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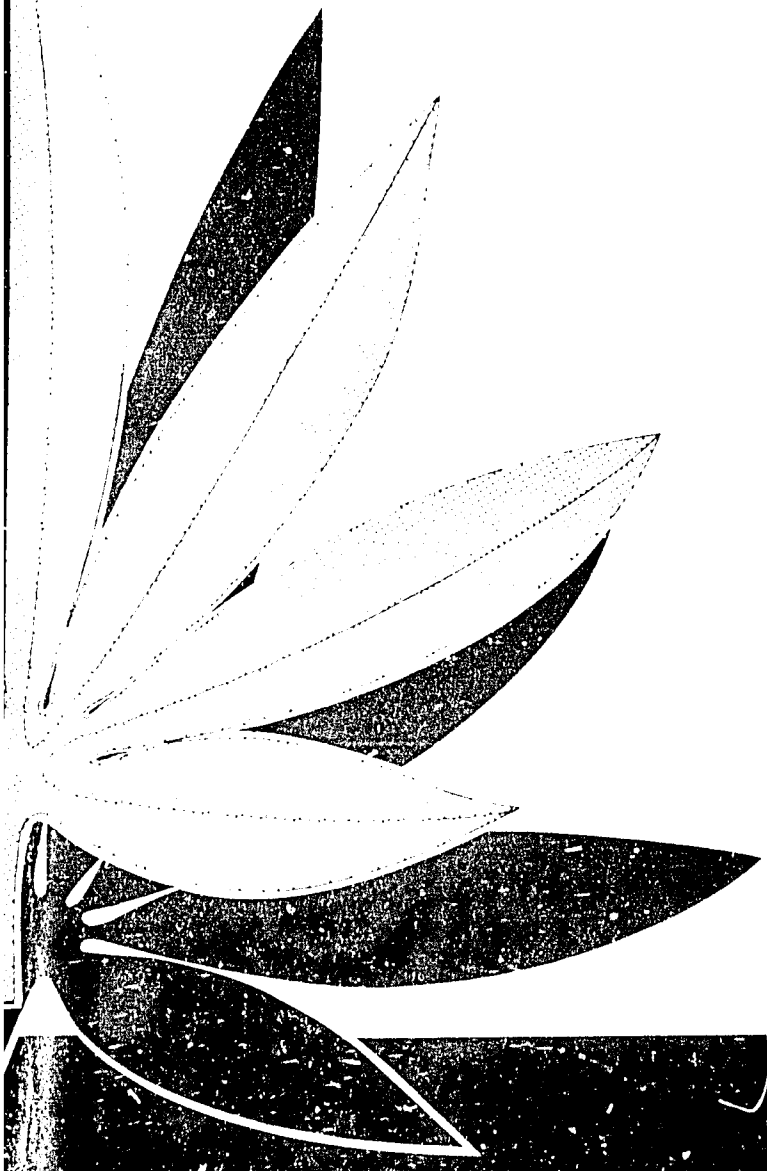
Abstracts on Cassava

(*Manihot esculenta* Crantz)

Vol. X No. 1 April, 1984



Centro Internacional de Agricultura Tropical

ABSTRACTS ON CASSAVA

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Information and conclusions reported herein do not necessarily reflect the position of any of the aforementioned entities.

To our readers:

As of this issue, the address of the first author of documents dated from 1981 on will be included, when available, immediately after the bibliographic citation, inside brackets.

These addresses are given as reported by the authors and will hopefully promote the exchange of information among colleagues within each of the research networks for beans, cassava, and tropical pastures.

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(*Manihot esculenta* Crantz)

Vol. X No. 1 April, 1984

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INTRODUCTION

This journal of analytical abstracts, which replaces the former combination of abstract cards and yearly cumulative volumes, is designed to provide a specialized guide to the world's literature on cassava (*Manihot esculenta* Crantz), disseminating research results and ongoing activities related to the crop.

The abstracts report condensed information from journal articles, booklets, mimeographed reports, theses, manuals and other conventional and nonconventional material, categorized into broad disciplinary fields to facilitate rapid scanning. Additionally, abstracts are author and subject 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 who request this search service. The full text of every article abstracted by the Documentation Center is also available, through the photocopy service.

CIAT's Documentation Center also publishes journals of analytical abstracts on field beans (*Phaseolus vulgaris* L.) grown under tropical conditions, and on tropical pastures. Other CIAT publications dedicated to keeping users aware of research developments in their respective fields include: Pages of Contents, Cassava Newsletter, Pastos Tropicales - Boletín Informativo, and Hojas de Fríjol.

COMPONENTS OF AN ABSTRACT

Accession number (for photocopy requests)

Authors

Sequential number in the journal (for use of indexes)

Year of publication

19527 IKEDIOBI, C.O.; ONYIKE, E. 0143 1982. The use of linamarase in gari production. Process Biochemistry 17(4):2-5. Engl., Sum. Engl., 12 Refs., Illus. [Dept. of Biochemistry, Ahmadu Bello Univ., Zaria, Nigeria]

Original title

Author address

Additional notes

Source

Pages

Language of paper

Language of summary

Cassava. Linamarase. Uses. Gari. Fermentation. Detoxification processes. Enzymes. Nigeria.

Keywords

The detoxification of cassava associated with fermentation depends on endogenous linamarase hydrolysis of the constituent cyanogenic glucosides. Addition of exogenous linamarase preparations to fermenting grated cassava not only increased the rate and extent of detoxification but also consistently yielded gari with innocuous levels of cyanide. A preliminary screening of several fungal isolates for their ability to synthesize linamarase, resulted in the identification of 2 fungi, Penicillium steckii and Aspergillus sydowi, capable of producing this enzyme in commercial quantities. The use of linamarase or linamarase-producing fungi in cassava fermentation for gari production may be an interesting possibility. (Author's summary) 102

Abstract

Abstractor and/or translator

Subject categories

HOW TO USE THE INDEXES

The numbers listed under each entry in the author and subject indexes correspond to the abstract's sequential number, found above each abstract within the journal.

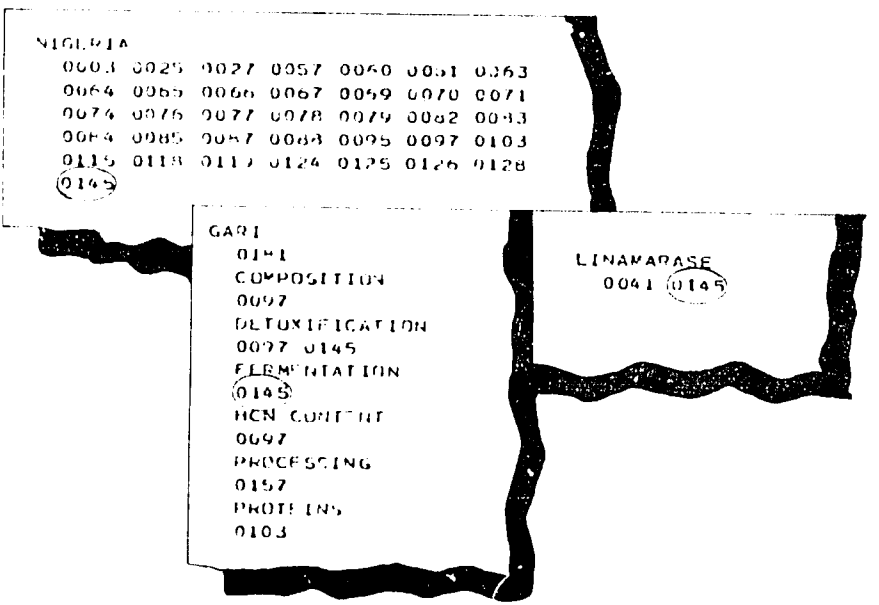
The last issue of the year contains cumulative author and subject indexes for the year.

Author Index

The Author Index can be used to find abstracts when the personal or corporate authors are known. The Author Index, which is alphabetically arranged, lists *all* author and co-author names cited in the publicaction.

Subject Index

The Subject Index presents an alphabetical list of descriptors used in cassava research, many of which are combined with other descriptors, allowing the identification of more specific topics.



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A00 BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

See 0106

B00 PLANT ANATOMY AND MORPHOLOGY

See 0005 0094 0100

C00 PLANT PHYSIOLOGY

0001

18968 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Cultivo de tejidos. (Tissue culture). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.115-125. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Tissue culture. Apical meristems. Disease control. Frog skin disease. Germplasm. Mosaic diseases. Colombia.

During 1981, the efforts to use meristem-culture methods have continued, together with thermotherapy for recovering healthy clones. Frog skin disease was eradicated up to 100% in different cassava clones during various propagation cycles through the culture of small meristem tips. A routine "cleaning-up" program consists of: (1) disinfestation of stakes containing dormant buds and treatment with thermotherapy; (2) cutting and disinfestation of shoot terminal buds; (3) isolation of meristem tips (0.5-0.6 mm) under sterile conditions and planting in culture medium; (4) transfer of meristem tips and nodes grown from the meristem to a rooting medium; (5) hardening of rooted plantlets prior to potting; (6) transplant to the field and to the greenhouse; (7) evaluation of the presence of frog skin disease after 3 mo. of growth; and (8) selection of symptom-free plants, grown again for 3 mo., and reevaluated. A germplasm bank in vitro is a long-term goal to conserve material and to isolate microorganisms. The main steps and procedures followed in the international exchange of clonal materials are described. During 1981, work was initiated aimed at developing anther-culture methods for cassava and to observe microsporogenesis stages in relation to the size of the floral bud. (Summary by EDITEC. Trans. by L.M.F.) C00

0002

18963 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Fisiología. (Physiology). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.7-25. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Plant physiology. Photoperiod. Water stress. Growth. Irrigation. Photosynthesis. Nutrient absorption. N. Analysis. Leaves. Colombia.

During 1981 the physiology section of CIAT's Cassava Program emphasized the understanding of factors that contribute to yield under stress conditions. Regarding photoperiodic effects, long days (16 h daylength) decreased HI and root yield while increasing total DM and the no. of apices/plant in

stomatal closure and reduced transpiration and leaf area. Plants under water stress formed larger leaves after being well watered (during recuperation). Leaf conductance was always greater in well-watered than in stressed plants at any given vapor pressure difference (VPD) and decreased rapidly as VDP increased. Max. water use efficiency is obtained at low leaf conductances and there is genetic variation among cv. in their response to VPD. Cassava is highly sensitive to changes in air humidity, which enables the cassava plant to reduce transpiration before it exhausts available soil water. Although cassava may be grown over a wide range of temp. since there are clones adapted physiologically to these temp., photosynthesis is considerably affected at temp. below 5-10°C. Cassava recycles large amounts of N since the N content of fallen leaves is about half that of leaves on the plant. Tables and diagrams completing the information given are included. (Summary by EDITEC. Trans. by L.M.F.) COO

0003

18962 NG, Y. 1982. Cassava and sweet potato—stamping out disease. West African Farming November/December 1982:15-16. Engl., Illus. [IITA, Oyo Road, PMB 5320, Ibadan, Nigeria]

Cassava. Tissue culture. Disease control. Nigeria.

Advances in research at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, for producing disease-free cassava and sweet potato are described. The Tissue Culture Lab. at IITA produces disease-free material and during 1981 requests from 37 different countries were fulfilled. Recommendations for transportation include avoiding low (10°C) or high (40°C) temp. and special protection from rain or direct sunlight. Tubes containing plantlets should be stored for at least 1 wk. after arrival in a humidity chamber with high levels of humidity. Quarantine obstacles have thus been overcome. The tissue culture system is described as well as the advantages of its use. The dissected cassava meristem tip is placed in a test tube with culture medium and kept in culture rooms at constant temp. (26°C night, 30°C day) with a 12-h-long photoperiod for 2-3 mo. With a slow growth culture in vitro environment at a temp. of 16-20°C, cassava, sweet potato, and yam can be kept in test tubes for more than 1 yr. The IITA, in collaboration with the United Nations Development Program, has offered a training course in tissue culture. (Summary by EDITEC. Trans. by L.M.F.) COO

0004

19992 SAN JOSE, J.J. 1983. Diurnal course of CO_2 and water vapour exchange in Manihot esculenta Crantz var. Cubaña. Photosynthetica 17(1):12-19. Engl., Sum. Engl., 19 Refs., Illus. [Instituto Venezolano de Investigaciones Científicas, Centro de Ecología, Apartado 1827, Caracas 101, Venezuela]

Cassava. Carbon dioxide. Leaves. Plant respiration. Photosynthesis. Timing. Plant physiology. Water requirements (plant). Venezuela.

The diurnal course of CO_2 and water vapor exchange in newly-expanded leaves (upper canopy) and aging leaves (lower canopy) of the C_3 plant cassava var. Cubana and the C_4 plant sugarcane var. Llanera was measured under field conditions in the High Central plains (Llanos) of Venezuela. The lower leaves in the cassava canopy exhibited a nonmetabolic aging. Their dark respiration did not adjust to a lower rate as did the upper leaves which received intensive radiation. On the other hand, the rate of dark respiration of the sugarcane leaves was consistently proportional to the

rate of gross photosynthesis during the measuring period (15 days). (Author's summary) C00

C01 Plant Development

0005

18954 LOPEZ C., A.M. 1976. Iniciación de enraizamiento y tuberización en yuca (Manihot esculenta C.) y efecto del almacenamiento de la estaca en el rendimiento. (Cassava root initiation and tuber formation and the effect of storage of the cutting on yield). Tesis Ing.Agr. Palmira, Universidad Nacional de Colombia. Facultad de Ciencias Agropecuarias. 88p. Span., Sum. Engl., Span., 26 Refs., Illus.

Cassava. Rooting. Root development. Root system. Plant anatomy. Timing. Starch content. Cuttings. Storage. Root productivity. Dry matter. Plant development. Germination. Colombia.

Two trials were conducted at CIAT's exptl. farm. In the 1st trial, the morphology of the root system of the cassava plant was studied, from root initiation to tuber formation. The development of different root tissues and the starch accumulation in them were also observed. Var. MCol 1513 was used. Plants were harvested 13, 17, 20, 25, 28, 32, 38, 41, 48, 61, and 82 days after planting, 3 plants/treatment. Cassava roots started to store starch 32-38 days after planting. Root age, and not diameter, was the determining factor for the presence of starch. No starch was deposited until secondary thickening occurred. Secondary thickening, however, may be present before starch accumulation occurs. Regarding the morphologic aspect, the planting system, either vertical or horizontal, did not influence the date on which starch appeared nor the amount deposited. In the 2nd trial, the effect of storing cassava stakes on the final yield was studied in a split plot design with 6 plants/treatment with 5 replications and 7 treatments (planting right after cutting; 1, 2, 3, 5, 7, and 10 days after cutting). Data on root yield (kg/ha), no. of thickened and thin roots, total dry wt., foliage dry wt., HI, plant height at 12 wk., and germination % were recorded. Storage under field conditions, with no fungicide treatment, reduced yield. The highest yields were obtained by planting stakes right after cutting, yielding up to 50% more than stakes planted 10 days after cutting. Two var., MCol 113 and MCol 22, were used. Different levels of var. resistance to stake storage were found; MCol 113 was more susceptible than MCol 22 to storage. Even with a germination of 99% for the trial in all treatments, there were large differences in yield. These suggest that germination % is not a reliable method to determine final yields. (Author's summary) C01

0006

19976 MACHADO M., L.F. 1975. Determinación del área foliar en yuca (Manihot esculenta Crantz) por el método de los discos foliares. (Determination of leaf area in cassava by the leaf disc method). Tesis Ing.Agr. Medellín, Universidad Nacional de Colombia. 39p. Span., Sum. Span., 27 Refs., Illus.

Cassava. Plant physiology. Leaf area. Analysis. Leaves. Colombia.

The leaf disc method to obtain the leaf area of cassava is given. A plot planted to the var. Llanera, established for yield trials by the Centro Nacional de Investigaciones Agropecuarias Tulio Ospina of the Instituto Colombiano Agropecuario (ICA), was selected in the Medellin valley. The random sampling method used in the field for the collection of material

is described. Results obtained showed that the association of the studied variables can be classified as high, evident in the homogeneity of the leaf tissues. Consequently, it is possible to calculate the leaf area by the regression equation: Y = -26.2646 + 13.7591 X, where X represents the wt. in mg of a disc of 8 mm in diameter, located 1.5-2.0 cm from the point of insertion of the petiole and Y, the leaf area in cm^2. The study has a diagram that indicates the location and form of taking a leaf disc and a glossary of the main terms used. (Author's summary. Trans. by L.M.F.) C01

See also 0014 0025 0029 0031 0056 0057 0072 0090 0093 0097 0193

C02 Cyanogenesis

0007

19218 BRUIJN, G.H. DE 1983. Toward lower levels of cyanogenesis in cassava. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.119-122. Engl., 30 Refs. [Dept. of Tropical Crop Science, Agricultural Univ. Wageningen, the Netherlands]

Cassava. Cyanogenesis. HCN content.

Genetic aspects and ecological factors are discussed regarding the possibility of cultivating cassava with low, or possibly zero, cyanide levels. The broad range of root HCN levels, from about 10 mg/kg to more than 600 mg/kg, gives evidence that the genetic control is multigenic. Low-cyanide clones at the International Institute of Tropical Agriculture (IITA) had a total root HCN content that varied between 33-92 mg/kg. The ratio between HCN content of root peel and that of the parenchyma was 2.6 (840 mg/kg:330 mg/kg) for 8 very toxic clones and 9.5 (690 mg/kg:73 mg/kg) for 8 less toxic clones. Some factors like the application of OM, pruning, and increasing plant population decrease glucoside levels, whereas N fertilization, severe drought, and the season (rainy) increase glucoside contents. The variations in soil fertility and rainfall pattern play an important role in the glucoside content of the roots; the influence of different ecological conditions is not yet well understood. Further breeding and selection work could produce zero-cyanide content clones. (Summary by EDITEC. Trans. by L.M.F.) C02

C03 Chemical Composition, Methodology and Analyses

0008

19221 COOKE, R.D. 1983. Effects of cassava processing on residual cyanide. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.138-142. Engl., 34 Refs., Illus. [Tropical Development & Research Inst., 56-62 Gray's Inn Rd., London WC1X 8LU, England]

Cassava. Processing. Cyanides. Composition. Cassava chips.

The importance of cyanogenic glucoside hydrolysis to free cyanide in determining the rate of cyanide removal during cassava processing is highlighted. An enzymatic assay that readily permits measurement of the

free and bound cyanide ratio in cassava and cassava products was developed. This assay achieves a rapid and quantitative hydrolysis of cyanogenic glucosides and obviates the need for steam distillation or aspiration. Different methods of processing to reduce cassava root toxicity and improve its palatability are described: (1) dehydration, a forced-air dryer is used and 25-30% of its bound cyanide is eliminated at 47 and 60°C with corresponding losses of free cyanide of 80 and 85% at 47 and 60°C, resp.; (2) boiling in water, which eliminates over 90% free cyanide content within 15 min; (3) soaking (leaching) in water, rapid stirring in cold water removed 90% of the free cyanide after 4 h, but not the bound cyanide. The differences in the rate of cyanide loss when processing homogenates are described. Free cyanide is much easier to remove than bound cyanide and the extended mixing in water, soaking in water with associated fermentation, and slow sun drying, constitute an efficient process for removing this residual cyanide. The enzymatic assay method allows higher residual cyanide levels to be found than those reported in earlier literature. The need to investigate chronic toxicity implications, especially of bound cyanide in cassava-based foods, is emphasized. (Summary by EDITEC. Trans. by L.M.F.) C03

0009

18938 ESCOVAR, I.B. 1982. Composición química del follaje de yuca. (Chemical composition of cassava foliage). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:627-635. Span., 3 Refs. [Laboratorio de Química, Univ. Simón Bolívar, 80659 Prados del Este, Caracas, Venezuela]

Cassava. Leaves. Stems. Cultivars. Protein content. Fat content. Ash content. Fibre content. Carbohydrate content. HCN content. Amino acids. Venezuela.

Protein, crude fat, carbohydrate, mineral, and fiber contents of dehydrated leaves and stems of 11 cassava var. from the locality of El Limón, state of Aragua, Venezuela, were analyzed. The amino acid profile, presence of HCN, and fatty acid content were also examined. Leaves and stems were finely grinded to a fine flour similar to that of alfalfa but with a lower crude fiber content. Var. UCV-2078, UCV-2437, and UCV-2284 were outstanding with av. values of 18.1, 3.7, 11.2, 21.0, and 45.0% crude protein, ether extract, ash, crude fiber, and carbohydrates, resp. Var. UCV-2365, UCV-2203, and UCV-2078 had the best amino acid profile with the highest concn., in particular, of essential amino acids. However, low levels of met. were found in all var. Ten fatty acids were identified among the saturated ones: lauric, myristic, palmitic, stearic, arachidic, and behenic acids; unsaturated ones were palmitoleic, oleic, linoleic, and linolenic acids. HCN values were less than 50 mg/kg after sun drying, in all var. Cassava leaf and stem flour is a source of energy and forage. Var. UCV-2078 had the best nutritional characteristics. (Summary by EDITEC. Trans. by L.M.F.) C03

0010

19512 GOMEZ, G.; VALDIVIESO, M. 1983. The effect of variety and plant age on cyanide content, chemical composition and quality of cassava roots. Nutrition Reports International 27(4):857-865. Engl., Sum. Engl., 23 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Cultivars. Cyanides. Composition. Timing. Dry matter. Starch content. Sugars. Fibre content. Ash content. Fat content. Roots. Colombia.

The effects of 2 cassava var. (CMC-40, low-cyanide cv. and CMC-84, high-cyanide cv.) and harvesting at 4 plant ages (from 9 to 12 mo.) on the cyanide content, chemical composition, and quality of roots were studied at CIAT. Plant age practically did not affect the concn. of cyanide in the parenchyma of each var.; the cyanide level in the parenchyma of roots of CMC-84 was approx. 3 times higher than that of roots of CMC-40 (623 ± 25 vs. 234 ± 10 ppm on DM basis). Root peel of CMC-40 had very high levels of cyanide, notably at 9 and 10 mo.; the cyanide in the peels of both var. decreased with plant age. Root parenchyma of CMC-84 had a markedly bitter taste and was considered unsuitable as a food vegetable; some of the roots of CMC-40 also showed some degree of bitterness, especially at 12 mo. Data on DM, starch, sugars, CP, crude fiber, ash, and ether extract are presented and discussed. Starch, the main chemical constituent of cassava roots, accounted for 83% of their DM. Cassava peels contained higher levels of some of the chemical components but peels constituted only 16-18% of the total root fresh wt. (Author's summary) C03

0011

19225 HERSHEY, C.H. 1982. Methodology: quick estimation of dry matter content of cassava roots possible using rapid evaluation technique. Cassava Newsletter no.11:4-5. Engl., 1 Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in Spanish.

Cassava. Laboratory experiments. Dry matter. Roots. Colombia.

To estimate DM content in cassava roots, CIAT has developed a modified rapid evaluation technique that requires a min. of materials and can be carried out at the field level. This method is based on the principle of the high relationship between root DM and root specific gravity, which is estimated in a solution of common table salt (NaCl) in water, with a known specific gravity. A series of 6 salt solutions with 50, 100, 150, 200, 250, and 300 g/l solute with specific gravities ranging from 1.034 to 1.192 was prepared. Samples were passed through each solution until they floated. DM content is estimated on the basis of the formula DM = 0.0358X + 0.1915, where X is the mean rating in salt solutions. Approx. 250-300 samples can be analyzed with less than a 10% change in the NaCl concn. of the solutions. This method has a highly significant correlation (r = 0.86) when compared with traditional methods (weighing in air and in water). This technique is recommended for breeding programs and in the selection of cassava where large no. of samples need to be analyzed. (Summary by EDITEC. Trans. by L.M.F.) C03

0012

19518 NASSAR, N.M.A.; DOREA, J.G. 1982. Protein contents of cassava cultivars and its hybrid with wild Manihot species. Turrialba 32(4):429-432. Engl., Sum. Span., Engl., 13 Refs. [Depto. de Engenharia Agronomica, Univ. de Brasilia, 70.910 Brasilia, D.F., Brasil]

Cassava. Hybrids. Manihot oligantha. Cultivars. Roots. Protein content. Brazil.

The protein contents of tubers of 16 cassava cv. and one hybrid of cassava with the wild species Manihot oligantha of the germplasm collection of the U. of Brasilia (Brazil) were estimated. Total N and DM were also determined. Seeds of cassava and 8 wild Manihot species maintained in the living collection at the University were also analyzed. Protein % in large peeled tubers of cassava cv. ranged from 0.7 to 1.2% and in small tubers

(less than 50 g), from 0.9 to 1.4%. Peeled tubers of the hybrid had 4.6% protein. Protein in wild Manihot species seed ranged from 27.9 to 37.3% compared with 26.8% in cassava seed. (Summary by L.M.F.) C03

0013

19999 SALES FILHO, J.B.; TELES, F.F.F.; SILVEIRA, A.J.; BATISTA, C.M. 1982. Efeito do método de determinacao de matéria seca no teor de carboidratos, em raízes de mandioca (Manihot esculenta Crantz). (Effect of the method of determining dry matter on the carbohydrate content of cassava roots). Revista Ceres 29(165):503-508. Port., Sum. Port., Engl., 19 Refs. [Conselho Nacional de Desenvolvimento Científico e Tecnológico, Av. Marechal Camara 365, 2o. and., 20.000 Rio de Janeiro-RJ, Brasil]

Cassava. Laboratory experiments. Dry matter. Carbohydrate content. Analysis. Brazil.

Various techniques for determining DM content in fresh cassava roots were compared and discussed. Best results were obtained with samples cut in small cubes (1 cm in width), placed in Petri dishes, and dried at 75°C for 8 h, in a forced-air oven. Higher temp. favored nonenzymatic browning with consequent decrease in reducing sugars and free amino acids (Maillard reaction) content. (Author's summary) C03

See also 0005 0006 0007 0014 0024 0041 0044 0051 0090 0091 0093 0095 0100 0102 0125 0138 0151 0173 0191

C04 Plant Nutrition

0014

19988 ALMENDRAS, A.S. 1982. Effect of liming, fertilization and mycorrhizal inoculation on NPK uptake and growth of cassava (Manihot esculenta Crantz). Mag.Sc. Thesis. College, Laguna, University of the Philippines at Los Baños. 92p. Engl., Sum. Engl., 53 Refs., Illus.

Cassava. Agricultural lime. Mycorrhizae. N. P. K. Fertilizers. Nutrient absorption. Mineral content. Analysis. Plant tissues. Growth. Dry matter. Shoots. Soil requirements. Philippines.

The response of cassava cv. Lakan to liming, NPK fertilization, and mycorrhizal inoculation was evaluated through a pot expt. using an acid infertile soil (Luisiana clay). Fertilization significantly increased the degree of mycorrhizal infection, tuber dry wt., and total DM yield regardless of inoculation and liming treatments. In unlimed but fertilized soils, inoculation significantly increased P uptake. Among fertilized treatments, no significant growth response was obtained from liming and inoculation. Using Lipa clay loam and Luisiana clay, the response of cassava to NPK fertilization and mycorrhizal inoculation was further investigated. The application of 45-60-60 in both soil types significantly increased tuber dry wt. and total DM yield. A significant increase in P uptake over the 0-60-60 treatment was observed in Lipa clay loam and Luisiana clay applied with 45-60-60 and 90-60-60, resp. N and K uptakes were not significantly affected by NPK level in both soil types. Mycorrhizal inoculation apparently increased the degree of mycorrhizal infection in Luisiana clay but not in Lipa clay loam. In both expt., results of correlation analyses showed that the degree of mycorrhizal infection was not related to shoot uptakes of N, P, and K, dry wt. of tubers, and that total production correlated best with shoot N uptake. (Author's summary) C04

0015

18965 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Proyecto micorriza. (Mycorrhiza project). in _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.57-67. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Mycorrhizae. P. Dry matter. Foliage. Herbicides. Cuttings. Colombia.

Advances of the Mycorrhiza Project of CIAT's Cassava Program are highlighted. Objectives include the collection, maintenance, multiplication, and testing of mycorrhizal strains and determination of favorable cultural practices for maintaining mycorrhizal activity during the growth period of cassava and preservation of high mycorrhizal spore populations in the soil. Strategies for utilization of vesicular-arbuscular (VA) mycorrhiza fungi in plant nutrition of cassava are focused on their use in nonsterilized, low fertility, acid soils. Twenty-five VA-mycorrhizal species of the genera Glomus, Gigaspora, Acaulospora, and Entrophospora were isolated. Strains C-1 and C-7 of Glomus sp. were the best adapted to 2 low-P sterilized soils. The competitive ability of selected strains with native mycorrhizal fungi was evaluated as well as the utilization of low-cost P sources of low solubility in combination with mycorrhiza and the critical level of spores of native mycorrhizal fungi in the soil (estimated to be 12 spores/100 g dry soil). The application of N and P to the soil reduced, while K increased, infection; however, observations indicate that soil and cv. differences exist due to differences in composition of the native mycorrhizal population. Stake treatments with fungicides had a negative effect on spore reproduction during the 1st 60 days of growth, time after which spore production increased. Some pesticides in relatively high concn. can influence mycorrhizal development. (Summary by EDITEC. Trans. by L.M.F.) C04

0016

19511 HAWKER, J.S.; SMITH, G.M. 1982. Salt tolerance and regulation of enzymes of starch synthesis in cassava (Manihot esculenta Crantz). Australian Journal of Plant Physiology 9(5):509-518. Engl., Sum. Engl., 22 Refs., Illus. [CSIRO, Div. of Horticultural Research, G.P.O. Box 350, Adelaide, South Australia 5001]

Cassava. Salinity. Resistance. Nutrient solution. Plant tissues. Mineral content. Stems. Plant development. Roots. Leaves. Starch content. Water content. Enzymes. Biochemistry. Plant physiology.

Growth rate of cassava cv. MAUS7 decreased with increasing NaCl concn. from 0 to 75 mM in nutrient solutions supplied regularly in a porous growth medium in a greenhouse. Tuber wt. was reduced 50% between 30-50 mM NaCl and there was some burning of apical leaves at 50 and 75 mM. Na^+ and Cl^- increased in all tissues with increasing NaCl concn. but Na^+ remained low in laminae until the 75 mM treatment. K^+ levels decreased in tubers. Starch concn. remained the same in tubers and K^+ stimulated starch bound ADPglucose starch synthase 1.5-fold. Leaves and tubers contained activities of ADPglucose pyrophosphorylase and ADPglucose-starch synthase similar to those found in leaves and storage organs of other starch synthesizing plants. ADPglucose pyrophosphorylase from leaves was stimulated 20-fold by 3-phosphoglyceric acid (3PGA) while the enzyme from tubers was almost completely dependent on 3PGA at pH 8.5. At pH 7.5 the leaf enzyme was stimulated 26-fold and the tuber enzyme was again almost completely dependent on 3PGA. The results support the view that it is not possible to

generalize about the magnitude of the control of ADPglucose synthesis in leaves as opposed to nonchlorophyllous tissues. (Author's summary) C04

0017

19521 HOWELER, R.H.; SIEVERDING, E. 1982. La importancia de las micorrizas en la absorción de fósforo por la yuca. (The importance of mycorrhiza in phosphorus absorption by cassava). Suelos Ecuatoriales 12(2):182-195. Span., Sum. Span., 20 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Mycorrhizae. P. Nutrient absorption. Cultivars. Dry matter. Mineral content. Productivity. Field experiments. Colombia.

