy output, in the form of processed food, to energy input in the form of human labor, averaged 13.9:1 over 2 cropping periods. Slightly more energy was devoted to field activities than to processing activities. *(Extracted from author's summary)* D03

15787 ROSARIO, R.R. DEL 1980. **Prospects of rootcrops for alcohol production.** *In* Seminar Workshop on Rootcrops as Energy Sources, Los Baños, Laguna, 1980. Proceedings. Los Baños, Laguna, Philippine Council for Agriculture and Resources Research. pp.45-55. Engl., Illus.

Cassava. Tuber productivity. Energy productivity. Alcohol.

The comparative yield of different carbohydrate sources and alcohol production using sugar cane and root crops including cassava as raw materials is presented. However, if root crops will be used as raw material for energy source, the industry will have a problem in saccharification. Exptl. yield and national av. for cassava are 40 and 6 t/ha/yr, resp. Recoverable carbohydrates for cassava are 2.0 t/ha/yr. *(Author's summary)* D03

See also *0007 0023 0025 0026 0027 0028 0035 0036 0041 0044 0053 0059 0105 0106 0111 0113 0118 0120 0122 0170*

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D04 Postharvest Studies

0070

15054 WHEATLEY, C.; LOZANO, J.C. 1980. **Susceptibilidad de los genotipos de yuca a la deterioración fisiológica.** *(Susceptibility of cassava genotypes to physiological deterioration).* Yuca. Boletín Informativo 8:15. Span.

Also in English.

Cassava. Tubers. Cultivars. Deterioration. Storage.

A method of evaluating the progression of vascular streaking down 15 cm root sections was used to investigate the variation in susceptibility of cassava genotypes to physiological deterioration. Although there was a great intravarietal variation (M Col 22, a highly susceptible var., varied between 87-60% and CMC 40, a resistant var., from 31-8%) it was possible to distinguish susceptible and resistant cv. Studies on roots from plants of different ages revealed no relationship between the % of deterioration and plant age, nor any correlation with HCN or fiber content. However, a significant positive correlation was found with the starch content of roots. *(Summary by F.G. Trans. by L.M.F.)* D04

0071

16591 WHEATLEY, C.C. 1982. **Studies on cassava (*Manihot esculenta* Crantz) root post-harvest physiological deterioration.** Ph.D. Thesis. London, University of London. 246p. Engl., Sum. Engl., 302 Refs., Illus.

Cassava. Laboratory experiments. Tubers. Storage. Deterioration. Pruning. Harvesting. Timing.

The poor post-harvest storage life of cassava roots, due to a physiological deterioration of both vascular and parenchymal tissues which renders the roots inedible, is a major limitation of this crop. These studies demonstrated that the principal factors controlling the susceptibility of cv. to physiological deterioration are environmental: plants defoliated due to severe stresses were more resistant than non-defoliated plants of the same cv. Site and prevailing preharvest environmental conditions also affected the degree of susceptibility. Pruning expt. gave results which closely agreed with the defoliation effects and confirmed reports that preharvest pruning induced resistance to physiological deterioration. Such induced resistance was maintained for at least 9 wk. after pruning and was unaffected by subsequent regenerative growth. A reduction in root DM content occurred following pruning but this was not causally related to resistance to physiological deterioration. Previous observations that root DM content was positively correlated with susceptibility were confirmed when considering a range of cv. but not when roots of 1 cv. were examined individually; neither was root HCN content correlated with physiological deterioration. Biochemical and physiological studies demonstrated the presence of a diffusible factor from deteriorating tissues, capable of inducing deterioration in fresh root tissues. This was identified as scopoletin, previously reported in deteriorating cassava root tissues. When applied to fresh tissues scopoletin induced intense and rapid deterioration. Fluorescence studies showed that visible physiological deterioration is preceded by scopoletin accumulation, while only trace amounts occur in freshly harvested tissues. Root tissues from pruned plants did not accumulate scopoletin to the levels formed in susceptible roots. While scopoletin did induce deterio-

ration in root tissues from pruned plants it had no effect on tissues from susceptible roots cured after harvest; the significance and possible practical applications of these resistance mechanisms are discussed. *(Author's summary)* D04

See also 0042 0063

E00 PLANT PATHOLOGY

0072

16595 PINO A., J.A.; RODRIGUEZ M., S. 1980. **Enfermedades bacterianas, fungosas, virales, micoplasmáticas y nemátodos del cultivo de la yuca.** *(Bacterial, fungal, viral, and mycoplasmal diseases and nematodes in cassava crops).* Boletín de Reseñas: Viandas, Hortalizas y Granos 1:1-49. Span., 137 Refs.

Cassava. Symptomatology. Disease control. *Xanthomonas manihotis. Xanthomonas cassavae. Erwinia carotovora. Sphaceloma manihoticola. Cercospora henningsii. Cercospora vicosae. Glomerella manihotis. Oidium.* **Viroses. Mycoplasmoses. Nematodes.**

A literature review is given on the geographical distribution, symptomatology, and control measures of diseases in cassava crops, classified as: (a) bacterial: CBB (*Xanthomonas campestris* pv. *manihotis*), bacterial angular leaf spot (*X. campestris* pv. *cassavae*), bacterial stem rot (*Erwinia carotovora* pv. *carotovora*), bacterial stem gall (*Agrobacterium tumefaciens*); (b) fungal: superelongation (*Sphaceloma manihoticola*), brown leaf spot (*Cercosporidium henningsii*); blight leaf spot (*Cercospora vicosae*), rust (*Uromyces* spp.), anthracnose (*Colletotrichum* or *Glomerella* spp.), stem rot, concentric ring leaf spot [*Phoma (Phyllosticta)* spp.], cassava ash (*Oidium manihotis*), root rots; (c) viral diseases (CAMV, common mosaic, leaf vein mosaic, and CLV), mycoplasmas, and nematodes. *(Summary by F.G. Trans. by L. M.F.)* E00

0073

16506 LOZANO, J.C.; BELLOTTI, A.; REYES, J.A.; HOWELER, R.; LEIHNER, D.; DOLL, J. 1981. **Problemas en el cultivo de la yuca.** *(Field problems in cassava).* Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie CIAT 07SC-1. 208p. Span., Illus.

Also in English.

Cassava. *Xanthomonas manihotis. Xanthomonas cassavae. Erwinia carotovora. Agrobacterium tumefaciens.* **Cassava African mosaic virus.** *Cercospora henningsii. Cercospora vicosae. Phyllosticta. Sphaceloma manihoticola. Oidium. Glomerella manihotis. Uromyces manihotis. Phytophthora drechsleri. Rosellinia necatrix. Diplodia.* **Deterioration. pH. Disease control.** *Mononychellus tanajoa. Tetranychus urticae. Oligonychus peruvianus.* **Thrips.** *Erinnyis ello. Silba pendula. Anastrepha pickeli. Aleurotrachelus socialis. Aonidomytilus albus. Phenacoccus. Vatiga manihotae. Jatrophobia brasiliensis.* **Pest control. Nutritional requirements. Predators. Mineral deficiencies. Toxicity.**

Information on some diseases and pests that attack cassava, as well as the symptoms induced by nutritional deficiencies and toxicities and damage resulting from the misuse of herbicides are given in this manual. Specific and general recommendations regarding the control of the described problems are included. Disease control on a commercial scale is discussed. Formulae suggested for stake treatment before planting and storage and a key for identifying some cassava diseases are annexed. Color photos on symtomatology are included. *(Author's summary)* E00 F00

0074

16586 MONTALDO, A. 1981. **Principales enfermedades y plagas transmisibles por semilla sexual y asexual en yuca en Venezuela y medidas cuarentenarias para evitarlas.** *(Principal diseases and pests transmissible by sexual and asexual seed in cassava in Venezuela and quarantine measures to avoid them).* Caracas, Universidad Central de Venezuela. Facultad de Agronomía. 32p. Span., 58 Refs.

Cassava. Bacterioses. Mycoses. Viroses. Nematodes. Injurious insects. Injurious mites. Disease control. Pest control. Symptomatology. Quarantine measures. Plant damage. Disease transmission. Venezuela.

The symptomatology, sexual or asexual transmission, host plants, geographic distribution, control and quarantine measures of the following diseases in cassava in Venezuela are described: common mosaic, leaf vein mosaic, witches' broom, CBB (*Xanthomonas campestris* pv. *manihotis*), bacterial stem rot (*Erwinia carotovora* pv. *carotovora*), concentric ring leaf spot [*Phoma (Phyllosticta)* spp.], superelongation (*Sphaceloma manihoticola*), brown leaf spot (*Cercosporidium henningsii*), blight leaf spot (*Cercospora vicosae*), infected propagation materials, anthracnose (*Colletotrichum* or *Glomerella* spp.), cassava ash (*Oidium manihotis*), stem rot (*Rhizoctonia solani*), and rust (*Uromyces* spp.). Aspects on the damage caused, control and quarantine measures of the following pests are also included: stemborers (*Chilomina clarkei* and *Coelosternus* spp.), fruit flies (*Anastrepha* spp.), cassava hornworm (*Erinnyis ello*), gall midges (*Jatrophobia brasiliensis*), lace bugs (*Vatiga* spp.), thrips, and mites (*Mononychellus* spp., *Tetranychus* spp., and *Oligonychus* sp.). *(Summary by F.G. Trans. by L.M.F.)* E00 F00

E02 Bacterioses

0075

10489 BRADBURY, J.F. 1979. **Identification and characteristics of** *Xanthomonas manihotis. In* Terry, E.R., Persley, G.J. and Cook, S.C.A., eds. Workshop on Cassava Bacterial Blight in Africa; past, present and future, Ibadan, Nigeria, 1978. Report. London, England, Centre for Overseas Pest Research. pp.1-4. Engl., 9 Refs.

Also in French.

Cassava. Laboratory experiments. *Xanthomonas manihotis.* **Etiology. Isolation.**

Fourteen tests are presented for the identification of *Xanthomonas manihotis. (Summary by Abstracts on Tropical Agriculture)* E02

0076

16523 NISHIYAMA, K.; ACHMAD, N.H.; WIRTONO, S.; YAMAGUCHI, T. 1980. **Causal agents of cassava bacterial wilt in Indonesia.** Bogor, Indonesia, Central Research Institute for Agriculture. Contributions no. 59. 19p. Engl., Sum. Engl., Mal., 26 Refs., Illus.

Cassava. Laboratory experiments. *Pseudomonas. Xanthomonas campestris.* **Symptomatology. Isolation. Etiology. Indonesia.**

The symptoms of cassava bacterial wilt known to occur in Indonesia were divided into 3 types; drooping, severe defoliation with remaining immature leaves at the top, and dieback. The former 2 types of symptoms were usually accompanied by affected roots, while the latter was not. Bacterial isolates from the plants showing the former 2 types of symptoms were identified as *Pseudomonas solanacearum*, while those from the plants showing dieback symptoms were identified as *Xanthomonas campestris* pv. *manihotis*, by their bacteriological characteristics and pathogenicity. These results indicate that 2 distinct diseases are included in what has been called cassava bacterial wilt; bacterial wilt in the narrow sense caused by *P. solanacearum* and bacterial dieback caused by *X. campestris* pv. *manihotis. (Author's summary)* E02

0077

17118 TERRY, E.R.; ARENE, O.B. 1977. **Identification of cassava diseases and scoring the susceptibility of the cultivars.** Umudike, Nigeria, National Root Crops Research Institute. 9p. Engl., Sum. Engl., 10 Refs.

Paper presented at NAFPP/Workshop, NRCRI, Umudike, Nigeria.

Cassava. *Xanthomonas manihotis.* **Cassava African mosaic virus. Symptomatology. Nigeria.**

Two major diseases of cassava, CBB (*Xanthomonas campestris* pv. *manihotis*) and CAMD are discussed. The severity of CBB on cassava, which is characterized by angular leaf spot, gum exudation, wilting, and die-back is measured by the degree of wilting and die-back observed. This is graded into 5 classes. CAMD is characterized by chlorosis, which alternates with islands of deep green tissue thus giving the affected leaves a mosaic pattern. In severe cases

there are malformation and stunting. The severity based on chlorosis and malformation is also graded into 5 classes. *(Author's summary)* E02 E04

0078

17122 NKOUKA, N.; ONORE, G.; FABRES, G. 1981. **Eléments d'un inventaire de l'entomofaune phytophage du manioc en vue de l'identification des insectes vecteurs de la bactériose vasculaire.** *(Elements for a review of the phytophagous entomofauna of cassava in order to identify the insects which are vectors of vascular bacterioses).* Cahiers O.R.S.T.O.M. (Série Biologie) 44:9-10. Fr., Sum. Fr., Engl.

Cassava. *Xanthomonas manihotis.* Disease transmission. Biological control. Congo.

A list of the phytophagous insects collected in cassava fields is given to help in the identification of the species involved in CBB (*Xanthomonas campestris* pv. *manihotis*) transmission. *(Author's summary)* E02

E03 Mycoses

0079

16502 THANKAPPAN, M.; GOVINDASWAMY, C.V. 1979. **Control of brown leaf spot disease of cassava (*Manihot esculenta* Crantz).** Journal of Root Crops 5 (1/2):46-49. Engl., Sum. Engl., 18 Refs.

Cassava. Field experiments. *Cercospora henningsii.* Disease control. Tuber productivity. India.

Cassava brown leaf spot disease (*Cercosporidium henningsii*) could be controlled effectively by 6 sprayings of benomyl 0.10% or thiophanate 0.20% at monthly intervals. These treatments significantly reduced disease rating and premature leaf fall, and increased tuber yield. The other treatments – thiophanate 0.10%, fentin acetate 0.05%, fentin chloride 0.05%, edifenphos 0.10%, and zineb 0.30% – were not effective. *(Author's summary)* E03

0080

16507 PINO A., J.A.; FILIPIA, R. 1980. **Algunas consideraciones sobre el ataque del hongo *Glomerella cingulata*, en el sistema de propagación rápida de yuca en Cuba.** *(Some considerations on the incidence of the fungus Glomerella cingulata on the cassava rapid propagation system in Cuba).* Agrotecnia de Cuba 12(1):53-57. Span., Sum. Span., Engl., 5 Refs.

Cassava. *Glomerella cingulata.* Symptomatology. Propagation. Disease control. Germination. Cuba.

The effect of the fungus *Glomerella cingulata* on the sprouting of cassava clone CMC-40 cuttings was evaluated in propagation chambers at 7, 12, and 17 days after planting and the % of diseased cuttings in each chamber was determined at 25 and 120 days. The fungus *G. cingulata* affects cassava seed and caused a loss of 54-82% in sprouting in the propagation chambers. Applications of fungicides such as TMTD (85% WP) and captan (50%) prevent the contamination of the chambers, and should be made before planting. Clone CMC-40 was susceptible to the stem necrosis caused by *G. cingulata. (Author's summary)* E03 D02

0081

16117 MUNIZ, J.O. DE L. 1981. **Severa ocorrência de ferrugem em cultivares de mandioca (*Manihot esculenta* Crantz) no Município de Cruz das Almas, Bahia.** *(Severe incidence of rust in cassava cultivars at Cruz das Almas, Bahia, Brazil).* Fitopatologia Brasileira 6:441-444. Port., Sum. Port., Engl., 8 Refs.

Cassava. Field experiments. Cultivars. *Uromyces manihotis.* Resistance. Symptomatology. Brazil.

The occurrence of rust (*Uromyces manihotis*) was observed in cassava cv. of the germplasm bank at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF, Cruz das Almas, Bahia), in May 1979. The manifestation of the disease was indicated by the presence of typical symptoms in 9 mo. old plants. A total of 288 cv. was evaluated for resistance to the disease under field conditions. Only 18 (6.3%) genotypes behaved as resistant, while 51

(17.7%) were moderately resistant, 105 (35.8%) tolerant, 82 (28.5%) susceptible, and 34 (11.8%) highly susceptible. *(Author's summary)* E03 G01

0082

15759 TAKATSU, A.; FUKUDA, CH. 1977. **Recomendações e medidas a serem tomadas, face á ocorrência de superalongamento da mandioca causado por *Sphaceloma manihoticola* na região de Belém, PA.** *(Recommendations and measures that should be taken into account during the incidence of cassava superelongation caused by Sphaceloma manihoticola in the Belém region, PA).* Brasilia, Universidad de Brasília. 6p. Port., 6 Refs.

Casava. *Sphaceloma manihoticola.* Mycoses. Disease control. Quarantine measures. Brazil.

Recommendations and quarantine measures given by the Centro de Pesquisa Agropecuária do Trópico Umido (CPATU) to avoid the dissemination of the superelongation disease, caused by *Sphaceloma manihoticola*, in the Belém region (Brazil) are included. *(Summary by F.G. Trans. by L.M.F.)* E03

0083

16106 PONTE, J.J. DA; CASTRO, F.E. 1981. **Resistência em mandioca, *Manihot esculenta* Crantz, à podridão-seca das manivas (*Diplodia manihoti* Sacc.).** *(Resistance in cassava to Diplodia manihoti).* Fitopatologia Brasileira 6:359-366. Port., Sum. Port., Engl., 9 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Resistance. *Diplodia.* Clones. Brazil.

Since 1977, dry-rot in cuttings caused by *Diplodia manihoti*, has been found to be one of the most important diseases of cassava in NE Brazil. Possible sources of resistance to this disease were identified by studying the behavior of 50 cassava cv. in relation to *D. manihoti.* Expt. were carried out under lab. and greenhouse conditions. Excluding clone EAB 647, which was moderately resistant, all other cassava cv. tested showed susceptibility to the pathogen. Eighteen of them were classified as highly susceptible and 31 as susceptible. As a result of the expt. conducted under conditions highly favorable to the fungus, clone EAB 647 was considered the only source of resistance to *Diplodia.* Consequently, it has potential value for controlling this pathogen. *(Author's summary)* E03 G01

0084

16115 TERI, J.M.; LOZANO, J.C.; THURSTON, H.D. 1981. **Epidemiology of cassava brown leaf spot.** Fitopatología Brasileira 6:341-344. Engl., Sum. Engl., Span., 3 Refs., Illus.

Cassava. Field experiments. Cultivars. Symptomatology. Disease control. Epidemiology. *Cercospora henningsii.* Colombia.

Symptoms of cassava brown leaf spot (*Cercosporidium henningsii*) consisting of angular spots confined to old leaves were 1st observed when the plants were 1.5 mo. old. The lag stage of the epidemic took 173 days and the logarithmic stage lasted for 40 days when the plants were between 6-8 mo. old. The post-logarithmic stage was reached 213 days after planting as a result of severe defoliation which left few leaves old and susceptible enough for further infection. The disease may not cause concern when cassava is grown in marginal rainfall areas. Planting cassava after the peak of the rains in high rainfall areas can avoid the disease. Plants will reach their most susceptible stage during the dry season. *(Author's summary)* E03

0085

17133 ZEIGLER, R.; LOZANO, J.C.; THURSTON, H.D. 1981. **Sexual stage of *Sphaceloma manihoticola*, causal agent of the superelongation disease.** Cassava Newsletter 9:9. Engl., Illus.

Also in Spanish.

Cassava. *Sphaceloma manihoticola.* **Etiology. .**

The sexual stage of *Sphaceloma manihoticola,* recently found on diseased cassava plants from the Llanos Orientales, Cauca Valley, and N. Coast areas of Colombia and Tabasco in Mexico, is briefly described. *(Summary by Abstracts on Tropical Agriculture)* E03

See also 0042 0108 0112

E04 Viroses

0086

15716 NEMOTO, M. 1980. Vírus do mosaico das nervuras da mandioca. *(Cassava leaf vein mosaic virus). In* Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária dos Cerrados. Relatório parcial do projeto da cooperação em pesquisa agrícola nos cerrados do Brasil 1978-1980. Cruz das Almas-BA, Brasil. pp. 35-42. Port., 14 Refs., Illus.

Cassava. Laboratory experiments. Isolation. Cassava vein mosaic virus. Inoculation. Disease transmission. Symptomatology. Brazil.

An expt. was conducted under greenhouse conditions at the U. de Brasil (Brasilia) to identify other host plants to the leaf vein mosaic virus, in order to facilitate biological and purification studies and also verify the possible transmission by aphids. A virus isolated in Rio de Janeiro was used and inoculated in cassava and plants of different species. Studies included mechanical transmission, transmission by grafting, by aphids (*Myzus persicae*), and through needle inoculation. No case occurred of virus transmitted by mechanical methods, needle inoculation, or aphids; only 3 of the 5 plants submitted to grafting presented symptoms after 1 mo. *Datura stramonium* had local wounds during the 1st wk.; 2 other host plants of the virus are *Chenopodium murale* and *C. amaranticolor. (Summary by F.G. Trans. by L.M. F.)* E04

0087

16567 WALTER, B. 1980. **Isolation and purification of a virus transmitted from mosaic-diseased cassava in the Ivory Coast.** Plant Disease 64(11): 1040-1042. Engl., Sum. Engl., 14 Refs., Illus.

Cassava. Field experiments. Laboratory experiments. Cassava African mosaic virus. Disease transmission. Isolation. Ivory Coast.

A virus was transmitted mechanically from cassava leaves with typical symptoms of the CAMD to *Nicotiana benthamiana* and to hybrid *N. chevelandii* x *N. glutinosa*, and from *N. benthamiana* to other solanaceous species. The virus was purified and appeared as geminated particles in electron micrographs. This is the 1st report of a geminivirus in mosaic-diseased cassava in W. Africa. *(Author's summary)* E04

0088

15027 IGWEGBE, E.C.K. 1981. **Properties of a severe strain of cassava latent virus isolated from field grown tobacco in Nigeria.** *In* Terry, E.R., Oduro, K.A. and Caveness, F.,eds. Triennial Root Crops Symposium of the International Society for Tropical Root Crops, 1st, Ibadan, Nigeria, 1980. Tropical root crops: research strategies for the 1980s. Proceedings. Ottawa, Canada, International Development Research Centre. Series IDRC-163e. pp.58-60. Engl., Sum. Engl., Fr.

Cassava. Field experiments. Laboratory experiments. Isolation. Inoculation. Symptomatology. Cassava latent virus. Nigeria.

An agent causing severe stunting, leaf curl, leaf epinasty, and chlorosis mottle was isolated

and tested in field-grown tobacco in Nsukka, Nigeria. The agent was shown to be a virus, isolates of which were able to infect *Datura stramonium* and several *Nicotiana* species. The virus exhibited thermal inactivation at 55-60°C, dilution endpoint of $< 10^{-1}$, longevity in vitro of < 24 h, and a spherical morphology. It was transmitted by *Bemisia tabaci*. Based on these properties, the virus was considered to be a severe strain of CLV, although results of studies on agar to demonstrate the possible serological relationship between the Nsukka virus and CLV were inconclusive. *(Author's summary)* E04

0089

16580 BOCK, K.R.; GUTHRIE, E.J.; FIGUEIREDO, G. 1981. **A strain of cassava latent virus occurring in coastal districts of Kenya.** Annals of Applied Biology 99 (2):151-159. Engl., Sum. Engl., 9 Refs., Illus.

Cassava. Laboratory experiments. Cassava latent virus. Cassava African mosaic virus. Isolation. Symptomatology. Kenya.

A strain of cassava latent geminivirus (CLV) was isolated from mosaic-affected cassava plants from coastal districts of Kenya. This virus (CLV-C) did not infect *Nicotiana clevelandii*, a diagnostic host of the type strain (CLV-T); exptl. host range was very restricted and CLV-C only infected *N. benthamiana* and *N. rustica* out of several solanaceous hosts readily infected by CLV-T. CLV-C and CLV-T seemed to occur resp. only in coastal and western districts but their ranges overlapped in central Kenya where they could have been introduced in infected material. A virus serologically indistinguishable from CLV-T was isolated from mosaic affected material obtained from Nigeria; E. African and Nigerian isolates were essentially similar in host range and symptomatology. In gel-diffusion serology tests, pronounced precipitation spurs developed between CLV-T and CLV-C indicating that the isolates were related but not identical serologically. Symptoms typical of CAMD appeared in only 3 of 105 plants in expt. on transmission of CLV-C and CLV-T by whiteflies, when attempted acquisition of either clarified CLV-infective sap or purified CLV was made through 'Parafilm' membranes. Because it is possible that the 3 infections resulted from contamination, they cannot constitute proof of transmission. The presence of CLV in relation to the etiology of CAMD thus remains unresolved. *(Author's summary)* E04

0090

16579 ADEJARE, G.O.; COUTTS, R.H.A. 1981. **Eradication of cassava mosaic disease from Nigerian cassava clones by meristem-tip culture.** Plant Cell, Tissue and Organ Culture 1(1):25-32. Engl., Sum. Engl., 14 Refs.

Cassava. Laboratory experiments. Cassava African mosaic virus. Tissue culture. Disease control. Nigeria.

Methods previously established for the propagation of cassava plants free from CAMD have been applied to Nigerian clones. Meristem tips from diseased plants subjected to heat treatment for not less than 30 days at 35-38° C were cultured on modified Murashige-Skoog medium. Concn. ranges of benzyladenine in combination with NAA and GA were investigated and, at optimal levels, 36% of the meristems regenerated. Regenerated plants, with callus and shoots only, were rooted with 80% efficiency by sub-culturing following a dip in a hormone rooting powder. All plants raised from heat-treated meristems were free of the disease as judged by visual inspection of the leaves, rooted explants, and assay for the suspected pathogenic agent of the disease. *(Author's summary)* E04

See also 0077 0110

E05 Mycoplasmoses

0091

17119 PONTE, J.J. DA; TORRES, J.; SIMPLICIO, M.E. 1980. **Comportamento de cultivares de mandioca em relação a nematòides das galhas.** *(Behavior of cassava cultivars in relation to the root-knot nematodes). In* Reunião de Nematología, 4, Piracicaba, Brasil, 1980. Trabalhos apresentados. Piracicaba-SP, Sociedade Brasileira de Nematología. Escola Superior de Agricultura Luiz de Queiroz. Publicação, no. 4. pp.107-113. Port., Sum. Port., Engl., 7 Refs.

Cassava. Laboratory experiments. Nematodes. Cultivars. Resistance. Brazil.

An expt. was carried out under greenhouse conditions to assess the behavior of 25 cassava cv., in relation to 2 root-knot nematode species, *Meloidogyne incognita* and *M. javanica*. The results obtained showed that the resistance of cassava to *Meloidogyne* is common and susceptibility is an exception. Among the 25 cv. tested, 19 showed immunity and 3 were found to be highly resistant. Only 3 cv. (Curimanzinha, Riqueza-IPEACO, and Saracura) showed susceptibility; these should not be grown in areas infested with nematodes. *M. incognita* was the only root-knot nematode species found infesting the susceptible cv. grown in this essay. *(Author's summary)* E05

E06 Nematodes

0092

16199 GAPASIN, R.M. 1980. **Reaction of Golden Yellow cassava to *Meloidogyne* spp. inoculation.** Annals of Tropical Research 2(1):49-53. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Laboratory experiments. Inoculation. Nematodes. Tuber productivity. Foliage. Philippines.

Cassava cuttings were planted in clay pots containing sandy loam soil. Eggs of *Meloidogyne* spp. were used as inoculum at a level of 0, 1000, 5000, 10,000, or 20,000/pot. Initial population of approx. 10,000 or 20,000 eggs of *M. incognita* significantly reduced root and top wt. of cassava over the control; however, reduction in tuber wt. was not significant between all treatments. Though there was a reduction in root, tuber, and top wt. at varying inoculation levels of *M. javanica*, there were no significant differences between the treatments. *(Summary by Abstracts on Tropical Agriculture)* E06

F01 Injurious Insects and their Control

0093

16162 PENA, J.E.; WADDILL, V.H. 1981. **Southern armyworm and black cutworm damage to cassava at different growth stages.** Journal of Economic Entomology 74(3):271-275. Engl., Sum. Engl., 7 Refs., Illus.

Cassava. Field experiments. Laboratory experiments. Injurious insects. Cutworms. Germination. Plant damage. USA.

Damage to cassava by larvae of the southern armyworm, *Spodoptera eridania*, and the black cutworm. *Agrotis ipsilon*, was studied in greenhouse and field tests. Germination of seed pieces planted in a slanted position was reduced 13.5 and 40.0% by *S. eridania* and *A. ipsilon*, resp. In vertically planted seed pieces, germination was reduced 68 and 36% by *S. eridania* and *A. ipsilon*, resp. Damage by both species was greater when larvae attacked plants 5 or 10 days old than when larvae attached 15-day-old plants, causing only minor damage. The no. of larvae/plant which can be tolerated without significant detriment to the plant under greenhouse conditions was one for each species. *(Author's summary)* F01

0094

16168 COX, J.M.; WILLIAMS, D.J. 1981. **An account of cassava mealybugs (Hemiptera: Pseudococcidae) with a description of a new species.** Bulletin of Entomological Research 71:247-258. Engl., Sum. Engl., 27 Refs., Illus.

Cassava. *Phenacoccus manihoti*. Biological control. Predators. Insect biology.

The literature on the history and biology of the cassava mealybug, *Phenacoccus manihoti*, in Africa is reviewed, and reports on the search for natural enemies of this species in the Neotropics for biological control purposes are summarized. Further records of the distribution of *P. manihoti* in Africa are presented. A new closely-related species of *Phenacoccus*, *P. herreni* sp. n., which causes distortion to cassava in the Neotropical Region is described, and a key is provided to separate it from *P. manihoti* and from a similar species from the Neotropical Region, *P. surinamensis*, which apparently does not occur on cassava. *P. surinamensis* is redescribed and illustrated. *(Author's summary)* F01

0095

16183 AGUDELO, F. 1980. **Sex ratio of *Telenomus sphingis* (Hymenoptera: Scelionidae) parasitizing *Erinnyis ello* (Lepidoptera: Sphingidae) eggs in the Dominican Republic.** Florida Entomologist 63(3):341-343. Engl., 4 Refs., Illus.

Cassava. Field experiments. Laboratory experiments. Biological control. *Erinnyis ello*. Dominican Republic.

The egg parasite *Telenomus sphingis* is an effective natural control agent of *Erinnyis ello* (an important pest of cassava in the Dominican Republic) causing up to 100% mortality in some mo. As part of investigations on the biology of the scelionid with a view to its possible use in biological or integrated control programs in the field, the sex ratio was determined by rearing parasitized eggs of *E. ello* in the lab. The no. of parasites emerging from a single host varied from 1-11, and the no. of male parasites that emerged from each host egg varied from

1-4. Most host eggs gave rise to both male and female parasites, and few contained any dead parasites; eggs producing both males and females usually contained only 1 male. From these findings it was calculated that the sex ratio averaged 3.23 females to 1 male. *(Summary by Review of Applied Entomology)* F01

0096

16551 FABRES, G. 1981. **Entomophagous insects associated with the cassava mealybug in Congo.** Tropical Pest Management 27(1):145-146. Engl., Illus.

Cassava. *Phenacoccus manihoti.* **Biological control. Predators. Congo.**

The complex of parasitic and predacious arthropods associated with *Phenacoccus manihoti* in the Congo is described, with notes on the effectiveness, time of appearance, and abundance of some of the more important ones, which include the parasite *Anagyrus* sp. and the predators *Exochomus flaviventris, E. concavus, Hyperaspis senegalensis* (and 6 other coccinellids), *Coccodiplosis citri* (and 2 other cecidomyiids), and *Spalgis lemolea.* The % parasitism of some of these beneficial insects by 4 encyrtids (*Homalotylus flaminius, Xyphigaster pseudococci, Cheiloneurus cyanonotus,* and *Procheiloneurus pulchellus*) is given. *(Summary by Review of Applied Entomology)* F01

0097

17127 ATU, U.G; OKEKE, J.E. 1981. **Effect of insecticide application on cassava yield in control of cassava mealybug (*Phenacoccus manihoti*).** Tropical Pest Management 27(3):434-435. Engl.

Cassava. Field experiments. *Phenacoccus manihoti.* **Insect control. Tuber productivity. Nigeria.**

An insecticide trial to control *Phenacoccus manihoti* was conducted in Feb. 1980 in Nigeria, using 4 mo. old cassava plants var. 30211. The insecticides diazinon, dimethoate, methidathion, monocrotophos, and phosphamidon were applied at the rate of 0.05%.a.i. in 400 *l* water/ha. Best results were obtained 10 mo. after application with diazinon. It is concluded that application of diazinon, phosphamidon, and methidathion at 0.05% a.i. on moderately infested late cassava crops, for control of *P. manihoti,* can improve both top and tuber yields. *(Summary by Abstracts on Tropical Agriculture)* F01

0098

17135 RAJAMMA, P. 1981. **On a new stemborer of cassava.** Cassava Newsletter 9:12-13. Engl., 2 Refs., Illus.

Also in Spanish.

Cassava. Injurious insects. *Sybra praeusta.* **Insect biology. Plant damage. India.**

The new cassava stemborer *Sybra praeusta* is briefly described. *(Summary by Abstracts on Tropical Agriculture)* F01

0099

16588 BELLOTTI, A.C.; FARIAS, A.R.N. 1979. **Pragas importantes na cultura da mandioca (*Manihot esculenta* Crantz) e meios de controle.** *(Important cassava pests and control measures).* Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 23p. Port., 57 Refs.

Paper presented at Curso Intensivo Nacional de Mandioca, 3o., Cruz das Almas, BA, 1979.

Cassava. Injurious insects. Injurious mites. Plant damage. Pest control. Brazil.

Plant damage and control measures of the major cassava pests in Brazil are described. Pests are classified according to the part of the plant affected: (a) planting material: scale insects, fruit flies (*Anastrepha* spp.), stemborers,and ants; (b) pre- and postgermination cuttings and seedlings: whitegrubs (*Leucopholis rorida*), cutworms (*Agrotis ipsilon* and *Prodenia eridania*) and ants; (c) canopy : leaf-feeding insects such as the cassava hornworm (*Erinnyis ello*) and leaf-cutting ants (*Atta* spp. and *Acromyrnex* spp.); sucking insects such as mites (*Mononychellus tanajoa* and *Tetranychus urticae*), lace bugs (*Vatiga manihotae* and *V. illudens*) and whiteflies (*Bemisia tabaci*); piercing insects such as thrips (*Frankliniella williamsi*); stemboring insects such as shoot flies (*Silba pendula*), fruit flies, and stemborers; leaf deforming insects such as gall midges (Cecidomyiidae); and stem sucking insects such as scale insects and mealybugs (*Phenacoccus* spp.); and (d) stored dry cassava (Coleoptera). *(Summary by F.G. Trans. by L.M.F.)* F01 F03

0100

17136 LOHR, B. 1981. **Cassava stemborers in Colombia.** Cassava Newsletter 9: 11-12. Engl., 4 Refs.

Also in Spanish.

Cassava. Injurious insects. Insect biology. Ecology. Predators. Insect control. Plant damage. *Lagochirus obsoletus. Chilomina clarkei. Eulechriops manihoti. Coelosternus granicollis.* **Colombia.**

Four species of cassava stemborers found in Colombia, *Lagochirus* sp., *Eulechriops manihoti, Coelosternus granicollis,* and *Chilomina clarkei* are briefly described, including morphology, biology, and ecology, natural enemies, economic damage, and control. *(Summary by Abstracts on Tropical Agriculture)* F01

See also 0101

F02 Rodents and other Noxious Animals

0101

16546 LA INCESTANTE batalla. *(If not disease... insects).* 1980. El CIID Informa 9(2):8. Span.

Also in English.

Cassava. Research. *Mononychellus tanajoa.* Cultivars. Resistance. Africa.

In spite of the progress made in research at the International Institute of Tropical Agriculture, IITA, Ibadan, Nigeria in obtaining CAMV-resistant var., investigators have been forced to start anew due to the severe attacks of 2 pests introduced from S. America, the green mite (*Mononychellus tanajoa*) and scale insects, which may reduce yields 50 and 70%, resp. *(Summary by F.G. Trans. by L.M.F.)* F02 F01

F03 Injurious Mites and their Control

0102

16583 FARIAS, A.R.N.; BELLOTTI, A.C.; ZEM, A.C.; FLECHTMANN, C.H.W. 1981. **Avaliação do dano produzido pelo ácaro *Mononychellus tanajoa* (Bondar, 1938) cultura da mandioca (*Manihot esculenta* Crantz), em Cruz das Almas, Bahia.** *(Evaluation of damage produced by the mite Mononychellus tanajoa in cassava crops at Cruz das Almas, Bahia).* Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 8p. Port., Sum. Port., Engl., 4 Refs.

Paper presented at VII Congresso Brasileiro de Entomología, Fortaleza, CE, 1981.

Cassava. Field experiments. Cultivars. *Mononychellus tanajoa.* Plant damage. Acaricides. Tuber productivity. Brazil.

The green neotropical cassava mite, *Mononychellus tanajoa*, is considered a serious pest of the crop. An expt. was set up at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, Bahia (Brazil), where annual precipitation is approx. 1200 mm to verify evidence that its damage is in close relationship to rainfall. Cv. Cigana Preta, Aipim São Bento, and Felisberta were used, with and without chlorobenzilate treatment. Mite infestation level was determined during the dry period, when the pest occurs. Root production, wt. of the aerial part (stems + leaves), canopy DM content, and starch content in the roots were determined at harvest time. The total no. of mites shows that the population recovered within 15 days after miticide treatment, suggesting a short residual effect of chlorobenzilate. Production analysis revealed that for all the parameters, production was considerably higher in the non-treated check plots (root yield). This implies a possible depressive effect of the miticide or that the green cassava mite is not of economic importance in the area studied. *(Author's summary)* F03

0103

17134 GUERRERO, J.M.; BELLOTTI, A.C. 1981. **Inventory of phytophagous mites in cassava in Colombia.** Cassava Newsletter 9:10-11. Engl.

Also in Spanish.

Cassava. Injurious mites. Colombia.

Forty species of mites have been found in cassava all over the world. In Colombia, the most common mites that cause economic damage to cassava are: *Mononychellus tanajoa, M. caribbeanae, Tetranychus urticae, T. cinnabarinus,* and *Oligonychus peruvianus. (Summary by Abstracts on Tropical Agriculture)* F03

0104

17137 PILLAI, K.S.; PALANISWAMY, M.S. 1981. **Some new records of predators of the spider mites of cassava.** Cassava Newsletter 9:10. Engl.

Also in Spanish.

Cassava. *Tetranychus cinnabarinus. Tetranychus neocaledonicus. Eutetranychus orientalis. Oligonychus biharensis.* **Predators. India.**

Spider mites are the most serious pests of cassava in India, reducing yield by 10-34%. Two new predators were identified: a thrips *Scolothrips indicus*, which feeds on eggs and nymphs, and the spider *Poecilochroa* sp. which feeds on adult mites only. *(Summary by Abstracts on Tropical Agriculture)* F03

See also 0099 0124

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G01 Breeding, Germplasm, Varieties and Clones, Selection

0105

15793 KAMARA, S.I.; RAYMUNDO, S.A.; JONES, R.A.D. 1980. New cassava and sweet potato varieties released in Sierra Leone. IITA Research Briefs 1(2):7. Engl., Illus.

Cassava. Cultivars. Tuber productivity. Selection.

In late 1978, the Rice Research Station at Rokupr (Sierra Leone) released 3 new var. of cassava (Rocass 1, 2, and 3) and 3 new var. of sweet potato (Ropot 1, 2, and 3). The new var. have superior yields as compared with local var.,and possess good resistance to major diseases (particularly CAMD and sweet potato virus complex) and pests. *(Summary by Abstracts on Tropical Agriculture)* G01 D03

0106

16123 MATTOS, P.L.P. DE.;CALDAS, R.C.;GOMES, J. DE C. 1979. Competição de cultivares e clone de mandioca para produção de massa verde. *(Comparisons of cassava cultivars and clones for fresh matter production).* Pesquisa Agropecuária Brasileira 14(3):269-271. Port., Sum. Port., Engl., 5 Refs., Illus.

Cassava. Field experiments. Cultivars. Clones. Tuber productivity. Foliage. Brazil.

Cassava cv. and clones were studied regarding their fresh matter production at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF) - Empresa Brasileira de Pesquisa Agropecuária, Cruz das Almas, Brazil. Cassava cv. used were Milagrosa, Salangor Preta, Aipim Bravo, Cigana Preta, and clone SIPEAL-01, arranged in a 5 x 5 Latin square design. According to the statistical analysis the best fresh matter yields from cv. were in function of the no. of prunings and were obtained by SIPEAL-01, Milagrosa and Aipim Bravo; highest fresh matter yields from Milagrosa and Salangor Preta were obtained 11 and 13 mo. after planting, resp. *(Author's summary)* G01 D03

0107

16166 TELES, F.F.F.; PRATA, F.C.;BARROSO, M.A.T.;HOLANDA DE, L.F.F. 1980. Toxidez de algumas mandiocas (*Manihot esculenta* Crantz) introduzidas no Estado do Ceará. *(Toxicity of some cassava cultivars introduced into the state of Ceará).* Revista Ceres 27(154):662-664. Port., Sum. Engl., 4 Refs.

Cassava. Field experiments. Laboratory experiments. Clones. Tubers. HCN content. Brazil.

The HCN content in roots of 5 cv. of cassava introduced into the state of Ceará, Brazil, was determined. The results, expressed in mg of HCN/100 g of roots, were: Aipim Manso, 7.4; Aipim Bravo, 11.4; Mamão, 13.8; Salongó, 21.6; and, Urubu, 22.6. *(Author's summary)* G01 C03

0108

16171 DUARTE, M.L.R., ALBUQUERQUE, F.C. DE; CARDOSO, E.M.R.; ROCHA, H.M. 1981. **Reação de cultivares de mandioca ao superalongamento causado por *Sphaceloma manihoticola* em condições de infecção natural.** *(Reaction of local cultivars to superelongation caused by Sphaceloma manihoticola in naturally infective conditions).* Pesquisa Agropecuária Brasileira 16(4):607-610. Port., Sum. Port., Engl., 3 Refs., Illus.

Cassava. Field experiments. Cultivars. Resistance. *Sphaceloma manihoticola.* Brazil.

During expt. of cassava cv. competition carried out in Belém, state of Pará, Brazil, the 17 cv. resistance to superelongation caused by *Sphaceloma manihoticola* in natural conditions of infection were studied. Different reaction types were observed and among the cv. tested Riqueza, Vassourinha Branca, and Lagoa were the more resistant while IPEAN-12, Engana-Ladrão, and Miguel were the most susceptible; Amazonas, Cachimbo, Guamanara, Hamburguesa, Iracema, Jurará, Mameluca, Mameluca-Branca, Mico, Pretinha, and R-18 cv. showed intermediate resistant reaction. *(Author's summary)* G01 E03

0109

16177 REPUBLICA DOMINICANA. SECRETARIA DE ESTADO DE AGRICULTURA. 1971. **Proyecto de diversificación y aumento de la producción en el Valle del Cibao. Avances de los trabajos en yuca.** *(Project on diversification and production increase in the Valle del Cibao. Advance in cassava research).* Santo Domingo. Serie Boletín Informativo no. 6. 24p. Span., Sum. Span., 1 Ref., Illus.

Cassava. Field experiments. Cultivars. Selection. Plant breeding. Adaptation. Tuber productivity. Planting. Spacing. Cuttings. Dominican Republic.

Considering the great importance of cassava in human nutrition and the numerous possibilities of its industrialization, the studies of the Proyecto de Diversificación y Aumento de la Producción in the Valle del Cibao, Dominican Republic, have been subdivided into 2 trends: (1) for human consumption, implying the search for high-yielding, marketable sweet var.; (2) for industrial purposes, in both starch production and in the manufacture of dry cassava chips that could be exported in the initial stages and later, preferably used in the production of feed for livestock in order to intensify the country's beef production. One of the problems found has been the extreme variability of the cv. that does not allow reliable conclusions to be reached. This problem has been studied from different points of view. The results of 2 trials conducted at the Pontón exptl. field, La Vega, show the production potential of 12 var. of which var. C-6 of Jamaica is outstanding. Other var. from Colombia and some local ones are currently in their multiplicative phase for future evaluation. Other studies are also being conducted to determine the most adequate planting densities and cultural practices that guarantee the highest yields. *(Author's summary. Trans. by L.M.F.)* G01 D02

0110

16187 SEIF, A.A. 1981. **Transmission of cassava mosaic virus by *Bemisia tabaci.*** Plant Disease 65(7):606-607. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Field experiments. Cassava African mosaic virus. Disease transmission. *Bemisia.* Cultivars. Resistance. Vectors. Kenya.

Four cassava cv. from different sources were evaluated in the screenhouse for resistance to CAMD. Test plants were exposed to 1-15 viruliferous whiteflies (*Bemisia tabaci*) The virus was transmitted by single whiteflies, but % transmission increased with the no. of insects/plant. The cv. from S. America were highly susceptible to the disease. A technique for quick screening of cassava for mosaic resistance is suggested. *(Author's summary)* G01 E04

0111

16501 OKEKE, J.E.; OBIGBESAN, G.G.; FAYEMI, A.A.A. 1979. **Evaluation of agronomic traits in six Nigerian cassava varieties on representative Ultisol and Alfisol of Southern Nigeria.** Journal of Root Crops 5(1/2):25-31. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Field experiments. Cultivars. Agronomic characters. Tuber productivity. Dry matter. Harvest index. Resistance. Cassava African mosaic virus. *Xanthomonas manihotis.* **Nigeria.**

In trials over 2 years on representative Alfisol and Ultisol in the rainforest belt of Nigeria, 6 cassava var. were evaluated for some agronomic traits related to high tuber yields. Amount of leaf blade DM and LAI at 3 mo. were good indices of mature tuber yields and response to fertilizers. However, resistance or level of tolerance to serious diseases, CAMD and CBB (*Xanthomonas manihotis*), was the best determinant of yield. *(Summary by Abstracts on Tropical Agriculture)* G01 D03

0112

16503 THANKAPPAN, M.; GOVINDASWAMY, C.V. 1979. **Resistance to brown leaf spot disease in cassava varieties.** Journal of Root Crops 5(1/2):56-59. Engl., Sum. Engl., 14 Refs., Illus.

Cassava. Field experiments. Cultivars. Hybrids. Resistance. *Cercospora henningsii.* **India.**

None of the 30 cassava var. tested, which included 2 indigenous var., 5 exotic selections, and 23 hybrids, was found to be immune to brown leaf spot disease caused by *Cercosporidium henningsii*; 11 var. were classified as tolerant, 14 as susceptible, 3 as highly susceptible, and 2 as field resistance to the disease. Hybrids H-1843 and H-2351 were the ones identified as field resistant. *(Summary by Abstracts on Tropical Agriculture)* G01 E03

0113

16504 PHILIPPINE ROOT CROP RESEARCH AND TRAINING CENTER. 1980. **PRCRTC releases superior root crops varieties.** Radix 2(1):12. Engl., Illus.

Cassava. Cultivars. Tuber productivity. Starch content. Philippines.

For cassava, recommended var. are PR-C13, PR-C24, and PR-C62; for sweet potato, PR-S10; for taro PR-GO68; and for yams PR-A35, PR-A5, PR-A7, PR-A10 and PR-A11 for the Philippines. A summary of important details about the recommended root crop var. is presented. *(Summary by Abstracts on Tropical Agriculture)* G01 D03

0114

16529 ARKCOLL, D.B. 1981. **Algumas variedades interessantes de mandioca (*Manihot esculenta* Crantz) da Amazônia.** *(Some interesting cassava varieties from the Amazon region).* Acta Amazônica 11(2):207-211. Port., Sum. Port., Engl., 5 Refs., Illus.

Cassava. Field experiments. Cultivars. Selection. Agronomic characters. Tuber productivity. Brazil.

Over 150 cassava var. have been collected from Indians and small holders during the last 3 yr. Initial expt. already have identified some with interesting characteristics such as: (1) a yellow var. (IM 171) with 3.2 mg carotenoids/100 g of roots; (2) IM 097 capable of yielding > 5 kg of root/m^2/yr when well fertilized on a yellow Latosol; (3) IM 159 capable of yielding 7 kg of root/m^2 in only 7 mo. on the fertile varzea; and (4) IM 176 with some tolerance to root rot (*Phytophthora drechsleri*). *(Author's summary)* G01

0115

16532 MUTHUKRISHNAN, C.R. 1980. **Tuber crop research in Tamil Nadu: a resume.** *In* National Seminar on Tuber Crops Production Technology, Coimbatore, India, 1980. Proceedings. Coimbatore, Tamil Nadu Agricultural University. pp.1-8. Engl., 29 Refs.

Cassava. Research. Plant breeding. Propagation. Planting. Inter-cropping. Plant-growth substances. Irrigation. India.

Except for the cereals, tropical tuber crops are the most important group of staple foods in the tropical world. In Tamil Nadu, India, cassava and sweet potato are grown on 48,006 and 7735 ha, resp. An estimated area of 500 ha is planted to *Coleus* sp., *Colocasia* sp., and *Dioscorea* sp. The results of investigations carried out on crop improvement of cassava and sweet potato, planting systems, intercropping, the application of growth regulators, the influence of leaf removal on tuber production, and plant protection measures are reviewed. *(Summary by Abstracts on Tropical Agriculture)* G01 D02

0116

16195 INSTITUTO COLOMBIANO AGROPECUARIO. 1980. **Agronomía: yuca.** *(Agronomy: cassava). In* _____. Informe de gerencia 1980. Bogotá, Colombia. pp. 32-33. Span., Illus.

Cassava. Research. Cultivars. Clones. Selection. Tuber productivity. Resistance. Pests. Colombia.

The activities carried out by the Instituto Colombiano Agropecuario (ICA) and the Centro Internacional de Agricultura Tropical (CIAT) at different exptl. centers in Colombia regarding the evaluation and selection of hybrids, clones, and var. for high production, pest and disease resistance, and good cooking and industrial quality are reported. *(Summary by F.G. Trans. by L.M.F.)* G01

0117

16132 SCHULTZ, G. 1981. **Cassava research in the Northern Territory.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. p.99. Engl.

Cassava. Field experiments. Cuttings. Cultivars. Tuber productivity. Australia.

During 1979-80, trials with cassava were carried out at Douglas Daly Expt. Station, St. Lucia, Australia on Blain soil; a summary of results is presented. Early establishment problems centered around attacks by Microceroterms and Mastotermes on the cuttings, which caused major losses of plants. Trials in 1979 showed that pieces dipped in 0.5% concn. of dialdrin or monocrotophos were not attacked by termites. During the establishment phase of the program when the major objective has been to build up sufficient stocks of planting material for cv. evaluation, it has been difficult to carry out accurate yield determination. However, cv. showing no yield potential have been eliminated and the following cv. were retained for detailed tests: M AUS 1, M AUS 4, M AUS 7, M AUS 9, M AUS 10, M AUS 13, COML. MM., Mameya, Ceiba, and 2 local Northern Territory accessions. Yield estimates have been made on cv. where possible but these need to be treated with caution. The most reliable estimates would come from plots of M AUS 10 and M AUS 7 which are in a reasonably advanced state of multiplication and with a 12 mo. growing period under irrigation from Dec. 1979-Dec. 1980 gave yield projections of 71 and 16 t/ha fresh wt. of roots, resp. *(Full text)* G01

0118

16533 NEELAKANTAN P., N.; ASHOKAN, P.K 1980. **Comparative performance of nine varieties of cassava in the red sandy loam soil of North Malabar.** *In* National Seminar on Tuber Crops Production Technology, Coimbatore, India, 1980. Proceedings. Coimbatore, Tamil Nadu Agricultural University. pp.32-34. Engl., Sum. Engl., 4 Refs.

Cassava. Field experiments. Cultivars. Plant development. Foliage. Plant height. Tuber productivity. India.

A field expt. was conducted at Coconut Research Station, Nileswar, India, during 1977-78 to study the performance of cassava var. H-165, H-226, H-2304, H-1687, H-312, H-3641, M-4, and ME-7 in red sandy loam soils, in a randomized block design with 4 replications. It was observed that in all the var.,height of plant, no. of functioning leaves, wt. of top and length of tuber, recorded at the time of harvesting were on par. The total no. of leaves produced by H-226 var. was higher than the other var. The most bulky tubers were produced by H-165 and an av. girth of 17.9 cm was recorded. The max. wt. of tubers/plant and yield/ha (18,016 kg/ha) were reported by H-2304. The lowest yield (10,700 kg/ha) was recorded by ME-7. *(Author's summary)* G01 D03

0119

16575 ROJANARIDPICHED, C. 1980. **Cassava breeding.** *In* Kasetsart University. Department of Plant Pathology. Research reports 1977-1978. Bangkok, Thailand. p.85. Thai., Engl.

Cassava. Field experiments. Hybrids. Germination. Technology evaluation. Selection. Thailand.

A total of 2574 hybrid seeds of cassava from 10 crosses obtained at the Centro Internacional de Agricultura Tropical, CIAT, Colombia in 1975, were planted at Bangkhen, Thailand in 1976. The germination rate was 66.8% and 1720 seedlings were obtained. All the seedlings were grown at Bangkhen for 1 yr, observing diseases and insects. Most of the hybrid seedlings did not form flowers; some hybrids formed staminate flowers but not pistillate ones. Red spider mites (*Tetranychus urticae*) were major pests at Bangkhen. Cuttings from seedlings were planted at the station at Sriracha where selection was to be made the following yr. *(Full text)* G01

0120

15751 MATTOS, P.L.P. DE; SAMPAIO, J.M.M.; CALDAS, R.C. 1980. **Competição de cultivares de mandioca (*Manihot esculenta* Crantz) no município de Santa Terezinha-Bahia.** *(Evaluation of cassava cultivars in the municipality of Santa Terezinha-Bahia).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado técnico no. 12. 6p. Port.

Cassava. Field experiments. Cultivars. Selection. Fertilizers. Tuber productivity. Foliage. Brazil.

At the exptl. station of the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF), Santa Terezinha, Bahia (Brazil), 2 trials were established to assess 2 local cv. and 8 promissory cv. for the Cruz das Almas region. A random block exptl. design was used with 10 treatments and 4 replications. In the 1st expt. the soil received no fertilization; whereas in the 2nd, fertilizers were applied depending on soil analysis. Cv. Salangor Preta had the highest root production; cv. Mamão, Preta da Mata, Salangor Branca, Cigana Preta, Aipim Bravo, Salangorzinha, Sutinga Preta, and Graveto are also good prospects for the region since they yielded more than 30 t/ha on fertilized soil. On soils without fertilization, best cv. were: Salangor Branca, Aipim Bravo, Mamão, Preta da Mata, Salangorzinha, Salangor Preta, and Cigana Preta with yields of > 17 t/ha. The cv. with the highest yields regarding branch utilization were: Graveto de Santa Terezinha, Graveto, and Sutinga Preta. *(Summary by F.G. Trans. by L.M.F.)* G01 D01 D03

0121

15768 SILVA, S. DE O.E. 1981. **Atuação do banco ativo de germoplasma de mandioca.** *(Activities of the active cassava germplasm bank).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos, 8. 12p. Port., 4 Refs., Illus.

Cassava. Germplasm. Cultivars. Selection. Brazil.

The objectives of the active cassava germplasm bank in Brazil, located at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF), are described: the collection and maintenance of cassava germplasm; the reduetion of synonymy; the obtainment of a complete description of each cv. or group of cv.; and the selection of promising cv. and germplasm for private institutions and/or rural extension services. The no. and % distribution of cassava cv. by the 1976-80 germplasm bank in 1976-80 are analyzed. *(Summary by F.G. Trans. by L.M.F.)* G01

0122

15747 EVANGELIO, F.A. 1980. Cassava varieties for alcohol. The Radix 2(1):5. Engl., Illus.

Cassava. Research. Cultivars. Tuber productivity. Energy productivity. Philippines.

Information is given on cassava var. for alcohol in the Philippines. Cassava var. for alcohol have not been specifically identified. For alcohol production the amount of fermentable product is important. In its 3 yr of worthwhile existence the Philippine Root Crop Research and Training Center came up with 3 recommended cassava var.,PR-C13, PR-C24, and PR-C62 which yielded 42, 43, and 46 t/ha, resp. at 10 mo. They are sweet-type var. and theoretically yield considerable amounts of alcohol in l/ha. PR-C13, PR-C24, and PR-C62 yield 7780, 7560, and 8280 l/ha, resp. using the conversion factor of 180 l/t freshly harvested tubers. *(Summary by Abstracts on Tropical Agriculture)* G01 D03

0123

16527 HOLGUIN M., F.; URIAS L., M.A.; ACOSTA E., J.; GONZALEZ L., V.W.; IBARRA L., F.A.; MENDEZ R., A.; OCHOA C., F.; PASTRANA A., L.; RUIZ B., P.; VILLALOBOS P., J. 1981. Sabanera y Costeña dos nuevas variedades de yuca para el trópico húmedo de México. *(Sabanera and Costeña, two new cassava varieties for the humid tropics of Mexico).* Tabasco, México, Secretaría de Agricultura y Recursos Hidráulicos. Folleto Técnico no. 1. 9p. Span., Illus.

Cassava. Field experiments. Cultivars. Selection. Agronomic characters. Plant development. Resistance. Pests. Mexico.

In breeding trials conducted for 4 yr by the Instituto Nacional de Investigaciones Agrícolas at the Huimanguillo exptl. field, Tabasco, Mexico, 2 cassava var. (Sabanera and Costeña) have been outstanding regarding yield response and resistance to thrips (*Frankliniella cephalica* and *Caliothrips* sp.) and CBB (*Xanthomonas manihotis*). A description is given of botanical (growth habit, height, no. of branches, color of the stem, and leaf length) and agronomic characteristics (growth cycle, av. no. of commercial roots and HI at 10 mo., resistance to CBB, superelongation, brown leaf spot, thrips, and adaptation to acid and nonacid soils).*(Summary by F.G. Trans. by L.M.F.)* G01

0124

14678 CRUZ, C. 1981. Differential mite infestation of cassava varieties. Journal of Agriculture of University of Puerto Rico 65(1):81-82. Engl.

Cassava. Field experiments. Cultivars. Resistance. *Mononychellus caribbeanae*. Puerto Rico.

The Agricultural Expt. Station in Puerto Rico introduced new var. to study their agronomic characteristics and select the better var. In 1972, 11 introduced var. and local var. Nativa (check) were planted in Isabela, a cassava growing area, in a randomized complete block design with 4 replications. These var. were infested by a mite identified as *Mononychellus caribbeanae*. To determine the degree of mite infestation in the var. an evaluation was conducted based on the symptoms and damage observed in the whole plot. All the introduced var. were more affected than var. Nativa. Mites were effectively controlled with 2

applications of dicofol at the rate of 1 lb/ac in 100 gal water. *(Summary by F.G. Trans. by L.M.F.)* G01 F03

0125

16599 VELASQUEZ L., J. 1975. **Determinación de porcentajes de almidón y proteínas en las raíces de 8 variedades de yuca (*Manihot esculenta*, Crantz).** *(Determination of starch and protein percentages in roots of 8 cassava varieties).* Medellín, Universidad Nacional de Colombia. Facultad de Ciencias Agrícolas. 65p. Span., Sum. Span., 12 Refs.

Cassava. Field experiments. Cultivars. Harvesting. Timing. Tubers. Starch content. Protein content. Water content. Colombia.

In order to study the variations in the starch, protein,and moisture contents with different harvest times and under different environmental conditions, 8 selected cassava var. were planted at the Granja Exptl. Tulio Ospina (temp. 21°C, alt. 1450 m.a.s.l., rainfall 1300 mm) and in Cotové (temp. 28°C, alt. 600 m.a.s.l., rainfall 700 mm), Antioquia, Colombia in April 1974. The var. studied were: Popayaneja, Clon 88, Cip 24-2, Palmireña, UCV. 2096, Clon 105, Algodonera, and Aguabajo of the collection of the Centro Nacional de Investigaciones Agropecuarias Tulio Ospina and the El Nús Exptl. Station. Harvest times were 9 and 12 mo. after planting. Starch, protein, and water % were determined on the basis of 100 g unpeeled roots immediately after harvest in the lab. of the Facultad de Ciencias Agrícolas of the U. Nacional de Colombia. A random block design was used with 4 replications and 8 var. under 2 environmental conditions and with 2 harvest times. Results highlight var. Aguabajo as promissory for its high starch content, especially under Cotové environmental conditions (21.6%). A highly significant increase was also observed in starch % in the 2 harvest times, corresponding to an av. of 14.11 and 19.44% at 9 and 12 mo., resp. The environment did not affect starch content for the majority of the var., except for Aguabajo and Palmireña which interacted significantly with the environment. Var. Aguabajo had the lowest MC (54.46%); the other var. did not have marked variations. The environmental conditions at the Granja Exptl. Tulio Ospina induced an av. water content of 59.1%, slightly lower than that at Cotové (65.2%). On the other hand, no differences were found in protein % for the different var., which varied between 2.0-2.7% nor in the effect of harvest times, environments, and interactions. *(Author's summary. Trans. by L.M.F.)* G01 C03

0126

16556 LOZANO, J.C.; BYRNE, D.; BELLOTTI, A. 1980?. **The relationships between cassava (*Manihot esculenta* Crantz), ecosystems, diseases and pests and their influence on breeding strategy.** Cali, Colombia, Centro Internacional de Agricultura Tropical. 24p. Engl., 34 Refs., Illus.

Cassava. Ecosystems. Diseases and pathogens. Pests. Plant breeding. Selection. Clones.

Based on the considerations related to the characteristics of cassava, centers of origin, and the traditional system of cultivation, several conclusions were made regarding the relationships between the plant and NPFs, constituted by disease and pest pressures and edaphic and climatic factors. It is concluded that: (1) the existence and/or severity of diseases and pests are related to the characteristics of the ecosystem; (2) there appears to be no evidence of race specialization among pathogens and pests of cassava; (3) resistance to NPFs appears to be stable; (4) cassava clones are regionally adapted var.; (5) *Manihot esculenta* probably has resistance to most NPFs existing in the different ecosystems since it has been selected under a wide range of ecosystems; (6) it is possible to find clones of *M. esculenta* with resistance to all the NPFs in a given ecosystem; and (7) on the basis of the aforementioned considerations, it is suggested that plant breeding programs should be decentralized to include several representative ecosystems as selection sites. *(Summary by I.B. Trans. by L.M.F.)* G01

0127

16134 LACEY, S.; WILSON, G.L. 1981. **Screening for assimilate distribution patterns.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland, Departament of Agriculture. pp.93-94. Engl.

Cassava. Laboratory experiments. Selection. Dry matter. Foliage. Temperature. Photoperiod. Growth. Australia.

Controlled environment expt. recently carried out at the U. of Queensland (Australia) indicate that patterns of dry wt. distribution between roots (in particular, storage roots) and tops, in response to temp. and photoperiod, may be important criteria for var. selection. The aim of this work is to develop a test whereby such responses can be recognized at a stage prior to that at which they can be identified morphologically. Moreover, the method should be suitable for large-scale screening either of responsiveness of a genotype to environmental variation, or of genotypes to an environmental factor. The hypothesis underlying this study is that such responses act directly through changes in patterns of assimilate distribution (rather than in consequence of morphogenetic changes with establish new sinks for assimilate). Such patterns should be readily identifiable by labelling photosynthates with ^{14}C. The initial stages of the work involve the correlation of ^{14}C distribution patterns with known changes in assimilate partitioning during the growth of the crop and under varying environmental conditions. *(Full text)* G01 C01

0128

16516 MOHR, W. 1944. **Análises quimicas de 115 variedades de *Manihot utilissima*, cultivadas no Campo Experimental de Mandioca, em Capela, Municipio de São Sebastiaõ do Cai.** *(Chemical analyses of 115 varieties of Manihot utilissima, cultivated at the Cassava Experimental Field, in Capela, municipality of São Sebastião do Cai).* Porto Alegre-RS, Brasil, Secretaria de Estado dos Negocios da Agricultura, Industria e Comercio. 18p. Port., Illus.

Cassava. Laboratory experiments. Cultivars. Analysis. Ash content. Protein content. Fibre content. Fat content. Water content. Carbohydrate content. HCN content. Brazil.

Comparative results of chemical analyses corresponding to 115 var. of *Manihot utilissima*, cultivated at the Cassava Exptl. Field in Capela, municipality of São Sebastião do Cai (Brazil) are given in order to select disease- and pest-resistant, high-yielding var., apt for the soils of the region. The technique utilized is described; based on the determination of MC + the value of 4.65% (mean value of the sum of ash, protein, lipid, and fiber %) and substracting this sum from 100, the carbohydrate content is determined, being susceptible to a max. error of 0.5%. The method used for determining HCN content in roots is annexed. *(Summary by I.B. Trans. by L.M.F.)* G01 C03

See also 0014 0015 0017 0081 0083

H02 Nutritive Disorders in Humans

0129

16197 OSUNTOKUN, B.O. 1981. **Cassava diet, chronic cyanide intoxication and neuropathy in the Nigerian Africans.** World Review of Nutrition and Dietetics 36: 141-173. Engl., 156 Refs.

Cassava. Human nutrition. HCN. Toxicity. Clinical manifestations. Ataxic neuropathy. Nigeria.

The sources of cyanide (cyanogenic glycosides, nitriles) and SCN in foods and plants are discussed. Cassava is used for food in several ways by Nigerians and is the main dietary cause of chronic cyanide intoxication and neuropathy. *(Summary by Food Science and Technology Abstracts)* H02

H03 Animal Feeding

0130

15715 WYLLIE, D.; LEKULE, F.P. 1980. **Cassava and molasses for fattening pigs under village conditions in Tanzania.** Tropical Agriculture 57(3):267-276. Engl., Sum. Engl., 26 Refs.

Cassava. Laboratory experiments. Laboratory animals. Swine. Animal nutrition. Cassava meal. Diets. Dry matter. Ash content. Fibre content. Protein content. Mineral content. Feed mixtures. Fattening. Molasses. Tanzania.

Two expt. were carried out with Large White x Landrace pigs. In the 1st expt. cassava root meal was substituted for maize at rates of 0, 18, 36, and 54% of the diet. The maize protein was replaced by a soybean-sesame meal mixture in a 1:2 ratio. The diets were fed from 41-90 kg livewt. according to a feeding scale giving levels of energy and protein intake below those for max. growth. Treatments did not differ significantly in their effect on performance, carcass characteristics, or wt. of various internal organs. The diet containing 36% cassava was the most economic in terms of the food cost of carcass gain. In the 2nd expt. equal wt. of cassava root meal and final cane molasses were substituted for one another at levels of 0, 17, 34, 51, and 68% of the diet. They were fed to a severely restricted scale from 38-80 kg livewt. Daily gain and food conversion efficiency increased linearly as the cassava content of the diet increased. Carcass measurements did not differ between treatments. As the proportion of molasses in the diet increased, kidney and liver wt. increased and the food cost of carcass gain decreased. The practical implications of these results are discussed. *(Author's summary)* H03

0131

16102 RAJAGURU, A.S.B.; RAVINDRAN, V.; RANAWEERA BANDA, R.M. 1979. **Manioc leaf meal (*Manihot esculenta* Crantz) as a source of protein for fattening swine.** Journal of the National Science Council of Sri Lanka 7(2):105-110. Engl., Sum. Engl., 10 Refs.

Cassava. Laboratory experiments. Laboratory animals. Cassava leaf meal. Swine. Animal nutrition. Finishing. Diets. Sri Lanka.

Studies were conducted to evaluate CLM as a source of protein in rations for growing and finishing pigs. Results suggest that CLM could be included up to a 30% level in fattening pig rations, without any adverse effects on animal performance. Significant improvements in growth rate and feed conversion efficiency were observed in growing pigs fed on 20 and 30% levels of CLM when compared to the coconut meal-based control ration. This effect was attributed to the high lysine content of CLM. *(Author's summary)* H03

0132

15798 MUDGAL, V.D. 1979. **Enriching the cattle feed.** Intensive Agriculture 17 (10):36-38. Engl., Illus.

Cassava. Feeds and feeding. Leaves. Animal nutrition. Protein content. Digestibility. Cattle.

Notes on the nutritional properties of wheat and paddy straw, together with details of

bagasse-molasses-sugarcane tops rations are presented. Brief notes on the use of spent lemon grass (*Cymbopogon flexuosus*), mulberry leaves, fruit and vegetable residues, cassava leaves, and mahua (*Madhuca longifolia*) seed cake in animal feeds are also included. *(Summary by Abstracts on Tropical Agriculture)* H03

0133

16103 RAJAGURU, A.S.B.; RAVINDRAN, V.; DIAS, E.A. 1978. **Utilization of cassava meal (*Manihot esculenta* Crantz) in swine feeding.** Journal of the National Science Council of Sri Lanka 6(2):95-102. Engl., Sum. Engl., 18 Refs.

Cassava. Laboratory experiments. Laboratory animals. Swine. Cassava meal. Animal nutrition. Dry matter. Protein content. Fibre content. Ash content. Finishing. HCN content. Diets. Sri Lanka.

The 2 feeding trials conducted at the U. of Sri Lanka with growing and finishing pigs on the use of CM indicate that the HCN-free CM could be used successfully as a substitute for maize up to 40% of the ration. However, the unprocessed CM depressed both growth rate and feed efficiency. Also, the scouring of pigs experienced with the feeding of unprocessed CM could be prevented completely by detoxifying it. Cassava-based diets reduced carcass recovery % slightly, although not statistically significant. Data was not conclusive as only 1 animal was used per treatment for carcass analysis. However, CM did not alter backfat thickness in the HCN-free ration but unprocessed meal caused an adverse effect on the backfat thickness, indicating that HCN also interferes with energy utilization. *(Author's summary)* H03

0134

16104 UDO, H.; FOULDS, J.; TAUO, A. 1980. **Comparison of cassava and maize in commercially formulated poultry diets for Western Samoa.** Alafua Agricultural Bulletin 5(1):18-26. Engl., Sum. Engl., 13 Refs., Illus.

Cassava. Laboratory experiments. Poultry. Diets. Maize meal. Animal nutrition. Eggs. New Zealand.

In W. Samoa there is a great need for locally produced raw materials for animal diets. Two expt. to evaluate cassava as a replacement for maize in poultry grower and layer diets are reported. In the 1st expt. isoenergetic grower diets balanced to the same total S amino acid content based on maize or cassava were fed to 240 Shaver 288 pullets from 6-18 wk. of age. There were no significant differences in body wt. gain, feed intake, and mortality between the 2 treatments. In the 2nd expt. maize- and cassava-based isoenergetic layer diets balanced to the same total S amino acid content were fed to 192 Shaver 444T hens. During the 20 wk. exptl. period data were collected on egg production and wt., feed consumption, yolk color, and mortality. The performance of the hens fed the maize-based diet, did not differ significantly from that of the hens fed the cassava-based diet, with the exception of the yolk color. Egg production on the maize-based diet averaged 72.1% compared to 68.5% on the cassava based diet. The daily feed intake was 119.1 and 116.9 g/day, resp. The cassava-fed hens produced eggs with a paler yolk than the maize-fed hens. Both expt. clearly demonstrate that in W. Samoa satisfactory results can be obtained with high inclusions of cassava in grower and layer diets when the cassava-based diets are adequately supplemented with energy and limiting amino acids. Some discussion as to the suitability of locally produced ingredients for use in commercial animal feeds is also presented. *(Author's summary)* H03

0135

16110 GOMEZ, G.; SANTOS, J. 1979. **Evaluación nutritiva de la harina de yuca con y sin melaza como fuente energética para cerdos en crecimiento y acabado.** *(Nutritive assessment of cassava flour with and without molasses as an energy source for growing and finishing pigs). In* Reunión Latinoamericana de Producción Animal, 7a., Panamá, 1979. Programa y Compendios. Panamá, Asociación Panameña de Producción Animal. pp.NR 48. Span.