Trials with cassava grown in soil and in nutrient solutions have shown that the root system of cassava is inefficient in P absorption; however, mycorrhizal association improves this absorption considerably. In pot trials with sterilized soil from Santander de Quilichao (Cauca, Colombia), non-inoculated plants required an application of 1600 kg P/ha for max. DM production while mycorrhizal-inoculated plants did not require P. The presence of mycorrhiza increased P absorption over 100-fold at some levels of P application. The critical level of soil P is found to be much higher when mycorrhizal populations are eliminated. When infected cassava roots were used as inoculum for 7 different plant species (cassava, maize, bean, cowpea, rice, Andropogon gayanus, and Stylosanthes guyanensis), all the species were infected and, except for rice, showed a marked response to inoculation, especially at an intermediate level of application (100 kg P/ha). When cassava seedlings were later inoculated with infected roots of these 7 species, almost all the plants were infected and showed a good response to inoculation, indicating that the host plant is not very selective regarding the mycorrhizal strains used. To determine if different degrees of effectiveness exist among the different mycorrhizal strains regarding cassava growth, several strains have been isolated from different regions of Colombia. The 1st trials with sterile soil showed a large difference among strains with P application. Trials on sterile and unsterile soil of Carimagua and Santander de Quilichao showed that the effect of inoculation was always greater on sterilized soil; however, some positive response was observed on unsterilized soil with native mycorrhizal populations. In the 1st field inoculation trial, a good initial response was observed, especially in sterilized soil. Inoculation on this soil was highly positive regarding root production, but there was no significant effect on unsterilized soil. These preliminary results clearly indicate the dependency of cassava on an efficient mycorrhizal association and indicate the possibility of limiting the use of P fertilizers with mycorrhizal inoculations. (Author's summary. Trans. by L.M.F.) C04

0018

19226 HOWELER, R.H. 1982. Mycorrhizal associations: important for cassava grown on soils low in P. Cassava Newsletter no.11:10-11. Engl., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in Spanish.

Cassava. Nutritional requirements. Mycorrhizae. P. Colombia.

Cassava grows well on some low-P soils and is less responsive to P fertilizers than many other crops due to the association of cassava roots with certain soil fungi, called vesicular-arbuscular (VA) mycorrhiza. Aspects of the symbiotic relationship fungus/plant are described. VA mycorrhiza produce hyphae in and around the roots and form arbuscles and vesicles

inside the root cortex. The P absorbed by the external hyphae of the fungus is released to the plant roots where interchange of substances occurs. More than 70 species have been identified, differing in their efficiency to absorb P. Since 1980 the Mycorrhiza Project at CIAT has collected, purified, and evaluated the efficiency of large no. of mycorrhizal strains to identify highly efficient strains adapted to particular soil and climatic conditions. Improved methods of inoculum production and application are also being studied. It is expected that the use of better strains will make field inoculation in nonsterilized soil an attractive alternative to using high levels of P fertilizer. (Summary by EDITEC. Trans. by L.M.F.) C04

See also 0024 0026 0030 0173

D00 CULTIVATION

0019

18939 GONZALEZ J., E.; SEDEK L., J.; GIL G., F. 1982. Consideraciones agroenergéticas de la yuca. (Agroenergetic considerations on cassava). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:637-647. Span., 12 Refs. [Univ. Central de Venezuela, Fac. de Agronomía, Apartado Postal 104, Caracas, Venezuela]

Cassava. Energy utilization. Land preparation. Cultivation. Harvesting. Food energy. Energy productivity. Venezuela.

The energy balance of cassava with the level of technology used in the east central region of Venezuela is analyzed. For each case, the cultural practices employed, required inputs, equipment and machinery utilized, and labor for each activity are described. Conversion parameters were used to express inputs in kcal/ha. The energy output for producing 1 ha of cassava was estimated to be 10,608,338 kcal of which more than half of the energy input (52.14%) is used in the mechanization process. NPK fertilization takes 25.1, 4.75, and 1.42%, resp. The energy cost for other inputs were: seeds, 7.24%; agricultural lime, 2.96%; labor, 1.9%; transportation, 1.56%; fuel, 1.47%; herbicides, 0.76%; and insecticides, 0.63%. Estimated yield was 25,000 kg roots/ha for a kcal value of 43,600,000. On a dry basis, the cassava canopy produces 2600 and 8000 kg of leaves and stems, accounting for 42% of total photosynthetic energy (10.2 and 37.6 x 10^6 kcal, resp.). Compared with sorghum and maize which produce 8.0 and 7.1 x 10^6 kcal, resp., at a cost of 11.9 and 12.2 x 10^6 kcal, cassava roots have a ratio product obtained:energy input of 4.10 vs. 0.87 and 0.58 for the other 2 crops mentioned. (Summary by EDITEC. Trans. by L.M.F.) D00

0020

18488 JAMESON, J.D.; THOMAS, D.G. 1970. Cassava—*Manihot esculenta* Crantz. In _____., ed. Agriculture in Uganda. London, Oxford University Press. pp.247-250. Engl.

Cassava. Production. Statistical data. Cultivation. Plant breeding. Cassava African mosaic virus. Cassava brown streak virus. *Cercospora henningsii*. *Verticillium dahliae*. Clones. Uganda.

Several aspects of cassava cultivation in Uganda are discussed: origin, time of introduction, soil and climatic conditions, plant development, regions and districts where cassava is grown, cultural practices (propagation system, planting distances, weeding), ways of preparation and consump-

tion. CAMD, transmitted by Bemisia sp., is one of the major diseases in cassava. It can be controlled by the growing of resistant var., these being produced since 1936 at the East African Research Station at Amani, Tanzania. A list is included of clones distributed to farmers in 1964 and their origin. Bylaws in force regarding the distribution of planting material to prevent disease dissemination are discussed. Other diseases reported are the brown streak virus, Cercosporidium henningsii, and Verticillium dahliae. (Summary by EDITEC. Trans. by L.M.F.) D00

0021

19245 PORTO, M.C.M.; MACEDO, M.M.C.; SOUZA, A. DA S.; GOMES, J. DE C.; SOUZA, L. DA S.; FUKUDA, W.M.G.; LOPEZ DE VELEZ, A.M. 1979. Rezoneamento do Estado da Bahia para implantacao de destilarias de álcool de mandioca; recursos naturais. (Rezoning the state of Bahia to introduce cassava alcohol distilleries; natural resources). Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 40p. Port.

Cassava. Cultivation. Production. Alcohol. Brazil.

The most important areas of the state of Bahia, Brazil, were selected to establish cassava alcohol distilleries. Within these areas important centers for alcohol production were determined on the basis of their potential in terms of climate, soils, crop production, area planted, and in some cases, exptl. results of research indicating the adaptation of cassava to the region. The areas selected were Reconcavo Baiano, Feira de Santana, Jequié, Andaraí, Senhor do Bonfim, Caitité, Brumado, and Mascote. In the Sao Francisco River region the areas of Barreiras y Angical were selected. For each one of the centers where a distillery can be established the following information is given: municipalities included, geographic localization, physiography, climate, type of vegetation and soil, major crops established, and soil potential for cassava cultivation. It is also indicated that the soils of this region have low fertility; a fertility index for the soils of each one of the potential centers is included. (Summary by EDITEC. Trans. by L.M.F.) D00

0022

18960 SOUZA, R.F. DE; PASSOS, O.S.; MATOS, P.L.P. DE; MACEDO, M.C.M.; CARVALHO, J.E.; PORTO, M.M. 1977. Sistema de producao para a mandioca. (Cassava production system). In Simpósio sobre o Cerrado, 4o., 1976. Bases para utilizacao agropecuária. Belo Horizonte, Itatiaia. pp.387-393. Port., 8 Refs.

Cassava. Cassava programs. Cultivation. Harvesting. Brazil.

The potential of cassava for energy production, its utilization for industrial purposes, and the employment that it generates in Brazil gave way to the development of policies destined to use the areas of Cerrado soil, characterized by low fertility, high acidity, low OM content, and high P fixation. The av. yield in these areas is expected to increase from 14 t/ha, at 18 mo., to 20-30 t. In order to do so, the use of selected cv., adapted to the region, is proposed as well as improvement of genetic potential. Cv. Riqueza Ipeaco 1. Vassourinha Sel-514, and Híbrida with yields of 30.0, 37.0, and 29.6 t/ha, resp., are recommended for the region of Sete Lagoas, localized in the Cerrado area. Results of trials carried out on planting time, spacing, herbicides, fertilization, pruning, harvest time, and rotation in Sete Lagoas are given. The Centro Nacional de Pesquisa de Mandioca e Fruticultura coordinates the different trials carried out in the Cerrado area that evaluate the different possible

production systems. Suggestions are given for research on cassava in this type of area. (Summary by EDITEC. Trans. by I.M.F.) DOO

0023

19516 WAHAB, A. 1978. Cassava agronomy. Bridgetown, Barbados, Inter-American Institute of Agricultural Sciences. 19p. Engl., 4 Refs.

Paper presented at Training Course in Cassava Agronomy at the Ministry of Agriculture, Bridgetown, Barbados, 1978.

Cassava. Cultivation. Diseases and pathogens. Injurious insects. Injurious mites. Jamaica.

General information is given on the origin and distribution of cassava, its uses, ecology and systematic botany, soil and nutrient requirements, methods of propagation, cultural practices, symptomatology of major diseases and pests and their control in Jamaica. In addition to its use in human and animal nutrition, cassava has multiple industrial uses, among which are the production of starch, glucose, alcohol, adhesives, and cosmetics. Growth cycle of var. varies between 6 mo. and 2-4 yr. The crops prefers light textured soils and grows best on sandy or sandy loam soils of reasonable fertility. With the removal of 467 kg K/ha, root yields of 59 MT/ha can be obtained. In moderate to strongly alkaline soils (pH above 8.0), deficiencies of B, Cu, Fe, Mn, and Zn occur. Among the major diseases of cassava in Jamaica are those caused by Xanthomonas manihotis, Erwinia sp., Cercosporidium henningsii, Cercospora vicosae, C. caribaea, Phoma (Phyllosticta) sp., Oidium manihotis, Colletotrichum manihotis, Phytophthora sp., and Pythium sp. Major pests include the mites Mononychellus tanajoa and Tetranychus urticae, the cassava hornworm (Erynnyis ello), shoot flies (Silba pendula), and other insects like Aonidomytilus albus, Vatiga manihotae, and termites (Coptotermes sp.). (Summary by EDITEC. Trans. by L.M.F.) DOO

See also 0069 0162 0177 0180

DO1 Soil, Water, Climate and Fertilization

0024

18964 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Suelos y nutrición de la planta. (Soil and plant nutrition). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.27-56. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Ca. S. Zn. N. P. K. Fertilizers. Cuttings. pH. Cultivars. Adaptation. Soil requirements. Soil fertility. Mycorrhizae. Root productivity. Starch content. Nutrient absorption. Dry matter. Mineral content. Colombia.

Advances in research of the soil and plant nutrition section of CIAT's Cassava Program in 1981 are given regarding symptoms of Ca and S deficiency, germplasm screening for adaptation to high acidity and/or low P; effect of fertilization (long-term fertility); level and time of K application; effect of nutrient status of planting material on the growth and yield of the crop; external P requirements; fertilizer response as related to soil fertility; and response to mycorrhizal inoculation. Critical levels were 0.27 and 0.3% for S and Ca, resp., DM production being severely reduced

below these levels. Different var. were grouped according to an adaptation index into 3 categories (highly adapted, adapted, and nonadapted to low-P soils) and according to variation in yield. Those var. with greatest efficiency of P uptake were also more tolerant to acid soils. Annual application of N-P-K increased yields from 20 to 43 t/ha. The application of 168 kg K/ha gave the highest root yield in var. M Ven 77, while the application of 84 kg K/ha increased its starch content. Root yield was closely related to total P content of stakes, reaching a max. at about 15 mg P/stake. Max. external P requirements were calculated to be 0.027 and 0.030 ppm for CMC-40 and M Col 1684, resp. Yield response of several cv. to different levels of N, P, and K application in 10 locations varied according to soil type. Response to mycorrhizal inoculation depends on P content in planting material and existence of native mycorrhizal populations; when rooted plantlets with little P reserves were used, the response was more marked. (Summary by EDITEC. Trans. by L.M.F.) D01

0025

19998 GHUMAN, B.S.; LAL, R. 1983. Mulch and irrigation effects on plant-water relations and performance of cassava and sweet potato. Field Crops Research 7(1):13-29. Engl., Sum. Engl., 32 Refs., Illus. [IITA, Oyo Road, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Mulching. Irrigation. Plant physiology. Growth. Plant height. Root productivity. Water requirements (plant). Nigeria.

Mulch and irrigation effects on plant-water relationships and performance of cassava cv. TMS 30001 and sweet potato cv. TIS 2148 and TIS 2295 were investigated at Ibadan, Nigeria. Straw mulch (6 t/ha) was spread immediately after planting in Sept. 1980. Irrigation equal to pan evaporation was applied during the dry season of 1980/81. Unmulched and/or nonirrigated plants of both crops had lower leaf water potential than mulched and/or irrigated. Averaged over all the treatments and cv., cassava had at 15.00 h leaf water potential of -3.6 bars as compared with -9.6 bars of sweet potato. The daytime leaf diffusion resistance of cassava was similar (2-5 s/cm) in unirrigated mulched, and irrigated mulched and unmulched plots. But in unirrigated unmulched plots, the resistance increased to 19 s/cm at 15.00 h. Mulching significantly reduced plant height and no. of leaves/plant in irrigated and nonirrigated treatments; however, it did not affect tuber yield or yield components. Irrigation significantly increased tuber yield and tuber diameter, this effect being more pronounced in unmulched treatments (45.3 vs. 27.5% in mulched treatments). (Author's summary) D01

0026

18983 GOMES, J. DE C.; FZETA, F.N. 1982. Nutricao e adubacao potássica da mandioca no Brasil. (Potassium nutrition and fertilization of cassava in Brazil). In Yamada, T.; Igue, K.; Muzilli, O.; Usherwood, N.R., eds. Simpósio sobre Potássio na Agricultura Brasileira, Londrina-PR, Brasil, 1982. Anais. Piracicaba-SP, Brasil, Instituto da Potassa e Fosfato. Instituto Internacional da Potassa. pp.487-506. Port., 26 Refs., Illus. [EMBRAPA-Centro Nacional de Pesquisa de Mandioca e Fruticultura, C.P. 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. F. Minerals. Nutrient uptake. Root productivity. Starch productivity. Foliage. Mineral content. Plant development. Plant height. Brazil.

Results of research on K nutrition and fertilization in cassava crops in Brazil are given; several studies to improve the understanding of the cassava plant requirements of K are suggested. Cv. Branca de Santa

Catarina and Mantiqueira were found to extract, on the av., per ton of root, 2.12 and 6.21 kg N, 0.22 and 0.62 kg P, 1.71 and 4.24 kg K, 0.66 and 3.37 kg Ca, 0.36 and 1.0 kg Mg, and 0.09 and 0.46 kg S, resp. In trials carried out with different levels and application times of N, P, and K in the state of Santa Catarina, root yields were observed to decrease in a dystrophic Cambisol Húmico with 4.3% OM when N was applied. On soils with a K content of 77 ppm, there was no response to the levels of application while in another soil with 43 ppm K, the application of 80 kg K/ha increased production from 10.9 to 21.5 t/ha. Other expt. conducted in the states of Sao Paulo, Minas Gerais, Rio de Janeiro, and Espirito Santo are described; these show the importance of PK fertilization in low-fertility soils, evaluate root production and other parameters such as plant height, stem diameter, and starch content in function of the different levels of K. Expt. with succession cropping should be carried out to evaluate the residual effect and capacity of the soil to fulfill plant requirements as well as studies on fertility gradients with K and research work in the areas of physiology and nutrition. (Summary by EDITEC. Trans. by L.M.F.) D01

0027

18495 IGBOKWE, M.C.; ENE, L.S.O.; NZEWI, G.I. 1982. Fertility trials, 1947-1981. Fertility trials on root crops: cassava. In _____. A review of soil fertility investigations in the Eastern States of Nigeria 1923-1981. Umudike, Nigeria, Federal Ministry of Agriculture. Federal Department of Agricultural Land Resources. Technical Report no.5. pp.32-38. Engl., Illus. [Federal Dept. of Agricultural Land Resources, Umudike, Nigeria]

Cassava. N. P. K. Fertilizers. Root productivity. Nigeria.

In fertilization trials conducted in Abak, Nigeria, in 1956, yields of cassava increased from 10 to 15 t/ha with increasing application rates (0, 126, 378, and 630 kg/ha) of mixed fertilizer of sulfate of ammonia, single superphosphate, and muriate of potash (2:1:1). A 2nd series of trials was conducted in Abakaliki, Achi, Akwete, and Umudike during 1957-60 with granular and nongranular fertilizers. Yield increase in comparison with the check ranged from 9.6 to 99.3% in 1957 and from 37.1 to 99.7% in 1958. In these trials the treatment with K in the sulfate form was the best. The 10:10:20 compound fertilizer was the best NPK treatment. The direct and cumulative effects of granular fertilizer were studied and although yields were low there were significant differences. The recommended rate was 269 kg 10:10:20 fertilizer/ha, yielding 6.93 t/ha in the direct effect trial and 6.02 t/ha in the cumulative effect trial. The effect of each of the nutrients NPK and their combination were studied in a 3^3 factorial design. Three rates each of N (0, 22.4, and 44.8 kg/ha), P (0, 22.4, and 44.8 kg/ha), and K (0, 44.8, and 89.6 kg/ha) were used; only N significantly increased yields of tubers. More recently, it was showed that the application of 150 kg K/ha increased fresh root yield from 9 to 27.5 t/ha. (Summary by EDITEC. Trans. by L.M.F.) D01

0028

18907 MONTALDO, A. 1982. Estudio agronómico sobre la factibilidad de la producción de yuca (raíz) para ser utilizada como fuente de materia prima en la fabricación de alimentos concentrados para animales. (Agronomic study on the feasibility of producing cassava to use as a source of raw material in the elaboration of feed concentrates). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:31-127. Span., 9 Refs., Illus.

[Univ. Central de Venezuela, Fac. de Agronomía, Apartado 4579, Maracay, Aragua, Venezuela]

Cassava. Cultivation. Technology evaluation. Maps. Climatic requirements. Soil requirements. Cultivars. Planting. Harvesting. Mechanization. Labour. Costs. Erinnyis ello. Chilomina clarkei. Lonchaea chalybea. Mononychellus caribbeanae. Xanthomonas manihotis. Cercospora henningsii. Atta. Acromyrmex. Venezuela.

The different levels of technology used in cassava cultivation in Venezuela are listed: rudimentary, basic, improved, and advanced technology. Information on area planted, planting time, soil type, type of farmer, description of cultural practices, and specified inputs through the processing plant stage are given for each one. Soil and climatic conditions are reviewed and observations on the technology used for producing sweet and bitter cassava in the most representative cassava growing regions of the country (Lake Maracaibo watershed, Eastern and Central East Plains, Guyana) are included. Aspects of cultivation and problems that occur are indicated: var., planting time, soils, crop technology, av. yield, cropping cycle, major pests and diseases, farm mechanization, technical assistance, and production costs. The technology required for industrialization includes: establishment of centers of mechanization and centers producing bacteriosis-free seed, technical assistance, demonstration and experimentation plots. The resistance characteristic for breeding var. of each region and the most recommendable technology for the crop are indicated. Bibliographic references of research work on cassava conducted in the 2 most important regions are included as well as maps of the different geographic zones studied. (Summary by EDITEC Trans. by L.M.F.) D01

0029

19970 PORRAS F., J.; MARTINEZ S., R. 1979. Efecto de tres fertilizantes en la relación área foliar y desarrollo radicular en yuca (Manihot esculenta Crantz). (Effect of three fertilizers on the relationship of leaf area and root development in cassava). Tesis Ing.Agr. Santa Marta, Colombia, Universidad Tecnológica del Magdalena. 47p. Span., Sum. Span., Engl., 14 Refs.

Cassava. N. P. K. Fertilizers. Timing. Leaf area. Costs. Root productivity. Colombia.

A trial was carried out on the exptl. farm of the U. Tecnológica del Magdalena, Colombia (annual pluviometric regime, 650 mm; av. temp., 27°C; RH, 75; alt., 15 m.a.s.l.), to establish the relationship between leaf area and root development with 3 different fertilizers (10-30-10, 10-20-20, 14-14-14) at 2 application times (80 and 140 days after planting). A split plot exptl. design was used with 8 treatments and 2 replications. Samples consisted of 10 plants/plot for the parameters of leaf area and root development. Data on leaf area was taken 20 days after fertilizer application. Yield was assessed 210 days after planting. According to the variance analysis, there were no statistically significant differences but the economic analysis did show differences among treatments. Best results were obtained with the treatments carried out at 80 days after planting. The treatment 10-20-20 produced the highest yields (36.04 t/ha) when applied at 140 days, followed by 14-14-14 at 80 days (32.16 t/ha). It was concluded that leaf area directly influenced root production and quality during a certain period of time. (Author's summary. Trans. by L.M.F.) D01

0030

19523 SANDOVAL A., L.E. 1969. Algunos aspectos sobre la fertilización de la yuca (Manihot utilisima Pohl). (Cassava fertilization). Tesis

Ing.Agr. Ibagué, Colombia, Universidad del Tolima. 30p. Span., Sum. Span., 15 Refs., Illus.

Cassava. N. P. K. Mg. Ca. Fertilizers. Colombia.

A brief revision of the importance of the nutrients N, P, K, Mg, and Ca in cassava and their symptoms of deficiency is given. The tissue of 2 common var., Blanca and Rosada, is analyzed and its feed value determined. Results of screening trials of the useful elements for cassava are given in table form for yield trials (responses to Mn, Mo, N, P, K, Ca, Mg) and root density (response to P). Information is also included on favorable ecological conditions for cassava cultivation, fertilization (manures, organic manures), results of fertilization trials carried out in different countries (Brazil, Costa Rica, Ghana, Nigeria, India, Vietnam, Vici Islands) and resulting recommendations. (Summary by L.M.F.) D01

See also 0014 0015 0017 0018 0049 0072 0074 0092 0093 0096 0097 0100 0164 0165 0173 0176 0185 0193

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

0031

19519 ABIT, O.P.; ABIT, S.E.; POSAS, M.B. 1981. Growth and development of cassava under the traditional and the Mukibat systems of planting. Annals of Tropical Research 3(3):187-198. Engl., Sum. Engl., 5 Refs., Illus. [Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte 7127, Philippines]

Cassava. Mukibat system. Propagation. Plant height. Leaf area. Root development. Branching. Timing. Philippines.

Two methods of propagating cassava were compared using 4 levels of fertilizer application (control, 30-60-90, 60-60-90, 90-60-90) in a split-plot randomized complete block design with 3 replications. One method was the Mukibat system based on the grafting of Manihot glaziovii with M. esculenta and the other was the traditional system using stalks of the M. esculenta as planting material. Methods of propagation served as the main plots and fertilizer levels as subplots. Higher rates of NPK application resulted in a significant increase in plant height, LAI, root diameter, length, and wt. of cassava for both methods of planting. However, cassava plants under the Mukibat system had taller stature, larger root diameter and heavier root wt. compared with those planted using the traditional system, although the latter had higher LAI. (Author's summary) D02

0032

18924 CENTENO S., A. 1982. Características agrotécnicas de la yuca, como parámetros de diseño para la cosecha mecanizada. (Agrotechnical characteristics of cassava as parameters of design for mechanical harvesting). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:295-303. Span., 10 Refs. [Univ. Central de Venezuela, Fac. de Agronomía, Apartado 4579, Maracay, Aragua, Venezuela]

Cassava. Harvesting. Mechanization. Land preparation. Root productivity. Foliage. Venezuela.

A trial was carried out on clay loam soil with cassava var. Branca Santa Catarina to evaluate plant characteristics and cultural practices that facilitate mechanical harvest. A randomized block design was used with 5 treatments (T) and 4 replications. In T_1, T_2, and T_3 cassava was planted on ridges with 0.80, 1.0, and 1.2 m interrow, 0.8 m intrarow, and planting densities of 15,625, 12,500, and 10,416 cuttings/ha, resp. T_4 included planting on the flat with 1.0 m interrow, 0.80 m intrarow, and 12,500 cuttings/ha; T_5 consisted of planting on the furrow sole at the same planting distance and density. Fertilizer 12-12-6 was applied at 500 kg/ha; plots were hand-weeded and irrigated during the dry season. Yields in kg roots/plant, kg roots/ha, and kg foliage/plant had significant differences in favor of planting on ridges. T_3 had the highest values with 3.1 kg roots and 1.6 kg foliage/plant. T_5 had the lowest values with 1.6 kg roots and 0.3 kg foliage/plant. Var. Branca Santa Catarina was compared with Morada de Yumare, a cv. with short, bulky roots. Highest-yielding populations were planted on ridges spaced 0.80 and 1.0 m and 0.60 m intrarow for 20,833 and 16,667 plants/ha with av. yields of 2.91 and 2.78 kg/plant for Branca Santa Catarina and Morada de Yumare, resp. Recommendations include: improved plant architecture to facilitate mechanical harvest; increased plant density with early maturing var. with numerous, short, bulky roots; and not using ridges on sandy soils. (Summary by EDITEC. Trans. by L.M.F.) D02

0033

19533 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Pruebas regionales. (Regional trials). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.189-210. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Cultivars. Hybrids. Adaptation. Field experiments. Root productivity. Dry matter. Planting. Timing. Cuttings. Propagation. Rooting. Selection. Colombia.

The seventh testing cycle for promising CIAT selections under improved, low-input technology was completed in 1981 at 9 locations in Colombia. The overall av. yield of the trials was 8.5 t/ha/yr, which is nearly 3 times the national av. yield of 3-3.5 t/ha. Av. yield of local cv. was about twice this national av. with 6.5 t/ha. The av. yield of best performing CIAT selections in each location was 12.9 t/ha. Cv. CM 507-37 outyielded the best local cv. by nearly 100% in all 9 locations. Best local var. were: in Media Luna, cv. Secundina (5.6 t/ha); in Chigorodo, Patepaba (6.0 t/ha); in Carimagua, Llanera (2.1 t/ha); in Rionegro and Nataima, Venezolana (6.3 and 9.9 t/ha, resp.); in San Martin, Tempranera (4.6 t/ha); in Florencia, Caqueteña (6.4 t/ha); in CIAT-Palmira, M Col 113 (5.2 t/ha); and in Caicedonia, Chiroza Gallinaza (13.4 t/ha). Cassava yields can be raised up to 400% with improved cultural practices and on-site selection of the best CIAT genotype. Results obtained during 7 yr of regional trials show that CIAT genotypes have yielded consistently higher than local var. In regional trials 1980/81 in Cuba, Haiti, Dominican Republic, Mexico, Honduras, Costa Rica, Venezuela, Ecuador, Bolivia, the Philippines, and USA (Florida), cv. M Col 1468 (CMC 40) and M Col 1684 were outstanding for their high fresh root yields (av. of 24.2 and 22.4 t/ha, resp.). The effect of planting date (May vs. Sept.) on root yield was compared at Media Luna. The Sept. planting produced 2.4 t more DM/ha than the May planting. This difference could be attributed to the heavier infestation of diseases and pests in the May planting. Planting material produced at Media Luna, Carimagua, and Rio Negro yielded higher than stakes produced at CIAT.

Leaf-bud propagation and the transferability of technology to farmers were also studied. (Summary by EDITEC. Trans. by L.M.F.) D02

0034

11436 CONCEICAO, A.J. DA; SAMPAIO, C.V.; GRAMACHO, D.D. 1979. Competicao de cultivares e épocas de colheita de aipim (Manihot esculenta Crantz) para consumo humano. (Competition of cultivars and harvesting dates of sweet cassava for human consumption). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.99-118. Port., Sum. Port., Engl., 20 Refs., Illus.

Cassava. Cultivars. Harvesting. Timing. Root productivity. Dietary value. Organoleptic examination. Cooking. Roots. Brazil.

Results of several competitive trials with 6 sweet cassava var. for human consumption are given. These were harvested monthly at 8-12 mo. of the growth cycle. These expt. were carried out during the 1972-75 crop years at the U. Federal da Bahia, Cruz das Almas, Brazil, on a Colonia Latosol, tertiary sediment of the Barreiras series, level relief, mesa, humid tropical climate with an annual av. rainfall of 1196 mm and av. annual temp. of 24.4°C. The following cv. competed, spaced at 1 x 0.6 m, on fertilized soil: Maragogipe (19.13 t/ha), Paraguai (14.48 t/ha), Casca de Queijo (18.22 t/ha), Cacau Branco (20.57 t/ha), Mantiqueira (10.26 t/ha), and Casca Roxa (16.03 t/ha). Yield of Cacau Branco surpassed that of Mantiqueira at a 5% level of probability using Tukey's test and there was no significant difference between this yield and those of cv. Maragogipe, Paraquai, Casca de Queijo, and Casca Roxa. Harvesting at 18 mo. of the cycle gave significant differences with respect to 8 mo. and was identical at 9, 10, and 11 mo. Studies regarding the cooking time of roots, flavor and appearance of cooked and raw pulp, and type of dough were carried out. More favorable organoleptic characteristics were found in cv. Maragogipe, Paraguai, Casca de Queijo, and Casca Roxa. (Author's summary. Trans. by L.M.F.) D02

0035

10780 PINHO, J.L.N. DE; MELO, F.I.O.; TAVORA, F.J.A.F.; GOMES, V.V.; OLIVEIRA, F.C. DE 1979. Obtencao de maniva-semente de mandioca através da poda, na regiao litoranea do Ceará. (Cassava seed-cuttings are obtained by pruning in the coastal region of Ceará). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.161-170. Port., Sum. Port., Engl., 2 Refs.

Cassava. Cuttings. Propagation materials. Pruning. Root productivity. Branching. Harvesting. Timing. Starch content. Brazil.

The low quality of cassava planting material is one of the main factors responsible for the low no. of established plants, the low plant vigor, and the resulting low productivity of cassava in the state of Ceará (Brazil). Pruning the plant canopy prior to harvest ' a practical means of obtaining planting material of both excellent nutritional quality and sanitary conditions. A field expt. was conducted to study the effect of the degree of pruning (0, 50, and 100% of the branches) on canopy and root production, and starch content. Results showed that pruning 12-mo.-old plants did not affect root production or starch content in plants harvested 2, 4, and 8 mo. after pruning. However, pruned plants had a significantly increased branch yield compared with the control. (Author's summary. Trans. by L.M.F.) D02

0036

18910 RANGEL H., P.O. 1982. Mecanización del cultivo de la yuca: plantación, cosecha y aprovechamiento de la parte aérea. (Cassava mechanization: planting, harvesting, and utilization of plant canopy). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:135-141. Span., 5 Refs. [Univ. Central de Venezuela, Apartado 4579, Maracay, Aragua, Venezuela]

Cassava. Planting. Harvesting. Mechanization. Agricultural equipment. Venezuela.