Cassava. Laboratory experiments. Laboratory animals. Swine. Diets. Cassava meal. Supplements. Molasses. Nutritive value. Animal nutrition. Colombia.

A study was conducted with a total of 40 weaned York x Duroc pigs divided into 4 exptl. groups of 10 pigs each. The following treatments were assigned: (1) check I, sorghum + soybean cake; (2) check II, sorghum + soybean cake + molasses; (3) CM + soybean cake; and (4) CM + soybean cake + molasses. Diets were calculated to supply 16 and 13%CP and 2 levels of addition of molasses were used: 10 and 20% for the growing (16-50 kg) and finishing (50-95 kg) periods, resp. Except for group 3 which took a week longer, the remaining groups took 16 wk. to reach market wt. The addition of molasses favored a slightly higher daily av. intake (kg) in sorghum-soybean based diets (2.35 vs. 2.52) but not in the CM based diet whose intake was similar (2.22 vs. 2.22). Daily av. wt. gain (kg)/animal was favorably affected by the addition of molasses (0.71, 0.74, 0.65, 0.69) but there was no marked differences regarding feed conversion (3.3, 3.4, 3.4, 3.2). Although one of the limiting factors in the use of CM is the greater quantity of protein ingredient required in the ration due to its low supply of protein compared to other energy sources, the addition of molasses slightly reduces the amount of protein supplement and, at the same time, provides greater palatability and consistence to the ration, which means a better utilization by the animal. *(Complete text. Trans. by L.M.F.)* H03

0136

16127 ADEWUSI, S.R.A.; OKE, O.L. 1980. **The effect of various levels of cassava on protein utilization by rats.** Nutrition Reports International 21(5):709-715. Engl., Sum. Engl., 14 Refs.

Cassava. Laboratory animals. Leaves. Digestibility. Proteins. Animal nutrition. Pellets. Nigeria.

Cassava was substituted for maize starch at 0-100% level in rat diets using casein as the source of protein. Apart from the 50%level where all the parameters determined were similar to those of the control, the general trend is that the PER decreased from 2.5 for 0% level gradually to 2.0 at 100% substitution. Digestibility in vivo (80.5-69.9) and in vitro (94.6-88.9) and the plasma SCN levels (1.6-3.6 mg/ml) followed the same pattern. The plasma urea level was the reverse, starting with 34.2 mg N/100 ml at 0% cassava and increasing as the level of cassava reached a maximum of 70.0 mg at 100% cassava. The high level of cassava did not seem to have any marked effect on the feed intake or on the available lysine (7.6-8.3 g/16gN). When leaf protein (LPC) from *Amaranthus* was used as sole source of protein at 100%cassava level the PER was low (1.26) but increased to 1.64 on supplementation with 0.2% met. and the best result was obtained when 50:50 mixture of LPC and casein was used (PER 2.15), better than casein alone (2.01). The other parameters were not affected to any extent. *(Author's summary)* H03

0137

16180 CASTILLO, L.S. 1980. **Cassava as animal feed – versatile but handle it with care.** Farming Today 6(7):18-21. Engl., Sum. Engl.

Cassava. Animal nutrition. Tubers. HCN content. Cultivars. Silage. Forage. Cassava leaf meal.

Numerous researches definitely show the importance of cassava as animal feed. However, quality should be emphasized. Adulteration should be avoided or minimized. The presence of HCN should be recognized and proper formulation made as regards nutrient requirements of energy, protein, amino acids, vitamins, minerals for specific class of animal. Adulteration of cassava feed products definitely reduces their feeding value and increases production costs. Fish meal was bought supposedly with 50% or higher protein control but on analysis the various sacks of 50 kg each gave 18-20% protein. Regarding HCN, care must be taken since it affects performance. Very faulty feed or food preparation will seriously affect animal performance if it does not cause death. There are many factors affecting HCN toxicity but carefulness is imperative. *(Author's summary)* H03

0138

16515 MEYRELES, L.; MACLEOD, N.A.; PRESTON, T.R. 1977. **Forraje de yuca como suplemento proteico en dietas de caña para ganado bovino: efectos de diferentes niveles sobre crecimiento y fermentación ruminal.** *(Cassava forage as a protein supplement in sugar cane diets for bovine cattle: effects of different levels on growth and rumen fermentation).* Producción Animal Tropical 2:76-83. Span., Sum. Span., 6 Refs., Illus.

Cassava. Laboratory experiments. Laboratory animals. Cattle. Forage. Animal nutrition. Supplements. Dominican Republic.

Thirty-six 1-yr-old animals with an initial livewt. of 160-200 kg were used to evaluate levels of cassava forage at 0, 15, 30, and 45% (fresh basis), substituting sugar cane urea. Cassava was cut 3-5 mo. old, containing an av. DM content of 20% and 15.8% of N x 6.25. Sugar cane contained 25.5% DM and 12.4° Brix. Both sugar cane and cassava forage were chopped in pieces approx. 10 mm long. The sugar cane mixed with urea and ammonium sulfate was left to ferment for 24 h before offering it to the animals; cassava was also left 24 h separated from the sugar cane. After 80 days of testing, daily gain was -14, 187, 105, and 144 g/day for the levels of cassava forage (significantly greater for the cassava combination vs. the control, $P < 0.03$). Voluntary intake was low in all treatments (from 1.72-1.92 kg DM/100 kg livewt.). Studies on the composition of rumen liquid of these and other fistulized animals receiving the same treatments, showed high pH values (> 6.8) and high levels of rumen ammonium (from 15-22 mg NH_3/100 ml), which did not vary among treatments. It was concluded that the possible reason for the low performance with cassava forage were the high levels of rumen ammonium caused by the high solubility of cassava protein combined with urea. There was no evidence of possible toxic effects due to hydrocyanic acid. *(Author's summary. Trans. by L.M.F.)* H03

0139

16179 MELLADO, M.; DANIELS, L.B.; ALBA, J. DE 1979. **Yuca y soya como complementos de raciones basadas en caña de azúcar y urea.** *(Cassava and soybeans as complements in sugar cane and urea-based rations). In* Reunión Latinoamericana de Producción Animal, 7a., Panamá, 1979. Programa y Compendios. Panamá, Asociación Panameña de Producción Animal. pp.R 31.Span.

Cassava. Laboratory experiments. Laboratory animals. Cattle. Animal nutrition. Diets. Digestibility.

Combinations of cassava and soybean cake, treated with 1% formalin, were tested in dry lot feeding regarding their ability to increase the voluntary intake of sugar cane (whole plant, chopped). In vitro digestibility trials showed a favorable interaction between these products on the total DM digestibility (72 vs. 62.8%). Thirty-six Brahman steers, with an av. initial wt. of 245 kg, were fed 4 diets with a 90-day confinement, 20 days were preliminary and not considered in the analysis. Diets were: (A) 97.5, 2.1, and 0.4% sugar cane, cassava (sliced and air-dried), and urea, resp.; (B) 97.4, 0.5, 1.8 and 0.4% sugar cane, soybean cake, cassava, and urea, resp.; (C) 96.6, 1.5, 1.5 and 0.4% sugar cane, soybean cake, cassava, and urea, resp.; and (D) 95.9, 2.5, 1.3 and 0.4% sugar cane, soybean cake, cassava, and urea, resp. The in vitro digestibility of rations was 57.0, 57.1, 52.3, and 54.5%, resp. Daily increases in wt. were 62, 258, 416, and 589 g for rations A, B, C, and D, resp. ($P < 0.05$). Differences are attributed to the increasing amount of soybean cake and no favorable interaction was found between both supplements. Voluntary intake was 1.43, 1.57, 1.65, and 1.68 (as % of livewt.; $P < 0.05$) for rations A, B, C, and D, resp. and differences were attributed only to the DM in the supplements and not to the intake of sugar cane in any of the rations. *(Full text. Trans. by L.M.F.)* H03

0140

16164 BARBOSA, C. 1972. **Aproveitamento da parte aérea da mandioca na alimentação animal.** *(Utilization of the cassava canopy in animal nutrition).* Tese Mag. Sc. Piracicaba-SP, Brasil, Escola Superior de Agricultura Luiz de Queiroz da Universidade de São Paulo. 71p. Port., Sum. Port., Engl., 56 Refs., Illus.

Cassava. Laboratory animals. Sheep. Forage. Foliage. Animal nutrition. Protein content. Digestibility. Cultivars. Fibre content. Brazil.

Hay from the canopy of cassava var. Guaxupé and Mantiqueira at 4, 7, and 10 mo. of age was studied regarding in vivo digestibility in sheep. Exptl. work was carried out at Nova Odessa Exptl. Station (São Paulo, Brazil) using a split-plot design. CP in both var. of cassava decreased as the age increased: 15.88, 13.40, and 13.06% for var. Guaxupé, and 17.30, 11.88, and 10.42% for var. Mantiqueira, at 4, 7, and 10 mo., resp. Crude fiber content increased with plant age: 21.56, 23.89, and 27.53% for var. Guaxupé and 21.24, 25.37, and 31.38% for var. Mantiqueira, at 4, 7, and 10 mo., resp. It was observed that the fiber digestibility of Guaxupé decreased slowly, having little effect on the corresponding protein digestibility. On the other hand, protein digestibility of var. Mantiqueira was greatly influenced by the decreasing rate of fiber digestibility. The highest production of cassava hay/ha was given by var. Mantiqueira. It is suggested to study other more productive var. regarding canopy and root production during both 1st and 2nd vegetative cycles. Guaxupé and Mantiqueira hay were considered satisfactory for animal nutrition. *(Author's summary)* H03 C03

0141

16160 TERLEIRA G., H.; TEN BRINKE, H.W.; LOPEZ C., W.; SANTISTEBAN S., D. 1975. Uso de raíces de yuca, coronta de maíz y cáscara de algodón en el engorde de novillos en Tarapoto - San Martín. *(The use of cassava roots, ground corn cobs, and cottonseed hulls for steer fattening in Tarapoto-San Martín, Peru).* Lima Perú, Ministerio de Alimentación. Dirección General de Investigación. 13p. Span., Sum. Span., Engl., 3 Refs.

Cassava. Laboratory experiments. Laboratory animals. Cattle. Diets. Animal nutrition. Fattening. Peru.

Rations with cassava roots, ground corn cobs, and cottonseed hulls were tested for fattening young crossbred steers (Brown Swiss x Gyr x Criollo) in a trial carried out at El Porvenir Agriculture Exptl. Station, from Jan.-May 1973. A completely randomized exptl. design was used with a total of 31 steers. The following 4 rations (treatments) were studied: A (control ration), B (chopped cassava roots + a protein supplement with 12% urea and 75% cottonseed meal), C (81.4% ground corn cobs + 16.3% cottonseed meal), and D (82.5% cottonseed hulls + 15.3% cottonseed meal). The steers were slaughtered after 108 days of feeding. Results on av. daily wt. gain/animal for rations A, B, C, and D were 1.664, 1.390, 0.869, and 0.993 kg, resp. Such an effect was statistically significant ($P < 0.01$) for rations A and B as compared to rations C and D. The values for daily feed intake for the treatments were 8.9, 17.4, 5.6, and 9.6 kg, resp. and for carcass dressing 54.0, 56.7, 46.0, and 50.4%, resp. Beef grade was of the extra class for A and B rations and extra and first class for C and D rations. Net income values were S/. 5,629.15, 4,994.26, 2,386.90, and 3,480.90, resp. It was concluded that the control ration and the ration with cassava roots + protein supplement are 2 possibilities recommended in feeding steers. The rations based on corn cobs and cottonseed hulls were less satisfactory [illegible] possibly to their inclusion in very high levels. *(Author's summary)* H03

0142

16587 ESHIETT, N.; ADEMOSUN, A.A. 1980. Sundried cassava root-meal in broiler diets. Nutrition Reports International 22(3):343-352. Engl., Sum. Engl., 18 Refs.

Cassava. Laboratory experiments. Laboratory animals. Chicks. Cassava meal. Diets. Animal nutrition. Finishing. Nigeria.

A total of 432 broiler chicks, aged 15 days, were fed 4 isocaloric and isonitrogenous diets containing 0, 15, 30, or 45% peeled, sun-dried cassava root meal (CRM). At 6 wk. of age the chicks were pooled and randomly divided into 4 groups and fed 4 finishing diets containing

0, 15, 30, or 45% CRM for a further period of 4 wk. During the starting phase rate of body wt. gain and feed:gain ratio were 26.72, 26.34, 25.41, and 25.55 g/chick/day and 1.88, 1.90, 1.93, and 1.85 for the 0, 15, 30, and 45% CRM diets, resp. The observed differences were not significant for all parameters. During the finishing phase the treatments did not significantly affect rate of body wt. gain, efficiency of feed conversion, carcass characteristics, and DM, CP, and fat content of livers of the broiler chickens slaughtered at 10 wk. of age. *(Author's summary)* H03

0143

16584 OJOFEITIMI, E.O.; AHRENS, R.A.; PRATHER, E.S. 1981. **Nutritional assessment of cassava grits in combination with cottonseed or defatted soybean proteins.** Nutrition Reports International 23(2):355-362. Engl., Sum. Engl., 23 Refs.

Cassava. Laboratory experiments. Laboratory animals. Animal nutrition. Supplements. Feed constituents. Diets.

The effects of supplementing cassava grits with casein, cottonseed (free of gossypol), or defatted soybean protein sources were measured in 21 day old male Sprague-Dawley rats. All diets were isonitrogenous, isocaloric, and provided protein at a level of 10% of the total wt. Cassava grits were added at a level of 20% of the total wt. The mean PER values of casein-cassava, cottonseed-cassava, and soybean-cassava diets were 3.1, 2.4, and 1.7, resp. Efficiency of N retention (ENR) for the cottonseed-cassava and soybean-cassava diets were 39.6 and 29.5%, resp. Both the mean PER and ENR values of the exptl. diets were significantly different ($P < 0.05$). The study showed that the nutritional quality of cassava could be improved by the addition of either of these vegetable proteins. However, texture, flavor, and palatability of the cooked mixtures should be investigated prior to human trials on these diets. *(Author's summary)* H03

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H04 HCN Toxicity and Detoxification

0144

16119 OKE, O.L. 1979. **Some aspects of the role of cyanogenic glycosides in nutrition.** World Review of Nutrition and Dietetics 33:70-103. Engl., Sum. Engl., 164 Refs.

Cassava. Cyanogenic glycosides. Human nutrition. Toxicity. HCN. Clinical manifestations. Detoxification.

Cyanogenic glycosides occur in many unrefined foodstuffs (linamarin in cassava and *Phaseolus lunatus*, amygdalin in almonds), and HCN is released on hydrolysis by acid during digestion or by endogenous enzymes in the plant by damage caused through harvesting or food preparation. This review focuses on the effects of ingestion of small doses of cyanogenic glycosides by people in developing countries who consume cassava, and its relation to the rarity of sickle cell anaemia and bowel cancer. The implication of this is discussed and the literature is reviewed. *(Summary by Food Science and Technology Abstracts)* H04

0145

16130 RUST, L.A.; FRY, W.E.; BEER, S.V. 1980. **Hydrogen cyanide sensitivity in bacterial pathogens of cyanogenic and non-cyanogenic plants.** Phytopathology 70(10):1005-1008. Engl., Sum. Engl., 30 Refs., Illus.

Cassava. HCN. *Xanthomonas manihotis.* **Cyanogen. Etiology.**

The cyanide sensitivity of bacterial pathogens of cyanogenic and non-cyanogenic plants was determined by observing the effects of HCN on their growth rates in buffered nutrient broth. The HCN concn. that reduced the growth rate of each strain to 50% of its growth rate in the absence of cyanide (EC_{50}) was calculated and used to compare strains. Bacterial pathogens of cyanogenic plants appeared to be only slightly more tolerant of HCN than were bacterial pathogens of non-cyanogenic plants; these differences were not statistically significant ($P = 0.05$). Pseudomonads generally were more sensitive to HCN than were the xanthomonads tested. Among xanthomonads, strains of *Xanthomonas manihotis*, a pathogen of the highly cyanogenic plant, cassava, appeared to be most tolerant. None of the bacteria appeared to either metabolize HCN or to adapt markedly to it. In contrast to fungal pathogens of cyanogenic plants, bacterial pathogens of cyanogenic plants are not distinctly more tolerant of HCN than are those of non-cyanogenic plants. *(Author's summary)* H04

See also 0166

I01 Cassava Starch and its Properties

0146

17103 RAFFI, J.; FREJAVILLE, C.; DAUPHIN, J.F.; DAUBERTE, B.; d'URBAL, M.; SAINT-LEBE, L. 1981. **Gamma radiolysis of starches derived from different foodstuffs. 2. Study of induced acidities.** Starch 33(7):235-240. Engl., Sum. Engl., Germ., 11 Refs., Illus.

Cassava. Cassava starch. Analysis. Irradiation.

The foodstuff from which the studied starches (maize, amylomaize, waxy maize, cassava, bread-wheat, potato, rice, and haricot bean) derive only has little influence upon the quantities of γ radio-induced acids. The ratios r between the max. and min. found values are 2.5 and 3.2 for formic acid and total acidity, resp. If r is equal to 13.6 for free acidity, it is only due to the very small values in haricot bean, potato, and rice starches. *(Author's summary)* 101

I02 Uses, Industrialization, Processing and Storage

0147

15082 FAFUNSO, M.; BASSIR, O. 1979. **Mannitol content of gari and other cassava-based foodstuffs.** Tropical Science 21(4):273-274. Engl., 3 Refs.

Cassava. Laboratory experiments. Gari. Foofoo. Cassava flour. Alcohol. Analysis. Tubers. Nigeria.

Gari, fufu, and lafun (the most common cassava-based Nigerian foods) were alcohol extracted and the extracts subjected to TLC to quantify mannitol. Fufu had 692 ± 84 mg mannitol/100 g dry wt. and lafun 329 ± 66. Gari grains (prepared traditionally by the local people in Ibadan) had a mannitol content of 499 ± 94, while mechanically processed gari had a lower mannitol content of 401 ± 48 mg/100 g dry wt. Processing tubers into these foods caused approx. 10-fold increase in mannitol content (due to fermentation and heating). Boiling, frying, and roasting tubers caused mean % increases in mannitol of 31 ± 10; 38 ± 12, and 109 ± 24, resp. *(Summary by Food Science and Technology Abstracts)* 102 C03

0148

15782 ODIGBOH, E.U. 1979. **Mechanical devices for peeling cassava roots.** *In* Plucknett, D.L., ed. Workshop on Small-Scale Processing and Storage of Tropical Root Crops, Honolulu, Hawaii, 1978. Proceedings. Boulder, Colorado, Westview Press. Westview Tropical Agricultural Series, no. 1. pp.309-325. Engl., Sum. Engl., 2 Refs., Illus.

Cassava. Peeling. Mechanization.

The design and construction of 2 mechanical cassava peeling devices are discussed. The 1st device is an improved model of a continuous-process mechanical peeler which consists of a cylindrical knife assembly and a solid cylinder, both mounted parallel and 20 mm apart on an inclined frame. The 2nd device is a batch-process mechanical peeling machine which works on the principle of abrasion. Basically, unpeeled cassava roots mixed with some inert abrasive materials and placed in a vessel are rotated for some time to peel them. Results of performance tests on the prototype device are presented. *(Author's summary)* 102

0149

15789 BRAUER, D. 1980. **Fuel from alcohol. Blessings and curses of a new technology.** Development and Cooperation 1:11-13. Engl., Illus.

Cassava. Ethanol. Energy productivity. Brazil.

Since the advent of high oil prices many countries have a serious fuel problem. Ethanol, as an alternative source of energy, is most easily produced from sugar cane or sugar beet, but may also be obtained from starch-containing cassava, maize, and wheat. In 1975 Brazil started an ambitious national alcohol program to reduce its dependence on oil imports (85% of its requirements). This study discusses whether this program offers a solution, and what other countries might learn from the Brazilian experience. *(Summary by Abstracts on Tropical Agriculture)* 102

0150

15790 COOMBS, J. 1980. **Renewable sources of energy (carbohydrates).** Outlook on Agriculture 10(5):235-245. Engl., Sum. Engl., 36 Refs., Illus.

Cassava. Ethanol. Biomass production. Alcohol. Production. Processing. Fermentation.

Alcohol produced from carbohydrates by gasification followed by catalytic re-synthesis or by fermentation can be used as substitute liquid transport fuel or as chemical feedstock. Sugar cane at present appears to be the most attractive resource in tropical countries but there are other potentially suitable cereal and root crops (cassava). Root crops have a lower starch content as harvested, but are potentially capable of yielding greater amounts of starch/ha. Although present yields of cassava are on av. below 10 t/ha the max. recorded is over 70 t/ha, indicating the tremendous potential as biomass crop: In temperate climates it is unlikely that biomass fuel will contribute much of the energy demand except in countries with large timber resources. *(Author's summary)* 102

0151

16107 ODIGBOH, E.U. 1979. **Cassava chips processing and drying: a cassava chipping machine.** *In* Plucknett, D.L. ed. Workshop on Small-Scale Processing and Storage of Tropical Root Crops, Honolulu, Hawaii, 1978. Proceedings. Boulder, Colorado, Westview Press. Westview Tropical Agricultural Series no. 1. pp.327-339. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Processing. Drying. Cassava chips. Mechanization. Water content.

The design of a cassava chipping machine and some drying expt. on cassava chips are described. Results showed that although all drying occurred in the falling-rate period, sun drying of machine-produced chips was fast and at a rate that remained nearly constant until a MC of approx. 20% (wet basis) was reached. For some hand-prepared 2.5 x 5 x 50 mm chips tested drying was much slower with more pronounced variable-rate drying characteristics. *(Author's summary)* 102

0152

16518 LEIHNER, D.E. 1981. **Fuel from biomass– future role and potential of cassava.** Entwicklung und Ländlicher Raum 15(1):18-21. Engl., 11 Refs., Illus.

Cassava. Biomass production. Alcohol. Processing. Energy productivity. Ethanol.

Information is given on the development of a renewable energy source based on biomass production using cassava. The important aspects in the biomass-to-alcohol process, including the conversion efficiency, expressed in the litres of alcohol produced/t of raw material, and the area-time productivity, (the no. of litres of alcohol produced/ha/yr), are discussed. Cassava is a efficient biomass producer converting solar into carbohydrate chemical energy at a rate of 250,000 Kcal/ha/day. Possible alcohol production from cassava with a yield of 20 t/ha/yr is 3600 l/ha/yr. The energy balance of alcohol production from cassava (tubers + stems)/ha/yr is provided. The net energy gain is 54.4 GJ/ha/yr, with a ratio between produced and expended energy of 2:1. *(Summary by Abstracts on Tropical Agriculture)* 102

0153

16528 MARINHO, H.A.; ARKCOLL, D.B. 1981. **Estudos sobre o caroteno em algumas variedades amazônicas de mandioca (*Manihot esculenta* Crantz).** *(Studies on carotene in some Amazonic cassava varieties).* Acta Amazônica 11(1):71-75. Port., Sum. Port., Engl., 22 Refs.

Cassava. Processing. Cassava flour. Cultivars. Carbohydrate content. Tubers. Storage. Brazil.

The carotenoid content of cassava roots varies with var. age, and the cross section of the root. Large losses occur during the processing of roots into the fermented flour eaten in the Amazon region. These losses can be reduced if the roots are well fermented and the flours

are stored in good conditions. About 30% of the carotenoides is β-carotene and the consumption of 100 g of flour could provide approx. 20% of the recommended daily adult intake of vitamin A. *(Author's summary)* 102 C03

0154

15781 WILLIAMS, C.E. 1979. The role of women in cassava processing in Nigeria. *In* Plucknett, D.L., ed. Workshop on Small-Scale Processing and Storage of Tropical Root Crops, Honolulu, Hawaii, 1978. Proceedings. Boulder, Colorado, Westview Press. Westview Tropical Agricultural Series no. 1. pp.340-353. Engl., Sum. Engl., 7 Refs.

Cassava. Processing. Gari. Peeling. Washing. Rasping. Fermentation. Pressing. Costs. Income. Mechanization. Nigeria.

The objectives of this study were: (1) to investigate the processing of cassava into gari in some selected villages in Oyo State, Nigeria and (2) to make recommendations on increasing the profit in gari and cassava production. The problem of introducing a capital-intensive labor-saving machine into gari production was investigated in order to compare it with the traditional way of processing cassava into gari. It is not yet clear that capital-intensive mechanization is the ideal, most economic way to develop cassava processing. A simple intermediate technology might provide an alternative, which includes the use of low-cost machines. In order to make efficient use of such machines, gari producers should encourage the formation of cooperative organizations. Farmers should also be backed with a supply of improved, high yielding cassava cuttings, fertilizers, pesticides, credit, a guaranteed market, and an efficient extension service. *(Author's summary)* 102 J00

0155

16131 CASIER, J.P.J.; PAEPE, G.M.J. DE; WILLEMS, H.E.J.; GOFFINGS, G.J. G.; HERMANS, J.L.; NOPPEN, H.E. 1979. **Bread production from pure flours of tropical starchy crops. III. From pure and mixed flours of cassava, millet, sorghum, corn, rice, and the starches.** *In* Inglett, G.E. and Charalambous, G., eds. Tropical foods: chemistry and nutrition. New York, Academic Press. v.1, pp.279-340. Engl., Sum. Engl., 21 Refs., Illus.

Cassava. Breads. Cassava starch. Composite flours.

A good quality bread was made from pure and mixed flours of several tropical starchy crops (cassava, millet, sorghum, maize, rice), pure starches (cassava, maize, rice) and mixtures of both, using 2-4% water-insoluble purified and technical rye pentosan. The well textured loaves, reached loaf vol./g of 6-7 and ± 4-4.5 for starches and flours, resp. The influence of water-insoluble pentosan on gas retention and dough texture formation in liquid starch doughs was studied. A highly significant straight correlation was found between gas retention (dough vol.) and pentosan content of added pentosan samples. With liquid dough loaves of starches and tropical crops, shelf life, texture, and crumb coherency were improved in function of higher pentosan content. Nutritional enrichment of composite tropical flours by protein rich products as defatted soy, skimmed milk improve crumb softness, coherency, and shelf life in liquid doughs; fat addition, however, decreases the texture and loaf vol. in starch dough. *(Author's summary)* 102

0156

15084 HOHNHOLZ, JURGEN H. 1980. **Manioc cultivation in South-East Asia. An agricultural geographical survey.** Applied Geography and Development 16: 117-135. Engl., 29 Refs.

Cassava. Forage. Human nutrition. Composition. Cultivation. Animal nutrition. Uses.

The importance of cassava as a fodder plant and food in SE Asia is shown by reference to 3 countries (Thailand, Indonesia, and Malaysia), each of which has its own form of cassava production. It is concluded that in future, not only should rice growing be promoted in SE

Asia by every means but also some of those efforts should be devoted to cassava, which is an important food for humans and animals and has considerable unexplored potential. *(Summary by World Agricultural Economics and Rural Sociology Abstracts)* 102

0157

16176 MOLINA, C.; OVALLE, L. 1976. **Estudio agro-económico del procesamiento de la yuca en la región Nor-oriental de Barlovento.** *(Agroeconomic study on cassava processing in the northeastern region of Barlovento).* Caracas, Venezuela, Ministerio de Agricultura y Cría. 9p: Span.

Cassava. Socio-economic aspects. Processing. Cultivation. Costs. Income. Casave. Venezuela.

An agroeconomic study on cassava processing in the Barlovento region, states of Miranda and Anzoátegui, Venezuela, was conducted to determine its characteristics and give the necessary recommendations for greater efficiency and profitability. The methodology used consisted of a case study of a representative sample (50 farms) of the major production centers in the region. A survey was conducted in rural areas in order to make the necessary adjustments; 50 farmers who process cassava were interviewed. According to data analysis, it is concluded that this is a major cassava-growing region. Bitter cassava is preferred; therefore, cassava is processed for the elaboration of casave. Its processing is a small family industry; rudimentary and conventional methods are used but mechanized grating has been currently incorporated into the process. Operating profit is reduced as a consequence of low unit yields. It is recommended that credit institutions establish timely and adequate loan programs to promote crop development and that research be conducted on cassava crops in association with maize and beans. Tables on the data obtained are included. *(Summary by F.G. Trans. by L.M.F.)* 102 J00

0158

12163 KENNEDY, R.J. 1979. **Making manioc starch in Sri Lanka: a rural industrial enterprise.** Appropriate Technology 6(3):4-5. Engl., Illus.

Cassava. Processing. Cassava starch. Peeling. Rasping. Washing. Drying. Sri Lanka.

A pilot project of the Eastern Technical Institute in Batticoloa, Sri Lanka is described, aimed at farmers who do not have access to irrigated paddy land. Cassava processing into starch and the harvesting, peeling, grating, and drying of tubers are described. *(Summary by L.M.F.)* 102

0159

16192 COWAN, E. 1980. **The roots of power: the growing of manioc in Brazil and Australia will lessen dependency upon oil imports.** The Humanist 40.26-30, 54. Engl., Illus.

Cassava. Production. Alcohol. Processing.

A general description is given on the agroindustrial scheme developed by Dr. Dick McCann for the use of the entire cassava plant in the production of ethanol, methane, and leaf protein, based on a complex producing 230,000 t of alcohol and 63,000 t of leaf protein/yr and serving a farm community of 116,000 ac of which 86,400 ac would be planted to cassava. One of the main priorities is the development of a yeast that will ferment the starch directly into alcohol. Characteristics of the plant and details on the use of alcohol as fuel are included. *(Summary by I.B. Trans. by L.M.F.)* 102

0160

16196 **ROOT CROPS; tropical root crops are relatively unfamiliar and underused as a source of animal feed and energy.** 1980. Agricultural Information Development Bulletin 2(4):27-29. Engl., Illus.

Cassava. Marketing. Consumption. Industrialization. Research. Technology.

The current and potential utilization of tropical root crops (170 million t/yr) is reported. Cassava accounts for approx. 2/3 of the total production of these crops and is widely cultivated in Asia (Indonesia and Thailand), India, w. Africa and in L.A., especially in Brazil and Colombia. The importance of this crop, its ability to be grown in a wide range of agricultural and climatic conditions and the attention it is currently given by research centers regarding its potential in human and animal nutrition, as industrial starch,and as a source of fuel (ethyl alcohol) and SCP are emphasized. Some priorities and strategies of cassava cultivation regarding the need for low production costs, the relative abundance of labor, limited access to land, and poor cash reserves are discussed. The role of new technologies and continued research is highlighted. *(Summary by I.B. Trans. by L.M.F.)* 102 J00

0161

16553 PARKER, B.L.; BOOTH, R.H.; HAINES, C.P. 1981. **Arthropods infesting stored cassava (*Manihot esculenta* Crantz) in Peninsular Malaysia.** Protection Ecology 3:141-156. Engl., Sum. Engl., 28 Refs., Illus.

Cassava. Laboratory experiments. Storage. Cassava chips. Pests. Deterioration. Malaysia.

Samples of cassava chips were collected from different locations in Peninsular Malaysia. Arthropods were extracted from the chips in a Berlese funnel. Ten arachnid and 60 insect species were found. The insects included 22 species that are known as primary or secondary pests of stored products. Of these, only 7 were listed as pests of cassava chips in a recent review of cassava storage. Eight minor storage pests, and 7 predators and 2 parasites of storage pests, were also identified. Notes are presented on the various species in relation to their probable roles in cassava storage. *Sitophilus zeamais* and *Cryptolestes klapperichi* were very common in the samples but the most abundant species were *Rhyzopertha dominica, Liposcelis* sp., and *Tribolium castaneum.* The wide var. of moisture-loving species present indicates the need for improved moisture control for the safe storage of cassava in the humid tropics. *(Author's summary)* 102

0162

16170 SILVA, J.F. 1981. **Brazil's gasoline replacement program increases pace as alcohol mix goes on sale.** Foreign Agriculture 19(5):12-13. Engl., Illus.

Cassava. Alcohol. Production. Ethanol. Brazil.

Brazil's program to replace gasoline with alcohol produced from sugar cane received more support in 1980 as motorists there began to use a mixture of up to 20% alcohol and 80% gasoline. The many intertwined activities of the gasoline replacement program, known as PROALCOOL, are reviewed. Sugar cane is the only feedstock now being used for alcohol production. Other possible alcohol sources are being scrutinized, including cassava with an extraction rate of 180 *l* of alcohol/t, sweet sorghum and vegetable oils as a substitute for diesel oil. *(Summary by Abstracts on Tropical Agriculture)* 102

0163

16566 OKEZIE, B.O.; KOSIKOWSKI, F.V. 1981. **Acid whey powder modification of gari from cassava.** Journal of Dairy Science 64(3):416-421. Engl., Sum. Engl., 20 Refs.

Cassava. Gari. Tubers. Fermentation.

A high protein food (11-12% protein) patterned on Nigerian gari was developed from ground cassava tubers, acid whey powder, and soybean concentrate. The amino acid profile of the acid whey-soy gari showed an improvement over that of the FAO and the World Health Organization reference pattern. Flavor and texture of modified acid whey gari were comparable to traditional gari. A 2-4 day fermentation of the ground cassava tubers resulted in a characteristic tangy flavor of the product and a loss of > 50% in HCN content. *(Author's summary)* 102 C03

0164

16569 ANDRES, C. 1979. **Gel with 'cuttable texture' produced without heat.** Food Processing 40(6):74-75. Engl., Illus.

Cassava. Cassava starch. Modified starches. Food products.

A bland-tasting, modified food starch based on cassava and which forms a rigid, cuttable but tender gel without heating has been developed for use in a wide range of food products (pie and pastry fillings and imitation jellies). Gels produced with the pre-gelatinized cassava starch can be used under a wide range of pH and sugar content conditions, and do not toughen with ageing. *(Summary by Food Science and Technology Abstracts)* I02

0165

16564 CABRA R., E. 1980. **Proyectos agroindustriales en el Darién.** *(Agro-industrial projects in the Darién region).* Tecnología (Colombia) 22(127):9-43. Span., Sum. Span., 6 Refs., Illus.

Cassava. Cassava programs. Cassava starch. Factories. Economics. Income. Socio-economic aspects. Processing. Colombia.

Three agro-industrial plans have been elaborated by the IIT (Instituto de Investigaciones Tecnológicas) for the Darién project (Colombia). These plans include a system for the storage of maize and rice, the production of alcohol from banana refuse, and the manufacturing of starch from cassava. The following aspects are analyzed: operational characteristics of cassava cultivation (subsistence farming); estimation of the capacity of the processing plant; supply of raw material; location (Apartadó); technical aspects related to the process of starch production; economic assessment including total capital investment and total production costs; project evaluation; profitability; social and environmental impact. According to the results obtained in the technoeconomic evaluation of the project, it is concluded that the project is viable, emphasizing its agricultural aspects. *(Summary by F.G. Trans. by L.M.F.)* I02

0166

16161 SEIGLER, D.S.; PEREIRA, J.F. 1981. **Modernized preparation of casave in the Llanos Orientales of Venezuela.** Economic Botany 35(3):356-362. Engl., 14 Refs., Illus.

Cassava. Casave. Washing. Peeling. Rasping. Grinding. Pressing. Cooking. Detoxification. Venezuela.

The preparation of casave and the mechanisms of detoxifying cassava in the Llanos Orientales (Venezuela) are discussed. *(Summary by Abstracts on Tropical Agriculture)* I02 H04

0167

16600 MOSCOTE M., P.; ORTIZ B., J.R. 1978. **Secador de almidón de yuca a base de energía solar.** *(Cassava starch drier based on sun energy).* Tesis Ing. Agr. Medellín, Universidad Nacional de Colombia. Facultad de Agronomía. 71p. Span., Sum. Span., 6 Refs., Illus.

Cassava. Field experiments. Cassava starch. Solar drying. Drying. Colombia.

An expt. was conducted in Medellín, Antioquia (Colombia) to determine the effects of the space separating a glass cover and cassava starch as well as the inclined length of the drier on the uniformity of drying in relation to the size of the starch sample. For these purposes, a series of driers in which the starch was deposited were built and used. These driers were placed in the sun in 2 positions: 1st with the surface towards the east from 9 a.m. to noon and later turned towards the west until 3 p.m. All the driers were placed

on a 12° slope, except the check which was placed in a horizontal position. Greater solar energy utilization was sought with the slope and the direction already mentioned. The exposure to the sun was conducted until the samples reached a wt. that varied between 250-260 g, indicating a water % between 15-18%, as found in preliminary expt. An optimum distance separating the glass cover from the starch was from 4.5 cm on, because at this distance no water condensation (that reduces the penetration of sun rays) is produced. The shorter the length of the drier, the more efficient. Results are given in graphic form; it is noted that the curves try to take on the characteristics of normal drying curves in a relative and non-absolute way since there are discontinuities or occasional increases due to the wt. loss in the samples during the night and the time of the day when not exposed to the sun. *(Author's summary. Trans. by L.M.F.)* I02

See also 0020 0046 0065 0173 0184

I03 Industrial Microbiology

0168

16122 COONEY, C.L 1979. **Possible applications of enzyme technology in rural areas.** *In* Conference on the State of the Art of Bioconversion of Organic Residues for Rural Communities, Guatemala, 1978. Papers presented. Tokyo, Japan The United Nations University. pp.54-59. Engl., Sum. Engl., 13 Refs., Illus.

Cassava. Laboratory experiments. Enzymes. Hydrolysis. Fermentation. Cellulose. Industrial microbiology. Transfer of technology. USA.

It was pointed out that the objective of using mixed cultures to degrade cellulose is to accelerate the production of other products such as lactic acid or butanol, not to increase sugar yields. The question was raised as to whether modifications could be introduced that would make more robust strains of cellulolytic organisms better suited to fermentation processes in rural communities. Although this may be possible, more research needs to be done. A mixed culture, taking advantage of sugar-accumulating properties of *Clostridium thermocellum*, was combined with a methane-producing bacterium. This kind of methane production has been pursued successfully in Wisconsin (USA) but the work at the Massachusetts Institute of Technology with mixed cultures has concentrated on production of more valuable products. It was noted that there are many ways in which advanced research in industrialized countries can produce results adaptable for use in rural communities. *(Author's summary)* 103

0169

17116 MUINDI, P.J.; THOMKE, S. 1981. **Protein quality studies on rats fed on cassava-root meal enriched with *Cephalosporium eichhorniae* 152 or with conventional plant-protein supplements.** Animal Feed Science and Technology 6:197-208. Engl., Sum. Engl., 26 Refs.

Cassava. Cassava meal. Protein enrichment. Animal nutrition. Laboratory animals.

Using rats, the protein content and quality of an enriched cassava root meal (CRM) biomass, produced by growing *Cephalosporium eichhorniae* 152 on a CRM medium in a submerged fermentation, was compared with that of SBM and cottonseed cake (CSC) in rats. The contents of CP of these feeds were 38.8, 52.0, and 42.3% on a DM basis, resp., and there were differences in their amino acid composition. N digestibility of the enriched CRM-biomass and of CSC was lower than that of SBM. The BV of the enriched CRM-biomass was equal to that of CSC, but lower than that of SBM. Net protein-utilization estimates for the enriched CRM-biomass and for CSC were similar, whereas that for SBM was greater. Enriching CRM by *C. eichhorniae* 152 seems to be a way of increasing protein supply for livestock production. *(Author's summary)* 103

J00 ECONOMICS AND DEVELOPMENT

0170

14586 ADAMS, R.I. 1979. **Agricultural adjustment to Brazil's alcohol program: a regional economic analysis.** Ph.D. Thesis. Columbus, Ohio State University. 180p. Engl., Sum. Engl., 129 Refs., Illus.

Cassava. Alcohol. Production. Cassava programs. Energy productivity. Prices. Labour. Economics. Brazil.

The impact of the Brazilian alcohol program on the agricultural sector is assessed. A profit maximizing linear programming model was used to examine the competitiveness of alcohol production under current (1976- policy directed) price relationslrips and under a simulated free energy market price structure, and to estimate the impact of different alcohol production and use levels on resource use and allocation within agriculture. Regional land and labor use, crop competition (sugarcane, cassava, and food and feed crops), and technological change are studied in relation to energy price changes and volume of energy production. Results indicate that, at simulated 1976 conditions, alcohol produced from sugarcane and/or cassava would be competitive with food crops at approx. US$0.85 to US$0.90/gallon gasoline. Labor surplus areas, with low cost family labc. inputs,are competitive at slightly lower price levels. The increased energy prices are themselves a source of increased cost of production, but the net effect is positive and principally so in non-mechanized production areas. The positive employment and income effects associated with energy crop production will help to stem the flow of rural migration to urban centers. *(Extracted from summary by Dissertation Abstracts International)* J00 D03

0171

15362 LYNAM, J.L. 1979. **A farming system analysis of improved cassava technology.** Cali, Colombia, Centro Internacional de Agricultura Tropical. 40p.

Cassava. Technology evaluation. Research. Marketing. Colombia.

The role of on-farm testing in the development of new cassava technology at the Centro Internacional de Agricultura Tropical (CIAT) is described in detail. On farm cassava trials have established a link between the research program and farms in the 1st stages of technology development. These trials become an integral part of research testings and evaluation; a systems approach is utilized. For crop programs a systems component at the final stage of the evaluation process is considered most effective. Farm trials fulfill the multiple objectives of problem identification, technology validation, and assessment of adoption constraints. The analytical power increases with the no. and diversity of the target area. The role of international cooperation in the modification of technology and the complexity of a farming system are highlighted. *(Summary by I.B. Trans. by L.M.F.)* J00

0172

15366 SANDERS, J.H.; LYNAM, J.K. 1979. **Trends and yield constraints in the production systems of beans and cassava in Latin America with emphasis on research design implications.** Cali, Colombia, Centro Internacional de Agricultura Tropical. 49p. Engl., 21 Refs., Illus.

Cassava. Economics. Productivity. Cultivation systems. Research. Latin America.

The trends and yield constraints in production systems of beans and cassava are analyzed; examples are given of the role of 3 types of information (macro stage, micro stage and critical inference stage) in the design of research for beans and cassava at the Centro Internacional de Agricultura Tropical (CIAT, Colombia). It is indicated that the principal focus of information processing in international centers is to achieve a more solid empirical support (or rejection) of the critical inferences, which are made explicit and are then evaluated with a more systematic data collection. In commodity programs there is a natural evolution to farm level data collection. In the evolution of crop technologies, the consequences new technologies may have on income distribution are discussed; cassava and beans are essentially produced by small farmers outside prime agricultural areas. The choice of breeding strategy that involves the relationship among several disciplines is also analyzed and it is noted that the different constraints and the different crop characteristics require different strategies for cassava and beans to produce the same output, a stable high-yielding var. not dependent on high levels of purchased inputs. *(Summary by I.B. Trans. by L.M.F.)* J00

0173

15783 PHILLIPS, T.P. 1979. **The implications of cassava processing and marketing for other root crops.** *In* Plucknett, D.L.,ed. Workshop on Small-Scale Processing and Storage of Tropical Root Crops, Honolulu, Hawaii, 1978. Proceedings. Boulder, Colorado, Westview Press. Westview Tropical Agricultural Series, no. 1. pp.378-396. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. Marketing. Processing. Cassava starch. Feeds and feeding. Food products. Prices.

All tropical root crops have experienced increases in production during the last 15 yr, but only cassava has experienced substantial development of new markets. In cassava the main developments are export markets as an animal feed ingredient in the EEC (accounting for approx. 10% of the production) or as an industrial starch in Canada, Japan, and the USA (accounting for < 1% of production). The diverse markets for cassava are examined in an attempt to identify factors which would be relevant to the market diversification for other tropical root crops. Additionally, new market possibilities for cassava (single cell protein and ethyl alcohol production) are examined and discussed in terms of their inference for other tropical root crops. Discussion of the size of cassava production and processing activities illustrates that small scale production and processing can successfully supply even export markets such as Thailand's cassava starch export industry. The possibility of small- and large-scale processing activities working together is also illustrated: the chipping (small scale) and pelleting (large scale) plants in Thailand. It is concluded that there are unexploited markets available to other tropical root crops, and that these markets need not depend on large scale processing. However, realization of these markets may require that processors, entrepreneurs, and governments appreciate that tropical root crops can be more than subsistence crops. *(Author's summary)* J00 102

0174

15788 ASSELDONK, J.S.O. VAN ; FABER, D.C.; STOLWIJK, H.J.J. 1980. **De betekenis van tapioca voor de landbouwsector in Thailand en Nederland.** *(The importance of cassava for agri-business in Thailand and the Netherlands).* Landbouwkundig Tijdschrift 92(4):202-214. Dutch., Sum. Engl., 13 Refs., Illus.

Cassava. Trade. Marketing. Costs. Income. Thailand.

In recent years cassava has become a very prominent livestock feed in the Netherlands, Germany, Federal Republic, and Belgium. Because it is cheaper, it makes it difficult for the French farming community to sell its maize and barley for the same purpose. The role of cassava is reviewed and it was found that a "voluntary" reduction in cassava export will not hurt Thailand's economy, but will have a serious impact on the income of some 500,000 Thai farmers. If therefore export restrictions should come about, the EEC should participate

in a crop diversification program in Thailand to alleviate the burden of those farmers. *(Summary by Abstracts on Tropical Agriculture)* J00

0175

15800 NWEKE, F.I. 1980. **Farm labour problems of the small landholder cropping systems in Southeastern Nigeria.** Quarterly Journal of International Agriculture 19(2):123-134. Engl., Sum. Engl., Germ., 9 Refs.

Cassava. Socio-economic aspects. Costs. Income. Labour. Cultivation. Nigeria.

Agricultural production in most of SE Nigeria is dominated by small-scale producers of such food crops as yam, cassava, cocoyam, and maize. In 1970-71 the av. area of the crops cultivated/farmer in the region was 0.2 ha of yam, cassava, cocoyam, and maize. But in spite of the scale, the small farmers face major labor constraints and spend as much as 65% of their annual farm expenses on hired labor used to supplement household labor. This cropping system survey attempts to identify the causes of and possible solutions for such labor constraints. *(Author's summary)* J00

0176

16175 REEVES, W.H. 1976. **A note on the IITA Training Program.** *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. pp.57-59. Engl., Illus.

Cassava. Research. Transfer of technology. Cassava programs. Nigeria.

The activities included in the training program of the International Institute of Tropical Agriculture, IITA, Nigeria are described: weekly seminars, postdoctoral fellowships that are offered each year to selected young scientists who have recently qualified for doctorate level degrees; research training under the supervision of IITAs main scientific staff; and crop production technology and extension training (the activities are designed to create production specialists who have a high level of technical, economic, scientific, farming, and communication competency). *(Summary by F.G. Trans. by L.M.F.)* J00

0177

15770 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. DEPARTAMENTO TECNICO-CIENTIFICO. 1981. **Programa nacional de pesquisa de mandioca.** *(National research program on cassava).* Brasilia. 64p. Port. 19 Refs.

Cassava. Research. Production. Cultivation. Pests. Cassava programs. Brazil.

A comprehensive analysis of the worldwide situation of cassava cultivation (production, area under cultivation, productivity, supply and demand) is given along with its situation in Brazil (area under cultivation and production) and perspectives of Brazilian production (domestic and foreign market, industrialization). Each one of the cassava-producing regions is studied in detail: north, NE, SE, south, and central west regarding their main cassava growing areas and problems of cultivation. Problems of cassava cultivation are discussed: cropping systems, production and commercialization systems, adaptation to different ecosystems, low fertility soil, soil management and conservation, pests and diseases, and water stress. The objectives and priorities of the national research program are listed. *(Summary by F.G. Trans. by L.M.F.)* J00

0178

15731 CHAYAPUTI, P.; PRAPERTCHOB, S.; SUETRONG, S.; HORNARK, A. 1979. **Cassava and mixed feed industry in Thailand.** *In* Khon Kaen University. Faculty of Agriculture. Cassava/nutrition project: annual report 1979. Khon Kaen, Thailand. pp.32-44. Engl.

Cassava. Factories. Trade. Feeds and feeding. Thailand.

A project on the adoption of cassava in the mixed feed industry in Thailand is reported; this being the result of the need to reduce the exports to the EEC. The structure of the mixed feed industry, its trends, growth, size and distribution of factories according to the invested capital, no. of laborers, machinery, raw material and ingredients required, market structure, and production are analyzed. Some of the reasons given by feed millers as to the nonuse of cassava in their industries are included: the low nutritional value of cassava as compared to other products, making a protein additive necessary; toxicity of cassava; poor quality of Thai products; and price fluctuations of cassava *(Summary by I.B. Trans. by L.M.F.)* J00

0179

16189 PELZER, K.M. 1978. Cassava. *In* ———. Agriculture; situation and possibilities. Hamburg, German, Department of Manpower and Transmigration. TAD-Report no. 2. pp.141-148. Engl.

Cassava. Production. Cultivation. Tuber productivity. Costs. Prices. Income.

The production area, vol. of production, and yields of cassava during 1960-76 are analyzed for the Kalimantan area, Borneo (Indonesia). Cultural practices and production costs (the most important factor being labor) are also described. The 1976 market prices, farm prices, and farm and net incomes from cassava, and return on labor are given along with recommendations on cultural practices for industrial cassava cultivation. *(Summary by F.G. Trans. by L.M.F.)* J00

0180

16191 VENEZUELA. MINISTERIO DE AGRICULTURA Y CRIA. 1981. Estadísticas de raíces y tubérculos: yuca. *(Statistical data on roots and tubers: cassava). In* ———. Anuario estadístico agropecuario 1978. Caracas. pp.168-170. Span.

Cassava. Statistical data. Production. Tuber productivity. Consumption. Cassava starch. Trade. Venezuela.

Statistical charts are included on the area planted to cassava, its production and yield during 1962-78 in Venezuela; area planted and harvested, production, yield and farm consumption/state during 1975-78; and starch production, imports, and value of imports during 1962-78. *(Summary by F.G. Trans. by L.M.F.)* J00

0181

16522 NESTEL, B. 1980. La yuca: un retorno a las raíces. *(Cassava research: a return to the roots).* El CIID Informa 9(2):4-5. Span., Illus.

Also in English.

Cassava. Research.

A brief review of research on cassava supported by the International Development Research Centre (IDRC) is given. The large inputs by the IDRC into L.A. and SE Asia should now be phased out, but the continuation of small programs in African countries that have limited research resources and of workshops on specific problems should be promoted. *(Summary by Abstracts on Tropical Agriculture)* J00

0182

15706 EMPRESA DE ASSISTÊNCIA TECNICA E EXTENSÃO RURAL DA BAHIA. 1977. Projeto de álcool a partir da mandioca Itaetê-Bahia; parte agrícola. *(Cassava-based alcohol program in Itaetê-Bahia: agricultural aspects).* Salvador-BA, Banco de Desenvolvimento da Estado da Bahia. 115p. Port.

Cassava. Alcohol. Factories. Cassava programs. Cultivation. Economics. Brazil.

The project of manufacturing alcohol from cassava in the region of Itaetê, Brazil is given; it shows adequate characteristics for its establishment and involves an area of 10,800 ha of which 7200 are permanently cultivated. General aspects of the project are included: location, physical, demographical, economic, financial, social, and cultural characteristics, and means of transportation. Edaphoclimatic characteristics of the area where the project will be established, the root production program, sales, and the cropping system are also included. Economic and financial aspects are described in detail. The planning system used modules of 5-100 ha; for each one, the potential of cassava cultivation, the definition of the corresponding technological package, levels of profitability, required infrastructure, and orientation of the public and private sectors regarding the establishment of the project are given. *(Summary by I.B. Trans. by L.M.F.)* J00

0183

15785 CONSTANTINO, M. 1980. **Financing program for cassava production.** *In* Seminar Workshop on Rootcrops as Energy Sources, Los Baños, Laguna, 1980. Proceedings. Los Baños, Laguna, Philippine Council for Agriculture and Resources Research. pp.15-23. Engl.

Cassava. Cassava programs. Marketing. Philippines.

The Development Bank of the Philippines (DBP) financing scheme to encourage and accelerate cassava production is discussed. It is also mentioned that DBP has adopted a financing program mainly to meet the need for a ready market for cassava. The requirements of the area/location where financing can be extended is also discussed. The qualifications of borrowers, collateral requirements, amount of loan to be extended by DBP of releases and marketing agreements are mentioned. *(Author's summary)* J00

0184

16193 CROWN, F. 1981. **White elephant tales: Venezuela's cassava processing plants.** Agribusiness Worldwide 2(1):24-29. Engl., Span., Illus.

Also in Spanish. pp.27-29.

Cassava. Economics. Processing. Factories. Venezuela.

A historical review is given on how Venezuela infused money from oil industries into cassava processing to develop alternative sources of animal feedstuffs by building 7 cassava processing plants (at a cost of US$ 20 million). Currently only 2 are in use. It seems that planners did not take the farmers of the region into account during the feasibility studies, considering that the statement that they grew cassava was enough. No mention was made of competing uses of land, government price policies, or import subsidies. *(Summary by F.G. Trans. by L.M.F.)* J00 102

0185

16573 CHANDRA, S. 1979. **Root crops in Fiji. I. Production, marketing and consumption patterns.** Fiji Agricultural Journal 41(2):73-85. Engl., Sum. Engl., 18 Refs.

Cassava. Production. Marketing. Consumption. Labour. Costs. Income. Fiji.

The early history of root crop production in Fiji is described. Present-day semi-subsistence production is examined under headings of land, labor, capital, current expenses, and productivity levels. The crop production systems for cassava, sweet potato, taro, and yams are discussed, and an expt. leading to a production model explained. The marketing structure for root crops involving urban markets, farmers, middlemen, and the national marketing authority is considered, as are consumption patterns (with reference to dietary preferences and problems of urbanization). Cassava, taro, yams, and sweet potatoes account for >

50% of the dai nergy needs of an adult rural Fijian (and slightly less for an urban Fijian). It is concluded that large-scale commercial root crop production in the urban hinterlands of Fiji may be possible to avoid malnutrition in low-income urban families. *(Summary by Food Science and Technology Abstracts)* J00

0186

16554 NORES, G.A.; RIVAS, L.; POSADA, R.; ALVAREZ, C.; DIAZ, R.O. 1976. **Latin America: trend highlights on beans, beef, pork, cassava, rice and corn.** Cali, Colombia, Centro Internacional de Agricultura Tropical. Internal Document Econ 1.2. 55p. Engl., 15 Refs., Illus.

Cassava. Production. Trade. Prices. Consumption. Colombia.

Perspectives on the market situation of the commodities of the Centro Internacional de Agricultura Tropical, CIAT (cassava, beans, beef, pork, rice, and maize) in 1976 are summarized. Useful information that could serve as frame of reference is included: relative importance of agriculture in L.A.; use and distribution of the land; population and nutrition; fertilizer situation and forecast. Information on production, yields, vol. of trade, and export prices of the aforementioned commodities is given. Regarding cassava it is reported that total and per capita production increased consistently during the 1960's but decreased during the 1st half of the 1970's due to the influence of the decrease of production registered in Brazil (approx. 10%). Per capita production varied greatly in L.A. Cassava yields decreased in 1973 to the lowest level in 20 yr due to poor seasonal conditions in Brazil. Several tables and figures are annexed. *(Summary by I.B. Trans. by L.M.F.)* J00

0187

16592 LYNAM, J.K. 1982. **Methodology in the cassava on-farm trials: an interim evaluation.** Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie Seminarios Internos SE-2-82. 38p. Engl., 4 Refs., Illus.

Cassava. Technology evaluation. Cassava programs. Experiment design. Cultivation. Marketing. Ecosystems. Colombia.

The different methodological stages of cassava on-farm trials and their relationships regarding the objectives and functions of the Cassava Program at the Centro Internacional de Agricultura Tropical (CIAT) are outlined. Site selection, farm trial design and analysis, and some illustrative results are included. Trials are currently focussed on: (1) comprehension of the factors determining yields in traditional cassava production systems; (2) determination of the changes in the systems necessary to support the higher yield plateau of the hybrid var.; and (3) determination of the changes necessary to adapt these systems to the requirements of new industrial markets. The need for clear objectives in this type of program is emphasized. On the other hand, the design of methodology will depend on the particular stage of development of the research program and the particular characteristics of the crop or cropping system. From these initial trials it was concluded that yield and quality variation was much greater between farms than between treatments, thus orientating methodology towards working with substantial variation in the yield estimates. On-farm trials will eventually evolve as a tool for ex-ante evaluation of integrated cassava production and market development projects. Tables on the types of variables used and the results obtained in trials carried out in Colombia are included. *(Summary by I.B. Trans. by L.M.F.)* J00

See also 0154 0157 0160

K00 OTHER ASSOCIATED COMMODITIES

0188

12995 MONGE, F. 1979. **Que la información sea accesible.** *(Making information accessible).* Cali, Colombia, Centro Internacional de Agricultura Tropical. Centro de Información sobre Yuca. 19p. Span., 12 Refs., Illus.

Also in English.

Cassava. Information retrieval.

A description is given of a new approach to provide information to cassava workers and the creation of a Cassava Information Center, one of a worldwide network of centers providing highly specialized, current information to agricultural researchers. Factors are described that have contributed to the success of this type of centre and their orientation towards the solution of food-production deficits in the world by using a commodity-oriented strategy. The following are analyzed: the relation between information and research; characteristics of the Latin American scientist regarding information production and consumption; publication infrastructure, that in Latin America is another illustration of the vicious circle of underdevelopment; the services offered by the Scientific Information Exchange Unit at the Centro Internacional de Agricultura Tropical (CIAT); and the concept of consolidated information that includes not only the recollection and dissemination of the results of research but also the mechanisms that synthesize these results and integrate them as scientific and technical knowledge to contribute to the advance of science and to the solution of problems. *(Summary by I.B. Trans. by L.M.F.)* K00

K01 Rotational Schemes and Intercropping

0189

15750 MATTOS, P.L.P. DE; SOUZA, L.DA S.;CALDAS, R.C.; DANTAS, J.L.L. 1980. **Utilização dos espacos livres das fileiras duplas de mandioca com** *Crotalaria juncea* **L.** *(Utilization of the free space between double rows of cassava by Crotalaria juncea).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado técnico no. 07. 7p. Port., Illus.

Cassava. Field experiments. Inter-cropping. Planting. Spacing. Legume crops. Cultivars. Tuber productivity. Starch content. Brazil.

Crotalaria juncea was grown as green manure in 3, 4, or 5 rows in each space between double rows of cassava cv. BGM-116 and BGM-001 spaced at 2.0, 2.5, or 3.0 m between the double rows and 0.5, 0.6, or 0.7 m between plants in the rows and between the 2 rows of each double row. The highest cassava root yields of 34.12 t/ha in cv. BGM-116 and 39.72 t in BGM-001 were given by double rows 2.0 m apart with 0.6 m between the 2 rows of each double row and between plants in the row, and these yields were 57 and 16%, resp., higher than a control with rows 1 m apart and 0.6 m between plants in the row. Yields with 2.5 or 3.0 m between rows were not significantly different from the control and differences in starch yield were not significant. Fresh matter yields of *C. juncea* ranged from 14.7 t/ha with 2.0 m between cassava rows and 0.5 m between plants in the row and between the 2 rows of each double row to 22.64 t with 3.0 m between cassava rows and 0.7 m between plants in the row and between the 2 rows of each double row. *(Summary by Field Crop Abstracts)* K01 D02

0190

15796 McINTOSH, J.L.; EFFENDI, S.; ISMAIL, I.G. 1980. **Productivity of tropical upland soils can be maintained and improved; five years of research in Sumatra show Red-yellow Podzolic soils are responsive to fertilizer and good crop management.** Indonesian Agricultural Research and Development Journal 2(1):13-16, 21. Engl., 8 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Fertilizers. Productivity. Indonesia.

In most cases upland crop production has rarely been as successful as lowland rice culture. Cassava is the basic crop in combination with either rice or maize, interplanted with legumes.A long-term study was started in 1973 to evaluate the productive capacity of red-yellow podzolic soils in S Sumatra, of which there is an estimated area of 15-20 million ha. Results so far from this cropping systems research show that: continuous cropping of cassava should always be accompanied by other crops to help protect the soil from the sun, rain, and leaching and provide mulch; fertilizer and lime applied to these intercrop combinations will increase crop yields and residue production; with some variation the pattern maize + upland rice + cassava + legume can be used for most upland crop situations; the productivity of tropical upland soils with cassava as one crop in the cropping pattern can be maintained and even improved with the management practices suggested. *(Summary by Abstracts on Tropical Agriculture)* K01 D01

0191

16198 KURUP, A.E.S.; SASIDHARAN, N.K.; KUMARI, S.S. 1979. "Catch" crops for summer annual fallow. International Rice Research Newsletter 4(5):23. Engl.

Cassava. Field experiments. Secondary crops. Growth. India.

In 1976-78, sesame, cassava, groundnut, cowpea, sweet potato, *Vigna radiata, Eleusine coracana,* and *V. mungo* were grown after winter rice at Kayamkulam, India. Cassava and sweet potato required more time than the 110-day interval between winter and autumn rice crops. *(Summary by Field Crop Abstracts)* K01

0192

15720 REGO, J.R.S. 1981. Efecto de arreglos espaciales de yuca sobre la competencia interespecífica en un cultivo intercalado de yuca con caupí. *(Effect of spatial arrangements in cassava on the interspecific competition of cassava intercropped with cowpea).* Cali, Colombia, Centro Internacional de Agricultura Tropical. 23p. Span., 8 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Cowpea. Planting. Spacing. Growth. Plant height. Tuber productivity. Colombia.

An expt. of cassava intercropped with cowpea was conducted at the exptl. station of the Centro Internacional de Agricultura Tropical (CIAT) located in Santander de Quilichao (Colombia) in order to evaluate different spatial arrangements as to the rate of soil cover and light interception and to identify the spatial arrangement that minimizes interspecific competition and maximizes the productivity of each crop. A divided-strip design was used with 4 replications. Treatments for factor A strips (planting systems) were: (1) cassava in monoculture; (2) cowpea in monoculture; and (3) cassava + cowpea. Those for factor B strips (spatial arrangements of cassava and cowpea, resp.) were: (1) 1 x 1 and 40-20-40; (2) 1.4 x 0.7 and 50-40-50; and (3) 1.8 x 0.55 and 60-30-30-60. A control of cassava in monoculture, planted at 30 x 30 cm, was planted. Monthly observations on height and width of cassava plants were made up to the 6th mo. and routine data on harvesting collected. Cassava in monoculture showed a slow initial growth; at 2 mo. cassava had an av. of 33% soil cover while in association with cowpea, the av. was 75%. In treatments of cassava intercropped with cowpeas max. soil cover was reached at 65 days. Plants in monoculture also showed a greater growth in association, on the av. they were 26% taller at 90 days after planting. *(Summary by F.G. Trans. by L.M.F.)* K01

0193

11837 EKMAHACHAI, P.; MANEEKAOW, A.; TONGHAM, A.; TIRAPORN, C.; SINTUPRAMA, S. 1976. [Methods of intercropping cassava with peanuts]. *In* Thailand. Ministry of Agriculture. Field Crop Division. Cassava research report 1976. Bangkok. Thai., Sum. Engl.

Cassava. Field experiments. Inter-cropping. Groundnut. Planting. Spacing. Tuber productivity. Thailand.

Cassava/peanuts intercropping expt. were carried out in order to study its effects on cassava yield. A Latin Square design was used with 4 replications and 4 treatments in which cassava was planted at 1 x 1 m and fertilized with 8 kg each of N, P_2O_5, and K_2O/rai (1 ha = 6.25 rai): (1) cassava monocrop; (2) peanuts intercropped within the cassava row with 4 hills of peanuts (20 cm between hills) between 2 hills of cassava; (3) cassava intercropped with 2 rows of peanuts (30 cm between rows and 20 cm between hills) between cassava rows, 35 cm apart from the cassava row; (4) cassava intercropped with 3 rows of peanuts (2 plants/hill) between cassava rows. Treatment 3 gave the highest peanut yield and income compared to the other treatments. A slight decrease of cassava root yields was also observed. *(Full text)* K01 D02

0194

15795 MAURYA, P.R.; LAL, R. 1980. **Effects of no-tillage and ploughing on roots of maize and leguminous crops.** Experimental Agriculture 16(2):185-193. Engl., Sum. Engl., 10 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Maize. Cowpea. Root development. Land preparation. Plowing. Nigeria.

Field trials were carried out at the International Institute of Tropical Agriculture (Nigeria) for 2 consecutive yr. to investigate root development with or without tillage, which consisted of disc plowing to 20 cm depth followed by harrowing. Maize was grown as a sole crop or intercropped with cowpea, pigeon pea, soybean, or cassava. It is concluded that root distribution varied with tillage practice, crop and crop combination. The combination cassava-maize did not allow another maize crop to be planted during the 2nd season. Root density in the surface 0-10 cm layer of no-tillage plots was greater in plowed plots for all crops, except soybeans. Soil moisture reserves were similar for the 2 tillage systems where maize was intercropped with cassava and cowpea, particularly by 4-6 wk. after planting. *(Summary by Abstracts on Tropical Agriculture)* K01 D02 C01

0195

16185 ANDRADE, E.B. DE; FRAZÃO, D.A.C. 1980. **Sistemas de produção em policultivo de mandioca, milho e caupi para a microrregião Bragantina-Pará.** *(Production systems in polycultivation of cassava, maize, and cowpea for the Bragantina-Pará microregion).* Belém-Pará, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Circular Técnica no. 4. 27p. Port., Sum. Port., Engl., 15 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Maize. Cowpea. Planting. Timing. Brazil.

Seven agricultural production systems in intercropping, rotation, and pure stands involving cassava, maize, and cowpea were tested. The maize – cassava intercropping followed by cowpea was the most advantageous. All possible intercroppings were more efficient than any pure stand. Competition among crops and the advantages of the cropping systems as alternatives to improve the welfare of the small farmer are also discussed. *(Author's summary).* K01

0196

17104 PODSELVER, L. 1980. **L'essartage et ses implications sur le mode de développement en milieu de forêt tropicale (Amazonie).** [*Shifting cultivation and its implications on the way of development in a tropical forest environment (Amazonia)*]. Journal d'Agriculture Traditionnelle et de Botanique Appliquée 27(1):5-18. Fr., Sum. Engl., 16 Refs.

Cassava. Research. Shifting cultivation. South America.

Shifting cultivation in tropical S. America is discussed. The predominant crops involved are cassava, maize, cocoyam, yam, and sweet potato. *(Summary by Field Crop Abstracts)* K01

0197

16563 INTERNATIONAL RICE RESEARCH INSTITUTE. 1979. **Cropping systems program. Asian cropping systems network. Testing of cropping patterns.** *In*_____. Annual Report for 1978. Los Baños, Laguna, Philippines. pp.417-421. Engl., Illus.

Cassava. Inter-cropping. Maize. Rice. Productivity. Asia.

Cropping patterns suitable for several sites in Indonesia were assessed in 1977-78. At Bandorajaya and Gunung Sugih (partially irrigated, dryland), under 5 mo. irrigation, the best pattern was wetland rice/rice/cowpea. The promising pattern on dryland farms was maize/

rice intercropping with relayed cassava in the maize rows and the intercropping of maize and cassava after the rice harvest. The total yield from this system was 36 t/ha. *(Summary by Field Crop Abstracts)* K01

0198

16116 LOPEZ M., J.; LEIHNER, D.E. 1980. **Control químico de malezas en policultivos con yuca (*Manihot esculenta* Crantz).** *(Chemical weed control in polycultures with cassava).* Revista Comalfi 7(1/2):19-28. Span.,Sum. Engl., Span., 4 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Maize. Beans. Cowpea. Mung beans. Groundnut. Weeding. Herbicides. Colombia.

In view of the lack of information on the use of herbicides in polycultures including non-commercial crop species, 2 expt. were designed to identify herbicides and doses suitable for crop associations including cassava. A total of 6 products were tested single or in mixtures having been chosen for their selectivity of cassava, which was considered as basic crop. Besides cassava, other crops included in this study were maize, dry beans, cowpea, mung beans, groundnuts, *Desmodium heterophyllum*, and *Crotalaria* sp. Herbicides were identified with selectivities ranging from very specific to rather broad, oxifluorfen being the most specific (selective only to cassava and groundnuts) and linuron having the broadest range of selectivity (selective of at least 6 crops). Two mechanisms were studied simultaneously to reduce phytotoxicity to each crop and increase the no. of crops not affected by the herbicides: (1) the use of half doses of herbicides, and (2) preplanting application. While the application of half doses increased the selectivity of all herbicides, the preplanting application practice had this effect only with some of the tested products. The best combination showing selectivity of all crops, except *D. heterophyllum*, together with an efficient weed control was linuron + metolachlor at 0.25 + 1.0 kg a.i./ha in either pre or postplanting application. The results further indicate that chemical weed control in polycultures is feasible using low doses of herbicides with a wide range of selectivity. *(Author's summary)* K01 D02

See also 0033

K02 Descriptive and Comparative Studies

0199

16105 WATERWORTH, J.V. 1980. **Green revolution methodology in Nigeria.** Experimental Agriculture 16(1):1-12. Engl., Sum. Engl., 14 Refs.

Cassava. Research. Cassava programs. Experiment design. Nigeria.

In order to quickly raise food production, Nigeria in 1972 adopted the National Accelerated Food Production Project (NAFPP), concentrating on rice, maize, wheat, sorghum, pearl millet, and later, cassava. Under the project, a large no. of minikit demonstration trials were laid out. Information on methodology, plot size, no. and choice of treatments, and recording are given. Sample record sheets are included. *(Summary by Abstracts on Tropical Agriculture)* K02

Z00 GENERAL

0200

16568 MALOSSINI, F. 1980. **La manioca.** *(Cassava).* Terra e Sole (Italy) 35 (458):623-626. Ital., 8 Refs., Illus.

Cassava. Production. Trade. Cassava flour. Digestibility. Animal nutrition. Toxicity.

Biological, agronomic, economic, and commercial aspects of cassava, its feeding value, toxic properties, and utilization in animal feeding are briefly described and discussed. *(Summary by Field Crop Abstracts)* Z00

0201

16594 CASTELLANOS, V.H.; BOX, L. 1981. **Investigaciones de yuca en República Dominicana: inventario de estudios realizados y en ejecución sobre** *Manihot esculenta* Cr. *(Cassava research in the Dominican Republic: a list of the studies conducted and in process on Manihot esculenta).* Santiago de los Caballeros, Investigación Agro-Sociológico de la Universidad Agrícola de Holanda. Centro de Desarrollo Agropecuario. Instituto Superior de Agricultura. Documento de Trabajo no. 1. 20p. Span., 5 Refs.

Cassava. Research. Developmental research. Dominican Republic.

A list of research work conducted or in process on cassava cultivation in the Dominican Republic is given. Its objective is to increase the information investigators have on the current research work carried out in the country. The year, author, title, type of research (descriptive, general or specific, and exptl.), location, and results are included for each one. *(Summary by F.G. Trans. by L.M.F.)* Z00

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LIST OF ABBREVIATIONS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
a.i.	Active ingredient
alt.	Altitude
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
AMV	Alfalfa mosaic virus
approx.	Approximate(ly)
atm.	Atmosphere
ATP	Adenosine 5'-triphosphate
av.	Average
BAP	6-Benzylaminopurine
BBMV	Broad bean mosaic virus
BCMV	Bean common mosaic virus
BGMV	Bean golden mosaic virus
BGYMV	Bean golden yellow mosaic virus
BOD	Biochemical oxygen demand
BPMV	Bean pod mottle virus
BRMV	Bean rugose mosaic virus
BSMV	Bean southern mosaic virus
BV	Biological value
BYMV	Bean yellow mosaic virus
°C	Degrees Celsius (centigrade)
ca.	About (circa)
CBB	Cassava bacterial blight
CBSD	Cassava brown streak disease
CEC	Cation exchange capacity
CER	CO_2 exchange rate
CF	Cassava flour
CGR	Crop growth rate
CLM	Cassava leaf meal
CLV	Cassava latent virus
CM	Cassava meal
cm	Centimeter
COD	Chemical oxygen demand
concd.	Concentrated
concn.	Concentration
CP	Crude protein
CSL	Calcium stearyl lactylate
CSW	Cassava starch wastes
C.V.	Coefficient of variation
cv.	Cultivar(s)
2,4-D	2,4-dichlorophenoxyacetic acid
DM	Dry matter
DNA	Deoxyribonucleic acid
EC	Emulsifiable concentrate
EDTA	Ethylenediaminetetraacetic acid
EEC	European Economic Community
e.g.	For example
ELISA	Enzyme- linked immunosorbent assays
EMS	Ethyl methane sulfonate
expt.	Experiment
exptl.	Experimental
°F	Degrees Fahrenheit
ft-ca	Foot candles (10.76 lux)
FYM	Farmyard manure
g	Gram(s)
G	Giga (10^9)
GA	Gibberellic acid
gal	Gallon(s)
GE	Gross energy
GERs	Glucose entry rates
GLC	Gas-liquid chromatography
govt.	Government
govtl.	Governmental
h	Hour(s)
ha	Hectare(s)
HCN	Hydrocyanic acid
HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
HI	Harvest index
IAA	Indoleacetic acid
IBA	Indolebutyric acid
in.	Inches
i.e.	That is
IU	International unit
J	Joule
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilogram-calorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate

kR	Kiloroentgen(s)
l	Liter(s) (only in combination with no.)
LAD	Leaf area duration
LAI	Leaf area index
lat.	Latitude
lb	Pound(s)
LD_{50}	Mean lethal dose
LER	Land efficiency ratio
LPC	Leaf protein concentrate
lx	Lux
M	Mega
M	Molar
m	Meter(s)
max.	Maximum
MC	Moisture content
ME	Metabolizable energy
meq	Milliequivalent(s)
met.	Methionine
mg	Milligram(s)
mho	Reciprocal ohm
min.	Minimum
min	Minute(s)
ml	Milliliter(s)
mm	Millimeter(s)
mo.	Month
mol.wt.	Molecular weight
m.p.	Melting point
NAA	α-Naphthalene acetic acid
NAD	Nicotinamide adenine dinucleotide
NADH	Nicotinamide adenine dinucleotide, reduced form
NAR	Net assimilation rate
NCE	Net CO_2 exchange
NE	Northeast
NER	Net energy ratio
nm	Nanometer(s) (10^{-9} m)
no.	Number(s)
NPFs	Negative production factors
NPR	Net protein ratio
NPU	Net protein utilization
NW	Northwest
OM	Organic matter
oz	Ounce(s)
P	Probability
Pa	Pascal(s)
PAN	Pexoxyacetic nitrate
PCNB	Pentachloronitrobenzene
PDA	Potato dextrose agar
PER	Protein efficiency ratio
pH	Hydrogen ion concentration
pphm	Parts per hundred million
PPI	Pre-planting incorporation
ppm	Parts per million
PSA	Potato sucrose agar
pv.	Pathovar.
resp.	Respective(ly)
R*f*	Retardation factor-chromatography
RGRs	Relative growth rate
RH	Relative humidity
RNA	Ribonucleic acid
S	Svedberg unit of sedimentation coeff. (10^{-13} s)
s	Second
$S_{20,w}$	Sedimentation coefficient corrected to water at 20°C
SBM	Soybean meal
SCN	Thiocyanate
SCP	Single cell protein
SDS	Sodium dodecyl sulfate
sp.	Specie
spp.	Species
SSL	Sodium stearyl-2-lactylate
t	Ton(s)
TDN	Total digestible nutrients
temp.	Temperature
TIA	Trypsin inhibitor activity
TIBA	2,3,5-Triiodobenzoic acid compound with *N*-methylmethanamine
TLC	Thin-layer chromatography
TMV	Tobacco mosaic virus
TSH	Thyroid-stimulating hormone
UDPG	Uridine diphosphate glucose
UMS	Unmodified cassava starch
UV	Ultraviolet
var.	Variety(ies). varietal
VFA	Volatile fatty acids
vol.	Volume
VPD	Vapor pressure deficit
vpm	Volume per million
W	West
wk.	Week
WP	Wettable powder
wt.	Weight
YFEL	Youngest fully expanded leaves
yr	Year(s)
α	*alpha*
β	*beta*
γ	*gamma*
δ	*delta*
ε	*epsilon*
λ	*lambda*
π	*pi*
ψ	*psi*
/	Per
μ	Micro
%	Percent(age)
>	More than, greater than
<	Less than
≤	Equal to or less than
≥	Equal to or greater than
±	Plus or minus
∅	Diameter
≪	Much less than
≫	Much greater than

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Abstracts on Cassava
(*Manihot esculenta* Crantz)

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FOREWORD

CIAT's documentation activities are focused on three research areas: cassava (*Manihot esculenta* Crantz) production and utilization, field beans (*Phaseolus vulgaris* L.) as grown under tropical conditions, and tropical pasture species and their management. The goal of the Documentation Center is to disseminate research results and report ongoing activities in these three areas.

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Cassava Newsletter (Yuca - Boletín Informativo) - a technical newsletter that provides information regarding cassava research in progress throughout the tropics.

Pastos Tropicales - Boletín Informativo - a newsletter on pasture research and on new developments in the tropical pastures network.

Hojas de Fríjol - a newsletter on bean breeding, agronomy, and cropping systems, and on the activities within the bean researchers' network.

We believe that each of these types of information plays a key role in research aimed at increasing agricultural productivity in the tropics. It is our hope that this range of publications satisfies the various information needs of our users.

A GUIDE FOR USERS

Components of a reference

Sequential number in this journal

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1 — 16172 TELES, F.F.F.; SILVEIRA, A.J.; BATISTA, C.M.; FEITOSA, E.P.G.;
2 — RESENDE, J.L.M. 1980. Açúcares solúveis em mandioca (*Manihot esculenta* Crantz). (*Soluble sugars in cassava*). Revista Ceres 27(151):325-328. Port., Sum. Engl., 11 Refs. — 3
7 — 4 5 6

8 — Cassava. Laboratory experiments. Tubers. Analysis. Carbohydrate content. Clones. Brazil.

9 — Total soluble carbohydrates, reducing and non-reducing sugars on 10 cassava clones, cultivated in the state of Minas Gerais, Brazil were analyzed. The analyses were carried out spectrophotometrically by the Teles' Reagent after extraction by mechanical shaking with ethanol 50% (v/v). Av. obtained, in mg/g of green matter, ranged from 1.3-7.8 of reducing sugars; 6.1-21.8 of non-reducing; and 7.5-29.6 of total soluble carbohydrates. Statistical analyses showed significant differences among clones ($P < 0.05$), and a correlation coefficient ($r = + 0.8$) between reducing and non-reducing sugars. (*Author's summary*) C03
10 11

1- Accession number
2- Author(s)
3- Original title
4- Title translation
5- Source
6- Pages
7- Additional notes
8- Descriptors
9- Summary
10- Abstractor and/or translator
11- Subject categories

Note: The use of abbreviations in the abstracts has been standardized by the Information Center. A complete list of these abbreviations is included at the end of this journal.

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Author index

Here you will find the complete list in alphabetical order of the authors of the documents summarized in this issue. The four-digit numbers at the right hand side of each author correspond to the sequential numbers of appearance of the documents herein (the number centered above the abstract).

Subject index

This index presents a list of terms in alphabetical order to which the user can translate his information needs on specific topics. To facilitate his search, most of these terms or general topics cover other subjects, and thus the user will find up to two more levels of specificity. The four-digit numbers under the terms correspond to the sequential number of the documents within this issue.

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C00 PLANT PHYSIOLOGY

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16541 EZETA, F.N.; CARVALHO, P.C.L. DE 1981. **Micorrizas, uma simbiose indispensável para o crescimento da mandioca.** *(Mycorrhizae, an essential symbiosis for cassava development).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em andamento no. 5. 2p. Port.

Cassava. Research.Mycorrhiza. Brazil.

The ability of cassava to grow and produce on low-fertility soils is briefly described. This characteristic has been attributed by investigators in physiology and nutrition to the efficient mycorrhizae in cassava which allow P and other nutrients to be extracted from very poor soils. Current research seeks to determine soil conditions that favor mycorrhiza formation and fungi species of greater affinity to form mycorrhiza in cassava. *(Summary by F. G. Trans. by L.M.F.)* C00

0203

16151 KEATING, B.A.; EVENSON, J.P. 1981. **Cassava response to temperature.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.50-55. Engl., Illus.

Cassava. Laboratory experiments. Cultivars. Temperature. Growth. Tuber productivity. Australia.

The effects of temp. on cassava growth and development were examined in a series of controlled environment studies at the U. of Queensland Research Station, Redland Bay, Australia. Cv. M AUS 10 and M AUS 7 were used at day/night temp. of (1) 34/28, 28/22, and 22/16°C, and (2) 28/28, 28/22, and 28/16°C. Higher temp. promoted all aspects of shoot growth, except forking which was inhibited in M AUS 10 at 34/28°C and delayed at 28/28°C. Tuber yield was highest at 28/22°C as plants at this combination produced highest DM along with a high distribution ratio to storage roots in both M AUS 7 and M AUS 10. *(Summary by F.G. Trans. by L.M.F.)* C00 C01 D01

0204

16542 CARVALHO, P.C.L. DE; EZETA, F.N. 1981. **Influência do fotoperíodo sobre a tuberização da mandioca.** *(Influence of photoperiod on cassava tuber development).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em andamento no. 3.2p. Port., 3 Refs.

Cassava. Laboratory experiments. Photoperiod. Cultivars. Tuber development. Cassava programs. Brazil.

Research was conducted at the headquarters of the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF) in Cruz das Almas, Bahia, Brazil to identify the degree of sensitivity of the most common cassava var. to different photoperiods and the hour of the day when max. DM accumulation occurs in the roots by extending daytime with artificial light.

With the information obtained photoperiod-insensitive cv. were selected, which can be used in breeding programs or distributed to the different Brazilian ecosystems. *(Summary by F. G. Trans. by L.M.F.)* C00 C01 D01

0205

17129 CONNOR, D.J.; PALTA, J. 1981. **Response of cassava to water shortage. 3. Stomatal control of plant water status.** Field Crops Research 4(4):297-311. Engl., Sum. Engl., 24 Refs., Illus.

Cassava. Field experiments. Cultivars. Water stress. Stomata.

Diurnal measurements of leaf water potential and the diffusive conductance of the abaxial surface of 2 cassava cv.,M Col 22 and M Mex 59, were made on 3 occasions on field grown plants during a 10-wk. period of rainfall exclusion. Conductances of about 10 mm/s were observed in the rainfed plots but generally the mean conductance was in the range 3-5 mm/s. The min. water potential of -1.8 MPa. was observed in the rainfed plots. Water shortage caused reduction in mean conductance to < 1 mm/s at which level the control of water loss maintained leaf water potential > -1.5 MPa. at all times. Stress plots recovered more slowly during the late afternoon but during the day had higher leaf water potentials than the controls. At the same levels of leaf water potential the conductance of M Mex 59 was less than that of M Col 22 in both control and stress plots. Measurements are also reported of the stomatal distribution, density, and pore size for both fully expanded leaves and those whose expansion was seriously restricted by the water shortage. *(Author's summary)* C00 D01

0206

13444 IKE, I.F.; THURTELL, G.W. 1981. **Water relations of cassava: water content, water, osmotic and turgor potential relationships.** Canadian Journal of Botany 59(6):956-964. Engl., Sum. Engl., Fr., 37 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Water requirements (plant). Soil moisture. Plant physiology.

The relative water content (RWC), water potential (ψ_L), osmotic potential ($\psi\pi$), and turgor pressure (ψ_p) relationships were studied in indoor-grown cassava cv. CMC9 and MCOL 113 (low and high starch, resp.). At low soil moisture tension, RWC and ψ_L fell to min. values during the day but recovered considerably at night. In turgid leaves $\psi\pi$ was -970 and -1000 kPa. in CMC9 and MCOL 113, resp. Diurnal variations in $\psi\pi$ were small in both cv.; those in ψ_p, were larger and paralleled changes in ψ_L. A marked hysteresis was evident in the RWC/ψ_L and RWC/ψ_p data obtained during the drying cycle. When ψ_L and ψ_p were changed rapidly by switching the lights on and off at short time intervals, no hysteresis was observed in the data. *(Summary by Soil and Fertilizers)* C00 D01

0207

16643 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **Physiology.** *In* ——. Cassava Program 1980. Annual Report. Cali, Colombia, CIAT Series no. 02ECI-80. pp.5-9. Engl., Illus.

Also in Spanish.

Cassava. Laboratory experiments. Water stress. Tuber productivity. Dry matter. Starch content. Leaf area. Photosynthesis. Colombia.

Research of the physiology section was centered on identifying the characters associated with high root yields and quality in cassava under stress conditions. Plant reaction to water stress was studied, specifically regarding growth and yields of var. M Mex 59 and M Col 22 with a period of artificial rain exclusion. Observations were made throughout the stress period and subsequent recovery. Water stress reduced LAI notably although M Mex 59

maintained a LAI approx. twice that of M Col 22 during the stress period. LAI for both var. increased during recuperation and by final harvest (10 mo.) they were similar in both control and stressed plants. DM and starch contents increased during the stress period but decreased during recuperation. *(Summary by F.G. Trans. by L.M.F.)* C00 D01 D03

0208

13438 IKE, I.F.; THURTELL, G.W. 1981. **Osmotic adjustment in indoor grown cassava in response to water stress.** Physiologia Plantarum 52(2):257-262. Engl., Sum. Engl., 28 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Water stress. Soil moisture. Plant physiology.

Using cassava cv. Llanera (CMC 9) and Colombia 113 (MCOL 113), low and high starch yielding, resp., water content/water potential relationhsips in stressed and unstressed plants were studied to ascertain the magnitude of osmotic adjustment in response to water stress and the mechanism of such adjustments. At any leaf water potential the water content was higher in stressed plants. The osmotic potentials of turgid leaves (100% relative water content) were -0.97 and -1.00 MPa. in unstressed plants of cv. CMC 9 and MCOL 113, resp. In stressed plants, the values were -1.13 MPa. (CMC 9) and -1.14 MPa. (MCOL 113). The 0.14-0.16 matric pressure (MPa) osmotic potential difference between stressed and unstressed plants suggested that a stress-induced osmotic adjustment occurred in both cv. The bulk volumetric elastic moduli at turgor pressures above 0.10 MPa. were 9.84 MPa. (CMC 9) and 13.58 MPa. (MCOL 113) in unstressed plants. The higher values found in stressed plants, 14.56 MPa. in CMC 9 and 16.91 MPa. in MCOL 113, suggested a stress-induced decrease in cell wall elasticity. Hence, the observed shift in the water content-potential relations in cassava involved both an osmotic adjustment and a decrease in cell wall elasticity. Increasing the no. of stress cycles/plant did not cause a further displacement of the water content-potential curves. *(Author's summary)* C00 D01

0209

16145 HICKS, L.N.; FUKAI, S. 1981. **Nutrient loss and redistribution in cassava during leaf shedding.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.78-83. Engl., 3 Refs., Illus.

Cassava. Leaves. Defoliation. Mineral content. N. P. K. Plant physiological processes. Australia.

An expt. was conducted to determine nutrient loss and redistribution in cassava during leaf shedding. Cv. M AUS 7 was planted in Redland Bay, Queensland (Australia) in Nov. 1978 to determine the suitable rates of N and K. Four treatments were chosen for the study of leaf shedding with 4 replicates. For each of the 16 plots, 9 av.-sized stems were chosen from 9 adjacent plants and on April 30, 1979, 5 leaves on every tenth node of the axis of each stem were tagged, beginning with the top visible leaves. During the exptl. period, almost no new leaves were produced. Tagged leaves were sampled on April 30, May 17, June 12, and July 2. One tagged leaf from each node position was taken from each plot for a total of 16 leaves for each node position. During these days, shed leaves with tags were collected from the ground as well as on June 22, July 13 and 27, and Aug. 27. These were then oven dried and weighed. Dry material was then ground and N, P, and K concn. were measured. The av. no. of shed leaves on any node increased gradually. There were marked effects of the node position on N and P concn. K concn. varied little among leaves of different ages, and the decrease with time was also small. *(Summary by F.G. Trans. by L.M.F.)* C00

0210

17194 HOWELER, R.H.; ASHER, C.J.; EDWARDS, D.G. 1982. **Establishment of an effective endomycorrhizal association on cassava in flowing solution culture and its effects on phosphorus nutrition.** New Phytologist 90:229-238. Engl., Sum. Engl., 35 Refs.

Cassava. Laboratory experiments. Cultivars. Inoculation. Mycorrhiza. Nutrient solution. Nutritional requirements. P. Dry matter. Nutrient absorption.

Eight cassava cv. were grown with or without mycorrhizal inoculation in flowing solution cultures containing approx. 0.1, 1, 10 or 100 μM phosphate. Rice, maize, cowpea, and French bean were included in the expt. for comparative purposes. Cassava required a higher external P concn. for max. yield ($\geq$ 10 μM) than the other species ($\geq$ 1 μM) regardless of the inoculation treatments. Roots of inoculated cassava plants were heavily infected with vesicular-arbuscular endophytes at 0.1 and 1 μM phosphate, but not at 10 or 100 μM. Noninoculated cassava plants were free of infection, and no infections were observed in any treatment on the other species. At 1 μM phosphate, infection of cassava roots was associated with large increases in whole plant dry wt., P concn. in tops and roots, and total P uptake. At 0.1 μM phosphate there were also substantial increases in P concn. in tops and roots but the infected cassava plants were still severely P-deficient and growth was not improved. The results are discussed in relation to the present state of knowledge about the P nutrition of cassava. *(Author's summary)* C00 D01

See also 0225

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C01 Plant Development

0211

16135 FUKAI, S.; KEATING, B.A.; HAMMER, G.L. 1981. **Development of a cassava growth model.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.91-92. Engl.

Cassava. Growth. Climatic requirements. Soil requirements. Australia.

A cassava growth model has been developed in order to estimate economic yield from a set of environmental and soil factors under standard cultural conditions with cv. M AUS 7 in northern Australia. Several submodels which describe particular processes of cassava growth are mentioned. *(Summary by F.G. Trans. by L.M.F.)* C01

0212

13356 HOSTALACIO, S. 1978. Fisiologia da mandioca. *(Cassava - physiology).* Lavras-MG, Brazil, Escola Superior de Agricultura de Lavras. 37p. Port., 47 Refs., Illus.

Paper presented at Curso Intensivo para Capacitação de Técnicos e de-Mão-de Obra Especializada para a Cultura da Mandioca, Lavras, 1978.

Cassava. Research. Adaptation. Temperature. Growth. Branching. Leaf area. Photoperiod. Photosynthesis.

A literature review on research conducted on different aspects of physiology of the cassava plant is given. Aspects on adaptation to lat., temp., and rainfall are discussed. Results of research on the effect of temp. on cassava growth, leaf size, and branching are given. Physiological aspects of the development of leaf area, photosynthesis efficiency, LAI, the effect of the photoperiod on root formation, mechanisms of root formation, photosynthesis, and the relationship between production and accumulation sites are considered. A ideal type of cassava plant determined by computer is described. *(Summary by A.J.C. Trans. by L.M.F.)* C01 D01

0213

16139 BAKER, G.; FUKAI, S.; WILSON, G.L. 1981. **Effects of water stress on cassava at different growth times on subsequent growth and tuber yield.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.88-89. Engl., 1 Ref.

Cassava. Water stress. Growth. Tuber productivity. Australia.

An expt. was designed to examine if severe water stress improved the distribution ratio to tubers and if plants at different stages of growth responded to water stress differently. The 3 treatments were irrigation, rainfed, and limited water supply by excluding most of the rainfall. Plant populations of 2 different stages of growth (cv. M AUS 7) were subjected to water stress at 2 different times (March-April, April-May). Plant response to water stress was assessed from sequential harvests, and leaf appearance rate and leaf senescent rate were estimated. Data obtained will be used to construct a water balance model. *(Summary by F.G. Trans. by L.M.F.)* C01 D03

0214

17173 GHUMAN, B.S.; LAL, R. 1981. **Cassava: growth and plant-water relations in relation to water table depth and flooding.** IITA Research Briefs 2(3):7-10. Engl., 4 Refs., Illus.

Cassava. Field experiments. Soil water. Cultivars. Growth. Transpiration. Water requirements (plant).

The influence of constant water table depths and transient and continuous flooding on growth, yield, and plant-water relations of cassava plants is briefly described. Seven drainage treatments were studied in field lysimeters: (1) WT_{15} (water table maintained at 15 cm depth from soil surface); (2) WT_{30}; (3) WT_{50}; (4) WT_{70}; (5) WT_{no} (control); (6) TF (transient flooding); and (7) continuous flooding. Plant height, leaf no., and tuber yield/plant were affected by the different water table depths and flooding treatments. In all treatments, leaf water potential of cv. TMS 30001 and Isunikankiyan decreased with the advance of the day until 1445 h and increased thereafter. The increase of leaf diffusive resistance during the 1st 2 days of flooding was approx. 6 times for var. TMS 30001 and 2.5 times for Isunikankiyan. Excess soil moisture in TF, WT_{15}, WT_{30}, and continuous flooding caused leaf wilting. *(Summary by F.G. Trans. by L.M.F.)* C01 D01

See also 0203 0204 0245 0248 0257 0259 0263 0266

C03 Chemical Composition, Methodology and Analyses

0215

17183 IKEDIOBI, C.O.; ONYIA, G.O.C.; ELUWAH, C.E. 1980. **A rapid and inexpensive enzymatic assay for total cyanide in cassava (*Manihot esculenta* Crantz) and cassava products.** Agricultural and Biological Chemistry (Japan) 44(12):2803-2809. Engl., Sum. Engl., 26 Refs., Illus.

Cassava. Analysis. HCN content. Linamarase. Enzymes. Tubers. Tapiocas. Cassava chips. Cassava flour. Nigeria.

The well-known alkaline picrate test for cyanide has been improved by incorporating an enzymatic step to make the assay much more specific and quantitative. The sensitivity or detection limit of this method was found to be 0.16 $\mu g/cm^3$ while the precision as indicated by the C.V. was 3%. The method was, in addition, found to be rapid, simple, inexpensive, and ideally suited for the analysis of large no. of cassava tissues and products, such as may be encountered in cassava agronomy and breeding work or in industrial quality control lab. A trained operator working alone consistently analyzed at least 700 samples/day using this assay method. *(Author's summary)* C03 I02

0216

17186 ANOSIKE, E.O.; UGOCHUKWU, E.N. 1981. **Characteristics of rhodanese from cassava leaves and tubers.** Journal of Experimental Botany 32(130):1021-1027. Engl., Sum. Engl., 19 Refs.

Cassava. Enzymes. Rhodanese. Cortex. Leaves. Detoxification. HCN.

Rhodanese activity has been established in the leaves, in the peel, and in the flesh of the tuberous part of cassava. The pattern of distribution of enzyme activity is shown to follow that of the concn. of the cyanogenic glucoside estimated on the basis of HCN released. For the 1st time, the presence of rhodanese is reported in higher plant tissues other than the leaves. Identity has been established between rhodanese from peel, leaves, and flesh of the cassava plant. The enzyme is inhibited by cyanide in the absence of thiosulphate or cysteine. Rhodanese is suggested to play a role in the detoxification of cyanide in cassava. *(Author's summary)* C03 H04

0217

16565 OLORUNDA, A.O., AWORH, O.C.; NUMFOR, F.A. 1981. **Technical note: predicting quality of cassava products with the aid of chemical and rheological properties.** Journal of Food Technology 16(4):447-450. Engl., 10 Refs.

Cassava. Laboratory experiments. Tubers. Cultivars. Analysis. Starch content. Gari. Nigeria.

The chemical and rheological properties of the tubers of 5 selected cassava cv. [Isunikakiyan (local), 30555, 30375, 30395, and 60444] and their relationship with the quality of the processed product, gari, were studied. Ten-mo.-old roots were harvested from uniform trial plots at the International Institute of Tropical Agriculture, Ibadan, Nigeria. The roots from each cv. were divided into 3 groups for fresh analysis, starch extraction, and processing into gari. Little difference was observed in the starch content of assessed tubers. Significant var.

differences in amylose content and pasting characteristics of the starch were noted. Gelation time of the starch also varied between cv. but bore no relationship with max. viscosity or amylose content. Sensory evaluation of gari made from the cassava cv. showed a definite preference for the local cv. Isunikakiyan in terms of color and flavor over the other var. *(Summary by F.G. Trans. by L.M.F.)* C03 I02

See also 0224 0230 0302 0310 0340

D00 CULTIVATION

0218

16638 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **Agronomy.** *In* ____. Cassava Program 1980. Annual Report. Cali, Colombia. CIAT Series no. 02ECI-80. pp.39-58. Engl., Illus.

Also in Spanish.

Cassava. Field experiments. Technology evaluation. Cultivars. Tuber productivity. Adaptation. Tissue culture. Inter-cropping. Cowpea. Cuttings. Storage. Colombia.

The results of regional trials for promising cassava var. under uniform improved technology are given. Trials were conducted in Media Luna, Chigorodó, Carimagua, Río Negro, San Martín, CIAT-Palmira, CIAT-Quilichao, and Caicedonia. In 7 of the 8 sites, var. M COL 1684, CM 342-55, and CM 489-1 outyielded the best local clones. Var. M COL 1468, M COL 1684, and M COL 22 tested over 45, 40, and 40 cycles, resp. have produced weighted av. yields of 29.1, 30.8, and 22.0 t/ha, resp. Yields of the 1st 2 are both high and relatively stable while yields of M COL 22 are lower and unstable. The Centro Internacional de Agricultura Tropical tested and simplified the single leaf-bud cutting technique for the international transfer of cassava var. in a joint project with Philippine workers. Trials were conducted on chemical weed control in cassava in monoculture and in mixed cropping systems. The response to N-P-K fertilization in cowpea/cassava intercrops was determined. Studies were conducted to determine the effect of chemical treatments and storage duration of cuttings on germination, early growth, and canopy formation. *(Summary by F.G. Trans. by L.M.F.)* D00

D01 Soil Water, Climate and Fertilization

0219

15769 MORAES, O. DE; MONDARDO, E.; VIZZOTTO, V.J.; MACHADO, M.O. 1981. Adubação química e calagem da mandioca. *(Chemical fertilization and liming on cassava).* Florianópolis, Santa Catarina, Brasil, Empresa Catarinense de Pesquisa Agropecuária, S.A. Boletim Técnico no. 8. 20p. Port., 17 Refs., Illus.

Cassava. Field experiments. Fertilizers. N. P. K. Agricultural lime. Tuber productivity. Brazil.

In 1976-79, cassava cv. Mandim Branca and Mico were used in fertilizer trials at 4 sites in the state of Santa Catarina and 3 in the Vale do Itajaí (Brazil). P, K, N, and Ca were applied individually or in combination at various rates and at different times in the growth cycle. At Ituporanga there was no response to N, but at Araranguá, where the soil had a low OM content, yield increased at 90 kg N/ha. Cassava yield at Ituporanga and Riosul responded at 80 kg P_2O_5/ha. In the southern regions levels of K in the soil were low and crops responded to 80 kg K_2O/ha, but in the Vale do Itajaí K levels were high and there was no response. The effect of liming on tuber yield depended on soil pH. *(Summary by Soil and Fertilizers Abstracts)* D01 D03

0220

17126 NAIR, P.G.; MOHAN KUMAR, B.; RAJENDRAN, N. 1980. Effect of different sources of potassium on the yield and quality of cassava. Journal of Root Crops 6(1/2):21-24. Engl., Sum. Engl., 11 Refs.

Cassava. Field experiments. Fertilizers. K. Tuber productivity. India.

The effect of application of Schoenite and Syngenite, 2 indigenous sources of K, on the yield and quality of cassava, was compared with KCl and wood ash at different levels of K_2O in acid laterite soil during 1973-76 at the Central Tuber Crops Research Institute farm (Trivandrum, India). These 2 sources were at par with KCl in increasing the tuber yield of cassava. The different sources did not show much influence on starch and HCN contents of tubers, residual available K and K uptake by plants, while increasing levels of potash application resulted in an increase in starch content and a decrease in HCN content of tubers. Among the different levels tried, 100 kg K_2O/ha was found to be the optimum for tuber yield. *(Author's summary)* D01 D03

0221

16543 DANTAS, J.L.L.; GOMES, J. DE C.; MATTOS, P.L.P. DE 1981. Biofertilização em mandioca (*Manihot esculenta* Crantz). *(Biofertilization in cassava).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em andamento no. 4. 3p. Port., 2 Refs.

Cassava. Field experiments. Green manures. Fertilizers. N. P. K. Tuber productivity. Brazil.

An expt. was conducted at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF), in Cruz das Almas, Bahia, Brazil to determine the influence of the application of

green manures on cassava yield. The trial was divided into 2 stages; the 1st included the selection and planting of 4 leguminous species (jack beans, beans, cowpea, and *Dolichus lablab*). Treatments were: (a) pulses with no fertilizer; (b) pulses + P; (c) pulses + PK; and (d) pulses + NPK. The 2nd stage will correspond to cassava planting in strips previously planted to pulses, keeping a strip for chemical fertilization. *(Summary by F.G. Trans. by L.M.F.)* D01 D03

0222

16141 PATTERSON, R.; FUKAI, S.; EDWARDS, D.G. 1981. **Potassium nutrition of field grown cassava.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.94-95. Engl.

Cassava. Field experiments. Fertilizers. K. Tuber productivity. Absorption. Australia.

The results of a series of expt. conducted at Mt. Cotton, Caloundra Downs, and Bribie Island (Australia) to determine the response of cassava cv. M AUS 7 to the application of K in terms of yield and uptake and distribution of K in the plant are given. No response to the application of K was recorded. *(Summary by F.G. Trans. by L.M.F.)* D01 D03

0223

13402 LOPES, A.S.; GUEDES, G.A. DE A. 1978. **Considerações sobre calagem e adubação química para a cultura da mandioca.** *(Considerations on liming and chemical fertilization in cassava).* Lavras-MG, Brazil, Escola Superior de Agricultura de Lavras. 33p. Port., Sum. Port., 20 Refs., Illus.

Paper presented at Curso Intensivo para Capacitaçao de Técnicos e de-Mao-de Obra Especializada para a Cultura da Mandioca, Lavras, 1978.

Cassava. Agricultural lime. Fertilizers. N. P. K. Ca. Mg. Nutrient absorption.

A literature review is given on the following aspects: OM production during the cassava growth cycle and the rate of nutrient absorption; results of expt. on liming and fertilization; and recommendations for lime and fertilizer applications according to available information. Cassava extracts greater amounts of N, P, K, Ca, and Mg. Two alternatives for liming are recommended: (a) 30% of the dosis generally recommended for other crops, assuming a low level of technology; (b) the dosis generally recommended, assuming a high level of technology. *(Summary by F.G. Trans. by L.M.F.)* D01

0224

13574 LORENZI, J.O.; GALLO, J.R.; MALAVOLTA, E. 1980. **Exigências de macronutrientes de dois cultivares de mandioca (*Manihot esculenta* Crantz).** *(Macronutrient requirements of two cassava cultivars).* Anais da Escola Superior de Agricultura Luiz de Queiroz 37:443-462. Port., Sum. Port., Engl., 33 Refs., Illus.

Cassava. Field experiments. Cultivars. Nutritional requirements. Tuber productivity. Dry matter. Brazil.

A field expt. was conducted at the Centro Exptl. de Campinas, SP, Brazil to study DM production, macronutrient absorption and accumulation, and root production in 2 cassava cv., Branca de Santa Catarina and IAC Mantiqueira. Plants received an uniform dressing of N, P_2O_5, and K_2O at 40, 80, and 60 kg/ha, resp. as ammonium sulphate, simple superphosphate, and muriate of potash; N was topdressed 60 days after emergence. Plants were irrigated twice, 15 and 45 days after planting. Plant samples were analyzed for macronutrient composition on 6 occasions at 60 day intervals. There was a statistical difference in the root production of the 2 cv. Extraction of macronutrients was the same for the 2 cv., except for P; accumulation was different only for K and S. *(Author's summary)* D01 D03 C03

0225

16644 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **Soils and plant nutrition.** *In* ____ . Cassava Program 1980. Annual Report. Cali, Colombia, CIAT Series no. 02ECI-80. pp.59-69. Engl., Illus.

Also in Spanish.

Cassava. Field experiments. Germplasm. Mineral deficiencies. P. Inoculation. Mycorrhiza. Nutrient absorption. Colombia.

Efforts to develop cassava technology for the vast areas of acid infertile soils were continued. Large-scale germplasm screening in the field was begun in Carimagua for tolerance to low levels of P and acidity and in Quilichao, for tolerance to low levels of P. Various fertilizer trials were used to determine: (a) nutrient absorption and distribution within the plant during a 12-mo. growth cycle; (b) the long-term effect of N, P, K applications on soil fertility and yield of continuously grown cassava; (c) the residual effect of various sources of P; (d) the lime x P interaction; and (e) the effect of mycorrhizal inoculation on P absorption. *(Summary by F.G. Trans. by L.M.F.)* D01 C00

0226

16159 KEATING, B.A.; EVENSON, J.P. 1981. **Field response to applied N and K at Redland Bay, S.E. Queensland.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.63-65. Engl., Illus.

Cassava. Field experiments. Fertilizers. N. K. Dry matter. Productivity. Australia.

A study was carried out to supply information on suitable fertilizer applications for exptl. plots of cassava at the U. of Queensland Research Station, Redland Bay, Australia. Soil type is a deep well-drained reddish brown clay loam; the previous crop was French beans followed by a cover crop of oats. A systematic design was used with 11 levels of N from 0-400 kg N/ha at intervals of 40 kg/ha applied in 1 direction and 18 levels of K from 0-680 kg K/ha at increments of 40 kg/ha being applied at right angles to the N application. Four replicates of the design were grown. Total DM yield of M AUS 10 increased with N application and a max. was reached at approx. 40-80 kg N/ha. No consistent response of total DM to N application was recorded for M AUS 7. Application of K increased total DM yield up to rates of 400 and 480 kg K/ha for M AUS 10 and 360-440 kg K/ha for M AUS 7. Max. yields were obtained for both cv. with a combination of low N (0-40 kg N/ha) and moderately high K (320-400 kg K/ha). *(Summary by F.G. Trans. by L.M.F.)* D01 D03

0227

10221 CADAVID, L.F.; CALVO, F.A.; HOWELER, R.H. 1977?. **La interacción de cal con fósforo y elementos menores en la producción de yuca (*Manihot esculenta*) en oxisoles de los Llanos Orientales de Colombia.** *(Interaction of lime with phosphorus and other minor elements in cassava production on Oxisols of the Colombian Llanos Orientales).* Cali, Colombia, Centro Internacional de Agricultura Tropical. 25p. Span., Sum. Span., 18 Refs., Illus.

Cassava. Field experiments. Fertilizers. Cultivars. Agricultural lime. P. B. Zn. Cu. Mo. Mn. Tuber productivity. Colombia.

Main objectives of the study were to incorporate high savanna lands into agricultural production and to analyze in detail the genetic differences in cassava regarding its tolerance to soil acidity and the interactions between applied lime, P, and minor elements. Five trials were carried out to study: (1) the response of cassava var. to applied lime; (2) the interaction between lime and minor elements; (3) the interaction between lime and P; (4) the effect of several rates, methods, and dates of P application. By using 4 levels of lime (0, 0.5, 2, and 6 t/ha), the tolerance of 134 cassava cv. to acidity was studied; a positive effect on yields was found at 0.5 t/ha. Some cv. responded up to 2 t lime/ha but above this rate, the effect was negative due to Zn deficiency. In the study on lime x P interaction, highest yields were obtained with 0.4 t lime/ha and applications of 50-100 kg P_2O_5/ha as triple super-

phosphate. With higher rates of lime, there was a negative effect on yield probably due to the deficiency of some minor elements. A positive response was observed with 0.5 t lime/ha and basal applications of P up to 200 kg P_2O_5/ha; there was no difference among applying in bands, broadcasting, or in hills at planting. A positive response was observed up to 2 t lime/ha in the interaction between lime and minor elements; yields decreased with increasing rates. When minor elements were applied, the response to applications of 20 kg Zn/ha, as SO_4Zn, was positive. The effect on yield was less with Cu, Mg, B, and Mo. *(Author's summary. Trans. by L.M.F.)* D01 D03

0228

13893 RIOS P., J.M. 1976. **Tentativa de determinación de los niveles críticos de los elementos menores: hierro, boro, zinc, cobre, y manganeso en el cultivo de la yuca (*Manihot esculenta*, Crantz), en las variedades MCol 22 y CMC 9.** [*Intent to determine the critical levels of minor elements (iron, boron, zinc, copper, and manganese) in the cultivation of cassava varieties MCol 22 and CMC 9*)]. Tesis Ing. Agr. Palmira, Universidad Nacional de Colombia. Facultad de Ciencias Agropecuarias. 87p. Span., Sum. Span., Engl., 21 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Nutrient solution. Mineral deficiencies. Fe. B. Zn. Cu. Mn. Nutritional requirements. Colombia.

The levels of minor elements (Fe, B, Zn, Cu, and Mn) of cassava var. MCol 22 and CMC 9 were determined under greenhouse conditions at the Centro Internacional de Agricultura Tropical, Palmira (Colombia). A split plot exptl. design was used for each of the minor elements with 9 levels and 3 replications. Var. MCol 22 was planted during the 2nd semester of 1974 and CMC 9 during the 1st semester of 1975. For var. MCol 22 only the av. content among the 9 levels of each one of the minor elements in young leaves 4 mo. after planting were registered. These averaged 245.3, 46.42, 42.0, 5.24, and 215.2 ppm for Fe, B, Zn, Cu, and Mn, resp. Var. CMC 9 did not respond to Fe applied at 9 levels, averaging 150.6 ppm in young leaves 3 mo. after planting. Critical levels of deficiency in var. CMC 9 at the age of 3 mo. were as follows: 30, 59, 4.2, and 86 ppm for B, Zn, Cu, and Mn, resp. Critical levels of toxicity for the same var. were 54, 72, 6.1, and 167 ppm, resp. *(Author's summary)* D01

0229

17187 AGBIM, N.N 1981. **Potentials of cassava peels as a soil amendment. I. Corn growth.** Journal of Environmental Quality 10(1):27-30. Engl., Sum. Engl., 17 Refs., Illus.

Cassava. Laboratory experiments. Cortex. Uses. Nigeria.

In a greenhouse study on maize to assess the potentials of cassava peels (CP) as a soil amendment, the peels were mixed with cattle dung (D) in different proportions and applied at rates up to 200 MT/ha to 4 kg of potted soil. N, P, K, and Mg fertilizers (F) were added as a variable. The higher the rate of the CP + D mixture and the more the proportion of D in the mixture, the greater the yield for the 1st crop except that CP + D + F treatments did not increase yield when applied at > 150 MT/ha. Mixtures without F containing 50% CP or above, and CP with F ≥ 100 MT/ha, gave higher yields with the 2nd cropping. This suggests that preplant incubation beyond the 3 wk. used was desirable to obtain greater N mineralization during the 1st cropping. Over the 2 cropping periods, increasing rates of CP increased yields from 29 to 244% of the control, thus showing the value of CP as a soil amendment. Moreover, CP + F was generally as effective as CP + D and D + F combinations. This obviates the necessity for D which is relatively scarce in W. Africa. The CP + D mixtures enhanced fertilizer efficiency with the 1st cropping. *(Author's summary)* D01

0230

13636 NAIR, G.M.; MOHAN KUMAR, C.R.; NAIR, B.G. 1980. **Response of cassava to sodium chloride (common salt).** Journal of Root Crops 6(1/2):55-56. Engl., 4 Refs.

Cassava. Field experiments. Fertilizers. N. P. K. Dung. Na. Tuber productivity. HCN content. Starch content. Philippines.

During 1975-76, the response of cassava to the application of NaCl was studied at the Central Tuber Crops Research Institute (CTCRI), Trivandrum, India. Five combinations of manure were assessed in a randomized block design with 3 replications: (1) FYM + NPK; (2) FYM + NP + 1/2K; (3) FYM + NP; (4) NPK; and (5) no FYM and 3 levels of NaCl at 200, 400, a 1 600 kg/ha along with a control (FYM + NPK alone). FYM and NPK were applied at rates of 12.5 t/ha and 100:100:100 kg/ha, resp. Analysis of tuber yield data showed that the combination FYM + NPK was significantly superior to the other treatments. However, the treatment combination FYM + NPK + 200 kg NaCl/ha recorded max. tuber yield (24.9 t/ha) which was at par with the control (22.7 t/ha). Among the different levels of sodium chloride no differences in yield were observed. HCN content in tubers was found to be significantly higher in FYM + NP (138 μg/g) in comparison with the treatment with no FYM (77 μg/g). The different levels of NaCl did not affect HCN content. Starch content in tubers was not affected by different manures or levels of NaCl. It is suggested that NaCl application does not increase yield nor does it improve tuber quality. *(Summary by F.G. Trans. by L.M.F.)* D01 C03

0231

13401 VILELA, E. DE A. 1978. **O clima na cultura da mandioca. IX. Cultura da mandioca.** *(Climate in cassava cultivation. IX. Cassava cultivation).* Lavras-MG, Brasil, Escola Superior de Agricultura de Lavras. 27p. Port., 21 Refs., Illus.

Paper presented at Curso de Capacitação de Técnicos para a Cultura da Mandioca. Convenio: INT - FUNAT/FAEPE.

Cassava. Temperature. Water requirements (plant). Adaptation. Planting. Spacing. Brazil.

Based on studies on heat (av. temp., solar radiation, and potential evapotranspiration) and water factors (rainfall and RH) of the climate that affect cassava adaptation, the municipalities of Guarabira (PB), Cruz das Almas (BA), Curvelo (MG), and Taquarí (RS), Brazil, were selected to verify if these zones are apt for cassava cultivation according to a classification of Brazilian regions for aptitude to cassava and if planting times recommended for these localities coincide with appropriate heat and water conditions. It was concluded that without irrigation, ideal planting time in the resp. regions are March-June, April-July, Oct.-Dec., and August-Oct. Thermal conditions of Guarabira and Cruz das Almas allow cassava to be planted throughout the year if irrigation is available. In Curvelo and Taquari the plant tends to detain its physiological activity in May-August due to low temp. as well as in Guarabira and Cruz das Almas in Sept.-Jan. due to water shortage. The 4 localities are apt for cassava cultivation but in Taquarí, early-maturing var. are required. *(Summary by A.J. C. Trans. by L.M.F.)* D01 D02

See also 0203 0204 0205 0206 0207 0208 0210 0212 0214 0248 0265 0313 0354

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

0232

14675 INSTITUTO COLOMBIANO AGROPECUARIO. 1980. **Como cultivar yuca.** *(How to cultivate cassava).* Bogotá, Colombia. Serie Cartilla Campesina no. 7. 10p. Span., Illus.

Cassava. Cultivation. Colombia.

This handbook for farmers briefly describes the most appropriate way to cultivate cassava. *(Summary by F.G. Trans. by L.M.F.)* D02

0233

15099 MONDARDO, E.; MORAES, O. DE 1981. **Rentabilidade de cultura da mandioca de um e dois ciclos no Sul de Santa Catarina.** *(Profitability of cassava cultivation for one and two seasons in southern Santa Catarina).* Florianópolis-SC Brasil, Empresa Catarinense de Pesquisa Agropecuária. Comunicado Técnico no. 4⁴. 9p. Port., 4 Refs.

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

An expt. was conducted at the Urussanga Exptl. Station of the Empresa Catarinense de Pesquisa Agropecuária to determine the profitability of cassava cultivation for 1 and 2 seasons in southern Santa Catarina (Brazil). Cv. Mico and Mandim Branca were used on an exptl. area with 1000 m^2 for each cv.; half of each plot (500 m^2) was harvested after 1 season (10 mo.) and the other half was pruned at 10 mo. and the branches stored. Roots were not harvested until May-July of the following yr. It was concluded that under the conditions of the southern region of the state, cassava cultivation for 2 seasons was more economical (production and prices were higher and costs were lower) than for 1 season. However, this does not mean that the farmer should wait until cassava completes both seasons to sell it. *(Summary by F.G. Trans. by L.M.F.)* D02

0234

15775 CARDOSO, E.M.R.; ALBUQUERQUE, M. DE; FERNANDES, A.A.C. 1980. **Efeito da época de plantio e de colheita sobre o rendimento da mandioca.** *(Effect of planting and harvest time on cassava yield). In* Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Relatório Técnico Anual 1979. Brasilia. pp.57-58. Port.

Cassava. Field experiments. Planting. Timing. Harvesting. Tuber productivity. Brazil.

A study on 4 planting times (March, June, Sept., and Dec.) and 3 harvest times (12, 15, and 18 mo. after planting) of cassava conducted at the Matapí Farm Colony, Federal Territory of Amapá (Brazil) is reported. Partial results showed a 50% increase in yield with the June planting (15,333 kg/ha) in comparison with that of March (7333 kg/ha) when harvesting took place 12 mo. after planting. The increase in the 2nd harvest time was less than 1 t in comparison with the 1st harvest. *(Summary by F.G. Trans. by L.M.F.)* D02

0235

17147 CASSAVA HARVESTER for 69-90hp tractors: a big leap forward. 1981. World Crops 33(4):IV. Engl.. Illus.

Cassava. Mechanization. Planting. Harvesting. Agricultural equipment.

A brief technical description of the Agri-Projects International (API) cassava harvester and planter is given. *(Summary by Abstracts on Tropical Agriculture)* D02

0236

15774 CARDOSO, E.M.R.; ALBUQUERQUE, M. DE; FERNANDES, A.A.C. 1980. Práticas culturais com mandioca na Região Amazônica. *(Cassava cultural practices in the Amazonian region). In* Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Relatório Técnico Anual 1979. Brasilia. p.57. Port.

Cassava. Field experiments. Planting. Spacing. Tuber productivity. Brazil.

An expt. with 2 replications conducted at the Matapí Farm Colony, Federal Territory of Amapá (Brazil) to study different spacings (100 x 120, 100 x 100, 100 x 80, and 100 x 60 cm) in cassava cv. Marapanim is reported. The best treatment was the 100 x 80 cm spacing with an av. yield of 8611 kg/ha. *(Summary by F.G. Trans. by L.M.F.)* D02

0237

16526 MACEDO, M.M.C.; SOUZA, J. DA S.; CERQUEIRA, J.H.A. DE; MACEDO, J.D. DE 1981. Avaliação de sistema de produção de mandioca. *(Evaluation of the cassava production systems).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em andamento no. 16. 2p. Port., 1 Ref.

Cassava. Cultivation. Technology evaluation. Brazil.

An expt. evaluating Sistemas de Produção para Mandioca (Cassava Production Systems) was established in the locality of Tapera, municipality of Sapeaçú, Bahia (Brazil) in order to study the technocconomical characteristics of these systems as well as the introduction of several technologies that are adjusted to the current process of cassava production in the region. Planting in double rows was highlighted as a technological innovation. *(Summary by F.G. Trans. by L.M.F.)* D02

0238

17146 PAYNE, P.C.J. 1981. Field mechanisation of cassava. World Crops 33(4): 76. Engl., Illus.

Cassava. Harvesting. Planting. Mechanization. Agricultural equipment.

The development of the Agri-Projects International (API) cassava harvester and planter is briefly discussed. *(Summary by Abstracts on Tropical Agriculture)* D02

0239

16537 MACEDO, M.C.M.; MATTOS, P.L.P. DE 1980. Normaniva: um implemento simples e eficiente para o preparo de manivas-semente de mandioca a baixo custo. *(Normaniva: a simple and efficient implement for preparing cassava cuttings at low costs).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado técnico no. 06. 10p. Port., Illus.

Cassava. Cuttings. Propagation materials. Agricultural equipment. Mechanization. Brazil.

A simple and efficient implement, fabricated by the Centro Nacional de Pesquisa de Man-

dioca e Fruticultura (CNPMF), Cruz das Almas, Bahia, Brazil for preparing low-cost propagation material is described in detail. It is recommended for plantings > 15 ha/yr. The characteristics of the material used, the diagram for its fabrication, and precautions are included. *(Summary by F.G. Trans. by L.M.F.)* D02 I02

0240

17168 TERNES, M. 1981?. Métodos de armazenamento de ramas. *(Methods for storing branches).* Florianópolis, Brasil, Empresa de Pesquisa Agropecuária Santa Catarina. Estação Experimental de Itajaí. 10p. Port., 4 Refs., Illus.

Paper presented at Curso Intensivo para a Capacitação Técnica na Cultura da Mandioca para a Região Sul Brasileira, 1o., 1981?.

Cassava. Storage. Cuttings. Temperature. Brazil.

Four methods of storing branches, that can be used depending on the intensity of min. temp. during the rainy season, are described: in tunnels, in furrows, underneath trees, and unprotected in the field. Tunnels consist of pits dug in high places, preferably constructed on a slope exposed to the sun to mitigate the low temp. during the rainy season. They may be covered with straw or tiles. Diagrams are included on their construction. *(Summary by F.G. Trans. by L.M.F.)* D02

0241

17169 CATAÑO A., H.O.; PEREZ F., C.A. 1982. Evaluación de tres sistemas de preparación de suelo en cuatro materiales de yuca (*Manihot esculenta* Crantz). *(Evaluation of three land preparation systems on four cassava cultivars).* Tesis Ing. Agr. Palmira, Universidad Nacional de Colombia. Facultad de Ciencias Agropecuarias. 157p. Span., Sum. Span., Engl., 54 Refs., Illus.

Cassava. Field experiments. Cultivars. Land preparation. Soil physical properties. Tuber productivity. Energy productivity. Colombia.

An expt. was conducted at the Centro Internacional de Agricultura Tropical, CIAT, Palmira, Colombia, in order to: (1) compare the effect of 3 different land preparation systems on production and productivity of cassava as well as the effect on physical properties of the soil (bulk density, total porosity ratio, water retention, and soil penetration resistance) and (2) compare the energy balance in cassava production (input-output energy) for each treatment. The systems studied were: (1) high tillage level (T_1), use of a disc plow at 30 cm, use of a heavy harrow twice at 15-30 cm, use of a light disc harrow, and ridges at 1 m distance and 0.30 m height; (2) medium tillage level (T_2), use of a chisel plow at 40 cm, use of a heavy disc harrow at 15-20 cm, ridges at a distance of 1 m and 0.30 m in height; and (3) low tillage level (T_3), ridges at a distance of 1 m and 0.30 m in height. A split plot exptl. design was used with 8 replications. Four cassava cv. were evaluated: HMC-1, M Col 1684, CM 489-1, and CM 321-188. The systems of land preparation were located on the main plots, and cassava cv. on the subplots. The highest yield was 34.74 t/ha with T_2 followed by 31.77 t/ha with T_1 and 31.08 t/ha with T_3. It is concluded that T_2 was the best alternative for cassava; however, T_3 gave the best energy efficiency ratio. *(Author's summary)* D02

0242

17164 EMPRESA BRASILEIRA DE ASSISTÊNCIA TECNICA E EXTENSÃO RURAL. 1980. Sistemas de produção para a cultura da mandioca; Curvelo. *(Cassava production systems).* Curvelo-MG, Brasil. Série Sistemas de Produção. Boletim no. 262. 23p. Port.

Cassava. Technological package. Land preparation. Planting. Fertilizers. Pest control. Disease control. Weeding. Harvesting. Brazil.

Two technological packages of large- and small -scale cassava production are given for Lato-

sols under Cerrado conditions, particularly those located in the area surrounding the alcohol plant in Curvelo, Minas Gerais, Brazil. The operations comprising each system are listed and technical recommendations are included on land preparation, selection of planting material, planting, var., planting time and density, fertilization, weed, pest, and disease control, harvesting, and transportation. The technical coefficients for each system are given. *(Summary by F.G. Trans. by L.M.F.)* D02

0243

14133 CONCEIÇÃO, A.J. DA 1977. **Efeito de épocas de plantio x cultivares médias e tardias x épocas de colheita na produção da raízes de mandioca,** *Manihot esculenta* Crantz. *(Effect of planting times x semi-precocious and late-maturing cultivars x harvest times on cassava root production). In* Universidade Federal da Bahia. Escola de Agronomia. Informe científico anual. Cruz das Almas-BA, Brasil. pp.73-75. Port.

Cassava. Field experiments. Cultivars. Planting. Timing. Harvesting. Tuber productivity. Brazil.

An expt. was conducted as part of the U. Federal da Bahia/BRASCAN NORDESTE agreement to study the joint effects of planting times, semi-precocious and late-maturing cv., and harvest times of cassava to guarantee the availability of industrial raw material between April-Dec. A 3^3 factorial exptl. design was used following the chronogram: planting time (April 15, May 15, and June 15 for treatments 0, 1, and 2, resp.); cv. (Cigana, Sutinga, and Salangor Preta); harvesting took place 12, 15, and 18 mo. after planting. Significant differences were found at a level of 5% for the effect of cv. and, at a 1% confidence level, for the interaction planting times x harvest times. Cv. Salangor Preta had the highest av. root production (28.33 t/ha). It was confirmed that the production of the 3 cv. was affected by planting time. Fiber and DM contents ranged from 80.90-86.69 and 1.72-2.80%, resp. *(Summary by F.G. Trans. by L.M.F.)* D02 G01

0244

17107 LEIHNER, D.E.; DOMINGUEZ, J.; KANO, Y.; LOPEZ, J. 1979. **Recomendaciones para el uso del nuevo herbicida pre-emergente "GOAL" en yuca.** *(Recommendations on the use of the new preemergence herbicide GOAL in cassava). In* Kano, Y. Cassava breeding and cassava cultural practice. Cali, Colombia, Centro Internacional de Agricultura Tropical. 11p. Span., Illus.

Cassava. Research. Herbicides. Tuber productivity. Colombia.

Observations and recommendations on the use of the herbicide oxyfluorfen are included on the basis of research conducted at the Centro Internacional de Agricultura Tropical (CIAT) on its efficiency in selective weed control in cassava, effect on yield, rates of application, and possible combinations with other products. *(Summary by F.G. Trans. by L.M.F.)* D02

0245

16154 KEATING, B.A.; EVENSON, J.P. 1981. **Effects of stem cutting length and orientation on subsequent growth and development.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.34-36. Engl., 8 Refs.

Cassava. Field experiments. Cuttings. Planting. Growth. Tuber productivity. Australia.

An expt. was conducted at the U. of Queensland Research Station, Redland Bay, Australia to determine the effect of cassava stem cutting length and orientation on subsequent growth and development. A randomized complete block exptl. design was used with 4 blocks, each consisting of 2 cutting lengths (40 and 20 cm) and 3 cutting orientations (vertical, oblique, and horizontal) of cv. M AUS 10. Each plot included 3 sample plants. The expt. revealed few differences in the growth and development of cassava cv. M AUS 10. *(Summary by F.G. Trans. by L.M.F.)* D02 C01

0246

15080 MOODY, K. 1979. **Weed control in root crops in the tropics: cassava.** Philippine Journal of Weed Science 6:81, 83-87, 93-97, 99-100. Engl., 73 Refs.

Cassava. Research. Weeds. Weeding. Herbicides.

A literature review is given of the research that has been conducted in the tropics on weed control in cassava. *(Summary by F.G. Trans. by L.M.F.)* D02

0247

16169 MAQUINARIA PARA mandioca. *(Machinery for cassava).* 1981. Agricultura de las Américas 30(8):34-35. Span., Illus.

Cassava. Agricultural equipment. Mechanization. Planting. Harvesting.

A mechanized system for cassava cultivation, developed by an English company, is briefly described. It consists of a cassava planter and harvester, both available separately. *(Summary by F.G. Trans. by L.M.F.)* D02

0248

17106 KANO, Y.; LEIHNER, D.E. 1978. **Optimum dosage of a new preemergence herbicide oxifluorfen (Commercial name GOAL) on the cassava planted in different soil types.** *In*____. Cassava breeding and cassava cultural practice. Cali, Colombia, Centro Internacional de Agricultura Tropical. 21p. Engl., Illus.

Cassava. Field experiments. Soil physical properties. Herbicides. Growth. Mineral deficiencies. Colombia.

The main objectives of this expt. were to study the optimum dosage of the preemergence herbicide, oxyfluorfen, on different soil types by evaluating the chemical injury on cassava leaves; investigate the relationship between the ϕ of the cutting and the initial growth; analyze aspects of mineral nutrition of N-deficient plants; and obtain general information about the effect of urea leaf application to these plants. Injury by the herbicide increased with increasing application of oxyfluorfen; as soil content increased and clay content decreased, herbicide damage increased. These was no correlation of the ϕ of the cutting to the germination rate or plant height. Fifty days after planting, the upper leaves of some plants showed N deficiency. Leaf application of 1 and 2% urea caused damage at the same degree of severity. *(Summary by F.G. Trans. by L.M.F.)* D02 D01 C01

0249

17152 FEDERACION NACIONAL DE CAFETEROS DE COLOMBIA. PROGRAMA DE DESARROLLO Y DIVERSIFICACION DE ZONAS CAFETERAS. 1981. **Yuca; requerimiento promedio de mano de obra y otros insumos por hectárea por año.** *(Cassava: average labor demand and other inputs per hectare per year).* *In*____. Costos, ingresos y rentabilidad para productos de diversificación. Bogotá. pp.52-54. Span.

Cassava. Cultivation. Costs. Income. Colombia.

Tables are included on the av. labor demand, inputs (propagation materials, fertilizers, insecticides, tools, and packing), costs, and income/ha/yr for cassava cultivation in coffee-growing areas of Colombia. *(Summary by F.G. Trans. by L.M.F.)* D02 J00

0250

16157 KEATING, B.A.; EVENSON, J.P. 1981. **Effects of planting density on growth and yield of M AUS 10 and M AUS 7.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.39-41. Engl.

Cassava. Field experiments. Cultivars. Planting. Spacing. Growth. Tuber productivity. Australia.

The effects of planting density on total DM production and distribution to storage roots were investigated over a 2 yr period (1975-77) at the U. of Queensland Research Station, Redland Bay, Australia. A random complete block exptl. design with 3 blocks was used with 2 harvests at 3 planting densities (5000, 10,000, and 20,000 plants/ha). Four plant samples were taken per plot. Harvests were 224 and 514 days after planting. Cv. M AUS 10 showed a plateau-type yield-density response curve over the 5000-20,000 plants/ha range. The density 10,000 plants/ha is optimum in terms of storage root yield and conservation of planting material under the cultural conditions used in this expt. *(Summary by F.G. Trans. by L.M.F.)* D02 D03

0251

10990 MACHADO, E.L. 1979. **Estudo sobre o número de gemas e época do preparo de manivas de mandioca.** *(Number of buds and time of preparation of cassava cuttings). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.209-224. Port., Sum. Port., Engl., 9 Refs.

Cassava. Propagation. Field experiments. Cuttings. Brazil.

Five expt. were conducted at the former Estaçao Exptl. de Mandioca, Vila Azevedo, RS (Brazil) combining 3 factors: the no. of buds; the age of the mother plant (1st or 2nd cycle), and the time of preparation (the day before or the same day of planting). Cuttings with 4, 8, 12, 16, 20, 24, or 28 buds were planted using a randomized block design. The % of harvested plants increased with the no. of buds; 12-bud cuttings gave the highest production. Cuttings prepared the day before were slightly superior and plants taken from mother plants during the 1st agricultural cycle gave higher production. *(Author's summary)* D02

0252

10741 FERRAZ, E.B.; BURITY, H.A.; LYRA FILHO, H.P.; BESSA, J.M.G.; SILVA, A.D.A. DA 1979. **Efeito do espaçamento sobre a produção no Município de Feira Nova-PE.** *(Effect of spacing on cassava yield in the municipality of Feira Nova-PE). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.137-147. Port., Sum. Port., Engl., 13 Refs., Illus.

Cassava. Field experiments. Cultivars. Planting. Spacing. Tuber productivity. Starch content. Brazil.

A trial was carried out on a Yellow Red Podzolic soil of the municipality of Feira Nova, PE (Brazil) to test 3 cassava cv. (Verdinha, Roxinha, and Pacaru) at 6 different spacings (1.00 x 0.70, 1.00 x 0.60, 1.00 x 0.50, 1.00 x 0.70 x 0.70, 1.00 x 0.70 x 0.60, 1.00 x 0.70 x 0.50 m). Cv. Verdinha had the highest root yield for all the spacings tested. Cv. Roxinha showed a higher starch content than the others. The spacings did not influence root and cutting yields, wt. of foliage, and % of starch. Cv. showing higher root yield, produced a lower no. of cuttings for planting. *(Author's summary)* D02 D03

0253

13877 KHELIKUZZAMAN, M.H. 1982. **Effects of plant population in cassava (*Manihot esculenta* Crantz) as influenced by planting methods.** Mag. Sc. Thesis. Serdang, Selangor, Universiti Pertanian Malaysia. 98p. Engl., Sum. Engl., 77 Refs., Illus.

Cassava. Field experiments. Planting. Spacing. Cuttings. Cultivars. Tuber productivity. Starch content. Tuber development. Colombia.

The effects of two planting methods (20-cm cuttings planted horizontally and 60-cm cuttings planted vertically) and plant populations ranging from 5000-40,000 plants/ha on the performance of 2 cassava var. were studied. The relationships of yield and yield components with plant populations were examined by fitting linear and quadratic regression equations to each planting method and var. In both var. horizontal planting yielded significantly better than vertical planting in terms of root and starch yields. The increase in root yield with var. MVen 119 was due to the increase in total root no. and in HI. In var. MCol 673 the increase in root yield was attributed mainly to the inerease in HI and the decrease in shoot no. Var. MVen 119 outyielded MCol 673 but there was no difference in starch yields between the 2 var. However, var. MCol 673 is favored because of its higher starch content. Root yield declined with increasing plant population, being highest for the lowest population tested in the study. Yield reduction at high plant populations was generally attributed to the excessive production of shoots as well as to the decrease in mean root wt. and length. Root no. was enhanced by horizontal planting and it also showed an increasing trend with plant populations which had been ascertained to be quadratic. Mean root length and wt., and starch content differed between var. but not between planting methods. Both var. and planting methods did not show any significant effects on mean root Ø. Generally, high plant populations affected root development, decreasing root length and Ø, mean root wt., and starch content. HI was greater in horizontal planting than in vertical planting while plant height was not markedly affected by the planting methods. The response pattern between plant population and HI, shoot no. and plant height, showed that HI declined as population increased, while shoot no. and plant height were enhanced. *(Author's summary)* D02 D03

0254

10569 MATTOS, P.L.P. DE; ALMEIDA, P.A. DE; CARVALHO, J.E.B. DE; CALDAS, R.C. 1979. Conservação de ramas de mandioca (*Manihot esculenta* Crantz) para plantio. *(Cassava stem conservation before planting). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.45-54. Port., Sum. Port., Engl., 5 Refs.

Cassava. Stems. Storage. Germination. Productivity. Propagation materials. Brazil.

An expt. was carried out in Cruz das Almas, Bahia (Brazil) to determine the effects of different types of cassava stem conservation on germination and productivity. A randomized block design was used with 4 treatments and time spans of 6, 4, and 2 mo. Stems were buried in a vertical position 10 cm in depth, either in the shade or in the open field, or they were placed horizontally on a wooden platform in the shade or in the open field protected with straw. Cassava productivity was not affected by the vertical or horizontal position or by the place of storage. The duration of storage is more relevant to productivity than the types of conservation. *(Author's summary)* D02

0255

10534 MATTOS, P.L.P. DE; SOUZA, L. DA S.; CALDAS, R.C.; PORTO, M.C.M. 1979. Adaptação de espaçamentos em fileiras duplas para a cultura da mandioca (*Manihot esculenta* Crantz). *(Double row planting systems for cassava). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.19-34. Port., Sum. Port., Engl., 13 Refs., Illus.

Cassava. Field experiments. Planting. Spacing. Cultivars. Tuber productivity. Foliage. Brazil.

Expt. were conducted on cassava planting in double rows during the 1977/78 and the 1978/79 crop yr at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, Bahia (Brazil). Cv. BGM-001 and BGM-116 were used in a randomized block design with split plots. Advantages of this system are discussed: other crops may be planted between the double rows; mechanical weeding is facilitated; labor costs are reduced; conditions for field inspection and chemical application are improved; the time required for soil preparation is

reduced by 75% ; and yields are higher than for conventional cassava cropping systems. Best spacing was 2.0 x 0.6 x 0.6 m. Branch and stem production decreased, and the no. of roots/ plant increased as the spacing between rows increased. *(Author's summary)* D02 D03

0256

10546 MATTOS, P.L.P. DE; PORTO, M.C.M.; CALDAS, R.C.; MUNIZ, J.O.L. 1979. **Influência do comprimento x diâmetro da maniva-semente sobre a produtividade de raíces em três cultivares de mandioca (*Manihot esculenta* Crantz).** *(Influence of the length and diameter of cuttings on root productivity in three cassava cultivars). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.35-43. Port., Sum. Port., Engl., 2 Refs.

Cassava. Field experiments. Cultivars. Cuttings. Tuber productivity. Brazil.

An expt. was conducted at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, Bahia (Brazil) to study the influence of cassava cutting length and ϕ of 3 cv. (BGM-0001, early maturing; BGM-0116, semi-precocious; and BGM-0072, late maturing). A randomized block design with split plots was used. It was concluded that cuttings with 1.5 cm in ϕ can be used without affecting cassava germination and productivity, but this ϕ should be compensated by using a greater cutting length. *(Author's summary)* D02

0257

10490 BADHUKUL, R.; TORO, J.C. 1977?. **A study of the growth characteristics of cassava by rapid propagation method.** Cali, Colombia, Centro Internacional de Agricultura Tropical. 30p. Engl., 13 Refs., Illus.

Cassava. Cuttings. Propagation. Shoots. Germination. Planting. Cultivars. Colombia.

Three expt. on cassava were conducted at the Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia to study (1) shoot production on 2-node cuttings with different planting positions and the qualities of buds; (2) shoot production of 2-node cuttings of 2 cassava var. taken from 3 parts of the stem; and (3) effects of shoot sizes on 2 cassava var. grown in flasks and then in the field. The quality and planting position of the cutting affected germination and shoot production; although 2-node cuttings taken from different var. gave different % of germination, it was shown that the % of germination of the cuttings taken from different parts of the stems of the s var. were not significantly different. The 5 cm-shoot production in propagation fra or 5 mo. was greater than the 25 cm-shoot production. *(Summary by F.G. Trans. by [illegible])* D02 C01

0258

13437 LEHNER, D.E.; LOPEZ M., J. 1980. **Pérdidas en el rendimiento y la calidad de la yuca (*Manihot esculenta* Crantz) causadas por coquito (*Cyperus rotundus* L.).** *[Losses in cassava yield and quality caused by purple nutsedge (Cyperus rotundus)]*. Revista Comalfi 7(3/4):21-29. Span., Sum. Span., 10 Refs., Illus.

Cassava. Field experiments. Weeds. Tuber development. Tuber productivity. Colombia.

The type and magnitude of losses in cassava caused by *Cyperus rotundus* were determined. Two field expt. were conducted at Instituto Colombiano Agropecuario-Caribia exptl. station, Magdalena (Colombia) at 35 m.a.s.l. The location has an annual mean temp. of 28°C, mean annual precipitation is 1350 mm, and the soil is a sandy loam with intermediate fertility. Cassava cv. M Col 22 was planted on ridges at 1 x 1 m in plots with heavy *C. rotundus* infestation and free of purple nutsedge. Loss in fresh tuber yield caused by *C. rotundus* was 17%. This significant reduction of yield was mainly due to competition for water and nutrients whereas competition for light appeared to be minimal. Yield reduction was a consequence of a reduction in the no. of thickened roots while root size was not affected. There was also a small but nonsignificant reduction in the starch concn. of the roots. The relatively moderate yield and quality reduction in cassava as compared with other crops is

probably explained by the small influence that *C. rotundus* has on the growth of cassava roots, a long vegetative cycle, and the absence of a critical period for yield formation. Economic implications of these findings are discussed; in cassava, good agronomic practices and cultural control methods should have prevalence over repeated applications of costly chemicals. *(Author's summary)* D02

0259

13474 ELLIS, R.H.; HONG, T.D.; ROBERTS, E.H. 1982. **An investigation of the influence of constant and alternating temperature on the germination of cassava seed using a two-dimensional temperature gradient plate.** Annals of Botany 49:241-246. Engl., Sum. Engl., 5 Refs., Illus.

Cassava. Research. Germination. Temperatures. Seed.

The germination of cassava seed in response to various constant and alternating temp. regimes within the range 19-40°C was investigated using a 2 dimensional temp. gradient plate. Almost all seeds were incapable of germination unless temp. for part of the day exceeded 30°C and the mean temp. was at least 24°C. However, dormant seeds required environments where the temp. for part of the day exceeded 36°C, the mean temp. was at least 33°C, and the amplitude of the diurnal temp. alteration was within the range 3-18°C. Providing these conditions were met. the times spent at the upper and lower temp. within a diurnal cycle were not critical. Hermetic storage of the seed for 77 days at 40°C with 7.9% MC did not influence the pattern of germination in response to constant and alternating temp. It is suggested that an alternating temp. regime of 30°C for 8 h/38°C for 16 h applied for a min. of 21 days is appropriate for cassava seed viability tests. *(Author's summary)* D02 C01

0260

10916 NORMANHA, E.S.; LORENZI, J.O.; MONTEIRO, D.A.; PEREIRA, A.S.; RICCI JUNIOR, A. 1979. **Armazenamento de ramas de mandioca para plantio.** *(Storage of cassava stems for planting). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.171-177. Port., Sum. Port.,Engl., 2 Refs.