The operation of several harvesters adapted to cassava harvesting is described. Two prototypes were designed, based on a model developed at CIAT, to correct problems created by the working angle and blade penetration. Machines with working widths of 1.0 and 1.5 m harvested 58.5 and 65.0% intact roots, resp., with planting on the flat and 87.1 and 72.4%, resp., with planting on ridges. A potato harvester was redesigned to eliminate the planting profile, screen the soil, and leave tubers clean and lined up on the ground; 54.0% intact roots were harvested on the flat and 54.5% on ridges. Three other prototypes were also designed and constructed: one for pulling out roots and 2 canopy cutters, one with a buzz saw and the other by pulling (blades with a steel cutting edge). The root harvester collected approx. 85% intact roots on 2 types of ridges. The design of a cassava planter is under study as well as the possible adaptation of a potato planter for use in cassava cultivation. (Summary by EDITEC. Trans. by L.M.F.) DOZ

0037

19294 YAMAGUCHI, B. 1981. [Some problems of mechanization in upland farming: a case study of mechanized cassava culture in south Sumatra]. Japanese Journal of Tropical Agriculture 25(4):189-192,200-201. Jap., Sum. Engl. [Mitsui & Co., Ltd., Otemachi Chiyodaku, Tokyo 100, Japan]

Cassava. Upland farming. Mechanization. Cultivation. Indonesia.

Problems involved in mechanization were studied in a large-scale mechanized cassava crop at Mitsugoro, Lampung, Sumatra. Reclamation demands a brush breaker and deep plowing of 30 cm or more to turn the soil over, burying surface OM deep. Cultivable land is expanded and erosion of the humus is prevented. High maize and cassava yields can therefore be obtained. A disk plow seems to be the most suitable for upland plowing, both in the dry and rainy seasons. Plowing should be done twice at a 20-day interval, followed by pulverization and leveling with a disk harrow. When soil humidity is high, soil structure tends to deteriorate. A trial-made ridger with a fertilizer attachment dug small drainage ditches on the farm and made ridges along contour lines to prevent erosion. A new operation system was set up in cassava planting, weeding, intermediate plowing, and cropping through improvements of machinery and operation procedures. A cubing system for treating raw cassava was introduced, which consisted of storing, washing, cubing, sun drying, and drying by heat. Problems of machinery repair and maintenance, and operation and administration are discussed. (Author's summary) DOZ

See also 0028 0054 0060 0072 0076 0090 0091 0093 0100 0164 0165 0169 0172 0173 0176 0185 0191 0193

0038

19548 BESSA, J.M.G.; WANDERLEY, M. DE B.; FRANCA, G.M. DA; PEDROSA, A.C. 1970. Algumas observacoes sobre cultivares de mandioca na Zona da Mata setentrional de Pernambuco. (Observations on cassava cultivars in the northern Zona da Mata area of Pernambuco). Pernambuco, Instituto de Pesquisas Agronomicas. 6p. Port., Sum. Port., 5 Refs.

Paper presented at Reuniao Nacional de Mandioca, 5a., Recife, 1970.

Cassava. Cultivars. Root productivity. Brazil.

Competitive expt. were conducted with cassava cv. Verdinha, Passarinha, Guajiru, Nove Folhas, and Itapissuma during the 1962-63, 1963-64, 1965-66, and 1966-67 crop years at the També expt. station of the Instituto de Pesquisas Agronômicas de Pernambuco, Brazil. A randomized block design was used with 5 replications. Annual production data were analyzed and a joint analysis was carried out by cv. and by year. Only during 1962-63 a significant effect was observed for the cv., among which Itapissuma was outstanding with a yield of 25.4 t roots/ha. In the other periods, no significant effects were observed among treatments. Joint analysis showed an effect due to yield and for the interaction cv. x years but there was no response due to cv. (Summary by EMBRAPA. Trans. by L.M.F.) D03

0039

18978 EMPRESA GOIANA DE PESQUISA AGROPECUARIA. 1982. Projeto mandioca. (Cassava program). In _____. Relatório técnico anual 1981. Goiania-GO, Brasil. pp.123-127. Port. [Empresa Goiana de Pesquisa Agropecuária, Caixa Postal 49, 74.000 Goiania-GO, Brasil]

Cassava. Cassava programs. Cultivars. Selection. Root productivity. Starch productivity. Foliage. Xanthomonas manihotis. Resistance. Brazil.

The results of research on cassava carried out in the state of Goias, Brazil, are summarized. In fields of the Goiania Exptl. Station a collection of 18 introductions was evaluated for resistance to Xanthomonas manihotis. Plants were spaced 1 m interrow and 0.40 m intrarow and inoculated 3 mo. after planting. Monthly evaluations were made during 4 mo. Fifteen var. were highly resistant, 38 moderately resistant, 67 moderately susceptible, and 60 highly susceptible. Var. IAC 12-829, Sonora, and Argentina were outstanding for both their high resistance and yields. Disease incidence is higher in the southern part of the state and is reported to be a limiting factor in the highlands, with min. temp. below 20°C and max. temp. above 30°C, with 1200 mm precipitation. In a randomized block design with 4 replications, 12 var. were assessed for root, branch, and starch production at the Goiania and Jataí Exptl. Stations. Harvesting took place at 19 mo.; var. IAC 12-829 was outstanding with av. yields of 31.6 and 26.3 t roots/ha and 10.8 and 8.6 t starch/ha in Goiania and Jataí, resp. Other promising var. were IAC-127 and Sonora with 26 t roots/ha and 8.4 t starch/ha. Var. Branca de Santa Catarina, considered as an industrial stock in Sao Paulo, did not figure among the best performing var. (Summary by EDITEC. Trans. by L.M.F.) D03

See also 0025 0027 0029 0032 0033 0035 0072 0079 0089 0090 0093 0097 0100 0169 0173 0179 0191 0192 0193

0040

19251 DATA, E.S.; URITANI, I.; TANIGUCHI, T.; HIROSE, S. 1981. Preliminary studies on the physiology, pathology and biochemistry of postharvest deterioration of cassava and sweet potato. Radix 3(2):8-10. Engl., 3 Refs., Illus. [Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte 7127, Philippines]

Cassava. Roots. Deterioration. Biochemistry. Philippines.

The results of different expt. carried out with cassava and sweet potato to study the physiological and pathological processes of 2 types of postharvest deterioration and their relationship with environmental factors are given. Two types of vascular streaking were observed: type I, a light brown discoloration around the inner part of the cortex and type II, blue-black pigmentation of vessels which appeared on or adjacent to the microbial rotted areas. The effect of pruning (leaving only 30 cm of the stem for 2-3 wk. before harvest) on deterioration of tubers of cassava cv. Golden Yellow was studied. Slight symptoms of deterioration appeared after 4 days in storage and microbial rotting after 9-10 days. Of the forty-two 8-mo.-old cv. tested for resistance to vascular streaking, 11 were highly resistant. Susceptibility to deterioration was negatively correlated with the MC of the tubers. Expt. were carried out to study the process of microbial rotting. A Phycomycetes fungus was isolated from the surface of the rotted cassava tuber and when the fungus was inoculated on the cut surface of the tubers, the same type II symptoms of deterioration were observed. Results indicate that microbial deterioration may occur with or without physiological deterioration. Results of expt. carried out to determine the relationship between climatic factors and the time required for drying are given as well as those of biochemical expt. that studied the physiological and pathological changes in affected roots. (Summary by EDITEC. Trans. by L.M.F.) D04

0041

19560 KOJIMA, M.; IWATSUKI, N.; DATA, E.S.; VILLEGAS, C.D.V.; URITANI, I. 1983. Changes of cyanide content and linamarase activity in wounded cassava roots. Plant Physiology 72:186-189. Engl., Sum. Engl., 14 Refs., Illus. [Faculty of Agriculture, Nagoya Univ., Chikusa, Nagoya 464, Japan]

Cassava. Roots. Cyanides. Linamarase. Biochemistry. Plant tissues. Analysis. Composition. Philippines.

When cassava root was cut into blocks and incubated under lab. conditions, the blocks showed more widespread and more even symptoms of physiological deterioration than those under natural conditions. Thus, the tissue block system has potential for biochemical studies of natural deterioration of cassava root. The changes in cyanide content and linamarase activity in various tissues during physiological deterioration were investigated. Total cyanide content increased in all parts of block tissue after 3-day incubation. The degree of increase in cyanide was most pronounced in white parenchymal tissue, 2-3 mm thick, next to the cortex (A-part tissue), where no physiological symptoms appeared. On the other hand, linamarase activity was decreased in all parts of block tissue after a 3-day incubation. A time course analysis of A-part tissue indicated a clear reciprocal relationship between changes in total cyanide and linamarase activity; total cyanide increased, while linamarase activity decreased. Free cyanide

constituted a very small portion of the total cyanide and did not change markedly. (Author's summary) D04

0042

19223 PADMAJA, G.; BALAGOPAL, C.; POTTY, V.P. 1982. Polyphenols and vascular streaking in cassava. Cassava Newsletter no.10:5-6. Engl., 3 Refs., Illus. [Central Tuber Crops Research Institute, Trivandrum 17, Kerala, India]

Also in Spanish.

Cassava. Roots. Deterioration. Biochemistry. Storage. Timing. Vascular streaking. India.

The causes of vascular deterioration of roots were studied using 6 cassava var.: local var. M4 and 5 hybrids, H226, H1687, H165, H2304, and H97 developed at the Central Tuber Crops Research Institute, Trivandrum, India. Total phenol content and the charges of titrable acidity of these var. were studied for 6 consecutive days of storage. In all var., a decrease in total phenols was noticed during the 2nd and 3rd days of storage with a slight increase during the 4th day. There was a concomitant increase in polyphenol oxidase activity during the 2nd day of storage, with the simultaneous occurrence of vascular streaking. As the deterioration in storage roots reached 50-60%, a sudden increase in phenolic values was observed. A similar trend was observed for titrable acidity. Roots treated with inhibitors/inactivators of polyphenol oxidase (ascorbic acid, glutathione, and potassium cyanide at concn. of 4×10^{-3}, 5×10^{-3}, and 5×10^{-3} M, resp.) for 8 h did not show symptoms of vascular deterioration. Polyphenols may be enzymically oxidized to highly reactive quinones, which may form colored complexes with amino acids and other micromolecules of the cells. These complexes, on deposition in the vascular bundles, produce the phenomenon of blue discoloration. (Summary by EDITEC. Trans. by L.M.F.) D04

0043

19561 TAMAFA, Y.; DATA, E.S.; HIROSE, S.; TANIGUCHI, T.; URITANI, I. 1983. Biochemical changes in secondary metabolites in wounded and deteriorated cassava roots. Agricultural and Biological Chemistry 47(4):693-700. Engl., Sum. Engl., 22 Refs., Illus. [Dept. of Agronomy & Soil Science, Visayas State College of Agriculture, Baybay, Leyte 7121, Philippines]

Cassava. Biochemistry. Roots. Deterioration. Coumarin. Enzymes. Analysis. Plant tissues. Post harvest technology. Philippines.

Bluish fluorescent and phenolic components were produced in cassava roots in response to cut injury, and in relation to physiological and microbial deterioration. The former proved to consist of 5 coumarin components, the main 3 of which were scopoletin, scopolin, and esculin, and the other 2 were scopoletin- and esculetin-containing conjugates. A main component of the latter was (+)-catechin. Some enzymes pertaining to the production of the secondary metabolites such as acid invertase, phenylalanine ammonia lyase, and peroxidase were formed in cut-injured tissue and in noninfected tissue adjacent to the soft rotten part. (Author's summary) D04

0044

19562 URITANI, I.; DATA, E.S.; VILLEGAS, R.J.; FLORES, P.; HIROSE, S. 1983. Relationship between secondary metabolism changes in cassava root tissue and physiological deterioration. Agricultural and Biological

[Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte 7127, Philippines]

Cassava. Roots. Metabolism. Deterioration. Plant tissues. Coumarin. Biochemistry. Post harvest technology. Storage. Timing. Enzymes. Philippines.

During the storage of cassava roots under room conditions, coumarins and phenols were produced and the activities of phenylalanine ammonia-lyase and peroxidase were activated in every part of the parenchymatous tissue, namely the outermost tissue (called the A-part), the intervening tissue (called the B-part), and the innermost tissue (called the C-part), in parallel with the occurrence of physiological deterioration in the B-part. In many cases, secondary metabolites were produced more strongly in the B-part than in the A- and C-parts. Parenchymatous tissue blocks were divided into the A-, B-, and C-parts and they were separately incubated, together with undivided parenchymatous tissue blocks. In both cases, metabolic changes occurred in the A-, B-, and C-parts and physiological deterioration was induced only in the B-part. The possible mechanism of physiological deterioration occurrence is discussed. (Author's summary) D04

See also 0047 0091 0099 0142

E00 PLANT PATHOLOGY

See 0001 0003

E02 Bacterioses

0045

18444 ATHAYDE, J.T.; FURTADO, M.J.; SANTOS, A.F. DOS 1983. Manjari, cultivar de mandioca com elevado nivel de resistencia a bacteriose (Xanthomonas campestris pv. manihotis). [Manjari, a cassava cultivar with a high level of resistance to bacteriosis (Xanthomonas campestris pv. manihotis)]. Cariacica-ES, Brasil, Empresa Capixaba de Pesquisa Agropecuária. Comunicado Técnico no.11. 6p. Port., 10 Refs. [Empresa Capixaba de Pesquisa Agropecuária, Caixa Postal 125, 29.154 Campo Grande, Cariacica-ES, Brasil]

Cassava. Cultivars. Resistance. Xanthomonas manihotis. Brazil.

The resistance of 10 cassava cv. (Manjari, Riqueza, Chagas, Mucuri Macaco, Arizoninha Branca, Pao do Chile Sul, Unha, Branquinha, Mangue Mirim, Sao Pedro Mirim) to Xanthomonas campestris pv. manihotis was studied in the municipality of Linhares, ES, Brazil. Plants were spaced at 1 x 0.50 m in a randomized block design with 3 replications and 10 treatments, and 117 plants/plot. Natural infection occurred in the field since the exptl. site was located near an infected crop. Resistance was evaluated by a scale 1 to 4 according to the following criteria: (1) resistant, plants with symptoms (angular spots) on less than 1% of the leaves, few lesions, dieback up to 1/4 of the stem; (2) moderately resistant, plants with symptoms (angular spots, blight) up to 50% of the leaves and dieback up to half the stem; (3) susceptible, plants with symptoms (angular spots, blight) on more than 50% of the leaves and dieback up to 3/4 of the stem; (4) susceptible, plants with symptoms on more than 50% of the leaves and total dieback. Of the 10 cv. tested, Manjari was classified as resistant and Riqueza as moderately resistant. (Summary by EDITEC. Trans. by L.M.F.) E02

0046

19532 BERROCAL C., J.A.; COGOLLO E., M.F. 1981. Añublo bacterial de la yuca (Xanthomonas manihotis Arthaud Berthet) Starr y su importancia económica en el Sinú medio. [Cassava bacterial blight (Xanthomonas manihoti) and its economic importance in the Sinu Medio]. Tesis Ing.Agr. Montería, Colombia, Universidad de Córdoba. Facultad de Ingeniería Agronómica. 48p. Span., Sum. Span., 14 Refs., Illus.

Cassava. Xanthomonas manihotis. Etiology. Symptomatology. Productivity. Maps. Colombia.

From Oct. 1979 to Feb. 1980 trials were carried out in 2 lots of each of the municipalities that form the Sinú Medio (Colombia): Montería, Cereté, San Pelayo, San Carlos, and Ciénaga de Oro. The incidence and severity of cassava bacterial blight (Xanthomonas manihotis) were determined and the different symptoms that appear in the field and on the different plant organs are described as well as the influence of the environment on disease development and severity. Yield losses in the study area were estimated. Disease incidence was fairly high throughout the area (25-100%) due in part to the use of seed of the same lot or from previous harvests. Severity was moderate to severe in all municipalities. There was a positive lineal correlation among rainfall, RH, and % severity. However, increasing temp. decreased disease severity. Deficient management of the lots also favored disease incidence and severity, since most farmers do not perform cultural practices. Yield losses ranged from 7.72 to 69.25% and are not due solely to bacterial blight but also to other causes (deficient management of lots and adverse climatic factors). (Author's summary. Trans. by L.M.F.) E02

0047

18967 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Patología. (Pathology). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.89-114. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Xanthomonas manihotis. Frog skin disease. Disease transmission. Cassava Caribbean mosaic virus. Sphaceloma manihoticola. Colletotrichum gloeosporioides. Colletotrichum manihotis. Diplodia. Ecology. Deterioration. Cultivars. Resistance. Pruning. Composition. Colombia.

Research on plant pathology carried out during 1981 emphasized the study of some epidemiological, etiological, and physiological factors related to the occurrence of the superelongation disease of cassava caused by Sphaceloma manihoticola. Dry-heat treatments (60°C for 14 days) breaks seed dormancy and controls the pathogen Xanthomonas campestris pv. manihotis, causal agent of CBB. Etiological factors of the frog skin disease were studied through spectrophotometric and electrophoretic analysis of concentrated extracts of infested cassava tissues. The presence of nucleoproteins and proteins not present in healthy plant tissues was revealed. Similar studies to identify the causal agent of the Caribbean cassava mosaic, observed in the northern coast of Colombia, detected an UV absorption curve typical of a nucleoprotein although no virus-like particles were observed. Other diseases studied include those caused by Choanephora curcubitarum, Colletotrichum manihotis, C. gloeosporioides, and Diplodia. Studies on biotic problems in 5 different edaphoclimatic zones in Colombia were continued as well as the studies on susceptibility of cv. to postharvest physiological deterioration. (Summary by EDITEC. Trans. by L.M.F.) E02

0048

19505 IKOTUN, T. 1981. Comparative studies of bacteria causing blight of cassava in Africa, Asia and South America. Egyptian Journal of Microbiology 16(1-2):35-45. Engl., Sum. Engl., Arab., 36 Refs., Illus. [Dept. of Agricultural Biology, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Xanthomonas manihotis. Xanthomonas cassavae. Isolation. Biochemistry.

Several isolates of the CBB from Africa, Asia, and South America were compared. Cultural, biochemical, physiological, and nutritional characteristics of the different isolates are discussed. The isolates were sufficiently similar to be regarded as strains of Xanthomonas manihotis which differed in several respects from a type culture of X. cassavae, another bacterial pathogen of cassava. (Author's summary) E02

0049

19073 LOZANO, J.C.; SCHWARTZ, H.F. 1981. Limitaciones a la resistencia a enfermedades de varios cultivos alimenticios de América Latina. (Factors limiting disease resistance in several food crops in Latin America). Fitopatología Colombiana 10(1-2):33-38. Span., 10 Refs. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in Fitopatologia Brasileira 7(3):327-332. 1982.

Cassava. Resistance. Ecology. Xanthomonas manihotis. Sphaceloma manihoticola. Cercospora caribaea. Colombia. Latin America.

Common problems in the tropics regarding the stability of bean and cassava commercial crops are discussed considering biotic, abiotic, cultural, and socioeconomic factors. This is related to the problems of stability that improved var. generally show in different ecosystems where they are introduced and selected on the basis of potential yields, and with the application of a great amount of inputs demanded by modern agriculture. General ideas on crop improvement in the tropics are given. There is a trend to maintain the stability reached in traditional farming. (Author's summary. Trans. by L.M.F.) E02

0050

18930 MUNIZ, J.C DE L.; FUKUDA, C. 1978. Doencas da mandioca. (Cassava diseases). Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 22p. Port.

Cassava. Cassava African mosaic virus. Cassava common mosaic virus. Cassava vein mosaic virus. Cassava brown streak virus. Mycoplasmoses. Frog skin disease. Xanthomonas manihotis. Xanthomonas cassavae. Xanthomonas carotovora. Agrobacterium. Colletotrichum. Sphaceloma manihoticola. Cercospora henningsii. Cercospora cassavae. Cercospora vicosae. Phoma. Periconia manihoticola. Oidium. Uromyces. Glomerella. Botryodiplodia. Disease control. Phytophthora. Rosellinia. Pythium. Fusarium. Rhizoctonia. Fomes. Brazil.

Diseases attacking the cassava crop are described. The geographic distribution, symptomatology, and control methods are given for major diseases. Viral diseases include CAMD, common mosaic, leaf vein mosaic, brown streak, and the latent virus. Other diseases are witches' broom (caused by a mycoplasma) and frog skin disease (causal agent unknown). Bacterial diseases include those caused by Xanthomonas manihotis, X.

cassavae, Erwinia carotovora var. carotovora, and Agrobacterium tumefaciens. Fungal diseases attack different parts of the plant (leaves, stems, and roots), and among the most important are those caused by Sphaceloma manihoticola, Colletotrichum spp., Cercosporidium henningsii, Cercospora caribae, Phoma spp., Periconia manihoticola, Oidium manihotis, and Uromyces spp. (Summary by EDITEC. Trans. by L.M.F.) E02

0051

19293 SADASIVAM, K.V.; RANGASWAMI, G.; PRASAD, N.N. 1976. Studies on the phyllosphere microflora of tapioca (Manihot utilissima Pohl). Zentralblatt fuer Bakteriologie. Abteilung II 131:632-643. Engl., Sum. Engl., Germ., 45 Refs., Illus.

Cassava. Cultivars. Foliage. Microflora. Leaves. HCN content. Timing. Mycoses. Bacterioses. India.

Studies on the phyllosphere microflora of cassava var. M. 4, H. 36/52, H. 105/44, and H. 12/49 and one local Indian var. during 1 complete growing season revealed that incidence of bacteria, fungi, and actinomycetes is independent of the var., but dependent on the age. Bacteria and fungi increased with increasing leaf age and were more on mature leaves, whereas no such difference was noticed in the occurrence of actinomycetes. The large majority of the isolates, that were Gram-negative bacteria, was also amino acid-requiring. The chromogenic types occurred in greater abundance. The phyllosphere mycoflora consisted mainly of species of Aspergillus, Penicillium, Mucor, Curvularia, Alternaria, Helminthosporium, Fusarium, Hormicium, and Fullularia, the 1st 3 being predominant. There was no correlation between HCN content of leaves and microorganisms in the phyllosphere. Regarding the interrelationship between different groups of microorganisms in the phyllosphere, a positive correlation between fungi and actinomycetes and bacteria and actinomycetes in 2 var. (M. 4 and H. 105/44) and a negative correlation for fungi and actinomycetes in one (H. 12/49) were obtained. The effect of leaf exudate and leaf, root, and tuber extracts on the germination of the conidia of 3 saprobic fungi (Curvularia sp., Alternaria sp., and Helminthosporium sp.) was tested. While the leaf exudate and tuber extracts slightly stimulated the germination of the conidia of the fungi, the leaf extract exerted a selective inhibitory effect on the germination of the conidia of Curvularia sp., but not on the conidia of Helminthosporium sp. and Alternaria sp. (Author's summary) E02

See also 0020 0023 0028 0039 0063 0090 0091 0093 0095 0096 0097 0100 0173

F03 Mycoses

0052

19569 ZEIGLER, R.S.; ALVAREZ, E.; LOZANO, J.C. 1983. Characteristics of cassava resistance to superelongation disease (Elsinoe brasiliensis). Tropical Pest Management 29(2):148-158. Engl., Sum. Engl., 20 Refs., Illus. [Dept. of Plant Pathology, Cornell Univ., Ithaca, NY 14853, USA]

Cassava. Elsinoe brasiliensis. Sphaceloma manihoticola. Resistance. Cultivars. Colombia.

Cassava cv. were inoculated, under controlled conditions, with single-conidium isolates of Elsinoe brasiliensis (Sphaceloma manihoticola) of diverse origins to study cassava resistance to superelongation disease. Disruption of the stem cuticle significantly increased the amount of stem disease on field-resistant and field-susceptible cv. In susceptible and

resistant cv. stem tissue developed a high level of resistance by the age of 10 days. Significant cv. x isolate interactions indicating pathogenic specialization were consistently observed. The interactions were weak, not always reproducible and none were characterized by a hypersensitive-like component. Field-resistant and field-susceptible cv. were treated with gibberellin A_4 (the plant hormone responsible for shoot elongation) at 0-1 micrograms/microliter and inoculated with a virulent isolate of the pathogen to test the possibility of using the hormone as a screening tool. No differences in response to the hormone were detected between resistant and susceptible cv. All cv. showed increases in length at 10^{-1} micrograms/microliter GA_4 and all showed increases in the level of disease (% diseased area involved in lesion x length of affected area) with hormone application. Gibberellin A_4 does not appear to have great potential as a screening tool for identifying field-resistant cv. (Author's summary) E03

See also 0020 0023 0028 0047 0049 0050 0051 0090 0091 0093 0095 0096 0100 0173

E04 Viroses

0053

20113 CHEN, C.T.; KO, N.C.; CHEN, M.J. 1981. Electron microscopy of cassava common mosaic in Taiwan. Report of the Taiwan Sugar Research Institute 93:21-28. Chin., Sum. Engl., Chin., 13 Refs., Illus. [Taiwan Sugar Research Inst., Dept. of Plant Protection, 54 Sheng Chan Rd., Taiwan, China]

Cassava. Cassava common mosaic virus. Electron microscopy. Taiwan.

A disease inducing mosaic symptoms was found on most of the cassava var. in the preservation nursery at Puli (Taiwan), and sporadically occurs on local var. By means of dip method, the infected leaf sap was detected to contain a high titre of elongated flexuous viruses of about 495 nm long and 15 nm in diameter. Some of the virus particles were decoated and only the core of nucleic acid was observed. Virus inclusions were observed in the cytoplasm of the leaf parenchyma cells. They consisted of fibrous masses containing filamentous particles, running more or less parallel, but not in a definite arrangement. Electron microscopy indicated that the disease is the cassava common mosaic. (Author's summary) E04

0054

19508 FEREOL, L.; DUCREUX, G. 1981. Multiplicacao vegetativa e eliminacao dos fenomenos de degenerescencia nos clones de mandioca (Manihot esculenta Crantz) cultivados in vitro. (Vegetative propagation and elimination of degeneration phenomena in cassava clones cultured in vitro). Acta Amazonica (Brasil) 11(2):213-226. Port., Sum. Port., Engl., 29 Refs., Illus. [Lab. de Estudos e Exploracao do Polimorfismo Vegetal Associado ao CNRS, Univ. Paris-Sud, 91 405 Orsay Cedex, France]

Cassava. Propagation. Cuttings. Thermotherapy. Cassava African mosaic virus. Symptomatology. Timing. Plant anatomy. Clones. Disease control. Laboratory experiments. Brazil.

Cassava clones traditionally cultivated in Africa, frequently show some degenerating signs (CAMD). The distribution, transmission, and progression of the causal agent were observed from cutting and graft expt. of a healthy clone from Vietnam, Faïa de Along, with 6 CAMD-infected African clones (H_{58}, H_{60}, CB, Mbengui, Kataoli, Abidjan). Thermotherapy treatments were

conducted and led to accelerated vegetative multiplication of healthy clones. (Summary by Biological Abstracts) E04

0055

19290 HORVAT, F.; VERHOYEN, M. 1981. Cytological modifications and presence of virus-like particles in cells of Nicotiana benthamiana (Domin) and Manihot utilissima (Pohl) infected with the geminivirus isolated from cassava infected with the cassava African mosaic disease. Parasitica 37(3):119-130. Engl., Sum. Engl., Fr., 28 Refs., Illus. [Faculte des Sciences Agronomiques, Place Croix du Sud, 4. B-1348, Louvain-la-Neuve, Belgium]

Cassava. Cytology. Cassava African mosaic virus.

Thin sections of leaf cells of Nicotiana benthamiana infected with the geminivirus isolated from a CAMD-infected plant collected in Zambia, and leaf cells of diseased cassava plants, were observed in electron microscopy. Structural modifications are described. Gross changes appeared only in the nuclei of the infected cells. In N. benthamiana, ring-like structures and granular inclusions, as described for other geminiviruses, were easily observed. In cassava, the same ring-like structures and granular inclusions were also found, but with difficulty. (Author's summary) E04

0056

20107 ROA V., J.I. 1983. Cultivo de meristemas, termoterapia y quimioterapia para el saneamiento de clones de yuca (Manihot esculenta Crantz) infectados con dos enfermedades virales. (Meristem culture, thermotherapy, and chemotherapy to clear up cassava clones infected with two viral diseases). Tesis Ing.Agr. Palmira, Universidad Nacional de Colombia. 70p. Span., Sum. Span., Engl., 40 Refs., Illus.

Cassava. Plant tissues. Apical meristems. Tissue culture. Temperature. Disease control. Cassava mosaic virus. Frog skin disease. Colombia.

The cleaning up of cassava clones infected with 2 viral diseases, frog skin disease and mosaic, by means of thermotherapy and chemotherapy (in vivo and in vitro) using meristem culture was studied. Temp., size of explant, type of organ used for rooting, duration of treatment, and concn. of Virazole were considered. Cuttings from cv. M Col 33, M Col 2062, and M Col 2063 were used. Meristems of various sizes were excised for culture and were micropropagated using stem tips and nodes. Elongation, fresh and dry wt. of the cultures were determined. The presence or absence of frog skin disease was assessed by the degree of symptom development and by electrophoresis; mosaic was also assessed by the degree of symptom development and by biological detection (grafting). Thermotherapy promoted stem elongation, increased fresh wt., and the rate of cleaning of both frog skin and mosaic diseases. Results showed the relationship exlsting between the type of organ used for rooting and high temp. with the rate of cleaning frog skin disease. The culture of stem tips at 40°C day/35°C night, during 16 days, produced 100% disease-free plants; however, only 80% healthy plants were obtained when stem nodes were used. A cleaning rate of 100% was also obtained when apices were cultured at 40°C day/35°C night during 20 days. Double treatment of thermotherapy (in vivo and in vitro) to cassava plants infected with frog skin and mosaic yielded 100% disease-free plants. In chemotherapy (in vivo) the application of Virazole did not greatly influence the cleaning of frog skin disease while the increase in concn. in the culture medium (in vitro) gradually reduced symptom development until healthy plants were obtained with 40 ppm during 80 days of culture. This work has showed the need for thermotherapy during the

elongation of the sprouts as prior to the culture of small meristems as an efficient means of cleaning up viral diseases of cassava. The use of thermotherapy in vitro can be an alternative for cleaning, gaining time and lab. space, but it should be coordinated with rooting of stem tips from apices. The results of chemotherapy (in vitro) using Virazole have been promising, but require further study, especially to reduce the period of treatment and phytotoxic effects. (Author's summary) E04

See also 0023 0047 0050 0063 0095 0096 0097 0100

E05 Mycoplasmoses

See 0050

E06 Nematodes

0057

19974 CAVENESS, F.E. 1982. Root-knot nematodes on cassava. In Research Planning Conference on Root-Knot Nematodes, Meloidogyne spp., 3rd., Regions IV and V, Ibadan, Nigeria, 1981. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.182-188. Engl., Sum. Engl., 21 Refs., Illus. [IITA, Oyo Road, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Nematodes. Plant development. Nigeria.