Cassava. Storage. Stems. Propagation materials. Brazil.

Five expt. were carried out to compare different methods of storing cassava stems for planting for a period of 4-5 mo. under plateau conditions of the state of São Paulo, Brazil. The effect of the environment on bundles of cassava stems placed in the open field and in the shade, both covered with corn straw, was studied in the 1st expt. The performance of the bundles of stems placed horizontally on the soil surface and vertically with stem bases buried 3 cm deep in previously prepared soil was studied. Fungicides were applied in all expt. The conservation of cassava stems for future planting is satisfactory when bundles are stored in the open and placed in a horizontal or vertical position and covered with straw. Fungicides were effective when bundles were placed horizontally, but unnecessary when stored vertically, probably because these stems rooted. *(Author's summary)* D02

0261

10722 CONÇEIÇÃO, A.J. DA 1979. **Influência da poda na cultura da mandioca (*Manihot esculenta* Crantz).** *(Effect of pruning on cassava yield). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.123-136. Port., Sum. Port., Engl., 10 Refs., Illus.

Cassava. Field experiments. Cultivars. Pruning. Tuber productivity. Harvesting. Timing. Brazil.

The effect of pruning on cassava yield was studied at the U. Federal da Bahia, Cruz das Almas, BA, Brazil during the 1971/75 crop yr. A random block exptl. design with split plots was used. Regional cv. Platina, Cigana, Sutinga, and Graveto were planted in the main plots and the subplots were given 3 treatments: (1) harvesting at 12 mo.; (2) pruning at 12 mo. and harvesting at 18 mo.; and (3) harvesting at 18 mo. without pruning. No significant differences in av. root yields among cv. Cigana (26.48 t/ha), Sutinga (22.47 t/ha), and Graveto (22.21 t/ha) were observed. Cv. Cigana showed a higher yield than Platina (21.57 t/ha) at a 5% level of probability. The effect of pruning was nonsignificant; therefore, the av. yield variability in the subplots may be only fortuitous. Disadvantages of pruning are also discussed. *(Author's summary)* D02

0262

10703 PORTO, M.C.M.; CARVALHO, J.E.B. DE; MATTOS, P.L.P. DE; MACEDO, M.C.M. 1979. **Influência da parte da haste na propagação rápida da mandioca.** *(Influence of stem part on the rapid propagation method of cassava). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.75-83. Port., Sum. Port., Engl., 7 Refs.

Cassava. Stems. Cuttings. Germination. Propagation. Brazil.

The possibilities of using different parts (basal, middle, and apical) of the main stem of cassava cv. BGM-2 and BGM-116 to obtain vegetative material by the rapid propagation method were studied at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Bahia (Brazil). A randomized block design with split plots was used with 5 replications, with cv. on the main plot and the different parts of the stem on the subplots. The influence on germination % and on the no. of cuttings obtained was determined. Best results were obtained with the middle and basal cuttings, but even apical ones may be used instead of the traditional method. There was no significant difference between cv. regarding germination % and the no. of cuttings obtained. *(Author's summary)* D02

0263

16156 KEATING, B.A.; EVENSON, J.P. 1981. **Effects of stem cutting thickness on subsequent growth and development.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.31-33. Engl., 5 Refs.

Cassava. Cuttings. Growth. Plant development. Cultivars. Australia.

An expt. was conducted at the U. of Queensland Research Station, Redland Bay, Australia to determine some effects of the nature of planting material on subsequent growth and development to develop optimum agronomic systems. A randomized complete block exptl. design was used. Each of the 4 blocks consisted of 2 cv. (M AUS 7 and M AUS 10) and 3 ϕ sizes (large, medium, and small). Each plot consisted of 4 sample plants. Emergence was slightly delayed for the small cuttings but this was only significant for M AUS 10. The no. of stems produced was also reduced for the smaller size classes, this being significant for M AUS 10 only. Total and storage organ yields declined with decreasing size of planting material, but these effects were small and nonsignificant. *(Summary by F.G. Trans. by L. M.F.)* D02 C01

0264

10705 CARVALHO, J.E.B. DE; CALDAS, R.C.; MATTOS, P.L.P. DE; ALMEIDA, P.A. DE; CUNHA, H.M.P. DA 1979. **Competição de herbicidas no controle das plantas daninhas na cultura da mandioca.** *(Herbicide competition in weed control in cassava). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.85-95. Port., Sum. Port., Engl., 8 Refs.

Cassava. Field experiments. Herbicides. Weeding. Brazil.

Economical doses of some herbicides used in cassava cultivation were determined and their selectivity shown in an expt. conducted from 1976-77 at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, Bahia (Brazil). Herbicides tested were diuron, alachlor, and fluometuron (all of them in 3 doses), and mixtures of diuron + alachlor and alachlor + fluometuron. A randomized block design was used with 13 treatments and 4 replications. Alachlor alone had a poor residual effect; best results were obtained with diuron + alachlor (1.0 + 1.5 kg a.i./ha), fluometuron (3.0 kg a.i./ha), diuron (1.0 kg a.i./ha), alachlor + fluometuron (1.5 + 2.0 kg a.i./ha), and fluometuron (1.5 kg a.i./ha). *(Author's summary)* D02

0265

10472 BRAWIJAYA UNIVERSITY. FACULTY OF AGRICULTURE. 1979. **Summary of the research results of the cassava research project, Faculty of Agriculture Brawijaya University, in the periods of 1975-1978.** Agrivita 2(1):25-32. Engl.

Cassava. Research. Fertilizers. N. P. K. Mukibat system. Spacing. Planting. Propagation. Tuber productivity. Java.

The results obtained in the cassava research project, Faculty of Agriculture, Brawijaya U., Malang (Java) during 1975-78 are summarized. Evaluations were made of promising var.; the influence of plant population, harvest time, application of N, P, K fertilizers, and OM on yields of Mukibat cassava; comparison of yields of Mukibat cassava derived from the 1st graft with those from 2nd reused graft materials; relation between the length of the growth period and Mukibat yield and traditional systems; comparison of yields of different cassava var. at different harvest times; comparison of yields from Mukibat, Satrawi, and normal cassava; and the development of mite (*Tetranychus bimaculatus*) populations on Mukibat cassava. *(Summary by F.G. Trans. by L.M.F.)* D02 D01

0266

10570 PORTO, M.C.M.; MATTOS, P.L.P. DE 1979. **Influência do tamanho da maniva sobre o número de hastes, rendimento e características agronômicas da mandioca.** *(Influence of cutting size on the number of stems, yield, and agronomic characteristics of cassava). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.55-74. Port., Sum. Port., Engl., 6 Refs.

Cassava. Field experiments. Cuttings. Foliage. Tuber productivity. Agronomic characters. Cultivars. Brazil.

In order to study the influence of cutting size on the no. of stems, yield, and other agronomic characteristics of cassava, an expt. was conducted at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, Bahia (Brazil). A randomized block design with split plots was used with cv. BGM-03, BGM-02, and clone EAB-503 in the main plots and 10, 20, 30, and 40 cm-cuttings in the subplots. The cutting size affected the no. of stems/plant; evidence exists that 30 cm-cuttings gave higher root yields, although greater foliage growth was obtained with 40 cm-cuttings. *(Author's summary)* D02 C01 D03

0267

10981 MONTAGNER, W. 1979. **Hibernação das ramas de mandioca.** *(Cassava stem storage). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.179-187. Port., Sum. Port., Engl., 4 Refs.

Cassava. Storage. Cuttings. Propagation. Brazil.

Different storage methods were compared at the Estação Exptl. Fitotécnica de Taquari (Brazil) to determine the most efficient method of storing cassava during the rainy season. Stems

of cassava cv. R 18-Prata (toxic) were used in a randomized block design with 7 treatments and 8 replications. All the stems existing at the final evaluation, were tested for their capacity to sprout under field conditions. The most efficient treatment consisted of stems stored outdoors, arranged horizontally on the ground and covered with a thin layer of soil. Other efficient treatments were: stems stored outdoors, arranged horizontally on the ground and covered with rice straw, and stems stored outdoors, arranged horizontally in layers in shallow pits and covered with straw. *(Author's summary)* D02

0268

10710 SOUZA, L. DA S.; MATTOS, P.L.P. DE; CALDAS, R.C. 1979. **Efeito de sistema de preparo do solo reduzido na produção da mandioca, plantada em fileiras duplas.** *(Effects of minimum tillage on yields of cassava planted in double rows). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.97-103. Port., Sum. Port., Engl., 5 Refs.

Cassava. Cultivation. Tuber productivity. Shoots. Starch content. Plant height. Brazil.

The effects of 3 different tillage systems on cassava planted in double rows were compared in an expt. conducted at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, Bahia (Brazil). Min. tillage (limited to the area between double rows) was superior to conventional tillage (all over the area) regarding root, shoot, and starch yield, root no./plant, and the height of 6 and 12 mo.-old plants. A cost reduction of 75% was also noticed when the 1st method was employed. *(Author's summary)* D02 D03

0269

13424 RENGIFO S., C. 1982. **Cultivo de la yuca en la selva peruana.** *(Cassava cultivation in the Peruvian jungle region).* Tarapoto, Perú, Instituto Nacional de Investigación y Promoción Agropecuaria. Centro de Investigación y Promoción Agropecuaria. Manual no. 1. 24p. Span., 9 Refs., Illus.

Cassava. Cultivation. Peru.

A description is given of cassava cultivation in the Peruvian jungle region, where a low level of technology is used along with intercropping (mainly cassava-maize-beans). Edaphic and climatic aspects are highlighted as well as the yields and major characteristics of outstanding var. in the areas of Tarapoto (Arpón Rumo, Motelina, Auquina Amarilla, Rumo Maqui, IAC-7-127, and Híbrido 2), Yurimaguas (Motelo Rumo, Ricachina, and Amarilla), and Tingo María (Rumo Maqui, Negra and Umishina); agronomic aspects (planting systems, times, and densities; selection, preparation, and treatment of cuttings); cultural practices (weed control and fertilization); harvesting; and major pests and diseases in the region. *(Summary by F.G. Trans. by L.M.F.)* D02

0270

13380 ALVARENGA, E.G. DE 1978. **Preparo do solo para a cultura da mandioca.** *(Soil preparation for cassava cultivation).* Lavras-MG, Brasil, Escola Superior de Agricultura de Lavras. 85p. Port., 10 Refs., Illus.

Paper presented at Curso Intensivo para Capacitação de Técnicos e de-Mão-de Obra Especializada para a Cultura da Mandioca, Lavras, 1978.

Cassava. Land preparation. Agricultural equipment. Plowing. Planting. Mechanization. Brazil.

The factors that should be taken into account when preparing soil for cassava cultivation are described in detail along with the steps to follow and the alternate machinery required for this cultural practice. Soil preparation was divided into 2 types according to the type of vegetation existing on the land: (1) initial preparation, which should be made on virgen soil and (2) periodic preparation on soils already cleared. For type 1, the following aspects are

discussed in detail: land clearing, selection of equipment, utilization of timber, elimination of wastes, application of lime, subsoiling, deep plowing, erosion control measures, and final clearing. For type 2, the types of plows and their use, harrows, rotary plows, and subsoilers are described. Finally, semimechanized and mechanized planting are discussed. Machinery and procedures are illustrated. *(Summary by A.J.C. Trans. by L.M.F.)* D02

0271

10162 VICHUKIT, V.; TORO, J.C. 1975?. **The effects of propagation techniques on the yield of cassava.** Cali, Colombia, Centro Internacional de Agricultura Tropical. 27p. Engl., 12 Refs., Illus.

Cassava. Field experiments. Cuttings. Propagation. Harvesting. Timing. Tuber productivity. Colombia.

At the Centro Internacional de Agricultura Tropical, Cali, Colombia, 2 expt. in a randomized block design with 4 and 3 replications, resp. were carried out to determine if the rapid propagation techniques are comparable to propagation by cuttings after a similar period of growth. Cuttings from var. M Col 673 were used to evaluate 5 propagation techniques: (1) rooting in peat pots filled with clay loam soil for 18 days and subsequent transplanting to the field without removing the pots; (2) rooting in waxed paper cups filled with clay loam soil for 18 days and subsequent transplanting to the field after careful removal of cups; (3) rooting in flasks filled with distilled water for 18 days and transplanting when roots are 1 cm long; (4) rooting in flasks filled with distilled water for 8-10 days and transplanting at the callus formation stage; and (5) as control treatment, planting 20-cm long cuttings directly to the field. Twenty-five and 126 plants were planted for each treatment in expt. 1 and 2, resp. In expt. 1, 9 central plants were harvested at 10 mo. after planting; in expt. 2, 4 plants were harvested per month from alternate rows. Root fresh wt., total plant fresh wt., no. of total roots, and no. of thickened roots were determined. Significant differences were found at the 5% level between the total and thickened root no. per plant. In expt. 2, the yields of treatments 1, 3, and 4 increased progressively, while in treatments 2 and 5, max. yield was reached at 9 mo. It is concluded that the rapid propagation method provides a greater amount of planting material and higher yield. *(Summary by H.B.M. Trans. by L.M.F.)* D02 D03

See also 0231 0287 0354

D03 Energy Productivity and Yields

See also *0207 0213 0219 0220 0221 0222 0224 0226 0227 0250 0252 0253 0255 0266 0268 0271 0302 0305 0310 0313 0366*

D04 Postharvest Studies

0272

15778 LINNEMAN, A.R. 1981. **Preservation of certain tropical root and tuber crops.** Abstract on Tropical Agriculture 7(1):9-12, 18-20. Engl., 55 Refs.

Cassava. Tubers. Deterioration. Storage.

The preservation of cassava tubers was analyzed on the basis on the following aspects: nature of losses (primary and secondary); var. (resistant or not to loss); pruning before harvest; mechanical damage; curing (temp. 35°C, RH 80-85%); fungi identified as infecting cassava tubers and their control; storage methods (field clamps, crates, polyethylene bags); and the effect of storage on quality. It is concluded that good storage practices for cassava tubers are essential to reduce food losses and make more land available for other crops. Thiabendazole is recommended for the control of fungal growth. *(Summary by F.G. Trans. by L.M.F.)* D04

0273

15784 AIYER, R.S.; NAIR, P.G.; PREMA, L. 1978. **No-cost method for preserving fresh cassava roots.** Cassava Newsletter 4:8-9. Engl., 10 Refs.

Also in Spanish.

Cassava. Tubers. Storage. Deterioration. Post-harvest losses.

A method for preserving fresh cassava roots by using leaves of different plants and of cassava is described. In a storage trial high-quality roots of cassava cv. M-4, with no bruises and cuts, were used and placed in 10 kg lots of roots interlayered with cassava, jack (*Atrocarpus heterophyllus*), and mango (*Mangifera indica*) leaves in boxes. The lowest % of deterioration was observed for roots stored in cassava leaves. Cassava leaves not only gave an optimum temp. (35-40°C) and a RH of 85-90% for curing wounds, but were also observed to liberate HCN slowly as they dried. *(Summary by F.G. Trans. by L.M.F.)* D04

0274

13864 RICKARD, J.E. 1982. **Investigation into post-harvest behaviour of cassava roots and their response to wounding.** Ph.D. Thesis. London, Queen Elizabeth College. Department of Biology. 161p. Engl., Sum. Engl., 147 Refs., Illus.

Cassava. Tubers. Deterioration. Laboratory experiments. Post-harvest losses. Storage.

Light and electron microscope observations showed that the initial response to injury in cassava roots involves both occlusion of the xylem vessels and production of a highly fluorescent phenolic substance in the storage parenchyma. Tyloses and pigmented material originating in the xylem parenchyma cells were observed to enter the vessel lumens via the pit areas. A cytochemical study of the occlusions showed carbohydrates, lipids, and lignin-like material to be the major components. In the early stages of development, however, free phenols including leucoanthocyanidins and catechins, were detected in both the xylem vessels and adjacent parenchyma, and in the storage parenchyma cells. Biochemical analysis of the phenolic constituents showed many changes in the roots following injury, however,

the increased fluorescence was mainly due to scopoletin. The coloring of the occluding material in the xylem vessels was accompanied by increases in the activities of polyphenol oxidase and peroxidase and a decrease in free phenols. Some of the lignin-like responses were due to condensed tannins derived from leucoanthocyanidins and catechins. Roots stored at high humidity showed a typical wound response with the localized production of phenols and periderm formation. Wounds covered in a semipermeable film did not produce a periderm, yet contained the wound responses. These roots had a much longer storage life. *(Author's summary)* D04

0275

17190 RICKARD, J.E.; COURSEY, D.G. 1981. Cassava storage. I. Storage of fresh cassava roots. Tropical Science 23(1):1-32. Engl., Sum. Engl., Fr., Span., 98 Refs., Illus.

Cassava. Storage. Tubers. Deterioration. Post-harvest losses.

Major developments in both the scientific understanding of the deteriorative processes involved, especially in the case of fresh cassava roots, and in the evolution of practical storage techniques since 1972 are reviewed; much of this progress resulting from studies undertaken at the Tropical Products Institute (England) and the Centro Internacional de Agricultura Tropical (Colombia), either separately, or more frequently in collaboration. In view of the rapid growth of the subject, of the fuller search of literature, and the possibility of interpreting earlier observations in the light of recently acquired knowledge, previous reviews were revised completely and updated. *(Author's summary)* D04 I02

E00 PLANT PATHOLOGY

0276

16642 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **Pathology.** *In* ——. Cassava Program 1980. Annual Report. Cali, Colombia, CIAT Series no. 02ECI-80. pp.19-26. Engl., Illus.

Also in Spanish.

Cassava. *Xanthomonas manihotis. Sphaceloma manihoticola. Glomerella manihotis. Diplodia.* **Frog's skin. Etiology. Isolation. Deterioration. Colombia.**

The presence of diseases, changes in severity, and the performance of cassava clones in 5 different ecosystems were studied. A wide-type resistance to existing biotic problems and its durability in these ecosystems were investigated. The relationship between plant reaction to CBB (*Xanthomonas campestris* pv. *manihotis*) in the greenhouse and in the field, and its stability through several continuous cycles was investigated. The differences in the severity of CBB, superelongation [*Sphaceloma manihoticola (Elsinoe* sp.)], and anthracnose (*Glomerella manihotis*) in monoclonal and multiclonal plots at high and low inoculum levels were also examined. Root and stem rot caused by *Diplodia manihotis*, which could be synonymous with *Botryodiplodia manihoticola*, was identified. Confirmation of this synonymy awaits further taxonomic study. Studies on the characterization of the causal agent of the frog skin disease continued with emphasis on detection, transmission, and isolation. Furthermore, the variation encountered in the field within and among cv. regarding their susceptibility to deterioration was studied and the biochemical processes which lead to physiological deterioration were analyzed. *(Summary by I.B. Trans. by L.M.F.)* E00

0277

13317 CASTRO, H.A. DE; ABREU, M.S. DE 1978. **Enfermidade da mandioca.** *(Cassava diseases).* Lavras-MG, Brazil, Escola Superior de Agricultura de Lavras. 36p. Port., 57 Refs.

Paper presented at Curso Intensivo para Capacitação de Técnicos e de-Mão-de Obra Especializada para a Cultura da Mandioca, Lavras, 1978.

Cassava. Cassava African mosaic virus. Cassava common mosaic virus. Cassava vein mosaic virus. Cassava brown streak virus. *Xanthomonas manihotis. Cercospora henningsii. Cercospora caribaea. Cercospora vicosae. Phyllosticta. Oidium. Uromyces manihotis. Glomerella manihotis. Sphaceloma manihoticola.* **Symptomatology. Disease control.**

A brief description is given of the symptomatology and control of diseases caused by virus and mycoplasma (African mosaic, leaf vein mosaic, common mosaic, brown streak virus, and witches' broom); fungus [brown leaf spot (*Cercosporidium henningsii*), white leaf spot (*Cercospora caribaea*), concentric-ring spot (*Phyllosticta*), blight leaf spot (*Cercospora vicosae*), cassava ash (*Oidium manihotis*), rust (*Uromyces manihotis*), anthracnose (*Colletotrichum* or *Glomerella manihotis*), and superelongation (*Sphaceloma* or *Elsinoe manihoticola*)]; root and stem rots, and damage caused by herbicides. The symptomatology, etiology, and epidemiology (dissemination, infection, and appearance of symptoms and survival of the causal agent in the soil) of CBB (*Xanthomonas campestris* pv. *manihotis*) are analyzed

in detail. Two methods of obtaining healthy materials in order to control CBB are described. The key to identifying some fungal diseases in cassava and recommended large-scale disease control measures are also included. *(Summary by F.G. Trans. by L.M.F.)* E00 E02

0278

15772 DUARTE, M. DE L.R. 1980. Doenças da cultura da mandioca. *(Diseases in cassava). In* Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Relatório Técnico Anual 1979. Brasilia. p.41. Port.

Cassava. *Xanthomonas manihotis.* Mycoses. Bacterioses. Brazil.

The incidence of diseases caused by *Cercospora, Xanthomonas manihotis,* and *Agrobacterium* sp. in cassava crops at the Centro de Pesquisa Agropecuária do Trópico Umido (CPATU), Brazil is reported. *(Summary by F.G. Trans. by L.M.F.)* E00

See also 0303

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E02 Bacterioses

0279

16593 PERREAUX, D. 1981. **Etude de la pathogenese de la bacteriose du manioc. Identification d'une substance toxique produite par** *Xanthomonas campestris* **pv.** *manihotis* **in vitro et in vivo.** *(Study on the pathogenesis of bacterioses in cassava. Identification of a toxic substance produced by Xanthomonas campestris pv. manihotis in vitro and in vivo).* Thèse de doctorat. Louvain-la-Neuve, Université Catholique de Louvain. Faculté des Sciences Agronomiques. 57p. Fr., 54 Refs., Illus.

Cassava. *Xanthomonas manihotis.* Etiology.

In 1979 the research on the characterization of a toxic substance extracted in 1978 from a culture of *Xanthomonas manihotis* in a modified Watanabe medium was continued. The toxin appears after 3 days in the culture when the bacterial population reaches a plateau-type growth curve; max. concn. is reached in approx. 6 days. The characteristics of this toxic substance, identified as 3-(methylthio)-propionic acid, are described. *(Summary by F. G. Trans. by L.M.F.)* E02

0280

16649 ELANGO, F.N.; LOZANO, J.C.; PETERSON, J.F. 1981. **Relationships between** *Xanthomonas c.* **pv.** *manihotis, X. c.* **pv.** *cassavae* **and Colombian yellowish isolates.** *In* Lozano, J.C., ed. International Conference on Plant Pathogenic Bacteria, 5th., Cali, Colombia, 1981. Proceedings. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.96-104. Engl., Sum. Engl., 39 Refs., Illus.

Cassava. Laboratory experiments. *Xanthomonas manihotis. Xanthomonas cassavae.* Etiology. Isolation. Colombia.

Physiological/biochemical tests were inadequate in separating *Xanthomonas campestris* pv. *manihotis, X. c.* pv. *cassavae,* and some Colombian yellowish isolates. However, serological techniques such as the Ouchterlony double diffusion and direct immunofluorescence indicated antigenic differences between *X. c.* pv. *manihotis* and *X. c.* pv. *cassavae.* The Colombian yellowish isolates were serologically similar to *X. c.* pv. *cassavae* but not to *X. c.* pv. *manihotis.* Therefore, retaining the distinction between the 2 pathogens is probably justified. *(Author's summary)* E02

0281

16650 ELANGO, F.N.; LOZANO, J.C. 1981. **Epiphytic survival of** *Xanthomonas manihotis* **on common weeds in Colombia.** *In* Lozano, J.C., ed. International Conference on Plant Pathogenic Bacteria, 5th., Cali, Colombia, 1981. Proceedings. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.203-209. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. *Xanthomonas manihotis.* Etiology. Laboratory experiments. Weeds. Colombia.

Many common weeds are implicated in the epiphytic survival of *Xanthomonas manihotis,* the CBB pathogen, during the dry season in Colombia. Studies using direct immunofluo-

rescence and ELISA techniques established pathogen survival in or on most weeds at < 10^4 cells/leaf disc approx. Studies on weed control in CBB-endemic and non-endemic areas are suggested. *(Author's summary)* E02

0282

16652 DANIEL, J.F.; BOHER, B. 1981. **Contamination of cassava flowers, fruits and seeds by *Xanthomonas campestris* pv. *manihotis*.** *In* Lozano, J.C., ed. International Conference on Plant Pathogenic Bacteria, 5th., Cali, Colombia, 1981. Proceedings. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.614-617. Engl., Sum. Engl., 5 Refs.

Cassava. Laboratory experiments. Flowers. Seed. Fruits. *Xanthomonas manihotis*. Isolation. Etiology.

The epiphytic survival of *Xanthomonas campestris* pv. *manihotis* on aerial parts of cassava plants was reported in 1978. This study of bacterial microflora of flowers, fruits,and sexual seeds from cassava plants in diseased fields provides demonstration of the pathogen's presence on these organs throughout the growing cycle of cassava plants. The bacteria was consistently found on symptomless flowers, green mature fruits, and seeds and in seed tissues (testa, caruncle, endosperm, cotyledon, and embryo). Histological studies (paraffin embedding and serial sections) using immunofluorescence to detect the pathogen confirmed these results. The level of populations present on and within the seed may be high (10^6 bacteria/seed). The strains of *X. c.* pv. *manihotis* present internally are viable and pathogenic, indicating that this is a seed-borne pathogen. The seed may assume its transport, dissemination, and conservation. However, in the case of a low level of seed contamination, the classical technique of isolation on nutrient broth and the immunofluorescence method are unable to detect the pathogen. A method of concn. associated with fluorescent antibody technique to increase the threshold of detection was proposed. The schedule of operations for the detection of *X. c.* pv. *manihotis* in seed is presented and illustrated. *(Author's summary)* E02

0283

16648 DANIEL, J.F.; BOHER, B. 1981. **Fluorescent antibody technique for detection on *Xanthomonas campestris* pv. *manihotis* on cassava leaves.** *In* Lozano, J.C., ed. International Conference on Plant Pathogenic Bacteria, 5th., Cali, Colombia, 1981. Proceedings. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.176-180. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Laboratory experiments. *Xanthomonas manihotis*. Etiology. Isolation.

During its disease cycle, *Xanthomonas manihotis* is known to have a "resident" phase on the above ground parts of the cassava plant. The adaptation of the indirect immunofluorescence method allows detection specifically of *X. manihotis* in place on the leaf surface. Two methods are proposed: (1) the impression method, that uses a leaf-disc collodion print stuck on adhesive tape and affixed to glass slides on which the immunofluorescence reaction is carried out; (2) the direct leaf disc method, where leaf discs were placed on adhesive tape on glass slides and stained by the fluorescent antibody technique. The observation of prints and leaf discs was made with a microscope using reflected light fluorescent microscopy. A schedule of operations is presented. Preliminary results of cassava leaf surface colonization by *X. manihotis* in fields and after artificial inoculations are given and the limitations of these methods are discussed. *(Author's summary)* E02

0284

16651 MARAITE, H.; WEYNS, J.; YIMKWAN, O.; LIPEMBRA, P.; PERREAUX, D. 1981. **Physiological and pathogenic variation in *Xanthomonas campestris* pv. *manihotis*.** *In* Lozano, J.C., ed. International Conference on Plant Pathogenic Bacteria, 5th., Cali, Colombia, 1981. Proceedings. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.358-368. Engl., Sum. Engl., 23 Refs., Illus.

Cassava. Laboratory experiments. *Xanthomonas manihotis*. Etiology. Inoculation.

A total of 53 *X. campestris* pv. *manihotis* strains from Brazil, Cameroon, Colombia, Ivory Coast, Java, Kenya, Mauritius, Nigeria, S. Africa, Sumatra, Taiwan, and Uganda were collected and analyzed. All strains showed gelatin and protein hydrolysis, formation of acid from D (-) arabinose, glucose, and mannose, but not from rhamnose and ribose. Pectate gel was not hydrolyzed. Variations among the strains, but without relation to the geographical origin, were observed regarding sodium chloride tolerance, H_2S production, and production of acid from glycerol, maltose, and raffinose. All 39 tested African strains showed a low amylase activity, while among the 8 S. American ones, only a strain from Bahia and a strain from Rio de Janeiro (Brazil) did so. Strong amylase activity was related with growth on SX agar and formation of acid from dextrin. Five strains were inoculated in an air conditioned glasshouse to 13 cassava cv. from Africa, Asia, and S. America, with various degrees of field resistance. Significant differences in virulence were observed among the strains. Some, on the other hand, were particularly virulent on specific cv. and less on others, suggesting some pathogenic specialization. Smooth colonial variants occurring occasionally during subculturing may show reduced virulence compared to the parental strain. *(Author's summary)* E02

See also 0278

E03 Mycoses

0285

13746 DENGEL, H.J. 1981. **On the etiology of cassava anthracnose.** Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz 88(8/9):525-529. Germ., Sum. Germ., Engl., 4 Refs., Illus.

Cassava. Laboratory experiments. *Glomerella cingulata.* **Etiology. Togo.**

Anthracnose symptoms in cassava, formerly attributed to *Glomerella cingulata,* could be incited by *Pseudotheraptus devastans,* whereas inoculation with a species of *Colletotrichum* isolated from the lesions failed. The fungus appears to be a secondary parasite. The disease is limited to S. Togo and subject to seasonal fluctuations. *(Summary by Review of Plant Pathology)* E03

0286

12062 YEN, J.M. 1980. **Etude sur les champignons parasites du Sud-est asiatique 37. Champignons parasites de Malaisie. 20.** *(Study on the parasitic fungi of South-east Asia 37. Parasitic fungi of Malaysia. 20).* Bulletin de la Société Mycologique de France 96(1):17-25. Fr., Sum. Engl., Illus.

Cassava. Mycoses. *Corynespora heterospora. Curvularia unicolorospora.* **Malaysia.**

Four new species of fungi which parasitize on different host plants in Malaysia are described. *Corynespora heterospora* and *Curvularia unicolorospora* were found in cassava. *(Author's summary)* E03

F00 PEST CONTROL AND ENTOMOLOGY

F01 Injurious Insects and their Control

0287

17132 SAUNDERS, J.L.; SALAZAR V., E. 1979. **Combate de *Anastrepha manihoti* para mejorar la calidad del material de propagación de yuca.** *(Control of Anastrepha manihoti to improve the quality of cassava propagation material). In* Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios, Reunión Anual 25, Tegucigalpa, Honduras, 1979. Memoria. Tegucigalpa, Secretaría de Recursos Naturales. pp.H15/1-H15-3. Span., 3 Refs.

Cassava. Field experiments. *Anastrepha manihoti.* Insect control. Insecticides. Propagation materials. Costa Rica.

An expt. was conducted with cassava var. Valencia at the exptl. station of the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica to determine if the preventive control of *Anastrepha manihoti* with a systemic insecticide would improve the quality of propagation material. A random complete block design with 5 treatments was used: (1) 10 g carbofuran (granules 5%) at planting; (2) 5 g carbofuran at planting; (3) 5 g carbofuran at planting and 5 g at 3 mo.; (4) 0.5 g diazinon a.i./l water, sprayed every 8 days; and (5) untreated control. The differences in the no. of larval exit holes between the control and the treatments were significant ($P = 0.05$). No significant differences were found among the av. yields and plant heights of the different treatments. This procedure improved the quality of cassava propagation material. *(Summary by F.G. Trans. by L.M.F.)* F01 D02

0288

15773 SILVA, A. DE B. 1980. **Levantamento e flutuação populacional de pragas de arroz, milho, feijão, mandioca e malva.** *(Identification and population fluctuation of pests in rice, maize, beans, cassava, and mallow). In* Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Relatório Técnico Anual 1979. Brasilia. pp.43-44. Port.

Cassava. Injurious insects. Injurious mites. Brazil.

Research conducted in the municipalities of Belem and Bragança (Brazil) with light traps to attract pests and their natural enemies in cassava crops is reported. The following pests were observed: *Anastrepha manihoti* (the most abundant species), *Silba pendula*, and *Mononychellus tanajoa. (Summary by F.G. Trans. by L.M.F.)* F01 F03

0289

17145 BANDEIRA, A.G. 1981. **Ocorrência de cupins (Insecta, Isoptera) como pragas de mandioca em Bujaru, Pará.** [*Incidence of termites (Insecta, Isoptera) as cassava pests in Bujaru, Pará*]. Acta Amazônica 11(1):149-152. Port., Sum. Port., Engl., 11 Refs.

Cassava. Injurious insects. Plant damage. Brazil.

In order to verify possible damage by termites in cassava fields in the municipality of Bujaru, state of Pará, Brazil, approx. 200 diseased plants of different cv. were uprooted and inspected. Several of these plants had termites in the tuber or stem. A total of 1025

cuttings, representing more than 10 cv., were planted in a termite-infested field and were harvested at 10 mo. *Heterotermes tenuis* and *Coptotermes testaceus* were found to be pests, and *Syntermes dirus* and *Nasutitermes corniger* were also suspected of contributing to the observed crop damage. Termites were found in cassava in other areas of the state, but on a smaller scale. *(Author's summary)* F01

0290

16640 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. Entomology. *In* ——. Cassava Program 1980. Annual Report. Cali, Colombia, CIAT Series no. 02ECI-80. pp.11-17. Engl., Illus.

Also in Spanish.

Cassava. Field experiments. ***Erinnyis ello. Phenacoccus. Vatiga manihotae. Chilomina clarkei. Cyrtomenus bergi. Aleurotrachelus socialis. Mononychellus tanajoa. Mononychellus urticae. Oligonychus peruvianus.*** **Insect biology. Biological control. Colombia.**

In 1980 major studies on entomology were directed to accumulating information on the complex of insects that attack the cassava crop, emphasizing biological control studies of important pests, especially *Erinnyis ello* and *Phenacoccus* sp. Basic studies on the stemborer (*Chilomina clarkei*) were conducted for the 1st time and a new pest, a subterranean Hemiptera (*Cyrtomenus bergi*) which causes considerable damage to cassava roots, is described. Three trials were conducted at the Nataima station of the Instituto Colombiano Agropecuario to determine losses from whitefly (*Aleurotrachelus socialis*) infestations. It was found that when whiteflies were not controlled, av. yields decreased from 26 to 9 t/ha. Nutritional habits, insect biology, and biological control of the mites *Mononychellus tanajoa, M. urticae,* and *Oligonychus peruvianus* were studied. The germplasm bank at the Centro Internacional de Agricultura Tropical was evaluated for resistance to the cassava lacebug (*Vatiga manihotae*); of the 1865 lines tested, 527 (28%) were scored ≤ 1 on a 0-5 damage scale. *(Summary by F.G. Trans. by L.M.F.)* F01 F03

0291

13450 SEIF, A.A. 1981. **Seasonal fluctuation of adult population of the whitefly,** *Bemisia tabaci,* **on cassava.** Insect Science and its Application 1(4):363-364. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Field experiments. ***Bemisia.*** **Temperature. Kenya.**

Population studies of *Bemisia tabaci* carried out on the Kenya coast indicated that the whiteflies were present in cassava all year round and that there were marked seasonal fluctuations in population levels. Possible explanations for these fluctuations are discussed. The interaction of atmospheric temp. and RH was highly correlated (r = 0.924) with the development of the insect. Results suggest that rainfall has an indirect effect on whitefly population. *(Author's summary)* F01

0292

13728 DENGEL, H.J. 1981. **Investigations on the incidence of adults of** ***Bemisia tabaci*** **(Genn.) on different cassava varieties.** Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz 88(6):355-366. Germ., Sum. Germ., Engl., 12 Refs., Illus.

Also in Plant Research and Development 14:37-49. 1981.

Cassava. Field experiments. Cultivars. ***Bemisia.*** **Vectors. Togo.**

The no. of adult *Bemisia tabaci* on the 2 youngest leaves at the apex on which infection was still possible fluctuated strongly on the cassava cv. included in trials conducted on the exptl. fields of Togo's Plant Protection Service. No consistent relationship existed between the no. of vectors counted on the 3 local cassava cv. (Kataoli, Goula, and Abidjan) as it varied with location and time of planting. Furthermore, vector population was higher in coastal regions.

When planting was carried out at the beginning of and during the rainy season, no extreme fluctuation of the vector population occurred. On the other hand, population increased with planting during the dry season with subsequent watering. Decisive factors for the population fluctuation are the physiological age of the cassava plants, the possibility of other nearby host plants of *B. tabaci*, and the production rate of leaf matter on cassava plants. *(Author's summary)* F01

0293

11484 CASTRO, L. DE L.; CARVALHO, R.F. DE 1939. **Observações sobre a biología e o combate biológico da lagarta da mandioca.** *(The cassava hornworm: biology and biological control).* Arquivos de Instituto de Pesquisas Agronômicas 2: 5-26. Port., Sum. Engl., 4 Refs., Illus.

Cassava. *Erinnyis ello.* **Injurious insects. Insect biology. Biological control. Predators. Insect control. Brazil.**

The history, synonymy, distribution, host plants, biology, chemical and biological control of the cassava hornworm (*Erinnyis ello*) are described in detail. Aspects are included of the biology and breeding in the lab. of the predators [*Calosoma* sp. (Coleoptera)] and parasites [*Oxysarcodexia* sp. (Stephanostomatidae), *Belvosia* sp. (Tachinidae), *Apanteles* sp. (Braconidae), *Chalcidideo* (Chalcididae), *Elachertideos* (Elachertidae)] found in research conducted by the Instituto de Pesquisas Agronómicas, Brazil. *(Summary by F.G. Trans. by L.M.F.)* F01

0294

10459 TERNES, M.; SCHMITT, A.T.; MIURA, L. 1978. **Ocorrência do "bicho capixaba"** *Lagria villosa* **em mandioca no Estado de Santa Catarina.** *(Incidence of the insect Lagria villosa in cassava in the state of Santa Catarina).* Florianópolis-SC, Brasil, Empresa Catarinense de Pesquisa Agropecuária. Comunicado Técnico no. 22. 5p. Port., 3 Refs., Illus.

Cassava. *Lagria villosa.* **Insect biology. Plant damage. Insect control. Brazil.**

The presence of the insect *Lagria villosa* in cassava crops in the municipalities of Tijucas, Itajaí, and Barra Velha in Santa Catarina, Brazil is reported. Insect characterization and biology, plant damage, and control are included. *(Summary by F.G. Trans. by L.M.F.)* F01

0295

17182 DEEMING, J. 1979. **Big new danger to Nigerian cassava.** Noma 2(2):1-2. Engl., Illus.

Cassava. *Aonidomytilus albus.* **Injurious insects. Plant damage. Predators. Nigeria.**

A scale insect identified as *Aonidomytilus albus* is reported to cause serious damage on cassava in Nigeria. The pest and its major predators are briefly described. *(Summary by Abstracts on Tropical Agriculture)* F01

See also 0296

F03 Injurious Mites and their Control

0296

17139 LAL, S.S.; HRISHI, N. 1981. **Note on the relative resistance of high-yielding cassava cultivars to infestations by tetranychid spider mites and whitefly.** Indian Journal of Agricultural Sciences 51(7):536-538. Engl., 1 Ref.

Cassava. Field experiments. Cultivars. Resistance. *Bemisia.* **Injurious mites. India.**

During 1977-78 the susceptibility of high-yielding cassava cv. to mites (*Tetranychus* spp. and *Eutetranychus orientalis*) and whiteflies (*Bemisia tabaci*) were studied under field conditions at Trivandrum, India. Five hybrids and one local var. were used in a random block design with 4 replications. Observations of the no. of *B. tabaci, Tetranychus* spp., and *E. orientalis* were made on 5 randomly selected central plants. Whiteflies occurred throughout the crop season, with max. no. in July 1977, whereas mite species appeared mostly during Jan.-April. *(Summary by F.G. Trans. by L.M.F.)* F03 F01

0297

12940 QUIROZ DE GONZALEZ, M. 1979. **Biología del ácaro** *Mononychellus planki* **(McGregor). Fluctuación poblacional y distribución en la planta, de las especies** *Mononychellus planki* **y** *Mononychellus tanojoa* **(Bondar), en el cultivo de la yuca (***Manihot esculenta* **Crantz).** *(Biology of the mite Mononychellus planki. Fluctuation of population and distribution of the species Mononychellus planki and Mononychellus tanajoa in cassava).* Maracaibo, Venezuela, Universidad del Zulia. 76p. Span., Sum. Span., 39 Refs., Illus.

Cassava. *Mononychellus planki. Mononychellus tanajoa.* **Insect biology. Field experiments. Laboratory experiments. Venezuela.**

An expt. was conducted in the state of Zulia, Venezuela to determine the biology of the mite *Mononychellus planki* under lab. conditions and to study the fluctuations of the populations of *M. planki* and *M. tanajoa* during the cassava growth cycle in the field. Results obtained on its biology indicate that *M. planki* under lab. conditions, at 3 different temp., has a period of embryogenesis, larvae, protonymph, and deutonymph lasting 4.97, 1.48, 0.84, and 0.94 days, resp. at a constant temp. of 25°C; while at 27 ± 1.5°C, these periods lasted 5.17, 1.21, 1.48, and 1.53 days, resp. At an av. temp. of 24.5°C the aforementioned periods lasted 5.72, 1.48, 1.04, and 1.58 days, resp. The total no. of days for the biological cycle, including resting stages, were 12.2, 12.32, and 13.32 days at temp. of 25, 27 ± 1.5, and 24.5°C, resp. Observations were made on habits, longevity of females and males, reproductive rate, preoviposition and oviposition periods, sex ratio of progeny, and growth rate of each species. Fluctuation of populations in the field were obtained from the exptl. plots located in the districts of Mara, Perijá, and Baralt of the state of Zulia. Climatic factors considered were: temp., RH, and rainfall. The no. of mites on the leaves was the parameter used to measure the variation in population during the growth cycle. Sampling was done every 15 days for the 3 plots. Mite populations varied considerably during the growth cycle for the 3 localities, being higher with high temp., little or no rainfall, and low RH. Plant age was also considered a factor correlated with the fluctuation of populations in the species studied. *(Extracted from author's summary. Trans. by L.M.F.)* F03

0298

17185 FLECHTMANN, C.H.W. 1981. **The cassava mite complex. II. New records and description of two new species in the genus *Tetranychus* from Asia.** International Journal of Acarology 7(1-4):81-86. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Injurious mites. *Tetranychus manihotis. Tetranychus bellottii.* **Asia.**

Literature on cassava mites is updated. Two new species, namely *Tetranychus manihotis* (Malaysia) and *T. bellottii* (India), are illustrated and described. New records of mites in cassava include *Atrichoproctus uncinatus* and *T. hydrangeae. (Author's summary)* F03

See also 0288 0290

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G00 GENETICS AND PLANT BREEDING

0299

16645 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **Tissue culture.** *In* ____ . Cassava Program 1980. Annual Report. Cali, Colombia, CIAT Series no. 02EC1-80. pp.79-85. Engl., Illus.

Also in Spanish.

Cassava. Tissue culture. Disease control. Germplasm. Transfer of technology. Colombia.

Activities of the tissue culture section of the Centro Internacional de Agricultura Tropical were focused on the improvement and utilization of meristem culture methods for disease eradication (frog skin), germplasm conservation and international exchange as well as the initiation of research on other tissue culture systems (anther, protoplast cell) in cassava. *(Summary by F.G. Trans. by L.M.F.)* G00

G01 Breeding, Germplasm, Varieties and Clones, Selection

0300

15771 ALBUQUERQUE, M. DE; CARDOSO, E.M.R.; DUARTE, M. DE L.R. 1980. **Melhoramento de cultivares de mandioca para a Região Amazônica.** *(Cassava cultivar breeding for the Amazonian region). In* Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Relatório Técnico Anual 1979. Brasilia. p.56. Port.

Cassava. Plant breeding. Cultivars. Uses. Selection. Brazil.

Selected cassava cv., recommended for areas similar to NE Paraense (Oxisol soils) are reported. Outstanding cv. were: for the extraction of starch and alcohol production (yields > 30%), Mameluca, Jurará, Tatauaria, Itaúba, and Boinha; for the production of table flour (yields > 25%), in addition to those already mentioned, Bubão, Manivainha, Hamburguesa, Pretinha, and Engana Ladrão; and for branch production, IAN-1, IAN-3, IAN-4, and Chapéu de Sol. *(Summary by F.G. Trans. by L.M.F.)* G01

0301

16548 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1980. **Cooperative programs IDRC, IDA, Belgian Government; cassava.** *In* ——. Annual Report 1979. Ibadan, Nigeria. p.75. Engl.

Cassava. Cassava programs. Selection. Clones. Cultivars. Resistance. Diseases and pathogens. Cameroon.

Results in research by the Cameroon Root Crops and Farming Systems Program, which is supported by the International Development Research Centre (IDRC), the International Institute of Tropical Agriculture (IITA), and the Cameroon National Office for Scientific and Technical Research (ONARFST) are reported briefly. Two nurseries with 7000 cassava seedlings, screened for resistance to major diseases and for vigor, were established. In preliminary yield trials, 38 clones, which outyielded local cv. by 15-100%, were selected. *(Summary by F.G. Trans. by L.M.F.)* G01

0302

16540 SILVA, S. DE O.E.; CARVALHO, H.W.L. DE; FUKUDA, W.M.G.; CALDAS, R.C. 1981. **Avaliação de clones de mandioca em Cruz das Almas-Bahia.** *(Evaluation of cassava clones in Cruz das Almas-Bahia).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em andamento no. 6. 4p. Port.

Cassava. Field experiments. Clones. Selection. Tuber productivity. Foliage. Starch content. Brazil.

From 1979-80 the performance of 42 cassava clones was studied in Cruz das Almas, Bahia, Brazil. A completely randomized exptl. design was used with 2 replications; 60, 80, and 60 kg NPK, resp. were applied per ha. Evaluations regarding root and branch wt. and starch content were made. Clones 13-14, 02-27, 24-22, and 24-42 had the highest root yields; clones 02-27, 06-13, and 29-15 registered the highest starch contents and the clones with

the highest branch yields were 12-03, 20-05, and 02-27. *(Summary by F.G. Trans. by L.M. F.)* G01 D03 C03

0303

16178 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1980. **Root and tuber improvement program; cassava.** *In* _____. Annual Report 1979. Ibadan, Nigeria. pp.53-63. Engl., Illus.

Cassava. Field experiments. Plant breeding. Selection. Clones. Resistance. *Colletotrichum manihotis.* **Cassava African mosaic virus.** *Phenacoccus manihoti. Mononychellus tanajoa.* **Nigeria.**

The results of research conducted by the International Institute of Tropical Agriculture (IITA), Nigeria, through its root and tuber improvement program in 1979, are given. Improved cassava clones were tested in different locations to determine promising clones in terms of yield. Seedlings were screened for resistance to major pests and diseases: the cassava mealybug (*Phenacoccus manihoti*), green mites (*Mononychellus tanajoa*), CAMD, and anthracnose (*Colletotrichum manihotis*). *(Summary by F.G. Trans. by L.M.F.)* G01 E00 F00

0304

16184 FURTADO, M.J.; SILVA, A.A. DA 1980. **Avaliação de cultivares de mandioca (*Manihot esculenta* Crantz) para indústria, no Estado do Espírito Santo.** *(Testing of cassava cultivars for industrial purposes in the state of Espirito Santo).* Cariacica-ES, Brasil, Empresa Capixaba de Pesquisa Agropecuária. Indicação EMCAPA v.2, no. 2. 6p. Port.

Cassava. Cultivars. Selection. Tuber productivity. Brazil.

Cassava cv. were tested in the municipalities of Linhares and São Mateus, Espirito Santo (Brazil) to determine those with the most appropriate characteristics for industrial use. Outstanding cv. in the area of Linhares were Paulista and Raimunda with harvesting at 12 mo. and Manjari and Pão do Chile "Sul" with harvesting at 17 mo. At São Mateus, best cv. were Mucuri Macaco and Pão do Chile "Sul". *(Summary by F.G. Trans. by L.M.F.)* G01

0305

17123 JOS, J.S.; HRISHI, N.; MAINI, S.B.; NAIR, R.G. 1980. **Two high yielding hybrids of cassava.** Journal of Root Crops 6(1/2):1-6. Engl., Sum. Engl., 9 Refs., Illus.

Cassava. Field experiments. Hybridizing. Hybrids. Tuber productivity. India.

Two high yielding hybrids, H-1687 and H-2304, were developed by intervar. hybridization involving indigenous and exotic genetic stocks at the Central Tuber Crops Research Institute (Trivandrum, India). In H-1687 yield ranged from 30.2-43.3 t/ha and in H-2304 it ranged from 34.9-41.8 t/ha under farm conditions while the control recorded 11.1-21.4 t/ha. Under multilocation trials they significantly outyielded the control. Both hybrids were found to be significantly superior to the local var. in minikit trials undertaken in 138 plots throughout the state of Kerala. H-2304 recorded a yield range of 30.41-58.39 t/ha and the mean was 44.99 t/ha. The mean yield recorded by H-1687 was 44.05 t/ha while the local var. registered a mean yield of only 30.43 t/ha. Hybrid 2304 had higher DM content and H-1687, significant amounts of carotene. The 2 hybrids were released for general cultivation under the names Sree Vishakham (H-1687) and Sree Sahya (H-2304). *(Author's summary)* G01 D03

0306

15755 ROSAS S., C.; DELGADO B., T.E. 1975. **Híbridos de yuca evaluados en La Molina.** *(Evaluation of cassava hybrids at La Molina).* Avances en Investigación (Perú) 4(3/4):3-6. Span.

Cassava. Plant breeding. Hybrids. Research. Selection. Crossbreeding. Peru.

Research work conducted at the Estación Exptl. Agrícola de La Molina, Peru (during the crop yr 1969-70 until 1973-74) is analyzed. Its main objectives were to select genetic material and to crossbreed domestic and introduced material from Brazil by natural pollination. The hybrids most recommended for human consumption and for material purposes were LM-I-1110-70 (31.8 MT/ha) and LM-3-1110-70 and for industrial use alone LM-CB-8-22-69. *(Summary by F.G. Trans. by L.M.F.)* G01

0307

17171 KAWANO, K. 1980. Cassava. *In* Fehr, W.R.; Hadley, H. H.,eds. Hybridization of crop plants. Madison, Wisconsin, American Society of Agronomy and Crop Science Society of America. pp.225-233. Engl., 12 Refs., Illus.

Cassava. Flowers. Hybridizing. Pollination. Seed. Colombia.

Aspects of cassava breeding are discussed in detail: origin of parental material; environmental conditions appropriate for flowering; floral characteristics; artificial hybridization and self-pollination (equipment to be used, preparation of the female flower, pollination, and factors affecting efficiency); natural hybridization; and seed development, harvest, and storage. *(Summary by F.G. Trans. by L.M.F.)* G01

0308

16539 CARVALHO, F.W.L DE 1981. **Avaliação de cultivares de mandioca no Centro Nacional de Pesquisa de Mandioca e Fruticultura.** *(Evaluation of cassava cultivars at the Centro Nacional de Pesquisa de Mandioca e Fruticultura).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em andamento no. 07. 2p. Port.

Cassava. Field experiments. Germplasm. Cultivars. Selection. Cassava programs. Agronomic characters. Tuber productivity. Ecosystems. Brazil.

Ten trials evaluating promising cassava cv. were established at the in vivo germplasm bank of the Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF) in July 1980 in order to select cv. with outstanding agronomic characteristics, high root yields, and improved adaptation to the ecological conditions of the NE ecosystem in Brazil. Trials received different treatments of fertilization. A great variation was observed in the initial vigor of the cv. and a large no. were considered promissory. *(Summary by F.G. Trans. by L.M.F.)* G01

0309

13466 NASSAR, N.M.A. 1981. **Collecting wild cassava in Brazil.** Plant Genetic Resources Newsletter 47:14-23. Engl., Sum. Engl., Fr., Span., 5 Refs., Illus.

Cassava. *Manihot.* Germplasm. Adaptation. Selection. Maps. Resistance. *Xanthomonas manihotis. Coelosternus manihoti.* Brasil.

Manihot sp. seeds and/or cuttings were collected in NE and west-central Brazil and planted in a living collection. At the U. of Brasilia approx. 726 introductions of the following species are now being grown: *M. caerulescens, M. glaziovii, M. dichotoma, M. pseudoglaziovii, M. epruinosa, M. heptaphylla, M. pohlii, M. grahamii, M. zenhtneri, M. reptans, Manihot* sp. (undetermined), and a natural hybrid. Six thousand seeds of the following species are being maintained for planting: *M. tripartita, M. gracilis, M. falcata, M. fruticulosa, M. longepetiolata, M. oligantha, M. pentaphylla, M. alutacea, M. pruinosa, M. paviaefolia, M. stricta, M. salicifolia, M. purpurea-costata, M. attenuata,* and *M. tomentosa.* The geographical distribution of these species is given. Some introductions were evaluated for resistance to *Xanthomonas manihotis* and *Coelosternus manihoti* and their capacity to form tubers is discussed. Seeds of these materials have been made available to breeders of the International Institute of Tropical Agriculture (Nigeria) and the Centro Internacional de Agricultura Tropical (Colombia). *(Author's summary)* G01

0310

10751 OLIVEIRA, H. DE F.; ANDRADE, M.J.B. DE; OLIVEIRA, A.B. DE 1979. **Avaliação de cultivares de mandioca na região Norte-Fluminense.** *(Evaluation of cassava cultivars in the Norte-Fluminense region). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.149-160. Port., Sum. Port., Engl., 12 Refs., Illus.

Cassava. Field experiments. Cultivars. Clones. Selection. Tuber productivity. Starch content. Dry matter. Brazil.

The characteristics of 135 cv. and 75 clones of cassava were evaluated at the Estação Exptl. de Campos, RJ, Brazil. This collection from different parts of the country was installed on an alluvial soil, with and without chemical fertilization, and harvested at 15, 19, 22, and 28 mo. The following cv. were selected on the basis of root production, starch and DM content: a) early-maturing cv. (15 and 19 mo.)– Bahia Preta, Curvelo, Manjari, and Engana Ladrão; b) late-maturing cv. (22 and 28 mo.) – Uvar and Passarinha. Protein content in the roots was not correlated with yield in the studied cv. *(Author's summary)* G01 D03 C03

0311

16641 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **Germplasm development.** *In* ____ . Cassava Program 1980. Annual Report. Cali, Colombia, CIAT Series no. 02ECI-80. pp.27-32. Engl., Illus.

Also in Spanish.

Cassava. Plant breeding. Germplasm. Ecosystems. Resistance. Adaptation. Colombia.

The cassava germplasm section of the Centro Internacional de Agricultura Tropical has developed a multi-stage genetic improvement procedure involving: (1) evaluation of germplasm accessions in various environments for possible recommendations as new cv. or as parents in a hybridization program; (2) formation of broad-based gene pools with high levels of resistance and/or adaptation in specific environments; (3) assure acceptability of the final product by producers, processors, and consumers. *(Summary by F.G. Trans. by L.M.F.)* G01

0312

16646 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **Varietal improvement.** *In* ____ . Cassava Program 1980. Annual Report. Cali, Colombia. CIAT Series no. 02ECI-80. pp.33-37. Engl., Illus.

Also in Spanish.

Cassava. Field experiments. Hybrids. Ecosystems. Selection. Adaptation. Seed. Colombia.

Since considerable progress has been made in the yielding ability and disease resistance through single-trait selection of cassava material for HI, branching type, or resistance to CBB (*Xanthomonas campestris* pv. *manihotis*) and superelongation [*Sphaceloma (Elsinoe) manihoticola*], emphasis in selection has gradually shifted towards overall performance over several years at each selection site. Production of hybrid seeds by controlled pollination was increased 4-fold after critical pest problems were overcome. *(Summary by F.G. Trans. by L.M.F.)* G01

0313

13690 PARTHASARATHY, V.K.; MEDH, R.P.; GHOSH, S.P. 1980. **Stability of a few varieties of cassava under two altitude conditions in Meghalaya.** Journal of Root Crops 6(1/2):53-54. Engl., 2 Refs.

Cassava. Adaptation. Cultivars. Climatic requirements. Tuber productivity. Selection. India.

The stability of some cassava var. was studied at 2 sites, Umling and Nayabunglow (Meghalaya, India) at 300 and 800 m.a.s.l., resp. during 1977-78. Var. M-4, M-165, M-97, H-312, H-3641, H-2304, H-43, H-226, H-1687, and a local var. were used in a randomized block design with 3 replications. Environmental additive effects were 0.58 and 0.377 for Nayabunglow and 2.873 and -3.832 for Umling during the periods 1977-78, resp. Hybrid H-312 gave the highest yield under both environmental conditions, but the highest deviation in regression analysis indicates its unstability; therefore, it is suggested that selection should be made for stability of yield over a range of environments. *(Summary by F.G. Trans. by L. M.F.)* G01 D01 D03

0314

17193 ENGELS, J.M.M.; BEUNINGEN, L.T. VAN; REININK, K. 1981. **A manual system for germplasm management. II. Some useful applications of edge-punched cards in handling data of systematic description.** Euphytica 30(3):635-641. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Germplasm. Information retrieval.

The application of the edge-punched card in taxonomy is briefly summarized. The data of a systematic description of a relatively small cassava collection are used to demonstrate the use of these cards in the detection of duplicates, in more complicated queries,and for simple statistical analysis. A comparison is made with the 'peek-a-boo' system. *(Author's summary)* G01

See also 0243

H00 NUTRITION

0315

17181 FLEURET, P.; FLEURET, A. 1980. **Nutritional implications of staple food crop successions in Usambara, Tanzania.** Human Ecology 8(4):311-327. Engl., Sum. Engl., 36 Refs.

Cassava. Production. Human nutrition. Tanzania.

Archival and ethnographic research carried out in NE Tanzania provides evidence of significant changes in production and consumption of staple food crops between 1850 and the present. The banana, which provided the bulk of calories and other nutrients in precolonial times, has been successively replaced by Irish potatoes, maize, and cassava in different localities. The reasons for the adoption of each of these introduced crops are explored, and their implications for human nutrition in the area are discussed. *(Author's summary)* H00

0316

16589 TREMOLIERES, J. 1980?. **Tapioca et dietetique. Tapioca et lait: une association bénéfique.** *(Cassava and dietetics. Cassava and milk: a favorable association).* Paris, l'Institut du Manioc. 16p. Fr., 17 Refs., Illus.

Cassava. Human nutrition. Nutritive value. Dietary value. Tapiocas.

Different aspects of the qualities of cassava as tapioca, in terms of digestion and assimilation by people of different ages and health conditions, are discussed. Its favorable influence on dyspepsia and vomiting is highlighted as well as its use in treating malnourished unweaned infants. Since cassava does not have gluten-type proteins, it is recommended for their intolerance and in treating allergies to cereals. Its energy properties are notable since the glycosides undergo a slow and progressive absorption that allows its total utilization. Data are included on its origin and utilization. The digestive properties of the tapioca-milk association are emphasized along with its lack of antitrypsic factors and limited neutralizing effect of gastric acids, which result in a flocculate of fine casein and of easy assimilation. Moreover, salivary amylolysis is faster with tapioca than with other starches and a total absence of cellulosic wastes was observed. Gastronomic information and experiences of dieticians and pediatricians are included. *(Summary by I.B. Trans. by L.M.F.)* H00

0317

16545 FLEURY, JEAN-MARC. 1980. **Un mensaje a los agrónomos.** *(A message for agronomists).* El CIID Informa 9(2):7-8. Span., Illus.

Cassava. Human nutrition. Iodine. Thyocianates.

Two important aspects that should be considered when promoting cassava cultivation in countries of the Third World are discussed in detail: the introduction of var. with lower HCN contents and the verification that the l consumption of the populations is normal. The appearance of new diseases caused by its toxicity would be avoided. *(Summary by F.G. Trans. by L.M.F.)* H00

H03 Animal Feeding

0318

15724 KITPANIT, N.; BUNSIDDHI, D. 1979. **The substitutional value of cassava root product of various quality grades for rice by-products in semi-commercial pig rations.** *In* Khon Kaen University. Faculty of Agriculture. Cassava/nutrition project; annual report 1979. Khon Kaen, Thailand. pp.95-103. Engl.

Cassava. Laboratory experiments. Swine. Animal nutrition. Cassava meal. Rice bran. Diets. Thailand.

An expt. was conducted to demonstrate the simple replacement of cassava root products for rice bran + broken rice in producer recommended mixtures. Thirty-two crossbred pigs averaging 26 kg initial body wt. were allotted in 4 dietary treatments (T) on the basis of body wt., sex, and genetic background. Each group was replicated 4 times. Pigs in T_1 were fed the control diet, containing commercial feed concentrate + rice bran + broken rice during the starting, growing, and finishing periods. Pigs in T_2, T_3, and T_4 were fed the same level of commercial feed concentrate used in T_1 + cassava/SBM mixture. Cassava root products + 17% SBM have similar nutritive value to rice bran + broken rice and can be substituted in the diet without any adverse effect on pig performance. *(Summary by F.G. Trans. by L.M.F.)* H03

0319

15078 MUEHLMANN, L.D. 1978. **Ensilaje de forraje de yuca, pura y en mezcla con caña de azúcar y pasto elefante y con utilización de varios niveles de melaza y urea.** *(Cassava forage silage, pure or mixed with sugar cane and elephant grass, and using several levels of molasses and urea). In* Curso de Adiestramiento en Producción y Utilización de Pastos Tropicales, 1., Cali, Colombia, 1978. Trabajos presentados. Cali, Centro Internacional de Agricultura Tropical. Programa Ganado de Carne. pp.98-106. Span., 33 Refs.

Cassava. Forage. Silage. Digestibility. pH. N. Colombia.

An expt. was conducted at the Centro Internacional de Agricultura Tropical (CIAT) to verify the performance of cassava as forage and of sugar cane and elephant grass (*Pennisetum purpureum*) H-534 mixed with 25% cassava forage using small clamps with different levels of molasses and urea. Treatments were: sugar cane + 25% elephant grass forage + 25% cassava forage + 0, 0.25, 0.5, and 1% urea and 0, 1, 4, and 8% molasses. Trials on pH, in vitro digestibility, and the determination of N in urea were conducted. Ensiled cassava forage improved digestibility. In all the treatments the pH was higher than the standards established for good-quality silage. In all the treatments with increasing rates of urea, an increase was observed in the % of N in DM. *(Summary by F.G. Trans. by L.M.F.)* H03

0320

17172 LOPES, D.C.; ALVARENGA, J.C.; DONZELE, J.L.; FERREIRA, L.F.A. 1981. **Utilização da mandioca na alimentação de suínos.** *(Utilization of cassava in swine nutrition). In* ——. Alimentos alternativos para suinos. Belo Horizonte-MG, Brasil, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.9-12. Port., 19 Refs.

Cassava. Research. Animal nutrition. Nutritive value. Cassava meal.

A brief literature review on the research conducted on the nutritive value of cassava in animal nutrition, especially for pigs, is given. On the basis of these studies, it was concluded that CM and chips may replace up to 50% maize, fresh cassava (chopped or sun-dried) can be used to totally substitute maize. The best ration included a 50% level of substitution, which may be used if the price relationship cassava x maize is favorable. *(Summary by F.G. Trans. by L.M.F.)* H03

0321

17174 PALAFOX, A. 1980. **Animal science.** *In* University of Guam. Annual Report 1980. Mangilao, Guam, Agricultural Experim nt Station. College of Agriculture and Life Sciences. pp.18-21. Engl., Illus.

Cassava. Laboratory experiments. Animal nutrition. Diets. Cassava meal. Finishing. Swine. USA.

Two expt. were conducted on Guam, USA, the 1st using copra meal as a source of protein for growing pigs and the 2nd using cassava and copra meals on finishing pigs. In the 2nd expt. 40 pigs were used, ranging from 75-94.5 lb initial wt. and distributed at random by wt., sex, and breed into 8 pens. Data showed that av. daily gain was significantly affected by the treatment. Pigs fed 40% cassava and 25% copra meal gained significantly less wt. than those fed 40% CM without copra meal. Finishing pigs fed copra meal consumed less feed than those fed their resp. controls. Observations with finishing pigs differ from those obtained with growing pigs. It was concluded that 40% CM may be incorporated into the diet of finishing pigs without significantly affecting final body wt. gain and feed efficiency. *(Summary by F.G. Trans. by L.M.F.)* H03

0322

16596 FOLGADO, C. 1978. **A mandioca como matéria-prima em alimentos animais.** *(Cassava as raw material in feedstuffs).* Pecuária 2(2):45-48. Port., Illus.

Cassava. Poultry. Animal nutrition. Composition. Nutritive value. Feeds and feeding. Brazil.

The nutritive value of cassava in poultry rations is briefly analyzed; the chemical composition of roots, cyanide content in tubers, comparison of amino acid content in cassava leaves with those of *Pennisetum purpureum, Panicum maximum,* and soybean meals are included. It is recommended to consider both the physiological aspects of nutritional balance and vol. in cassava-based rations. *(Summary by F.G. Trans. by L.M.F.)* H03

0323

12584 DOSSEVI, L.; BANTSIMBA, M.; DIGAUD, A.; FOURNIER, P. 1980. **Effets des glucides solubles de quelques aliments tropicaux (manioc, arachide, noix de coco, papaye) sur l'utilisation du calcium chez le rat.** [*Effect of soluble carbohydrates from some tropical foods (cassava, peanut, coconut, and papaya) on calcium utilization in rats*]. Annales de la Nutrition et de l'Alimentation 34(3): 527-536. Fr., Sum. Engl., Fr., 20 Refs., Illus.

Cassava. Laboratory experiments. Soluble carbohydrates. Carbohydrate content. Animal nutrition.

Cassava, peanut, coconut, and papaya were used to prepare ethanol extracts containing soluble sugars. Six-mo.-old rats were given 10 m*M* $CaCl_2$ solution (+ ^{45}Ca) containing a carbohydrate by stomach tube. Depending on the group, the carbohydrate was glucose, melibiose, or raffinose at 200 m*M* concn., or ethanol extract. Blood samples were taken at different times after the administration and plasma radioactivity was measured. Rats were sacrificed at 24 h; femur radioactivity was used as a measure of Ca absorption. Extracts of cassava, peanut, and papaya were more potent in promoting Ca absorption. Physiological activity of the extracts was correlated with the nature of the sugars, identified by paper

chromatography. Cassava contained raffinose. The current expt. confirmed previous findings that these sugars enhanced Ca utilization. *(Author's summary)* H03

0324

12240 VERAMENDI R., E. 1978. **Sustitución del maíz por harina de yuca en acabado de cerdos en Jenaro Herrera.** *(Substituting maize with cassava meal in finishing diets for pigs at Jenaro Herrera).* Tesis Ing. Zoot. Tingo María, Perú, Universidad Nacional Agraria de la Selva. Departamento de Ciencias Pecuarias. 46p. Span., Sum. Span., 28 Refs., Illus.

Cassava. Swine. Animal nutrition. Cassava meal. Diets. Finishing. Peru.

An expt. was conducted at the Granja Porcina of the Proyecto de Asentamiento Rural Integrado (PARI) in Jenaro Herrera, state of Loreto, Peru, to assess CM as an energy source for substituting maize at levels of 33, 66, and 100% in diets for finishing pigs. Thirty-two crossbred Hampshire x Landrace pigs with an av. initial wt. of 60 kg were used; these were randomly distributed in 4 lots with 8 animals each. Greatest wt. gain was obtained in animals fed the diet containing 33% CM although differences were not statistically significant. Regarding feed conversion there was no significant difference among treatments. Economic analysis revealed that the treatment with 33% CM gave the highest economic returns. *(Extracted from author's summary. Trans. by L.M.F.)* H03

0325

10211 MELLO, R.P. DE; SILVA, J.F.C. DA; CAMPOS, O.F. DE; SAMPAIO, I. B.M. 1976. **Milho desintegrado com palha e sabugo, raspa de mandioca e sementes de sorgo moidas, em concentrados para vacas em lactação.** *(Ground ear corn with straw, cassava chips, and ground sorghum grains in concentrates for lactating cows).* Revista da Sociedade Brasileira de Zooteenia 5(2):105-118. Port., Sum. Port., Engl., 23 Refs.

Cassava. Animal nutrition. Cattle. Cassava chips. Composition. Mineral content. Brazil.

Twenty-four Schwyz x Zebu cows with an av. daily milk production of 14 kg were used to study the use of ground maize, cassava chips, and ground sorghum grain as energy supplements, according to the following treatments: T_1, ground maize 69.5% + cottonseed meal 28.5%; T_2, cassava chips 54.7% + cottonseed meal 43.3%; and T_3, ground sorghum 74.0% + cottonseed meal 24.0%. These rations were supplemented with sodium chloride (1.0%) and bone meal (1.0%). Cows were fed sorghum silage ad libitum + 11 kg brewers' drled grains + concentrate to meet animal requirements. Results showed that milk production was not affected by the source of energy in the concentrate. Total DM intake averaged 3.17% of the livewt., and silage DM intake, 1.72%. *(Author's summary)* H03

0326

12441 CALVO DEL AGUILA, R. 1979. **Efecto de la yuca fresca en la performance de peso de cerdos en período de acabado, bajo confinamiento.** *(Effect of fresh cassava on the weight gain of finishing pigs kept in confinement).* Tesis Ing. Zoot. Tingo María, Perú, Universidad Nacional Agraria de la Selva. Departamento de Ciencias Pecuarias. 46p. Span., Sum. Span., 21 Refs., Illus.

Cassava. Swine. Animal nutrition. Diets. Finishing. Peru.

An expt. was conducted at the Granja Porcina of the Proyecto de Asentamiento Rural Integrado (PARI) in Jenaro Herrera, state of Loreto, Peru, to evaluate fresh cassava as an energy source when substituting maize at levels of 0, 50, 75, and 100% (corresponding to treatments I, II, III, and IV, resp.) in basic diets for finishing pigs. Twenty crossbred Yorkshire-Landrace-Hampshire pigs with an initial av. wt. of 60 kg were used; these were randomly distributed in 4 lots of 5 animals each. After 42 days, the animals were slaughtered. Treatment II had a daily wt. gain of 0.757 g compared with treatment IV with 0.671 g. Carcass yields were similar for all treatments and no statistical difference was detected among them.

Back fat thickness averaged 2 cm in all treatments. Economic analysis indicated a higher net profit for treatment I and a lower one for treatment IV. *(Extracted from author's summary. Trans. by L.M.F.)* H03

See also 0357

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H04 HCN Toxicity and Detoxification

0327

17117 ARGUEDAS, P.; COOKE, R.D. 1982. **Residual cyanide concentrations during the extraction of cassava starch.** Journal of Food Technology 17:251-262. Engl., Sum. Engl., 24 Refs., Illus.