Meloidogyne incognita race 2 and M. javanica significantly reduced stalk height, stalk wt., and storage root wt. of cassava cv. TMe 30555 and TMe 30572, after a 15.5 mo. growing period in the tropical rain forest zone of southern Nigeria. (Author's summary) E06

0058

17115 DIOMANDE, M. 1981. Root knot nematodes on upland rice (Oryza sativa and O. glaberrima) and cassava (Manihot esculenta) in Ivory Coast. Abidjan, Office de la Recherche Scientifique et Technique Outre-Mer. Centre d'Adiopodoume. 13p. Engl., 11 Refs., Illus. [ORSTOM, Centre d'Adiopodoume, B.P. V 51, Abidjan, Cote d'Ivoire]

Cassava. Nematodes. Ivory Coast.

The relationships between the nematode Meloidogyne sp. and rice and cassava crops in Ivory Coast were studied. In trials carried out with cassava, 2 clones (CB and Bonoua) were simultaneously inoculated with M. incognita and Pratylenchus brachyurus. These clones were not good hosts for nematodes. In the inoculation test, only the root wt. of Bonoua decreased significantly, probably due to P. brachyurus. (Summary by EDITEC. Trans. by L.M.F.) E06

0059

19973 SAKA, V.W. 1982. International Meloidogyne Project Report in Malawi. In Research Planning Conference on Root-Knot Nematodes, Meloidogyne spp., 3rd., Regions IV and V, Ibadan, Nigeria, 1981. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.31-36. Engl., 6 Refs. [Bvumbwe Research Station, Box 5748, Limbe, Malawi]

Cassava. Nematodes. Malawi.

Root-knot nematodes (Meloidogyne javanica) were first identified on Phaseolus vulgaris, tomato, celery, banana, and cotton. Pathogenicity tests were then conducted on pigeon pea, Chloris gayana, cowpea, Pisum sativum, maize, cotton, and cassava var. Piligodo, Thipula, Chithekele, Masangwi, T7, and Folowete. Results show that all cotton var., C. gayana var. Katambora, and cassava var. Masangwi are immune to M. javanica, and therefore can be used in crop rotations. On the other hand, cassava var. Chithekele was highly susceptible. (Summary by I.M.F.) E06

See also 0097

F00 PEST CONTROL AND ENTOMOLOGY

F01 Injurious Insects and their Control

0060

19591 AGU, T.C.; ATU, U.G. 1982. The potentials of sprinkler irrigation in the control of cassava mealybug and green spider mite. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.142-145. Engl., Sum. Engl., 8 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Insect control. Mite control. Irrigation. Nigeria.

The incidence of cassava mealybug (Phenacoccus manihoti) and green spider mite (Mononychellus tanajoa) is very severe in Nigeria from Nov. through March-April. This period coincides with the dry season during which cassava plants suffer severe moisture stress. The use of sprinkler irrigation for the control of pests during this period is proposed, based on the hypothesis that cassava stands a better chance of resisting the mealybug attack if adequate moisture is supplied to it during the dry season. Also the spray action of sprinkler irrigation tends to reduce establishment of the pest and prevent economic damage on cassava plants. (Author's summary) F01

0061

19583 ATU, U.G.; EZULIKE, T.O.; OKEKE, J.E. 1982. Greenhouse assay of insecticides for control of cassava mealybug (Phenacoccus manihoti). In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.88-93. Engl., Sum. Engl., 7 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Laboratory experiments. Insecticides. Phenacoccus manihoti. Insect control. Nigeria.

Twelve insecticides (propoxur, methidathion, monocrotophos, oxydemeton-methyl, diazinon, carbosultan, phosphamidon, dimethoate, permethrin, penthion, malathion, and carbofuran) were tested for effectiveness against the cassava mealybug (Phenacoccus manihoti) in 2 greenhouse expt. The

insecticide sprays were applied with CP-3 type sprayer calibrated to discharge 500 l spray vol./ha. Three-mo.-old infested cassava var. 30211 plants were at the early phase of presenring bunchy top symptoms when the insecticides were applied. The carbofuran granular insecticide was broadcasted (4 g/plant) in a groove made in the soil around the young plant. In sample counts of nymphs and adult mealybugs knocked down at 48 h after insecticide application, propoxur, methidathion, malathion, diazinon, carbosulfan, oxydemeton-methyl, monocrotophos, and dimethoate were effective, in that order. No significant differences were observed among them. Crawlers and adult mealybugs were observed dropping off carbofuran-treated plants after 1 wk. Scores (1-4 scale) on cassava vegetative growth and top wt. at 4 and 6 wk., resp., after insecticide application were higher for the plants treated with the 9 insecticides (including carbofuran) with high no. of knocked-down mealybugs. (Author's summary) F01

0062

18966 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Entomología. (Entomology). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.69-88. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Entomology. Lagochirus. Chilomina clarkei. Silba pendula. Root productivity. Pest damage. Cultivars. Vatiga manihotae. Vatiga illudens. Predators. Aleurotrachelus socialis. Erinnyis ello. Phenacoccus herreni. Mononychellus tanajoa. Oligonychus peruvianus. Tetranychus urticae. Colombia.

Losses in root and planting material production caused by different pests as well as their biological control are evaluated. Studies of pests damaging dried cassava in storage were initiated. Biological aspects and form of attack of the following pests are described: stemborers (Lagochirus rogersi, L. araneiformis, Chilomina clarkei), shoot flies (Silba pendula), nymphs and adults of Cyrtomenus bergi, and lacebugs (Vatiga manihotae and V. illudens). Zelus nugax (Reduviidae) was identified as a major predator of V. manihotae. The presence of whiteflies (Aleurotrachelus socialis) and sooty mold reduces root yield. The varietal preference for oviposition by Erinnyis ello was determined as well as the effect of simulated damage on yield, starch content, and cooking quality of cassava. Five major enemies of the cassava mealybug Phenacoccus herreni were identified: Ocyptamus, Cleothera, Anagyrus, Sympherobius, and Chrysopa. An unidentified species of mite belonging to the family Eriophyidae found attacking cassava leaves is parasitized by the fungus Hirsuthella tompsonii. Fifteen insect species were found feeding on stored cassava; among these, Araecerus fasciculatus and Lasioderma serricorne are the most frequently found pests. Both species are parasitized by the hymenopteran Anisopteromalus sp. (Summary by EDIIEC. Trans. by L.M.F.) F01

0063

19571 CHAUDHRY, A.B.; OGO, R.C. 1982. Cassava mealybug. A problem in the offing in the Kainji Lake Basin. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.23-27. Engl., Sum. Engl., 4 Refs. [Kainji Lake Research Inst., P.M.B. 666, New Bussa, Nigeria]

Cassava. Phenacoccus manihoti. Cassava African mosaic virus. Xanthomonas manihotis. Nigeria.

Work on root crops production was initiated as part of farming systems research in the drawdown area of the Kainji Lake Basin (Nigeria) during 1977. Surveillance was maintained on cassava pests. To date observations show no serious cassava mealybug (Phenacoccus manihoti) problem since farms are rarely too close. However, some mealybug presence is suspected on farms around New Bussa, where the owners, on interview, explained that the propagation material was brought in from the Bendel State area. Because of limited sources of improved cassava cuttings, there is an increased demand for seed from the south of the country, thus leaving ample scope for transportation of mealybug to Kainji Lake Basin. Measures such as organized seed supply and interinstitutional coordination to alleviate this danger are suggested. (Author's summary) F01

0064

19570 EMEHUTE, J.F.U.; EZULIKE, T.O. 1982. Observations on cassava mealybugs Phenacoccus manihoti (Mat-Ferr) and Ferrisia virgata (Ckll) Hemiptera:Pseudococcidae in South-East Nigeria. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.18-22. Engl., Sum. Engl., 4 Refs., Illus. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Ferrisia virgata. Insect control. Biological control. Predators. Nigeria.

Two species of the cassava mealybug, Phenacoccus manihoti and Ferrisia virgata, occur in SE Nigeria. P. manihoti is more widespread and devastating than F. virgata. Their life histories and association with cassava are discussed. An integrated strategy involving cultural, chemical, and biological control is recommended. It has been reported that P. manihoti is endemic in L.A. where both the pest and its natural enemies have been collected and identified. (Author's summary) F01

0065

19595 ENYINNAYA, A.M.; OKOLI, O.O. 1982. An ecological view of cassava mealybug (Phenacoccus manihoti) and green spider mite (Mononychellus tanajoa) control in Nigeria. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.165-172. Engl., Sum. Engl., 24 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Ecology. Insect control. Mite control. Nigeria.

Commonly available methods of insect control (cultural, chemical, biological, genetic resistance of host plant, physical and mechanical, and regulatory controls) are described and the advantages and limitations of each method are considered. The trend in pest control in Nigeria, which has generally leaned toward chemical control, is discussed. An integrated pest management approach is proposed in which the best aspects of all available control methods that apply to a given pest problem are brought together in a complementary workable combination to ensure long-term effective control

without affecting the environment. Traditionally, too much emphasis is placed on a single and isolated method of pest control, especially on the use of chemicals, to control the mealybug (Phenacoccus manihoti) and the green spider mite (Mononychellus tanajoa). The establishment of a well-staffed and well-equiped insect survey bureau is suggested for a systematic monitoring and indexing of all economic pests in Nigeria. The government, scientists, and farmers should all cooperate in solving the problems caused by the cassava mealybug and the green spider mite, as well as other Nigerian pests. (Author's summary) F01

0066

19594 ENYINNIA, T. 1982. Suggested integrated control of cassava mealybug and green spider mite. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.158-164. Engl., Sum. Engl., 11 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Insect control. Mite control. Insecticides. Cultivars. Resistance. Biological control. Predators. Nigeria.

Several lines of control approaches, forming a package for the suppression and eradication of the cassava mealybug (Phenacoccus manihoti) and green spider mite (Mononychellus tanajoa), have been advanced. They should be articulated in such a manner that each complements the others for the realization of their full benefits. A suggested combination of these approaches for the immediate suppression of the pests and their eradication includes: immediate legislation and enforcement of the plant quarantine laws; adoption of cultural control methods; stem dipping in insecticides before planting; use of resistant/tolerant planting materials; suitable weed control throughout most of the growth cycle of the crop; identification of alternate hosts and their protection or elimination as necessary; breeding and selection for high levels of resistance and/or tolerance while conserving native and exotic germplasm; and the search for, identification, and utilization of indigenous biological control agents. (Author's summary) F01

0067

19582 ESIABA, R.O. 1982. The plant quarantine services and new cassava pests in Nigeria. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.77-86. Engl., Sum. Engl., 8 Refs. [Post-Entry Plant Quarantine Service, Federal Dept. of Agriculture, Moor Plantation, P.M.B. 5672, Ibadan, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Propagation materials. Quarantine measures. Legal aspects. Insect control. Biological control. Predators. Nigeria.

The Nigerian Plant Quarantine Service is responsible of preventing the introduction of foreign plant pests and diseases to protect crops, including cassava, from the ravages of these pests and diseases. The organization and mode of operation of the Plant Quarantine Service and the import regulations regarding cassava propagation materials are outlined. The role of the Plant Quarantine Service in combatting the cassava mealybug

(Phenacoccus manihoti) and green spider mite (Mononychellus tanajoa) since their outbreak in Nigeria is discussed. Import requirements for biological control agents, import permits so far issued, and actual importations of insects for cassava mealybug and spider mite control are also discussed. The need to comply with plant quarantine regulations at all times is stressed. (Author's summary) F01

0068

19526 GOLOB, P.; HODGES, R. 1982. Study of an outbreak of Prostephanus truncatus (Horn) in Tanzania. London, Tropical Products Institute. Report no.G164. 23p. Engl., Sum. Engl., Fr., Span., Illus. [Tropical Development & Research Inst., 56/62 Gray's Inn Road, London WC1X 8LU, England]

Cassava. Injurious insects. Prostephanus truncatus. Storage. Maps. Entomology. Tanzania.

Prostephanus truncatus, a pest of stored maize, was found in grain stores in 46 of 56 villages examined in the Tabora region of Tanzania in 1981. The pest was also found in the Shinyanga region and 1 markets in the Mwanza region and at stores in the Morogoro region. After storage for 4-6 mo., maize samples from the villages exhibited up to 34% wt. loss, despite very dry weather and very dry maize (av. MC 11.2%). It was considered that P. truncatus would cause a widespread grain shortage and a dearth of seed for the following season. Besides attacking maize, the pest also heavily damaged cassava and, to a lesser extent, other commodities such as groundnuts. Wooden implements and storage structures were also damaged. The beetle poses a threat throughout East and Central Africa. The setting up of insecticidal trials with pirimiphos-methyl, fenitrothion, bromophos, and permethrin is described, and a key for the identification of Bostrichidae that infest stored products is presented. (Extracted from author's summary) F01

0069

19587 IGBOKWE, M.C.; ODURUKWE, S.O. 1982. Cultural control: an immediate measure against mealybug and spider mite. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.120-126. Engl., Sum. Engl., 24 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Insect control. Cultivation. Intercropping. Resistance. Nigeria.

Cultural control measures for the reduction of the incidence of the cassava mealybug (Phenacoccus manihoti) and the green spider mite (Mononychellus tanajoa) in Nigeria are indicated. These include good rotational practice, mixed cropping, planting at the onset of rains, use of clean planting materials, balanced fertilization, and early weeding of the crop to ensure fast and good crop development. Sanitation (burning of crop residues before planting, destruction by burning of infested cassava sticks at harvest), planting of tolerant/resistant var., and the use of sprinkler irrigation for production of late-season crops where possible for large- scale farmers are other cultural measures. Most of these measures are of immediate practical application; all form an indispensable part of an integrated program for the control of cassava pests. (Author's summary) F01

0070

19530 IHEAGWAM, E.U. 1981. The influence of temperature on increase rates of the cassava mealybug Phenacoccus manihoti Mat.-Ferr. (Homoptera, Pseudococcidae). Revue de Zoologie Africaine 95(4):959-967. Engl., Sum. Engl., 13 Refs., Illus. [Dept. of Zoology, Univ. of Nigeria, Anambra State, Nsukka, Nigeria]

Cassava. Phenacoccus manihoti. Insect biology. Entomology. Nigeria.

At 25, 28, or 31°C, populations of the cassava mealybug, Phenacoccus manihoti, survived for over 62% of their lifespan. Times for populations to reach 50% mortality (LT_{50}) were 29 days at 25°C, 20 days at 28°C, and 11 days at 31°C. Egg laying generally commenced within the 1st 7 days of adult life. The mean preoviposition periods were 6.5 ± 1.08 days at 25°C, 5.7 ± 0.95 days at 28°C, and 3.9 ± 0.32 days at 31°C. The max. mean fecundity/day (^{m}x) was generally reached on the 3rd day of the reproductive period except at 28°C, where it occurred on the 6th day. Apart from a mean postreproductive period of 2.2 days at 25°C, P. manihoti generally died soon after laying their last batch of eggs. Values of the daily intrinsic rate of increase (^{r}m) were 0.149, 0.172, and 0.204 at 25, 28, and 31°C, resp. (Author's summary) F01

0071

19574 LEMA, K.M.; HERREN, H.R. 1982. Effect of constant temperatures on the development of the cassava mealybug. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.35-36. Engl., Sum. Engl., 1 Ref. [IITA, Oyo Road, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Phenacoccus manihoti. Entomology. Nigeria.

The effect of constant temp. (20, 27, and 34°C) on cassava mealybug (Phenacoccus manihoti) development is being studied under lab. conditions. Preliminary results showed that egg mortality was higher at 34°C (29.37%) than at 27 or 20°C (2.40 and 6.54%, resp.). The insect completed its life cycle in 45.47 and 26.79 days at 20 and 27°C, resp. (Author's summary) F01

0072

19588 LUTALADIO, N.B.; EZUMAH, H.C.; KISOSUANGA, N. 1982. Effect of cultural and soil management practices on mealybug incidence and cassava root yield in Zaire. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.127-132. Engl., Sum. Engl., 4 Refs. [IITA, Oyo Road, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Land preparation. Planting. Timing. Mulching. Root productivity. Root development. Phenacoccus manihoti. Zaire.

Expt. were conducted at M'Vuazi and Kimpese, Zaire, to determine the effect of time of planting and soil management practices on mealybug (Phenacoccus manihoti) incidence and root yield. It was observed that planting early in the rainy season (1st season planting) helped reduce mealybug incidence. Infested and severely damaged cassava plants planted in the beginning of the rainy season showed a reduction of root yield of 54.4%, while up to 85% reduction was noted on cassava planted late in the season (2nd planting

season). Mealybug attack affected the size of roots on early-planted cassava; root size and no. were reduced on late-planted cassava. Mulching has a beneficial effect on the degree of pest damage (1.0-1.5), on the % of attacked plants (24.0-24.7%), and on root yield, irrespective of methods of cultivation. (Author's summary) F01

0073

18453 MATILE-FERRERO, D. 1976. Les cochenilles nuisibles au manioc en Republique Populaire du Congo; suggestions pour un programme d'études et de lutte. (Injurious cochineal insects on cassava in Congo; suggestions for a study and control program). Rapport de mission. Paris, Muséum National d'Histoire Naturelle. 15p. Fr., 4 Refs., Illus.

Cassava. Phenacoccus manihoti. Insect control. Biological control. Insecticides. Maps. Congo.

The 1st report of a commission that assessed the presence of Phenacoccus manihoti in Congo, where it has become a new and important pest of cassava during the past 2 yr, is given. Six plantations were examined and thousands of cochineal insects were collected in addition to 17 of their parasites and predators. The sanitary condition of the plantations is reported; some of them are disease-free (Kiani, Kouilou, and towns distant from the railroad). The origin and dissemination of the pest is discussed and some control measures (cultural, chemical, and biological) are suggested on the short, middle, and long term. The short-term control measures include the establishment of a prevention and control network, sanitary protection of plant cuttings, accelerated tuber harvest, controlled plots for the production of cuttings, total burial of the cuttings, avoidance of the juxtaposition of old and new cassava crops, alternate intercrops, and destruction of infected plants and crops. On the middle term, the selection of the most resistant var. and research on an industrial plantation scale of a nontoxic insecticide are recommended. On the long term, the rate of infestation should be observed and assessed during a whole crop cycle, the short-term plant sanitary interventions should be controlled scientifically, the biology of P. manihoti should be studied in detail as well as that of its predators and the population dynamics of the insect and its natural enemies. The most promising of these enemies will be reared on exptl. plots and later, on an industrial scale. (Summary by I.B. Trans. by L.M.F.) F01

0074

19590 NJOKU, B.O.; OGBUEHI, S.N. 1982. Soil fertility aspects of mealybug and green spider mite control. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.137-141. Engl., Sum. Engl., 6 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Soil fertility. Insect control. Mite control. Nigeria.

The Nigerian Green Revolution Program is currently threatened by 2 new pests of cassava: the mealybug (Phenacoccus manihoti) and the green spider mite (Mononychellus tanajoa). A survey of cassava growing regions where these pests are prevalent reveals that in most cases the soils are acid in reaction and have nutritional problems, including high exchangeable Al and low levels of some essential nutrients. In addition to planting cassava early in the growing season, and balanced fertilization at recommended

rates, periodical fertilization with the nutrients known to be deficient is recommended. The nutrients need not be applied to the soil towards the end of the rainy season as they are likely to increase the salt content of the soil and hence increase soil solution Al by mass action effect. Judicious foliar sprays of the nutrients towards the end of the rainy season when pest populations start to build up is recommended. It is believed that integration of these recommendations with other control measures will help to achieve the needed control of these pests of cassava. (Author's summary) F01

0075

19589 NSIAMA SHE, N.D. 1982. Burial of the cassava planting materials as a possible preventive control measure against the cassava mealybug. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.133-136. Engl., Sum. Engl., 3 Refs. [IITA, Oyo Road, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Phenacoccus manihoti. Insect control. Cuttings. Zaire.

Planting cassava cuttings completely buried in the soil as a possible preventive control measure against the cassava mealybug (Phenacoccus manihoti) was investigated. Conserved infested materials were buried in the soil at 0, 5, 10, 30, 40, and 50 cm depth and removed after 1, 3, 5, and 7 days for planting in a greenhouse. A treatment of cuttings with dimethoate at the rate of 0.1% was included for comparison. No mealybug was found on the insecticide-treated cuttings or on cuttings kept in the soil at 5 cm for 5 and 7 days or on those kept at a depth of 10 cm or more for 3 days or more. (Author's summary) F01

0076

19584 NWOKEDI, P.M.; NWANDIEOM, G.I. 1982. Cassava stem dipper as a means of mechanical mealybug control. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.103-105. Engl., Sum. Engl., 3 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Insect control. Agricultural equipment. Cuttings. Nigeria.

Considering the severe damage caused by the cassava mealybug (Phenacoccus manihoti) in cassava crops in Nigeria, and the resulting shortage of gari and CF, the National Root Crops Research Institute, Umudike, Umuahia, Imo State, designed and fabricated a cassava stem dipper to aid the farmers in treating cassava stem cuttings with chemicals before planting, since some of the chemicals are poisonous. The dipper also serves in commercializing the treatment of cassava stems for large- and small-scale farmers. This portable machine can treat up to 400 cassava stem cuttings in 2 min and is very simple to fabricate by local blacksmiths. (Author's summary) F01

0077

19592 OKEKE, J.E.; ENE, L.S.O.; ATU, U.G. 1982. Mealybug (Phenacoccus manihoti Mat-Ferr) and green spider mite (Mononychellus tanajoa Bondar) threat to cassava industry in Nigeria: strategies for control at the

National Root Crops Research Institute, Umudike, Nigeria. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.147-153. Engl., Sum. Engl., 12 Refs., Illus. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Insect control. Mite control. Resistance. Biological control. Predators. Nigeria.

History, spread, and scope of cassava mealybug (Phenacoccus manihoti) and green spider mite (Mononychellus tanajoa) infestation in Nigeria are discussed. The effect on the national economy is estimated in terms of price trend of the basic staple, which has increased by over 300% since 1977 base year. A 2-phase control strategy, crisis management and development of durable permanent solution, is described. (Author's summary) F01

0078

19580 OKOLI, O.O. 1982. Prospects of breeding for host plant resistance to cassava mealybug (Phenacoccus manihoti) and to green spider mites of cassava (Mononychellus tanajoa). In _____.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.72-75. Engl., Sum. Engl., 16 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Plant breeding. Resistance. Nigeria.

The cassava mealybug (Phenacoccus manihoti) and the green spider mite (Mononychellus tanajoa) occur mostly during the dry season in Nigeria. Cassava var. that recover quickly from damage due to these pests at the onset of rains have been identified as well as var. that mature before the pests build up to economic injury levels in late dry season. Although the components of identified resistance are yet to be known, prospects of selecting other clones and species with varying degrees of one or more components of resistance as well as of combining these components in a breeding population are discussed. (Author's summary) F01

0079

19579 OYOLU, C. 1982. Field observation on tuber yield and quality of two cultivars of early season cassava subsequently infested by mealybug (Phenacoccus manihoti Mat-Ferr). In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.65-71. Engl., Sum. Engl., 5 Refs., Illus. [Dept. of Crop Science, Univ. of Nigeria, Anambra State, Nsukka, Nigeria]

Cassava. Cultivars. Root productivity. Phenacoccus manihoti. Nigeria.

Two cassava cv., Nwugo and 60506, planted in April 1980 in the University Farm at Nsukka, Nigeria, were seriously infested by mealybug (Phenacoccus manihoti) by Dec. 1980. Vegetative regrowth occurred in both cv. from the onset of the rains in April 1981. When the crops were harvested in June/July 1981, both cv. had satisfactory gross tuber yields. The tubers in 60506 were, however, more variable in quality than in Nwugo. Some tubers

in 60506 had decomposed, some softened ('bread') while less than 60% of the tubers were fresh. Consequently net tuber yield was significantly lower in 60506 than in Nwugo. (Author's summary) F01

0080

19557 SALICK, J. 1983. Agroecology of the cassava lacebug. Ph.D. Thesis. Ithaca, N.Y., Cornell University. 152p. Engl., Sum. Engl., 82 Refs., Illus.

Cassava. Vatiga manihotae. Insect biology. Ecology. Intercropping. Maize. Beans. Entomology. Colombia. Mexico.

Information is given on the ecology, agroecology, and management of Vatiga manihotae, insect-plant interaction, potential control methods, lacebug abundance and consumer concn. in simple and complex communities, dispersal of the insect, and importance of temporal and spatial scales. Regarding the distribution and incidence of V. manihotae several methods were used to determine the population dynamics in the field and lab., plant-insect interactions, insect responses to the environmental parameters, predator-prey relations, and biogeographic distributions. The phyllogenetic affinity of V. manihotae with the family Tingidae was evident in its high reproductive rate and a marked response to seasonality (a characteristic of the host too). The simplistic generalizations on tropical biology were overriden and the importance of a more detailed examination of the habitat is emphasized. Some of the suggested control strategies are: release of predators (Chrysopa valida, Zelus nugax), breeding for cassava resistance, trap cropping with wild Manihot spp., defoliation, and cultural practices that favor small-scale cultivations. The mechanism that determines the increase of V. manihotae in traditional maize-cassava polycultures was studied and compared with other crops (beans-cassava, weeds-cassava, and cassava in monoculture and multiclonal cassava). This mechanism consists in consumer concn. (more insects are concentrated on less plants), explained by their movement through passive dispersion by the wind, random immigration into a field, and local selection of the host plant. Polycultures that do not affect leaf density do not have this mechanism, while sparsely planted monocultures also concentrate insect concn. on the reduced resource. Other mechanisms were experimentally rejected. Patterns of colonization were found to affect the biology of V. manihotae and cropping systems. Dispersal studies with diffusion modeling and dispersion aaalyses conclude that at a local scale (plant-to-plant), insect movement is random as well as the immigration into new fields and from one field to another. However, the dispersion within mature fields and over Colombia was widespread and aggregated. The insect moved more frequently during the evening when the wind and humidity were low. V. manihotae illustrated the importance of the temporal and spatial scales for the impact of dispersal. (Summary by I.B. Trans. by L.M.F.) F01

0081

18445 SCARDINI, D.M.B. 1982. Uso da armadilha luminosa no controle do mandarová da mandioca, no município de Linhares, Espírito Santo. (Use of a light trap to control the cassava hornworm, Erinnyis ello, in the municipality of Linhares, Espírito Santo). Cariacica-ES, Brasil, Empresa Capixaba de Pesquisa Agropecuária. Comunicado Técnico no.10. 7p. Port., Illus. [Empresa Capixaba de Pesquisa Agropecuária, C.P. 125, 29.154 Campo Grande, Cariacica-ES, Brasil]

Cassava. Entomology. Erinnyis ello. Agricultural equipment. Insect control. Brazil.

A model for constructing a light trap is given; this trap is designed to provide cassava growers of the state of Espírito Santo, Brazil, with an integrated control system of the cassava hornworm (Erinnyis ello). The installment of the trap in the center of a 6-ha crop in Linhares gave data on the insect population curve, allowed pest attacks to be avoided, and notably reduced the use of pesticides for its control. The protective efficiency of the trap has been determined in areas up to 20 h in other states. The trap is installed on posts 1 m above cassava foliage. A list of necessary materials is included as well as explanatory diagrams for trap construction. (Summary by EDITEC. Trans. by L.M.F.) F01

0082

19596 UKPA, N.; EMEHUTE, J.K.U.; EZULIKE, T.O. 1982. Control of cassava mealybug and green spider mite in Nigeria: problem, progress and prospects. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.173-177. Engl., Sum. Engl., 7 Refs. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Insect control. Mite control. Biological control. Predators. Nigeria.

Problems found in the control of the cassava mealybug (Phenacoccus manihoti) and the green spider mite (Mononychellu tanajoa) in Nigeria are discussed. A proposal that cassava pests and diseases may be controlled if var. are grown in their appropriate ecological zones using recommended technology is advanced. Three ecological zones (rain forest, savannah, and derived savannah) are viewed as the most suitable for cassava production in Nigeria. Ecotype selection, based on an interdisciplinary approach, is in progress to identify suitable var. for these zones. Quick, effective, and cheap answers to such complex problems as the mealybug, the green spider mite, and CBB (Xanthomonas manihotis) are needed. The advantages of collaborative research among scientists are emphasized. The possible role of Amblyseius fustis as a biocontrol agent for M. tanajoa is discussed. (Author's summary) F01

0083

19995 UMEH, E.D.N. 1982. Biological studies on Hyperaspis marmottani Fairm. (Col., Coccinellidae), a predator of the cassava mealybug Phenacoccus manihoti Mat-Ferr. (Hom., Pseudococcidae). Zeitschrift für Angewandte Entomologie 94(5):530-532. Engl., Sum. Engl., Germ., 4 Refs. [Dept. of Science Technology, Inst. of Management & Technology, P.M.B. 1079, Enugu, Nigeria]

Cassava. Phenacoccus manihoti. Predators. Insect biology. Entomology. Nigeria.

Hyperaspis marmottani, occurring widely in SE Nigeria, is a potentially effective predator of the cassava mealybug, Phenacoccus manihoti. It took about 28 days for H. marmottani to complete development at 28°C, passing through the egg, 4 larval, a prepupal, and pupal instars. The duration of the larva, prepupa, and pupa was 11.9, 2.0, and 9.1 days, resp. All the larval instars and the adult fed actively on the different stages of the mealybug. H. marmottani controls cassava mealybug by 2 methods: by mechanically injuring and killing them and by predation. The larvae and adults are secretive, hiding under the egg masses, cracks, and curled up leaves. (Author's summary) F01

0084

19585 UMEH, E.D.N. 1982. Hyperaspis marmottani, a potentially effective predator of Phenacoccus manihoti. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.107-110. Engl., Sum. Engl., Illus. [Dept. of Science Technology, Inst. of Management & Technology, P.M.B. 1079, Enugu, Nigeria]

Cassava. Phenacoccus manihoti. Predators. Biological control. Entomology. Nigeria.

Population levels of Phenacoccus manihoti and Hyperaspis marmottani were monitored over a period of 7 mo. to assess the potentiality of H. marmottani for biological control of P. manihoti. Field observations on some aspects of its biology and preliminary lab. investigations of its mode of predation were also made. H. marmottani larvae and adults were observed to control P. manihoti in 2 ways: (1) mechanical injury and subsequent death, (2) predation. The 1st instars of P. manihoti are usually swallowed whole by the predators, particularly the adults, whereas only the abdomen of the larger preys was swallowed, the head and thorax being cut off and discarded. The predator hides under egg masses, in cracks, and under curled up leaves. (Author's summary) F01

See also 0023 0028 0085 0093 0095 0096 0097 0100 0165 0173

F03 Injurious Mites and their Control

0085

19576 AFINLOSOTU, T.A. 1982. Report of investigations on the green spider mite (Mononychellus tanajoa) and the cassava mealybug (Phenacoccus manihoti) at the Institute of Agricultural Research and Training, Ibadan, Nigeria. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.40-42. Engl., Sum. Engl., 2 Refs. [Inst. of Agricultural Research & Training, Univ. of Ife, P.M.B. 5029, Moor Plantation, Ibadan, Nigeria]

Cassava. Mononychellus tanajoa. Phenacoccus manihoti. Mite control. Biological control. Insecticides. Nigeria.

A brief summary of the investigations conducted on the green spider mite (Mononychellus tanajoa) and the cassava mealybug (Phenacoccus manihoti) at the Institute of Agricultural Research and Training, Ibadan, Nigeria, is given. Investigations were carried out on the seasonal trend of the green spider mite population and its relationship with weather factors, effects of planting time on the yield of cassava attacked by green spider mites, chemical control trials, and some aspects of the biological control. Future plans of the Institute regarding pests are also discussed. (Extracted from author's summary) F03

0086

19517 BERNARDO, E.N.; ESGUERRA, N.M. 1981. Seasonal abundance of red spider mite and its predators on selected cassava accessions. Annals of Tropical Research 3(3):199-205. Engl., Sum. Engl., 4 Refs. Illus.

[Dept. of Plant Protection, Visayas State College of Agriculture, Baybay, Leyte 7127, Philippines]

Cassava. Tetranychus kanzawai. Predators. Cultivars. Resistance. Philippines.

The seasonal abundance of the cassava red spider mite (Tetranychus kanzawai) and its predators in unsprayed cassava plantings at the Visayas State College of Agriculture, Philippines, is reported. The possible effect of prevailing environmental conditions on insect population and the appropriate time to plant cassava to avoid severe mite damage during the critical growth stage of the plant were studied. In an unsprayed cassava planting, the cassava red spider mite population fluctuated in lesser magnitude in moderately resistant Accessions 8, 12, and 46 than in Golden Yellow and susceptible Accessions 35, 36, and 38. Irrespective of the susceptibility level, population buildup of the spider mite occurred during low rainfall re., which, during the 2-yr period covered, were from Dec. 1978 to April 1979, Aug. and Sept. 1979, and in May, June, and July 1980. In some instances, factors other than rainfall seemed to reduce mite population. Temp. and RH did not show adverse effect on spider mite population. Predaceous insects such as coccinellid and staphylinid beetles, cecidomyiid fly, and thrips (in decreasing order of abundance) and predaceous phytoseiid mites fluctuated in population density only slightly and showed min. buildup despite the presence of high mite population. Factors other than predators could have helped also in reducing mite population in certain months. It is suggested that field planting should be planned such that the critical stage of growth of cassava (3-5 mo. after planting) will not coincide with the population peaks of the cassava red spider mite to avoid significant loss in tuber yield. (Author's summary) F03

0087

19510 EZULIFE, T.O.; ODEBIYI, J.A. 1982. Functional response of Amblyseius fustis (Acarina Phytoseiidae) to increasing prey density. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.F., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.111-117. Engl., Sum. Engl., 17 Refs., Illus. [National Root Crops Research Inst., P.M.B. 1006, Umudike, Umuahia, Imo State, Nigeria]

Cassava. Oligonychus gossypii. Mononychellus tanajoa. Predators. Biological control. Mite control. Nigeria.

Amblyseius fustis, a phytoseiid mite, was found preying on both the red spider mite, Oligonychus gossypii, and the green spider mite, Mononychellus tanajoa. A. fustis consumed eggs, larvae, nymphs, and adults of the preys. There was no significant difference in the rate of consumption of the phytophagous mites. The functional response of A. fustis to increasing prey density was determined at 5 levels of prey densities: 10, 20, 30, 40, and 50 adults of O. gossypii. The daily prey consumption of mated A. fustis male and female increased gradually until the density reached 30 and thereafter declined with further increase in prey density. Thus the optimum prey density was 30/day. Although the no. of eggs laid at the optimum prey density was numerically higher, this was not significantly higher than the no. of eggs laid at other prey densities. (Author's summary) F03

0088

19578 NYIIRA, Z.M. 1982. Mononychellus tanajoa (Bondar): implications and approach to its management. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.;

Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.47-64. Engl., Sum. Engl., 32 Refs. [International Service for National Agricultural Research, P.O. Box 93375, 2509AJ, The Hague, the Netherlands]

Cassava. Mononychellus tanajoa. Mite control. Insecticides. Biological control. Predators. Nigeria.

Twenty-eight tetranychid species associated with cassava are discussed and their alternate host plants listed. Mononychellus tanajoa is recognized as the most destructive. The existence of the various tetranychids as pests of cassava and the increasing importance of cassava as a food crop in developing countries reflect a potential danger through new pest introductions or increased economic status of mites as cassava pests. Strict sanitation during transfer of plant material is advocated. Since its introduction in Africa, M. tanajoa has spread from East Africa where it was initially recorded in Uganda in 1974 to Central and West Africa. Var. differences, climate, and weather and soil conditions affect the severity of damage. There is a resistance/tolerance factor in some var. of cultivated cassava and wild Manihot species. Agronomic factors that minimize infestation and damage are discussed. Present knowledge indicates that many predators feed on the different stages of M. tanajoa. The list, their status, and prey/host relationship are discussed. Prospects of chemical, biological, and integrated control are reviewed. An integrated management system incorporating resistant, quick-maturing cassava var., suitable agronomic factors, and the use of selected but effective biological control agents in a well integrated formula is proposed for the control of the green cassava mite. (Author's summary) F03

0089

19572 PILLIAI, K.S.; PALANISWAMI, M.S. 1982. Assessment of loss in yield due to spider mites damage on cassava in India. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.28-32. Engl., Sum. Engl., 5 Refs. [Central Tuber Crops Research Inst., Trivandrum 695017, Kerala, India]

Cassava. Eutetranychus orientalis. Oligonychus biharensis. Tetranychus cinnabarinus. Tetranychus neocaledonicus. Productivity. Cultivars. India.

Detailed studies of cassava yield loss due to the spider mites (Oligonychus biharensis, Eutetranychus orientalis, Tetranychus cinnabarinus, and T. neocaledonicus) in India are described. The studies were conducted during 2 planting seasons for 4 yr under rainfed conditions, with 3 commonly cultivated var. (H-2304, H-1687, and Malayan 4). Exptl. results showed that the yield loss due to the spider mites ranged from 17.82 to 33.11%. Therefore, these mites are considered as potential pests of cassava and their control will give enhanced economic yield. (Author's summary) F03

See also 0028 0060 0062 0065 0066 0067 0069 0074
0077 0078 0082 0093 0095 0096 0097

G01 Breeding, Germplasm, Varieties and Clones, Selection

0090

18969 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Desarrollo de germoplasma. (Germplasm development). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.127-146. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Germplasm. Cultivars. Adaptation. Selection. Root productivity. Dry matter. HCN content. Resistance. Injurious mites. Xanthomonas manihotis. Sphaceloma manihoticola. Phoma. Harvest index. Propagation. Seed. Germination. Roots. Leaves. Colombia.

During 1981 the introduction of germplasm was continued with an additional 147 clones from Brazil in the form of aseptic meristem cultures. Cassava germplasm bank evaluation for adaptation, resistance to diseases and pests, yield, and root quality is in progress in the north coast of Colombia (Media Luna, Fonseca, and Valledupar), Carimagua (Llanos Orientales), Popayán, and Palmira. General characteristics of germplasm accessions include: low yield potential of the majority of existing accessions (low HI); low frequency of accessions with high resistance to any given disease or pest; very low frequency of accessions having combined high resistance to all diseases and pests in a given region; limited range of adaptation of a given accession: Much variability to be exploited in breeding exists. Gene pools are being formed for each edaphoclimatic zone. Studies on methods for improving selection efficiency by early generation selection within cassava-growing edaphoclimatic zones in Colombia are being continued. Advances in screening for early maturity, the use of herbicide mixtures for seeds and transplants, and the reevaluation of accessions selected for low root HCN levels are reported. (Summary by EDITEC. Trans. by L.M.F.) G01

0091

18970 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Mejoramiento varietal. (Varietal improvement). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.147-172. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Plant breeding. Root productivity. Cultivars. Xanthomonas manihotis. Sphaceloma manihoticola. Resistance. Symptomatology. Cuttings. Dry matter. Roots. Deterioration. HCN content. Colombia.

During 1981 genotype evaluation and selection continued at the ICA (Instituto Colombiano Agropecuario)-Caribia and the ICA-CIAT-Carimagua stations and at CIAT-Palmira, considered representative sites, resp., of (1) low-input technology with medium to high fertility soils in hot, lowland tropics (edaphoclimatic zone I), (2) low- to medium-input technology with extremely low fertility soils in the tropical savannas (edaphoclimatic zone II); and (3) low-input technology with high fertility soils in the medium alt. tropics (edaphoclimatic zone IV). In zone IV, there has been a steady upward trend in root yield as of 1973, with current av. yields of 40 t/ha and max. yields of 60 t/ha with more than 45% DM. In zone I, av. yields of 40 t/ha with more than 30% DM are also obtained. In zone II, F_1 clones have

already outyielded local cv., mainly due to improved resistance to CBB and superelongation disease (Sphaceloma manihoticola). Advances in yield stability were analyzed on the basis of spatial stability (macro and microspatial), system stability (over fertility levels and over farm management), and temporal stability (especially regarding the nature of resistance to CBB and the superelongation disease, quality of planting stakes, deterioration of cv., and unforeseen factors). Aspects related to economically valid yields are analyzed: root DM content and eating quality, root perishability, HCN content, and ease of harvest. CIAT's capacity for production and distribution of hybrid seeds has increased; 30,000 seeds are used each year in the selection process and approx. another 20,000 seeds are sent to collaborating national programs. (Summary by EDITEC. Trans. by L.M.F.) G01

0092

19564 CHAVES, L.J. 1982. Um modelo nao-linear aplicado ao estudo das interacoes de genótipos com ambientes. (A nonlinear model applied to the study of genotype-environment interactions). Tese Mag.Sc. Piracicaba-SP, Brasil, Escola Superior de Agricultura Luiz de Queiroz da Universidade de Sao Paulo. 117p. Port., Sum. Port., Engl., 47 Refs.

Cassava. Genetics. Statistical analysis. Plant breeding. Productivity. Ecology. Genotypes. Colombia.

The analysis of genotype-environment interaction was based on a nonlinear model, which is multiplicative in genetic and environmental parameters, under the assumption that the environment acts multiplicatively on genotypes. Mathematical deductions provided the basis for verifying some implications of the multiplicative action of the environment and genotypes on some plant breeding aspects. Exptl. yield data of soybean, wheat, cassava, maize, and common bean cv. were analyzed to determine the applicability of the nonlinear model to genotype-environment interaction studies. For soybean, cassava, and wheat, results showed that the multiplicative model was similar to the linear model. For maize and common bean data, the nonlinear model fitted better than the linear model; for opaque maize, normal maize, and common bean data, the nonlinear model accounted for 16.9, 9.8, and 10.1% of the interaction sum of squares, resp. The model transformed to logarithmic scale was less efficient than the others, as far as the power of fitness is concerned. The application of the residual sum of squares of the nonlinear model in measuring the similarity of locations, with respect to genotype-environment interaction, was investigated. Such sum of squares was compared with that due to interaction in the linear model and also with part of the interaction sum of squares that is due to lack of correlation of the cv. means between locations. Such comparison showed no apparent differences between the statistics for measuring the distance between locations in agglomerations studies. (Auther's summary) G01

0093

18975 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO NACIONAL DE PESQUISA DE MANDIOCA E FRUTICULTURA. 1979. Projeto mandioca. (Cassava program). In _____. Relatório técnico anual do Centro Nacional de Pesquisa de Mandioca e Fruticultura 1977. Cruz das Almas-BA, Brasil. pp.20-56. Port., Illus.

Cassava. Cassava programs. Plant breeding. Germplasm. Root productivity. Dry matter. Tubers. Leaves. Stems. Cuttings. Cultivars. Selection. Starch content. Germination. Propagation. Spacing. Minerals. Mononychellus tanajoa. Predators. Biological control. Erinnyis ello. Weeding. Herbicides.

Xanthomonas manihotis. Cercospora henningsii. Sphaceloma manihoticola. Resistance. Brazil.

Results of research on cassava carried out during 1976-77 at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, in Cruz das Almas, BA, Brazil, are given. Genetic breeding is oriented toward improving cassava productivity in Brazil. Botanical and agronomic characteristics of 288 cv. of the germplasm bank were assessed, fresh root yields being between 2.7-38.5 t/ha. Among these, 100 cv. yielding more than 30 t/ha were selected and crosses were made to achieve resistance to bacteriosis. Physiology work studied plant growth and development stages and some factors affecting these processes. In particular, the following aspects were studied: the accumulation of DM and the chemical composition of different cv., several rapid propagation methods, the effect of growth regulators on rooting of young stems, induction of flowering, influence of the size of cuttings and no. of branches on plant height, root and canopy production, no. of storage roots. Plant development was also analyzed on the basis of DM accumulation and the influence of plant density on the performance of different cv. Expt. on plant nutrition were conducted regarding: levels and ways of fertilizer application (N, P, and K, and others such as Ca, S, and micronutrients); control of Mononychellus tanajoa, Tetranychus urticae, T. neocaledonicus, and Erinnyis ello. The biological control of E. ello with Bacillus thuringiensis was assessed and 2 parasites (Euphorocera sp. and Telenomus sp.) were observed. The toxicity of different herbicides during various stages of the growth cycle and the critical period of weed competition was determined. Resistance to Xanthomonas manihotis, Cercosporidium henningsii, and Cercospora vicosae was examined. The effect of plant density on crop yield was studied. (Summary by EDITEC. Trans. by L.M.F.) G01

0094

19991 GALINDO R., G.A. 1982. Caracterización morfológica de germoplasma de yuca Manihot esculenta Crantz. (Morphological characterization of cassava germplasm). Tesis Ing.Agr. Zapopan, Jalisco, Universidad de Guadalajara. 81p. Span., Sum. Span., 32 Refs., Illus.

Cassava. Germplasm. Plant anatomy. Leaves. Stems. Roots. Agronomic characters. Cultivars. Mexico.

The cassava germplasm existing in Mexico was assessed and outstanding collections were identified and those with similar characteristics grouped. In 1980 the 157 cassava collections (116 national cv. and 41 exotic cv.) existing in the germplasm bank of the Campo Agrícola Exptl. Cotaxtla (CAECOT) were planted on this exptl. field. These were evaluated considering morphological and agronomic characteristics. The information was analyzed through agronomic monitoring and techniques of numeric taxonomy, using the complement of the correlation coefficient (rc=1-r). Results indicate that 149 cassava collections were evaluated of which the following were selected as promising on the basis of agronomic characteristics and field observations: Big Yar Marllie Hill, Bunch of Keys, Sin nombre H-56-1, SG-435-C-59-9, SG-445-C-59-10, MN-9, MN-29, MN-65, MEX-53, MN-52, MN-53, and Cubana. The classification by numeric taxonomy using the complement of the correlation coefficient (rc) at a level of 0.63 dissimilarity grouped the collections in 20 well-defined groups, which was verified in the field, and the classification at a level of 0.90 dissimilarity grouped the materials into 7 groups. On the basis of this latter classification, the distribution of the groups of cassava existing in Mexico and their possible origin was made, taking into consideration the relationship with exotic collections. (Author's summary. Trans. by L.M.F.) G01

0095

19214 HAHN, S.K. 1983. Cassava research to overcome the constraints to production and use in Africa. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.93-102. Engl., 20 Refs., Illus. [IITA, Oyo Road, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Cassava programs. Research. Cassava African mosaic virus. Xanthomonas manihotis. Phenacoccus manihoti. Mononychellus tanajoa. Nematodes. Insect control. Mite control. Disease control. Weeding. Plant breeding. HCN content. Cyanides. Leaves. Protein content. Detoxification. Nigeria.

Cassava, a staple food crop in Africa, provides more than 50% of the caloric requirement for over 200 million inhabitants. Despite its importance yields are declining mainly due to diseases such as CAMD, CBB, and anthracnose (Colletotrichum spp.), and insect pests such as cassava mealybug (Phenacoccus manihoti), green spider mite (Mononychellus tanajoa), and grasshoppers (Zonocerus spp.). Other contributory constraints include root-knot nematodes (Meloidogyne incognita and M. javanica) and weed competition, both of which could be reduced through improved cultural practices. Disease and insect control needs to be achieved primarily through resistant var. and partly through biological control. Already clones resistant to the cassava mealybug and the green spider mite have been identified. Cassava contains a large amount of cyanide both in the tuberous roots and leaves, which is reduced by tedious labor-intensive processing procedures. These are accomplished following traditional methods, each of which removes different amounts of cyanide. Root processing methods are more successful in reducing cyanide levels than leaf processing methods, where the cyanide content remains relatively high. The International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, has undertaken breeding for low cyanide since 1973 through continuous recombinations and selections based on the picrate leaf test. Low cyanide var. generally had a poorer performance than high cyanide var. However, relatively high-yielding low cyanide var., resistant to CAMD and CBB, have been produced. (Summary by J.R.) G01

0096

18946 HERSHEY, C.H. 1982. Mejoramiento de la yuca para adaptación en condiciones de estrés: desarrollo de una metodología. (Breeding in cassava for adaptation to stress conditions: development of a methodology). Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie Seminarios Internos SE-15-82. 16p. Span., 7 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Plant breeding. Hybridizing. Selection. Adaptation. Germplasm. Soil requirements. Climatic requirements. Bacterioses. Mycoses. Viroses. Injurious insects. Injurious mites. Colombia.

Several physical and biological factors that limit cassava productivity are described: temp. and photoperiod, soil water availability, RH, soil characteristics (fertility and pH), and pests and diseases. Six edapho-climatic zones (ECZ) for cassava production are defined on the basis of temp.: lowland tropics, ECZ 1 (low to moderate rainfall and long dry season; high annual temp.), ECZ 2 (moderate to high rainfall on acid, infertile soils), and ECZ 3 (no marked dry season, high rainfall, high constant RH); intermediate alt. tropics, ECZ 4; highland tropics, ECZ 5; and subtropics, ECZ 6. A unique combination of potential pest and disease problems can be identified for each ECZ. In Colombia, conditions for 5 of

the 6 ECZ (ECZ 1-5) have been identified. CIAT's improvement strategy consists of: (1) germplasm collection in different Colombian ECZs; (2) selection of parents and formation of gene-pools for each ECZ; (3) evaluation and selection of hybrids within and between the zones; and (4) recommendations to national programs on the testing of selected clones and/or specific progenies. Results obtained using this methodology prove the high potential existing for improving cassava productivity under stress conditions through var. improvement methods and simple cultural practices. (Summary by EDITEC. Trans. by L.M.F.) G01

0097

18977 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1981. Root and tuber improvement program; cassava. In _____. Annual report 1981. Ibadan, Nigeria. pp.49-68. Engl., Illus. [IITA, Oyo Road, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Cassava programs. Plant breeding. Cultivars. Root productivity. Dry matter. Gari. Cassava African mosaic virus. Xanthomonas manihotis. HCN content. Laboratory experiments. Phenacoccus manihoti. Mononychellus tanajoa. Resistance. Predators. Biological control. Light. Photoperiod. Rooting. Root development. N. P. K. Fertilizers. Flowering. Timing. Nematodes. Chickwangue. Foofoo. Detoxification processes. Tissue culture. Nigeria.

Studies carried out in 1981 by the Root and Tuber Improvement Program of the International Institute of Tropical Agriculture in cassava are reported. Regarding genetic improvement, the performance of var. during 2 planting seasons was assessed, breeding lines were screened for low HCN content, and 2 methods for HCN analysis (manual and autoanalyzer) were compared. Resistance to both the cassava mealybug (Phenacoccus sp.) and the green spider mite (Mononychellus tanajoa) is related to the high hair density on the upper- and undersides of leaves of improved cv. The release of 2 natural enemies of the cassava mealybug, Scymnus sp. and Apoanagyrus lopezi, considerably reduced pest populations. Leaf pubescence is a mechanism of resistance to the cassava green spider mite. Permeability changes in cassava leaves infected with Xanthomonas campestris pv. manihotis were studied as well as the pathogenicity of some isolates of Colletotrichum manihotis and the role of the insect Pseudotheraptus devastans in the etiology of anthracnose. The effect of light intensity (shaded or unshaded) and NK fertilization on root initiation and development was examined. Agronomic characters associated with fresh root yield and the effect of daylength on cassava flowering were determined. In expt. with nematodes, Meloidogyne incognita race 2 and M. javanica produced, resp., an av. of 467 and 671 eggs on cassava cv. TMS 30572 and TMS 30555. The effect of root size on quality and yield of 3 processed products (chickwangue, gari, and foofoo) was assessed. The rate of detoxication of cassava roots after fermenting in water was found to decrease from 4.45-17.25 mg/100 g fresh wt. to 0.13-0.60 mg/100 g. Meristem culture allows healthy material to be distributed. Progress in research at the Cameroon National Root Crops Improvement Program and at the Zairean National Manioc Program are given. (Summary by EDITEC. Trans. by L.M.F.) G01

0098

18432 JOS, J.S.; BAI, K.V. 1981. Functional male sterility in cassava. Current Science 50(23):1035-1036. Engl., 8 Refs., Illus. [Indian Inst. of Horticultural Research, Bangalore 560 080, India]

Cassava. Plant fertility. Microsporogenesis. India.

Microsporogenesis was studied in a plant from a tetraploid clone of cassava, which was found to be functionally male sterile even though it contained 73% fertile pollen. The failure of the tapetum to degenerate at the proper time and provide nutrition to the developing pollen grain may be the cause of the 27% pollen sterility reported in this clone. Although this clone is pollen fertile, the absence of dehiscence and the retaining of the pollen indefinitely inside the anthers make it functionally male sterile. (Summary by EDITEC. Trans. by L.M.F.) G01

0099

20101 KAWANO, K.; ROJANARIDPICHED, C. 1983. Genetic study on post-harvest root deterioration in cassava. Kasetsart Journal 17(2):14-26. Engl., Sum. Engl., 16 Refs., Illus. [Dept. of Plant Science, Kasetsart Univ. Bangkok, Thailand]

Cassava. Roots. Deterioration. Genetics. Post-harvest technology. Vascular streaking. Resistance. Plant breeding. Timing. Colombia.

Postharvest root deterioration or vascular streaking of cassava clones (accessions and breeding lines) was evaluated with harvests at different ages (8 and 12 mo.), seasons (beginning and end of wet season), and locations (CIAT-Palmira, Carimagua, and Caribia in Colombia) to assess the effect of environmental factors on cassava genotypes. Vascular streaking was sensitive to any of these environmental factors. Genotype x location interaction was highly significant suggesting that final cv. selection should be carried out in each location. Genetic analysis carried out in one location suggested that inheritance of vascular streaking was, at least partly, controlled by additive factors and was quantitative rather than qualitative. Narrow sense heritability of 0.64 was obtained. Vascular streaking was highly and significantly correlated with root DM content in all the trials conducted during 7 yr. Since free recombination between resistance to vascular streaking and high root DM content may not be possible, the most acceptable balance between these 2 traits should be defined according to the use of product and edaphoclimatic condition of production area prior to selection program. (Author's summary) G01

0100

18911 MONTALDO, A.; GUILLEN, R.D.; BARRIOS, J.R.; QUINTERO, F.; AZUAJE, S. 1982. Germoplasma de yuca. (Cassava germplasm). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:143-166. Span., Illus. [Univ. Central de Venezuela, Fac. de Agronomía, Apartado 4579, Maracay, Aragua, Venezuela]

Cassava. Germplasm. Identification. Cultivars. Venezuela.

At the Samán Mache exptl. station in the state of Carabobo, Venezuela, a collection of 581 cassava clones is maintained by vegetative reproduction. Introductions are from different regions of the country (Zuliana and the central east, the Andes, the Llanos, central region, state of Sucre, Guayana and Territorios Federales, Delta Amacuro, and the Amazons) and from countries such as Brazil, Colombia, and Costa Rica. The entry of each introduction includes a botanical description of plant characteristics, stem, leaves, inflorescence, seeds, and roots. Agronomic observations are also made on the presence or absence of diseases (Bothryodiplodia theobromae, Botrytis sp., Cercospora sp., Gloeosporium manihotis, Helminthosporium manihotis, Phyllosticta sp., Rhizoctonia sp., Rosellinia sp., Fromyces janiphae, Pseudomonas manihotis, Xanthomonas manihotis, mosaic, witches' broom) and pests (Coelosternus sp., Aspiodes sp., Erinnyis ello, Introphobia brasiliensis, Silba pendula, Anastrepha manihoti, lace

bugs, thrips, Atta sp.), reaction to the brown streak virus, total root DM, carbohydrate content, CP, ether extract (dry basis) and HCN (wet basis). Other criteria for the production of bitter cassava for flour industry are given. There are 62 outstanding clones in the collection; their characteristics are given in table form. Clones 2402, 2384, 2156, 2436, 2385, 2428, and 2441 are outstanding for their high DM content and root yield. (Summary by EMITEC. Trans. by L.M.F.) G01

See also 0001 0012 0020 0078 0173

G02 Cytogenetics

See 0098

H00 NUTRITION

H01 Cassava Foods and Nutritive Value

0101

20108 DIXON, J.A. 1982. Cassava in Indonesia: its economic role and use as food. Contemporary Southeast Asia 3(4):361-373. Engl., 6 Refs. [Inst. of Southeast Asian Studies, Heng Mui Keng Terrace, Pasir Panjang, Singapore 0511]

Cassava. Statistical data. Production. Fresh roots (vegetable). Gaplek. Cassava starch. Uses. Human nutrition. Economics. Indonesia.

The use of cassava as human food in Indonesia, how it is grown and processed, its nutritional aspects, the economics of the substitution between cassava and other staples, and the possibilities of increasing demand and consumption of cassava in the future are examined. Comparative details of cassava, rice, and maize for various SE Asian countries are also provided. (Author's summary) H01

0102

19568 LANCASTER, P.A.; BROOKS, J.E. 1983. Cassava leaves as human food. Economic Botany 37(3):331-348. Engl., Sum. Engl., 117 Refs., 11lus. [Tropical Development & Research Inst. 56/62 Gray's Inn Road, London WC1X 8LU, England]

Cassava. Human nutrition. Cassava leaves (vegetable). Nutritive value. Food energy. Water content. Protein content. Fat content. Carbohydrate content. Fibre content. Ash content. Mineral content. Leaves. Vitamin content. Amino acids. HCN content. Processing.

The use of cassava leaves as human food is reviewed and their value as a source of protein and vitamins for supplementing predominantly starchy diets reemphasized. The problem of the toxicity of the leaves is considered, and the effects on both nutritive value and toxicity of the traditional methods of preparing the leaves, such as drying, pounding, and long periods of boiling, are described and discussed. Loss of nutrients, particularly vitamins, occurs during processing but remaining levels can still make an important contribution to the diet. HCN levels are reduced considerably by the processing methods, although the toxic effects of residual levels need further investigation. (Author's summary) H01

0103

19567 OSUJI, G.O. 1983. The effect of glutathione on the cohesiveness of pounded cassava, cocoyam, gari and yam. Journal of Food Technology 18:265-270. Engl., Sum. Engl., 17 Refs., Illus. [Biochemistry Dept., Anambra State Univ. of Technology, Enugu, Nigeria]

Cassava. Gari. Yams. Cocoyams. Analysis. Proteins. Nigeria.

To understand the part played by glutathione on the cohesiveness of the tropical staple items of food, pounded cassava, cocoyam, gari and yam, varying amounts of glutathione were added to the foods after which the resistance to shear stress (cohesiveness) of each food was determined. In each pounded food the added glutathione immediately increased the food's cohesiveness. There was also a linearly increasing relationship between the foods' cohesiveness and their endogenous glutathione contents on one hand and between the foods' cohesiveness and foods' protein contents on the other hand. Glutathione, therefore, increases the cohesiveness of tropical pounded foods by interacting with their proteins which then assume new conformations that increase the cohesiveness of the foods. (Author's summary) H01

0104

18990 SILVA, G.A. DA 1979. Utilizacao da mandioca na alimentacao humana e animal. (Use of cassava in human and animal nutrition). Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional d Pesquisa de Mandioca e Fruticultura. 20p. Port., 22 Refs.

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

Cassava. Uses. Human nutrition. Animal nutrition. Nutritive value.

The current use of cassava in human and animal nutrition is reviewed as well as some problems related to its excessive consumption. The potential of cassava to obtain food with a higher biological value in Brazil is indicated. In relation to human nutrition the nutritional deficiencies resulting from its consumption are classified as primary or secondary. The resulting disorders can be reduced by mixing cassava by-products with high protein foods. In animal nutrition the interference of HCN in the metabolism and the precautions that should be taken when offering rations supplemented with cassava leaves, stems, or roots are considered. Several tables are included that describe the composition of different cassava-based foods and the protein content of other products that could possibly be mixed with cassava. (Summary by EDITEC. Trans. by L.M.F.) H01

0105

19289 TERRY, [illegible]; BASS, M.A.; KOLASA, K.A. 1979. Rainy season food behavior of selected East Nicaraguan Miskito Indians. Home Economics Research Journal 8(2):118-126. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. Human nutrition. Diets. Socio-economic aspects. Nicaragua.

Because certain Nicaraguan villagers must travel long distances to procure food, it was hypothesized that seasonal rains would alter the villagers' core foods. Field research (including observation, participant observation, and key informant interviewing) was conducted in the east coast village of Kakabila in July-Aug., 1976, to study the availability, distribution, and consumption of food by a group of Miskito Indians; also a week of home observation was carried out with 4 families. The family farm supplied the

largest % (39) of total servings of food/family. Other food sources were grocery stores, fishing, fruit trees, loans, gifts, and purchases from other villagers. Cassava was the core food, with fish, green bananas, breadfruit, coconuts, and mangoes also being important. Thus, the villagers adapted to seasonal food shortages through food sharing, and the initial hypothesis was not confirmed. (Author's summary) H01

0106

18976 TRIANA, G. 1982. Procesamiento y complejo dietético de la yuca brava entre los indígenas Puinaves del río Inírida. (Processing and dietary complex of bitter cassava among the Puinaves Indians of the Río Inírida). Caldasia 13(64):549-566. Span., 9 Refs., Illus. [Inst. de Ciencias Naturales, Museo de Historia Natural, Univ. Nacional de Colombia, Bogotá]

Cassava. Bitter cassava. Small-scale processing. History. Peeling. Rasping. Screening. Drying. Casave. Socio-economic aspects. Human nutrition. Colombia.

Different aspects related to cassava cultivation, processing, and the dietary complex among Puinaves Indians living in eastern Colombia are discussed. The origin and domestication of bitter cassava is referred to. Cultural practices of cassava in the slash and burn system are indicated, these being subjected to climatic variations during the dry (Nov.-March) and the rainy (April-Nov.) seasons. Land clearing usually takes place at the beginning of summer and burning, 2 mo. later. The stages of cassava processing are described: transportation to the village, peeling, rasping, straining, and sifting of the mix, and toasting the flour. Cassava is transported in baskets; the women are in charge of the peeling, separating part of the cassava for rasping and drying and the other for fermentation. Fermented cassava is rasped and mixed with the dried cassava. This mixture is then strained using an instrument called "sebucán". When the mix is sifted, the finely ground flour is used for casave and the coarse flour is used for mañoco. The flour is toasted in a "budare", a large ceramic plate (50-120 cm in diameter), where both casave and mañoco are produced. During one morning, a woman can make 25 cakes in a 80-cm budare from 60 kg of cassava; a family of 5 members consumes up to 3 cakes daily. "Yukuta" is a beverage prepared with water and mañoco or casave. Dietary complex of cassava is associated with hunting, fishing, and harvesting. (Summary by EDITEC. Trans. by L.M.F.) H01

See also 0034 0130 0133 0160 0166 0181

H02 Nutritive Disorders in Humans

0107

19210 RAMIREZ, I.; CRUZ, M.; VAREA, J. 1983. Endemic cretinism in the Andean region: new methodological approaches. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.73-76. Engl., 22 Refs., Illus. [Escuela Politécnica Nacional, Depto. de Radioisótopos, Apartado 2759, Quito, Ecuador]

Cassava. Cretinism. Toxicology. South America. Central America.