Cassava. Cyanogenic glycosides. Processing. Cyanides. Cassava starch.

A literature review is given on residual cyanide concn. during the process of extracting cassava starch. *(Summary by F.G. Trans. by L.M.F.)* H04

See also 0216

I00 PROCESSING, PRODUCTS AND USES

I01 Cassava Starch and its Properties

0328

17121 BELLO, R.A.; PIGOTT, G.M. 1979. **A new approach to utilizing minced fish flesh in dried products.** Journal of Food Science 44(2):355-358, 362. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. Cassava starch. Modified starches. Uses.

A dried fish product to be kept without refrigeration was developed, using the mixed, minced flesh from various fish species (lingcod, rockfish, herring, and Pacific cod). Modified cassava starch, texturized soybean fiber, and salt were required to enhance the binding and rehydration properties and sensory attributes of the product. Temp. of 71-82°C during approx. 10 h were required to dry the patties to 5% moisture level; 20 min submerged in water were enough to rehydrate the product. Physicochemical, microbiological, organoleptical, and histological tests were conducted during the development of the product. *(Author's summary)* I01

0329

17189 NGAN, P.V.; VAZZOLER, A.E.A. DE M. 1981. **Utilização do amido hidrolisado obtido a partir de fécula de mandioca comercial na análise eletroforética de proteína de peixes.** *(Utilization of hydrolyzed starch obtained from commercial cassava starch in electrophoretic analysis of fish protein).* Ciencia e Cultura 33(11): 1469-1472. Port., Sum. Engl., 10 Refs., Illus.

Cassava. Cassava starch. Hydrolysis. Brazil.

A modification of the original method of zone electrophoresis to obtain hydrolyzed starch from commercial cassava starch was described. Electrophoretograms of the same samples obtained under the same conditions in gel prepared from hydrolyzed cassava starch gave a better separation and the electrophoretograms were clearer. Hydrolyzed cassava starch is relatively simple to prepare, giving excellent and repeatable results. *(Author's summary)* I01

0330

15726 HORKAWAT, S.; SIRITORN, P.; DITPONGPIN, W. 1979. **The effect of microbial contamination on the nutritive value of cassava root products. A preliminary study.** *In* Khon Kaen University. Faculty of Agriculture. Cassava/nutrition project; annual report 1979. Khon Kaen, Thailand. pp.85-87. Engl.

Cassava. Cassava chips. Nutritive value. Pellets. Thailand.

This trial attempts to make a preliminary observation and isolation of microorganisms present in products available at Khon Kaen markets, Thailand. Crop characteristics are also studied to enable the improvement of the processing technique in order to minimize adverse effects. Samples of cassava chips and pellets were taken from each of the drying firms and pelletizers in the area; these were mixed with 100 ml of sterilized water. After a 3-day incubation at room temp., microorganisms were counted and classified. Results indicate that the predominant microorganisms in cassava root products were *Aspergillus* fungi and *Bacillus* bacteria; cassava chips have a higher MC and consequently, higher mold contamination than pellets; CP concn. of pellets tends to be higher than that of chips. It is suggested that chips should be pelletized as soon as they are dry. *(Summary by F.G. Trans. by L.M.F.)* I02

0331

17120 ADOUR ENTREPRISE. 1981. **High protein cassava.** Pau, France. 12p. Engl., Illus.

Cassava. Technological package. Fermentation. Cultivation. Food products.

A process to ferment cassava starch without hydrolyzing it is described in detail. Data on investments, operational costs, and selling price for the plantation/fermentation complex are included. *(Summary by F.G. Trans. by L.M.F.)* I02

0332

17101 HATUM, L. DO C. 1981?. **Mandioca: máquina para fazer raspas.** *(Cassava: a machine to make chips).* Brasilia, Empresa Brasileira de Assistência Técnica e Extensão Rural. Serie Técnica para produção vegetal. EMBRATER T 106. 2p. Port., Illus.

Cassava. Cassava chips. Processing. Mechanization. Brazil.

The steps to follow in the fabrication of a machine for homemade cassava chip elaboration are briefly described. Diagrams are included. *(Summary by F.G. Trans. by L.M.F.)* I02

0333

15777 PINHEIRO, J.C.D. 1980. **Tiquira da mandioca.** *(Cassava brandy).* Mandi-Noticias 3(2):8-10. Port., 6 Refs.

Cassava. Beverages. Processing. Trade. Brazil.

The importance, types, and commercialization of cassava brandy as an alternative for

cassava industrialization are analyzed. The process of elaboration is described: preliminary treatment of raw material (cleaning, weighing, and peeling), preparation of cooked mix, saccharification, fermentation, and distillation. Cv. used for its manufacture are: Tumazinha, Najazinha, and Branquinha de Santa Quitéria. An av. of 18-20 *l* are obtained from 120 kg cassava. *(Summary by F.G. Trans. by L.M.F.)* I02

0334

17102 FELIPE, M. DE P. 1981?. **Mandioca: cortador de rama.** *(Cassava: branch cutter).* Brasilia, Empresa Brasileira de Assistência Técnica e Extensão Rural. Serie Técnica para produção vegetal. EMBRATER T 93. 2p. Port., Illus.

Cassava. Agricultural equipment. Mechanization. Brazil.

The steps to follow in the fabrication of a cassava branch cutter are briefly described. Diagrams are included. *(Summary by F.G. Trans. by L.M.F.)* I02

0335

17155 GOULARTE, R.D. 1981?. **Mandioca; ralador.** *(Cassava rasper).* Brasilia, Empresa Brasileira de Assistência Técnica e Extensão Rural. Serie Técnica para Produção Vegetal. EMBRATER T 156. 3p. Port., Illus.

Cassava. Agricultural equipment. Mechanization. Processing. Rasping.

The steps to follow in the fabrication of cassava raspers are briefly described. Diagrams are included. *(Summary by F.G. Trans. by L.M.F.)* I02

0336

10721 ESPINAL, J.L.R.; ALMY, S.W. 1979. **A casa de farinha no Recôncavo Baiano.** *(Cassava flour processing plants in Recôncavo Baiano). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.17-26. Port., Sum. Port., Engl., 10 Refs.

Cassava. Socio-economic aspects. Cassava flour. Processing. Brazil.

The current forms and problems of cassava processing for human and animal nutrition in the region of Recôncavo Baiano, municipality of Sapeacú, Brazil are described. The implications of the technoeconomic changes in the structure of domestic CF processing plants on socioeconomic conditions in the area are discussed. *(Extracted from author's summary)* I02

0337

12470 LAPORTE, J.C.; SAUTIER, C. 1979. **Protéolyse du lait en présence de tapioca et de divers produits amylacés.** *(Proteolysis of milk in presence of tapioca and different starch products).* Cahiers de Nutrition et de Dietetique 14(3):219-220. Fr., Sum. Engl., Fr.

Cassava. Tapiocas. Hydrolysis. Nutritive value. Laboratory experiments. Biochemistry.

To determine the methods of digestion of cow milk/starch mixtures, basic products in child nutrition and origin of certain diseases, in vivo proteolysis of pepsin and trypsin of skimmed milk was studied with or without the supplementation of tapioca and maize, wheat, and potato starches, cooked or raw. These supplements did not affect the in vitro proteolysis of skimmed milk. However, a slight fixation of the hydrolysis products was observed, except for cooked tapioca. *(Author's summary. Trans. by L.M.F.)* I02

0338

10152 BIRSE, D.G.; CECIL, J.E. 1980. **Starch extraction: a check list of commercially available machinery.** London, Tropical Products Institute. Report G142. 16p. Engl.

Cassava. Industrial machinery. Cassava starch. Washing. Peeling. Rasping. Screening. Silting. Drying.

A comprehensive list of manufacturers and suppliers of starch extraction and processing equipment is given. In order to classify the equipment, starch extraction was divided into 5 basic operations: preparation (washing and peeling), comminution, screening, separation (sedimentation-dewatering), and drying. A brief description of each operation is given. Major organizations that produce equipment that use cassava as raw material are Newell Dunford Engineering (United Kingdom), Projects Development Institute (PRODA-Nigeria), Starcosa (German Federal Republic), Hovex Engineering and Nivoba (Netherlands). *(Summary by F.G. Trans. by L.M.F.)* 102

0339

13212 BENITEZ, O.C.; HERNANDEZ, F.A. 1979. **Estudio tecnológico sobre el uso de la harina de yuca en la fabricación del pan.** *(Technological study on the use of cassava flour in bread-making).* Tesis Ing. Agr. Santiago de los Caballeros, República Dominicana, Universidad Católica Madre y Maestra. 70p. Span., Sum. Span., 19 Refs., Illus.

Cassava. Cassava flour. Composite flours. Breads. Analysis. Dominican Republic.

The technological possibilities of using CF as an element for substituting wheat flour in bread-making were determined. It is feasible to substitute up to 20% wheat flour in doughs for sandwich bread, 10% in French bread, and 5% in 'de agua' type bread. The physical, chemical, and nutritional characteristics of these breads were evaluated by physicochemical and statistical analyses. It was concluded that the Dominican Republic should invest in the field of cassava industrialization for the obtainment of flour; if CF is used in making different types of bread, costly imports of wheat flour would lower. *(Extracted from author's summary. Trans. by L.M.F.)* 102

0340

17188 IGBEKA, J.C. 1982. **Simulation of moisture movement during drying a starchy food product – cassava.** Journal of Food Technology 17:27-36. Engl., Sum. Engl., 15 Refs., Illus.

Cassava. Drying. Water content. Statistical analysis. Simulation models.

A mathematical model of the moisture transfer in cassava during drying was developed. The model took into account the dependence of moisture diffusivity on MC and temp. and therefore was not made a constant. The solution of the model was achieved by an IBM 360 digital computer which utilized the statement oriented 360 CSMP (Continuous Systems Modelling Program). Predicted moisture profiles were compared with exptl. data. Correlation coefficients between the predicted and exptl. values ranged between 0.97-0.99. The mechanism of moisture transfer was analyzed. *(Author's summary)* 102 C03

See also 0215 0217 0239 0275 0352 0358

I03 Industrial Microbiology

0341

12880 REVUZ, B.; VOISIN, D. 1980. **Le manioc protéiné, procédé Adour Speichim.** *(Protein-enriched cassava. The Adour - Speichim process).* Industries Alimentaires et Agricoles 97(10):1079-1084. Fr., Sum. Germ., Engl., Fr., 8 Refs., Illus.

Cassava. Protein enrichment. Fermentation. Industrial microbiology.

The development of the Adour Speichim process is described; a starchy raw material is transformed into a balanced food rich in carbohydrates, proteins, and vitamins, by a selected strain of *Candida tropicalis* without prior hydrolysis. The pilot plant stage for cassava processing is described with the aid of diagrams and a scheme for a complete production plant is given. On DM, 13-40% protein can be produced as required. The protein contains all the essential amino acids, especially lysine and threonine, but is low in S-containing acids. *(Summary by Food Science and Technology Abstracts)* I03

0342

12980 LAMO, P.R. DE; MENEZES, T.J.B. DE 1979. **Bioconversão das águas residuais do processamento de mandioca para produção de biomassa.** *(Bioconversion of cassava processing waste water for fungal biomass production).* Coletânea do Instituto de Tecnologia de Alimentos 10:1-14. Port., Sum. Port., Engl., 8 Refs., Illus.

Cassava. Biomass production. ***Aspergillus.*** **Waste utilization. Industrial microbiology. Fermentation. Brazil.**

Studies were conducted on the use of waste water from cassava processing as a substrate for production of fungal biomass for use as a food. Trials were conducted with *Aspergillus niger, Gliocladium deliquescens, Trichoderma viride, Penicillium elegans,* and *A. oryzae.* Data are given for the composition of the waste water before biomass production, the BOD and COD reduction by the various species of fungi, DM yield, fermentation kinetics, and the protein content of the biomass produced. The culture of *G. deliquescens* reduced the pollution load of the waste water by approx. 80% and gave a biomass containing 35% protein. *A. oryzae* gave lower reduction in pollution load and lower biomass yield than *G. deliquescens;* protein content of its biomass was, however, higher (41%). *(Summary by Food Science and Technology Abstracts)* I03

0343

12976 MENEZES, T.B. 1978. **Caracterização bioquímica de uma celúlase fúngica e sua influência no rendimento de álcool da mandioca.** *(Biochemical characterization of a fungal cellulase and its influence on the alcohol yield from cassava).* Coletânea do Instituto de Tecnologia de Alimentos 9:175-200. Port., Sum. Engl., Port., 11 Refs., Illus.

Cassava. Alcohol. Fermentation. Industrial microbiology. pH. Temperature. Brazil.

Some biochemical properties of a cellulolytic broth obtained from a soil-isolated Basidiomycete were determined. It was shown that optimum pH for the activities of the C_1, Cx, and β-glucosidase fractions were all around 4.5. Max. pH stability for the C_1 and β-glucosidase fractions was found to be between 3.8-4.5 while the Cx fraction showed a wider range of pH stability. Optimum temp. ranges for the activities of the fractions were from 47-52, 40-65, and 60-70°C for C_1, Cx, and β-glucosidase, resp. Lower temp. provided greater stability for the enzyme, the stability being drastically reduced at temp. > 50°C. The cellulolytic broth obtained from a 30 *l* fermenter was used as an aid for the saccharification of cassava must in order to increase alcohol yields. Although an improvement of the rheological properties of the must (for instance a decrease in viscosity) was observed no substancial increase in alcohol yields was detected. *(Author's summary)* 103

0344

17144 MIKAMI, Y.; GREGORY, K.F.; LEVADOUX, W.L.; BALAGOPALAN, C.; WHITWILL, S.T. 1982. **Factors affecting yield and safety of protein production from cassava by *Cephalosporium eichhorniae*.** Applied and Environmental Microbiology 43(2):403-411. Engl., Sum. Engl., 30 Refs., Illus.

Cassava. Laboratory experiments. Protein enrichment. Culture media. pH. Biomass production. Cassava starch. Cassava meal.

The properties of *Cephalosporium eichhorniae* 152 (ATCC 38255) affecting protein production from cassava carbohydrate, for use as an animal feed, were studied. This strain is a true thermophile, showing optimum growth at 45-47°C, max. protein yield at 45°C, and no growth at 25°C. It has an optimum pH of about 3.8 and is obligately acidophilic, being unable to sustain growth at pH 6.0 and above in a liquid medium, or pH 7.0 and above on solid media. The optimum growth conditions of pH 3.8 and 45°C were strongly inhibitive to potential contaminants. It rapidly hydrolyzed cassava starch. It did not utilize sucrose, but some (approx. 16%) of the small sucrose component of cassava was chemically hydrolyzed during the process. Growth with CM [50 g/*l* (ca. 45 g/*l*, glucose equivalent)] was complete in approx. 20 h, yielding around 22.5 g/*l* (dry/biomass), containing 41% CP (48-50% CP in the mycelium) and 31% true protein (7.0 g/*l*). Resting and germinating spores (10^6-10^8/animal) injected by various routes into normal and γ-irradiated 6-wk.-old mice and 7-day-old chickens failed to initiate infections. *(Author's summary)* 103

J00 ECONOMICS AND DEVELOPMENT

0345

17105 **TENDÊNCIA DOS PREÇOS médios recebidos pelos produtores para os principais produtos: mandioca.** *(Trends of mean prices received by producers for major products: cassava).* 1981. Informe Agropecuário (Belo Horizonte) 7(84): 59. Port.

Cassava. Prices. Statistical data. Brazil.

A description is given of the increasing trend of mean annual standard prices of cassava received by producers in Brazil during 1971-80. *(Summary by F.G. Trans. by L.M.F.)* J00

0346

16558 CORPORACION REGIONAL DE DESARROLLO DE URABA. PROGRAMA DE AYUDA AGRICOLA INTEGRAL. 1981. **La producción de yuca en Urabá.** *(Cassava production in Urabá).* Revista Corpourabá 2(4):6-10. Span., Illus.

Cassava. Cultivation. Trade. Colombia.

Aspects of cassava commercialization and costs in Uraba, Colombia are briefly discussed. *(Summary by F.G. Trans. by L.M.F.)* J00

0347

17125 RAJESWARI AMMA, K. 1980. **A rational price for tapioca.** Journal of Root Crops 6(1/2):11-14. Engl., Sum. Engl., 1 Ref.

Cassava Production. Prices. Price maintenance. India.

A time series study was conducted to examine the structure of cassava prices in Kerala (India) and its effect on production and to suggest a methodology for determining a rational price for the commodity. Data obtained show that cassava prices have been unfavorable in recent years, reflected in the declining trend of production and area under cultivation. As cassava is a staple foodstuff, a source of income, and an important industrial raw material, it is necessary to maintain the % of this crop in the cropping pattern of the state. The need of a systematic and coordinated price policy with respect to this crop is emphasized. A parity approach may serve as a useful guideline for this endeavor. *(Author's summary)* J00

0348

16577 ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION. 1981. **Volumen de la producción de los principales productos agropecuarios, pesqueros y forestales: yuca, mandioca.** *(Production volume of major farm and animal, fishing, and forestry products: cassava). In*____. El estado mundial de la agricultura y la alimentación 1980. Roma. Colección FAO: Agricultura no. 12. pp.136, 139-142. Span.

Cassava. Production. Statistical data.

Cassava production vol. on à worldwide level, in Africa, L.A., the Near and Far East, and Asia are included for 1970-79. *(Summary by F.G. Trans. by L.M.F.)* J00

0349

17124 PUHAZHENDHI, V.; RAMASAMY, C. 1980. **Temporal growth of area, roduction and productivity of tapioca in Tamil Nadu.** Journal of Root Crops 6(1/2):7-10. Engl., Sum. Engl., 1 Ref.

Cassava. Production. Productivity. Statistical data. India.

The chronometric growth rate of cassava at Tamil Nadu (India) was estimated by using the compound growth rate model. The study revealed that the area has increased by 10.61% from 1967-68 to 1976-77 and the production and productivity by 168 and 143%, resp. The area and production increase was highest in S. Arcot district followed by Dharmapuri district. Kanyakumari district showed a negative trend. Results show that the area, production, and productivity of cassava may be enhanced and factors like price, product development, and technology should be given utmost care by planners and administrators. *(Author's summary)* J00

0350

15779 CASSAVA. 1981. Food Outlook 8:17-18. Engl.

Cassava. Production. Trade. Prices. Statistical data.

World cassava production, commercialization, and prices during 1978-80 are analyzed and estimates for 1981 are made, emphasizing major cassava-producing countries. Cassava prices will depend mainly on the size of the next Thai crop harvested during the last 4 mo. of the year and on the quantities purchased by the USSR. Pellet export prices are included. *(Summary by F.G. Trans. by L.M.F.)* J00

0351

17170 SELVADURAI, S. 1978. **Tapioca.** *In* ——. Agriculture in Peninsular Malaysia. Kuala Lumpur, Malaysia, Ministry of Agriculture. Bulletin no. 148. pp.155-162. Engl.

Cassava. Productivity. Processing. Production. Costs. Income. Statistical data. Malaysia.

Several aspects of cassava cultivation in Peninsular Malaysia are analyzed in detail: area cultivated by states during 1970-75 and the area cultivated on the whole peninsula between 1966-75; var.; yields (estimated as 8.5 t/ae); costs, returns, and prices; processing (animal feeds in the form of dried roots or chips; starch products such as CF, cassava flakes and pearls; and starch by-products in the form of refuse and low grade starch); imports and exports of products; and development. *(Summary by F.G. Trans. by L.M.F.)* J00

0352

11770 BONOMI, A.; BRANCO, J.R.C. 1979. **Etanol de mandioca: avaliação técnico econômica.** *(Cassava ethanol: technoeconomic evaluation). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.189-209 Port., Sum. Port., Engl., 9 Refs., Illus.

Cassava. Ethanol. Processing. Economics. Productivity. Brazil.

Cassava roots were compared with the traditional Brazilian raw material, sugar cane, regarding their value as raw material for ethanol production. The economical analysis of the cassava agroindustry clearly establishes the need to introduce specific technology for cassava processing along with intensive research in the agroeconomic area to provide raw materials. The proposed innovations, continuous processing operations for all the production stages, distillation with suspended solids, anaerobic digestion of stillage, and utilization of the

immobilized enzyme technique in a porous medium, are evaluated for their economic impact. *(Author's summary)* J00 I02

0353

16639 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. Economics. *In* ——. Cassava Program 1980. Annual Report. Cali, Colombia, CIAT Series no. 02ECI-80. pp.71-77. Engl., Illus.

Also in Spanish.

Cassava. Economics. Technology evaluation. Technological package. Inter-cropping. Maize. Marketing. Colombia.

The long-term objective of the economics section of the Centro Internacional de Agricultura Tropical is to analyze the potential impact of improved cassava technology in Latin America. On-farm trials conducted in Media Luna (Magdalena) and Mondomo (Cauca) are described as well as cassava/maize intercropping trials. A case study analyzing the cassava market in the poultry industry in Colombia is included. Tables were also presented on yields and net incomes from various cassava and maize intercropping systems at Media Luna and cassava and bean intercropping systems at Caicedonia; DM and fiber content, and % of total roots with root rot of 4 cassava lines at different harvesting times; fresh root yield of var. Americana and Algodona on individual farms related to plot history and farm size at Mondomo. *(Summary by F.G. Trans. by L.M.F.)* J00

0354

13021 TEIXEIRA, N.M.; ECHEVERRIA, L.C.R.; CORREA, H. 1973. **Aspectos econômicos da produção de mandioca em solo sob cerrado de Minas Gerais.** *(Economic aspects of cassava production on soils under the Cerrado conditions of Minas Gerais).* Informativo Estatístico de Minas Gerais 7(102):2-22. Port., 11 Refs., Illus.

Cassava. Prices. Costs. Harvesting. Timing. Income. Brazil.

An economic analysis of the cost of production of 1 ha planted to cassava under 4 cropping systems (mechanized, animal traction, nonmechanized, and traditional) was conducted at the headquarters of the Instituto de Pesquisas e Experimentação Agropecuárias do Centro-Oeste in Sete Lagoas, MG (Brazil) during the crop years 1969-71. Branch and root production at 6, 9, 12, 15, and 18 mo. was also analyzed. Major economic implications from the comparison between av. unit price of cassava and the av. price received by farmers when the product is sold for industrial purposes and for fresh consumption are discussed along with net sales and returns obtained from cassava exploitation. Harvesting was the most expensive factor in the process of cassava production; fertilizers and amendments occupying 2nd place. The most appropriate time for harvesting was at 18 mo. The systems studied did not show differences in the cost of production (except for the traditional cropping system). *(Author's summary. Trans. by L.M.F.)* J00 D01 D02

0355

13458 ROCHE, F.C. 1979. **Cassava production and production systems on Java: initial observations.** Stanford, California, Stanford University. 30p. Engl., 8 Refs., Illus.

Cassava. Production. Maps. Cultivation systems. Labour. Uses. Indonesia.

A preliminary descriptive report of the results of the 1st 4 mo. of research on cassava production systems in Java is given. Data (area harvested, production, and yield), maps, and descriptions of cassava-producing areas are given; prevailing production systems (monoculture, intercropped with maize, peanuts, soybean, sweet potatoes and/or a vegetable crop, with upland rice/maize, planted on field edges and in small plots or home gardens) are described. Technology and labor use are described and the use of cassava leaves for human

and animal consumption is indicated as a widespread practice in Java. The nature of current cassava support services in research and extension is discussed. Tentative considerations on factors affecting cropping patterns in dry areas of w. Java are given. *(Summary by A.J.C. Trans. by L.M.F.)* J00 K01

0356

16647 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. **International cooperation.** *In* ___ . Cassava Program 1980. Annual Report. Cali, Colombia. CIAT Series no. 02ECI-80. pp.87-89. Engl.

Also in Spanish.

Cassava. Transfer of technology. Colombia.

The progress achieved by CIAT's cassava program through training activities related to the crop in Latin America, Asia, and Oceania are given. In collaboration with the training office at the Centro Internacional de Agricultura Tropical, the cassava program in 1980 trained 38 professionals from 15 countries (Brazil, Colombia, Mexico, Bolivia, USA, Thailand, Dominican Republic, S. Africa, Ecuador, Haiti, Honduras, W. Germany, the Netherlands, Great Britain, and Italy). *(Summary by F.G. Trans. by L.M.F.)* J00

0357

13463 PACHICO, D. 1981. **Crop improvement strategy: an analysis of the potential benefits of new cassava production technology in Colombia.** Cali, Colombia, Centro Internacional de Agricultura Tropical. 15p. Engl., Sum. Engl., 12 Refs.

Cassava. Technology evaluation. Economics. Income. Marketing. Feeds and feeding. Statistical analysis. Colombia.

The potential benefits of cassava var. suitable for the feed market are estimated. A linear programming feed mix model simulates the cost reduction in feed resulting from cheaper cassava. Then, elasticities of demand and supply of poultry are estimated to calculate economic surplus from the new technology. *(Author's summary)* J00 H03

0358

13403 CALDEIRA, A. DE F. 1978. **Cultura da mandioca. Elaboração de projeto agrícola para a cultura da mandioca.** *(Cassava cultivation. Elaboration of an agricultural project for its cultivation).* Lavras-MG, Brazil, Escola Superior de Agricultura de Lavras. 28p. Port.

Paper presented at Curso de Capacitação de Técnicos para a Cultura da Mandioca. Convênio: INT - FUNAT/FAEPE.

Cassava. Cassava programs. Cultivation. Industrialization. Brazil.

Guidelines for elaborating an agricultural project of cassava production are given along with the basic principles of programming to be carried out by the National Alcohol Program for the obtainment of alcohol in Brazil. The difficulties of introducing cassava in areas with cerrado vegetation in Central North Minas Gerais are discussed and solutions proposed. Elements necessary to elaborate the project, information required to obtain these elements (agricultural techniques and practices, machinery and equipment, inputs and their costs, and diverse maps), and the tasks to develop are included. An example of this type of project, carried out in Frei Orlando, Morada Nova, MG, is given. *(Summary by A.J.C. Trans. by L.M.F.)* J00 I02

0359

13457 UNNEVEHR, L. 1979. **Cassava marketing on Java.** Stanford, California, Stanford University. Cassava Project. 26p. Engl., 12 Refs., Illus.

Cassava. Marketing. Distribution. Processing. Gaplek. Cassava starch. Consumption. Java.

Cassava marketing systems in Java are described in order to identify those aspects of economic behavior that are not fully understood. Marketing chains and the geographical flows of the various cassava products are described. Marketing channels are divided into 4 categories: fresh roots sold to urban consumers; fresh roots sold to starch producers; gaplek for rural and urban markets; and gaplek for exportation. Associated costs and price behavior according to the type of product, time, and region are discussed. Price formation and overall efficiency of the market are examined. A case study comparing the areas of Desa Petung and Desa Tamansari (East Java) regarding cassava production, consumption, and marketing is included. *(Summary by A.J.C. Trans. by L.M.F.)* J00

0360

13462 NELSON, G.C. 1979. **Indonesian supply and international demand for cassava products.** Stanford, California, Stanford University. Cassava Project. 40p. Engl., Sum. Engl.

Cassava. Trade. Cassava chips. Pellets. Cassava starch. Wastes. Factories. Gaplek. Indonesia.

Elements of the recent evolution of Indonesian and world trade in cassava, the current situation in the cassava processing industry, and the potential for expanding cassava product exports in Indonesia are examined. The trade of cassava chips and pellets made from dried roots (gaplek products), cassava starch, and wastes from the elaboration of starch is analyzed. Regarding industry, starch and gaplek processing firms and government policies affecting the cassava processing industry (especially investment, domestic tax, regulation, and foreign trade policies) are analyzed. The capacity of the cassava processing industry to absorb additional production and the development of world trade for cassava products in 1978-79 are also analyzed. Tables with data on the commercialization of cassava products are included. *(Summary by A.J.C. Trans. by L.M.F.)* J00

0361

17177 MULINDANGABO, J. 1981. **Synthèse de la recherche agronomique sur la culture du manioc au Rwanda.** *(Summary of agricultural research on cassava cultivation in Rwanda).* Bulletin Agricole du Rwanda 14(1):33-37. Fr., 8 Refs., Illus.

Cassava. Research. Toxicity. Tubers. Composition. Tuber productivity. Selection. Cultivars. Maps. Cassava programs. Rwanda.

Cassava is one of the main food crops in Rwanda, introduced in the 1930's. Four ecological zones in which the crop is grown are distinguished. Research has been conducted on: toxicity of the roots of different var.; influence of the environment on that toxicity; chemical composition of the roots; yield capacity of var.; selection for resistance to the mosaic disease; production, evaluation, and multiplication of clones. Guidelines are also included for future and long-term research. *(Summary by Abstracts on Tropical Agriculture)* J00

0362

17176 FLACH, M. 1981. **De stand van zaken in het cassave-onderzoek.** *(The present cassava research situation).* Landbouwkundig Tijdschrift 93(5):131-134. Dutch., 17 Refs., Illus.

Cassava. Research.

Recent cassava research is critically reviewed. In spite of a high level of research, yields/ha have not been improved. The nutrient uptake of cassava is low and the yield potential high if compared to other root crops. Mixed cropping and breeding for yield and disease resistance are 1st priorities for future research. *(Summary by Abstracts on Tropical Agriculture)* J00

0363

17178 TITAPIWATANAKUN, B. 1980. **Maize and cassava marketing in Thailand.** Bangkok. Kasetsart University. Extension Bulletin (ASPAC/FFTC) no. 153:10-19. Engl., Sum. Engl., Illus.

Cassava. Trade. Pellets. Cassava chips. Cassava meal. Cassava starch. Wastes. Thailand.

Thai maize industry has been an export-oriented industry for decades. The market has developed to provide spot trading and various types of forward trading. A further change in the maize industry is expected, if domestic maize consumption increases at a faster rate than production. Thai cassava industry has been an export-oriented industry from its very beginning. This rapidly growing industry has been able to adapt quickly to external changes. The cassava marketing institutions are now facing a strong possibility of trade restrictions in the EEC market and decreasing cassava production caused by the low root price and the government's policy to restrict cassava production areas. *(Summary by Abstracts on Tropical Agriculture)* J00

0364

17192 BOJANIC H., A.J. 1981. **La yuca en Santa Cruz y los aspectos agroeconómicos de su producción en "Las Marotas".** *(Cassava in Santa Cruz and agroeconomic aspects of its production in "Las Marotas").* Tesis. Ing. Agr. Santa Cruz de la Sierra, Bolivia, Universidad Boliviana Gabriel René Moreno. Facultad de Ciencias Agrícolas. 141p. Span., Sum. Span., 90 Refs., Illus.

Cassava. Socio-economic aspects. Cultivation. Bolivia.

An agroeconomic study of the Las Marotas community with an area of approx. 3000 ha, located in the Santistevan Province, Santa Cruz, Bolivia, was conducted to determine the role cassava plays in regional agriculture and its importance in production systems as well as to observe the cassava production process to direct research towards major NPFs. Data were collected in July 1979 in a questionnaire and census of all of the cassava growers in the area. Main crops were: cassava, rice, and maize, covering 75.6% of the total area under cultivation. Cassava was planted to an area larger than that of other crops; however, rice and maize were for sale and generated higher income for farmers. The process of cassava production is characterized by rudimentary practices and no inputs. Major limiting factors were: floods, weeds, wild animals, and insects. Due to its agroecological conditions, the area has potential for agricultural production. *(Extracted from author's summary. Trans. by L.M.F.)* J00

See also 0249

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotation Schemes and Intercropping

0365

12453 LAZARTE S., W.H. 1980. **Ensayo de asociación de yuca (*Manihot esculenta* Crantz) con fríjol (*Phaseolus vulgaris*).** *(Cassava/bean intercropping trials).* Tesis Ing. Agr. Lima. Perú, Universidad Nacional Agraria La Molina. 59p. Span., 15 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Beans. Planting. Timing. Tuber productivity. Peru.

An expt. was conducted at the Campo Agrícola Expt. of the U. Nacional Agraria La Molina (Peru) on sandy loam soils from recent alluvial sediments (Entisols) with neutral pH, low OM content, and deficient in total N to: (1) determine the feasibility of bean/cassava intercropping and (2) determine the most adequate time to intercrop. Cassava cv. Negra Mochera and Caraota beans were used in a randomized complete block design with 9 treatments and 4 replications: F_1 (beans in monoculture - check); Y_1 (cassava in monoculture - check); $F_1 Y_1$ (planted at the same time); $F_{30} Y_1$ (beans planted 30 days after cassava planting). $F_{45} Y_1$ (beans planted 45 days after cassava planting); $F_{60} Y_1$ (beans planted 60 days after cassava planting); $F_1 Y_{30}$ (cassava planted 30 days after bean planting); $F_1 Y_{45}$ (cassava planted 45 days after bean planting); $F_1 Y_{60}$ (cassava planted 60 days after bean planting). Planting date affected both cassava and bean production. The shade produced by bean plants affected cassava growth during the initial stages. Root wt. did not vary due to planting or intercropping date. The $F_1 Y_{60}$ treatment gave greater land use efficiency, productivity, and total profit/ha; there was a difference of 8844 kg as compared with beans and cassava in monoculture. The highest economic returns/ha/mo. were obtained with treatment $F_{45} Y_1$. *(Summary by I.B. Trans. by L.M.F.)* K01

0366

17191 KAWANO, K.; THUNG, M.D. 1982. **Intergenotypic competition and competition with associated crops in cassava.** Crop Science 22(1):59-63. Eng., Sum. Engl., 11 Refs., Illus.

Cassava. Inter-cropping. Beans. Soybeans. Germplasm. Cultivars. Tuber productivity. Harvest index. Colombia.

The competitive ability (defined as root yield in mixture/root yield in monoculture) of cassava genotypes in monoculture, mixed populations, and in multiple cropping systems was studied in the field. Strong competitors produced more roots and stems in genotypic mixtures than in monoculture and did so at the expense of weak competitors. Competitive ability was positively correlated with spacing response and stem and leaf wt. at harvest, but negatively correlated with HI (proportion of root wt. to total plant wt.) and root yield in monoculture. Because of the negative correlation of competitive ability with root yield in monoculture, improvement in the productivity of cassava cv. will likely occur through improvements in plant efficiency and at the expense of competitive ability. It is therefore recommended that in selecting high yielding genotypes potentially adapted to productive environments, strong competitors should be eliminated from segregating populations. Modest yield reductions (9-13%) occurred when cassava was planted in association with beans or soybeans. Beans, planted in association with cassava, had nonsignificant reductions

in yields whereas yields of soybeans were severely reduced. Yields of beans and soybeans were negatively correlated with vegetative vigor of the associated cassava genotype, but were not correlated with yield or intergenotypic competitive ability of the cassava genotype. Cassava can be planted in association with short-duration crops without sacrificing much in the yields of either crop. High-yielding cassava genotypes with low vegetative vigor would bring about high combined yields of cassava and the associated crop. *(Author's summary)*
K01 D03

See also 0355

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Z00 GENERAL

0367

17138 TUPINAMBA, E.A. 1981. **Projeto mandioca.** *(Cassava program). In* Empresa Brasileira de Pesquisa Agropecuária. Relatório Técnico Anual da Unidade de Execução de Pesquisa de Âmbito Estadual de Aracaju 1980. Aracaju-SE, Brasil. pp.43-45. Port.

Cassava. Research. Disease control. Planting. Spacing. Plant breeding. Fertilizers. P. Brazil.

Results are given of research conducted in 1980 by the subprojects on disease control, cropping system, breeding, and study on macro and micronutrients of the cassava program at the Unidade de Execução de Pesquisa de Âmbito Estadual (UEPAE), Aracaju, Brazil. *(Summary by F.G. Trans. by L.M.F.)* Z00

0368

15053 LOPEZ S., J. 1980. **Características de la literatura sobre yuca.** *(Characteristics of cassava literature).* Yuca. Boletín informativo 8:11-15. Span., 6 Refs., Illus.

Also in English.

Cassava. Information retrieval.

The numerical distribution of documents produced on cassava (1831-1980) among the different types of publications (periodicals, books, proceedings, pamphlets, patents, and thesis) is analyzed. The production of literature by discipline is analyzed for the decade of the 60s and 70s; agronomy, nutrition, and industrialization occupied the 1st 3 places. *(Summary by F.G. Trans. by L.M.F.)* Z00

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LIST OF ABBREVIATIONS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
Afr.	Afrikaans
a.i.	Active ingredient
alt.	Altitude
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
AMV	Alfalfa mosaic virus
approx.	Approximate(ly)
atm.	Atmosphere
ATP	Adenosine 5'-triphosphate
av.	Average
BAP	6-Benzylaminopurine
BBMV	Broad bean mosaic virus
BCMV	Bean common mosaic virus
BGMV	Bean golden mosaic virus
BGYMV	Bean golden yellow mosaic virus
BOD	Biochemical oxygen demand
BPMV	Bean pod mottle virus
BRMV	Bean rugose mosaic virus
BSMV	Bean southern mosaic virus
BV	Biological value
BYMV	Bean yellow mosaic virus
°C	Degrees Celsius (centigrade)
ca.	About (circa)
CBB	Cassava bacterial blight
CBSD	Cassava brown streak disease
CEC	Cation exchange capacity
CER	CO_2 exchange rate
CF	Cassava flour
CGR	Crop growth rate
CLM	Cassava leaf meal
CLV	Cassava latent virus
CM	Cassava meal
cm	Centimeter
COD	Chemical oxygen demand
concd.	Concentrated
concn.	Concentration
CP	Crude protein
CSL	Calcium stearyl lactylate
CSW	Cassava starch wastes
C.V.	Coefficient of variation
cv.	Cultivar(s)
2,4-D	2,4-dichlorophenoxyacetic acid
DM	Dry matter
DNA	Deoxyribonucleic acid
EC	Emulsifiable concentrate
EDTA	Ethylenediaminetetraacetic acid
EEC	European Economic Community
e.g.	For example
ELISA	Enzyme-linked immunosorbent assays
EMS	Ethyl methane sulfonate
Engl.	English
expt.	Experiment
exptl.	Experimental
°F	Degrees Fahrenheit
Fr.	French
ft-ca	Foot candles (10.76 lux)
FYM	Farmyard manure
g	Gram(s)
G	Giga (10^9)
GA	Gibberellic acid
gal	Gallon(s)
GE	Gross energy
Germ.	German
GERs	Glucose entry rates
GLC	Gas-liquid chromatography
govt.	Government
govtl.	Governmental
h	Hour(s)
ha	Hectare(s)
HCN	Hydrocyanic acid
HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
HI	Harvest index
IAA	Indoleacetic acid
IBA	Indolebutyric acid
Illus.	Illustrated
in.	Inches
i.e.	That is
Ital.	Italian
IU	International unit
J	Joule
Jap.	Japanese
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilogram-calorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate
kR	Kiloroentgen(s)
l	Liter(s) (only in combination with no.)
LAD	Leaf area duration
LAI	Leaf area index
lat.	Latitude
lb	Pound(s)
LD_{50}	Mean lethal dose

LER	Land efficiency ratio
LPC	Leaf protein concentrate
lx	Lux
M	Mega
M	Molar
m	Meter(s)
Mal.	Malay
max.	Maximum
MC	Moisture content
ME	Metabolizable energy
meq	Milliequivalent(s)
met.	Methionine
mg	Milligram(s)
mho	Reciprocal ohm
min.	Minimum
min	Minute(s)
ml	Milliliter(s)
mm	Millimeter(s)
mo.	Month
mol. wt.	Molecular weight
m.p.	Melting point
NAA	α-Naphthalene acetic acid
NAD	Nicotinamide adenine dinucleotide
NADH	Nicotinamide adenine dinucleotide, reduced from
NAR	Net assimilation rate
NCE	Net CO_2 exchange
NE	Northeast
NER	Net energy ratio
nm	Nanometer(s) (10^{-9} m)
no.	Number(s)
NPFs	Negative production factors
NPR	Net protein ratio
NPU	Net protein utilization
NW	Northwest
OM	Organic matter
oz	Ounce(s)
P	Probability
Pa.	Pascal(s)
PAN	Pexoxyacetic nitrate
PCNB	Pentachloronitrobenzene
PDA	Potato dextrose agar
PER	Protein efficiency ratio
pH	Hydrogen ion concentration
pphm	Parts per hundred million
PPI	Pre-planting incorporation
ppm	Parts per million
PSA	Potato sucrose agar
pv.	Pathovar.
Ref(s).	Reference(s)
resp.	Respective(ly)
Rf	Retardation factor-chromatography
RGRs	Relative growth rate
RH	Relative humidity
RNA	Ribonucleic acid
Rom.	Romanian
Russ.	Russian
S	Svedberg unit of sedimentation coeff. (10^{-13} s)
s	Second
$S_{20,w}$	Sedimentation coefficient corrected to water at 20°C
SBM	Soybean meal
SCN	Thiocyanate
SCP	Single cell protein
SDS	Sodium dodecyl sulfate
Sk.	Slovak
sp.	Specie
Span.	Spanish
spp.	Species
SSL	Sodium stearyl-2-lactylate
Sum.	Summary
t	Ton(s)
TDN	Total digestible nutrients
temp.	Temperature
TIA	Trypsin inhibitor activity
TiBA	2,3,5-Triiodobenzoic acid compound with *N*-methylmethanamine
TLC	Thin-layer chromatography
TMV	Tobacco mosaic virus
TSH	Thyroid-stimulating hormone
UDPG	Uridine diphosphate glucose
UMS	Unmodified cassava starch
UV	Ultraviolet
var.	Variety(ies), varietal
VFA	Volatile fatty acids
vol.	Volume
VPD	Vapor pressure deficit
vpm	Volume per million
W	West
wk.	Week
WP	Wettable powder
wt.	Weight
YFEL	Youngest fully expanded leaves
yr	Year(s)
α	*alpha*
β	*beta*
γ	*gamma*
δ	*delta*
ε	*epsilon*
λ	*lambda*
π	*pi*
ψ	*psi*
/	Per
μ	Micro
%	Percent(age)
>	More than, greater than
<	Less than
≤	Equal to or less than
≥	Equal to or greater than
±	Plus or minus
ϕ	Diameter
≪	Much less than
≫	Much greater than

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(*Manihot esculenta*, Crantz)

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Abstracts on Cassava
(*Manihot esculenta* Crantz)

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FOREWORD

CIAT's documentation activities are focused on three research areas: cassava (*Manihot esculenta* Crantz) production and utilization, field beans (*Phaseolus vulgaris* L.) as grown under tropical conditions, and tropical pasture species and their management. The goal of the Documentation Center is to disseminate research results and report ongoing activities in these three areas.

This journal of analytical abstracts, which replaces the former combination of abstract cards and yearly cumulative volumes, is designed to provide users with both an update service and a permanent record of information that contains essential data for their research activities. The abstracts are categorized in broad disciplinary fields to facilitate rapid scanning. Additionally, abstracts are subject and author indexed to enable more comprehensive consultation. When retrospective or exhaustive coverage of a topic is desired, mechanized bibliographic searches of the entire document collection can be provided by CIAT's Documentation Center. Abstracts of all articles that match the topic of interest are provided to users of this mechanized search service. The full text of every article abstracted by the Documentation Center is available, through the Center's photocopy service.

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Cassava Newsletter (Yuca - Boletín Informativo) - a technical newsletter that provides information regarding cassava research in progress throughout the tropics.

Pastos Tropicales - Boletín Informativo - a newsletter on pasture research and on new developments in the tropical pastures network.

Hojas de Fríjol - a newsletter on bean breeding, agronomy, and cropping systems, and on the activities within the bean researchers' network.

We believe that each of these types of information plays a key role in research aimed at increasing agricultural productivity in the tropics. It is our hope that this range of publications satisfies the various information needs of our users.

A GUIDE FOR USERS

Components of a reference

Sequential number in this journal

0012

1 16172 TELES, F.F.F.; SILVEIRA, A.J.; BATISTA, C.M.; FEITOSA, E.P.G.;
2 RESENDE, J.L.M. 1980. Açúcares solúveis em mandioca (*Manihot esculenta* 3
Crantz). (*Soluble sugars in cassava*). Revista Ceres 27(151):325-328. Port., Sum.
7 Engl., 11 Refs. 4 5 6

8 Cassava. Laboratory experiments. Tubers. Analysis. Carbohydrate content. Clones. Brazil.

9 Total soluble carbohydrates, reducing and non-reducing sugars on 10 cassava clones, cultivated in the state of Minas Gerais, Brazil were analyzed. The analyses were carried out spectrophotometrically by the Teles' Reagent after extraction by mechanical shaking with ethanol 50% (v/v). Av. obtained, in mg/g of green matter, ranged from 1.3-7.8 of reducing sugars; 6.1-21.8 of non-reducing; and 7.5-29.6 of total soluble carbohydrates. Statistical analyses showed significant differences among clones ($P < 0.05$), and a correlation coefficient ($r = + 0.8$) between reducing and non-reducing sugars. (*Author's summary*) C03
10 11

1- Accession number
2- Author(s)
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4- Title translation
5- Source
6- Pages
7- Additional notes
8- Descriptors
9- Summary
10- Abstractor and/or translator
11- Subject categories

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B00 PLANT ANATOMY AND MORPHOLOGY

0369

10203 BAI, K.V.; JOS, J.S. 1981. **A simple and rapid method of screening stomatal distribution and trichomes in cassava.** Current Science 50(17):773-774. Engl., 4 Refs., Illus.

Cassava. Leaves. Stomata. India.

Sixty-four genetic stocks of cassava were studied by adopting the adhesive peeling technique in order to determine stomatal distribution and hairiness. This technique consists in smearing the desired leaf with Fevicol, a synthetic adhesive resin having SH bond. The smeared leaflet is allowed to dry for about 1 h; later, the film of the adhesive can be easily peeled off and directly studied under the microscope. A wide variation of stomatal distribution ranging from 30.3-73.7/unit area (278.2-676.8/mm^2) in different clones was established. The adhesive peelings further revealed the presence of hairs in varying degress on the leaf surface. *(Summary by F.G. Trans. by L.M.F.)* B00

0370

16666 LIU, M.C.; YANG, L.S. 1982. **Histological examinations of anther's structure and its callus origin in cassava.** Taiwan Sugar 29(1):8-14. Engl., Sum. Engl., 18 Refs., Illus.

Cassava. Anthers. Pollen.

The structure and callus origin in cassava anthers were histologically investigated. Morphology of male flowers and of pollen, histology of anthers, and the site of anther callus formation are described in detail and illustrated. Among the various structures in an anther, a specialized endothecium of microsporangial wall and a feature mosaic configuration on pollen surface were observed. Callus was initiated from the endothecial cells and proliferated also from the intermicrosporangial stripe. *(Author's summary)* B00

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C00 PLANT PHYSIOLOGY

0371

16267 REY. H.; MROGINSKI, L.A.; FERNANDEZ, A. 1980. **Inducción *in vitro* de callos y raíces en explantos de seis cultivares de mandioca (*Manihot esculenta* Crantz).** *(In vitro induction of callus and root formation in explants of six cassava cultivars).* Phyton 39(1):161-170. Span., Sum. Span., Engl., 16 Refs., Illus.

Cassava. Laboratory experiments. Tissue culture. Culture media. Cultivars. Plant-growth substances. Propagation. Roots. Argentina.

Leaf, shoot, and anther explants from 6 cassava cv. were cultured in vitro in Murashige & Skoog (M.S.) medium supplemented with different auxins and cytokinins. The M.S. medium + 1 mg 2,4-D/*l* + 0.5 mg K/*l* was one of the best for callus formation. Callus originated roots but not shoots. Cytologic analysis of the callus cells showed that most cells have 36 chromosomes, although some have 37, 38, 39, or 40. *(Author's summary)* C00

0372

16268 IKE, I.F.; THURTELL, G.W. 1981. **Response of indoor-grown cassava to water deficits and recovery of leaf water potential and stomatal activity after water stress.** Journal of Experimental Botany 32(130):1029-1034. Engl., Sum. Engl., 14 Refs., Illus.

Cassava. Laboratory experiments. Water stress. Leaves. Stomata. Plant physiological processes.

In greenhouse trials cassava was grown at soil water potentials of -0.01 to -0.03 MPa. Leaf wilting occurred in acropetal succession at leaf water potentials between -0.9 and -1.1 MPa. Only severe water stress caused discoloration and abscission of basal leaves. Leaf resistance was independent of leaf water potential above -0.5 MPa but increased as the potential fell below this. Leaf water potential recovered rapidly within 0.5 h after rewatering. The max. value after rewatering depended on the severity of the water stress. *(Summary by Field Crop Abstracts).* C00

0373

16142 WARRINER, S.A.; ASHER, C.J.; EDWARDS, D.G. 1981. **Effects of root temperature on growth and nutrient uptake of cassava (*Manihot esculenta* Crantz).** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.96-97. Engl.

Cassava. Laboratory experiments. Temperature. Roots. Growth. Nutrient absorption. Australia.

A greenhouse expt. was conducted to determine the effect of root temp. on the growth of 6 cassava cv. (M AUS 1, M AUS 7, M AUS 15, M AUS 19, M AUS 21, and Ceiba) in solutions maintained at adequate concn. of all essential elements and also to identify nutrient limitations on growth through plant analysis. Each of the 7 root temp. (14.5, 17.0, 20.8, 24.5, 28.1, 32.5, and 37.2°C) was assigned to a flowing culture solution unit. All cassava cv. had a root temp. range for 90% max. top dry wt. of only 3-5°C. Elemental analysis of plant tops

indicated a slight Mg deficiency at root temp. of 14.5, 17.0, and 37.2°C in cv. M AUS 1, M AUS 19, and M AUS 21. Cassava is more sensitive than other crops to root temp. variation,its optimum being 28°C. *(Summary by F.G. Trans. by L.M.F.)* C00

0374

11098 SANTOS, Z.G. DOS; TUPINAMBA, E.A. 1979. **Deficiência de manganês em mandioca (*Manihot esculenta* Crantz) no Estado de Sergipe.** *(Manganese deficiency in cassava in the state of Sergipe). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.279-291. Port., Sum. Port., Engl., 21 Refs., Illus.

Cassava. Field experiments. Mineral deficiencies. Mn. Chlorosis. Brazil.

In order to determine the relationship between the appearance of interveinal chlorosis on cassava leaves, the nutritive state of the plant, and soil conditions, samples of leaves from chlorotic and non-chlorotic plants of cassava cv. Caravela were taken and analyzed as well as samples from the surrounding soil in an expt. conducted in the municipality of Araua, SE, Brazil. At levels < 20 ppm in cassava leaves Mn was found to cause chlorosis. Soil pH values > 5.8 and Ca^{++} and Ca^{++} + Mg^{++} contents > 3.8 meq/100 g, resp. seem to be related to the decrease in Mn content in cassava leaves and the appearance of external symptoms of Mn deficiency. *(Author's summary)* C00 D01

0375

16291 PEREIRA, A.R.; MACHADO, E.C.; CAMARGO, M.B.P. DE 1982. **Solar radiation regime in three cassava (*Manihot esculenta* Crantz) canopies.** Agricultural Meteorology 26(1):1-10. Engl., Sum. Engl., 42 Refs., Illus.

Cassava. Plant physiology. Solar radiation. Canopy. Leaves. Brazil.

The solar radiation regime above and within the canopies of 3 cassava cv. with different plant structure and leaf geometry during the period of max. LAI is described. Cv. Branca de Santa Catarina (218 cm tall with high branching and large leaves), IAC-12-829 (184 cm tall with low branching and large leaves), and IAC-7-127-Iracema (176 cm tall with high branching and narrow leaves) were planted on a 50 x 170 m flat field at the Campinas Exptl. Station, Instituto Agronômico, Campinas-SP, Brazil. For solar elevation > 20° and clear sky conditions, the near infrared (NIR) and photosynthetically-active radiation (PAR) were, resp., 0.54 and 0.46 of the incoming solar radiation. During the period of max. LAI, plant structure had no apparent effect upon the crop reflection, transmission, and absorption coefficients which were, however, functions of solar elevation. NIR was always more reflected and transmitted but less absorbed than PAR regardless of the plant structure. For the wavebands considered the following radiometric relations were, in general, obtained: (1) incoming radiation, IPAR = 0.85 INIR; (2) reflected radiation, RPAR = 0.07 RNIR; (3) net solar radiation, NPAR = 1.29 NNIR; (4) transmitted radiation, TPAR = 0.5 TNIR. *(Author's summary)* C00

0376

16621 COELHO, K.J.F.; OLIVA, M.A. 1981. **Eficiência no uso de água em plantas jovens de mandioca (*Manihot esculenta*, Crantz) submetidas á deficiência hídrica.** *(Water use efficiency in young cassava plants submitted to water stress).* Agropecuária Técnica 2(1):20-30. Port., Sum. Port., Engl., 23 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Water stress. Transpiration. Water requirements (plant). Photosynthesis. Brazil.

The effects of water stress on water loss due to transpiration and CO_2 fixation were studied in 4 cassava cv. (Sutinga, Cacau, Gigante Branca, and Manteigão). Total plant resistance to drought was evaluated considering leaf diffusive resistance and the transpiration rate as prevention parameters. The rate of photosynthesis, the water compensation point, and

water use efficiency were used as tolerance parameters. Max. rates of photosynthesis were obtained with the highest water contents. As the relative water content of the leaf decreased, net photosynthesis and transpiration for all 4 cv. were reduced. Cv. Cacau had the strongest stomatal sensibility to water stress; cv. Gigante Branca presented the lowest water compensation point and only at 80% relative water content stomatal closure increased. Water use efficiency was higher in turgid plants, except with cv. Sutinga and Gigante Branca which showed a certain tolerance to water stress; other cv. were less tolerant to dehydration. *(Author's summary)* C00 D01

0377

17505 VILLEGAS, C.D.; BAUTISTA, A.T.; COTEJO JUNIOR, F.R. 1981. **Accurate and rapid techniques for leaf area measurement in cassava and sweet potato.** Radix 3(1):10. Engl.

Cassava. Leaves. Leaf area.

Four techniques of measuring leaf area (planimetric, weighing, square counting, and statistical methods) in cassava and sweet potato were evaluated to determine the most rapid and accurate method. A total of 120 leaves each of cv. BNAS-51 (sweet potato) and Golden Yellow (cassava) were used. Among the 4 techniques used, the statistical method proved to be the most rapid technique for both crops since the amount of time spent was shorter than the other 3 methods. The planimetric, statistical, and weighing methods were the most accurate. *(Summary by F.G. Trans. by L.M.F.)* C00

0378

16143 ZAMORA, O.; WILSON, G.L. 1981. **Canopy photosynthesis.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.98-99. Engl.

Cassava. Field experiments. Cultivars. Photosynthesis. Canopy. Planting. Spacing. Australia.

Two field trials were carried out, followed by greenhouse studies, to determine the photosynthetic productivity of cassava canopies. In the 1st trial cv. M AUS 7 was planted at a density of 20,000 plants/ha. For most of the season there was a greater depth of the canopy in terms of both height and LAI. The possibility that canopy structural changes might improve light penetration characteristics was examined in the 2nd trial. Cv. M AUS 7 and M AUS 13 with different leaf shape were used at 3 plant densities (20,000, 40,000, and 80,000 plants/ha). Most of the photosynthesis occurred in a relatively shallow leaf layer, regardless of plant density and cv. There were no differences between the cv. in total photosynthetic activity, but there was a large population effect. *(Summary by F.G. Trans. by L.M.F.)* C00

0379

12974 MAESHIMA, M.; URITANI, I., ASAHI, T. 1980. **Effect of temperature on the activities of cytochrome *c* oxidase and respiration in cassava root mitochondria.** Agricultural and Biological Chemistry 44(10):2493-2494. Engl., 7 Refs., Illus.

Cassava. Enzymes. Biochemistry. Plant physiological processes. Mitochondria.

The temp. dependence of cytochrome *c* oxidase activity and respiratory rate of cassava root mitochondria was studied. Crude mitochondrial fraction was prepared from the homogenate of root pulp by differential centrifugation and then fractionated to obtain a purified fraction which was suspended in 0.1 *M* KCl. This was subjected twice to sonic oscillation and centrifugation and then suspended in 50 m*M* of Tris-acetate buffer (0.25 *M* sucrose). Cytochrome *c* oxidase activity in the submitochondrial particles was determined; an oxygenelectrode apparatus was used to assay the respiratory activity of the crude mitochondrial fraction and an electric thermoregulator controlled the temp. Two transition temp. were observed on Arrhenius plots. It is reasonable that the transition temp. of

cytochrome *c* oxidase activity is different from that of respiratory activity due to the rapid reaction of the 1st. There is a transition point in the Arrhenius plot for cytochrome *c* oxidase activity of mitochondria in plants grown in tropical or subtropical zones but not in cold or temperate areas. *(Summary by I.B. Trans. by L.M.F.)* C00

See also 0493

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C01 Plant Development

0380

16279 INDIRA, P.; RAMANUJAM, T. 1979. **Effect of photoperiod on tuberization in cassava.** Journal of Root Crops 5(1/2):39-42. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Photoperiod. Growth. Tuber development. Tuber productivity. India.

The effect of photoperiod on plant growth and tuber development in cassava var. M-4 was studied under 8-, 12-, 16-, and 20-h day periods under field conditions. The 12-h day length affected tuber formation when compared to short- and long-day treatments; however, tuber development was promoted when plants were exposed to 16- and 20-h photoperiods. The short-day (8 h) treatment reduced tuber size as well as tuber yield. *(Author's summary)* C01

0381

13404 SALADAGA, F.; SEBIDOS, R. 1979. **Study on the flowering behavior of 280 local and introduced cassava varieties at different dates of planting.** Radix 1(1): 14-15. Engl., 8 Refs.

Cassava. Field experiments. Cultivars. Germplasm. Planting. Timing. Flowering. Philippines.

The flowering behavior of different cassava cv. of the germplasm collection of the Philippine Root Crop Research and Training Center was studied to provide basic information on selected accessions under conditions of the Visaya State College of Agriculture. Twelve plantings were set up at monthly intervals. Each var. in the monthly planting was allowed to stay in the field for 18 mo. Observations were recorded for each planting on the no. of days to flower, duration, and flowering behavior. When cassava var. were planted at different dates, differences in flowering behavior were noted, the highest amount of flowering among var. being in Oct., Nov., Jan., and Feb. A particular var. may flower at a certain planting date, but no var. was observed to flower in all plantings. Regardless of the planting date, age and duration of flowering are functions of plant genetics rather than of the effect of seasonal fluctuations during the crop season. *(Summary by F.G. Trans. by L.M.F.)* C01 D02

0382

13587 RAMANUJAM, T. 1980. **Influence of late branching on the yielding capacity of cassava under rainfed condition.** Journal of Root Crops 6(1/2):57-58. Engl., 5 Refs., Illus.

Cassava. Research. Branching. Leaf area. Growth. Dry matter. Tuber productivity. India.

A study was conducted to compare the yielding ability of branched and nonbranched cassava plants. A total no. of 250 plants of cv. H-1687 were maintained in a block. Leaf area, plant growth, and DM distribution among 25 branched plants were compared with 25 nonbranched plants selected at random and tested for significance. Branching in H-1687 occurred 120-150 days after planting. Growth parameters recorded at harvest indicated that the nonbranching plants grow significantly taller than the branched plants. The no. of nodes/plant was higher in branched plants; however, the internodal length of lateral branches was longer when compared with the main shoot. The av. leaf no./plant and LAI

observed during the 5-10 mo. period were significantly higher in branched plants (130-2.96) than in nonbranched ones (72-2.03). Mean tuber yield of branched plants (3.6) was higher than the nonbranched ones (3.3). A more baianced MS distribution was observed in the branched population. *(Summary by F.G. Trans. by L.M.F.)* C01 D03

0383

17520 TAVORA, F.J.A.F.; QUEIROZ, G.M. DE; PINHO, J.L.N. DE; MELO, F.I. O. 1982. **Comportamento de cultivares de mandioca com diferentes características foliares submetidas a diversas densidades de plantio.** *(Behavior of cassava cultivars with different leaf characteristics grown under different plant populations).* Pesquisa Agropecuária Brasileira 17(3):417-431. Port., Sum. Port., Engl., 11 Refs., Illus.

Cassava. Field experiments. Cultivars. Planting. Spacing. Dry matter. Leaf area. Harvest index. Tuber productivity. Brazil.

A field trial was conducted on the eastern coast of the state of Ceará, Brazil, from March 1978-Aug. 1979 (2 growing seasons) to study the behavior of 2 cassava cv., Do Céu and Saracura, with broad- and narrow-lobed leaves, resp., grown under varying population densities. The pattern of the plant DM accumulation and distribution was also studied. The LAI of the cv. showed max. values 4 and 15 mo. after planting, corresponding to the rainy seasons of 1978 and 1979. Cv. Saracura showed a higher LAI at all population densities, the highest differences taking place during the 2 rainy seasons. The LAI followed closely the amount of rainfall in the exptl. area. Cv. Saracura had considerably smaller leaves than Do Céu. Both cv. had larger leaves during the 1st growing season. Cv. Saracura slightly outyielded Do Céu in total biomass, root yield, and had a higher HI. For both cv. the HI was highest 7 mo. after planting. The best performance of cv. Saracura does not seem to be related to its narrow-leaf lobes but to the ability of this cv. to rapidly produce a high LAI and to translocate large amounts of DM to the roots. For both cv. root DM was reduced with increasing plant populations. *(Author's summary)* C01 D02

0384

17521 FAHL, J.I.; MACHADO, E.C.; PEREIRA, A.R.; ARRUDA, H.V.; LORENZI, J.O. 1982. **Características fisiológicas de três cultivares de mandioca.** *(Physiological characteristics of three cassava cultivars).* Pesquisa Agropecuária Brasileira 17(3):399-405. Port., Sum. Port., Engl., 16 Refs., Illus.

Cassava. Field experiments. Cultivars. Planting. Spacing. Harvest index. Leaf area. Growth. Dry matter. Brazil.

Root production, HI, and LAI of 3 cassava cv. (Branca de Santa Catarina, IAC-12-829, and IAC-7-127-Iracema) were not significantly affected by planting densities (10,000, 16,666, and 25,000 plants/ha). HI asymptotically approached the value 0.67. Cv. whose stems had the highest wt. had the lowest root wt. Max. LAI achieved for all var. was 4.0. Cv. IAC-12-829 and Branca de Santa Catarina had the highest root yield, while Branca de Santa Catarina also had the highest plant wt. Max. CGR were 11.5, 10.2, and 8.8 g/m^2/day for Branca de Santa Catarina, IAC-12-829, and IAC-7-127-Iracema, resp. Max. root growth rate followed the same sequence with 6.9, 6.3, and 6.2 g/m^2/day, resp. Accumulation of DM in the roots began only after the plants had approx. 270 g/m^2. *(Author's summary)* C01 D02

0385

16153 HERMUS, R.C.; WILSON, G.L. 1981. **Sprouting of cassava from stem cuttings.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.48-49. Engl.

Cassava. Cuttings. Storage. Temperature. Germination. Australia.

The sprouting of cassava cv. M AUS 7 was studied in relation to the storage conditions of stem cuttings and to temp. during the sprouting of stems cut by different methods (trans-

verse, oblique, and rough). None of the cutting methods gave significant differences in sprouting characteristics (total fresh wt. of new growth at emergence or time to emergence). Temp. during sprouting had marked effects on the rate of sprouting. Sprouting was not adversely affected by the storage of cuttings up to 32 days at ambient temp.; however, RH during storage had a marked effect on subsequent sprouting. *(Summary by F.G. Trans. by L.M.F.)* C01 D02

0386

16670 COELHO, K.J.F. 1980. **Produtividade primária e eficiência no uso de água de mandioca (*Manihot esculenta*, Crantz), submetida a deficiência hídrica.** *(Primary production and water use efficiency of cassava subjected to water stress).* Tese Mag. Sc. Viçosa-MG, Universidade Federal de Viçosa. 36p. Port., Sum. Port., 59 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Water stress. Transpiration. Photosynthesis.

The effect of increasing water stress on water loss and CO_2 fixation was studied in cassava cv. Cacau, Manteigão, Sutinga, and Gigante Branca. Total plant resistance to drought was estimated using leaf diffusion resistance and transpiration rates as prevention parameters and the rate of photosynthesis, water compensation point, and water use efficiency as tolerance parameters. In turgid plants, the rates of photosynthesis decreased as CO_2 concn. inside the system decreased. The water compensation point for cv. Manteigão occurred at a higher relative water content than other cv., the lowest being that of cv. Gigante Branca. When water stress increased, transpiration rates were reduced and a tendency to stabilize about 70% of the relative water content was observed. Cv. Cacau showed a strong stomatal reaction to water stress. Cv. Gigante Branca showed a certain tolerance to water stress; other cv. were not tolerant to dehydration. *(Extracted from author's summary. Trans. by L.M.F.)* C01

0387

17557 MABANZA, J.; JONARD, R. 1981. **La multiplication des clones de manioc (*Manihot esculenta* Crantz) à partir d'apex isolés in vitro.** *(Multiplication of cassava clones from apexes cultured in vitro).* Comptes Rendus des Séances de l'Académie des Sciences (Série III) 292(13):839-842. Fr., Sum. Fr., Engl., 8 Refs., Illus.

Cassava. Tissue culture. Culture media. Plant-growth substances. Plant development.

An expt. was carried out to assess callus growth from cassava plant apexes cultured in vitro and kept in a Murashige & Skoog mineral solution containing different concn. of growth substances: benzylamine purine (BAP), 0.5 mg/*l*; NAA, 1 mg/*l*; and GA, 0.1 mg/*l*. Apexes produced callus capable of intense budding. When first kept in a solution containing BAP-NAA leaf budding occurred; rooting of leaf buds was promoted when transferred to a solution low in NAA. A single explant may produce more than 50 plants in about 40 days. *(Summary by J.L.S.)* C01

See also 0395 0435 0474 0478

C02 Cyanogenesis

0388

16656 NARTEY, F. 1977. **The biogenesis and metabolism of cyanogenic glucosides in germinating cassava seed and seedlings.** *In* Leakey, C.L.A., ed. Symposium of the International Society for Tropical Root Crops, 3rd., Ibadan, Nigeria, 1973. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.145-158. Engl., Sum. Engl., Fr., Span., 24 Refs., Illus.

Cassava. Seed. Analysis. Cyanogenic glycosides. Linamarin. Lotaustralin. HCN. Metabolism.

Analyses of storage lipids (47%) and proteins (34%) of cassava seeds indicate that these could be nutritionally and industrially useful sources of vegetable fats and proteins. Seedlings have high lipolytic and proteolytic activities. In seedlings storage lipids are converted to carbohydrates. Valine and isoleucine are incorporated resp. into the cyanogenic glucosides linamarin and lotaustralin. Seedlings of both bitter and sweet cv. contain large amounts of cyanogenic glucosides. Electron microscope and tracer studies showed that the biosynthesis and metabolism of cyanogens, cyanide, proteins, and lipids are associated with specific organelles and microbodies which become apparent after 10 days of active seed germination. *(Author's summary)* C02 C03

C03 Chemical Composition, Methodology and Analyses

0389

16276 LONGE, O.G. 1978. **Carbohydrate constituents of different cassava varieties grown in Nigeria.** Journal of Root Crops 4(2):1-8. Engl., Sum. Engl., 20 Refs.

Cassava. Cultivars. Tubers. Dry matter. Sugar content. Pulp. Cortex. Protein content. Ash content. Nigeria.

Tubers of 4 improved cassava cv. and 14 locally grown cv. from Nigeria were separated into peel and pulp, and both sections were analyzed for DM, proximate composition, starch and sugars, and cell wall constituents. DM content (%) in pulp varied from 15.5 in Okobo to 33.5 in 60506 (mean 26.37 ± 5.61); ether extract (%) was 0.41 in Boma II to 0.81 in 53101 (mean 0.59 ± 0.11); ash (%) was 0.68 in 60506 to 5.74 in Imo (mean 2.44 ± 1.56); CP (%) was 0.99 in Birakpo to 4.52 in Ozu-Nwagwe. Wt. of pulp as % of the tuber was 52.32 in 60447 to 84.23 in Ife (mean 77.5 ± 7.6). Ethanol-soluble sugars (fructose, glucose, maltose, sucrose) and starch were determined in pulp; total soluble sugar, as % DM, was 2.21 in 60506 to 9.37 in Imo. *(Summary by Food Science and Technology Abstracts)* C03 G01

0390

16241 FUKUBA, H.; MENDOZA, E.M.T. 1982. **Determination of cyanide in cassava.** *In* Uritani, I.; Reyes, E.D., eds. Bio-resources investigation on production, storage, processing and vegetation of root crops in the tropics. 1981 Interim Report. Nagoya, Japan, Nagoya University Cooperation. pp.48-62. Engl., Sum. Engl., 4 Refs., Illus.

Cassava. Laboratory experiments. Cultivars. Analysis. HCN content. Tubers.

In order to gain fundamental data on cyanogenic glucoside contents in cassava, cyanide contents of cassava tubers and leaves were determined by 3 different methods (alkaline picrate, pyridine-pyrazolone, and isotachoelectrophoretic) following the release of cyanide from cyanogenic glucoside by added partially purified linamarase. Cv. Lakan W 78 and S.M.I. 150 belonged to the sweet or edible type; Davao City 6, W 236, M Mex 59, Mameya Black Twig, M Col, and B.S.C. to the intermediate type (moderately poisonous), while the other cv. tested belonged to the bitter or dangerously poisonous type. Cyanide contents determined by the alkaline picrate method were higher than those obtained by the other 2 methods. *(Author's summary)* C03 H04

0391

16269 CUNHA, C.M.C. DA; NEVES, M. DE F.S.; SOARES, J.B. 1980. **Fontes amiláceas para a produção álcool.** *(Sources of starch for alcohol production).* Ciência Agronómica 10(1):23-25. Port., Sum. Engl., 3 Refs.

Cassava. Tubers. Starch content. Cultivars. Brazil.

The two main sources of starch available in NE Brazil for the production of ethyl alcohol are cassava roots and the babassu (*Orbignya speciosa*) coconut. The determination of starch

in the mesocarp of the coconut and in several cassava var. traditionally cultivated in the state of Ceará is given. A large difference was found in the amount of starch among these var. On the other hand, almost no difference in the starch content of the babassu has been detected. *(Author's summary)* C03

0392

16274 MOORTHY, S.N. 1978. **Physical and chemical properties of cassava seed oil.** Journal of Root Crops 4(2):13-15. Engl., Sum. Engl., 4 Refs.

Cassava. Seed. Composition. Analysis. Fat content. HCN content. India.