Results of research carried out in Ecuador with neurological endemic cretinism are reported. New methodological approaches were used, namely,

computerized cranial tomography (CT), brainstem auditory evoked potentials (BAEP), and electroencephalograms (EEG). The application of each method is explained. CTs of mentally retarded, deaf-mutes, and those exhibiting dysarthia were consistent with a severe ponto-mesencephalic atropic process, associated with a moderate cerebellar atrophy, especially of the vermis and middle cerebellar peduncles. The BAEP method suggests impairment of the middle ear, contrasting with results of audiometric tests performed previously. EEGs in clinically noncretin young infants between the ages of 12-14 mo. revealed anomalies in 52 of the study group, those being consistent with the concept of minimal brain damage found in the noncretin part of the hyperendemic population. Further investigation is recommended. (Summary by I.B. Trans. by L.M.F.) H02

0108

19207 SINGH, K.B. 1983. Public health and nutritional aspects of endemic goitre in Nepal. Summary. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.62-63. Engl., 10 Refs. [Immunization and Goitre and Cretinism Eradication Project, Kathmandu, Nepal]

Cassava. Endemic goitre. Toxicology. Nepal.

The most important findings of studies carried out since 1908 on public health and nutritional aspects of endemic goitre in Nepal are summarized. The impact of a goitre control program, started in 1972 with the import of iodized salt from India, was not significant due to a shortage of transportation facilities and poor packing. Currently, the semiautonomous Goitre and Cretinism Eradication Project (1979), with support from UNICEF and WHO, involves the mass injection of the population in goitrous regions (70% of the population of 20 districts) with slowly absorbable iodized oil, by the end of 1985. (Summary by I.B. Trans. by L.M.F.) H02

See also 0183

H03 Animal Feeding

0109

18487 ALHASSAN, W.S.; ODOI, F. 1982. Use of cassava leaf meal in diets for pigs in the humid tropics. Tropical Animal Health and Production 14(4):216-218. Engl., 5 Refs. [National Animal Production Research, Inst., Ahmadu Bello Univ., Shika, P.O.B. 116, Zaria, Nigeria]

Cassava. Leaves. Cassava meal. Dietary value. Uses. Swine. Animal physiology. Animal nutrition. Ghana.

The potential of CLM for feeding growing and finishing pigs was evaluated. The expt. was a completely randomized design with 3 treatments: a control diet containing no CLM, a 10% CLM diet changed to 20% after 56 days of trial, and a 20% CLM diet changed to 30% after 56 days of trial. Sixty Large White pigs were grouped into 5/pen with 4 pens/treatment. The expt. had 2 phases: in the 1st phase 24 pigs were slaughtered after 100 days of trial and in the 2nd, the remaining 36 pigs were kept until they reached a slaughter wt. of 90 kg. There were no differences among treatments in av. daily wt. gain in the 1st phase, but in the 2nd phase pigs on the control diet grew at a faster rate. In both phases the feed efficiency of the pigs on the control diet was better. It is suggested that the performance decline from long periods of CLM feeding might be associated with a cumulative effect of HCN toxicity. (Summary by EDITEC. Trans. by L.M.F.) H03

0110

11759 EUCLIDES, V.P.B.; EUCLIDES FILHO, K. 1979. Mandioca na alimentacao do gado de corte. (Cassava in beef cattle nutrition). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.143-148. Port., 21 Refs.

Cassava. Animal nutrition. Beef cattle.

A bibliographic review is given on the utilization of different parts of the cassava plant in beef cattle nutrition as well as the nutritional value of the roots (highly digestible carbohydrates) and leaves, which have a high CP content (arginine, histidine, leusine, phenylalanine, met., valine, tryptophan, threonine, and other nonessential amino acids), high Ca content and low P content in comparison with maize and sorghum. There are few research papers on the nutritional value of cassava branches; in France these have been used in the nutrition of calves. A need for more information on HCN toxicity in ruminants exists. The cassava root, rich in energy and with a low fiber content, should be used in the nutrition of monogastric animals; ruminants could feed on cassava branches. (Summary by I.B. Trans. by L.M.F.) H03

0111

20104 FERREIRA, A.S.; GOMES, P.C.; FIALHO, F.T.; ALBINO, L.F.T.; SOBESTIANSKY, J. 1982. Mandioca in natura na alimentacao de suínos em crescimento e terminacao. (Raw cassava in growing and finishing pig nutrition). Revista da Sociedade Brasileira de Zootecnia 11(4):695-705. Port., Sum. Engl., Port., 13 Refs. [EMBRAPA/Centro Nacional de Pesquisa de Suínos e Aves, C.P. D-3, 89.700 Concordia-SC, Brasil]

Cassava. Swine. Feeds and feeding. Growing. Finishing. Concentrates. Animal physiology. Animal nutrition. Digestibility. Brazil.

Ninety-six Landrace x Large White unsexed pigs were used in a completely randomized expt. with 3 treatments and 8 replicates to evaluate biologically the use of fresh raw cassava on the basis of animal performance and carcass characteristics. Treatments used were: T1, raw cassava (ad libitum) and protein concentrate with 40% CP ad libitum in the free choice system; T2, raw cassava ad libitum, and a basal ration with 16% CP in the growing phase and 13% CP in the finishing phase, ad libitum, in the free choice system; and T3, a basal ration with 16% CP in the growing phase and 13% CP in the finishing phase, ad libitum. The daily ingestion of CP and digestible energy were 529 g and 7992 kcal, 291 g and 9478 kcal, and 332 g and 7745 kcal, resp., for T1, T2, and T3, supplying a ratio of kcal of digestible energy:g CP of 15.1, 32.6, and 23.3, resp. The animals receiving T2 had higher consumption (based on DM and higher ingestion of digestible energy ($P < 0.05$) than the animals receiving T1 and T3. The animals receiving T1 has the highest CP ingestion ($P < 0.05$). Best results regarding back fat thickness and real feed conversion (based on DM consumption) were obtained with T3 (2.50 cm and 3.60) when compared with that obtained with T1 and T2 (3.22 cm and 3.19; 3.52 cm and 3.60). The T1 showed a higher feed conversion ($P < 0.05$) than T2. According to animal performance and carcass characteristics, T3 is considered the best treatment. The availability and relationship between prices of cassava and maize will finally determine the best treatment in economical terms. (Author's summary) H03

0112

19216 GOMEZ, G. 1983. Cassava, cyanide, and animal nutrition. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research

and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.109-113. Engl., 16 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Cyanides. Composition. Cassava chips. Drying. Cassava meal. Animal physiology. Animal nutrition. Toxicity. Colombia.

Some of the factors, such as var. and age of plants, that affect the cyanide content in roots are reviewed as well as the effects of drying cassava chips on cyanide elimination. The results of animal feeding trials using CM produced from roots with low or high cyanide content are given. Roots of 9 var. studied at CIAT contained cyanide levels ranging from 49 to 221 mg/kg. The root cortex contains higher cyanide concn. than the parenchyma. Recent studies indicate that plant age (9-12 mo.) does not affect the cyanide content of the parenchyma but decreases the cyanide concn. in the root cortex. In expt. of drying cassava chips on concrete floors with 2 loading rates (10 and 12 kg/m^2) or on inclined trays with 3 loading rates (10, 15, and 20 kg/m^2), the 1st method was more efficient in reducing cyanide content. Data indicate that these 2 methods and oven-drying at 60°C led to a reduction of 10-30% of initial cyanide content. To establish the effect of cyanide content on animal performance, several feeding trials, using CM from both low- and high-cyanide content var., were carried out on rats, pigs, and chickens. The drying process considerably reduced the cyanide content of the roots and thus, the toxicity of cassava when incorporated into balanced diets for growing animals. (Summary by EDITEC. Trans. by L.M.F.) H03

0113

19507 HOYOS M., C.; SANTOS N., J. 1982. Comparación de dos niveles de harina de yuca con alto y bajo contenido de cianuro en dietas para pollos de engorde. (Comparison of two levels of cassava flour with high and low cyanide in diets for broiler chicks). Acta Agronómica (Colombia) 33(1):45-53. Span., Sum. Span., Engl., 11 Refs. [Univ. Nacional, Fac. de Ciencias Agropecuarias, Palmira, Colombia]

Cassava. Cassava meal. HCN content. Chicks. Feeds and feeding. Dietary value. Costs. Animal nutrition. Colombia.

Two expt. were carried out using 1-day-old, mixed sex, Arbor Acres broiler chicks to evaluate the nutritive value of 2 levels of CM (10 and 20%), obtained from var. with high and low cyanide contents. Results of the 1st trial showed a better response to the level of 20% CM for both var., indicating that there was no detrimental effect at that level. In the 2nd trial the diet containing 20% CM plus enough vegetable oil to increase the ME content by approx. 5%, gave similar wt. gains (± 2.18 kg) and better feed conversion than the group fed a commercial diet (2.08 vs. 2.19). These preliminary results indicate that CM can be used in broiler rations up to 20%, provided that the diets are formulated to ensure a good nutritional balance. (Author's summary) H03

0114

19224 JAYARAM, M.G.; SHETTY, H.P.C. 1981. Formulation, processing and water stability of two new pelleted fish feeds. Aquaculture 23(4): 355-359. Engl., Sum. Engl., 9 Refs. [Univ. of Agricultural Sciences, College of Fisheries, Mangalore-575002, India]

Cassava. Cassava flour. Uses. Feeds and feeding. Animal nutrition. India.

Details of the formulation and processing of 2 new dry pelleted fish feeds are discussed. Dry ingredients used for dry pelleted feed F and S were, resp., rice bran (31 and 16%), groundnut oil cake (22 and 34%), CF (14 and 16%), fish meal (33 and 0%), and dried silkworm pupae (0 and 34%). Water stability of pellets was determined over a period of 7 h. Results of the stability test show that pellet F was more stable at the end of 1 h, while at the end of 3 h the stability of both the pellets was found to be almost the same. Beyond 3 h, pellet S was decidely more stable. Pellet S was found to promote better growth of common carp and catla, indicating the possibility of substituting costlier fish meal by the cheaper silkworm pupae as a protein source in pelleted fish feeds, without affecting the physical or nutritional quality of the feed. (Summary by L.M.F.) H03

0115

19296 JOE, T.A.; OLUYEMI, J.A.; AWOPEJU, A.F.; ODEYEMI, T.O. 1980. Optimal level of cassava (Manihot esculenta Crantz) flour in the diet of the growing chick. Zentralblatt fuer Veterinaermedizin Reihe A 27(8): 669-674. Engl., Sum. Engl., Germ., Fr., Span., 17 Refs.

Cassava. Cassava flour. Chicks. Feeds and feeding. Animal physiology. Animal nutrition. Nigeria.

The effect of CF on the performance of White Rock male chicks (0-9 wk. old) and cockerels (10-20 wk. old) was studied. Six dietary regimes were used in each trial; the maize in a maize and groundnut cake diet was replaced with CF at levels of 10, 20, 30, 40, and 50%. Results indicated that in terms of wt. gain, feed intake, and mortality, CF could replace 10% of the maize in diets for chicks. While N retention was not significantly ($P > 0.05$) affected by dietary treatment, there was a fairly regular decrease in ME and an increase in the % mortality with the increase in dietary CF. (Summary by L.M.F.) H03

0116

19975 MEJIA C., T.R. 1960. Valor comparativo entre la yuca y el maíz en la alimentación de cerdos. (Comparative value of cassava and maize in swine nutrition). Tesis Ing.Agr. Medellín, Universidad Nacional de Colombia. 42p. Span., Sum. Span., 16 Refs., Illus.

Cassava. Maize. Feeds and feeding. Swine. Nutritive value. Animal physiology. Animal nutrition. Colombia.

Three groups of 7 pigs each were used to compare the nutritive value of cassava and maize. Rations were: (1) 40% cassava; (2) 20% cassava + 20% maize; (3) 40% maize. The remaining 60% of all the rations included corn meal (20%), wheat bran (9%), sesame cake (15%), fish meal (5%), cottonseed cake (10%), and a mineral supplement (1%). One pound of Aurofac was added per ton feed. Pigs were weighed at 14-day intervals at the same hour and before eating. Ration 1 surpassed the other 2 rations for pig raising and fattening. Daily wt. gain varied during the exptl. period but at the end av. daily wt. gains were 0.607, 0.544, and 0.527 kg for rations 1, 2, and 3, resp. Feed intake was similar in all lots. Feed efficiency was 4.63:1, 5.19:1, and 5.29:1 for the 3 rations, resp. (Author's summary. Trans. by L.M.F.) H03

0117

19528 MONTONG, M.; TALUMEWO, J.; SITORUS, P.; ABDURRAYS. 1981. Pengaruh pemberian litter dan onggok pada sapi perah dara. (The effect of litter and onggok meal in dairy heifer diets). Bulletin Lembaga Penelitian

Peternakan 29:1-13. Indon., Sum. Engl., Indon., 18 Refs. [Fakultas Peternakan, Universitas Sam Ratulangi, Jl. Wolter Monginside, Manado, Indonesia]

Cassava. Waste utilization. Dairy cattle. Feeds and feeding. Dietary value. Digestibility. Proteins. Concentrates. Animal nutrition. Indonesia.

The possibility of using litter and onggok meal (cassava waste product) in diets for dairy heifers was studied using five 8-mo.-old Holstein-Friesian heifers in a 5 x 5 latin square design with a 10-day preliminary period and a 7-day period of data collection. Treatments were 100% Pennisetum purpureum (R_0), 97% rice bran (R_1), 57% rice bran + 40% litter (R_2), 52% rice bran + 40% litter + 5% onggok meal (R_3), 47% rice bran + 40% litter + 10% onggok meal (R_4). Results showed that crude fibre intake in diets containing 100% P. purpureum were higher than that of 40% litter in the concentrate ($P < 0.01$). TDN intake on the 100% P. purpureum ration was higher than that of other rations. The differences among treatments did not increase significantly DM intake and CP ($P > 0.05$). The digestibility of DM, crude fiber, and N-free extract of R_4 and R_0 was higher than that of R_2 ($P < 0.01$). CP digestibility increased more with R_3 than with R_1 ($P < 0.01$). N balance was positive in R_4. Daily wt. gain was higher in rations containing 40% litter + 10% onggok meal compared with the other treatments ($P < 0.05$). (Author's summary) H03

0118

19291 OBIOHA, F.C.; ANIKWE, P.C.N. 1982. Utilization of ensiled and sundried cassava peels by growing swine. Nutrition Reports International 26(6):961-972. Engl., Sum. Engl., 24 Refs. [Dept. of Animal Science, Univ. of Nigeria, Anambra State, Nsukka, Nigeria]

Cassava. Cortex. Uses. Feeds and feeding. Swine. Silage. HCN content. Amino acids. Animal physiology. Animal nutrition. Costs. Nigeria.

Four test diets comprising 21.8% ensiled cassava peels (ECP), 21.8% sun-dried cassava peels (SCP), 43.6% ECP and 43.6% SCP were evaluated in relation to a maize-based reference diet, using 25 growing Large White x Nigerian Local pigs. Av. daily gains, feed efficiency, digestible energy intake, and DM digestibility were significantly depressed at the 43.6% but not at the 21.8% level of cassava peel inclusion. However, feed intake (g/kg bodywt.$^{0.75}$) was not depressed by cassava peel. Ensilage generally improved gains and did not increase liver and kidney wt. or kidney fat as did the SCP diets. HCN intake was negatively and significantly correlated with gains, feed efficiency, and PER. Mortality or histopathological symptoms were not observed. Cassava peels reduced feed cost of gain by 24% and at the 21.8% of the diet were as good as the maize-based reference diet. (Author's summary) H03

0119

19501 OMOLE, T.A.; SONAIYA, E.B. 1981. The effect of protein source and methionine supplementation on cassava peel meal utilization by growing rabbits. Nutrition Reports International 23(4):729-737. Engl., Sum. Engl., 14 Refs. [Dept. of Animal Science, Univ. of Ife, Ile-Ife, P.M.B. 5029, Moor Plantation, Ibadan, Nigeria]

Cassava. Cortex. Cassava meal. Rabbits. Feed constituents. Feeds and feeding. Dietary value. Proteins. Supplements. Animal physiology. Animal nutrition. Nigeria.

A total of 120 six- to seven-wk.-old New Zealand White x Chinchilla rabbits were used to evaluate the utilization of cassava peel meal (CPM) in 2

separate expt. Diets containing 0, 20, and 40% CPM with either fish meal (FM) or groundnut cake (GC) as the sole protein supplement were fed to 6 groups of rabbits in the 1st study while each of the 6 diets was further supplemented with 0.20% met. and fed to another group of rabbits in the 2nd trial. Live performance, carcass characteristics, and blood and urine SCN levels were assessed in fryer rabbits. The 40% CPM diet was not significantly ($P > 0.05$) different from the 20 or 0% CPM diet in feed intake, daily gain, or feed efficiency. FM diets were consistently superior to GC diets especially at the 40% CPM level ($P < 0.05$). Except at the 40% CPM level, met. supplementation equalized the 2 protein sources and lowered serum and urine SCN levels. The expt. seem to indicate that up to 40% CPM could be acceptable to rabbits fed FM supplements and that GC may replace FM to a large extent in CPM diets supplemented with met. (Author's summary) H03

0120

17195 PEU UTILISE dans les aliments volailles en France, le manioc est "sorti" des formules alimentaires au printemps. (Cassava, scarcely used in poultry feed in France, has been eliminated from spring feed formulas). Aviculteur 392:39-41. 1979. Fr., illus.

Cassava. Cassava products. Uses. Feeds and feeding. Animal nutrition. France.

Data is given on cassava, one of the main products used by French manufacturers for energy substitution in poultry and swine rations (800,000 t) up to the spring of 1979. In 1977 the prices of cassava were attractive, being purchased by Dutch, German, and French processors. Three products are on the market: locally produced pellets and special grade pellets (62 and 65% starch, resp.); chips (70-75% starch), which have storage problems and low demand; and cut roots (only 1 shipment over 2 yr). The nutritive value of cassava is discussed as well as its dependence on storage conditions since heat and moisture cause fermentation, glucide degradation, and occurrence of fungi and anaerobic flora according to lab. analyses. Cassava can be used more successfully in swine nutrition (up to 45-50% in rations); rations for layers can include up to 40%. In rations for broiler chicks, limitations to its use are more technological than nutritional due to its pulverulent texture and the need to incorporate fat. The price of cassava-based products exceeded 80 F during the spring; therefore cassava will possibly be eliminated from rations during the 2nd semester of 1979. (Summary by I.B. Trans. by L.M.F.) H03

0121

18937 REVERON R., A.E.; RODRIGUEZ H., J.E. 1982. La yuca en la alimentación de rumiantes. (Cassava in ruminant nutrition). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:613-624. Span., 46 Refs. [Inst. de Investigaciones Zootécnicas, CENIAP, Ministerio de Agricultura y Ganadería, Apartado 4653, Maracay 2101, Venezuela]

Cassava. Calves. Dairy cattle. Beef cattle. Sheep. Goats. Uses. Animal nutrition.

Over the last years there has been a growing interest in cassava cultivation and its use in ruminant nutrition in Venezuela; research carried out in different parts of the world indicate that cassava can be used as a cereal substitute in ruminant rations. A general review is given on several of these studies, highlighting the importance of cassava in the nutrition of dairy cows, beef cattle, rations for bull calves, and to a

lesser extent, goats and sheep. Results of several feeding trials carried out with bull calves using rations containing different levels of cassava, mixed with other ingredients such as grasses, concentrates, molasses, and urea, are briefly discussed. Other studies on dairy cattle nutrition included mixtures with maize, oil cakes, cotton flour, and oats. Research results indicate a reduction in the cost of rations for ruminants, highlighting the potential value of cassava as a cereal substitute in animal nutrition. (Summary by EDITEC. Trans. by L.M.F.) H03

0122

19994 SANCHES, R.L.; RODRIGUEZ, N.M.; SOCORRO, E.P. DO; PIZARRO, A.E. 1982. Digestibilidade aparente de resíduo da producao de álcool a partir da mandioca. (Apparent digestibility of a by-product obtained from the production of alcohol from cassava roots). Arquivos da Escola de Veterinária da Universidade Federal de Minas Gerais 34(3):587-598. Port., Sum. Port., Engl., 36 Refs. [Ministerio de Agricultura, LANARA, MG, Brasil]

Cassava. Alcohol. Wastes. Sheep. Digestibility. Nutritive value. Waste utilization. Carbohydrate content. Mineral content. Animal physiology. Animal nutrition. Brazil.

A digestibility trial was conducted to study the nutritive value of a by-product obtained in cassava alcohol production. Eight adult wethers were kept in metabolism cages in a 4 x 4 Latin square design with 4 treatments: (1) by-product; (2) by-product + 10% molasses; (3) by-product + 1.5% urea; (4) by-product + 10% molasses + 1.5% urea. Water and minerals were available. Digestibility of DM, crude protein, crude fibre, and energy ranged from 33.74 to 39.71, 19.62 to 47.85, 31.00 to 38.27, and 40.21 to 44.99%, resp.; values were highest for treatments 3 and 4. Total digestible nutrients ranged from 43.40 to 46.45%. Contents of digestible energy were 1.80, 1.92, 1.98, and 2.02 and of ME, 1.62, 1.73, 1.80, and 1.81 kcal/g. Intakes of DM, crude protein, and ME per $kg^{0.75}$ were highest, (40.09 g, 5.62 g, and 74.92 kcal) with treatment 4. With urea N balance was positive. Poor intake and digestibility were ascribed to lignin content, 16.25%. Nutritive value of the plentifully available by-product, which presented no toxic hazards, was considered similar to that of low-quality tropical grasses. (Summary by Nutrition Abstracts and Reviews) H03

0123

19514 SISIFA, A.F. 1981. Village production of pigs using fresh cassava. Alafua Agricultural Bulletin 6(1):51-57. Engl., Sum. Engl., 22 Refs., Illus. [Ministry of Agriculture, Forests & Fisheries, Tonga]

Cassava. Cassava roots (vegetable). Foliage. Uses. Feed and feeding. Swine. Animal nutrition. Tonga.

Available information on the feed value and use of fresh cassava foliage in village pig raising systems are reviewed. Village subsistence and small-scale commercial or semicommercial intensive pig raising based on fresh sweet cassava is discussed with particular reference to Tonga. (Extracted from author's summary) H03

0124

19298 SONAIYA, E.B.; OMOLE, T.A.; ADEGBOLA, A.A. 1982. Effects of methionine-supplemented cassava meal diets on performance and carcass characteristics and some organ weights of growing-finishing pigs. Nutrition Reports International 26(1):25-34. Engl., Sum. Engl., 16 Refs.

[Dept. of Animal Science, Univ. of Ife, Ile-Ife, P.M.B. 5029, Moor Plantation, Ibadan, Nigeria]

Cassava. Cassava meal. Supplements. Fattening. Finishing. Swine. Methionine. Animal physiology. Animal nutrition. Nigeria.

CM, prepared from raw cassava flakes by sun drying and grinding, was included in balanced rations for growing-finishing pigs at levels of 0, 15, 30, and 45%; 0.05% DL met. was incorporated into the rations which were fed to pigs from 8.7 kg live wt. until slaughter. The 30% CM diet promoted the fastest rate of gain. All the diets containing CM induced faster growth than the control but they contained higher levels of fish meal. Carcass and organ measurements were not significantly influenced by dietary cassava. The 45% CM diet resulted in leaner carcasses. Growing pigs utilized rations with higher levels of CM more efficiently while finishing pigs made better wt. gains on diets containing lower levels of CM. (Author's summary) H03

0125

19984 TEWE, O.O.; AJAYI, S.S. 1982. Performance and nutrient utilization by the African giant rat (Cricetomys gambianus Waterhouse) on household wastes of some local foodstuffs. African Journal of Ecology 20(1):37-41. Engl., Sum. Engl., Fr., 7 Refs. [Dept. of Animal Science Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Cortex. Waste utilization. Dietary value. Dry matter. Ash content. Fibre content. Protein content. Fat content. Food energy. Animal nutrition. African giant rat. Nigeria.

Growth studies conducted with weanling domesticated giant rats showed that cassava peels, yam peels, plantain peels, maize chaff, cocoyam and yam tubers could not sustain satisfactory growth when fed alone. Digestibility of nutrients in these feedstuffs was generally low except for crude fibre, N-free extractives, and energy. Apparent digestibility coefficients in cassava peels were 35.6, -75.5, 33.51, -61.4, 66.2, and 39.0% for DM, CP, crude fiber, ether extract, N-free extractives, and energy, resp. Maize chaff showed significantly higher values ($P < 0.05$) than other feeds. The retention of energy was fairly low on all rations, while negative N retention was observed in all feeds except cocoyam tuber. (Author's summary) H03

See also 0104 0128 0135 0138 0159 0174 0175 0178 0185

H04 HCN Toxicity and Detoxification

0126

19219 OKE, O.L. 1983. Processing and detoxification of cassava. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues. Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.129-133. Engl., 5 Refs., Illus. [Faculty of Science, Univ. of Ife, Ile-Ife, P.M.B. 5029, Moor Plantation, Ibadan, Nigeria]

Cassava. Detoxification processes. Processing. Food products. Cassava products. HCN content. Nigeria.

Different methods of processing and of detoxifying cassava are given. Traditionally, cassava is processed into various dried products using

simple techniques. Traditional and mechanized production of gari, a granular free flowing product, is described. Fermentation takes place in 2 stages through the action of 2 microorganisms, Corynebacterium manihoc and Geotricum candida. Residual cyanide is very low (less than 10 ppm). Other foodstuffs derived from cassava roots are described: fufu, chickwangue, ntuka, and moteke. In some tropical regions, roots are fermented to make beer and also used in the production of alcohol. Some physiological mechanisms of detoxification are mentioned. Methods of reducing toxicity are discussed, such as removal of water contained in the root, followed by the elimination of residual glucoside by some form of heating. In other cases, detoxification is carried out by heating only (cooking or sun drying). Simple drying of roots is capable of removing about 90% of the glucoside at 60°C, but is less effective if heating is carried out at 100°C due to denaturing of linamarase. Traditional methods of processing cassava to remove cyanide should be studied more closely and more accurate analytical techniques are needed to determine and improve the principles involved in the detoxification process. (Summary by EDITEC. Trans. by L.M.F.) H04

0127

19563 PHILBRICK, D.J.; HILL, D.C.; ALEXANDER, J.C. 1981. Influence of dose level and methionine intake on the effects of linamarin administration to rats. Journal of Toxicology and Environmental Health 8(1-2): 159-168. Engl., Sum. Engl., 21 Refs. [Dept. of Nutrition, Univ. of Guelph, Ontario W1G 2W1, Canada]

Cassava. Toxicology. Linamarin. Laboratory animals. Biochemistry. Animal physiology. Methionine.

A total of 108 male rats were fed a semipurified diet providing 10% casein supplemented with met. for 2 wk., at which time some animals received the same diet without the met. for 4 days. Animals that received linamarin were given a single oral dose containing 500 or 250 mg/kg bodywt. At the higher linamarin dose all animals died within 5 h after dosing. Biochemical and physiological changes observed in these rats included severe metabolic acidosis, decreased cytochrome oxidase activities, atrial fibrillation, and decreased respiratory rates. In general, the cardiac adenosinetriphosphatase enzymes were inhibited by linamarin. None of these changes were moderated by dietary met. supplementation. At the lower linamarin dose dietary supplementation with met. appeared to reduce incidences of clinical toxicity signs and fatalities. No met. effect was observed in the other biochemical and physiological measurements in rats given this amount of linamarin. Results suggest that dietary supplementation with met. provided some protection against the toxicity of the lower level of linamarin administered. (Author's summary) H04

0128

19217 TEWE, O.O. 1983. Thyroid cassava toxicity in animals. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.114-118. Engl., 15 Refs. [Nutritional Biochemistry Division, Dept. of Animal Science, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Toxicity. Cultivars. HCN content. Animal physiology. Nigeria.

Studies carried out at the U. of Ibadan, Nigeria, and at CIAT to quantify HCN levels of Nigerian cassava var. and their implications with respect to thiocyanate production, I metabolism, and thyroid histology during the growth and reproductive phases of life are reported. Whole roots of bitter

cv. averaged 74.5 ppm HCN, whereas those of sweet cv. averaged 32.9 ppm. Different studies have reported increased serum thiocyanate concn. in rats and humans fed cassava-based diets; pathological lesions have been observed in the thyroid of pigs. The interaction of cyanide, protein, and I in thiocyanate production and I metabolism were investigated in rats and pigs. Results indicate that thyroid cassava toxicity can be aggravated by consuming cassava diets that are not nutritionally balanced. Two studies were conducted on rats and pigs to monitor the effect of cassava diets on placental thiocyanate transfer, I metabolism, thyroid wt., and histology in gestating animals. A fresh cassava diet containing 173 ppm HCN increased thiocyanate concn. of urine, serum, and amniotic fluid from gestating rats. In pigs similar changes were observed and milk thiocyanate and colostrum I concn. were significantly higher (P 0.05). (Summary by EDITEC. Trans. by L.M.F.) H04

See also 0008 0112 0145 0183

100 PROCESSING, PRODUCTS AND USES

101 Cassava Starch and its Properties

0129

19989 FAJARDO, M.N. 1981. Saccharification of cassava (Manihot esculenta Crantz) root powder by glucoamylase immobilized on diethylaminoethyl-Sephadex. Mag.Sc. Thesis. College, Laguna, University of the Philippines at Los Baños. 75p. Engl., Sum. Engl., 34 Refs., Illus.

Cassava. Cassava starch. Biochemistry. Enzymes. Analysis. Saccharification. Processing. Gelatinization. Viscosity. Philippines.

The catalytic activity of glucoamylase immobilized of DEAE (diethylamino ethyl)-Sephadex was evaluated in a fluidized-bed reactor for the saccharification of cassava root powder. Substrate pretreatments included heat gelatinization, acid prehydrolysis, and thinning with alpha-amylase. The cassava root powder preparations which had been thinned with alpha-amylase were finally selected for the saccharification trials. The immobilized enzyme system exhibited the highest activity at 55°C. Higher saccharification values of cassava root powder were obtained with 10% than with 20% solids level. For both substrate concn. tested, lower flow rates led to higher conversion of starch to sugar by the enzyme reactor system. Highest concn. of reducing sugar (w/v) from the combined activities of alpha-amylase and immobilized glucoamylase were obtained at 20% solids level at the lowest flow rate tested. (Author's summary) I01

0130

19529 GALLANT, D.J.; BEWA, H.; BUY, G.H.; BOUCHET, B.; SZYLIT, O.; SEALY, L. 1982. On ultrastructural and nutritional aspects of some tropical tuber starches. Starch/Stärke 34(8):255-262. Engl., Sum. Engl., Germ., 10 Refs., Illus. [LTAA - Microscopie, INRA, Centre de Recherches Agroalimentaires, 44072, Nantes Cedex, France]

Cassava. Cassava starch. Analysis. Nutritive value.