Seeds of indigenous cassava were pooled and sampled for oil composition. Physical properties of the seed oil were a very pale yellow color, a faint odor, a refractive index at 29° C of 1.471538, and a specific gravity of 0.8637. Chemical examinations showed the oil to have an undetectable HCN content, I value of 120, saponification value of 145, acid value of 4.0, and a peroxide value of 0.0. The lipid was 8.5% palmitate, 2.1% stearate, 14.1% oleate, 62.84% linoleate, 6.05% linolenate, and 6.4% unidentified. Comparison is made between the lipid of cassava seeds and that of sunflower, soybean, safflower, and castor oil plants. *(Summary by Food Science and Technology Abstracts)* C03

0393

17506 POSAS, M.T.D.; ROA, C.C. 1981. **Processing lessens hydrocyanic acid content of cassava tubers.** Radix 3(1):8-9, 19. Engl., 7 Refs.

Cassava. Cassava tubers (vegetable). Dried tubers. HCN content. Cultivars. Philippines.

An expt. with 5 cassava var. (Colombia, Kadabao, Hawaiian 5, Golden Yellow, and Java Brown) showed that fresh tubers yielded the highest HCN concn. (av. 111 mg/kg), followed by cooked tubers (65 mg/kg), and by dried tubers (21 mg/kg). *(Summary by Abstracts on Tropical Agriculture)* C03

0394

16678 TORO, J.C.; CAÑAS, A. 1982. **Determinación del contenido de materia seca y almidón en yuca por el sistema de gravedad específica.** *(Determination of dry matter and starch content in cassava by the specific gravity technique). In* Centro Internacional de Agricultura Tropical. Programa de Yuca. 1982. Yuca: investigación, producción y utilización. Cali, Colombia. pp.567-575. Span., 6 Refs.

Cassava. Dry matter. Starch content. Tubers. Analysis. Colombia.

The specific gravity technique (a simple and practical method) to determine DM and starch content in cassava roots is described; the materials used and the methodology are included. A conversion table to determine DM and starch % in cassava is given. *(Summary by F.G. Trans. by L.M.F.)* C03

0395

17200 COOKE, R.D.; CRUZ, F.M. DE LA 1982. **The changes in cyanide content of cassava (*Manihot esculenta* Crantz) tissues during plant development.** Journal of the Science of Food and Agriculture 33(3):269-275. Engl., Sum. Engl., 21 Refs., Illus.

Cassava. Leaves. Apical meristems. Cortex. Roots. HCN content. Growth. Costa Rica.

The cyanide concn. in the leaves, meristems, root cortex and root parenchymal tissues of cassava cv. Valencia were investigated at 2-mo. intervals up to a plant age of 17 mo. Six plants were analyzed at each interval and sampling methods investigated to ensure that the cyanide estimations (by enzymic assay) were representative for each plant. Root yield/plant increased to 10 mo. and then remained almost constant to 17 mo. Leaf wt./plant reached

a max. at 6 mo. (380 g/plant), decreased to 12 mo. and then slowly increased. Cyanide concn. in the root parenchymal tissue and root cortex were not significantly different between 6 and 14 mo.; both tissues displayed peak concn. at 6 and 14 mo. Cyanide concn. maxima in the leaves appeared to precede those shown by the roots. Meristem concn. showed similar trends to those shown by the leaves. The precise plant age at harvest had little effect on the potential toxicity of the roots. A modification to the earlier published procedure for leaf tissue is described. The cyanide concn. in old (green) leaves was < 50% of that in young leaves of the same plant. Intra-leaf and inter-leaf cyanide concn. variations are described, and the importance to low-cyanide cassava screening programs indicated. *(Author's summary)* C03 C01

0396

17522 ROSSI, S.J.; FIOREZE, R.; CAVALCANTE, V.M. DE S.; FARIAS, H.R. DE 1981. **Curvas de teor de umidade de equilíbrio e calor latente de vaporização para castanhas de caju e raspas de mandioca.** *(Moisture level equilibrium curves and latent heat of vaporization for cashew nuts and cassava).* Revista Brasileira de Armazenamento 6(2):5-10. Port., Sum. Port., Engl., 8 Refs., Illus.

Cassava. Cassava chips. Water content. Statistical analysis.

The static method of different saturated salt solutions was used to determine moisture level equilibrium curves for cashew nuts and cassava, cut into rectangular bars 3.0 cm in length, at temp. of 20, 35, and 50°C. The parameters of the equations of Henderson-Thompson and of Roa were obtained by means of nonlinear regression using the computer program available at the computation center of the U. Federal da Paraíba (Brazil). The latent heat of water vaporization of the product, as a function of its MC, was determined on the basis of the moisture level equilibrium curves obtained and by the equation used by Othmer, concerning a liquid-vapor system in equilibrium. For this determination, a calculus program was developed for the calculator TI-59. *(Author's summary)* C03

0397

17545 HOWELER, R.H.; EDWARDS, D.G.; ASHER, C.J. 1982. **Micronutrient deficiencies and toxicities of cassava plants grown in nutrient solutions. 1. Critical tissue concentrations.** Journal of Plant Nutrition 5(8):1059-1076. Engl., Sum. Engl., 27 Refs., Illus.

Cassava. B. Cu. Mn. Zn. Mineral deficiencies. Toxicity. Plant tissues. Mineral content. Leaves. Laboratory experiments.

The programmed nutrient addition technique was used in a series of 5 expt. to determine the response in growth and micronutrient content of cassava cv. M Aus 10 to 8 supply levels of B, Cu, Fe, Mn, and Zn. The 9-wk.-long expt. utilized 22 *l*-pots of nutrient solution. Supply levels for each micronutrient covered the range from severe deficiency to toxicity. Critical tissue concn. for deficiencies were determined by relating total DM production to the nutrient concn. in the youngest fully expanded leaf blades. Critical concn. were: B, 35; Cu, 6; Mn, 50; and Zn, 30. Critical concn. for toxicities in the same index tissue were (μg/g): B, 100; Cu, 15; Mn, 250; and Zn, 120. In the Fe expt., the data were too variable to allow precise determination of critical concn. for deficiency and toxicity. Critical micronutrient concn. in the petioles of the youngest fully expanded leaves were also determined, but offered no advantage over the leaf blades. *(Author's summary)* C03 D01

0398

17560 BATTISTI, C.R. DE; TELES, F.F.F.; COELHO, D.T.; SILVEIRA, A.J. DA; BATISTA, C.M. 1981. **Determinação de toxicidade cianogênica e carboidratos solúveis totais em cultivares de mandioca (*Manihot esculenta* Crantz).** *(Determination of cyanogenic toxicity and total soluble carbohydrates in cassava cultivars).* Revista Ceres 28(159):521-525. Port., Sum. Engl., 8 Refs.

Cassava. Cultivars. HCN content. Soluble carbohydrates. Tubers. Brazil.

Total soluble carbohydrates and HCN contents were determined for 10 cassava cv. (Pirassununga, Manteiga, Sabará entre Rios, Vassourinha, Branca de Santa Catarina, Mico, Preta de Quilombo, Guaxupé, SFG-2-204, and Engana Ladrão) grown in the state of Minas Gerais, Brazil. Lowest HCN toxicity was found in cv. Pirassununga, which also was the highest in total soluble carbohydrates. The cyanide contents of the 10 cv. ranged from 0.10-0.21 mg HCN/g green matter; and total soluble carbohydrates from 12.93-29.91 mg/g green matter. The correlation coefficient between HCN and total soluble carbohydrates was only -0.13. *(Author's summary)* C03

0399

17561 TELES, F.F.F.; OLIVEIRA, T.T. DE; ALMEIDA, M.G. DE; SILVEIRA, A.J. DA; BATISTA, C.M.; REZENDE, J.L.M. 1981. **A determinação do ácido cianídrico em mandiocas (*Manihot esculenta* Crantz) por difusão.** *(Determination of hydrocyanic acid in cassava by diffusion analysis).* Revista Ceres 28(159):458-467. Port., Sum. Port., Engl., 9 Refs.

Cassava. HCN content. Tubers. Analysis. Laboratory experiments.

A new method for determining HCN in cassava roots, using Conway diffusion cells, was developed. Photometric measurements were carried out with the use of the Teles reagent at 540 nm. The new method is safer and cheaper than conventional assays, and allows batch analysis of 60 samples. A detailed description is given of the technique thus facilitating repetitions by other lab. *(Author's summary)* C03

0400

17562 MIRANDA, L.C.G. DE; COELHO, D.T.; TELES, F.F.F.; SILVEIRA, A.J. DA; REZENDE, J.L.M. 1981. **Comparação entre os teores de amido e ácido cianídrico de alguns cultivares de mandioca (*Manihot esculenta* Crantz) cultivados em Minas Gerais.** *(Comparison of starch and hydrocyanic acid contents of several cassava cultivars grown in Minas Gerais).* Revista Ceres 28(160):555-559. Port., Sum. Port., Engl., 14 Refs.

Cassava. Cultivars. Starch content. HCN content. Tubers. Brazil.

Twenty cassava cv. grown in the state of Minas Gerais, Brazil, were analyzed for HCN and acid-digestible carbohydrate contents. Results were: Rosa, 0.13 and 35.7; SFG-444, 0.07 and 37.2; Cacau Branco, 0.12 and 36.5; Abelha Danta, 0.07 and 30.3; Mandioca Osso, 0.27 and 35.5; Amarela Casca Roxa, 0.09 and 38.1: Julião Roxo, 0.32 and 25.4; Clone 452543, 0.18 and 38.9; Engole Boi, 0.13 and 33.4; Sabará, 0.09 and 32.6; Maniva Grande, 0.17 and 32.3; Caipira, 0.06 and 34.8; Periquita, 0.25 and 29.9; IAC 3526, 0.11 and 28.6; Manca, 0.24 and 38.1; Riqueza, 0.07 and 35.5; SFG-696, 0.21 and 31.8; Var. III Colúmbia, 0.16 and 34.5; Macedônia, 0.22 and 33.2; and Havana, 0.06 and 37.5 mg HCN/g and % acid-digestible carbohydrates in the green matter, resp. *(Author's summary)* C03

0401

17559 TELES, F.F.F.; KIMO, J.W.; BATISTA, C.M.; SILVEIRA, A.J. DA 1982. **Clorofila total e toxidez cianogênica de folhas de mandiocas (*M. esculenta* Crantz) cultivadas em Minas Gerais.** *(HCN and chlorophyll content in leaves of cassava grown in Minas Gerais).* Seiva 42(89):72-76. Port., Sum. Port., Engl., 7 Refs.

Cassava. Leaves. Cultivars. HCN content. Chlorophyll. Plant pigments.

Leaves of 12-mo. old cassava var. (Lagoa, Pereirinha, Hibrido-Bravo, Branca de Santa Catarina, Gigante Branca, Mantiqueira, Rosada, Engana Ladrão, Gigante Preta, and Preta de Quilombo) grown in the state of Minas Gerais, Brazil, were analyzed for HCN and total chlorophyll. On a fresh wt. basis, mean HCN values ranged from 0.157-0.930 mg/g, and total chlorophyll from 0.263-0.974 mg/g. Although the statistical analyses showed significant differences among var., the correlation coefficient for these constituents was +42. *(Summary by J.L.S.)* C03

See also 0388 0407 0416 0420 0423 0480 0513 0517 0518 0519 0520 0521 0523 0524 0527

D00 CULTIVATION

0402

12012 BRAWIJAYA UNIVERSITY. FACULTY OF AGRICULTURE. CASSAVA RESEARCH PROJECT. 1979. **Progress report VIII. (October 1979).** Malang, Indonesia. 119p. Engl., Illus.

Cassava. Research. Planting. Spacing. Fertilizers. N. Mukibat. Pruning. Growth. Cuttings. Mukibat system. Indonesia.

The results of phase II expt., conducted jointly by Brawijaya U. (Indonesia) and the International Development Research Centre (Canada) are reported and discussed. Results of a survey of the efficiency and income of Mukibat cassava farming system in Tulungagung, East Java, conducted in 1978, are also reported. Populations of 8000-17,800 plants/ha did not show a significant influence on root yield of common and Mukibat cassava. Mukibat cassava produced higher yields/area of land than common cassava. Distribution patterns of DM in the plant were similar for both cv. Doses of 75, 100, 120, and 150 kg N/ha did not show any significant effect on yields of Mukibat cassava at Turen. In East Java the following diseases were observed: dieback (*Phyllosticta* sp.), leaf spots (*Cercospora* spp.), and anthracnose (*Colletotrichum* -*Glomerella*- sp.). Mite population was higher on common cassava than on Mukibat cassava. The application of 1 cc monocrotophos/*l* at 10-day intervals to control mites increased yields 24.87 and 13.63% for common and Mukibat cassava, resp. The profit of the Mukibat cassava farming system is higher than that of common cassava. *(Summary by F.G. Trans. by L.M.F.)* D00 E00 F03 J00

0403

16673 HARRIS, N.V. 1980. **Energy crops in Australia: cassava.** *In* Fuel Ethanol Research and Development Workshop, Camberra, 1980. Camberra, Australia, Department of National Development and Energy. Australian Government Publishing Service. pp.173-178. Engl., 13 Refs.

Cassava. Cultivation. Productivity. Research. Australia.

The potential use of cassava as a source of ethanol in northern Australia is briefly assessed on the basis of exptl. results and recent observations on climatic and soil constraints, pests and diseases, crop mechanization, and weed control. Several areas of research are identified. (1) more closely defined climatic limitations; (2) the demand for fertilizers on defined soil types; (3) effective economic means of controlling weeds; and (4) determination of production costs of units of various sizes. *(Summary by I.B. Trans. by L.M.F.)* D00 J00

0404

16680 TORO, J.C.; CAÑAS, A.; GRANADOS, F. 1982. **Sistema para la toma de datos en pruebas regionales de yuca.** *(System for data recording in cassava regional trials). In* Centro Internacional de Agricultura Tropical. Programa de Yuca. 1982. Yuca: investigación, producción y utilización. Cali, Colombia. pp.587-605. Span., Illus.

Cassava. Field experiments. Data handling. Cultivation. Colombia.

A system for data recording, based on the experience obtained with regional trials at the Centro Internacional de Agricultura Tropical during 7 yr, is given. This system uses time advantageously by simplifying data recording and by computerizing analysis; errors in information management and transcription are thus avoided. The information obtained in these trials within each country and at an international level is also synthesized, making its use easier. The 8 basic records are: general data of the locality; soil analysis; establishment of the crop; distribution in the field; germination, weed control; pests, diseases, and edaphic problems; data on harvest; and daily precipitation. Instructions on how to fill out the records are included along with tables for pest and disease evaluation. *(Summary by F.G. Trans. by L.M.F.)* D00

See also 0488

D01 Soil Water, Climate and Fertilization

0405

11314 CORREA, H.; ROCHA, B.V. DA; TANAKA, R.T.; ANDRADE, A.M.S.; GUEDES, G.A.A. 1979. **Estudo dos diferentes níveis de nitrogênio, fósforo e potássio na cultura da mandioca (*Manihot esculenta* Crantz) num Latossolo Vermelho Escuro.** *(Study of different levels of nitrogen, phosphorus, and potassium in cassava crops on dark red Latosol).* In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.325-330. Port., Sum. Port., Engl., 13 Refs.

Cassava. Field experiments. Fertilizers. N. P. K. Tuber productivity. Foliage. Dry matter. Brazil.

The effect of increasing rates of NPK on cassava cv. Riqueza growth and root yield was analyzed under field conditions on a sandy clay loam dark red Distrophic Latosol, cerrado phase, in the municipality of Felixlândia, MG, Brazil. A 3^3 factorial expt. was arranged in a randomized block design with 3 replications. N, P, K were applied at rates of 0, 30, and 60; 0, 60, and 120; and 0, 120, and 240 kg/ha, resp. P and K were applied in the furrow at planting and N, 50 days after planting; 3 t calcitic limestone were also applied per ha. Harvesting took place at 18 mo. and the following parameters were registered: branch, root, and root DM production, and final stand. *(Summary by L.M.E.)* D01 D03

0406

16622 MBA, C.C. 1981. **Humus production from cassava (*Manihot esculenta*) peels by *Eudrilus eugeniae* (terrestrial oligochete).** Tropenlandwirt 82(2):145-148. Engl., Sum. Engl., Germ., 4 Refs.

Cassava. Cortex. Uses. Manures. Mineral content. Nigeria.

A biovariant of *Eudrilus eugeniae*, a Nigerian Oligochete which can feed on and detoxify cassava peels, was isolated. The compost resulting from the earthworm dejections has a very high water-holding capacity, high K content, high CEC, low C/N and C/P ratios in relation to the original cassava peels. Normal earthworms could thrive well in the cassava peel – *E. eugeniae* – compost. Agronomic properties of the compost are discussed. *(Author's summary)* D01

0407

16605 SOUZA, A.B. DE 1979. **Efeitos de fontes e níveis de fertilizantes fosfatados na cultura da mandioca (*Manihot esculenta* Crantz).** *(Effects of sources and levels of phosphated fertilizers on cassava).* Tese Mag. Sc. Viçosa-MG, Brasil, Universidade Federal de Viçosa. 36p. Port., Sum. Port., 47 Refs., Illus.

Cassava. Field experiments. Fertilizers. P. Plant height. Tuber productivity. Starch content. Dry matter. Tubers. Harvest index. Brazil.

An expt. was conducted in Viçosa, MG, Brazil during the 1977/78 crop yr to determine the effects of the sources and levels of P fertilizers on cassava. The trial was conducted on a

Cambic red yellow podzolic soil, terrace phase, Distrophic and var. Pão do Chile was used. A 3 x 4 factorial design was arranged in randomized blocks with 4 replications. Four rates of P (0, 40, 80, and 120 kg/ha) were used from 3 sources (Araxá phosphate, Patos phosphate, and triple superphosphate). Limb analysis was conducted 6 mo. after planting to evaluate the nutrients N, P, K, Ca, and Mg, and DM. Harvesting took place at 10 mo. and the following parameters were estimated: plant height, stem ϕ; canopy wt.; root no., ϕ, wt., size, [illegible] and DM content; and HI. The rates of P used increased P and Mg contents in the limb; they also affected HI significantly. Neither did the sources of P nor the interaction source x rate of P significantly affect the evaluated parameters. *(Author's summary. Trans. by L.M.F.)* D01 D03 C03

0408

16265 LORENZI, J.O.; MONTEIRO, D.A.; PEREIRA, A.S. 1980. **Efeito de três níveis de adubação NPK em quatro variedades de mandioca.** *(Effect of three levels of NPK on four cassava varieties).* Bragantia 39:219-223. Port., Sum. Engl., 3 Refs.

Cassava. Field experiments. Cultivars. Fertilizers. N. P. K. Tuber productivity. Dry matter. Brazil.

Three field trials were carried out in soils of low fertility to investigate the behavior of 4 cassava var. when submitted to different levels of fertilization. The fertilization rates used were 0-0-0, 20-40-30, and 40-80-60 kg of N, P, and K/ha, resp. Regarding root yields, results showed significative differences between the studied var. and a positive linear effect of fertilization. Variation in root DM content showed that, in one of the trials its increase was due to the effect of the fertilization and, in the others the differences were due to the var. effect. In both cases, there was no interaction between var. and fertilizers. *(Author's summary)* D01

0409

11365 SILVA, J.R. DA; LORENZI, J.O.; MONTEIRO, D.A.; NORMANHA, E.S.; CAMPOS, H. DE 1979. **Efeito do cálcario e de micronutrientes na cultura da mandioca** *(Manihot esculenta* Crantz). *(Effect of liming and micronutrients on cassava). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.355-361. Port., Sum. Port., Engl., 3 Refs.

Cassava. Field experiments. Agricultural lime. B. Cu. Fe. Mg. Mn. Mo. Zn. Fertilizers. Tuber productivity. Brazil.

Five field trials were conducted in Araras, SP, Brazil to study the effect of liming and micronutrients, applied alone or together, on the yield of cassava cv. Branca de Santa Catarina. A randomized block design with split plots was used with 4 replications. All treatments received basic N-P-K fertilization at 40, 80, and 50 kg/ha, resp. Limestone was broadcasted at 2 t/ha, 2-3 mo. before planting. P and K were applied to the furrow at planting and incorporated into the soil along with the micronutrients. N was top dressed 45-60 days after planting. Treatments were: T_1, NPK + 10 kg B/ha; T_2, NPK + 20 kg Cu/ha; T_3, NPK + 20 kg Fe/ha; T_4, NPK + 20 kg Mg/ha; T_5, NPK + 20 kg Mn/ha; T_6, NPK + 0.5 kg Mo/ha; T_7, NPK + 20 kg Zn/ha; T_8, NPK + micronutrients; T_9, NPK + micronutrients + Mg; T_{10} (control). The effect of liming was studied on the subplots. Results show that the fertilizer treatments did not affect root yield significantly. Since there was no significant interaction between liming and fertilization, it was concluded that under these conditions, the micronutrients applied behaved in an analogous manner regarding root production in both the absence and presence of limestone. Zn deficiency is common in cerrado soils but is reduced by liming. Marked responses to B, Zn, and Mo application were observed. B tended to decrease root production and the presence of limestone or Zn tended to increase yields. *(Author's summary)* D01 D03

0410

11090 GOMES, J. DE C.; MAGALHAES, A.F. DE J.; MATTOS, P.L.P. DE 1979. **Influência da adubação mineral sobre a produção de mandioca** *(Manihot esculenta* **Crantz) no Estado da Bahia.** *(Effect of fertilization on cassava yields in the state of Bahia). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.263-277. Port., Sum. Port., Engl., 12 Refs., Illus.

Cassava. Field experiments. Fertilizers. N. P. K. Agricultural lime. Zn. Cu. B. Mo. Tuber productivity. Brazil.

A series of 8 expt. was carried out in cassava-growing areas of the state of Bahia (Brazil) in order to determine the effects of 3 different rates (0, 60, and 120 kg/ha) each of N, P, K application on cassava root production. A 3 x 3 x 3 factorial design was used. Additional expt. on the effect of lime, S, and micronutrients (Zn, Cu, B, and Mo) were also conducted using a randomized block design with 3 replications. Results show that yield significantly increased with P fertilization; however, N and K fertilization showed little influence on yield. At only 1 site a significant response to N was observed while K responses were significant in 2 expt. Liming and micronutrient application did not show marked effects on productivity. *(Author's summary)* D01 D03

0411

16246 SILVA, B.N.R. DA; BASTOS, T.X.; DINIZ, T.D. DE A.S. 1980. **Aptidão edafo-climática da região situada entre a Serra dos Carajás e o Porto de Itaqui para mandioca, babaçu, dendê, cana-de-açúcar e seringueira.** *(Edapho-climatic aptness of the region between the Carajás Mountain Range and the port of Itaqui for cassava, babassu, African oil palm, sugar cane, and the rubber tree).* Belém-PA, Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Boletim de Pesquisa no. 18. 16p. Port., Sum. Port., Engl., 12 Refs., Illus.

Cassava. Climatic requirements. Soil requirements. Cultivation. Maps. Brazil.

The edapho-climatic potential of the region between the Carajás Mountain Range, PA, and the port of Itaqui, MA, Brazil is analized. Areas named as suitable, marginal, and unsuitable for cassava, babassu (*Orbignya speciosa*), African oil palm, sugar cane, and the rubber tree are indicated and delimited in an edapho-climatic map. *(Author's summary)* D01

0412

11329 CORREA, H.; TANAKA, R.T.; GUEDES, G.A.A.; ANDRADE, A.M.S.; ROCHA, B.V. DA 1979. **Efeito de doses de fósforo e épocas de aplicação de nitrogênio e de potássio na cultura da mandioca** *(Manihot esculenta* **Crantz) em Latossolo Vermelho Escuro.** *(Effect of levels of phosphorus and time of nitrogen and potassium application on cassava planted to dark red Latosols). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.339-347. Port., Sum. Port., Engl., 15 Refs.

Cassava. Field experiments. Fertilizers. N. K. Tuber productivity. Brazil.

The effect of different rates of P (0, 60, 120, and 180 kg/ha) and time and form of NK application on cassava cv. Riqueza was studied under field conditions on a dark red clay Distrophic Latosol, cerrado phase, in the municipality of Felixlândia, MG, Brazil. A randomized block design was used with 4 replications. P was applied to the furrow combined with the following treatments of N (30 kg/ha) and K (90 kg/ha): (a) N + K at planting, (b) K at planting and N top dressed at 60 days; (c) N at planting and K top dressed at 60 days; (d) N + K top dressed at 60 days; (e) K at planting; (f) without N and K application; and (g) control. No significant differences were observed for N and K application times.

There was an increasing response with increasing levels of P application. N applied both at planting and top dressed had a negative effect on production. *(Summary by L.M.F.)* D01 D03

0413

11298 CORREA, H., TANAKA, R.T.; GUEDES, G.A.A.; ANDRADE, A.M.S.; ROCHA, B.V. DA 1979. **Níveis de fósforo e épocas de aplicação de nitrogênio e potássio na cultura da mandioca** *(Manihot esculenta* Crantz) **em Latossolo Vermelho Escuro.** *(Levels of phosphorus and time of nitrogen and potassium application in cassava cultivation on a red dark Latosol). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.317-323. Port., Sum. Port., Engl., 9 Refs.

Cassava. Field experiments. Fertilizers. N. K. P. Tuber productivity. Foliage. Dry matter. Brazil.

The effect of different levels of P and times of NK application on cassava branch, root, and root DM production was studied on a sandy clay loam dark red Distrophic Latosol, cerrado phase, in the municipality of Felixlândia, MG, Brazil. A randomized block design with split plots was used with 4 replications. Branch production did not differ among P treatments; however, these were statistically higher than the check. No effect of the time of N and K application was observed; however, there was a significant interaction between P rates and times of NK application regarding root yield and root DM content. When 90 kg P were applied per ha, highest yields were obtained in the absence of N and K. *(Author's summary)* D01 D03

0414

11263 BRINHOLI, O.; NAKAGAWA, J.; KROLL, L.B. 1979. **Efeitos de potássio e boro na cultura de mandioca** (*Manihot esculenta* Crantz), **cultivar 'Guaxupé'.** *(Effect of potassium and boron on cassava cultivar Guaxupé). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp. 293-305. Port., Sum. Port., Engl., 21 Refs.

Cassava. Field experiments. Fertilizers. K. B. Agricultural lime. Tuber productivity. Brazil.

Two expt. were established on a red yellow Latosol, sandy phase at the Fazenda Exptl. São Manuel, SP, Brazil in order to study the response of cassava cv. Guaxupé to different doses of K and B. A 3 x 3 factorial design was used with 4 replications. Dolomitic limestone was applied 2 mo. before planting at 1.5 and 4.5 t/ha in expt. 1 and 2, resp. N, P, and Zn were applied in both expt. at 80, 120, and 4 kg/ha, resp.; N was top dressed 90 and 120 days after planting whereas P and Zn were applied in the furrow at planting. Three levels of K (0, 60, and 120 kg/ha) and 3 of B (0, 17, and 3.4 kg/ha) were also used. K fertilization was shown to significantly increase root and canopy yield and the no. of roots/plant in the presence of 4.5 t lime/ha. B significantly increased root yield when 1.5 t lime was added per ha. An interaction between K and B was observed in both expt. *(Author's summary)* D01 D03

0415

11296 TANAKA, R.T.; ROCHA, B.V. DA; ANDRADE, A.M.S.; CORREA, H.; GUEDES, G.A.A. 1979. **Estudo sobre a aplicação de diferentes níveis de fósforo, potássio e calagem na produção de mandioca** *(Manihot esculenta* Crantz) **num solo sob vegetação de Cerrado.** *(Effects of different levels of phosphorus, potassium, and lime on cassava yield under cerrado land conditions). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp. 307-315. Port., Sum. Port., Engl., 8 Refs.

Cassava. Field experiments. Fertilizers. P. K. Agricultural lime. Foliage. Dry matter. Brazil.

The effect of liming (0, 3, and 6 t/ha), P (0, 60, and 120 kg/ha) and K (0, 60, and 120 kg/ha) application on cassava cv. Riqueza was studied on a sandy clay loam dark red Distrophic Latosol, in the municipality of Felixlândia, MG, Brazil. A randomized block design with split plots was used with 4 replications. Lime was applied to the main plots and P and K to the subplots. No response to liming was observed. Branch production increased significantly with P application, obtaining the best response at 60 kg/ha. Increasing levels of K had a negative effect on root DM production. *(Author's summary)* D01

0416

11010 GOMES, J. DE C.; MACEDO, M.C.M.; SOUZA, L. DA S.; CALDAS, R.C. 1979. **Doses e épocas de aplicação de nitrogênio na cultura da mandioca** *(Manihot esculenta* Crantz). *(Levels and time of application of nitrogen in cassava). In* Congresso Brasileiro de Mandioca, 1., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.249-261. Port., Sum. Port., Engl., 14 Refs.

Cassava. Field experiments. Fertilizers. N. Tuber productivity. Canopy. Starch content. Plant height. Brazil.

In expt. established at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Brazil, the effect of 3 rates of N application (40, 80, and 120 kg/ha) and 6 application times on cassava root and canopy production, and starch content was studied. In additional trials an absolute control (without NPK fertilizer) and a relative one (without N) were included in order to determine the best rate and application time. Parameters assessed were root and canopy production; plant height; stem ø; and starch content. There was no response to N fertilization. A tendency for increasing root yield with late N application was observed. Basic NPK fertilization increased root and canopy yield. Fertilizer application did not affect starch content. *(Author's summary)* D01 D03 C03

0417

11318 CORREA, H.; GUEDES, G.A.A.; ANDRADE, A.M.S.; TANAKA, R.T.; ROCHA, B.V. DA 1979. **Níveis e épocas de aplicação de potássio na cultura da mandioca** *(Manihot esculenta* Crantz), **num Latossolo Vermelho Escuro fase cerrado.** *(Levels and time of potassium application in cassava on a dark red Latosol, cerrado phase). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA. 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.331-337. Port., Sum. Port., Engl., 11 Refs.

Cassava. Field experiments. Fertilizers. P. Tuber productivity. Brazil.

An expt. was conducted under cerrado conditions to observe the response of cassava cv. Riqueza to 4 different levels (60, 120, 240, and 360 kg/ha) and 3 times of K application (at planting; ½ at planting and ½ top dressed 60 days after planting; 1/3 at planting and 2/3 top dressed 60 days after planting). A factorial design was arranged in randomized blocks with 4 replications. The levels and time of application of K were not significant and no interaction was observed between them; however, significant differences were found regarding the check. *(Summary by L.M.F.)* D01 D03

0418

11337 SILVA, J.R. DA; LORENZI, J.O.; MONTEIRO, D.A.; NORMANHA, E.S.; PEREIRA, A.S. 1979. **Métodos de aplicação da adubação potássica em mandioca.** *(Methods of applying potassium fertilizer to cassava). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.349-353. Port., Sum. Port., Engl., 3 Refs.

Cassava. Field experiments. Fertilizers. P. K. Tuber productivity. Brazil.

Two expt. were conducted on sandy soil (Araras, SP, Brazil) to study different methods of applying K fertilizer to cassava cv. Branca de Santa Catarina. A randomized block design was used with 6 replications and 5 treatments. Methods of fertilizer application were: (a) incorporated into the furrow at planting; (b) applied in lateral rows at a distance of 20 cm at 5 cm depth and covered with soil; and (c) top dressed 2-3 mo. after planting. Treatments were: T_1 (control); T_2, P applied as in (a) + N applied as in (c); T_3, PK applied as in (a) + N applied as in (c); T_4, P applied as in (a) + NK applied as in (c); T_5, P applied as in (a) + K applied as in (b) + N applied as in (c). No significant differences were observed in root yield among treatments. When P was top dressed 2 mo. after planting or applied in lateral furrows at planting, root yield increased 18 and 25%, resp. as compared with method (a). *(Summary by L.M.F.)* D01 D03

0419

16655 GODFREY-SAM-ACGREY, W. 1977. **Effects of different fertilizers on cassava root yield, root number per plant and average root weight per plant after six years bush fallow in Sierra Leone using cuttings of different age.** *In* Leakey, C.L.A., ed. Symposium of the International Society for Tropical Root Crops, 3rd., Ibadan, Nigeria, 1973. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.307-311. Engl., Sum. Engl., Fr., Span., 7 Refs.

Cassava. Fertilizers. N. P. K. Mg. Agricultural lime. Tuber productivity. Cuttings. Sierra Leone.

Effects of ammonium sulfate, basic slag, potassium sulfate, lime, and magnesium sulfate on tuber yields, tuber no./plant, and av. tuber wt./plant from 3 differently-aged cassava cuttings were studied. P (basic slag) significantly increased tuber yields for all types of cuttings. P and Ca with midstem cuttings and NPKMg with top stem cuttings showed significant effects on root no./plant. The most effective treatments affected yield through both tuber no. and tuber wt. *(Author's summary)* D01 D03

0420

16626 PERIM, S. 1982. **Efeitos de níveis de fósforo e de calcário no crescimento e na acumulação de P, Ca, Mg e Zn pela mandioca (*Manihot esculenta* Crantz) em casa de vegetação.** *(Effect of levels of phosphorus and limestone on the growth and accumulation of P, Ca, Mg, and Zn in cassava under greenhouse conditions).* Tese Mestre. Lavras-MG, Brazil, Escola Superior de Agricultura de Lavras. 100p. Port., Sum. Port., Engl., 73 Refs., Illus.

Cassava. Laboratory experiments. Fertilizers. P. Agricultural lime. Growth. Canopy. Tubers. Mineral content. Cultivars. Brazil.

The effects of the application of 4 rates of P (0, 200, 600, and 1800 kg P/ha) and the 3 levels of limestone (0, 2.04, and 4.08 t/ha, 100% $CaCO_3$) on the growth and accumulation of P, Ca, Mg, and Zn in the canopy and roots of cassava cv. Mantiqueira and Sonora were assessed under greenhouse conditions at the Escola Superior de Agricultura de Lavras, MG, Brazil during Oct.-Dec. 1981. Samples of a Distrophic Red Latosol, clay texture, were used. A randomized block design was used in a factorial scheme (4 x 3 x 2) with 5 replicates. Results indicated a positive effect of both P and limestone application on cassava growth, the effect of P being more noticeable. No P x limestone interaction was observed. Max. total DM yields were achieved with 1598.5 and 1712 kg P/ha for cv. Sonora and Mantiqueira, resp. Total DM yield increased 8.6% with the application of 4.03 t limestone/ha, in relation to the no limestone treatment. This indicated that liming had a positive effect on cassava plant growth in spite of cassava being considered tolerant to low pH and high Al saturation. The accumulation of P, Ca, Mg, and Zn in different parts of the plant increased with rates of P; these treatments may allow higher levels of nutrients to be extracted from the soil. Liming increased P, Ca, and Mg accumulation in the canopy and Ca and Mg contents in

roots, but drastically reduced Zn accumulation in different plant parts. Rates of 4.08 t limestone/ha reduced levels of Zn in the canopy by 42.9 and 55.6% for cv. Sonora and Mantiqueira, resp. and 58.3% in roots when compared with no limestone treatment. *(Author's summary)* D01 C03

0421

16681 DIAZ, R.O.; HOWELER, R.; CADAVID, L.F. 1982. **Análisis económico de un ensayo de fertilización en yuca.** *(Economic analysis of a fertilization trial in cassava). In* Centro Internacional de Agricultura Tropical. Programa de Yuca. 1982. Yuca: investigación, producción y utilización. Cali, Colombia. pp.643-656. Span., Illus.

Cassava. Field experiments. Cultivars. Fertilizers. N. P. K. Income. Costs. Tuber productivity. Colombia.

In May 1980 the soil section of CIAT's cassava program established a fertilization trial with 3 cassava var. [Barranqueña (regional), M Col 113, and CMC 92] to measure its effect on yield and establish optimum levels from an economical point of view. The trial took place in Mondomito and Agua Blanca, municipality of Santander de Quilichao, Cauca (Colombia). Twelve levels of NPK (0-0-0; 0-100-100; 50-100-100, 100-100-100; 200-100-100; 100-0-100; 100-50-100; 100-200-100; 100-100-0; 100-100-50; 100-100-200; 200-200-200) were applied. Partial budgeting was used for the economic analysis. The highest income was reached with M Col 113 in the 100-100-200 treatment and the lowest income with CMC 92 in the check treatment. Tables and diagrams with the variable costs and clear profits corresponding to each treatment are given. *(Summary by F.G. Trans. by L.M.F.)* D01 J00

0422

17514 LIMA, A.R. DA C. 1980. **Superfícies de resposta em experimentos fatoriais 3^3 incompletos de adubação NPK em mandioca no Estado do Ceará.** *(Response surfaces in incompleted 3^3 factorial experiments of NPK fertilization in cassava in the state of Ceará).* Tese Mestre. Piracicaba-SP, Brasil, Escola Superior de Agricultura Luiz de Queiroz da Universidade de São Paulo. 100p. Port., Sum. Port., Engl., 34 Refs.

Cassava. Statistical analysis. Fertilizers. N. P. K. Brazil.

Several mathematical models were tested to find which would represent best the production function of cassava fertilization in the state of Ceará, Brazil using the data of 22 incomplete 3^3 factorial expt. of NPK fertilization from the EMBRATER/FAO/EA project, installed from 1972-76. The exptl. data were adjusted to polynomial regression and asymptotic regression models. Trials were combined in several groups according to the available information: 1 group with 22 trials; 2 according to physiographic regions; 5 by counties; 2 by soil texture; 3 by vegetation; and 4 by growing season. The estimates of the parameters and their resp. confidence intervals and those of the yields and their resp. confidence intervals were discussed along with the optimum levels of nutrients and their resp. confidence intervals; cuts in the response surface, when possible; and comparisons of the optimum levels of nutrients in the studied models. Statistical analysis showed only a linear effect of nutrients. The economic study is indicated through asymptotic regression. Optimum levels of nutrients varied between groups of trials, making it difficult to recommend a fertilization formula. The confidence intervals for economic doses were bread. In the asymptotic regression they always presented a negative inferior limit. There is evidence of response to NP fertilization and that the economically advisable dosage is higher than the highest levels used in the trials analyzed. *(Author's summary)* D01

0423

17509 MUTHUSWAMY, P.; RAO, K.C. 1981. **Influence of nitrogen and potash on the quality of tapioca tuber at different months of growth.** Madras Agricultural Journal 68(3):169-173. Engl., Sum. Engl., 12 Refs.

Cassava. Field experiments. Cultivars. Fertilizers. N. K. Growth. Timing. Dry matter. HCN content. Starch content. Fibre content. India.

A the Tamil Nadu Agricultural U. Farm , Coimbatore (India), field expt. were carried out over 2 seasons with varying levels of N and K on cassava var. Burma, H.165, and Coimbatore local. In all var. the tuber DM increased with the age of the crop but heavy rainfall at the time of harvest caused a reduction. In Burma and H.165 var. the starch content significantly increased up to the 9th mo. Crude fiber and HCN significantly increased with N application. K had no effect on fiber content but reduced HCN content. Fiber content decreased with the maturity of the tuber. Highest HCN content during growth was found in H.165 followed by Coimbatore and Burma. However, all var. registered lowest HCN content at the time of harvest. *(Author's summary)* D01 C03

0424

17489 HAMMOND, L.L. 1977. **Effectiveners of phosphate rocks in Colombian soils as measured by crop response and soil phosphorus levels.** Ph.D. Thesis. East Lansing, Michigan State University. 193p. Engl., Sum Engl., 57 Refs., Illus.

Cassava. Field experiments. Fertilizers. P. Tuber productivity. Colombia.

Seven phosphate rocks from the USA, Colombia, Peru, and Tunisia were compared with triple superphosphate and/or basic slag as sources of P. A greenhouse expt. with *Panicum maximum* and 2 field expt. were conducted, one with cassava using an acid oxisol deficient in P and another with beans on an acid andosol deficient in P. At the time of planting cassava, each phosphate rock was applied at rates of 50, 100, and 400 kg P/ha. A treatment with no P was also included. Finely ground phosphate rocks and the basic slag were broadcast and incorporated to a depth of 12 cm. The triple superphosphate was applied in a band 5 cm deep and 10 cm to the side of the seed. A split plot design was used with levels of application as the main plots and sources of P as the subplots. There were 3 replications. Soil samples were collected from each plot (at 20 cm in depth) at 50, 110, and 360 days. The center 12 plants of each plot were harvested 360 days after planting. Av. yields were increased 96, 145, and 180% with applications of 50, 100, and 400 kg P/ha, resp. Marked differences were observed in the agronomic effectiveness among the phosphate rocks. Crop response was related to soil P extracted, but the response curves obtained with the phosphate rocks do not coincide with those obtained with superphosphate. *(Summary by F.G. Trans. by L.M.F.)* D01 D03

0425

16661 PINHO, J.L.N. DE; MELO, F.I.O.; GOMES, V.V.; MELO, Q.M.S.; TEIXEIRA, L.M.S.; OLIVEIRA, F.C. DE 1979. **Ensaio de sistema produção para mandioca.** *(Trials of cassava production systems). In* Empresa de Pesquisa Agropecuária do Ceará. Relatório Anual de Pesquisa, Fitotecnia 1978. Fortaleza-CE, Brasil. pp. 81-101. Port., Sum. Port., 1 Ref.

Cassava. Field experiments. Cultivars. Fertilizers. N. P. K. Ca. Harvesting. Timing. Tuber productivity. Brazil.

In a field trial at Pacajus, CE (Brazil), 6 cassava cv. were grown with or without 100 kg N + 80 kg P + 60 kg K + 300 kg Ca and harvested after 14, 18, or 22 mo. Av. root yields for harvests at 14, 18, and 22 mo. were 11.6, 13.5, and 12.9 t/ha, resp., without fertilizer and 17.3, 19.1 and 16.9 t with fertilizer. Yields without fertilizer ranged from 10.4 t in cv. Do Céu to 14.4 t in cv. Mucambo, while with fertilizer they ranged from 14.9 t in cv. Pery to 21.6 t in cv. Bujá. In a similar trial at Redenção the same fertilizer rates were applied except that no K was given, 3 cv. were replaced by others and harvests were made after 14 and 18 mo. at which av. root yields were 9.3 and 8.0 t/ha without fertilizer and 16.3 and 18.4 t with fertilizer. Yields without fertilizer ranged from 7.9 t in cv. Aciolina to 9.0 t in Curimenzinha and with fertilizer from 15.2 t in Macaxeira Preta to 21 t in Curimenzinha. *(Summary by Field Crop Abstracts)* D01 D03

See also 0374 0376 0397 0545

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

0426

13715 MATTOS, P.L.P. DE; DANTAS, J.L.L.; SOUTO, G.F. 1981. **Mandioca: pesquisa, evolução agrícola e desenvolvimento tecnológico.** *(Cassava: research, agricultural evolution, and technological development).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos no. 9. 103p. Port., 70 Refs., Illus.

Cassava. Research. Cultivation systems. Trade. Adaptation. Soil conservation. Soil fertility. Bacterioses. Mycoses. Injurious insects. Waste utilization. Technological package. Propagation. Brazil.

Basic research on cassava up to date, crop evolution, and technological development in Brazil are described. The advantages of cassava cultivation are included along with its alternatives for small-, intermediate-, and large-scale plantings. Major cultivation problems in Brazil are discussed: cropping system, production and commercialization system, adaptation to different ecosystems, low fertility soils, soil management and conservation, diseases [*Xanthomonas campestris* pv. *manihotis, Colletotrichum (Glomerella) manihotis, Sphaceloma (Elsinoe) manihoticola,* the mycoplasma causing witches' broom, *Cercospora* spp., *Uromyces* spp., and various causal pathogens of root rots - potential diseases such as the African mosaic and frog skin are also discussed], pests (mites, *Erinnyis ello,* shoot flies, scale insects, and stemborers), and industrial wastes (especially from fuel alcohol production). Recommended technologies for cassava cultivation in Brazil are described; the selection of cv., the selection and preparation of planting material, cutting size, mechanized soil preparation, planting times, planting systems, planting distances and depth, fertilization, weed control, intercropping, crop rotation, irrigation, and harvesting are included. The current levels of technology are discussed and alternate systems of technology are given with their corresponding technical coefficients. The production of cuttings for planting is discussed, as well as the use of stems for multiplication, as forage and as fuel. *(Summary by A.J.C. Trans. by L.M.F.)* D02 E00 F00

0427

16297 AGUILAR V., R. 1980. **Yuca, enfermedades y otros aspectos de cultivo.** *(Cassava, diseases and other aspects of cultivation).* Turrialba, Costa Rica, Ministerio de Agricultura y Ganadería. Centro Agrícola Regional de la Zona Norte. 19p. Span.

Cassava. Cultivation. Mycoses. Injurious insects. Injurious mites. Costa Rica.

Recommendations are given for cassava cultivation in Costa Rica, including the following aspects: land preparation; preparation and selection of cuttings (quality and healthiness); var.; planting systems (on the flat, on ridges, in furrows, and in beds); fertilization; weed control; harvesting; and commercialization. Major diseases and pests are described: superelongation [*Sphaceloma (Elsinoe) manihoticola*], brown leaf spot *(Cercosporidium henningsii),* white leaf spot *(Cercospora caribaea)* and blight leaf spot *(C. vicosae),* anthracnose [*Colletotrichum (Glomerella) manihotis*], rust *(Uromyces* sp.), cassava ash *(Oidium manihotis),* stem and root rots, thrips, mites, and the cassava hornworm *(Erinnyis ello).* *(Summary by F.G. Trans. by L.M.F.)* D02 E00 F00

0428

13017 MATTOS, P L.P. DE 1979. **Plantio de mandioca em fileiras duplas.** *(Cassava planting in double rows).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Comunicado Técnico no. 2. 5p. Port., Illus.

Cassava. Field experiments. Planting. Spacing. Tuber productivity. Starch content. Costs. Income. Brazil.

During the 1977/78 crop yr, an expt. was set up at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, BA, Brazil to determine the effect of adapting the double row planting system on cassava productivity. A randomized block design was arranged in split-split plots with populations that varied from 7000-16,666 plants/ha of 2 cassava cv. The double row planting distance of 2.00 x 0.60 x 0.60 m increased root productivity by 25% compared with the control. Economic results of the expt. are also included. The adaptation of this practice could be advantageous for the crop, allowing the free spaces to be used for other crops (maize, beans, soybeans, rice, sorghum, and peanuts). *(Summary by F.G. Trans. by L.M.F.)* D02 D03 J00

0429

16219 MATTOS, P.L.P. DE 1979. **Seleção e preparo de manivas-semente para plantio.** *(Selection and preparation of cuttings for planting). In* Curso Intensivo Nacional de Mandioca, 3o., Cruz das Almas-BA, Brasil, 1979. Trabalho apresentado. Cruz das Almas, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. pp.1-14. Port., 15 Refs., Illus.

Cassava. Propagation materials. Selection. Cuttings. Propagation.

Aspects that should be taken into account when selecting planting material are briefly analyzed: var., healthiness, age, diameter, size, viability of the cutting, and mechanical damage; quantity; harvesting, transportation, storage, cut and treatments of the cutting. *(Summary by F.G. Trans. by L.M.F.)* D02

0430

16222 MATTOS, P.L.P. DE; ALMEIDA, P.A. DE 1979. **Sistema de plantio para mandioca.** *(Cassava planting system). In* Curso Intensivo Nacional de Mandioca, 3o., Cruz das Almas-BA, Brasil, 1979. Trabalho apresentado. Cruz das Almas, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. pp.1-13. Port., 11 Refs., Illus.

Cassava. Planting. Land preparation. Cuttings. Spacing. Timing. Tuber productivity. Brazil.

The aspects that should be taken into account when planting cassava are analyzed: land preparation (furrows, ridges, and on the flat); cutting position (vertical, inclined, and horizontal) and depth (5-10 cm); spacing, depending on soil fertility, cv., and type of exploitation; and harvest times. Results of an expt. conducted at the Centro Nacional de Pesquisa de Mandioca e Fruticultura to study the effect of the double-row planting system on cassava production are included. This system allows the free spaces to be used by other crops (maize, beans, soybeans, and rice). Tables with comparative data are given. *(Summary by F.G. Trans. by L.M.F.)* D02

0431

16620 CHANDAPILLAI, M.M. 1975. **Weed control in tapioca** (*Manihot utilissima*, Pohl). *In* Indonesian Weed Science Conference, 3rd., Bandung, Indonesia, 1975. Proceedings. Bandung, Weed Science Society of Indonesia. pp.288-304. Engl., Sum. Engl., 4 Refs.

Cassava. Field experiments. Weeding. Herbicides. Tuber productivity. Malaysia.

A field expt. was conducted in Negeri, Sembilan, Malaysia in order to determine the relative efficiency of selected preemergent herbicides on weed control, growth and yield of cassava. A replicated factorial design was used with the herbicides diuron, nitralin, chloramben, and alachlor applied at 3 rates (diuron, 1.68, 3.36 and 5.07 kg/ha and for the others, 2.25, 4.50 and 6.75 kg/ha) and at 3 times (1 wk. before planting, at planting, 1 wk. after planting). Data on the no. of plants/plot sprouted at 4 wk., fresh wt. of regenerated weeds/plot 2 mo. after planting, the total fresh wt. of tubers/plot, the no. of plants harvested/plot, av. fresh wt. of tubers/plant, the no. of stems/plot, and the no. of tubers/plot are presented and discussed. The toxic effects of diuron on cassava were briefly considered. The best application time for controlling weed regeneration for all 4 herbicides was 1 wk. before planting. Weed control was best with nitralin followed by diuron, alachlor, and chloramben. Herbicides applied at planting or 1 wk. afterwards enabled a higher no. of cuttings to sprout. Although the no. of plants harvested differed significantly according to the various treatments, no differences were established in terms of total fresh wt. of tubers/plot, av. fresh wt. of tubers/plant, no. of stems/plot, or no. of tubers/plot. The use of selected preemergent herbicides for a cheaper and rapid establishment of leguminous creepers under plantation crops is recommended. *(Author's summary)* D02

0432

16235 CUNHA, M.A.P. DA 1981. **Programa Nacional de Pesquisa de Mandioca.** *(National Research Program on Cassava). In*_____. A pesquisa em mandioca e fruticultura. Cruz das Almas-BA, Brazil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos CNPMF no. 2. pp.21-27, 38-41. Port.

Cassava. Research. Cassava programs. Cultivation. Brazil.

Research priorities of the Programa Nacional de Pesquisa de Mandioca (National Research Program on Cassava - Brazil) are given: cropping, production, and commercialization systems; adaptation to different ecosystems; development of cv. in low fertility soils; soil conservation and management; var. resistance to diseases [CBB (*Xanthomonas campestris* pv. *manihotis*), root rots (various pathogens); superelongation [*Sphaceloma (Elsinoe) manihoticola*], and brown leaf spot (*Cercosporidium henningsii*)] and pests [cassava hornworm (*Erinnyis ello*), mites, and shoot flies (*Silba pendula*)]; water stress; and the different uses of cassava. The active germplasm bank has 619 introductions, of which 383 were tested. Double-row planting increased root production by 32%; N and P fertilization also increased root production. With adequate cultural practices, significant responses were observed and min. soil preparation reduced time input by 75%, therefore reducing costs. *(Summary by F.G. Trans. by L.M.F.)* D02

0433

16654 DOLL, J.D.; PIEDRAHITA C., W. 1977. **Effects of time of weeding and plant population on the growth and yield of cassava.** *In* Leakey, C.L.A., ed. Symposium of the International Society for Tropical Root Crops, 3rd., Ibadan, Nigeria, 1973. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.399-405. Engl., Sum. Engl., Fr., Span., 2 Refs., Illus.

Cassava. Field experiments. Cultivars. Weeding. Growth. Herbicides. Planting. Spacing. Tuber productivity. Colombia.

The critical period of weed competition for cassava occurs between 60-120 days after planting. Weeds competing with cassava during the 1st 60 days reduced production 50%. Cassava kept weed-free during the 1st 60 days produced 76% of the yield of cassava kept weed-free during the complete growth cycle; that kept weed-free for 120 days, 88% of the max. Optimum plant density varied with the weed control practice used. Densities of 6000-8000 plants/ha were optimal for cassava kept chemically weed-free, whereas for cassava hand-weeded only once at 30 days, or twice at 30 and 60 days after planting, densities > 8000 plants/ha were necessary to obtain the max. yield. *(Author's summary)* D02

0434

16679 TORO, J.C.; CELIS, E.; JARAMILLO, G. 1982. **Nueva guía para la conducción de pruebas regionales de yuca.** *(Guideline for carrying out regional trials in cassava). In* Centro Internacional de Agricultura Tropical. Programa de Yuca. 1982. Yuca: investigación, producción y utilización. Cali, Colombia. pp.579-585. Span.

Cassava. Technology evaluation. Research. Cassava programs. Colombia.

A guideline for carrying out regional trials in cassava is given, including necessary steps (identification of collaborators, selection of sites, identification of person in charge, planting and harvesting season, exptl. design, plot size, and border rows); the technology used (selection and treatment of cuttings, plant density, land preparation, planting position, application of herbicides and fertilizers, pest and disease control); necessary visits (a min. of 7); and final agronomic trials to determine optimum density and age of var. at harvest. *(Summary by F.G. Trans. by L.M.F.)* D02

0435

16158 KEATING, B.A.; EVENSON, J.P. 1981. **Effects of time of planting on growth and yield development.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.43-44. Engl.

Cassava. Field experiments. Planting. Timing. Growth. Tuber productivity. Australia.

The growth and development of cv. M AUS 10 planted at 12-mo. intervals were studied under the nonlimiting nutritional and moisture conditions of Redland Bay, Australia (site with a broad range of seasonal conditions). Sequential harvests carried out at 45 day intervals over a 1 yr period for each planting date indicated the effects of temp. and photoperiod on patterns of assimilate distribution. Final emergence was reduced from 98-100 to 2% for the planting dates of Nov.-Feb. and May, resp. Canopy development was also highly seasonal with LAI ranging from above 10.0 for early planted crops in March and April to 0 for all planting dates in Aug. and Sept. Max. CGR varied from 23.8-2.4 $g/m^2/day$ for the various planting dates and occurred from Feb. to early June. Temp. and solar radiation are highly correlated in the Redland Bay environment. Important seasonal differences in the proportion of total DM assimilation partitioned to storage organs (referred to as distribution ratio, DR) were observed with low DR over the Jan.-March period (0.1-0.3) when CGR was at a max. compared with 0.4-0.5 in Nov. and Dec. and 0.5-1.0 from April to June. *(Summary by F.G. Trans. by L.M.F.)* D02 C01 D03

0436

16155 WILSON, G.L.; PARTODIDJOJO, M. 1981. **Relationship between size of planting piece and population density in yield.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.36-39. Engl.

Cassava. Research. Planting. Spacing. Cuttings. Tuber productivity. Dry matter. Australia.

The relationship between the size of the cutting and plant density on cassava yield was assessed. Three plant densities (10,000, 15,625, and 40,000 plants/ha) and 3 cutting lengths (6.25, 16.0, and 25.0 cm) were used; cuttings were planted horizontally on a square pattern. The no. of stems produced/ha increased with total planting material, although not proportionally due to the effects of apical dominance. Short cuttings spaced at least 1 m^2 were adequate to provide an effective canopy for DM production. *(Summary by F.G. Trans. by L.M.F.)* D02

0437

17504 APILAR, E.G.; VILLAMAYOR JUNIOR, F.G. 1981. **Length of planting materials influences cassava yield.** Radix 3(1):11. Engl., Illus.

Cassava. Cuttings. Propagation materials. Tuber productivity. Harvest index. Philippines.

Root yield from 3 different cutting lengths - whole stem, half of whole stem, and normal length (25 cm)- of cassava var. Golden Yellow were 17.8, 21.7, and 34.8 t/ha, resp. *(Summary by Abstracts on Tropical Agriculture)* D02 D03

0438

16682 TORO, J.C.; ROCA, W.; COCK, J.H. 1982. **Métodos de multiplicación acelerada de material genético promisorio de yuca** *Manihot esculenta* **Crantz.** *(Methods for rapid propagation of promissory cassava genetic material). In* Centro Internacional de Agricultura Tropical. Programa de Yuca. 1982. Yuca: investigación, producción y utilización. Cali, Colombia. pp.147-152. Span., 6 Refs.

Cassava. Propagation. Shoots. Cuttings. Colombia.

Two methods of rapid propagation of promissory cassava genetic material are described in detail: by shoots on 2-node stem sections and by single leaf-bud cuttings. *(Summary by F.G. Trans. by L.M.F.)* D02

0439

16188 FURTADO, M.J.; OLIVEIRA, D. DE 1980. **Cultivo da mandioca (*Manihot esculenta* Crantz) em fileiras duplas.** *(Cassava cultivation in double rows).* Cariacica-ES, Brasil, Empresa Capixaba de Pesquisa Agropecuária. Comunicado EMCAPA v.2, no. 7.9p. Port., 1 Ref., Illus.

Cassava. Research. Planting. Spacing. Tuber productivity. Brazil.

A review of literature on the results obtained in research conducted in Brazil on the effect of plant density and the border effect on cassava production is given. The advantages of planting in double rows vs. the traditional cropping system are listed. Tables are included on the increase in cassava root production in border areas compared with the useful plot area with different cassava cv.; the effect of spacing in double and single rows on root and starch production; economic results of double row planting expt.; distribution patterns of plants in double rows. *(Summary by F.G. Trans. by L.M.F.)* D02 D03

0440

17507 VILLAMAYOR JUNIOR, F.G. 1981. **Increase cassava yield through optimum plant population.** Radix 3(1):6-7. Engl.

Cassava. Planting. Spacing. Tuber productivity. Philippines.

The optimum plant density of cassava varies according to cv., soil fertility, season, farming system, planting position, and weed control. For cassava plantations which usually grow late maturing var. and where good management practices are employed such as thorough land preparation, fertilization and adequate weed control, a population of 10,000-15,000 plants/ha is appropriate. For small growers who raise early maturing var. as a side crop on the poorer parts of their land without adequate fertilizer and weed control practices, 20,000-40,000 plants/ha are recommended. *(Summary by Abstracts on Tropical Agriculture)* D02 D03

0441

16699 EMPRESA BRASILEIRA DE ASSISTENCIA TECNICA E EXTENSAO RURAL. 1980. **Sistemas de produção para mandioca.** *(Production systems for cassava).* Manaus-AM, Brazil, Empresa Brasileira de Pesquisa Agropecuária. Série Sistemas de Produção. Boletim no. 205. 14p. Port.

Cassava. Technological package. Land preparation. Planting. Cuttings. Weeding. Pest control. Processing. Harvesting. Trade. Storage. Brazil.

A cassava production system is described for farmers using family labor and/or mutual assistance, with an area planted to cassava of 2-6 ha and yields of 16 t during a 12-18 mo. cycle. Recommendations are included as well as the technical coefficients of the different processes of the system: land choice and preparation; selection and preparation of cuttings; planting; weed, pest, and disease control; harvesting; processing; commercialization; and storage. *(Summary by F.G. Trans. by L.M.F.)* D02

0442

17548 LYRA, G. DE M. 1981. **Recomendações técnicas para a cultura da mandioca.** *(Technical recommendations for cassava cultivation).* Natal-RN, Empresa de Pesquisa Agropecuária do Rio Grande do Norte. Boletim Técnico no. 7. 37p. Port., 12 Refs.

Cassava. Technological package. Land preparation. Planting. Spacing. Fertilizers. Timing. Pest control. Weeding. Harvesting. Processing. Brazil.

The taxonomy, anatomy, and soil and climate requirements of cassava are described. Recommendations and technical coefficients for cassava growing in the area of Rio Grande do Norte, Brazil, are included: land clearance and preparation; plant density; soil amendment and application of fertilizers; planting system and time; var.; weed, pest, and disease control; harvesting; and processing (production of CF and cassava alcohol). *(Summary by F.G. Trans. by L.M.F.)* D02

0443

16561 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1980. **Evaluation of cassava harvesting tools.** *In* ——. Annual Report 1979. Ibadan, Nigeria. pp.48-49. Engl.

Cassava. Harvesting. Agricultural equipment. Nigeria.

The characteristics and advantages of different equipment used for mechanized cassava harvesting are given. The lever designed by the International Institute of Tropical Agriculture (IITA) to reduce the force exerted to pull cassava from the ground had a ratio of 3.67 when this method was compared with manual harvesting (4.96 and 18.20 kg force/kg tuber harvested, resp.). Stem breakages is a major problem in hard soils. When the plant had 3 main stems or more, the stems were too weak to stand the tensile force of the lever. With 2 main stems, pulling was successful 50% of the time. With one main stem with an angle of 35° or more to the soil, pulling was successful 95% of the time. In trials with tractor-pulled harvesters, the IITA harvester (a copy of CIAT's) had the greatest potential in comparison with Ransomes and Alpha Record, due to its low cost, simple and rugged construction, use on uneven land, low root damage and no. of roots left in the soil. *(Summary by I.B. Trans. by L.M.F.)* D02

0444

17555 RODRIGUEZ M., S.; GARCIA G., M. 1981. **Relación entre la procedencia de la semilla y los rendimientos de yuca** (*Manihot esculenta*). *(Relationship between seed origin and cassava yields).* Ciencia y Técnica en la Agricultura: Viandas, Hortalizas y Granos 4(1):17-30. Span., Sum. Span., Engl., 13 Refs.

Cassava. Cuttings. Selection. Tuber productivity. Germination. Foliage. Field experiments. Cuba.

The results of a comparative study on cassava clone Señorita using cuttings from different parts of the plant (stump, main stem, secundary and tertiary branches). These were taken from plants whose 1st branching occurred at 1.2 m or higher. Cuttings from main stems and stumps had significantly higher sprouting % than those from secundary and tertiary branches. The no. of days between planting and field cover by foliage was significantly lower in plots planted to cuttings from the main stems and stumps. Commercial tuber yield

was higher with cuttings from main stems ($P \leq 0.05$). The utilization of cuttings from main stems as propagation material for commercial plantings is recommended. *(Author's summary)* D02 D03

See also *0381* *0383* *0384* *0385* *0494* *0546*

D03 Energy Productivity and Yields

See also *0382* *0405* *0407* *0409* *0410* *0412* *0413* *0414* *0416* *0417* *0418* *0419* *0424* *0425* *0428* *0435* *0437* *0439* *0440* *0444* *0457* *0476* *0477* *0478* *0479* *0494* *0501* *0544* *0551*

D04 Postharvest Studies

0445

16240 URITANI, I.; DATA, E.S.; TANAKA, Y. 1982. **Biochemistry of post-harvest deterioration of cassava and sweet potato roots.** *In* ——.; Reyes, E.D., eds. Bio-resources investigation on production, storage, processing and vegetation of root crops in the tropics. 1981 Interim Report. Nagoya, Japan, Nagoya University Cooperation. pp.32-47. Engl., Sum. Engl., 19 Refs., Illus.

Cassava. Tubers. Deterioration. Analysis. Post-harvest studies.

The biochemical mechanism of post-harvest deterioration of cassava roots, with reference to physiological and pathological approaches to the elucidation of the mechanism are given, emphasizing the formation of the secondary metabolites in cassava roots (coumarins, phenols, terpenes, and cyanogenic glucosides). In relation to physiological and microbial deteriorations and in response to injury, bluish fluorescence as well as phenolic components were produced in cassava roots. It was elucidated that the former was composed of 5 coumarin components, the main 3 of which were scopoletin, scopoline, and esculin, and the other 2 were some kind of conjugates. A main component of the phenolics was *d*-catechin. In response to cut-injury, some enzymes participating in the production of the secondary metabolites were formed. Acid invertase formed early, and then phenylalanine ammonia lyase appeared. Peroxidase activity steadily increased after a lag of 1 day. These enzyme activities were also activated in noninfected tissue adjacent to the soft-rot region of cassava root tissue. When cycloheximide was applied to cassava root slices, the occurrence of both fluorescent components and physiological discoloration was partially inhibited, suggesting the participation of protein synthesis in these cytological events. Glucosidic and free cyanide contents in cassava roots were investigated in relation to storage and physiological deterioration. Some preliminary data are presented. *(Author's summary)* D04

0446

16239 TANIGUCHI, T.; DATA, E.S. 1982. **The role of microorganisms in post-harvest deterioration of cassava roots** *In* Uritani, I.; Reyes, E.D., eds. Bio-resources investigation on production, storage, processing and vegetation of root crops in the tropics. 1981 Interim Report. Nagoya, Japan, Nagoya University Cooperation. pp. 22-31. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Tubers. Deterioration. Post-harvest studies. Vascular streaking. Philippines.

The relationship between 2 types of deterioration of cassava roots in the Philippines was studied and a pathogenic microorganism was isolated from decaying cassava. Cubes of cassava root tissues of approx. 0.5 cm in thickness were prepared from healthy portions and others affected by vascular streaking (VS). After washing, the cubes were left on wet filter paper for several days. Some pieces deteriorated but no differences were established in the rate of deterioration between pieces from both portions. In another expt., the surfaces of the root pieces were sterilized and left for 3 days on the potato agar culture media containing streptomycin (50-100 ppm). No fungal hyphae were observed on the tissues but sometimes yeast-like microorganisms grew on the media around the tissues. A fungus (Phycomycetes) was isolated from the recently cut surface. When this fungus was inoculated into cassava roots, decay was caused and developed rapidly in the roots. This fungus was again isolated

from the decaying part. When healthy roots were inoculated with this fungus, another type of VS was observed mainly in the nondecaying area, although typical VS symptoms did not appear. Under a light microscope, abnormal colored xylem vessels were observed, indicating another type of VS. Results show that there is no direct relationship between VS (typical type) and decay. *(Author's summary)* D04

0447

17179 MARRIOTT, J.; PLUMBLEY, R.A.; RICKARD, J.E. 1980. **Physiological aspects of the storage of cassava and other tropical root crops.** *In* Hurd, R.G.; Biscoe, P.V.; Dennis, C., eds. Opportunities for increasing crop yields. London, Pitman, pp.363-375. Engl., 39 Refs., Illus.

Cassava. Research. Tubers. Storage. Deterioration. Post-harvest studies.

A literature review on physiological investigations on cassava and yams stored within the normal range of tropical ambient temp. is given; regarding cassava, postharvest physiological deterioration in roots is emphasized. Virtually nothing is known of the storage physiology of aroid root crops [principally taro and tannia *(Xanthosoma sagittifolium)*], sweet potato, and potato under these tropical conditions. *(Summary by Field Crop Abstracts)* D04

0448

16238 HIROSE, S.; DATA, E.S. 1982. **Physiology of post-harvest deterioration of cassava roots.** *In* Uritani, I.; Reyes, E.D., eds. Bio-resources investigation of production, storage, processing and vegetation of root crops in the tropics. 1981 Interim Report. Nagoya, Japan, Nagoya University Cooperation. pp.1-21. Engl., Sum. Engl., 13 Refs., Illus.

Cassava. Tubers. Post-harvest studies. Deterioration. Storage. Vascular streaking. Cultivars. Resistance. Pruning. Starch content.

The process of root deterioration, especially vascular streaking (types I and II), and microbial deterioration were observed in detail, and the relations between the deterioration process and environmental factors were studied. Two distinct types of vascular streaking (VS) were observed. One was a light-brown discoloration found as a ring along the outer part (including the vascular bundle) of the parenchymatous tissue and around the inner part of the cortex and the other was a blue-black pigmentation of the xylem vessels which appeared commonly on microbially deteriorated and adjacent areas. Thus, the 2 types of VS were distinguished as VS-types I and II, resp. With severe injury of the roots, VS-type II and the simultaneous or subsequent microbial deterioration frequently occurred before VS-type I. VS-type II seemed to be associated with microbial deterioration as it was frequently observed in the initial stage of microbial deterioration. Tested under UV light, the cut surfaces of bored and nonbored cassava roots showed the presence of some coumarin components with distinctive bright bluish fluorescence. Roots of 42 cv., 8 mo. old, were tested for susceptibility or resistance to VS. Eleven were assessed as very resistant cv. with no VS while another 11 cv. belonged to the susceptible group with the assessment score of 4. The susceptibility to VS-type I showed a negative correlation with root MC. The effect of pruning the plants, leaving only 30 cm of the stem for 2-3 wk. before harvest, on the incidence of root VS was studied and compared with roots of unpruned plants as well as roots buried underground. Roots of pruned cv. Golden Yellow plants showed slight symptoms of deterioration 3 days after storage. After 3-4 days, however, microbial rotting commenced, developing gradually and resulting in complete decay 9-10 days after storage. The roots buried underground for 3 wk. showed almost no deterioration during storage. However, some deterioration were observed 11 days after storage under ambient conditions. With cv. Hawaiian-5, the roots were more resistant not only to VS but also to microbial deterioration. Starch content of the roots of pruned and nonpruned cassava plants was determined. There was a reduction in root starch content of plants pruned prior to harvest ranging from approx. 3-7% as compared with that of unpruned plants which was associated

with a decrease in root quality. Drying rates were closely associated with some climatic factors. The decreasing rates in MC to total integrated solar radiation were expressed in regression formula of the 1st degree, which was dependent on chip size and loading rate. *(Author's summary)* D04 102

See also *0525*

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E00 PLANT PATHOLOGY

0449

17528 MENDOZA M., J. 1982. **Enfermedades y plagas transmisibles por semilla sexual y asexual de yuca en Ecuador.** *(Diseases and pests transmitted by cassava sexual and asexual seed in Ecuador). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.131, 254-255, 277-295. Span., 274 Refs.

Cassava. Diseases and pathogens. Injurious insects. Injurious mites. Ecuador.

A list is given with the common name, causal agent, and symptoms of cassava diseases and pests in Ecuador. The information available on these diseases and pests is scarce, especially that regarding pathogens. Up to date the common mosaic virus, frog skin (unidentified causal agent), and a bacterial disease caused by *Erwinia* sp. have been detected. Major fungal diseases attack the foliage (*Cercospora*). *Glomerella* sp. caused rot and necrosis in cuttings. The mites *Mononychellus tanajoa, Tetranychus urticae,* and *Oligonychus peruvianus* are mentioned as major pests. *(Summary by I.B. Trans. by I.M.E.)* E00 F00

See also 0402 0426 0427 0487 0497

E02 Bacterioses

0450

17131 PERREAUX, D.; MARAITE, H.; MEYER, J.A. 1982. **Identification of 3(methylthio) propionic acid as a blight-inducing toxin produced by *Xanthomonas campestris* pv. *manihotis* in vitro.** Physiological Plant Pathology 20:313-319. Engl., Sum. Engl., 19 Refs., Illus.

Cassava. *Xanthomonas manihotis*. Isolation. Leaves.

A toxic substance was extracted by ethyl acetate from a broth culture of *Xanthomonas campestris* pv. *manihotis* acidified at pH 4 with 1 N HCl. When infiltrated into cassava leaves the crude extract produced blight symptoms similar to those induced by the bacterial infection. The toxic substance was purified by gel filtration on a Sephadex G10 column and by TLC on silica gel 60, where it showed a R_F of 0.5 using as migration system methanol: chloroform: *n*-hexane (3:2:1, vol./vol.). By mass spectrometry, infrared spectroscopy, and C, H, N analyses the purified toxin was identified as 3(methylthio) propionic acid. This identification was confirmed by chemical synthesis. On detached cassava leaves, 3(methylthio) propionic acid gave a toxic effect up to a conen. of 9.9 m*M* corresponding to 24 μg of pure substance in a 20 μl drop of water. *(Author's summary)* E02

0451

17511 DEDAL, O.L.; PALOMAR, M.K., NAPIERE, C.M. 1980. **Host range of *Xanthomonas manihotis* Starr.** Annals of Tropical Research 2(3):149-155. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Laboratory experiments. *Xanthomonas manihotis*. Inoculation. Resistance. *Manihot glaziovii*.

Of 26 plant species from different families tested, only 4 species of the Euphorbiaceae (*Manihot glaziovii*, variegated ornamental cassava, *Euphorbia pulcherrima*, and *Pedilanthus tithymaloides*) were infected by *Xanthomonas campestris* pv. *manihotis*. Diagnostic symptoms on the alternative hosts were similar to those on cassava (used as check). *(Author's summary)* E02

0452

16691 CHALFOUN, S.M.; TANAKA, M.A.S. 1982. **Caracterização de variedades regionais de mandioca quanto à resistência, tolerância ou susceptibilidade a *Xanthomonas manihotis* (Arthaud Berthet) Starr., em condições de casa-de-vegetação e campo.** *(Characterization of regional cassava varieties regarding resistance, tolerance, or susceptibility to Xanthomonas manihotis under greenhouse and field conditions). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.79-86. Port., Sum. Port., 9 Refs.

Cassava. Laboratory experiments. Field experiments. Cultivars. *Xanthomonas manihotis*. Resistance. Brazil.

An expt. was carried out to characterize some of the cassava var. existent in the state of Minas Gerais, Brazil, regarding resistance, tolerance, or susceptibility to CBB (*Xanthomonas*

campestris pv. *manihotis*). Thirty-eight cv. were tested in the greenhouse and 9 in the field. In the greenhouse expt. 8 cv. (Arrebenta Burro, Cambadinha, Engana Ladrão, IAC 353-6, Sabará, SF 2578, SF 393, and Sonora) behaved as resistant, 4 cv. (IAC 1418, João Pires, Sertaneja, and Vassourão) as tolerant, and 26 as susceptible. In both expt. cv. Sonora was resistant to the disease. Cv. Guaxupé, Branca de Santa Catarina, Broto Roxo, and Híbrida were susceptible in the greenhouse and were more or less tolerant in the field. Cv. Baiana and Vassourinha SEL 514 were susceptible under both conditions. *(Author's summary. Trans. by L.M.F.)* E02 G01

0453

17549 ELANGO, F.N. 1980. **Relationship between *Xanthomonas manihotis* (Arthaud Berthet and Bondar) Starr and *Xanthomonas cassavae* (Wiehe and Dowson), and some epidemiological studies on cassava bacterial blight.** Ph.D. Thesis. Montreal, Quebec, McGill University. 301p. Engl., Sum. Engl., Fr., 207 Refs., Illus.

Cassava. *Xanthomonas manihotis. X. cassavae.* **Biochemistry. Serology. Symptomatology. Epidemiology. Disease transmission. Temperature. Colombia.**

Xanthomonas manihotis and *X. cassavae*, bacterial pathogens attacking cassava, showed similarities in their physiological/biochemical properties but differences in serology and pathogenicity. Therefore, retaining the distinction between *X. manihotis* and *X. cassavae* is probably justified. Fluctuating temp. (± 5-15°C) exerted more effect than steady temp. (± 2°C) on severity of CBB (*X. manihotis*). Lab., greenhouse, and field studies on pathogenic variability did not indicate the occurrence of distinct biochemical types or pathogenic races of *X. manihotis*. Available soil moisture was not significantly correlated with CBB severity. Direct immunofluorescence and ELISA techniques showed that *X. manihotis* survived epiphytically on weeds as on host tissue, and was seed-transmitted in cassava. The pathogen survived in seed embryos at concn. of 5×10^4 cells/embryo, with embryo infections varying from 0-40% depending on sampling season. Some recommendations for CBB control are based on these findings. *(Author's summary)* E02

E04 Viroses

0454

16289 ADEJARE, G.O.; COUTTS, R.H.A. 1982. **Ultrastructural studies on *Nicotiana benthamiana* tissue following infection with a virus transmitted from mosaic-diseased Nigerian cassava.** Phytopathologische Zeitschrift 103(1):87-92. Engl., Sum. Engl., Germ., 21 Refs., Illus.

Cassava. Disease transmission. Cassava African mosaic virus. Cassava latent virus. Nigeria.

In *Nicotiana benthamiana* tissue infected with a virus transmitted from mosaic-diseased Nigerian cassava, specific alterations to the nuclei of infected cells were noted particularly in the phloem parenchyma. These alterations included segregated nucleoli, an axial arrangement of chromatin, fibrillar rings, and the appearance of virus-like particles at the edges of the rings in the nucleoplasm, approx. 13 days after inoculation. Typically geminate virus particles have been isolated and purified from this tissue. The virus was shown to cause alterations in the nuclei of infected cells similar to those caused by other geminiviruses, but it was not demonstrated that the virus, termed CLV, was associated with the mosaic disease of cassava, as similar nuclear changes have yet to be identified in cassava tissue. *(Author's summary)* E04

0455

17516 KAISER, W.J.; LOUIE, R. 1982. **Heat therapy of cassava infected with African cassava mosaic disease.** Plant Disease 66(6):475-477. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. Cuttings. Temperature. Cassava African mosaic virus. Disease control. Hot water treatments. Kenya.

Thermotherapy was used to free 3 cassava cv. of CAMD, an important viruslike disease of cassava in East Africa. The pathogen was eradicated from 33-44% of tip cuttings (1.0-1.5 cm long) after hot-air treatment of mother plants at 37°C for 87-105 days. Survival of these tip cuttings after 35-105 days ranged from 22-73%. Exposure of entire cassava plants to hot-air treatments at 37°C for 42-96 days caused temporary remission of symptoms in most plants. Only one of 129 surviving plants was freed of disease. Two successive hot-water treatments of diseased stem cuttings at 50 or 55°C for varying intervals were not therapeutic. *(Author's summary)* E04

0456

13761 DENGEL, H.J. 1979. **Methods and proposals for combatting cassava mosaic disease in the Republic of Togo.** Plant Research and Development 10:76-83. Engl., 13 Refs., Illus.

Cassava. Cassava African mosaic virus. Disease control. Quarantine measures. Togo.

The phytopathological measures that should be taken into account in the control of CAMD are discussed. Recommendations include the selection of healthy planting material, improvement through the search for resistant var., quarantine measures to avoid disease dissemination, and cooperation between scientists and institutions to acquire knowledge on research results. *(Summary by F.G. Trans. by L.M.F.)* E04

0457

17552 SEIF, A.A. 1982. Effect of cassava mosaic virus on yield of cassava. Plant Disease 66(8):661-662. Engl., Sum. Engl., 10 Refs.

Cassava. Cassava African mosaic virus. Field experiments. Tuber productivity. Cultivars. Kenya.

Yield reductions of cassava infected with CAMV under field conditions in Kikambala, Kenya, ranged from 24-75% . There was a strong correlation between disease severity and yield loss. Incorporation of yield loss assessments in evaluation of var. for mosaic resistance would seem advisable in view of these results. *(Author's summary)* E04 D03

0458

16550 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1980. Virology Unit: cassava. *In* ——. Annual Report 1979. Ibadan, Nigeria pp.134-135. Engl.

Cassava. Cassava African mosaic virus. Laboratory experiments. Nigeria.

The CAMV was purified from infected tissues of *Nicotiana benthamiana* (primary isolation host), *N. glutinosa, N. tabacum,* and *N. clevelandii* as well as infected cassava leaves. The 0.05 *M* phosphate buffer (pH 7.8) containing 0.1% of 2-mercaptoethanol gave good results regarding virus yield and infectivity on *N. benthamiana.* Treatment with chloroform gave better infectivity. Centrifugation yielded higher amounts of virus on a linear gradient of 10-40% sucrose in a phosphate buffer (0.05 *M*, pH 7.2) during 4 h at 25,000 rpm in a SW-27 rotor. Two UV absorbing regions were obtained when monitored at 254 nm; both were infective when tested on *N. benthamiana.* Virus yields from cassava leaves were approx. 1% of the yield from *N. benthamiana. (Summary by I.B. Trans. by L.M.F.)* E04

E06 Nematodes

0459

17148 GAPASIN, R.M. 1981. **Control of *Meloidogyne incognita* and *Rotylenchulus reniformis* and its effect on the yield of sweet potato and cassava.** Annals of Tropical Research 3(2):92-100. Engl., Sum. Engl., 28 Refs.

Cassava. Laboratory experiments. Nematodes. Pest control. Growth. Tuber productivity. Philippines.

The effect of pre-plant treatment of different nematocides (aldicarb, carbofuran, triazophos, dibromochloropropane, and Bunema) and chicken manure effects on the growth of sweet potato and cassava and on the population of *Meloidogyne incognita* and *Rotylenchulus reniformis* 4 mo. after application was studied in pot expt. Low gall and egg mass ratings were obtained in chemical-treated plants, except those treated with triazophos. In all cases, the application of dibromochloropropane and aldicarb increased the root, tuber and top wt. of sweet potato and cassava and gave 65-80% reduction in nematode population compared to carbofuran and Bunema, which gave 45-70% reduction. Triazophos was the least effective among the chemicals tested. The application of chicken manure significantly increased roots, tubers and tops of sweet potato and cassava compared to those obtained with nematocides. There was no apparent correlation between growth response and % control. *(Author's summary)* E06

0460

17553 CHARCHAR, J.M.; HUANG, C.S. 1981. **Círculo de hospedeiras de *Pratylenchus brachyurus*. 3. Plantas diversas.** *(Host range of Pratylenchus brachyurus. 3. Different species).* Fitopatologia Brasileira 6(3):469-473. Port., Sum. Port., Engl., 14 Refs.

Cassava. Nematodes. Brazil.

The multiplication of *Pratylenchus brachyurus* on 13 field, forage, oil, and cover crops was studied under greenhouse conditions. The index of reproduction (IR, final population/initial population) of the nematode on tobacco cv. Matozinho, *Centrosema pubescens* cv. Comercial, and lima bean cv. Fava 1395 were 25.6, 19.4, and 16.2, resp. during a 3 mo. exptl. period. These plants were considered good hosts. Cassava cv. IAC-105.66, soybean cv. UFV-1, cotton cv. AFC-65.523, sesame cv. Branco Haste, kudzu (*Pueraria javanica*), sunflower, dry bean cv. Rico 23, and peanut gave nematode IR varying from 8.4-1.2, in decreasing order, under the same condition. For cassava and beans, IR were 8.43 and 2.01, resp. *(Author's summary)* E06

F00 PEST CONTROL AND ENTOMOLOGY

0461

17550 McCAFFERY, A.R.; PAGE, W.W. 1982. **Oviposition behaviour of the grasshopper *Zonocerus variegatus*.** Ecological Entomology 7(1):85-90. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. *Zonocerus variegatus*. **Insect biology. Entomology. Nigeria.**

In studies in cassava-growing areas near Ibadan, Nigeria, in the dry seasons of 1975-77, long-term changes in the no. of *Zonocerus variegatus* at oviposition sites reflected changes in the maturity of the general population. Short-term changes in the no. at oviposition sites were associated partly with normal diurnal behavior in which roosting occurred at night. Immigration, especially of females, into the oviposition site occurred prior to periods of oviposition activity. Emigration followed oviposition. The majority of the grasshoppers moved upwind into the oviposition site, suggesting an odor or sound attraction. Periods of intense oviposition activity followed heavy rainfall. *(Author's summary)* F00

See also 0426 0427 0449

F01 Injurious Insects and their Control

0462

17184 FABRES, G. 1981. Bioecologie de la cochenille du manioc (*Phenacoccus manihoti* Hom. Pseudococcidae) en Republique Populaire du Congo. [*Bioecology of the cassava mealybug (Phenacoccus manihoti) in the Congo Republic*]. Agronomie Tropicale 36(4):369-377. Fr., Sum. Fr., 6 Refs., Illus.

Cassava. *Phenacoccus manihoti*. Insect biology. Ecology. Congo.

During 1979-80, the population dynamics of *Phenacoccus manihoti* was studied. The following parameters were determined: % of infested plants, av. rate of infestation, and av. no. of mealybugs/apex in cassava var. M'Tembe in the Kombé region, Congo. The dissemination of the early stages of the pest and the growth of colonies during the dry season are analyzed. The role of biotic and abiotic factors responsible for seasonal variations of the mealybug is determined and explained; these factors can provide the bases for an integrated pest control. *(Author's summary. Trans. by I.M.E.)* F01

0463

16238 PENA, J.E.; WADDILL, V. 1982. Pests of cassava in South Florida. Florida Entomologist 65(1):143-149. Engl., Sum. Engl., Span., 13 Refs., Illus.

Cassava. *Erinnyis ello. Spodoptera eridania. Neosilba perezi. Diabrotica balteata. Aonidomytilus albus. Phenacoccus. Mononychellus caribbeanae. Tetranychus urticae.* Insect biology. Plant damage. Biological control. USA.

Insect pests found on cassava in southern Florida, USA, included the cassava hornworm (*Erinnyis ello* L.) cassava shoot fly (*Neosilba perezi*), banded cucumber beetle (*Diabrotica balteata*), southern armyworm (*Spodoptera eridania*), cassava scale (*Aonidomytilus albus*), Caribbean black scale (*Saissetia neglecta*), Mexican mealybug (*Phenacoccus gossypii*), *Phenacoccus* sp. near *obscurus* and several species of stem borers. The mites, *Mononychellus caribbeanae*, *Tetranychus urticae*, and *Panonychus citri* were found feeding on the leaves. The lace bug, *Corythuca gossypii*, is recorded for the 1st time as a cassava pest. *(Author's summary)* F01 F03

0464

16623 NWANZE, K.F. 1982. Relationships between cassava root yields and crop infestations by the mealybug, *Phenacoccus manihoti*. Tropical Pest Management 28(1):27-32. Engl., Sum. Engl., 4 Refs., Illus.

Cassava. Field experiments. *Phenacoccus manihoti*. Cultivars. Planting. Timing. Tuber productivity. Zaire.

Reductions in cassava root yield were related to infestations of the crop by the cassava mealybug, *Phenacoccus manihoti*, in field trials that combined several var., planting dates, and dates of onset of infestation in Zaire. Reductions in root yields of up to 84.4 and 54.4% were measured in late- and early-planted cassava, resp. There was a gradual increase in yield loss due to pest attack with every delay in planting. Root yields for Dec., Feb., and

April plantings were reduced by 2.6, 11.2, and 31.2% , resp. when compared with the 1st planting in Oct. However, a delay in the onset of mealybug infestation results in a decrease in yield loss. A correlation coefficient of r = 0.77 was obtained between root yield and date of initial pest infestation. While peasant farmers are unable to offset early pest attacks on their crop, they can reduce crop damage by avoiding late plantings. In the absence of highly resistant var., cassava var. that are able to offset early peaks in pest populations are recommended. *(Author's summary)* F01

0465

17512 BOZA, J.A.; WADDILL, V.H. 1978. **A cassava shoot fly, *Neosilva perezi* Romero and Ruppel: notes on biology and effect on cassava yield.** Proceedings of the Tropical Region. American Society for Horticultural Science 22:226-237. Engl., Sum. Engl., Span., 6 Refs., Illus.

Cassava. *Neosilba perezi*. Insect biology. Plant damage. Tuber productivity.

Immature and adult cassava shoot flies *Neosilba perezi* were reared at 3 constant temp.: 15.6, 21.1, and 25.6° C. Duration of the immature stages and adult longevity was extended by decreasing temp. Seasonal abundance, mean no. of eggs and larvae/terminal, and mating behavior were also investigated. The effects of the shoot fly on cassava growth and yield were studied by simulating larval damage. The damage had significant effects on plant height and no. of terminals/plant, but not on the no. of leaves, roots, marketable yield, or total yield. Linear regression equations are presented to estimate total yield, marketable yield, and the no. of marketable roots. *(Author's summary)* F01

0466

17501 LAL, S.S. 1980. **A note on *Prospaltella flava* Shafee, an aphelinid parasitoid of *Bemisia tabaci* (Gennadius).** Madras Agricultural Journal 67(8):557-558. Engl., 3 Refs.

Cassava *Bemisia*. Predators. India.

Prospaltella flava was found parasitizing *Bemisia tabaci* on cassava in Kerala, India, in 1976-77. The level of parasitism varied from 6.81% in Dec. to 29.50% in Oct. *(Summary by Review of Applied Entomology)* F01

0467

17199 LAL, S.S.; PILLAI, K.S. 1981. **Cassava pests and their control in southern India.** Tropical Pest Management 27(4):480-491. Engl., Sum. Engl., 55 Refs., Illus.

Cassava. Pests. Insect biology. Plant damage. Predators. Pest control. India.

From surveys in southern India in 1975-78, an annotated list is presented of cassava pests, including about 30 kinds of arthropods. The information provided includes the part of the plant attacked and the nature of the damage caused. For each of 9 pests or groups of pests [including *Odontotermes* sp., *Leucopholis coneophora*, *Aonidomytilus albus*, *Nipaecoccus filamentosus (Pseudococcus filamentosus)*, *Harpurostreptus* sp., *Retithrips syriacus*, *Bemisia tabaci*, and mites], a review is given of their biology, injuriousness, and control; information on natural enemies being included in some cases. *(Summary by Review Applied Entomology)* F01

0468

16292 COSENZA, G.W.; PERIM, S.; COSTA, I.R.S. 1981. **Resistência de variedades de mandioca ao percevejo de renda, *Vatiga illudens* (Drake, 1922).** *(Resistance of cassava varieties to the lace bug, Vatiga illudens).* Planaltina-DF, Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária dos Cerrados. Pesquisa em Andamento no. 7. 6p. Port.

Cassava. Cultivars. Resistance. *Vatiga illudens*. Field experiments. Entomology. Brazil.

Preliminary results are given of an expt. conducted at the Centro de Pesquisa Agropecuária dos Cerrados, DF (Brazil), on the resistance of 20 cassava var. to the lace bug *Vatiga illudens*. Var. Cacau Vermelho, Sertaneja, Guaxupé, Cavalo, and Branca de Santa Catarina were the most resistant. The resistance mechanism of Cacau Vermelho is probably tolerance since in addition to presenting the least damage, it had a high no. of adults and nymphs on its leaves. In screen cages the var. preferred by the insect had low HCN contents, indicating that the resistance mechanism is related to this factor. Cavalo was the var. least preferred. Var. Mantiqueira did not promote insect development, even though it proved to be attractive for adults. There are possibilities of using resistant plants in an integrated control system. *(Summary by I.B. Trans. by L.M.F.)* F01

0469

17529 BELLOTTI, A.C.; VARGAS H., O. 1982. **Diseminación de las plagas de la yuca por semilla sexual, asexual y por la raíz seca almacenada.** *(Dissemination of cassava pests by sexual and asexual seed and by stored dry roots).* *In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca. 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.117-130, 277-295. Span., 274 Refs., Illus.

Cassava. Injurious insects. Injurious mites. Propagation materials. Colombia.

Major cassava pests and their geographical distribution are given: **mites** *(Mononychellus tanajoa, M. caribbeanae, Oligonychus peruvianus, Tetranychus urticae, T. telarius,* and *T. cinnabarinus)*; **thrips** *(Frankliniella williamsi, Corynothrips stenopterus, Caliothrips masculinus, Euthrips manihoti, Scirtothrips manihoti,* and *Retithrips syriacus)*; **scale insects** *(Aonidomytilus albus, Pinnaspis minor, Saissetia hemisphaerica, S. nigra, S. miranda, Ceroplastes* sp., *Eurhizococcus* sp., and *Monophebus* sp.); **mealybugs** *(Phenacoccus manihoti, P. herreni, P. gossypii,* and *P. grenadensis)*; **stemborers** *(Coelosternus* spp., *C. manihoti, Lagochirus* spp., and *Chilomina clarkei)*; **storage pests of cassava** *(Araecerus fasciculatus, Tribolium castaneum, Dinoderus minutus, Stegobium paniceum, Lasioderma serricorne, Rhizopertha dominicana, Tenebroides* sp., *Oryzaephilus surinamensis, Latheticus oryzae,* and *Ephestia cautella)*. Of the main groups of pests, 17 are found in the Americas, 12 in Africa, and 5 in Asia, and many have been disseminated from one continent to the other due to the exchange of genetic material. The material sent for cassava propagation should be sexual seed or in vitro meristem cultures. Some recommendations are given for the donor country and for the receiving country when it is necessary to send asexual seed (cuttings). *(Summary by I.B. Trans. by L.M.F.)* F01 F03

0470

13167 GIRLING, D.J. 1978. **Report on a visit to Zaire to release natural enemies of cassava pests.** Curepe, Trinidad, Commonwealth Institute of Biological Control. 3p. Engl., 3 Refs.

Cassava. *Mononychellus tanajoa, Phenacoccus manihoti.* **Predators. Biological control. Zaire.**

As part of a project of the Commonwealth Institute of Biological Control (Trinidad), funded by the International Development Research Centre (Canada) for the biological control of the cassava mite (*Mononychellus tanajoa*), plans were made for the release of *Oligota minuta* and several parasites of the cassava mealybug, *Phenacoccus manihoti*, in Kivu Province, Zaire. The initial shipment contained approx. 400 *O. minuta* adults and the following mealybug parasites: *Anagyrus* sp. nr. *greeni*, *Anagyrus* sp. nr. *jocundus*, and *Acerophagus coccois*. Although the arrangements made to assure that the *O. minuta* would arrive in good conditions worked smoothly (50% arrived alive at Kinshasa), less than 5% of the shipment were still alive at the time of the flight to Bukavu (Kivu). Thus, the operation, as initially planned, was given up. Regarding the no. of parasites of the cassava mealybug, 40 *Anagyrus* sp. nr. *greeni*, 15 *Anagyrus* sp. nr. *jocundus*, and 10 *A. coccois* were released and further releases were planned using lab. cultures. *(Summary by I.B. Trans. by L.M.F.)* F01

0471

13051 GIRLING, D.J. 1979. **Report on a visit to the Peoples' Republic of Congo to advise on the biological control of the cassava mealybug,** *Phenacoccus manihoti* **Mat.-Ferr.** Curepe, Trinidad, Commonwealth Institute of Biological Control. 12p. Engl., 4 Refs., Illus.

Cassava. *Phenacoccus manihoti.* **Predators. Biological control. Congo.**

Since the natural enemies of *Phenacoccus manihoti* in Africa are incidental and, therefore, have few possibilities of playing an important role in controlling this cassava pest, the Commonwealth Institute of Biological Control is recommended to send an important nucleus culture of natural enemies available in Trinidad: predators (*Diomus ochroderus, Hyperaspis donzeli, H. jucunda, H. onerata,* and *Nephus bilucernarius*) and parasites (*Acerophagus coccois, A. nubilipennis, Aenasius phenacocci, Anagyrus* sp. nr. *greeni,* and *Anagyrus* sp. nr. *jucundus*). Other recommendations include technical assistance, pilot field releases of natural enemies, construction of a quarantine insectary, and assessment visits. A list of natural enemies of *P. manihoti* in Congo, Zaire, and Senegal is included. *(Summary by I.B. Trans. by L.M.F.)* F01

See also 0473 0487

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F03 Injurious Mites and their Control

0472

16231 MORAES, G.J.; DENMARK, H.A.; GUERRERO, J.M. 1982. **Phytoseiid mites of Colombia (Acarina:Phytoseiidae).** International Journal of Acarology 8 (1):15-22. Engl., Sum. Engl., Port., 20 Refs., Illus.

Cassava. Injurious mites. Insect biology. Colombia.

Phytoseiids are registered for the 2nd time in Colombia. A new genus and species, *Quadromalus colombiensis* and *Euseius ricinus* n. sp. are described, totalling 17 species of phytoseiid mites for Colombia. The following species found in cassava are described: *Iphiseiodes zuluagai, Typhiodromalus limonicus, Neoseiulus anonymus, Galendromus annectens,* and *G. longipilis.* The specie *T. limonicus* is frequently found associated with *Mononychellus tanajoa* and the specie *N. anonymus* with the mites *M. tanajoa, M. caribbeanae, Tetranychus urticae,* and *T. cinnabarinus. (Summary by F.G. Trans. by L.M.F.)* F03

0473

13763 HIBLER, M. 1979. **Biological control of cassava pests.** Courier 57:80-82. Engl., Illus.

Cassava. *Oligota minuta.* **Predators. Biological control.** *Mononychellus tanajoa. Phenacoccus manihoti.*

A historical review is given on the predators and parasites found to control the mite *Mononychellus tanajoa* and the cassava mealybug *Phenacoccus manihoti.* The predator that has been most outstanding in mite control is *Oligota minuta* (Staphylinidae). *(Summary by F.G. Trans. by L.M.F.)* F03 F01

See also 0402 0463 0469 0475

G00 GENETICS AND PLANT BREEDING

0474

16263 PEREIRA, A.S.; ANDO, A.; NORMANHA, E.S.; SILVA, J.R.; LORENZI, J.O.; MONTEIRO, D.A. 1980. **Tentativa para induzir mutação na cor do feloderma das raízes de mandioca pela irradiação de sementes.** *(Attempt to induce phelloderm color mutation of cassava roots by seed irradiation).* Bragantia 39:167-169. Port., Sum. Engl., 2 Refs.

Cassava. Seed. Germination. Irradiation. Roots. Brazil.

Selfed seeds of cassava cv. IAC Mantiqueira, with a purple phelloderm, were treated with γ irradiation from a Co^{60} irradiation source at the Centro de Energia Nuclear, Piracicaba, Brazil. Germination was initially low, but slightly higher for the irradiated seeds when compared with the control. The untreated control seeds and the samples irradiated with 20 and 30 kR gave origin resp. to 8, 13, and 21.6% of seedlings with white phelloderm roots. Cassava seedlings with a white phelloderm resulting from the untreated seeds are considered as genetic recombinants of a selfed heterozygous parent. The excess in the no. of seedlings with white phelloderm among the population resulting from the treated seeds, suggest that it was due to the mutagenic effect of irradiation. *(Author's summary)* G00 C01

G01 Breeding, Germplasm, Varieties and Clones, Selection

0475

16215 FARIAS, A.R.N.; FUKUDA, W.M.G.; SILVA, S. DE O.E.; MELO, Q.M.S. 1981. **Seleção preliminar de cultivares e clones de mandioca visando resistência a ácaros.** *(Preliminary selection of cassava cultivars or clones for mite resistance).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em Andamento no. 18. 3p. Port.

Cassava. Field experiments. Cultivars. Clones. Resistance. Injurious mites. Selection. Brazil.

Between 1979-80, 357 cassava cv./clones from the Centro Nacional de Pesquisa de Mandioca e Fruticultura were assessed in Pacajus, CE, Brazil in order to obtain mite-resistant material. A randomized block design was used with 2 replications; mite incidence was evaluated 3 times. Root, branch, stem, and stump wt. were determined. Clones EAB 451 (26.09 t/ha) and CPM 11-14 (18.50 t/ha) gave the highest root and branch yield, resp. The cv. with the highest starch content was BGM 222 (28.14%). According to the analysis of av. incidence, 51 cv./clones were considered promissory regarding mite resistance. *(Summary by F.G. Trans. by L.M.F.)* G01 F03

0476

16216 SILVA, S. DE O.E.; FUKUDA, W.M.G.; PINHO, J.L.N.; QUEIROZ, G.M. 1981. **Seleção de cultivares/clones de mandioca em Pacajus-CE.** *(Cassava cultivar/clone selection in Pacajus-CE).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em Andamento no. 22. 4p. Port., Illus.

Cassava. Field experiments. Cultivars. Clones. Selection. Tuber productivity. Foliage. Brazil.

Between 1979-80, the performance of 360 cassava cv./clones was studied at the Unidade de Pesquisa do Litoral, Pacajus, CE, Brazil. A randomized block design was used with 2 replications. Cv./clones were evaluated regarding root and canopy (leaves + branches + stumps) wt. Fifty cv./clones were selected for root production with yields varying between 27.75-15.36 t/ha for cv BGM 187 and clone CPM 15-11, resp. Cv./clones with a greater ability for canopy production were clone CPM 11-14 (46.25 t/ha) and cv. BGM 168 (40.71 t/ha). *(Summary by F.G. Trans. by L.M.F.)* G01 D03

0477

16255 SCHMIDT, N.C.; PEREIRA, A.S. 1980. **Novos clones de mandioca obtidos por cruzamento entre cultivares.** *(New cassava clones obtained by crossing cultivars).* Bragantia 39:137-145. Port., Sum. Port., Engl., 8 Refs.

Cassava. Cultivars. Field experiments. Crossbreeding. Selection. Clones. Tuber productivity. Resistance. Pests. Brazil.

The behavior of 6 clones of cassava cv. Mantiqueira (sweet cassava) x cv. Cafelha (bitter

cassava) was analyzed. Clones no. 17 and 50 were selected on the basis of 4 yr of observations on final stand, productivity, and disease and pest resistance. New clones were as productive as Mantiqueira; however, their root cortex, phelloderm, and pulp are white, and consequently of higher industrial value. Regarding disease resistance, results showed that the clones no. 17 and no. 50 were as good as cv. Mantiqueira and better than the other 4 clones. *(Author's summary)* G01 D03

0478

16625 ULLOA U., M. 1981. **Comparación de rendimiento con 16 variedades de yuca en Riberalta - Beni.** *(Yield comparison of 16 cassava varieties in Riberalta - Beni).* Tesis Ing. Agr. Santa Cruz de la Sierra, Bolivia, Universidad Boliviana Gabriel René Moreno. 64p. Span., Sum. Span., 35 Refs., Illus.

Cassava. Field experiments. Cultivars. Germination. Plant height. Flowering. Branching. Tuber productivity. Deterioration. Bolivia.

Yields of 16 cassava var. in Riberalta, Beni (Bolivia) were compared at the Exptl. Substation El Maral of the Instituto Boliviano de Tecnología Agropecuaria, IBTA. Var. M COL 22, M COL 638, M COL 1684, CMC 40, CMC 84, CM 305-38, CM 323-375, HCM 1, M VEN 218, M VEN 156, M PAN 70, M MEX 17, Colla, Gancho were used and as checks local var. Rama Blanca and Rama Negra in a randomized complete block exptl. design with 4 replications and 16 treatments. Data registered were: % of germination, plant height, branching type, days to flowering, days to defoliation, % of plants harvested, Ø and length of commercial roots, stem color, Ø, leaf shape, no. of lobes, petiole color, palatability of cassava prepared in 3 different ways (stewed, fried, and toasted flour or 'chive'), cassava deterioration at 14 days, and protein %. Av. germination of cuttings of the different var. was 96.2%. Root production was expressed in no. of roots/plot and wt. in t/ha for its corresponding statistical analysis according to Calzada's model (1970) and later with Duncan's test. Significant differences were observed between treatments. Var. M PAN 70 had the highest yield (wt. of total roots), outyielding the best local check Rama Blanca by 32.2%. Var. M PAN 70 and Colla can be prepared in any of the 3 ways for human consumption; on the other hand, var. CMC 40 and 2 local checks can be used for human consumption fried or as chivé. Var. CMC 84, M COL 638, and CM 305-38 can only be used for human consumption in the form of chivé and var. M VEN 156, Gancho, M MEX 17, HCM 1, and M VEN 218 for industrial purposes. Due to their resistance to deterioration, cv. HCM 1 and CMC 84 are indicated for conservation or transportation to other consumption centers. *(Author's summary. Trans. by L.M.F.)* G01 C01 D03

0479

16149 KEATING, B.A.; EVENSON, J.P. 1981. **Cultivar trials 1975-80.** *In* Cassava Research Program. St. Lucia, Australia. University of Queensland. Department of Agriculture. pp.58-61. Engl., Illus.

Cassava. Field experiments. Cultivars. Growth. Tuber productivity. Dry matter. Australia.

Tuber growth and yield of 28 cassava cv. were compared at the University Research Station, Redland Bay, Australia during 1978-80. These included cv. collected in Australia and others recently introduced from the Centro Internacional de Agricultura Tropical and from Puerto Rico. Cuttings 20 cm long and 11 mo. old were planted on Oct. 20,1978. Harvesting took place at 265 and 623 days. Trials were replicated 4 times. The highest yielding cv. after the 2nd harvest was M AUS 7 with storage root + cutting fresh wt. yield of 45.2 t/ha. Cv. M AUS 3, M AUS 13, COML. MM., CMC 84, CMC 76, and CMC 72 produced yields varying from 9-10 t DM/ha. The fresh and dry wt. yield of tops (mainly stems, but also leaves and petioles) at the time of harvest differed considerably among cv. High total dry wt. combined with high HI was the successful combination of the highest yielding cv. (M AUS 1, M AUS 7, M AUS 10, and Ceiba). Mean storage root + cutting yield of all cv. increased by approx. 64% between the 1st and 2nd yr harvest. *(Summary by F.G. Trans. by L.M.F.)* G01 D03

0480

16658 HRISHI, N.; JOS, J.S. 1977. **Breeding for protein enhancement in cassava.** *In* Leakey, C.L.A., ed. Symposium of the International Society for Tropical Root Crops, 3rd., Ibadan, Nigeria, 1973. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.11-13. Engl., Sum. Engl., Fr., Span., 12 Refs.

Cassava. Hybridizing. Polyploidy. Germplasm. Protein content. Mutation. India.

An intraspecific cross in *Manihot esculenta* between a Madagascar clone and a clone from Malaysia has a protein content of 7.9% but a low yield potential. In interspecific crosses between *M. saxicola* and *M. esculenta* there was a higher protein content in the roots of the offspring than in the parents, but the protein content reverted to normal levels in the clonal offspring of the hybrid seedlings. Tetraploids were produced from Malayan 4 and the protein content of these was increased by 42% over the level in the diploids and this was stable under vegetative propagation. Mutation breeding is also being undertaken. *(Author's summary)* G01 C03

0481

16657 MAGOON, M.L.; KRISHNAN, R. 1977. **Extending frontiers of genetic improvement in cassava.** *In* Leakey, C.L.A ed. Symposium of the International Society for Tropical Root Crops, 3rd., Ibadan, Nigeria, 1973. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.14-18. Engl., Sum. Engl., Fr., Span., 31 Refs.

Cassava. Plant breeding. Clones. Selection. Tuber productivity. India.

Special problems that delay genetic improvement are discussed and methods for overcoming barriers for gene flow are evaluated. The principles discussed have been applied in the cassava breeding program at the Central Tuber Crops Research Institute, Trivandrum (India) and proved valuable. Pachytene analysis for studying the karyotype and chromosomal homology at an interspecific level is described and has revealed the close relationship between cassava and *Manihot glaziovii*. After careful testing, 3 clones (H-165, H-97, and H-226) were selected from var. x var. crosses. They have 2-3 times the yield potential of local control cv. in regional trials. For future work a return to the diploid level for more intense selection before reforming polyploids from selected diploids is suggested as a promising technique. *(Author's summary)* G01

0482

17523 BRATHWAITE, C.W.D. 1982. **Política del IICA sobre intercambio de germoplasma de papa y yuca en América Latina y El Caribe.** *(IICA policies on the exchange of potato and cassava germplasm in Latin America and the Caribbean). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.223-230, 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Latin America. Caribbean.

The objectives, activities, and strategies adopted by the Plant Health Program of the Instituto Interamericano de Cooperación para la Agricultura (IICA) to reduce the risks involved in germplasm introduction are given. In the cases of potato and cassava in L.A. and the Caribbean these risks are high. Some factors determining the level of risk, the classes of risk established internationally, recommended protection measures, and a list of recommendations for plant quarantine inspectors are included. *(Summary by I.B. Trans. by L.M.F.)* G01

0483

17537 RODRIGUEZ M., S. 1982. **Reglamentación cuarentenaria sobre semilla sexual y asexual de yuca en Cuba.** *(Quarantine regulations on cassava sexual and asexual seed in Cuba). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.35-41, 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Propagation materials. Cuba.

Cuba has reached an adequate phytosanitary control. The starting point for clonal selection and hybridization was the establishment of the Centro de Mejoramiento de Semillas Agámicas (CEMSA) in 1967 and the search for material throughout the country. Cuba has diagnosis stations, quarantine or post entry specialists, and specialists in plant inspection at production and research centers; all of these services are carried out in a coordinated manner. For cassava, the pathogens not included in the following list are subjected to quarantine measures: *Aristoima* sp., *Cercosporidium henningsii, Cercospora caribaea, Stangospora cassavae, Uromyces jatrophae, U. manihotis, Choanephora cucurbitarum, Colletotrichum manihotis, Sphaceloma manihoticola, Botrydiplodia* sp., *Oidium erysiphoides, Sclerotium rolfsii, Rosellinia bidones, Xanthomonas manihotis,* and *X. cassavae.* Cassava pests not included in the following list are also subject of quarantine measures: *Anartia jatrophae guantanamo, Atta insularis, Cryptocephalus marginicolis, Erinnyis ello, Frankliniella cubensis, Leptostylus biustus, Lagochirus* sp., *Lepidosaphes alba, Lonchaea chalybea, Pachnalus litus, Saissetia* sp., *Phenacoccus gossypii Vatiya illudens, Tetranychus telarius, T. bimaculatus,* and *Schizotetranychus caribeanae.* The need to maintain the transfer of genetic material among cassava-producing countries, following quarantine measures, is highlighted. Max. cropping systems and meristem culture are 2 important ways of obtaining rapid multiplication with a min. risk of introducing pests and diseases. The release of new clones should be based on research on genotype x environment interactions. Post-entry stations prevent unnecessary risks in the handling of introduced materials. *(Summary by I.B. Trans. by L.M.F.)* G01

0484

17535 DELGADO, S. 1982. **Mecanismos de introducción, requisitos cuarentenarios y recursos de seguimiento fitosanitario del material de yuca y papa introducido en México.** *(Mechanisms of introduction, quarantine requirements, and methods of phytosanitary monitoring of introduced cassava and potato materials in Mexico). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp. 59-63, 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Mexico.

The process of introducing genetic material of potato and cassava into Mexico is described as well as the phytosanitary requirements for the introduction of potato germplasm. Mexico has had little experience in the transfer of cassava genetic material; therefore, most of J.C. Lozano's recommendations have been applied. The regulations of the Mexican Plant Health Office for controlling the movement and planting of imported genetic material are included. Under current quarantine conditions it is not feasible to reach 100% phytosanitary control. However, if the benefit is to be greater than the risk, new germplasm should be available to users at a short term in different places of the world and with a margin of phytosanitary control that prevents economic effects adverse for agricultural production. A worldwide census of pathogens attacking commercial crops in each country and their classification according to the damage caused is proposed. *(Summary by I.B. Trans. by L.M.F.)* G01

0485

17525 DELGADO, S. 1982. **El intercambio de germoplasma de yuca en México.** *(Exchange of cassava germplasm in Mexico). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.203-209, 277-295. Span., 274 Refs.

Cassava. Germplasm. Cassava programs. Mexico.

General objectives of cassava cultivation, especially the exchange of germplasm, in Mexico are given. The importance of this crop as a possible answer to the carbohydrate deficit, research carried out by the Instituto Nacional de Investigaciones Agrícolas (INIA), advantages of germplasm exchange and its problems are discussed as well as the infrastructure required to solve these problems, var. and hybrid assessment, release of new var. to farmers, training of agricultural consultants, collaboration with other institutions, and commercial production (approx. 200,000 ha in 7 yr). *(Summary by I.B. Trans. by L.M.F.)* G01

0486

16660 SINTHUPRAMA, S. 1978. **Varietal improvement of cassava in Thailand.** Bangkok, Thailand, Department of Agriculture, Field Crop Division, Root Crop Branch. 12p. Engl., 9 Refs.

Paper presented at the Workshop on Cassava Production and Utilization, Khon Kaen, Thailand, 1978.

Cassava. Plant breeding. Cultivars. Selection. Clones. Pollination. Thailand.

An analysis is given of varietal improvement of cassava in Thailand, which is divided into 2 types depending on if the var. are sweet or bitter. Industrial types or bitter var. are emphasized. Breeding procedures (introduction, selection, and hybridization) are described in detail. Most industrial-type cassava var. are relatively similar in their agronomic characteristics. In the clonal selection, the introduced materials did not outyield the check, Rayong 1. A wide range of variation in yield was found among plants from an open-pollinated seed population. Tables including var. introduced into Thailand during 1937-78 and av. yields and HI of tested var. and selected clones are given. *(Summary by F.G. Trans. by L.M.F.)* G01

0487

17536 PINO A., J.A. 1982. **Control del riesgo de diseminación de plagas y enfermedades de la yuca en Cuba.** *(Control of risk of pest and disease dissemination in cassava in Cuba). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.43-49, 252-253, 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Cuttings. Seed. Injurious insects. Injurious mites. Diseases and pathogens. Cuba.

Systems controlling the risk of pest and disease dissemination in Cuba are analyzed. Cuba has a seed certification system covering areas dedicated to the production of high-quality propagation material (seed banks) with internal quarantine inspectors of plant health and specialized technicians of the Empresa Productora de Semillas Varias of the Ministry of Agriculture who periodically inspect these areas. Agricultural enterprises are in charge of the phytosanitary follow-up of material released to cassava producers. Each province has diagnosis stations that work in collaboration with provincial lab. of plant protection and health. It has not been possible to release disease- and pest-free genetic material, thus chemical treatment of propagation material should be emphasized as well as the eradication

of virosis through tissue culture and heat therapy, studies on new methods of rapid multiplication of cassava and quarantine procedures. The recommendations made by several countries in 1975 at the Centro Internacional de Agricultura Tropical are still in force. These are included as well as a list of 14 species of insect pests, 3 mites, and 16 plant pathogens identified in Cuba. *(Summary by I.B. Trans. by L.M.F.)* G01 E00 F01

0488

17524 MONTALDO, A.; QUINTERO, F. 1982. **Introducción y manejo del germoplasma de yuca en Venezuela.** *(Introduction and handling of cassava germplasm in Venezuela). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.211-218, 277-295. Span., 274 Refs.

Cassava. Germplasm. Cultivation. Injurious insects. Diseases and pathogens. Venezuela.

Aspects are given of the Venezuelan program of introducing and handling cassava germplasm, which was introduced as asexual seed and observed regarding agronomic characteristics and behavior. Var. yield trials were set up in the Lago Maracaibo watershed, in the region of the Llanos Occidentales, and in Maracay and Maturín. The need to establish propagation centers and to increase the area planted to cassava (40,000-220,000 ha according to a crop expansion program for 1982-86) is emphasized. The infrastructure available for phytosanitary monitoring is described; problems found regarding the genetic material available in Venezuela are discussed: major pests and diseases, methods of agricultural mechanization, propagation material, cultural practices, yields, and desirable characteristics for the var. planted to the Lago Maracaibo watershed and the region of the Llanos Orientales. *(Summary by I.B. Trans. by L.M.F.)* G01 D00

0489

16683 COCK, J.H. 1982. **Infraestructura necesaria para el intercambio de germoplasma de yuca.** *(Infrastructure required for the exchange of cassava germplasm). In* Centro Internacional de Agricultura Tropical. Programa de Yuca. 1982. Yuca: investigación, producción y utilización. Cali, Colombia. pp.127-130. Span.

Cassava. Germplasm. Seed. Cuttings. Apical meristems. Propagation. Colombia.

Adequate resources and infrastructure for the exchange of cassava germplasm are discussed according to the type of material received (sexual seed, cuttings, and meristems). The final objective of exchanging cassava germplasm among different countries is to obtain improved var.; in order to do so, the continuity of breeding programs that handle introduced genetic material should be assured along with professionals trained to manage the different ways of germplasm exchange, technical assistants, physical facilities such as tissue culture lab., greenhouses, and exptl. fields, and a mechanism for multiplying new var. and releasing them to farmers. *(Summary by F.G. Trans. by L.M.F.)* G01

0490

17541 BARBA D., C. 1982. **Reglamentación cuarentenaria sobre la semilla sexual y asexual de yuca en Ecuador.** *(Quarantine regulations for cassava sexual and asexual seed in Ecuador). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.55-57, 114-116, 277-295. Engl.

Cassava. Germplasm. Quarantine measures. Pest control. Ecuador.

Ecuadorian regulations for introducing and handling cassava plant material in the country are described and analyzed. The National Program of Plant Inspection and the Instituto Nacional de Investigaciones Agropecuarias have greenhouse and screen cage facilities at the

expt. stations in Pichilingue and Boliche and laboratories in Guayaquil for propagating introduced material. They also have quarantine facilities at the airports in Quito and Guayaquil, health inspectors in every province in Ecuador, and plant quarantine inspectors at the ports equiped for the entry of plant propagation material. The tissue culture technique and the cooperation among international research centers can help minimize the risk of introducing pests and diseases. *(Summary by F.G. Trans. by L.M.F.)* G01

0491

17538 DAO, F. 1982. **Reglamentación cuarentenaria sobre semilla sexual y asexual de yuca y papa en América Central.** *(Quarantine regulations on sexual and asexual cassava and potato seed in Central America). In* Roca, W.M.; Hershey, C. D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.23-33, 273-275. 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Costa Rica. Guatemala. Honduras.

Current quarantine regulations are analyzed as well as the infrastructure and methods for the production, multiplication, commercialization, distribution and handling, quality control, and exchange of sexual and asexual cassava and potato seed in Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. In most of these countries legislation on seed and its enforcement are responsibilities of governmental agencies. The legislation of these countries involves common policies and principles. Special attention is given to field inspection and the monitoring of seed production. Requirements for var. registration vary among countries and are the major problem affecting trade. The importation of seed (prohibited in Costa Rica except for scientific purposes) is restricted in order to protect national seed industries and to exact quarantine enforcement. All of the Central American countries have imported seed analyzed in governmental lab before withdrawing them from customs. In general, trials on seed quality are based on rules established by the International Seed Testing Association (ISTA). It is recommended that these trials be carried out by independent organizations and that the same methodologies be adopted by the interested countries. Personnel dedicated to seed activity in Central America and Panama are identified, including the institutions at which they work and the technical activities that they carry out in Central America. The governmental regulations for the exchange of potato plant material in Guatemala are annexed. *(Summary by I.B. Trans. by L.M.F.)* G01

0492

17539 TAKATSU, A. 1982. **Reglamentación cuarentenaria sobre el material de propagación de yuca en Brasil.** *(Quarantine regulations for cassava propagation material in Brazil). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.7-13, 277-295. Span., 274 Refs., Illus.

Cassava. Germplasm. Quarantine measures. Propagation materials. Tissue culture. Brazil.

Data on phytosanitary issues in cassava crops in Brazil are given. Cassava is attacked by more than 20 pathogens. The need to establish quarantine regulations for cassava propagation material is indicated. The Empresa Brasileira de Pesquisa Agropecuária, through the Centro Nacional de Recursos Genéticos (Decree 1111 of 1978 of the Ministry of Agriculture), controls the importation of cassava propagation material for investigation. No other legal legislation prohibits or restricts the importation of these materials; nor does there exist any regulation on the movement of cassava propagation material and other products within Brazil. Available resources and infrastructure for phytosanitary follow-up are reviewed as well as the evaluation and release of introduced material to the users. There is a hiatus in the process of multiplying materials since regional or state research centers are not responsible for these operations and extension services do not have the resources or infra-

struct . : to do so. The in vitro tissue culture technique is recommended for the exchange of genetic material for those cassava cv. whose phytosanitary condition is uncertain, thus facilitating the introduction or transfer of a great no. of cv. to the Banco de Germoplasma de Mandioca of the Centro Nacional de Pesquisa de Mandioca e Fruticultura in Cruz das Almas. *(Summary by I.B. Trans. by L.M.F.)* G01

0493

17540 ROCA, W.M.; RODRIGUEZ, J.; BELTRAN, J.; MAFLA, G.; ROA, J. 1982. **Método de mantenimiento e intercambio de germoplasma de yuca.** *(Method of maintenance and exchange of cassava germplasm). In* —— .; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.135-151, 277-295. Span., 274 Refs., Illus.

Cassava. Germplasm. Apical meristems. Tissue culture. Seed. Cuttings. Plant physiology. Colombia.

The methods currently used or under study at the Centro Internacional de Agricultura Tropical (CIAT) to conserve and exchange cassava germplasm are discussed in detail. CIAT's germplasm collection has more than 2800 accessions and is maintained as clones (cuttings and in vitro cultures derived from meristems) and as true seed. In vitro meristem cultures allow genetic material to be kept free from contamination by microorganisms and retain varietal characteristics. CIAT has developed a 2-step technique: shoot growth, with or without root formation, is promoted in the 1st step, and rooting is induced in the 2nd without interference of the var. effect. In vitro meristem culture is combined with techniques to detect virus in order to guarantee clean planting material. Conditions (interaction between low temp. and sucrose and cytokinin concn.) to maintain in vitro cassava cultures during approx. 2 yr without transferring have been established. Aims are to transform the entire cassava collection, which currently covers 8 ha in the field, into meristem cultures. To eliminate the possibility of variation in genetic material and to assure max. viability, liquid N at -196°C was used (suspended animation at ultralow temp.). Seed conservation and the possibility of maintaining cassava germplasm in the form of pollen were studied. The process of exchanging cuttings, in vitro cultures, and seeds is detailed. Illustrations and tables are included. *(Summary by I.B. Trans. by L.M.F.)* G01 C00

0494

17546 KAWANO, K.; TIRAPORN, C.; TONGSRI, S.; KANO, Y. 1982. **Efficiency of yield selection in cassava populations under different plant spacings.** Crop Science 22:560-564. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Selection. Tuber productivity. Harvest index. Spacing. Inheritance. Field experiments. Colombia.

At the Centro Internacional de Agricultura Tropical, 20 genotypes were evaluated on medium to high fertility soils in a relatively moderate tropical climate for single-plant yield and HI in segregating populations and single-row trials at different plant spacings. The same genotypes were also evaluated for unit-area yield in a replicated large-plot trial to assess efficiency of selection. Broad-sense heritability for the yield of a single plant in segregating populations was much higher than that for HI, regardless of the spacing used. The correlation of single-plant yield in segregating populations with unit-area yield was invariably lower than the correlation of HI with unit-area yield. This result indicates that HI is a better selection criterion than is single-plant yield in segregating populations or in single-row trials, when the final objective of the selection is unit-area yield. Competition between genotypes appeared to be the major cause for a low correlation between single-plant yield and unit-area yield. The most efficient spacings were 1 x 2 m in segregating populations, and 2 m between rows in single-row trials. *(Author's summary)* G01 D02 D03

0495

17532 PERALTA S., M.M. 1982. **Reglamentación cuarentenaria sobre semilla sexual y asexual de papa y yuca en República Dominicana.** *(Quarantine regulations on sexual and asexual potato and cassava seed in the Dominican Republic). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.73-77, 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Dominican Republic.

In the Dominican Republic, appropriate regulations and laws for [illegible]t quarantine services were 1st applied in 1974. The importation of genetic materials is contemplated under the Law 4990 of plant quarantine which authorizes the Plant Health Department (PHD) to supervise, evaluate, and accept or reject these materials. The PHD coordinates with the Seed Department the phytosanitary measures of the process of seed multiplication, certification, and commercialization and defines pathogen tolerance %, disinfection methods and products, regions not considered apt for cassava cultivation, and sampling method and frequency. There are no special decrees regarding the introduction of cassava propagation material; it is almost absolutely prohibited to import cassava propagation material from Africa, the Middle East, and Asia. The multiplication and selection of cassava planting material corresponds to the Department of Agricultural Research; the quarantine service also effects a follow-up. The need of technical experience and infrastructure in order to maintain germplasm exchange with other countries is highlighted. As of 1982 there will be a post-entry quarantine station and 2 fumigation chambers according to international standards. *(Summary by I.B. Trans. by L.M.E.)* G01

0496

17533 BUSTAMANTE R., E. 1982. **Reglamentación cuarentenaria para el material genético de yuca y papa introducido en Colombia.** *(Quarantine regulations for introduced cassava and potato genetic material in Colombia). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.15-21, 239-251, 256-261, 277-295. Span., 274 Refs., Illus.

Cassava. Germplasm. Quarantine measures. Propagation materials. Colombia.

Basic requirements for importing cassava genetic material (sexual and asexual) are given. The Instituto Colombiano Agropecuario (ICA) is responsible for issuing the phytosanitary certificate, after determining the origin, type, transportation system, destination, and name of the organization held responsible for the material. The Centro Internacional de Agricultura Tropical (CIAT) has to file a different request for each species it wants to import. Both institutions jointly supervise exportation. The general criteria of the phytosanitary follow-up of plant material imported by CIAT (Agreement no. 6A signed by ICA and CIAT) are annexed as well as Colombian laws and legislations on plant production, unregistered phytosanitary problems in Colombia, and governmental requirements for potato seed certification in the country. *(Summary by I.B. Trans. by L.M.E.)* G01

0497

17542 LOZANO, J.C.; JAYASINGHE, U. 1982. **Problemas fitopatológicos de la yuca diseminados por semilla sexual y asexual.** *(Pathologic problems of cassava disseminated by sexual and asexual seed). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.111-116, 277-295. Span.

Cassava. Germplasm. Quarantine measures. Disease transmission. Seed. Cuttings. Colombia.

Among sexual seed-disseminated pathogens are those that infest the seed after dehiscence and probably cause abundant mucilaginous propagules (*Colletotrichum* spp., *Phoma* spp., *Diplodia* spp., and *Xanthomonas campestris* pv. *manihotis*) and those that also infect the seed (*X. campestris* pv. *manihotis* and *Colletotrichum* spp.) without excluding the possibility of other agents. Among the pathogens disseminated by plant material, commonly used in cassava propagation, localized pathogens which sometimes have symptoms specific to the causal agent and other times, symptoms (medullar, cortical, and epidermic degradation) common to other species are mentioned. Systemic pathogens, on the other hand, include fungi (*D. manihotis*), bacteria (*X. campestris* pv. *manihotis* and pv. *cassavae*), and viruses (their identification can be made by serology, bioassays, or by protein analysis-techniques that have not been sufficiently developed). Therefore, the introduction of plant material should only be done when strictly necessary, taking every possible precaution. Recommendations on how to reduce the risk of pest dissemination are given. The efficiency of sanitary measures to protect cassava planting material depends on the correct application given by donors and receivers. *(Summary by I.B. Trans. by C.M.E.)* G01 E00

0498

17534 VALENCIA T., F. 1982. **Reglamentación cuarentenaria sobre la semilla de papa y yuca en Perú.** *(Quarantine regulations for potato and cassava seed in Peru). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6 (82). pp.65-71, 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Research. Cassava programs. Peru.

Different aspects of handling, phytosanitary follow-up, research, and release of potato genetic material to users are examined along with the role of different Peruvian institutions and the Centro Internacional de la Papa. Regarding cassava, the Estación Exptl. Agrícola La Molina has a germplasm bank with 260 var. from several countries and 36 hybrids, and greenhouses to isolate genetic material. Currently, there are no specific programs for cassava breeding in Peru. There are no legal objections in force on introducing cassava material into the country as long as the phytosanitary importation permit and the official phytosanitary certificate of the country of origin have been granted. The establishment of a center in the Selva region (Tarapoto, department of San Martin) to investigate and multiply cassava and promote its cultivation is planned. *(Summary by I.B. Trans. by I.M.E.)* G01

0499

17531 MONTALDO, A.; QUINTERO, F. 1982. **Reglamentación cuarentenaria sobre la semilla sexual y asexual de yuca en Venezuela.** *(Quarantine regulations for sexual and asexual cassava seed in Venezuela). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.79-82, 277-295. Span., 274 Refs.

Cassava. Germplasm. Quarantine measures. Venezuela.

Governmental decrees on the transfer of cassava propagation material in Venezuela are given. These forbid the transfer of propagation material from the states of Anzoátegui and Monagas to the rest of the country, except roots for consumption and with the corresponding permit. Importation of cassava seed, plants, and plant parts is forbidden except for research purposes and after the corresponding authorization and fulfillment of sanitary regulations. These decrees are contemplated in the Law on Plant and Animal Health Protection, their enforcement corresponding to national and state authorities, plant health inspectors, customs and post office officials. Recommendations include the introduction of domestic quarantines, a census of cassava pests and diseases in Venezuela, identification of types of pathogens, a study on the advantages of applying fungicides, insecticides, and miticides, and crop rotation. Finally, it is stressed that the corresponding authorities and

institutions should undertake an integrated cassava program for adequate planning, coordination, and control. *(Sumamary by I.B. Trans. by L.M.F.)* G01

0500

17526 RODRIGUEZ B., A. 1982. **El intercambio de germoplasma de yuca en Colombia: aspectos que requieren investigación.** *(Exchange of cassava germplasm in Colombia: aspects requiring research). In* Roca, W.M.; Hershey, C.D.; Malamud, O. S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali. Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.187-189, 277-295. Span., 274 Refs.

Cassava. Germplasm. Research. Colombia.

Collaborative aspects between the National Tuber Crop Program of the Instituto Colombiano Agropecuario (ICA) and the Centro Internacional de Agricultura Tropical (CIAT) regarding the multiplication and handling of cassava genetic material are briefly mentioned. The utilization of material available at both institutions (2600 accessions at CIAT and 250 clones at ICA) is emphasized. Recommendations include a more precise determination of the components involved in the concept of cassava quality, especially that for table use. On the other hand, its use in animal feed implies the selection of material containing a high DM content. Advantage should be taken of the genetic characteristics of local or regional var. Finally, it is proposed that CIAT should publish a periodic report on its cassava germplasm collection, thus facilitating the establishment of collections in sites of interest or so far unexploited. *(Summary by I.B. Trans. by L.M.F.)* G01

0501

16207 MACHADO, E.L. 1976. **Melhoramento da mandioca no Rio Grande do Sul.** *(Cassava breeding in Rio Grande do Sul).* IPAGRO Informa 14:28-30. Port., Illus.

Cassava. Plant breeding. Tuber productivity. Brazil.

A brief account is presented on cassava breeding for productivity and disease resistance at the Estação Exptl. da Taquari, RS, Brazil. Yields of 48 t/ha have been obtained with no fertilizers with hybrid S 18-7, which also outyielded its parent var. M. Vassourinha T 5 in all trials (35,895 vs. 34,020 t/ha in 1973-75). *(Summary by J.L.S.)* G01 D03

0502

17527 EZETA, F.N.; CUNHA, M.A.P. DA 1982. **El intercambio de germoplasma de yuca en Brasil.** *(Exchange of cassava germplasm in Brazil). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82). pp.177-181, 277-295. Span., 274 Refs.

Cassava. Germplasm. Brazil.

Cassava genetic material enters Brazil through the Centro Nacional de Recursos Genéticos (CENARGEN) for the Centro Nacional de Pesquisa de Mandioca y Fruticultura (CNPMF), which determines the technical and financial viability of all research work carried out in cassava. The National Research Program on Cassava (PNP-Mandioca) recommends the course of research to be followed for 3 yr; its objective is to find solutions to current or potential problems of the farmers when growing cassava. Germplasm exchange should be directed towards solving the problems found by PNP-Mandioca. The CNPMF acts as an active germplasm bank, enriched with material from different regions of Brazil, and distributes the material available in the germplasm bank (approx. 800 entries). Major problems in cassava cultivation are listed and restrictions on germplasm exchange inside and outside the country are discussed. All cassava material that enters or leaves the country

should do so as in vitro meristem cultures. The entry of materials from Africa is forbidden and the entry of material from countries that have African materials in their collections is restricted. Material introduction should focus on the solution of specific problems and not on increasing genetic diversity, since Brazil is the center of origin of the species. Moreover, germplasm exchange should have early-maturing, high-yielding cv. *(Summary by I.B. Trans. by L.M.F.)* G01

0503

17530 HERSHEY, C.H. 1982. **El germoplasma de yuca conservado en el CIAT.** *(Cassava germplasm conserved at CIAT). In* Roca, W.M.; Hershey, C.D.; Malamud, O.S., eds. Taller Latinoamericano sobre Intercambio de Germoplasma de Papa y Yuca, 1o., Cali, Colombia, 1982. Memorias. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC-6(82) pp.93-102, 277-295. Span., 274 Refs., Illus.

Cassava. Germplasm. Plant breeding. Adaptation. Productivity. Colombia.

The Centro Internacional de Agricultura Tropical (CIAT) currently maintains a collection of 2676 accessions from 15 countries and has developed an effective system to conserve in vitro cassava seedlings for approx. 2 yr in a sterile artificial medium in test tubes. Six basic combinations of soil and climatic characteristics for cassava cultivation have also been determined. CIAT's key strategy has been to test the germplasm bank in each one. In 1973 the intensive testing of cassava germplasm and parental selection began. CIAT produces 150,000-200,000 hybrid seeds/yr of which 50,000-60,000 are planted at CIAT and the rest stored or sent to other countries. Selected lines go through the following stages: F_1 generation, observation in the field, yield trial, and regional trials. CIAT's new hybrids, cultivated with improved technology, can triple the yields of local var. (CM 321-188, 11.4 t DM/ha/yr). Important characteristics of cassava are discussed and some generalizations on CIAT's germplasm collection are pointed out on the basis of the information gathered in numerous evaluations. The basic cassava breeding procedure is summarized and the importance of the information flow from both the point of view of selection as well as the farmers' is highlighted. International germplasm (sexual and asexual material) distribution is discussed. *(Summary by I.B. Trans. by L.M.F.)* G01

See also 0389 0452

H00 NUTRITION

H01 Cassava Foods and Nutritive Value

0504

17150 JOAO, W.S.J.; ELIAS, L.G.; BRESSANI, R. 1980. **Efecto del proceso de cocción-extrusión (Brady Crop Cooker) sobre el valor nutritivo de mezclas elaboradas a base de fríjol caupí (*Vigna sinensis*)-maíz, y de fríjol caupí-yuca.** [*Effect of the cooking-extrusion process (Brady Crop Cooker) on the nutritive value of cowpea/maize and cowpea/cassava blends*]. Archivos Latinoamericanos de Nutrición 30(4):539-550. Span.. Sum. Span., Engl., Port., 18 Refs., Illus.

Cassava. Diets. Nutritive value. Laboratory animals. Methionine. Cooking. Human nutrition. Guatemala.

Cowpea/maize (65:25) and cowpea/cassava (72:18) blends were extrusion-processed in a Brady Crop Cooker at an extrusion temp. of 290-300°C. Protein nutritional value of the raw and extruded products was evaluated in rat feeding trials, with and without met. supplementation. Data are given for rat growth and PER. For both blends, PER was improved by extrusion and/or met. supplementation. PER of the extruded met.-supplemented products was equal (2.6) for both blends. *(Summary by Food Science and Technology Abstracts)* H01

0505

17510 PALOMAR, L.S.; PEREZ, J.A.; PASCUAL, G.L. 1980. **Wheat flour substitution using sweet potato or cassava in some bread and snack items.** Annals of Tropical Research 3(1):8-17. Engl., Sum. Engl., 2 Refs., Illus.

Cassava. Cassava flour. Breads. Composite flour. Cassava bread. Philippines.

Cassava and sweet potato flour were processed and used to substitute wheat flour from the 20-100% level in some yeast breads (pan de sal and hot rolls), quick breads (paborita, cheese crackers, and coconut cookies) and snack items (polvoron, gollorias, and doughnut). Cassava and sweet potato flour have a coarser texture than wheat flour but CF approximates the color of wheat flour. CF has almost similar chemical properties as wheat flour except for protein and crude fiber; sweet potato flour differed in protein, texture, and color. Preference tests showed that products with root crop flour, except doughnut, were preferred by consumers. Based on cost analysis, root crop flour is a good substitute for wheat flour. *(Author's summary)* H01

0506

16659 PREMA, L.; VIMALAKUMARI, N.K., USHA, V.; UKKURU, M. 1982. **Indian dishes with cassava.** Trichur, Kerala Agricultural University. 147p. Engl.

Cassava. Human nutrition. India.

Recipes are given of 180 Indian dishes, which use cassava as basic ingredient in main dishes, side dishes, or snacks. A detailed survey was conducted on various aspects of cassava with emphasis on the methods of incorporation in food preparations among the rural population of Kerala State. It was found that there exists a lack of ability to innovate new recipes; therefore, lab. expt. were conducted with cassava, substituting potato in well-known Indian

preparations. All recipes were evaluated regarding their nutritive value, cost, and acceptability. Several appendixes of great use in the preparation of these recipes are included. *(Summary by I.B. Trans. by L.M.F.)* H01

See also 0518 0521

H03 Animal Feeding

0507

13223 KITPANIT, N., KHAJARERN, J.M.; VIBULCHAI, A. 1979. **Biological titration of Thai cassava root products of various quality grades, trial II.** *In* Khon Kaen University. Faculty of Agriculture. Cassava/nutrition project; annual report 1978. Khon Kaen, Thailand. pp.112-122. Engl., 7 Refs.

Cassava. Cassava flour. Swine. Animal nutrition. Animal physiology. Diets. Thailand.

In a randomized complete block design with 3 replications and 4 treatments, the feeding values of cassava root meal of grades A, B, and C (quality scores > 80 points, 70-80 points, and 70-75 points, resp.) fed ad libitum in pig diets. Each treatment included 3 pigs with an av. initial body wt. of 14 kg. Treatment 4 was a commercial diet used as check. The levels of cassava used in the starting, growing, and finishing diets for each treatment were 50, 60 and 70%, resp. Feed consumption and body wt. were measured at 7-day intervals during the entire exptl. period which was considered terminated when the av. body wt. of the pigs reached 100 kg. The 2nd largest animal in each group was slaughtered to measure the dressing % , carcass length, back fat thickness, iodine no. of leaf fat, kidney wt., liver wt., stomach wt., and cross-sectional area and proximate analysis of **Longissimus dorsi** muscle. Av. daily gain was significantly higher (P=0.05) for the commercial diet in every growth period (0.552, 0.695, and 0.508 kg for starting, growing, and finishing periods, resp.) compared with the other treatments (0.262, 0.542, and 0.560, resp. for grade A cassava; 0.320, 0.509, and 0.598 for B; and 0.293, 0.449, and 0.379 for C), except with grades A and B for the finishing period. A similar trend was observed for wt. gain (growth rate). The efficiency of utilization was higher for the commercial diet (av. 2.87 kg/kg gained) than for grades A, B, and C (3.19, 3.33, and 3.63 kg/kg gained). Pigs fed the commercial diet reached market wt. quicker (158.33 days) than those fed grades A, B, and C (185.67, 186.00, and 212.67 days, resp.). No differences were observed among treatments regarding carcass characteristics. It was concluded that only grade A and B cassava can be used in levels up to 50, 60, and 70% for starting, growing, and finishing diets, resp. These diets should include high quality protein. Feed enhancers and flavouring should be incorporated into starting and growing diets to increase feed intake. *(Summary by A.J.C. Trans. by L.M.F.)* H03

0508

16521 TEWE, O.O.; MANER, J.H. 1981. **Performance and pathophysiological changes in pregnant pigs fed cassava diets containing different levels of cyanide.** Research in Veterinary Science 30:147-151. Engl., Sum. Engl., 15 Refs., Illus.

Cassava. Swine. Animal nutrition. Diets. Cyanides. Animal physiology. Toxicology.

Eighteen pregnant Yorkshire gilts were allotted to 3 equal groups and fed fresh cassava diets containing 0, 250, and 500 mg cyanide/kg of fresh cassava offered. Dietary cyanide level had no significant effect on either the no. or the wt. of 110-day-old fetuses. Serum SCN concn. was slightly but not significantly increased in the 500 ppm cyanide group and serum protein-bound. I decreased during gestation in all groups. Fetal serum SCN concn. was significantly (P < 0.05) higher in the group fed 500 ppm added cyanide. A small increase in

maternal thyroid wt. with increasing levels of cyanide was observed. Pathological studies showed proliferation of glomerular cells of the kidney in gilts in all groups and reduced activity of the thyroid gland in gilts fed 500 ppm cyanide. Cyanide fed during gestation did not effect performance during lactation. Milk SCN and colostrum I concn. were significantly ($P < 0.05$) higher in the group fed 500 ppm cyanide. *(Author's summary)* H03

0509

16602 SOARES, M. DE C.; NEVES, J.F. 1978. **A mandioca na alimentação de suínos.** *(Cassava in swine nutrition).* Lavras-MG, Ministério da Educação e Cultura. Escola Superior de Agricultura de Lavras. 24p. Port., 35 Refs.

Paper presented at Curso Intensivo para Capacitação de Técnicos na Cultura da Mandioca, Lavras, MG, 1978.

Cassava. Animal nutrition. Swine. Processing. Research. Nutritive value.

A brief literature review on the use of cassava in swine nutrition is given; the var. used, methods of processing, nutritive value, and a brief summary of the major results of research conducted during 1928-74 are included. *(Summary by E.G. Trans. by L.M.F.)* H03

0510

16270 BALOGUN, O.O.; FETUGA, B.L. 1981. **Methionine requirement of weanling Large White x Landrace pigs as determined by plasma urea concentration, nitrogen retention and some urinary nitrogenous components.** Journal of Nutrition 111(6):1025-1032. Engl., Sum. Engl., 26 Refs., Illus.

Cassava. Laboratory experiments. Swine. Diets. Cassava meal. Methionine. Animal nutrition. Nigeria.

The met. requirements of weanling Large White x Landrace pigs fed a 20% protein CM-SEM diet were evaluated using N balance, plasma urea concn., urinary nitrogenous end products, and the index (allantoin/urinary urea) x protein intake (A/U x Ip). Sensitivities of the response criteria to sex differences in met. requirements were compared. Allantoin excretion consistently and significantly ($P < 0.05$) increased with increasing met. levels to a max. of 0.55% total met. Max. N retention was observed in diets containing 0.55, 0.47, and 0.55% total met. for castrated males, females, and the pooled data for both sexes, resp. Min. urea concn. in plasma was obtained with the diets containing 0.55% met. The index, + A/U x Ip, showed that the diet was better utilized when it contained 0.63, 0.55, and 0.63% total met. in castrates, females, and combination of the 2 sexes, resp. *(Author's summary)* H03

0511

17517 ADEBOWALE, E.A. 1981. **Reemplazamiento del maíz por cáscaras de la yuca fermentada** *(Manihot utilissima* Pohl) **en raciones para ovejas.** *(Maize replacement value of fermented cassava peels in rations for sheep).* Producción Animal Tropical 6(1):58-64. Span., Sum. Span., 16 Refs.

Cassava. Sheep. Cortex. Fermented products. Digestibility. Dry matter. Supplements. Costs. Income. Nigeria.