Type A starches (Manihot utilissima, Dioscorea dumetorum, and Colocasia antiquorum) and type B starches (Canna edulis, D. alata, and D. cayenensis) are investigated. The degradation of the pure tuber starch as compared with that of feeds made from a particular starch is more or less the same. Type

A starches are more rapidly degraded by bacterial alpha-amylase. The susceptibility to attack is compared with the nutritional efficiency of the feeds using axenic and holoxenic chickens. Comparison of the degree of degradation of the starch granules in the crop and in the feces (by in vitro and in vivo studies) is made by scanning electron microscopy. Type A starches always show a higher susceptibility to alpha-amylase attack. The feed efficiency tested on chicken and digestibility of tuber starches in the sheep rumen and in the chicken crop increase as their ease of degradation by bacteria alpha-amylase (in vitro) increases. (Author's summary) I01

0131

19297 LORENZ, K.; KULP, K. 1982. Cereal and root starch modification by heat-moisture treatment. 1. Physico-chemical properties. Starch 34(2): 50-54. Engl., Sum. Engl., Germ., 12 Refs., Illus. [Dept. of Food Science & Nutrition, Colorado State Univ., Fort Collins, CO 80523, USA]

Cassava. Cassava starch. Analysis. Modified starches. Gelatinization. Viscosity.

The effects of heat-moisture treatment of varied severity (18, 21, 24, and 27% moisture and 16 h at 100°C) on the physicochemical parameters of 3 cereals (barley, triticale, red millet) and 2 tuber starches (arrowroot, cassava) were studied. The treatment restricted the swelling powers of all tested starches. Solubilities of cereal starches increased while those of the tuber starches were reduced at 90°C, indicating different types of reorganization of the starch polymers in the 2 types of granules. Enzyme susceptibilities and water-binding capacities were augmented by the treatment. X-ray diffraction studies showed decreases in degree of crystallinity of cereal starches and changes of C-pattern to A-pattern of tuber starches by the treatment. Effects on pasting properties are also given. (Author's summary) I01

0132

19524 MOORTHY, S.N. 1982. Behaviour of cassava starch in various solvents. Starch/Stärke 34(11):372-374. Engl., Sum. Engl., Germ., 16 Refs. [Central Tuber Crops Research Inst., Trivandrum 695017, Kerala, India]

Cassava. Cassava starch. Gelatinization. Viscosity. Analysis. India.

Solubilization and gelatinization of cassava starch in various solvents of different polarity and water miscibility were studied. Formalin was also used. Results indicated that starch gelatinizes in dimethylsulfoxide (DMSO), ethanediol, glycerol, and formalin at varying temp. The viscosity of 2% solution in these solvents varies largely. The clarity is almost equal, whereas solution stability is highest in case of formalin. The I staining expt. shows that, in formalin solution, a reversible complex is formed between starch and formaldehyde. (Author's summary) I01

I02 Uses, Industrialization, Processing and Storage

0133

19985 AGUIRRE, J.M. DE; TRAVAGLINI, D.A.; TRAVAGLINI, M.M.E.; FERREIRA, V.L.P.; SHIROSE, I.; FIGUEIREDO, I.B. 1978. Aproveitamento do resíduo de extrato protéico de soja em mistura com farinha de mandioca. (Utilization of soybean milk residue for protein enrichment of cassava flour).

Boletim do Instituto de Tecnologia de Alimentos no.56:129-156. Port., Sum. Port., Engl., 17 Refs.

Cassava. Cassava flour. Soybean flour. Composite flours. Waste utilization. Protein enrichment. Nutritive value. Organoleptic examination. Composition. Brazil.

Two processes for incorporating soybean milk residues into different types of CF (crude and "baiana") were studied: (1) The residue was incorporated during processing, just before the drying stage. (2) Dried CF and soybean milk residue were simply mixed. Samples of the final product were evaluated on the basis of their physical aspects, chemical composition, and organoleptic and nutritional characteristics. The addition of up to 40% soybean milk residue to both types of flour was feasible, resulting in products with at least 10% protein, and with good organoleptic qualities. Preliminary results showed that the products presented satisfactory PER values as compared with the PER values of casein. For the samples obtained by the dried components mixture process, the PER values were superior to those found in the samples obtained by the predying mixture process. (Author's summary) I02

0134

11791 BALEEIRO, R.R. 1979. Potencial agrícola do Estado da Bahia para a producao de álcool de mandioca. (Agricultural potential of the state of Bahia for cassava alcohol production). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.277-282. Port.

Cassava. Alcohol. Brazil.

The participation of Brazil in the international cassava market (chips and starch) is outlined and the state and perspectives of cassava growing in the state of Bahia, major cassava producing state of Brazil (expected production in 1979 = 4,563,000 t), are analyzed. Alternatives for alcohol production in Bahia are discussed. Characteristics found lead to the following conclusions: (1) there is a regular supply of the product; (2) cassava growing is carried out on small farms that would benefit from the National Alcohol Program (PRO-ALCOOL); (3) a possibility exists to specialize in certain areas (for alcohol or for flour production); (4) there is a possibility of increasing the farmers' actual income with the resulting social benefits that would prevent rural emigration and provide direct or indirect employment; and (5) cassava cultivation will possibly not become large-scale, as in the case of sugar cane, since apt lands are abundant, soil and climate requirements are few, and the av. productivity can be increased (currently 15 t/ha) through new agricultural technology, without increasing the area cultivated. (Summary by I.B. Trans. by L.M.F.) I02

0135

18932 BLANCO, O. 1982. Evaluación del procesamiento de yuca. (Evaluation of cassava processing). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:479-505. Span. [Univ. Simón Bolívar, 80659 Prados del Este, Caracas, Venezuela]

Cassava. Factories. Technology evaluation. Cassava chips. Cassava meal. Pellets. Feeds and feeding. Venezuela.

The evaluation of cassava processing in Venezuela involved the following steps: (1) examination of operativeness and operation problems of cassava

processing plants, (2) search for information about optimum cassava processing, (3) survey on cassava utilization in feed concentrates, (4) visit to and technical diagnosis of cassava mills, (5) evaluation of the technical diagnosis of the processing plants for each level of processing and line of production, and (6) technical feasibility of improving problems of transportation, receipt, and storage to reduce the cost of the end product. The processing plants of Caicca, Caipaca, El Piñal, and Agroinmoca were visited and a technical diagnosis of each was made. These have a production capacity of 10,000, 70,000, 80,000, and 100,000 kg/day, resp., of CM, pellets, starch, and feed concentrates. The main processing equipment of each plant was assessed, giving specific recommendations for each. Seven alternatives for distributing the different operations of the production process among the farmers, the cassava mill, and the feed concentrate factory are proposed and analyzed. (Summary by EDITEC. Trans. by L.M.F.) 102

0136

18933 BOCCALANDRO, A.; CASALTA, M.; KOTZER, M. 1982. Producción de glucosa a partir de yuca. (Glucose production from cassava). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:507-514. Span., 58 Refs. [Agroindustrial América, C.A., Caracas, Venezuela]

Cassava. Cassava starch. Uses. Glucose industry. Venezuela.

Two systems for producing glucose from cassava starch are briefly described. In the 1st system starch is mixed with HCl in a tank with agitators and then is passed to another tank with a temp. of 145°C for 5-7 min. This mixture is neutralized with sodium carbonate to a pH value of 4.7-4.8 and cooled to 75°C. Refining follows, the mixture being filtered in a 3-stage-process through tanks with activated C, a rotary vaccum filter with diatomaceous earth, and another filter. It is finally concentrated to 80.3% DM in heated tubes that form films that evaporate easily. The 2nd system uses the alpha- and beta-amylase enzymes to liquefy starch in continuous tubular heat exchangers that reach temp. between 86-88°C. There starch is gelled and liquefied. It is then heated rapidly to 140-150°C to assure complete dispersion allowing enzymatic action to occur. The temp. is lowered to 86-88°C and liquefaction is completed. It is cooled to 60°C and sent to saccharification tanks where the mixture is acidified at a pH of 4.7. Amyloglucosidase is then added and the mixture is maintained at constant temp. during 48-72 h to be purified and concentrated in the same manner as the 1st system. Cassava can produce 12 t more anhydrous glucose/ha than sugarcane. (Summary by EDITEC. Trans. by L.M.F.) 102

0137

19547 BONOMI, A.; ABOUTBOUL, H.; SCHMIDELL, W. 1981. Simulation of the continuous fermentation of manioc hydrolysate. Biotechnology and Bioengineering 11(suppl.):333-357. Engl., Sum. Engl., 16 Refs., Illus. [Promon Engenharia S.A., Avenida 9 de Julho, 4949,01407, Sao Paulo-SP, Brasil]

Cassava. Hydrolysis. Fermentation. Statistical analysis. Simulation models. Ethanol. Productivity. Brazil.

The simulation of the continuous fermentation of cassava hydrolysate utilizing a yeast strain of Saccharomyces cerevisiae, isolated from the commercial pressed yeast largely employed in Brazilian distilleries, is discussed. The model used in the simulation is derived from batch exptl. runs. In order to assess the economical competitiveness of the continuous

fermentation, some additional concepts, such as cell recycle, and 2 fermentors connected in series with and without feed division of fresh substrate, are analyzed and compared. (Author's summary) 102

0138

18973 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Utilización de la yuca. (Cassava utilization). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.231-250. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Roots. Dry matter. Starch content. Timing. Cultivars. Sugars. Cyanides. Leaves. Uses. Cassava chips. Solar drying. Piglets. Chicks. Technology evaluation. Animal nutrition. Colombia.

The factors affecting the quality of cassava roots were studied: var. and age of the plant; DM, starch, and sugar contents in the roots; cyanide contents in leaves and roots. Roots of bitter var. CMC-84 showed higher DM contents than those of sweet var. CMC-40. Total and reducing sugar contents followed slightly different trends throughout the 9-12 mo. period in both var. Total cyanide content in CMC-84 was less affected by age than that of CMC-40; root parenchyma tissue had moreless stable total cyanide content in both var. Expt. were conducted on the effect of drying cassava on concrete floors and on inclined trays on HCN elimination. Both methods efficiently reduced HCN levels for animal feeding. Sun drying on trays and oven drying were compared. For all var., oven drying at 60°C produced dried chips with a lower HCN content ($P \leq 0.05$). The silage process of CMC-40 reduced total cyanide content to 25-36% of the initial concn. after 6 mo. Piglet preference for diets containing 0, 14, 20, 28, and 40% CM was studied and a consistent preference was found for diets containing 28 and 40% CM. In 1 expt. 53% of the total feed consumed contained 40% CM. In expt. carried out with broilers, results indicated that CM can be used up to 20% without causing nutritional problems. Preliminary information was also obtained on cassava processing for the animal feed market on the north coast of Colombia, through a pilot collaborative project carried out by the Integrated Rural Development Program (DRI), the Canadian International Development Agency, and CIAT. (Summary by EDITEC. Trans. by L.M.F.) 102

0139

19990 CHITTENDEN, A.E.; HEAD, S.W.; BREAG, G. 1980. Anaerobic digesters for small-scale vegetable processing plants. London, Tropical Products Institute. Report no.G139. 28p. Engl., Sum. Engl., Fr., Span., 7 Refs., Illus.

Cassava. Waste utilization. Biogas production.

The digestion of vegetable materials for biogas production for small industrial purposes was studied to obtain practical experience in both biogas digester design and operation with the possible application of the process to waste products from cassava peelings. The digester used was designed for continuous operation and was approx. 3 m^3 in vol. It proved impracticable to operate the digester below 30°C while still obtaining worthwhile gas production. The operating temp. was therefore kept above that commonly found in tropical countries. As it was not possible to obtain cassava residues in sufficient quantities to operate this plant, potatoes were utilized as a substitute. To compare these results to operation on cassava, expt. were also carried out in a 5 l fermentation vessel operating at 35°C on potatoes, peeled cassava tubers, and cassava

peelings. Details of the rate of gas production and performance of the plant (3 m^3) under various operating conditions are given. Energy requirements for the process are also considered. (Author's summary) 102

0140

18931 DAVILA V., A. 1982. Estudio técnico-económico del proceso de transformación de la yuca. (Technicoeconomical study of the process of cassava transformation). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31: 451-477. Span., Illus. [IICA, Fondo Simón Bolívar, Apartado. 55, Coronado, Provincia de San José, Costa Rica]

Cassava. Processing. Factories. Costs. Cassava meal. Pellets. Cassava flour. Venezuela.

The situation of Venezuelan cassava root processing plants is reviewed on general basis. Processed products, installment capacity, investment, location, and current status are described. There are 11 plants for processing flour, pellets, chips, balanced feed, and starch. Some are just being installed. Others have problems with the supply of raw material. Capacities of processing cassava roots varied between 12,960 and 36,000 t/yr. Costs of the different processes involved in transforming roots into CF, pellets, chips, and flour for breadmaking for a pilot plant are included as well as maps that locate the geographic distribution of cassava production zones and the processing plants. Variable costs of cassava processing for animal feeds represent 85% of the total costs and the substitution of sorghum by cassava is not economically feasible. Therefore it is recommended to use cassava for starch and alcohol production. (Summary by EDITEC. Trans. by L.M.F.) 102

0141

20112 DIAS, A.B.; SICSU, A.; KATZ, F. 1981. Mandioca e cana-de-acúcar: exploracoes sobre uma talvez feliz complementaridade. (Cassava and sugarcane: a possibly happy complementarity). Revista de Economia Rural (Brasil) 19(1):35-49. Port., Sum. Port., Engl., 5 Refs. [CME-PIMES/UFPE, Univ. Federal de Pernambuco, Cidade Universitaria, Recife-PE, Brasil]

Cassava. Uses. Alcohol. Energy productivity. Brazil.

An innovative complementary use of cassava and sugarcane to produce alcohol in Brazil is presented. The current performance of both crops is analyzed on the basis of new technology. The complementary use of sugarcane/cassava (cassava or cassava chips used between cane crops) allows the annual production of alcohol to expand 50%, with the same capacity of distillation currently installed and without significantly increasing the amount of capital destined for the industrial stage of alcohol production. The lower soil requirements of cassava allows lands of lower opportunity costs, that could not be used for cane production, to be employed thus incorporating these poorer lands to energy production and extending the benefits of PROALCOOL to regions and populations not yet benefited. Other aspects are analyzed such as the possibility of using bagasse in the process of cassava alcohol production. Further analysis of the principal variables and aspects is needed to promote a rational energetic policy, mainly regarding liquid vegetal fuel to substitute those of mineral origin. Each of the alternatives to the expansion of alcohol production should be examined: (1) expansion of cultivated area, maintaining current practices; (2) additional production of sugarcane molasses to produce alcohol out of the crop seasons; (3) complementary use of raw cassava; and (4) complementary use of

cassava chips. Private and social cost of production and stock formation and maintenance should be taken into account as well. (Author's summary) I02

0142

19559 FLORES, D.M.; GARCIA, V.V.; URITANI, I. 1983. The relationship between methods of making cassava flour and coumarin formation during drying. Nippon Shokuhin Kogyo Gakkaishi 30(3):175-177. Engl., Sum. Engl., Jap., 8 Refs. [Dept. of Food Science & Technology, Univ. of the Philippines at Los Baños, College, Laguna, 3720, Philippines]

Cassava. Laboratory experiments. Cassava flour. Processing. Coumarin. Drying. Biochemistry Analysis. Philippines.

The relationship between methods of making CF and coumarin formation during drying was studied in order to determine the most suitable method of making CF in tropical regions and of evaluating the quality of CF or cassava chips. Harvested roots of cv. Lakan were dried in 3 different ways: (1) sun dried for about 6 h, then oven dried at 45-50°C for 10 h; (2) microwave for 5 min before sun or oven drying; (3) dried in a cabinet drier with air blower at 40°C for 16 h. All were pulverized in a coffee mill. Roots of cv. Golden Yellow were sliced 30 and 10 mm thick and sun dried for 28 and 21 h, resp., and then pulverized. Pulverized sun-dried chips approx. 20-40 mm thick of white flesh type were also used. UV-light exposure on the developed TLC plate indicated the presence of the stress metabolites, scopoletin, esculin, and scopolin in the alcoholic extracts of CF. The intensities of the bluish fluorescence obtained from the 3 coumarin derivatives varied, depending on the methods of making CF. Fast drying hardly enabled the slices to form coumarin derivatives, producing fine quality CF. (Author's summary) I02

0143

19537 GREENFIELD, P.F.; BROOKS, R.B. 1982. Processing of cassava to produce ethanol—effect of raw material preparation. Starch/Stärke 34(6):192-197. Engl., Sum. Engl., Germ., 5 Refs., Illus. [Dept. of Chemical Engineering, Univ. of Queensland, St. Lucia, Qld., Australia 4067]

Cassava. Hydrolysis. Fermentation. Processing. Alcohol. Analysis. Cassava starch. Composition. Australia.

The effect of disintegration severity on starch hydrolysis and ethanol production from cassava roots and stems was evaluated. A considerable fraction of the starch in the roots was made available for hydrolysis with relatively crude processing; all such material was readily fermented. To achieve a very high fermentables yield, either very intensive processing or, preferably, a 2-stage process, with the 2nd stage being applied only to the oversize material, is required. Whether it is economically viable to process the oversize material further depends on a no. of site-specific factors. The 2-stage option appears the more attractive alternative especially in small- to medium-size cassava to ethanol plants because of the need to minimize power requirements and thereby steam usage. (Author's summary) I02

0144

19502 HUG, H.; PFENNINGER, H. 1980. Cassava als Rohstoff für die Bierherstellung. (Cassava as raw material for beer production). Brauerei-Rundschau 91(9):149-153. Germ., 8 Refs.

Cassava. Cassava flour. Cassava starch. Cassava chips. Uses. Cassava beer.

Botanical and economic aspects of cassava are discussed and chemical composition is described. Cassava chip flour and cassava starch were used in pilot plant scale brewing trials, being combined with malt at 50:50 or 30:70 malt:cassava ratios, in 1- or 2-mash decoction processes, or in infusion mashing. Analytical data of resulting worts and beers are tabulated in detail. Although use of cassava led to difficulties at lautering, dark color, and low total and amino N, suggestions are made for improving processing quality, such as use of simple filter aids, use of cassava starch instead of cassava chips, and use of the infusion process. Beers made from 50:50 malt:cassava were still of acceptable sensory quality. The possible use of domestic cassava as an adjunct in brewing in tropical countries is demonstrated. (Summary by Food Science and Technology Abstracts) 102

0145

19527 IKEDIOBI, C.O.; ONYIKE, E. 1982. The use of linamarase in gari production. Process Biochemistry 17(4):2-5. Engl., Sum. Engl., 12 Refs., Illus. [Dept. of Biochemistry, Ahmadu Bello Univ., Zaria, Nigeria]

Cassava. Linamarase. Uses. Gari. Fermentation. Detoxification processes. Enzymes. Nigeria.

The detoxification of cassava associated with fermentation depends on endogenous linamarase hydrolysis of the constituent cyanogenic glucosides. Addition of exogenous linamarase preparations to fermenting grated cassava not only increased the rate and extent of detoxification but also consistently yielded gari with innocuous levels of cyanide. A preliminary screening of several fungal isolates for their ability to synthesize linamarase, resulted in the identification of 2 fungi, Penicillium steckii and Aspergillus sydowi, capable of producing this enzyme in commercial quantities. The use of linamarase or linamarase-producing fungi in cassava fermentation for gari production may be an interesting possibility. (Author's summary) 102

0146

19531 KUNHI, A.A.M.; GHILDYAL, N.P.; LONSANE, B.K.; AHMED, S.Y.; NATARAJAN, C.P. 1981. Studies on production of alcohol from saccharified waste residue from cassava starch processing industries. Starch/Stärke 33(8): 275-279. Engl., Sum. Engl., Germ., 20 Refs., Illus. [Central Food Technological Research Inst., Cheluvamba Mansion, V.V. Mohalla P.O., Mysore 570013, India]

Cassava. Cassava starch. Factories. Waste utilization. Alcohol. India.

A fibrous waste residue (20%) obtained in the manufacture of starch and sago from cassava poses disposal problems. Fermentation studies, using Saccharomyces cerevisiae, for the production of alcohol on saccharified waste revealed that enrichment with mineral salts and N is essential. An inoculum size of 24.2×10^6 cells/50 ml medium was optimal, while highest quantity of alcohol formed with 96 h fermentation. Though optimum initial sugar concn. in the fermentation medium was about 15%, the saccharified waste needed expensive concn. treatment to raise the sugar concn. to the optimum level. Economic considerations suggest the use of saccharified waste without concn. (Author's summary) 102

0147

11796 MELLO, J.C.; URBAN, C.W. 1979. Aspectos economico-energéticos do etanol de mandioca. (Economic and energetic aspects of cassava ethanol). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.283-322. Port., Illus.

Cassava. Ethanol. Factories. Industrialization. Productivity. Economics. Processing. Brazil.

Technical data are summarized from diverse sources (Empresa de Assistencia Técnica e Extensao Rural, Empresa de Pesquisa Agropecuária de Minas Gerais, INDI, Instituto do Acúcar e do Alcool, Fundacao Instituto Brasileiro de Geografia e Estatística, and farmers' meetings) on ethanol production from cassava and other starchy, saccharíferous, or cellulosic farm products (biomass) which mainly differ in the stages of supply and preparation for fermentation within the process of alcohol production. The establishment of polyvalent factories that use more than one raw material is thus made possible. The utilization of the whole cassava plant, social and economic benefits, and the possibility of technical improvement are highlighted and examples are given. Agricultural, industrial, and energetic advantages of cassava and sugarcane as raw materials for alcohol production are compared in detail, cassava having favorable results (e.g., the energy input in the industrial phase would be 1380-1420 kcal/l for cassava vs. 1780-2000 kcal/l for sugarcane). Tables and figures are included. (Summary by I.B. Trans. by L.M.F.) 102

0148

11765 MENEZES, T.J.B. DE 1979. Avancos tecnológicos e perspetivas de aplicacao na producao de álcool da mandioca. (Technological advances and possibilities of application in cassava alcohol production). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais, Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.181-187. Port.

Cassava. Alcohol. Industrialization. Brazil.

Cassava alcohol production is discussed in relation to the energy balance of the process and the factors that determine whether this balance is favorable or not. Major advances in technology, aimed at overcoming the difficulties that occur when cassava is used for alcohol production, are described. The possibilities of industrial improvement are discussed, based on the consideration that the energy balance is a means to detect faults in the production process. These improvements involve: (1) the search for an adequate fuel; (2) saccharification; (3) production of enzymes; (4) continuous cooking; (5) immobilization of saccharifying enzymes; (6) microwave cooking; and (7) use of cellulase as an aid in the saccharification of cassava pastes. (Summary by I.B. Trans. by L.M.F.) 102

0149

11811 PARENTE, E.J. DE S.; CARIOCA, J.O.B.; ARORA, H.L.; SAEED, K.A.; SAMPAIO, F. 1979. Sistema mandioca - Aguapé. [Cassava - water hyacinth (Eichhornia crassipes)]. In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.323-349. Port., 6 Refs., Illus.

Cassava. Production. Statistical data. Alcohol. Industrialization. Economics. Brazil.

A model of cassava alcohol production (20,000 l capacity) is outlined; the energy source for the process is the biogas from anaerobic digesters that use the water hyacinth (Eichhornia crassipes), an aquatic plant with extraordinary growth and propagation rates, as raw material. The system of integration proposed would consist of a lagoon to cultivate water hyacinth, installment of anaerobic digesters, a vapor and electricity generating unit, and a cassava alcohol production unit. The biogas produced serves as fuel of a boiler feeding a low-pressure turbogenerator for the industrial process. The filtrate from the biodigester would be returned to the lagoon, the residues (cake) would be used as fertilizer for cassava crops, and the surplus would be pelleted for commercialization. The process of obtaining cassava alcohol is explained. The fibers resulting from this process, together with the residual broth of fermentation and of distillation and the recovered yeast, would make up a ration for bovine cattle, along with the aerial part of cassava plants. Part of the bovine manure would be used in obtaining greater efficiency in anaerobic biodigestion. Details and background of the project are given in table form and in flow charts. The use of planted forest growth as alternative energy source is also mentioned. (Summary by I.B. Trans. by L.M.F.) 102

0150

19241 PARK, Y.K.; CRUZ R., B. 1982. Alcohol production from various enzyme-converted starches with or without cooking. Biotechnology and Bioengineering 24(2):495-500. Engl., 5 Refs., Illus. [Univ. Estadual de Campinas, Faculdade de Engenharia de Alimentos, C.P. 1170, Campinas-SP, Brasil]

Cassava. Cassava starch. Ethanol. Enzymes. Fermentation. Industrial Microbiology.

The effectiveness of alcoholic fermentation from cassava, maize, potato, and babassu starches was compared. Aspergillus awamori NRRL 3112 and A. niger were isolated from beiju (naturally fermented cassava mash) and were used for production of amyloglucosidase. Bacillus subtilis NRRL B-941 was used for production of bacterial alpha-amylase and bakers' yeast for alcohol fermentation. The preparation of amyloglucosidase and bacterial alpha-amylase is described as well as the assay carried out to determine enzyme activity. Two procedures of alcohol fermentation, with cooked starch or without cooking, were used. Alcohol yields from raw starch were 90.0, 89.0, 48.9, and 11.4%, resp., for maize, cassava, babassu, and potato. When starches were cooked and liquefied by bacterial alpha-amylase, higher yields were obtained: 93.9, 92.0, 73.0, and 91.0%, resp. The degree of hydrolysis of the different starches by purified amyloglucosidases showed formation of reducing sugars at levels of 15.7, 15.2, 0.9, and 0.7 mg/ml for maize, cassava, babassu, and potato starches, resp. (Summary by EDITEC. Trans. by L.M.F.) 102

0151

19997 PASSOS, E.F.; FORTES, M.; MELLO, J.C. 1982. Condutividade térmica da pasta de mandioca. (Thermal conductivities of cassava paste). Revista Ceres 29(162):222-231. Port., Sum. Port., Engl., 12 Refs., Illus. [Depto. de Física, Univ. Federal de Vicosa, Av. P.H. Rolfs S/N, 36.570 Vicosa-MG, Brasil]

Cassava. Cultivars. Cassava pastes. Analysis. Biochemistry. Laboratory experiments. Brazil.

Thermal conductivities of pastes of different cassava var. were measured as functions of MC. The thermal conductivities of 2 different var. were

compared and a statistical analysis yielded no significant difference at the 5% significance level between the regression equations. A preliminary study on the effect of enzymes on paste thermal conductivity is presented. (Author's summary) 102

0152

18942 RIBEIRO FILHO, F.A. 1982. O programa brasileiro de producao e utilizacao de etanol. (The Brazilian ethanol production and utilization program). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:703-739. Port., Illus. [Petrobrás Química, S.A., Rio de Janeiro, Brasil]

Cassava. Alcohol. Uses. Cultivation. Statistical data. Economics. Brazil.

The National Alcohol Program of Brazil (Proálcool) seeks to increase the production of alcohol for fuel and as a raw material for industrial purposes. Incentives and restraints for program development are given. Different aspects of the use of cassava and sugarcane for alcohol production are compared, namely, costs, other inputs used, by-products, advantages and disadvantages. Likewise, flow charts are given for producing fuel from other raw materials. Production expected for 1985 is 10,700 x 10^6 l while that expected for 1981 was 4071 x 10^6 l. In Brazil there is low productivity of sugarcane, which can be partially substituted by cassava that is grown more extensively. Programs on the use of fuel alcohol include: substitution of gasoline and diesel oil, and generation of electricity and gas for domestic use. (Summary by EDITEC. Trans. by L.M.F.) 102

0153

19503 SAINT, W.S. 1982. Farming for energy: social options under Brazil's National Alcohol Programme. World Development 10(3):223-238. Engl., Sum. Engl., 52 Refs. [Fundación Ford, Apartado 6025, Lima, Perú]

Cassava. Production. Cultivation. Alcohol. Socio-economic aspects. Brazil.

The 1st 5 yr of the Brazilian National Alcohol Program are assessed in terms of their stated social objectives of reducing regional inequalities and rural-urban income disparities, and expanding employment opportunities. The effects of energy production systems based on the 2 principal competing energy feedstocks, sugarcane and cassava, are compared in terms of these objectives, as well as their impact on land distribution, food supply, migration, and environment. Greater use of cassava is clearly indicated from a social standpoint, but initial policies, influenced by institutional interests, have favored sugarcane. Possible strategies for enhancing the Program's social development potential are suggested. (Author's summary) 102

0154

11864 SANTOS, M.L. DOS; COUTINHO, P.H. DE A. 1979. Aplicacao de álcool para fins energéticos e nao-energéticos. (Alcohol applied for energetic and nonenergetic purposes). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.357-372. Port., 4 Refs., Illus.

Cassava. Ethanol. Uses. Brazil.

A general review is given of the current state of projects in progress and sponsoring entities and the prospects of applying ethyl alcohol obtained

from different raw materials, including cassava, in Brazil. Improved technology is being used for cassava alcohol production, e.g. at the factory in Curvelo. Among the energetic purposes of alcohol, on the basis of the equipment used, are the use of alcohol in boilers and ovens, turbines, in Otto-cycle motors, Diesel engines, and domestic gas. Among nonenergetic purposes (alcohol chemistry), the economic advantages and strategies of partial substitution of raw materials with alcohol are given for naphtha substitution, production of vinyl acetate monomer, and production of dichloroethane, using the same processes and without additional investments. The sell of technology to other countries has already been discussed regarding the last process, developed by Petrobras. Tables on major alcohol-based products that can be obtained and on perspectives in Brazil are included. The increased use of hydrated alcohol has been more marked than that of anhydrous alcohol. The advantages of using cassava as raw material in the production of alcohol are discussed. (Summary by I.B. Trans. by L.M.F.) 102

0155

11760 SCHINDLER-LORENZ, F. 1979. Alcool de mandioca. (Cassava alcohol). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-Ba., 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.161-170. Port.

Cassava. Alcohol. Industrialization. Brazil.

Two forms of preparing cassava when used as raw material in the elaboration of alcohol are compared regarding the advantages offered during the different stages of the industrial process. The 1st used the whole cassava root and in the 2nd, there was a previous separation of the pulp and obtainment of starch milk. The disadvantages of the 1st system are discussed and the stages of the 2nd system are described in detail: preparation of the roots, disintegration of the roots, preparation of the pulp, hydrolysis, saccharification, fermentation, distillation, utilization of yeasts and residual products. Precautions that should be taken with the 2nd system are given as well as the advantages it offers. (Summary by I.B. Trans. by L.M.F.) 102

0156

18950 SILVA, J.R. DA 1980. A producao de raspas de mandioca no Brasil utilizando a energía solar. (Production of cassava chips in Brazil using solar energy). Brasil, Ministerio da Agricultura. Secretaria Nacional de Producao Agropecuária. 27p. Port., 2 Refs., Illus.

Cassava. Cassava chips. Feeds and feeding. Uses. Processing. Solar drying. Costs. Animal nutrition. Brazil.