For 6 mo. groups of 6 sheep were given 20, 40, and 60% fermented cassava peel to replace maize in the control diet of maize 60, groundnut cake 10, brewer's dried grains 20, and dried cassava leaves 4%. DM digestibility was 80, 76, 64, and 84%, wt. gain 10.8, 6.9, 5.5, and 12.0 kg, and feed intake/kg wt. gain 7.8, 10.9, 11.8, and 7.4 kg, resp. The use of 20, 40, and 60% peel increased the economic return by 15, 15, and 19%, resp. *(Summary by Nutrition Abstracts and Reviews)* H03

0512

17518 TEELUCK, J.P.; NICOLIN, R.; HULMAN, B.; PRESTON, T.R. 1981. **Apuntes sobre el uso de la yuca (*Manihot esculenta*) como fuente combinada de proteína y forraje para el crecimiento de becerros alimentados con dietas de miela-za/urea.** *(A note on the use of cassava as a combined protein and forage source for growing cattle fed molasses/urea).* Producción Animal Tropical 6(1):90-93. Span., Sum. Span., 3 Refs., Illus.

Cassava. Calves. Animal nutrition. Diets. Forage. Supplements.

Two groups of 4 weaned calves were given a basal diet with molasses and urea at 2.5% and fresh cassava forage at 4% of livewt. daily. Av. daily gain with the basal diet was 191 g and with a supplement of cottonseed meal at 200 g daily 488 g; corresponding feed intakes were 11.5 and 6.93 kg/kg gain. *(Summary by Nutrition Abstracts and Reviews)* H03

0513

17547 MAINI, S.B. 1981. **Cassava: a protein-rich animal feed.** Indian Farming 30 (11):27, 29-30. Engl.

Cassava. Tubers. Leaves. Nutritive value. Feeds and feeding. Cassava meal. Cassava chips. India.

The nutritive value of cassava leaves and tubers (chips and meal) as a supplement in animal feeding is analyzed and discussed. Tables on the chemical composition of cassava chips and flour and recommended feed formulae are included. *(Summary by F.G. Trans. by L.M.F.)* H03 C03

0514

17554 HOYOS M., C. 1982. **Comparación de dos niveles de harina de yuca proveniente de variedades con alto y bajo contenido de cianuro en dietas para pollos de engorde.** *(Comparison of two levels of cassava meal from varieties with low and high cyanide content in diets for broilers).* Tesis Zoot. Palmira, Universidad Nacional de Colombia. Facultad de Ciencias Agropecuarias. 125p. Span., Sum. Span., Engl., 61 Refs., Illus.

Cassava. Chicks. Cassava meal. HCN content. Digestibility. Feeds and feeding. Costs. Cyanide. Animal physiology. Animal nutrition. Colombia.

Two expt. were carried out at the exptl. farm of the Animal Husbandry Section, U. Nacional (Palmira, Colombia), to compare the nutritive value of 2 levels (10 and 20%) of CM from var. with low and high cyanide content in rations for broilers. In the 1st trial, 840 one-day-old, mixed sex, Arbor Acres broiler chicks were randomly assigned to each of 6 treatments with 4 replicates/treatment. Each pen constituted an exptl. unit with 35 chicks. CM from the high-cyanide var. M Col 1684 and the low-cyanide var. M Col 113 was used. The 2nd trial included 735 chickens in a similar arrangement but with 7 dietary treatments and 3 replications each; in this expt. M Col 113 was replaced by var. Llanera. Sun-drying on concrete floor of chips from roots of cassava var. M Col 1684 and M Col 113 and Llanera produced CM with the following av. total cyanide content, expressed on DM basis: 115 (9% as free-CN), 31 (71% as free-CN), and 20 (33% as free-CN) mg/kg, resp. A commercial diet was used as control and the test diets with fixed levels (10 and 20%) of CM were balanced by min.-cost feed formulation using linear programming. All exptl. chicks were fed the diets and water ad libitum. Live wt. and feed consumption were recorded weekly. Results of the 1st expt. demonstrated the superiority of the commercial diet; however, diets containing 20% CM produced better results than those with 10% for both CM used, suggesting that there is no apparent toxic effect at these levels. It was evident that the lower feed intake of the chickens fed the CM-based diets was partially responsible for the inferior

performance of these groups. Observations during the exptl. period indicated that chickens fed CM diets spent more time eating compared with those fed the control diet. For the 2nd expt. 2 additional treatments were studied by supplementing the 20% CM diet with sufficient amount of vegetable oil to increase the ME of these diets by approx. 5%. Overall results were better than those reported for the 1st expt. The addition of vegetable oil resulted in similar body wt. (± 2.18 kg) and better feed conversion than the group fed the commercial diet (2.08 vs. 2.19). These preliminary results indicate that CM, adequately processed from cassava var. containing high-cyanide levels, can be used in broiler rations up to 20% without any deleterious effect from the nutritional point of view. However, since cassava-based diets require increased amount of expensive protein sources, economic consideration will be a determinant factor. *(Author's summary)* H03

H04 HCN Toxicity and Detoxification

See also *0390* *0532*

100 PROCESSING, PRODUCTS AND USES

101 Cassava Starch and its Properties

0515

17197 EVANS, I.D.; HAISMAN, D.R. 1979. **Rheology of gelatinised starch suspensions.** Journal of Texture Studies 10(4):347-370. Engl., Sum. Engl., 22 Refs., Illus.

Cassava. Cassava starch. Gelatinization. Analysis.

When starch powders (corn, potato, cassava, and wheat flour starches and modified corn starch) were mixed with water and heated at or above the gelatinization temp., the granules absorbed large quantities of water and formed a viscous paste. The gelatinized pastes were shear-thinning fluids, whose flow curves fitted the expression $n = ky^{m}$ over a wide range of shear rates (where n = apparent viscosity, k and m are constants, and y = shear rate). Behavior at very low shear rates indicated the existence of a yield stress. Under oscillatory shear the elastic moduli of the pastes considerably exceeded the loss moduii, and both showed only weak dependence on frequency over the range 0.002-2.5 Hz. The apparent viscosities, pseudoplasticity constants, yield stresses, and elastic moduli of the pastes were all concn.-dependent, assuming significant values only when the starch level exceeded a min. concn. In many cases this threshold concn. corresponded closely to the point at which the vol. of flocculated swollen starch granules just filled the total vol. of the system. *(Author's summary)* 101

0516

17196 RAFFI, J.; AGNEL, J.P.; DAUBERTE, B.; D'UREAL, M.; SAINT-LEBE, L. 1981. **Gamma radiolysis of starches derived from different foodstuffs. I. Study of some induced carbonyl derivatives.** Starch 33(6):188-192. Engl., Sum. Engl., Germ., Fr., 12 Refs., Illus.

Cassava. Cassava starch. Irradiation. Analysis.

Maize, amylomaize, waxy maize, bread wheat, cassava, rice, haricot bean and potato starch were irradiated at 0-30 kGy (1 kGy = 0.1 Mrad), and the total carbonyl derivatives, malonaldehyde, formaldehyde and acetaldehyde were determined. Results, shown graphically and in tables, revealed that the amounts of γ-radiation-induced carbonyl derivatives were not greatly affected by starch source. For cassava, these were 0.40, 5.9, and 2.4 μg for malonaldehyde, formaldehyde, and acetaldehyde, resp. The ratio between max. and min. values was always < 5; the ratio-induced amounts in maize starch (reference material) did not differ by $> 30\%$ from the mean values for the other starches; and the curves showing the effects of radiation dose, atm. (O_2 or N_2), MC (up to 25%) had the same shape for all types of starch. It was concluded that, as the amounts of other radio-induced products previously found in maize or bread wheat starch (glyceraldehyde, dihydroxyacetone, 2-hydroxymalonaldehyde) are very small, it is not worth continuing these studies any further. *(Summary by Food Science and Technology Abstracts)* 101

I02 Uses, Industrialization, Processing and Storage

0517

16271 RAJA, K.C.M.; SREEDHARAN, V.P.; ABRAHAM, T.E.; SREEMULANATHAN, H.; MATHEW, A.G. 1978. **Effect of fractional sieving on some quality aspects of cassava flour.** Journal of Root Crops 4(2):17-21. Engl., Sum. Engl., 13 Refs.

Cassava. Tubers. Starch content. Fibre content. Water content. Screening. Cassava flour. Protein content. Ash content. Sugar content. India.

Two popular cassava cv., (i) local white and (ii) red (Malayan-4) were used to compare the physicochemical and cooking quality characteristics of their flours. Cassava was made into dry chips, which were hand-pounded into a uniform sample or further blended mechanically for 5 or 30 s, and the stickiness of sieved fractions was examined. Directly ground samples of dry chips were also prepared and sieved through mesh sizes 8-100. Particles of > 85 mesh size (coarser) had lower starch content (82.0-85.5%) than those of < 85 mesh size (89.1-90.3%). Cooking quality was greater in the coarser flours, as was free sugar % (0.54-0.99 vs. not detectable-0.32), fibre % (2.05-2.60 vs. 0.75-1.60), and protein % (2.00-2.57 vs. 1.65-1.86). Finer fractions were undesirable as regards stickiness, mouth feel, and appearance, and so could not be directly used, but are suited to incorporation in starchy products. *(Summary by Food Science and Technology Abstracts)* 102 C03

0518

16242 KAWABATA, A.; GARCIA, V.V.; ROSARIO, R.R. DEL. 1982. **Processing and utilization of root crops in the tropics.** *In* Uritani, I.; Reyes, F.D., eds. Bioresources investigation on production, storage, processing and vegetation of root crops in the tropics. 1981 Interim Report. Nagoya Japan, Nagoya University Cooperation. pp.63-83. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Human nutrition. Fresh products. Analysis. Cassava flour. Viscosity. Uses. Philippines.

The processing and utilization of root crops (cassava, taro, and sweet potatoes) in the Philippines were investigated. A survey on the consumption frequency of root crops by the U. of the Philippines, Los Baños, faculty members and farmers and fishermen in Laguna province was carried out to gain 1st hand information on the extent root crops were used in daily menus. The frequency of consumption and preference for noodles made from root crop flour and starch was studied. It was found that noodles were eaten often and were a highly preferred foodstuff. Regarding physicochemical properties of fresh cassava, pectic substances were extracted fractionally from 2 cv., and the galacturonic acid in each fraction determined. Total galacturonic acid contents were 1.14 and 1.30% for cv. Lakan W 78 and Vassourinha, resp. In the sensory evaluation, cv. Lakan W 78 was preferred to cv. Vassourinha from the standpoints of color, fibrosity, stickiness, and mouthfeel. General components of the flours of cassava, taro, and sweet potato were analyzed through the study of their amylograph and farinograph characteristics. In addition, analysis of the viscoelasticity of the dough was conducted obtaining a profile of the physicochemical property of each flour. Noodles were made from 25 and 50% CF mixed with wheat flour, and kneaded with water at 30°C and

boiling water. As control, 100% wheat flour noodle was used. Measurements of the tensile strength and cooking loss of the noodles indicated that the noodle was increasingly stretchable as the amount of CF was increased. Cooking loss was less as CF was increased. Sensory evaluation showed that noodles made from 25% CF and kneaded with boiling water had the highest acceptability. "Sotanghon" style noodles were prepared from 20% cassava and sweet potato starches, mixed with mung bean starch; 100% mung bean starch noodle was used as control. Sensory evaluation showed that the 20% cassava starch noodle was evaluated highest. *(Author's summary)* I02 C03 H01

0519

16252 PASCHOALINO, J.E.; PEREIRA, A.S.; BERNHARDT, L.W.; FIGUEIREDO, I.B.; SHIROSE, I. 1980. **Avaliação de algumas variedades de mandioca ao processo de congelamento.** *(Evaluation of the suitability of cassava varieties for freezing).* Boletim do Instituto de Tecnología de Alimentos 17(1):73-82. Port., Sum. Port., Engl., 9 Refs., Illus.

Cassava. Storage. Cultivars. Temperature. Tubers. Starch content. Protein content. HCN content. Fibre content. Sugar content. Water content. Brazil.

Comparative studies were conducted on the suitability of 16 cassava var. (including both white-fleshed and yellow-fleshed types) for freezing. The tubers were washed, cut into slices 5 cm thick, peeled, rewashed, frozen at -40°C, packaged in polyethylene bags (each containing approx. 400 g cassava), and stored at 22°C. Data are given for the composition (starch, protein, HCN, fibre, reducing sugars, total sugars, moisture) of the raw materials, peeling losses, ease of peeling, and the flavor, texture and color of the frozen product. Relative merits of the var. studied are discussed; yellow-fleshed var. were generally preferred. Var. IAC 289-70, which had good peeling characteristics, and the best texture and color of the frozen product, is the most suitable var. for freezing. *(Summary by Food Science and Technology Abstracts)* I02 C03

0520

16243 YOSHII, H.; GARCIA, V.V. 1982. **Processing of cassava into fermented foods.** *In* Uritani, I.; Reyes, E.D., eds. Bio-resources investigation on production, storage, processing and vegetation of root crops in the tropics. 1981 Interim Report. Nagoya, Japan, Nagoya University Cooperation. pp.84-103. Engl., Sum. Engl., 5 Refs., Illus.

Cassava. Processing. Cassava flour. Fermented products. Viscosity. Water content. Sugar content. Mineral content. Amino acids. Human nutrition. Philippines.

The suitability of CF as a rice flour substitute in Philippine fermented rice cake (puto) formulation was studied. With up to 50% substitution, the vol. and texture of the finished product were almost equal to that with rice flour only, although at > 60% substitution the puto vol. decreased and was harder or had very high viscosity. The quality of fermented black soybean (Tausi) on the market was also determined and a process for Tausi-making utilizing raw cassava was investigated. In commercially available Tausi the liberation of amino acids is insufficient and the product consequently less savory. A new process for Tausi making was developed in which the hydrolysis of the legume protein was promoted. The liberation ratio of amino acids, including glutamic acid, nearly doubled producing excellent sensory results. *(Author's summary)* I02 C03

0521

16217 MAINI, S.B.; BALAGOPAL, C.; NAIR, P.G. 1981. **Cassava chips industry in Kerala.** Indian Farming 30(5):13-14. Engl.

Cassava. Cassava chips. Processing. Drying. Uses. Nutritive value. Carbohydrate content. Protein content. Water content. Mineral content. Fat content. India.

Production of cassava chips in Kerala is discussed regarding preparation, drying, storage, and utilization of chips, and nutritive value. Vella chips (both rind and skin removed) are commonly used as human food, mostly after sun drying, when they can be stored for making into flours. Dried cassava chips contain 82.09% carbohydrate, 13% moisture, 2.01% salts, 1.05% protein, 0.30% fat, 0.11% Ca, 0.09% P, 1.09 mg % Fe, 0.32 mg % vitamin B, and 341 calories. *(Summary by Food Science and Technology Abstracts)* 102 C03 H01

0522

16245 VITTI, P.; PIZZINATTO, A.; LEITAO, R.F.F. 1978. **Comparação de raspas de mandioca obtidas por dois processos - uso de suas farinhas em panificação.** *(Comparison of cassava chips made by two processes, and use of their flours in breadmaking).* Boletim do Instituto de Tecnología de Alimentos 59:89-98. Port., Sum. Port., Engl., 12 Refs.

Cassava. Cassava chips. Processing. Cassava flour. Cassava bread. Analysis. Composition. Brazil.

Cassava tubers of the var. Branca de Santa Catarina were used in comparative studies on the effects of chip size (5 x 2 x 1 cm vs. 1.5 x 1.5 x 0.5 cm before drying) on the quality of the dried product. Tables of data are given for the yield, MC, density, color, pH, acidity, and brabender viscograph characteristics of the 2 types of cassava chip. Smaller chip size gave faster processing and a higher quality product. Flour was prepared from cassava chips of the 2 types, and used in breadmaking trials; 15% CF/85% wheat flour blends being used. Tables of data are given for the specific vol., crust color, shape, crumb texture and color, and overall quality score of the bread. Addition of CF reduces the quality of bread; however, the reduction in quality was less for the CF from the smaller chips. *(Summary by Food Science and Technology Abstracts)* 102

0523

13471 LANCASTER, P.A.; INGRAM, J.S.; LIM, M.Y.; COURSEY, D.G. 1982. **Traditional cassava-based foods: survey of processing techniques.** Economic Botany 36(1):12-45. Engl., 175 Refs., Illus.

Cassava. Plant geography. Toxicity. Nutritive value. Tubers. Composition. Small-scale processing. Cassava products.

A review on literature from major cassava producing areas is given to focus attention on the diversity of processing techniques and the wide variety of cassava-based food and beverages that are produced. Following a general analysis of the cassava plant, its origins and distribution, problems of toxicity, and the nutritive value of cassava and its products, the traditional processing techniques for preparing different cassava products in tropical America, Africa, Asia, and the S. Pacific are described in turn. *(Summary by A.J.C. Trans. by L.M.F.)* 102 C03

0524

16613 FOOD RESEARCH INSTITUTE, GHANA. 1980. **Cassava research at F.R.I.** Newsletter 11(3):1-10. Engl.

Cassava. Research. Storage. Processing. Gari. Labour. Cassava products. Protein content. Fibre content. Ash content. Water content. Carbohydrate content. Ghana.

Major research work carried out at the Food Research Institute (Ghana) is summarized: (1) storage project on root crops, evaluating methods of storing cassava roots in boxes with sawdust, covered with line suspension, and underground; (2) labor saving and rural technology programs, consisting of the evaluation and improvement of equipment for cassava, gari, and kokonte processing using equipment fabricated at the institute; (3) processing and preservation program, aiming to produce pineapple wine using glucose syrup

(as a source of sugar) obtained from extracted cassava starch; (4) nutrition program which studies cassava toxicity. A table is included on nutrient analysis of cassava and cassava products along with a list of the publications of the Food Research Institute. *(Summary by F.G. Trans. by L.M.F.)* I02 C03

0525

17502 DATA, E.S.; ARRIENDA II, F.Q. 1981. **Village level technology on cassava storage.** Radix 3(1):17. Engl.

Cassava. Field experiments. Tubers. Storage. Post-harvest losses. Post-harvest studies. Deterioration. Philippines.

The Postharvest Technology Section of the Philippine Root Crop Research and Training Center conducted an investigation on cassava roots to extend cassava shelf life and prevent the occurrence of vascular streaking. Different soil types were assessed to determine the most adequate type for underground storage. Soil types used were sea sand, river sand, clay, and clay loam. Roots stored in all types of soil showed no evidence of vascular streaking. Buried cassava tubers gained wt. instead of losing it. Roots buried in river sand exhibited the lowest % of deterioration; the highest % of deterioration was observed in cassava roots buried in clay soil. *(Summary by F.G. Trans. by L.M.F.)* I02 D04

0526

16636 THANH, N.C.; LOHANI, B.N. 1978. **Cassava chipping and pelleting in Thailand.** Bangkok, Thailand, Asian Institute of Technology, Environmental Engineering Division. 15p. Engl., Sum. Engl., 2 Refs., Illus.

Paper presented at Cassava Production and Utilization, Khon Kaen University, Thailand, 1978.

Cassava. Cassava chips. Pellets. Drying. Small-scale processing. Thailand.

Cassava chipping using Thai, Malaysian, and a newly-designed cutter was studied in order to produce an optimal chip size and shape for drying and pelleting purposes. Expt. were carried out with a CPM Master Model Pellet Mill to determine a series of controllable parameters including the MC of chips used in the process, their forms, and pretreatment such as conditioning with steam before pressing. Two different systems for pellet cooling were also studied. Controllable parameters for producing cassava pellets with good consistency and glossy appearance are emphasized. *(Author's summary)* I02

0527

17519 CHIEPPE, F.; CARVALHO, V.D. DE; CASTRO-GOMEZ, R.; CALVIDAL, J. 1982. **Secagem ambiental e artificial de mandioca.** *(Natural and artificial drying of cassava).* Pesquisa Agropecuária Brasileira 17(4):583-597. Port., Sum. Port., Engl., 26 Refs., Illus.

Cassava. Cultivars. Cassava chips. Drying. Starch content. Water content. Brazil.

Three cassava var. (Branca de Santa Catarina, Riqueza, and Mantiqueira) with possibilities of utilization in alcohol production were submitted to natural (23 ± 2°C) and artificial (40 and 60°C) drying. Roots of several sizes were cut into slices 0.5 cm thick with Ø ranging from 2.5-6 cm. Typical curves of water loss as a function of slice Ø and specific surface were made for each var. under these exptl. conditions. Drying rates showed significant differences among var. The starch content remained almost the same after each treatment, as indicated by chemical and microscopic analyses. These results are of interest in the application of drying techniques for cassava preservation during handling and storage at alcohol production plants. *(Author's summary)* I02 C03

0528

17198 KUSUMAWARDHANI, A.L.; HANDOKO, W.S.; RAKHMADIONO, S.; KUMALANINGSIH, S. 1981. **Effect of initial pH and cassava glucose syrup concentration on ethanol production.** Agrivita 4(4):13-16. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Confectioneries. Glucose. Uses. pH. Ethanol. Fermentation. Indonesia.

Alcoholic fermentation using glucose syrup from cassava at various initial pH was studied at the Department of Food Science and Technology, Brawijaya U., Malang (Indonesia). Glucose syrup concn. of 8, 12, 16, and 20% (wt./vol.) were fermented at the initial pH of 3.8, 4.5, and 5.2. All treatments were replicated 4 times. *Saccharomyces cerevisiae* var. *ellipsoideus* was used. Initial pH significantly influenced ethanol concn., residual glucose, and plant efficiency. Treatments with initial pH of 4.5 and 5.2 yielded higher concn. than that of with initial pH of 3.8. Glucose concn. significantly influenced ethanol concn., residual glucose, and plant efficiency. The highest ethanol concn., 7.05% (wt./vol.), was obtained in 20% (wt./vol.) glucose syrup. Plant efficiency of this treatment, however, is the lowest (54.8%). *(Author's summary)* 102

0529

16653 WADHWA, N.D. 1977. **Gari project report.** *In* Leakey, C.L.A., ed. Symposium of the International Society for Tropical Root Crops, 3rd., Ibadan, Nigeria, 1973. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.481-485. Engl., Sum. Engl., Fr., Span.

Cassava. Factories. Gari. Marketing. Costs. Income. Processing. Ghana.

Commercial factories have been designed in Ghana which are able to process gari economically. All the machinery can be locally manufactured in Accra. The costs of a plant to process 8-10 t cassava/day working for 250 days/yr and another to process 2-3 t cassava/day are given in detail; these gave net returns (over 250 days) of ₵ 62,817 (53% capital cost) and ₵ 11,625 (36% capital cost), resp. The plant is available from Agricultural Engineers Ltd., Accra, Ghana. *(Author's summary)* 102 300

0530

16665 RODRIGUEZ U., F. 1982. **Desarrollo de tecnología apropiada para el procesamiento de la yuca en las áreas rurales colombianas.** *(Development of appropriate cassava processing technology in Colombian rural areas).* Bogotá Universidad de los Andes. Centro de Estudios e Investigación. Serie Investigaciones 1-2. 71p. Span., Sum. Span., 3 Refs., Illus.

Cassava. Small-scale processing. Small-scale equipment. Rasping. Silting. Costs. Socio-economic aspects. Colombia.

A new technology was developed with low farmer investment, reducing production costs but seeking to improve cassava quality and prices thus increasing profitability. Alternatives were identified by collecting information regarding the different cassava processing systems currently existing in Colombia as well as the options proposed. These different alternatives for cassava processing were analyzed in the regions of Mesa de Limones, Nilo (Tolima), Cauca, and the Llanos Orientales, taking into consideration the level of technology used (mechanization, sources of energy). The economic analysis of the alternatives was conducted by determining the annual costs/t of cassava for each one of the alternatives. Regarding the social aspect, the existing technology was related to the form of farmer production found in the representative regions for the different options. The changes in technology are shown to be representative of the existing social structure in each area. Tables and figures are included. *(Author's summary. Trans. by L.M.F.)* 102 300

0531

16700 MULLER, W.C., MILLER, F.D. 1981. **Recovery of starch from amylaceous roots and/or grains as aqueous slurries.** United States Patent 4,252,900. 6p. Engl., Sum Engl., 6 Refs., Illus.

Cassava. Cassava starch. Patents. Processing.

Starch is recovered from an amylaceous material such as cassava root or maize in the form of an aqueous slurry containing substantially all of the soluble components (carbohydrates and proteins) of the amylaceous material prior to processing. The material is milled in 1 or more steps in the presence of water to give a slurry containing liberated starch particles and non-starch components. The initial aqueous starch slurry is then concentrated by removal of water. The water removed from the initial starch slurry contains soluble elements of the starch and is recycled to restore these elements to the starch recovery system. *(Author's summary)* 102

0532

16560 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1980. **Bitter and sweet cassava acceptance.** *In* ———. Annual Report 1979. Ibadan, Nigeria. p.51. Engl.

Cassava. Sweet cassava. Bitter cassava. Uses. Gari. Processing. Nigeria.

The importance of research in Nigeria on cyanide content in cassava processing and utilization and consumer acceptance was studied. Data were collected by administering a questionnaire to 122 farmers selected from 2 villages each in Anambra, Bendel, Ogun, and Kaduna States. Results show that high cyanide content is not a prerequisite for obtaining good gari flavor; therefore, low cyanide cassava offers no advantage. Sweet cassava (70% has a low or medium cyanide content) will continue to be grown by farmers who prefer to eat non-processed forms of cassava or do not have access to gari-making equipment or technology. Farmers, however, would quickly adopt a high-yielding sweet cassava var. since it would be of importance if cassava is used for animal feed in the future. A new squeeze press method for gari-making is mentioned. *(Summary by I.B. Trans. by L.M.E.)* 102 H04

0533

17558 PIZZINATO, A.; VITTI, P. 1979. **Produção de pão tipo frances á base de farinha composta de trige, soja e mandioca.** *(French-type bread made from composite wheat, soybean, and cassava flours).* Boletim da Sociedade Brasileira de Ciencia e Tecnología de Alimentos 48:1-19. Port., Sum. Port., Engl., 32 Refs.

Cassava. Cassava flour. Breads. Composite flours. Bread improvers. Analysis. Wheat flour. Soybean flour.

The baking characteristics of composite wheat, soybean, and cassava flours for preparing French-type bread were assessed. For comparison, flour from pregelatinized cassava was also used. Ascorbic acid, CSL, and polysorbate 80 were added to the composite flours. Results showed the feasibility of preparing French-type bread from composite flours by replacing 10% wheat flour with 7% CF and 3% of defatted soybean flour. *(Author's summary)* 102

See also 0448

I03 Industrial Microbiology

0534

17513 THERKILDSEN, H. 1980. **Symbiotic growth of a yeast and a bacteria in batch fermenters.** Biotechnology Letters 2(3):117-122. Engl., Sum. Engl., 4 Refs., Illus.

Cassava. Fermentation. Laboratory experiments. Industrial microbiology. Cassava starch. Uses.

SCP was produced from cassava starch by symbiotic growth of the α-amylase producing the bacterium *Bacillus subtilis* NCIB 8646 and the yeast *Candida utilis* ATCC 9256. Batch fermentation showed that the pH fluctuations during fermentation and the concn. and age of the inoculum were extremely important parameters. Best results were obtained with 200 ml of 3-day old cultures of each organism in a 5l batch fermentor at pH 5.5. The product, in which *B. subtilis* made up 2-5% of DM, contained 52% protein. *(Summary by Food Science and Technology Abstracts)* I03

J00 ECONOMICS AND DEVELOPMENT

0535

13276 NELSON, G.C. 1982. **Implications of developed country policies for developing countries: the case of cassava.** Ph.D. Thesis. Stanford, California, Stanford University. 161p. Engl., Sum. Engl., 39 Refs., Illus.

Cassava. Trade. Gaplek. Processing. Cassava starch. Prices. Indonesia. Thailand.

The implications of the policies undertaken by developing countries on developing countries are analyzed using as example the study on the factors that led to the increase in imports of dried cassava roots (gaplek) during recent years in Indonesia and Thailand as a consequence of the common agricultural policies of the European Economic Community (EEC). The international demand for gaplek products is analyzed, emphasizing their use as animal feed in the EEC. The performances of Thailand and Indonesia as cassava producing countries are compared. Technical aspects of the processing of cassava products in Indonesia (gaplek and starch) are discussed along with social implications, and government policies. Price determination in international markets is discussed. EEC policies that affect gaplek trade are examined; the positions of 3 groups are emphasized: EEC officials, French grain and meat producers, and Dutch, German, and Belgian traders, feed compounders and meat producers. The increase in gaplek exports from Thailand and Indonesia resulted, not from decisions in either country, but of both domestic and foreign policies designed to effect changes outside the agricultural sectors of the 2 countries, on the basis of the EEC demand for gaplek. *(Summary by A.J.C. Trans. by L.M.F.)* J00

0536

13295 UNNEVEHR, L.J. 1982. **Cassava marketing and price behavior on Java.** Ph.D. Thesis. Stanford, California, Stanford University. 169p. Engl., 38 Refs., Illus.

Cassava. Marketing. Gaplek. Cassava starch. Cassava tubers (vegetable). Prices. Java.

The efficiency of cassava marketing systems on Java is analyzed. Product flows (fresh roots, gaplek, and starch) and marketing costs are documented. The ability of the market and of informal institutions to adapt to constraints on trade is examined, as well as the capacity of private trade to respond to increases in supply and demand. The efficiency of the marketing system of cassava in transmitting price incentives to producers and consumers was studied. The marketing system on Java is efficient for both upland producers and poor consumers who satisfy their calorie requirements with cassava. Evidence regarding efficiency was found in the market response to cost incentives, the degree of competition in cassava markets, and the integration of cassava prices. Imperfections were detected in the market system in terms of access to credit. Domestic prices follow the same trend as world prices, indicating market efficiency. Although the private marketing system is efficient, government policies that have implications for improved systems include those that reduce costs and stimulate competition (especially improved transport infrastructure and greater access to information on markets and prices for the producers) and those related to access to credit. *(Summary by A.J.C. Trans. by L.M.F.)* J00

0537

16559 BRASIL. MINISTERIO DA AGRICULTURA. COMISSAO DE FINANCIAMENTO DA PRODUCAO. 1977. Mandioca (Raiz). [*Cassava (Roots)*]. *In* ——. Fixação de preços mínimos para a safra 1976/77 das regiões norte e nordeste. Brasilia. pp.104-116. Port., Illus.

Cassava. Marketing. Prices. Costs. Cassava flour. Production. Brazil.

Economic aspects of cassava roots and CF in N and NE Brazil are analyzed, including foreign and domestic markets, wholesale prices, prices paid to producers, production costs, and min. price offered. Tables are included on industrial products (direct and derived); production, exports, and prices for 1970-75 for cassava roots and CF; production of N and NE states for 1972-75; financing extended to CF producers during 1970-75; av. production costs of cassava roots for NE states. *(Summary by F.G. Trans. by L.M.F.)* J00

0538

16285 MATAIO, N. 1981. Economics of root crops cultivation in the Cook Islands, 1981. Rarotonga, Ministry of Agriculture and Fisheries. Farm Management Notes no. 11. 15p. Engl., Sum. Engl., 5 Refs.

Cassava. Land preparation. Cultivation. Costs. Pest control. Tuber productivity. Income. Processing. Cook Islands.

Root crops, including cassava, sweet potato, taro, and new cocoyam, form a major part of the staple food on the Cook Islands (Oceania). The production environment, cultural practices, yields and returns, and cassava processing are discussed. Export of root crops increased between 1974-80 from 0.4 to 33 t. *(Summary by Abstracts on Tropical Agriculture)* J00

0539

16300 MURDIYONO.; SUTRISNO, S.; WIJOYO, P.; SOEDARMANTO. 1981. Pattern of consumption of staple food in cassava production centre: a case study in the village of Sumberdadap, regency of Tulungagung. Agrivita 4(3):9-11. Engl., Sum. Engl., 1 Ref.

Cassava. Socio-economic aspects. Consumption. Human nutrition. Indonesia.

A study on staple food consumption was conducted in the village of Sumberdadap, Tulungagung, Indonesia, from July-Dec. 1980. The consumption pattern among the villages was rice-cassava maize. Increase of income tended to reduce cassava consumption. An increase of 1% income would result in a decrease in cassava consumption up to 0.79%. A negative correlation coefficient (r = −0.81) between the level of cassava consumption and that of rice supports the hypothesis that reducing cassava consumption would increase rice consumption. *(Author's summary)* J00

0540

16634 TITAPIWATANAKUN, B. 1979. Wholesale marketing of farm products in Thailand. Bangkok, Thailand, Kasetsart University. 23p. Engl., Sum. Engl.

Paper presented at a Seminar on Institutional Improvements in Agricultural Marketing, Taipei, Taiwan, 1979.

Cassava. Marketing. Trade. Thailand.

An overview of marketing organization and institutions of major agricultural products in Thailand is discussed emphasizing maize and cassava. A tendency towards decentralized

marketing channels at the local markets was observed. Thai cassava industry development is briefly described, especially the role of cassava products for animal feed. The industry has been developed rapidly by expanding cassava chip and pellet processing for exports, reaching its peak and ranking as the largest export profit for Thailand in 1978. The recent development of warehouse facilities and bulk transportation of cassava products help reduce the cost of exporting and transportation. *(Author's summary)* J00

0541

16627 TITAPIWATANAKUN, B. 1982. **The role of transnational corporation in tapioca trade.** Bangkok, Thailand, Department of Agricultural Economics. Kasetsart University. Staff Paper no. 47. 25p. Engl., Sum. Engl., 5 Refs., Illus.

Cassava. Marketing. Trade. Thailand.

The role of Thai transnational corporations (TNCs) regarding cassava products for animal feed is discussed. Discussion on the existence of the TNCs in the cassava industry is included and TNCs operations, structure and marketing practices, TNCs and trade regulations, and TNCs future role are described. The existence of the TNCs was found to be mainly due to the preliminary interest of the TNCs in cassava trade, their expertise in the non-grain feed market in the EEC, and their shipping operation. Most of the market share belonged to the TNCs, but not all of them operated at a considerable profit margin the past 5 yr. They cooperated among themselves in facilitative marketing functions but not in exchange marketing functions. Most of the trade regulations imposed by the Thai Government during the late 1980's have created benefits for TNCs but not for Thai exporters. The TNCs have been playing a major role in the cassava industry, and they are expected to make their contributions in future in terms of technological and market developments by actively cooperating with the upgrading of the cassava industry. *(Author's summary)* J00

0542

16671 LOKAPHADHANA, T. 1981. **Impact of trade policy on six agricultural exports of Thailand.** Ph.D. Thesis. Minneapolis, University of Minnesota. 204p. Engl., Sum. Engl., 71 Refs., Illus.

Cassava. Trade. Prices. Costs. Cultivation. Processing. Economics. Thailand.

The effect of Thai government intervention in the determination of prices of 6 major Thai agricultural export commodities (rice, sugar, maize, cassava, kenaf, and rubber) was examined. The economic efficiency of producing the 6 commodities was also evaluated and the social opportunity cost of earning a net marginal unit of foreign exchange through exporting the 6 commodities was measured. The imposition of export taxes and/or quotas (and EEC import duties on cassava) depressed the domestic prices, favoring domestic consumers and discriminating against producers. Exports were less than otherwise would have been. The empirical results showed that government interventions imposes a deadweight loss upon the Thai society. An implicit trade distortion was the overvaluation of the Thai currency of 6-14% prior to the historical July 1981 devaluation. Overvaluation further depressed producer prices and exports and imposes a higher social loss. The results of the domestic resource cost calculation indicated that the expansion and export of all commodities under study except kenaf was economically justified. Regardless of the efficiency of production and exports, the government interventions explicitly discriminated heavily against rice, maize, and rubber and implicitly discriminated against all agricultural exports through overvaluation of the baht. The results suggest a policy of freer trade and an exchange rate closer to the equilibrium rate. Emphasis should be put more on research programs, which would lead to a higher growth rate. *(Author's summary)* J00

See also 0402 0403 0421 0428 0529 0530 0544

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0543

16277 PRABHAKAR, M.; NAIR, G.M. 1979. **Pigeon pea as an intercrop with cassava.** Journal of Root Crops 5(1/2):70-71. Engl., 3 Refs., Illus.

Cassava. Inter-cropping. *Cajanus cajan.* **Growth. Tuber productivity. India.**

At the Central Tuber Crops Research Institute, studies were conducted to determine the influence of pigeon pea/cassava intercropping on yield of both crops. Cassava var. H-1687 and pigeon pea var. Co-3 were used, planting a row of pigeon peas at a spacing of 75 cm between 2 rows of cassava. Pigeon pea intercropped with cassava decreased tuber yield from 24.42 to 17.49 t/ha. Pigeon pea yielded 704 kg/ha and net profit was increased. *(Summary by L.M.F.)* K01

0544

16244 FRAZAO, D.A.C.; HOMMA, A.K.O.; ANDRADE, E.B. DE 1980. **Aspectos econômicos em sistemas de produção com culturas alimentares para agricultores de baixa renda na Microrregião Bragantina, Pará.** *(Economic aspects in production systems with food crops for low income farmers in the microregion of Bragança, state of Pará).* Belém, Pará, Empresa Brasileira de Pesquisa Agropecuária. Centro de Pesquisa Agropecuária do Trópico Umido. Boletim de Pesquisa no. 6. 13p. Port., Sum. Port., Engl., 5 Refs., Illus.

Cassava. Field experiments. Inter-cropping. Maize. Cowpea. Planting. Spacing. Rotational crops. Tuber productivity. Labour. Income. Brazil.

An economic analysis was made of multiple cropping systems including cassava, maize, and cowpea under single and multiple cropping, as well as rotational cropping in order to find adequate production systems for low income farmers in the Bragança region of the state of Pará (Brazil). The cassava/maize system in rotation with cowpea was the most efficient among the 7 systems under study, regarding nutritional aspects, family labor utilization during the year, and its capacity of selling surplus production. *(Author's summary)* K01 D03 J00

0545

17180 MUTSAERS, H.J.W.; MBOUEMBOUE, P.; BOYOMO, M. 1981. **Traditional food crop growing in the Yaoundé area (Cameroon). II. Crop associations, yields and fertility aspects.** Agro-Ecosystems 6(4):289-303. Engl., Sum. Engl., 18 Refs.

Cassava. Inter-cropping. Tuber productivity. Planting. Spacing. Nutrient absorption. Soil fertility. Cameroon.

Crop associations include: groundnuts, maize, cassava, tannia (*Xanthosoma sagittifolium*), cocoyam, plantain, okra, yam, *Cucumis sativus*, leafy vegetables, tomatoes, sugar cane, tobacco, *Cucurbita maxima*, and *Solanum* sp. Yields of groundnuts, cassava, tannia, maize, and plantain are 417-1464, 2700-15,000, 1150-5000, 320-680, and 12,000 kg/ha, resp. Yields correspond closely with the fertility of the land. Some improvement or stabilization of the system is possible through better crop residue and fallow management, but in order

to raise productivity significantly, external fertility would have to be introduced. *(Summary by Abstracts on Tropical Agriculture)* K01 D01

0546

13408 MATTOS, P.L.P. DE; SOUZA, A. DA S. 1982. **Mandioca em consorciação no Brasil: problemas, situação atual e resultados de pesquisa.** *(Cassava intercropping in Brazil: problems, current situation, and results of research).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos no. 1. 51p. Port., 24 Refs., Illus.

Cassava. Research. Inter-cropping. Beans. Maize. Rice. Planting. Spacing. Tuber productivity. Brazil.

The advantages and disadvantages of intercropping are discussed. Major factors limiting the yields of associated crops are highlighted: limited improved technology; crop density and growth habit; competition for water, light, nutrients, and CO_2; inadequate planting time and farmer's reluctance to accept new technology. The current situation of cassava in Brazil is analyzed; production, harvested area, and av. yield in the different states are included. The characteristics of cassava/bean, cassava/maize, cassava/maize/bean, and cassava/rice intercroppings are given. Results of research on single- and double-row planting systems in intercropping are analyzed. *(Summary by F.G. Trans. by L.M.F.)* K01 D02

0547

13210 MATTOS, P.L.P. DE; DANTAS, J.L.L. 1981. **Utilização do cultivo da mandioca consorciada com feijão.** *(Use of cassava/bean intercropping).* Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Circular Técnica no. 02. 24p. Port., 13 Refs., Illus.

Cassava. Inter-cropping. Beans. Maize. Planting. Spacing. Brazil.

Major characteristics of cassava/bean and cassava/maize/bean intercropping in the NE region of Brazil are described. Tables are included on the production of the federal units; major cultivation problems; effect of intercropping on cassava and bean yields; cassava production in association with beans, maize, rice, groundnut, soybean, and sorghum, and the results of research on various rows of beans planted between double rows of cassava. *(Summary by F.G. Trans. by L.M.F.)* K01

0548

16201 MUTSAERS, H.J.W.; MBOUEMBOUE, P.; BOYOMO, M. 1981. **Traditional food crop growing in the Yaoundé area (Cameroon). I. Synopsis of the system.** Agro-Ecosystems 6(4):273-287. Engl., Sum. Engl., 10 Refs., Illus.

Cassava. Inter-cropping. Maps. Fallowing. Shifting cultivation. Tuber productivity. Cameroon.

Food crop growing in the Yaoundé area, Cameroon (alt. 700 m, 1600 mm rainfall) is based on shifting cultivation. At present the main crop is groundnut grown in association with cassava, tannia (*Xanthosoma sagittifolium*), maize, plantain, and small quantities of other crops. Two yr of cropping is followed by a 3-5 yr fallow period. The system is discussed in relation to the original system in which the main crop was ngon (*Cucumeropsis manii*) associated with tuber crops, maize and plantain, followed by a groundnut crop followed by a much longer fallow period. *(Summary by Abstracts on Tropical Agriculture)* K01

0549

16572 PEARCE, S.C.; GILLIVER, B. 1978. **The statistical analysis of data from intercropping experiments.** Journal of Agricultural Science 91(3):625-632. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Inter-cropping. Statistical analysis.

When 2 species (cassava-maize) are interplanted the interpretation of exptl. data presents statistical difficulties because the yields of the 2 crops will not in general be independent. It is therefore desirable to have a method that will both allow significance levels to be determined and give full importance to the treatment means of the 2 crops. It is shown that a bivariate analysis of variance can be carried out with little difficulty and precise tests can be based upon it; it is helpful to combine the 2 crops in any way (on the basis of calorific value or price). *(Author's summary)* K01

0550

17142 WILAIPON, B.; GUTTERIDGE, R.C.; CHUTIKUL, K. 1981. **Undersowing upland crops with pasture legumes. 1. Cassava with *Stylosantes hamata* cv. Verano.** Thai Journal of Agricultural Science 14(4):333-337. Engl., Sum. Engl., 2 Refs.

Cassava. Inter-cropping. Legume crops. Field experiments. Weeding. Tuber productivity. Thailand.

Field trials were carried out to study the effects of weeding and sowing time of Verano stylo (*Stylosanthes hamata* cv. Verano) on cassava and stylo when grown alone and in association. Planting stylo and cassava at the same time significantly reduced cassava yield as compared with planting cassava alone. However, planting stylo 6 wk. after cassava caused very little and insignificant reduction in cassava yield and the resulting yield of stylo could be considered as a direct additional benefit. This undersowing technique could be adopted by farmers in NE Thailand to increase forage availability for their livestock. *(Author's summary)* K01

0551

17143 ESCALADA, R.G. 1981. **Manipulation of cultural practices for ipil-ipil and its effect on the intercropped cassava.** Annals of Tropical Research 3(2):136-143. Engl., Sum. Engl., 5 Refs., Illus.

Cassava. Inter-cropping. Legume crops. Spacing. Tuber productivity. Planting. Philippines.

Pruning and intercropping with cassava affected plant height and fresh herbage yield of ipil-ipil (*Leucaena*). Both parameters declined as the crop was cut back periodically. Plant population also compounded the effect. At high plant population, the pruned plants developed thin and elongated stems which reduced herbage yield/plant/unit area. However, the higher no. of plants/unit area compensated for the reduced vegetative growth. High herbage yields were obtained at close planting distance. Cassava plants competed intensely with ipil-ipil for light and space. Due to rapid growth and development of the pruned ipil-ipil, growth and development of plant parts and formation of cassava tubers were greatly affected as manifested by the higher yield of the monoculture crop. A planting distance of 3 m x 15 cm for ipil-ipil resulted in the production of reasonable cassava tuber yields/ha. *(Author's summary)* K01 D03

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LIST OF ABBREVIATIONS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
Afr.	Afrikaans
a.i.	Active ingredient
alt.	Altitude
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
AMV	Alfalfa mosaic virus
approx.	Approximate(ly)
atm.	Atmosphere
ATP	Adenosine 5'-triphosphate
av.	Average
BAP	6-Benzylaminopurine
BBMV	Broad bean mosaic virus
BCMV	Bean common mosaic virus
BGMV	Bean golden mosaic virus
BGYMV	Bean golden yellow mosaic virus
BOD	Biochemical oxygen demand
BPMV	Bean pod mottle virus
BRMV	Bean rugose mosaic virus
BSMV	Bean southern mosaic virus
BV	Biological value
BYMV	Bean yellow mosaic virus
°C	Degrees Celsius (centigrade)
ca.	About (circa)
CBB	Cassava bacterial blight
CBSD	Cassava brown streak disease
CEC	Cation exchange capacity
CER	CO_2 exchange rate
CF	Cassava flour
CGR	Crop growth rate
CLM	Cassava leaf meal
CLV	Cassava latent virus
CM	Cassava meal
cm	Centimeter
COD	Chemical oxygen demand
concd.	Concentrated
concn.	Concentration
CP	Crude protein
CSL	Calcium stearyl lactylate
CSW	Cassava starch wastes
C.V.	Coefficient of variation
cv.	Cultivar(s)
2,4-D	2,4-dichlorophenoxyacetic acid
DM	Dry matter
DNA	Deoxyribonucleic acid
EC	Emulsifiable concentrate
EDTA	Ethylenediaminetetraacetic acid
EEC	European Economic Community
e.g.	For example
ELISA	Enzyme-linked immunosorbent assays
EMS	Ethyl methane sulfonate
Engl.	English
expt.	Experiment
exptl.	Experimental
°F	Degrees Fahrenheit
Fr.	French
ft-ca	Foot candles (10.76 lux)
FYM	Farmyard manure
g	Gram(s)
G	Giga (10^9)
GA	Gibberellic acid
gal	Gallon(s)
GE	Gross energy
Germ.	German
GERs	Glucose entry rates
GLC	Gas-liquid chromatography
govt.	Government
govtl.	Governmental
h	Hour(s)
ha	Hectare(s)
HCN	Hydrocyanic acid
HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
HI	Harvest index
IAA	Indoleacetic acid
IBA	Indolebutyric acid
Illus.	Illustrated
in.	Inches
i.e.	That is
Ital.	Italian
IU	International unit
J	Joule
Jap.	Japanese
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilogram-calorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate
kR	Kiloroentgen(s)
l	Liter(s) (only in combination with no.)
LAD	Leaf area duration
LAI	Leaf area index
lat.	Latitude
lb	Pound(s)
LD_{50}	Mean lethal dose

LER	Land efficiency ratio
LPC	Leaf protein concentrate
lx	Lux
M	Mega
M	Molar
m	Meter(s)
Mal.	Malay
max.	Maximum
MC	Moisture content
ME	Metabolizable energy
meq	Milliequivalent(s)
met.	Methionine
mg	Milligram(s)
mho	Reciprocal ohm
min.	Minimum
min	Minute(s)
ml	Milliliter(s)
mm	Millimeter(s)
mo.	Month
mol. wt.	Molecular weight
m.p.	Melting point
NAA	α-Naphthalene acetic acid
NAD	Nicotinamide adenine dinucleotide
NADH	Nicotinamide adenine dinucleotide, reduced from
NAR	Net assimilation rate
NCE	Net CO_2 exchange
NE	Northeast
NER	Net energy ratio
nm	Nanometer(s) (10^{-9} m)
no.	Number(s)
NPFs	Negative production factors
NPR	Net protein ratio
NPU	Net protein utilization
NW	Northwest
OM	Organic matter
oz	Ounce(s)
P	Probability
Pa.	Pascal(s)
PAN	Peroxyacetic nitrate
PCNB	Pentachloronitrobenzene
PDA	Potato dextrose agar
PER	Protein efficiency ratio
pH	Hydrogen ion concentration
pphm	Parts per hundred million
PPI	Pre-planting incorporation
ppm	Parts per million
PSA	Potato sucrose agar
pv.	Pathovar.
Ref(s).	Reference(s)
resp.	Respective(ly)
Rf	Retardation factor-chromatography
RGRs	Relative growth rate
RH	Relative humidity
RNA	Ribonucleic acid
Rom.	Romanian
Russ.	Russian
S	Svedberg unit of sedimentation coeff. (10^{-13} s)
s	Second
$S_{20,w}$	Sedimentation coefficient corrected to water at 20°C
SBM	Soybean meal
SCN	Thiocyanate
SCP	Single cell protein
SDS	Sodium dodecyl sulfate
Sk.	Slovak
sp.	Specie
Span.	Spanish
spp.	Species
SSL	Sodium stearyl-2-lactyiate
Sum.	Summary
t	Ton(s)
TDN	Total digestible nutrients
temp.	Temperature
TIA	Trypsin inhibitor activity
TIBA	2,3,5-Triiodobenzoic acid compound with *N*-methylinethanamine
TLC	Thin-layer chromatography
TMV	Tobacco mosaic virus
TSH	Thyroid-stimulating hormone
UDPG	Uridine diphosphate glucose
UMS	Unmodified cassava starch
UV	Ultraviolet
var.	Variety(ies), varietal
VFA	Volatile fatty acids
vol.	Volume
VPD	Vapor pressure deficit
vpm	Volume per million
W	West
wk.	Week
WP	Wettable powder
wt.	Weight
YFEL	Youngest fully expanded leaves
yr	Year(s)
α	*alpha*
β	*beta*
γ	*gamma*
δ	*delta*
ε	*epsilon*
λ	*lambda*
π	*pi*
ψ	*psi*
/	Per
μ	Micro
%	Percent(age)
>	More than, greater than
<	Less than
≤	Equal to or less than
≥	Equal to or greater than
±	Plus or minus
ϕ	Diameter
≪	Much less than
≫	Much greater than

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EMPRESA BRASILEIRA DE ASISTENCIA TECNICA E EXTENSADO RURAL.
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EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA.DEPARTAMENTO TECNICO-CIENTIFICO.
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0340

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0116 0232

INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE.
0301 0303 0443 0458 0532

INTERNATIONAL RICE RESEARCH INTITUTE.
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ISLAM, A.K.M.S.
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KAWABATA, A.
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0093 0467

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0495

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PEREZ F., C.A.
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PEREZ, J.A.
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RAO, K.C.
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0131 0133

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REGO, J.R.S.
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REZENDE, J.L.M.
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RIBEIRO, J.V.
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RICCI JUNIOR, A.
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RICKARD, J.E.
0274 0275 0447

RIOS P., J.M.
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0005 0259

ROCA, W.M.
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0108

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0500

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RODRIGUEZ U., F.
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SANDERS, J.H.
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SANTOS, J.
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SANTOS, P.F. DOS
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SANTOS, Z.G. DOS
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SASIDHARAN, N.K.
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SAUTIER, C.
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SCHMIDT, N.C.
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SCHMITT, A.T.
0294

SCHULTZ, G.
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SEBIDOS, R.
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0110 0291 0457

SEIGLER, D.S.
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0288

SILVA, A.A. DA
0304

SILVA, A.D.A. DA
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SILVA, B.N.R. DA
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SILVA, J.F.
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SILVA, J.F.C. DA
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SILVA, J.R. DA
0409 0418

SILVA, S. DE O.E.
0004 0121 0302 0475 0476

SILVEIRA, A.J.
0012 0017

SILVEIRA, A.J. DA
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SIMPLICIO, M.E.
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0486

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SOARES, J.B.
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0015 0128 0230 0392 0393 0423
CASSAVA CHIPS
0215
CASSAVA FLOUR
0215
CASSAVA MEAL
0133 0514
CORTEX
0395
LEAVES
0017 0395 0401
ROOTS
0395
TUBERS
0017 0107 0137 0215 0390 0398 0399
0400 0519

HERBICIDES
0056 0061 0062 0198 0244 0246 0248
0264 0431 0433

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0455

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0129 0144 0156 0315 0315 0316 0317
0337 0504 0506 0518 0520 0539

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PRODUCTIVITY
0305
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0112
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0119 0306 0312
TUBER PRODUCTIVITY
0305

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0168 0337
CASSAVA STARCH
0329

INCOME
0025 0154 0157 0165 0174 0175 0179
0185 0249 0351 0354 0357 0421 0428
0511 0529 0538 0544

INDIA
0002 0010 0023 0041 0079 0098 0104
0112 0115 0118 0191 0220 0296 0305
0313 0347 0349 0369 0380 0382 0392
0423 0466 0467 0480 0481 0506 0506
0506 0513 0517 0521 0543

INDONESIA
0014 0025 0076 0190 0205 0355 0359
0360 0402 0528 0535 0536 0539

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0338

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0001 0282 0307 0370

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0494

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0074 0093 0098 0099 0283 0289 0294
0295 0297 0309 0426 0427 0449 0465
0466 0469 0487 0485
ALEUROTRACHELUS SOCIALIS
0290
ANASTREPHA MANIHOTI
0287
AONIDOMYTILUS ALBUS
0463
BEMISIA
0110 0291 0292 0466
COELOSTERNUS GRANICOLLIS
0100
ERINNYIS ELLO
0095 0290 0293 0463
LAGOCHIRUS OBSOLETUS
0100
PHENACOCCUS MANIHOTI
0094 0096 0097 0303 0462 0464 0470
0471 0473
ZONOCERUS VARIEGATUS
0461

INJURIOUS MITES
0074 0099 0103 0124 0288 0296 0298
0427 0449 0469 0472 0475 0487
OLYGONYCHUS PERUVIANUS
0073 0290
MONONYCHELLUS TANAJOA
0073 0101 0102 0290 0297 0303 0470
0473
TETRANYCHUS CINNABARINUS
0104
TETRANYCHUS URTICAE
0073 0463

INOCULATION
0023 0092 0210 0225
DISEASES AND PATHOGENS
0086 0088 0284 0451

INSECT BIOLOGY
0094 0098 0100 0290 0293 0294 0297
0461 0462 0463 0465 0467 0472

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0287

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0115 0190 0543 0545 0548 0549
BEANS
0198 0365 0366 0546 0547
COWPEA
0192 0194 0195 0198 0218 0544
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0193 0198
LEGUME CROPS
0189 0192 0194 0195 0198 0218 0550
0551
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0033 0194 0195 0197 0198 0353 0544
0546 0547
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0197 0546
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0366

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0317

IRON
0228 0459

IRRIGATION
0034 0035 0041 0062 0115

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DISEASES AND PATHOGENS
0042 0075 0076 0086 0087 0088 0089
0276 0280 0282 0283 0450

KENYA
0089 0110 0291 0455 0457

LABORATORY ANIMALS
0130 0131 0133 0135 0136 0138 0139
0140 0141 0142 0143 0169 0504

LABORATORY EXPERIMENTS
0009 0011 0012 0013 0014 0016 0017
0021 0024 0042 0047 0050 0075 0076
0086 0087 0088 0089 0090 0091 0092
0093 0095 0107 0127 0128 0130 0131
0133 0134 0135 0138 0139 0141 0142
0143 0147 0161 0168 0203 0206 0207
0208 0210 0217 0228 0229 0248 0274
0280 0281 0282 0283 0284 0285 0297
0318 0321 0323 0337 0344 0371 0372
0373 0376 0386 0387 0390 0397 0399
0420 0450 0451 0452 0458 0459 0510
0534

LABOUR
0170 0175 0185 0355 0524 0544

LAGOCHIRUS OBSOLETUS
0100

LAND PREPARATION
0194 0242 0441 0442
AGRICULTURAL EQUIPMENT
0270
MECHANIZATION
0062 0270
TUBER PRODUCTIVITY
0241 0453 0538

LEAF AREA
0038 0207 0212 0377 0382 0383 0384

LEAVES
0004 0006 0058 0064 0205 0207 0212
0369 0372 0375 0377 0377 0382 0453
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0013
ANIMAL NUTRITION
0132 0136 0513
HCN CONTENT
0017 0395 0401
MINERAL CONTENT
0029 0209 0397
MINERAL DEFICIENCIES
0397
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0513
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0132
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0216

LINAMARASE
0215

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0386

LOTAUSTRALIN
0388

MAGNESIUM
0011 0021 0024 0223
TUBER PRODUCTIVITY
0039 0419

MALAYSIA
0161 0286 0351 0431

MANGANESE
0011 0227 0228 0374 0397 0409

MANIHOT GLAZIOVII
0451

MANURES
0406
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0221
DUNG
0230

MARKETING
0160 0171 0174 0178 0183 0185 0186
0187 0346 0353 0357 0426 0441 0540
0541 0542
CASSAVA CHIPS
0360 0363
CASSAVA FLOUR
0537

CASSAVA MEAL
0363
CASSAVA STARCH
0173 0180 0359 0360 0363 0535 0536
GARI
0529
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0360 0363

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0062 0063 0148 0151 0154 0238 0239
0270 0332 0334 0335

METHIONINE
0504 0510

MEXICO
0123 0484 0485

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0021 0024 0040 0073 0225 0228 0248
0374 0397

MINERALS
0011 0021 0024 0025 0027 0028 0029
0030 0033 0036 0039 0041 0209 0210
0219 0220 0221 0223 0225 0227 0228
0230 0265 0367 0374 0397 0405 0408
0409 0410 0412 0413 0414 0415 0417
0418 0419 0420 0421 0422 0423 0424
0425

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ACARICIDES
0102

MODIFIED STARCHES
0164 0328

MOLYBDENUM
0039 0227 0409 0410

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0073 0101 0102 0290 0297 0303 0470
0473

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0010 0174

MUKIBAT SYSTEM
0265 0402

MUTATION
0480

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0072 0073

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0202 0210 0225

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0042 0276 0278 0285 0286 0426 0427

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0072 0073 0074 0079 0080 0082 0084
0277
RESISTANCE
0081 0083 0108 0112 0303

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0072 0074 0091 0092 0459 0460

NIGERIA
0020 0029 0077 0088 0090 0097 0111
0129 0136 0142 0147 0154 0175 0176
0194 0199 0215 0217 0229 0295 0303
0389 0406 0443 0454 0459 0461 0510
0511 0532

NITROGEN
0024 0025 0026 0029 0033 0036 0039
0041 0209 0219 0221 0223 0226 0230
0265 0319 0402 0405 0408 0410 0412
0413 0416 0419 0421 0422 0423 0425

NOXIOUS ANIMALS
0072 0074 0092 0093 0094 0095 0099
0100 0101 0102 0103 0110 0124 0289
0290 0291 0292 0293 0294 0295 0296
0298 0309 0426 0427 0449 0459 0460
0461 0462 0463 0464 0465 0466 0468
0469 0470 0471 0472 0473 0475 0488

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0021 0024 0040 0210 0228

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0021 0022 0025 0026 0027 0028 0029
0030 0033 0036 0039 0040 0041 0060
0073 0091 0120 0190 0210 0219 0220
0221 0222 0223 0224 0226 0227 0228
0230 0242 0265 0367 0402 0405 0406
0407 0408 0409 0410 0412 0413 0414
0415 0416 0417 0418 0419 0420 0421
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0072 0073 0277

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0073 0290

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0531

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0148 0154 0158 0166 0338

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0136 0330 0360 0363
PROCESSING
0526

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0141 0269 0306 0324 0326 0365 0498

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0072 0073 0074 0079 0080 0082 0084

0097 0099 0102 0242 0277 0287 0294
0299 0367 0441 0442 0455 0459 0467
0490 0535

PESTS
0004 0040 0042 0072 0074 0075 0077
0079 0081 0082 0083 0084 0086 0087
0088 0089 0092 0093 0094 0099 0099
0101 0102 0103 0109 0110 0111 0112
0116 0123 0124 0126 0151 0177 0240
0258 0275 0277 0280 0281 0282 0283
0284 0285 0286 0288 0289 0290 0291
0292 0293 0294 0295 0297 0298 0301
0309 0426 0427 0449 0451 0452 0453
0454 0455 0456 0457 0458 0460 0461
0462 0463 0465 0466 0467 0468 0469
0470 0471 0472 0473 0475 0477 0480

PETIOLES
0029

PH
0024 0173 0319 0343 0528
CASSAVA FLOUR
0020
CASSAVA STARCH
0344
SOIL ANALYSIS
0040

PHENACOCCUS
0073 0290 0463

PHENACOCCUS MANIHOTI
0094 0096 0097 0303 0462 0464 0470
0471 0473

PHILIPPINES
0001 0044 0045 0064 0092 0113 0122
0183 0230 0381 0393 0437 0440 0446
0459 0505 0518 0520 0525 0551

PHOSPHORUS
0011 0025 0027 0029 0036 0039 0041
0209 0210 0219 0221 0223 0225 0227
0230 0265 0367 0405 0407 0408 0410
0413 0415 0418 0419 0420 0421 0422
0424 0425

PHOTOPERIOD
0037 0127 0204 0212 0380

PHOTOSYNTHESIS
0207 0212 0376 0378 0386

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0073 0277

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0006 0007 0008 0010 0021 0023 0024
0029 0033 0034 0037 0040 0043 0048
0052 0053 0118 0127 0191 0192 0194
0206 0208 0212 0213 0214 0263 0268
0373 0380 0382 0384 0395 0416 0459
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0073

PIAUHY RUBBER
0013

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0052 0523

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0064 0115 0371 0387

PLANT HEIGHT
0007 0021 0053 0113 0192 0264 0407
0416 0478

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0009 0034 0207 0209 0210 0212 0223
0225 0372 0373 0378 0379 0379 0545
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0214 0375 0385

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0491

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0010-0052 0307 0486

PLANT TISSUES
0047 0397 0439 0493

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0008 0045 0115 0195 0242 0257 0381
0441
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0238 0270
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0428
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0544
MECHANIZATION
0062 0063 0238 0270
SPACING
0007 0050 0053 0060 0062 0109 0189
0192 0193 0231 0236 0250 0252 0253
0255 0265 0367 0378 0383 0384 0402
0428 0430 0433 0436 0439 0440 0442
0544 0545 0546 0547 0551
TUBER PRODUCTIVITY
0007 0044 0048 0053 0060 0063 0109
0189 0192 0193 0234 0236 0243 0245
0250 0252 0253 0255 0265 0365 0383
0428 0430 0433 0435 0436 0439 0440
0464 0544 0545 0546 0551

PLOUGHING
0194

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0010 0052 0370

POLLINATION
0010 0052 0307 0486

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0480

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0042 0273 0274 0275 0525

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0134 0142 0322 0514

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0347

PRICES
0170 0173 0179 0185 0347 0354 0535
0536 0537 0542

PROCESSING
0015 0063 0152 0153 0157 0159 0165
0173 0184 0327 0332 0333 0336 0351
0352 0359 0441 0442 0509 0519 0520
0522 0524 0529 0531 0532 0535 0533
0542
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0151 0158 0167 0338 0340 0521 0526
0527
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0150 0154 0163 0168 0331 0341 0342
0528 0534
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0166
PEELING
0146 0154 0158 0166 0338
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0154 0166
RASPING
0154 0158 0166 0335 0338 0530
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0338 0517
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0338 0530
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0154 0158 0166 0338

PROPAGATION
0064 0080 0115 0251 0257 0262 0265
0267 0271 0371 0426 0429 0438 0489

PROPAGATION MATERIALS
0001 0005 0030 0045 0047 0048 0057
0060 0062 0063 0064 0109 0117 0218
0239 0240 0245 0251 0253 0254 0256
0257 0259 0260 0262 0263 0266 0267
0271 0287 0307 0385 0388 0402 0419
0429 0430 0436 0437 0438 0441 0444
0455 0469 0474 0483 0487 0489 0492
0493 0496 0497

PROTEIN CONTENT
0050 0128 0130 0133 0140 0480 0520
0521 0524
LEAVES
0132
TUBERS
0125 0389 0517 0519

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0169 0344
FERMENTATION
0341

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DIETARY VALUE
0136
DIGESTIBILITY
0136

PRUNING
0061 0062 0071 0261 0402 0448

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0076

PULP
0389

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0074 0082 0456 0482 0483 0484 0487
0490 0491 0492 0495 0496 0497 0498
0499

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0154 0158 0166 0335 0338 0530

RESISTANCE
0040 0101 0116 0123 0124 0296 0311
0448 0475 0477
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0081 0083 0108 0110 0111 0112 0301
0309 0451 0452
INJURIOUS INSECTS
0110 0303 0309 0468

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0216

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0048 0064

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0371
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0373 0395
HCN CONTENT
0395
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0001 0474
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0373 0395

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0062
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0544

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0361

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0191

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0001 0282 0307 0312 0338 0497 0489
0493 0497
COMPOSITION
0005 0392
GERMINATION
0005 0357 0259 0474 0474

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0140 0511

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0068 0196 0548

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0037 0047 0064 0257 0268 0438

SIERRA LEONE
0026 0027 0419

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0073

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0338 0530

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0530

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0523 0526 0530

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0157 0165 0175 0336 0364 0530 0539
0539

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0230

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0040

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0040

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0030 0031 0426 0545

SOIL MOISTURE
0043 0206 0208

SOIL PHYSICAL PROPERTIES
0241 0244 0248

SOIL REQUIREMENTS
0030 0031 0040 0043 0206 0208 0211
0411 0426 0545

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0214

SOLAR DRYING
0167

SOLUBLE CARBOHYDRATES
0019 0323 0398

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0366

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0007 0050 0053 0060 0062 0109 0189
0192 0193 0231 0236 0250 0252 0253
0255 0265 0367 0378 0383 0384 0402
0428 0430 0433 0435 0439 0440 0442
0494 0544 0545 0546 0547 0551

SPHACELOMA MANIHOTICOLA
0072 0073 0082 0085 0126 0276 0277

STAMENS
0010 0370

STARCH CONTENT
0018 0028 0054 0063 0113 0125 0189
0207 0217 0230 0252 0253 0268 0302
0310 0391 0394 0400 0407 0416 0423
0428 0448 0517 0519 0527

STATISTICAL ANALYSIS
0340 0357 0396 0422 0549

STATISTICAL DATA
0180 0348 0349 0351

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0001 0004 0254 0260 0262
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0014
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0029

STOMATA
0205 0369 0372

STORAGE
0005 0045 0062 0063 0070 0071 0153
0161 0218 0240 0254 0260 0260 0267
0272 0273 0274 0275 0385 0441 0447
0448 0519 0524 0525

SULPHUR
0021 0039

SUPPLEMENTS
0135 0138 0143 0511 0512

SWEET CASSAVA
0015 0532
TUBER PRODUCTIVITY
0029

SWINE
0135 0318 0507 0508 0509 0510
FATTENING
0130

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0131 0133 0321 0324 0326

SYMPTOMATOLOGY
0040 0080
DISEASES AND PATHOGENS
0072 0074 0076 0077 0081 0084 0086
0089 0277 0453

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0123

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0215
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0316
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0316 0337

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0067 0160 0168 0299 0356 0530
TECHNOLOGICAL PACKAGE
0242 0331 0353 0426 0441 0442
TECHNOLOGY EVALUATION
0004 0022 0049 0060 0119 0171 0187
0216 0237 0353 0357 0434

TEMPERATURE
0037 0127 0203 0212 0231 0240 0259
0291 0343 0373 0385 0453 0455 0519

TETRANYCHUS CINNABARINUS
0104

TETRANYCHUS URTICAE
0073 0463

THAILAND
0021 0031 0054 0119 0174 0178 0193
0318 0330 0363 0486 0507 0526 0535
0540 0541 0542 0550

THIOCYANATES
0317

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0047 0090 0218 0299 0371 0387 0492
0493

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0073 0129 0144 0200 0361 0397 0523

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0129 0144 0508

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0174 0178 0186 0333 0346 0426 0441
0540 0541 0542
CASSAVA CHIPS
0360 0363
CASSAVA FLOUR
0205
CASSAVA MEAL
0363
CASSAVA STARCH
0180 0360 0363 0535
PELLETS
0360 0363

TUBER DEVELOPMENT
0204 0253 0258 0380

TUBER PRODUCTIVITY
0007 0009 0023 0025 0026 0027 0028
0029 0032 0033 0034 0035 0036 0039
0041 0044 0046 0048 0053 0055 0060
0063 0069 0079 0092 0097 0102 0105
0106 0109 0111 0113 0114 0116 0117
0118 0120 0122 0179 0180 0189 0192
0193 0203 0207 0213 0218 0219 0220
0221 0222 0224 0227 0230 0233 0234
0236 0241 0243 0244 0245 0250 0252
0253 0255 0256 0258 0261 0265 0266
0268 0271 0302 0304 0305 0308 0310
0313 0361 0365 0366 0380 0382 0383
0405 0407 0408 0409 0410 0412 0413
0414 0416 0417 0418 0419 0421 0424
0425 0428 0430 0431 0433 0435 0436
0437 0439 0440 0444 0457 0459 0464
0465 0476 0477 0478 0479 0481 0494
0501 0538 0543 0544 0545 0546 0548
0550 0551

TUBERS
0004 0037 0058 0163 0229 0361 0406
0420
ANALYSIS
0012 0147 0215 0217 0390 0394 0399
0445
DETERIORATION
0042 0070 0071 0272 0273 0274 0275
0445 0446 0447 0448 0525

DIETARY VALUE
0511
DRY MATTER
0018 0389 0394 0407 0511
HCN CONTENT
0017 0107 0137 0215 0390 0398 0399
0399 0400 0519
NUTRITIVE VALUE
0513 0523
SILAGE
0137
STARCH CONTENT
0018 0054 0125 0217 0391 0394 0400
0407 0448 0517 0519
STORAGE
0070 0071 0153 0272 0273 0274 0275
0447 0448 0519 0525
SUGAR CONTENT
0018 0019 0020 0389 0517 0519

UREA
0027

UROMYCES MANIHOTIS
0073 0081 0277

VASCULAR STREAKING
0446 0448

VENEZUELA
0068 0074 0157 0166 0180 0184 0297
0488 0499

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0455

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0518 0520

WASTE UTILIZATION
0342 0426

WASTES
0360 0363

WATER CONTENT
0005 0125 0128 0151 0340 0396 0517
0519 0520 0521 0524 0527

WATER REQUIREMENTS(PLANT)
0035 0041 0206 0214 0231 0376

WATER STRESS
0032 0034 0035 0038 0043 0208 0213
0376 0386
LEAVES
0205 0207 0372

WEEDING
0056 0061 0062 0198 0242 0246 0248
0264 0431 0433 0441 0442 0550

WEEDS
0246 0258 0281

XANTHOMONAS CASSAVAE
0280 0453
DISEASE CONTROL
0072 0073

XANTHOMONAS MANIHOTIS
0077 0078 0111 0278 0309 0450 0452
0453
DISEASE CONTROL
0072 0073 0277
ETIOLOGY
0075 0145 0276 0279 0280 0281 0282
0283 0284
INOCULATION
0284 0451

ZAIRE
0464 0470

ZINC
0039 0227 0228 0397 0409 0410

ZONOCERUS VARIEGATUS
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