Aspects of cassava production in Brazil related to its processing for industrial purposes and for human and animal nutrition are described. Hydraulic presses and fuel-based dehydrators have been used for drying when producing dried cassava chips, thus rising its price. Sun drying on cement floors is considered as an alternative to reduce costs. Foreign and domestic marketing conditions are analyzed. Regarding the foreign market the transformation of cassava into alcohol is considered. This demands a production of 400,000 t of roots on 61,540 ha, within a period of approx. 18-24 mo. Cassava could also be used in the production of animal feed for balanced rations, substituting maize. Strategies for processing cassava, methods of sun drying, machinery, equipment, and installations, and forms of organizing small-scale cassava growers are pointed out. Production costs are estimated. Tables and figures are also included. (Summary by FDITEC. Trans. by L.M.F.) 102

0157

19258 VINCK, D. 1983. La transformation du manioc en gari. (Transforming cassava into gari). Annales de Gembloux 89:101-115. Fr., 21 Refs. [Faculté des Sciences Agronomiques de l'Etat, 5500 Gembloux, Belgium]

Cassava. Gari. Small-scale processing. Processing. Technology evaluation. Socio-economic aspects. Africa.

Information is given on: the use of cassava as raw material in the manufacture of gari; the finished product, probably the most important traditional foodstuff in Western Africa; the different transformation processes; levels of technology used (traditional, intermediate, and industrial). Conclusions on technological, economic, and social aspects are reached. Plant synonymy, morphology, and chemical composition are included as well as types of root deterioration, toxicity, and easiness of cultivation. The numerous uses given to gari in cooking and demand trends are discussed. The transformation process is described which includes the removal of the inner and outer cortex; rasping which facilitates detoxification as the linamarine contacts the enzyme linamarase; fermentation which detoxifies and enhances the characteristic flavor and aroma of gari at the same time that the water-binding capacity of starch is modified; hydrolysis of cyanogenic glycosides, 1st enzymatically and then chemically, causing no microorganism to intervene in the detoxification process; extraction of up to 50% of the water; gelatinization or garification, causing the rupture of intermolecular bonds; and drying to assure good conservation. The different types of technology are assessed in relation to yield, labor productivity/day, hygiene, product quality, fuel input, economic aspects of industrial and intermediate technology, and social aspects such as the impact on the work assigned to women, migration and employment, capacity of innovation, nutrition, agriculture, and ecology. The perspectives of manufacturing gari are considered. (Summary by I.B. Trans. by L.M.F.) 102

See also 0021 0068 0097 0103 0106 0122 0129 0158 0159 0162 0165 0176 0177 0180 0187 0188 0189

103 Industrial Microbiology

0158

19292 PARK, Y.K.; ZENIN, C.T.; UEDA, S.; MARTINS, C.O.; MARTINS NETO, J.P. 1982. Microflora in Beiju and their biochemical characteristics. Journal of Fermentation Technology 60(1):1-4. Engl., Sum. Engl., 8 Refs., Illus. [Univ. Estadual de Campinas, Faculdade de Engenharia de Alimentos, C.P. 1170, Campinas-SP, Brasil]

Cassava. Beiju. Cassava pastes. Microflora. Moulds. Enzymes. Biochemistry. Industrial microbiology. Fermentation. Brazil.

Beiju is a naturally fermented cassava mass resembling koji in oriental countries, used for production of an indigenous alcoholic beverage called tiquira. Microbial populations in beiju were found to be predominantly molds, and the no. of colonies on PDA that developed from 1 g of beiju were 6×10^1 to 1.9×10^6. Predominant molds were Aspergillus niger and Paecilomyces sp. Moderate no. of Rhizopus sp. resembling R. delemar and small no. of Neurospora sp. were also found in beiju. It was found that Paecilomyces sp. produced high activity of alpha-amylase, while R. delemar produced small amounts of the enzyme. On the other hand, A. niger and R. delemar produced large amounts of amyloglucosidase, while Paecilomyces sp.

delemar produced large amounts of amyloglucosidase, while Paecilomyces sp. and Neurospora sp. produced small amounts of the enzyme. (Author's summary) 103

0159

20102 SANTOS, J.; GOMEZ, G.; ALEXANDER, J.C. 1983. Production of fungal protein from rasped fresh cassava roots using 200- and 3000-litre fermentors. Animal Feed Science and Technology 8(4):313-324. Engl., Sum. Engl., 24 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Roots. Protein enrichment. Biomass production. Industrial microbiology. Aspergillus. Fermentation. Culture media. Analysis. Carbohydrate content. Protein content. Productivity. Amino acids. Colombia.

The results are given of expt. on the nonaseptic, high-temp. production of a fungal biomass from cassava. The expt. were conducted at the pilot plant level at CIAT, using the fungus Aspergillus fumigatus 1-21A as a 2nd stage in the evaluation of the technology developed and tested previously on a lab. scale at the U. of Guelph. A brief description of the process and a schematic representation of the different steps required at this level are included. The substrate employed was grated fresh cassava roots from several low-cyanide cv. with a total quantity utilized approx. 425 kg of cassava/fermentation. The initial concn. of carbohydrates in the culture medium was adjusted to 40 g/l. The fungus used is characterized by its ability to grow at very low pH (3.5) and reasonably high temp. (45°C), selective growth conditions which appear to obviate the need for sterilization and maintenance of aseptic conditions. The protein yields reported were not as high as obtained in previous small-scale fermentations, with the total CI content of the final product averaging less than 35% DM. This was partially due to an incomplete utilization of carbohydrates. The quality of the tap water as related to pH of the culture medium might also have had some adverse effect on the growth of the microorganism. While the protein of the final product was low in sulphur-containing amino acids, particularly met., its amino acid profile compared favorably with that of other protein sources. The results obtained to date suggest that SCP production from cassava may have potential for practical application in cassava producing areas provided safe operational procedures can be established. (Author's summary) 103

See also 0137

J00 ECONOMICS AND DEVELOPMENT

0160

19504 ALDERMAN, H.C.; TIMMER, C.P. 1980. Food policy and food demand in Indonesia. Bulletin of Indonesian Economic Studies 16(3):83-93. Engl., 4 Refs.

Cassava. Consumption. Statistical analysis. Human nutrition. Income. Prices. Indonesia.

Cross section analysis is used to examine how household decision parameters vary at different income levels. The analysis deals only with rice, fresh cassava, and total calorie intake from rice, fresh cassava, and maize which are the most important foodstuffs for Indonesian consumers. Income elasticities for rice are high for the 1st 2 income classes indicating that it is a luxury for the lowest 30-40% of the population. Income elasticities for fresh cassava are high and exceed unity for the lowest 10-15% of the

rural population and remain positive for 50-60% of the population. The calorie income elasticities are somewhere between the rice and fresh cassava elasticities. The results reported argue that for this particular society food should be disaggregated into its important calorie sources and that society must be analyzed by income levels. By doing so there is a possibility of providing farmers with incentive prices for the preferred food (rice) and charging consumers relatively higher prices as well while keeping the prices of secondary grains (maize) and root crops (cassava) low, even subsidized, to protect the poor. (Summary by World Agricultural Economics and Rural Sociology Abstracts) J00

0161

19513 BAHIA. SECRETARIA DA AGRICULTURA. 1983. Produtos agrícolas; área colhida, producao, rendimento e valor real da producao Bahia, Nordeste e Brasil: 1973-75 a 1980: mandioca. (Agricultural commodities; area harvested, production, yield, and market value in Bahia, the northeastern region, and Brazil from 1973-75 to 1980: cassava). In _____. A producao agrícola da Bahia no contexto regional e nacional 1973-75 a 1980. Salvador-BA, Comissao Estadual de Planejamento Agrícola da Bahia. Série Subsidios ao Planejamento Agrícola no.4. pp.61-62. Port., Illus.

Cassava. Production. Statistical data. Brazil.

Trends in Brazilian cassava production on a regional (state of Bahia, NE region) and national basis, during 1973-80, are given regarding the following variables: production, area harvested, yield, and market value. Indices and diagrams are included of these 4 variables at the 3 levels mentioned. (Summary by J.L.S. Trans. by L.M.F.) J00

0162

19520 BANCO CENTRAL DE VENEZUELA. 1974. Grupos de raíces y tubérculos. B. Yuca (Manihot esculenta). (Tuber and root crops. B. Cassava). Caracas, Técnicos y Consultores Agropecuarios. 129p. 5pap., 14 Refs., Illus.

Cassava. Cassava programs. Production. Productivity. Timing. Statistical data. Prices. Costs. Consumption. Marketing. Trade. Technology evaluation. Casave. Cassava starch. Socio-economic aspects. Venezuela.

Different economic aspects related to cassava cultivation in Venezuela are analyzed and the fundamental problems and their possible solutions are discussed. Production, consumption, markets, foreign trade, extension and research services, type of financing, policies regarding cassava, and the level of technology reached are studied. Public and private corporations specifically in charge of aspects related to cassava are mentioned; agroindustrial relationships and the supply of inputs for industrial production are described. Among basic problems are: (1) agrotechnical issues which include those regarding infrastructure, localization, technical assistance, technology, and management; (2) economic issues such as prices, costs, and marketing; (3) institutional ones related to price policies for cassava growers, agroindustries, financing, and zonation, and those related to public and private organizations; (4) social factors that include education and training, land tenancy, agrarian reform, and organization. Efforts should be directed toward solving research problems (ecological, physiological, and those related to soils, genetic and agronomic breeding, mechanization, irrigation and drainage, pests and diseases, economy, technology and industrialization, animal nutrition, and cultural practices) and others related to financing, legal aspects, agrarian reform and agroindustrial integration. The creation of the National Cassava Board is there-

fore recommended in order to arrange hierarchically problems encountered and to formulate necessary policies. (Summary by EDITEC. Trans. by L.M.F.) J00

0163

19215 BRUIJN, G.H. DE 1983. Agricultural research on cassava in Asia and Australia. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.103-107. Engl., 16 Refs. [Dept. of Tropical Crop Science, Agricultural Univ. Wageningen, 6701 DB Wageningen, Salverdaplein 10, the Netherlands]

Cassava. Cassava programs. Research. Indonesia. Thailand. India. Taiwan. China. Philippines. Sri Lanka. Malaysia. Australia.

Recent developments of cassava research activities in Asia and Australia are reported. Research activities are compared with the relative importance of cassava within the different countries. Information on programs was obtained through direct contact with research workers from main research centers and the publication Abstracts on Cassava, Vol. 1-6 (CIAT's Cassava Information Center) was screened for publications from Asia and Australia, assuming that this would give a representative picture of research activities. Research in Indonesia, Thailand, India, China/Taiwan, Philippines, Sri Lanka, Malaysia, and Australia is discussed. From 1970-78, there was a fivefold increase in the no. of publications in Thailand while in Malaysia the no. was relatively stable. A "research intensity factor" for each of the countries was calculated by dividing the total no. of publications cited by the production level/yr in millions of tons. Australia had a very high research intensity followed by Malaysia. "Normal" values were obtained in India, Thailand, the Philippines, and Sri Lanka while very low values were found for Indonesia and China/Taiwan. (Summary by EDITEC. Trans. by L.M.F.) J00

0164

19578 CACERES. B.B. 1981. Adoption behavior of root crop growers in four Bicol provinces. Ph.D. Thesis. College, Laguna, University of the Philippines at Los Baños. 184p. Engl., Sum. Engl., 94 Refs., Illus.

Cassava. Technology evaluation. Cultivars. Land preparation. Planting. Spacing. Weeding. Fertilizers. Minerals. Disease control. Pest control. Income. Socio-economic aspects. Maps. Marketing. Philippines.

The study was conducted in 4 selected provinces of the Bicol Region (Philippines), namely Sorsogon, Albay, Camarines Sur, and Camarines Norte. The objectives of the study were to: (1) describe the characteristics of the root crop growers in these provinces; (2) determine the cultural practices and technology adopted by the root crop growers; (3) compare the degree of adoption of the recommended technology among the cassava, sweet potato, and gabi (Colocasia spp. and Xanthosoma sp.) growers; and (4) determine the variables which influence the adoption of the recommended technology. The data was gathered from 265 root crop growers. Means and % were used to describe the characteristics and the technology adopted by the farmers. To compare the 3 groups of root crop growers, analysis of variance and the Duncan's multiple range test were used. Chi-square determined the relationship of variables under study. The root crop growers were middle-aged, predominantly males, married, with low educational attainment, and came from a family of 7 members. Generally, they had middle income (6000-8999 pesos), one-third of which came from root crop farming. Majority

were non-owners of the land they tilled with an av. farm size of 3.17 ha. As to their farming experience, most of them had been in the occupation for 20 yr or more. They were also affiliated to various organizations and more than half of them had low level of aspiration. Communicationwise the root crop growers had low exposure to radio, print, and interpersonal sources. Likewise, their access to market, transportation facilities, and credit was relatively low. The findings also revealed that in terms of the technology adopted, the root crop growers were modern as to the var. planted, system of land preparation, cultivation and weeding practices. Significant difference existed among the 3 groups of farmers; the cassava group differed significantly from both the sweet potato and gabi farmers. The cassava respondents adopted more new practices/technology than the other 2 groups. The degree of adoption was significantly related to the farmer's income, farm size, level of aspiration, exposure to interpersonal sources, and the type of transportation facilities used. (Author's summary) J00

0165

18492 CACERES C., J.W. 1979. Ante-proyecto para el fomento de la producción de yuca en la región norte de Honduras. (Preliminary plan for fomenting cassava production in northern Honduras). San Pedro Sula, Honduras, Secretaría de Recursos Naturales. 50p. Span., Illus.

Cassava. Cassava programs. Production. Costs. Land preparation. Planting. Cuttings. Weeding. Minerals. Insect control. Harvesting. Packaging. Marketing. Honduras.

The Ministry of Natural Resources of Honduras initiated the National Cassava Research Project in July 1976 with headquarters at San Pedro Sula. Objectives were to: (1) diversify agricultural production, (2) increase production, and (3) establish agroindustries for export and local consumption. Soil, climatic, and fertilization requirements, and geographic locations for cassava cultivation are described. The institutions collaborating with the project, in addition to the Ministry of Natural Resources, are the Instituto Nacional Agrario, the Banco Nacional de Fomento, and CIAT. An organization chart of the project is included as well as a cost-benefit ratio of the crop regarding labor and inputs. The marketing of cassava can be established through international animal feed companies. Production trends are expected to show an increase of an av. 18 t/ha during 1981-85. Var. Itú, Criolla de San Andrés, and Valenca are recommended for commercial production, yielding an av. of 24, 23, and 20 t/ha, resp. Project development can increase farmers' income, create new enterprises that produce employment, and result in a higher foreign exchange for Honduras with exports. A pilot plan for a 1st phase of experimentation and commercialization should be constructed; its subsequent expansion on a commercial scale is proposed. The multiplication of plant material for seed should begin as soon as possible. The appendix includes the uses of cassava, a diagram of the industrialization process, and an article on the proposal of alcohol production in Brazil. (Summary by EDITEC. Trans. by L.M.F.) J00

0166

10991 CARVALHO, L.E. 1979. Consumo de raiz e derivados. (Consumption of roots and by-products). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.27-43. Port., 10 Refs.

Cassava. Human nutrition. Consumption. Statistical data. Brazil.

The consumption of cassava and cassava by-products at a world level and in Brazil, where it varies from region to region, is analyzed. In Brazil, in particula. the NE region, cassava supplies 24.1% calories, 21.6% Fe, and 17.7% Ca/capita/day. It is also the main source of calories, especially in lower income levels of the population. Cassava, of more importance for feeding rural populations, is planted as a subsistence crop. Some projections to estimate the future role of cassava are made. It can be affirmed that CF consumption is accompanied by av. growth in income, being insensitive to price variations. This indicates that nutritional problems resulting from a poorly balanced diet, e.g. excessive consumption of cassava, can not be solved in the near future. Tables on the consumption of major foodstuffs and on prices are included. (Summary by I.B. Trans. by L.M.F.) J00

0167

18175 CASSAVA. Food Outlook 2:12-13. 1983. Engl.

Cassava. Production. Statistical data. Asia. Africa. Brazil. Colombia.

The forecast of world cassava production for 1983 is discussed. Production is expected to be slightly lower than the level of 1982 of 128 million tons. In Africa, the main producing region, production will equal 1982's with 48.6 million tons; South America will follow a similar trend with 31 million tons. Prospects in Asia point to a decline in output from 48.8 million tons in 1982 to 45.2 million tons in 1983. The use of cassava in animal feed is expected to increase. In some importing countries, like the Republic of Korea, levels of cassava consumption are expected to increase. The EEC imported a record 7.8 million tons in 1982. The demand for cassava by other importing countries, representing less than 500,000 million tons, will remain constant. In view of the decline in the volume of world imports and the depressed feedstuffs prices, it is unlikely that cassava prices will continue to rise. Since European cereal producers pressure to restrict cassava imports, exporting countries may be forced to lower their output. (Summary by EDITEC. Trans. by L.M.F.)

0168

18974 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Cooperación internacional. (International cooperation). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.251-261. Span. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Hybrids. Cultivars. Adaptation. Productivity. Cuba. Ecuador. Haiti. Dominican Republic. Paraguay. Malaysia. Thailand. Colombia.

Activities of international cooperation during 1981 are given. Training courses in cassava production, tissue culture, physiology, and in advanced research for postgraduate work were attended by 38 professionals from 16 countries. From 1973 to 1981 cassava hybrid seeds have been distributed in Latin America, North America and Europe, Asia, Africa, and other regions. Cassava program scientists visited the national programs of several Latin American and Asian countries to follow up the progress in cassava research and gather information. The most important trials carried out and results obtained in the countries visited are indicated. CIAT germplasm selections and hybrid materials provide opportunities for var. selection in national programs; germplasm exchange needs more training efforts in cassava tissue culture to reduce the risk of disease transmission. It is considered that

the impact of research has thus far not reached the farmers due to the long time required to test and then multiply new cassava genotypes and that crop expansion for industrial purposes must be integrated with drying, processing, utilization, and commercialization. (Summary by EDITEC. Trans. by L.M.F.) J00

0169

18972 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Economía. (Economics). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.211-230. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Technology evaluation. Planting. Harvesting. Timing. Weeding. Productivity. Cultivars. Hybrids. Marketing. Prices. Income. Labour. Socio-economic aspects. Colombia. Brazil.

During 1981 the analysis of the potential adoption and impact of improved cassava production technology was continued at various levels and included: farm-level studies of the profitability of improved technology and constraints to adoption; analysis of costs of processing and marketing; and research on final demand, especially the potential of cassava to enter alternative markets. Major determinants of yield in the cassava cropping system and other factors related to farming and marketing systems and their interaction with var. and climate are given. Cassava is harvested earlier than may be considered optimum due to constraints of marketing and labor availability. The effect of planting date on yield and profitability of cassava in high-management expt. was studied in 4 regions of Colombia (Media Luna, Mondomo, Socorro, and the Llanos) with different var.; different marketing strategies used by the farmers are described. Var. Barranqueña and Sata Dovio are considered suitable for the fresh market, while Algodona and CMC 92 are considered only suitable for industrial use. Min. quality characteristics necessary to enter the fresh market may be considered to be 33% DM or more and 100-200 ppm HCN or less. Recommendations include the development of dual-purpose var. with the requisite quality characteristics, the use of improved technology for local var., and specialization of production for the fresh market or processing depending on the area (prime land or marginal areas). The impact of new technology on the consumption of CF by the different income groups in Brazil was studied. In the feed concentrate market cassava can increase its production to fill the demand for raw material in different Latin American countries. (Summary by EDITEC. Trans. by L.M.F.) J00

0170

17380 CHANDRA, S. 1982. Current status of root crop production in Fiji. Tropical Root and Tuber Crops Newsletter 12-13:22-31. Engl. [Development Studies Centre, Research School of Pacific Studies, Australian National Univ., Box 4, P.O., Canberra, A.C.T. 2600, Australia]

Cassava. Production. Taro. Yams. Sweet-potatoes. Statistical data. Fiji.

Data on the production of cassava, taro, yam, and sweet potato in Fiji, obtained during the 1978-80 Agricultural Census, are given. Approx. 34,935 farmers cultivate cassava in monoculture (5892 ha) and in mixed cropping (1042 ha). The av. national yield of cassava in monoculture is 24.2 t/ha and in mixed cropping, it varies between 18.4 t/ha in the Northern Division and 26.8 t/ha in the Central Division. Fiji annually produces 159,376 t of

cassava, 9086 t of yam, and 1646 t of sweet potato. Tables are included for each crop on area, plot size, and no. of farms growing the crop in the different provinces of the country. (Summary by EDITEC. Trans. by L.M.F.) J00

0171

19295 CUNHA, M.A.P. DA 1982. A pesquisa em mandioca e fruticultura: princípios, linhas gerais e modo de acao para a década de 80. (Research in cassava and fruit growing: principles, general lines, and mode of action for the 1980's). Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos no.5. 18p. Port., 5 Refs. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, Ministerio da Agricultura, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cassava programs. Research. Brazil.

Research priorities for cassava and fruit growing in Brazil are indicated. The terms "science" and "research" are defined and the strategies used in the research systems at the Empresa Brasileira de Pesquisa Agropecuária and the Cooperative System of Agricultural Research are described. Major objectives are: (1) introduction and preservation of germplasm, (2) genetic breeding, (3) release of planting material, (4) integrated pest and disease control, (5) soil conservation, (6) soil fertility, (7) improved use of water and irrigation technology, (8) energy production. The technological innovations introduced by the Cooperative System of Agricultural Research in 8 products, among which is cassava, will hopefully provide higher incomes in Brazil. In addition to the multiple uses of cassava and its possibilities of exportation, the possibilities of cassava production within the National Alcohol Program are also considered. (Summary by EDITEC. Trans. by L.M.F.) J00

0172

13447 EMPRESA BRASILEIRA DE ASSISTENCIA TECNICA E EXTENSAO RURAL. 1981. Estudo preliminar da concentracao da producao da mandioca. (Preliminary study on the concentration of cassava production). Brasilia. Serie Estudos Diversos no.10. 127p. Port., Illus. [EMBRATER, SEP/Norte - W3, Q.515 - Lote 03, Brasilia, D.F., Brasil]

Cassava. Production. Statistical data. Maps. Planting. Timing. Cassava programs. Brazil.

Areas technically apt for cassava production in south, central west, SE, and NE Brazil were identified to promote cassava production in these areas. A map is included with crop distribution in the different municipalities for each of the following states: Paraná, Santa Catarina, Rio Grande do Sul, Minas Gerais, Espirito Santo, Rio de Janeiro, Sao Paulo, Mato Grosso, Mato Grosso do Sul, Goiás, Maranhao, Piaví, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, and Bahia. A list of municipalities grouped into homogeneous microregions, planting times, and a list of seed producing municipalities or potential producers are also included for each one. Statistical data on the no. of cassava producing municipalities, area harvested, and production obtained/municipality in Brazil and in each of the states by homogeneous microregions are given. (Summary by EDITEC. Trans. by L.M.F.) J00

0173

20106 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO NACIONAL DE PESQUISA DE MANDIOCA E FRUTICULTURA. 1982. Programa nacional de pesquisa de mandioca. (National cassava research program). In _____. Relatorio Técnico Anual do Centro Nacional de Pesquisa de Mandioca e Fruticultura 1982. Cruz das Almas-BA, Brasil. pp.99-155. Port., Sum. Engl., 28 Refs., Illus. [CNPMF, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cassava programs. Root productivity. Starch productivity. Cultivars. Agronomic characters. Ecology. Adaptation. N. P. K. Mycorrhizae. Fertilizers. Soil fertility. Mineral content. Leaves. Intercropping. Cowpea. Maize. Costs. Economics. Cultivation. Land preparation. Technology evaluation. Germplasm. Selection. Xanthomonas manihotis. Sphaceloma manihoticola. Erinnyis ello. Brazil.

The Centro Nacional de Pesquisa de Mandioca e Fruticultura conducted 21 cassava research projects in 1982 dealing with: characterization and evaluation of germplasm; obtainment of cv. and clones resistant to Xanthomonas manihotis, Sphaceloma manihoticola, and mites; biological control of Erinnyis ello; mycorrhiza in the use of P; N, P, and K fertilization and green manures; plant development; intercropping (maize, Vigna sp.); production systems; and cultural practices. Results obtained show that cassava grown in double rows intercropped with short-cycle crops has a significant increase in the efficiency of land use, as compared with sole cropping. In the soil fertility area, results have shown the necessity of reducing nutrient dosages previously recommended. With the dosages presently recommended a reduction of 46% in the cost of fertilization can be obtained. Preliminary results have indicated that min. tillage can considerably reduce the cost of soil preparation with no detrimental effect on root yield. The identification of factors that limit the adoption of new techniques is important. At the same time, the development of cultural practices and cv. which can maintain high and stable yields under stress environments and low input situations, which characterize most Brazilian cassava production systems, is necessary. (Author's summary) J00

0174

18929 ESCOVAR P., R. 1982. La yuca (mandioca) en el Mercado Común Europeo. (Cassava in the European Common Market). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:431-436. Span. [Banco Central de Venezuela, Depto. Agrícola, Esquina de las Carmelitas, Caracas, Venezuela]

Cassava. Trade. Consumption. Uses. Feed and feeding. Europe.

The European Economic Community (EEC) increased the demand for cassava in recent years at 20% per annum. Imports increased from 413,000 t in 1962 to 1,120,000 t in 1973, mainly of West Germany and Holland. Projected needs, during 1980, of CM for animal nutrition in EEC countries, estimated by the FAO, were between 8682-22,417 thousands of tons of fresh roots. Data are included on levels of cassava in animal feeds for bovine cattle, pigs, and poultry in Holland, Germany, Benelux, France, Italy, and the United Kingdom as well as on the commercialization of cassava products at a world level. (Summary by EDITEC. Trans. by L.M.F.) J00

0175

18199 FITZGERALD, C. 1982. EEC trading arrangements favour use of cereal substitutes in strong currency countries. Farm and Food Research 13(5):152-154. Engl., Sum. Engl., Illus.

Cassava. Trade. Prices. Feeds and feeding. Europe.

The effect of currency movements and monetary arrangements for intra-EEC trade on the use of cereal substitutes in the EEC is examined on a least-cost basis. CP contents and digestible energy values of barley are compared with those of other cereal substitutes, namely, SBM, maize gluten, cassava, and mixes of cassava with SBM and with maize gluten. Cereal substitute mixes were cheaper than barley in Great Britain and Northern Ireland. As a result of the appreciation in value of the pound sterling and its effect on subsequent trading arrangements, cereal substitutes have become more competitive on the animal feed market in Great Britain; the use of cereal substitutes increased from 15.8% in July-March 1980-81 to 30.9% in July-March 1981-82. Animal feed markets in a grain surplus area with a stable currency (Republic of Ireland), a grain surplus area with an appreciating currency (Great Britain), and a grain deficit area with an appreciating currency (Northern Ireland) were compared and the analysis conclusions indicated that the monetary arrangements for intra-EEC trade favor the substitution of other raw materials for barley in animal feed, in economic areas where the currency is appreciating. (Summary by EDITEC. Trans. by L.M.F.) J00

0176

19556 GONZALEZ G., J.A. 1981. Diagnóstico de la producción e industrialización de yuca (Manihot sp. L) San Juan, Sanarate, El Progreso. (Diagnostics of cassava production and industrialization at San Juan, Sanarate, El Progreso, Guatemala). Tesis Ing.Agr. Guatemala, Universidad de San Carlos. 49p. Span. Sum. Span., 38 Refs.

Cassava. Production. Socio-economic aspects. Industrialization. Statistical data. Cultivation. Cultivars. Cassava products. Marketing. Processing. Costs. Harvesting. Guatemala.

A study was carried out in San Juan, Sanarate, El Progreso (Guatemala) to describe the current characteristics of cassava production and industrialization, level of technology, technical assistance, and commercialization. Research results are given under 2 aspects: economic-industrial and social importance. The 1st includes land tenancy, obtainment of raw material, cultural practices, processing stages to obtain "yuquilla", and marketing. The 2nd considers cassava industry as a source of employment and its social coverage and importance within the cassava grower's family. The low level of technology employed in farm work is evident in the generalized use of traditional hand tools to work the land. Mechanization (animal traction or mechanical) is not possible due to topographic characteristics of the village; farmers do not use fertilizers or control diseases and pests. Processing is on a mechanical basis, consisting of a cassava mill and an internal-combustion engine. Farmers plant cassava (var. Papa and Cogollo Morado) in association with grain crops (maize, beans, and others). However, these are not apt for this region due to the topographical and hydrographic conditions of the region. They are therefore used for domestic consumption. Cassava, on the contrary, is the economic basis of the region, destined to the elaboration of "yuquilla", chopped and fresh cassava. Sansare, followed by Guatemala City, are the most important internal markets of "yuquilla". The USA and El Salvador buy fresh cassava and "yuquilla" on a large scale. Recommendations are given for the different institutions. (Extracted from author's summary. Trans. by L.M.F.) J00

0177

18928 GUILLEN, R.D.; NIETO, J.M. 1982. Planteamientos para el desarrollo de la agroindustria de la yuca. (Proposals for the development of the

cassava agroindustry). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:425-430. Span. [Univ. Central de Venezuela, Fac. de Agronomía, Apartado 4579, Maracay, Aragua, Venezuela]

Cassava. Industrialization. Cultivation. Prices. Venezuela.

The cassava agroindustry in Venezuela is facing a series of problems originating in the agronomic, industrial, and economic sectors. In the area of agronomy, priority should be given to (1) the production of improved seed, tested for different areas, (2) planning the development of selected areas, and (3) use of recommended cultural practices. Among industrial problems, the lack of a suitable technology that can be improved according to the experience of Venezuelan industrial centers is highlighted. One of the most important economic aspects is the price of one ton of fresh roots or of dehydrated cassava for industrial purposes. Several alternatives for establishing relationships between the producers of raw material and the processing plants are suggested, such as the establishment of services contracts between the 2 parts to determine the price of the product and the formation of cooperatives for the production of propagation material, for farm mechanization and transportation, and for the purchase of inputs. Planting trials should be carried out in the different cassava growing regions of Venezuela, in 10-ha plots with 3 levels of inputs (low, intermediate, and high) in order to determine costs and yields/ha for each one. (Summary by EDITEC. Trans. by L.M.F.) J00

0178

19525 HIGH CEREAL prices at the root of the substitutes problem. Agra Europe 987:E/1-E/2. 1982. Engl.

Cassava. Cassava products. Trade. Statistical data. Feeds and feeding. Europe.

A report by the European Feed Manufacturers Federation (FEFAC) is summarized and discussed. It argues that the reason for the increased use of cassava in EEC feed mixes is the continuing high price of cereals under the Common Agricultural Policy. FEFAC holds that cassava is the only product which can properly be called a cereals substitute because its price is so favorable in relation to cereals. Maize gluten has mainly been used as an alternative to secondary cakes such as palm kernel or copra and citrus pulp to replace imported beet pulp and brans. The data presented for 1974-80 do not wholly support these claims. (Summary by World Agricultural Economics and Rural Sociology Abstracts) J00

0179

18979 HOLMES, E.B.; PAIVOKE, A. 1982. Subsistence food crop review: cassava. In _____. Subsistence food crops review: cassava, sago palm and nipa palm. Papua New Guinea, Energy Planning Unit Policy and Planning Division. Department of Minerals and Energy. Report no.9/82. pp.1-30. Engl., 29 Ref.

Cassava. Cassava programs. Developmental research. Cultivation. Root productivity. Papua New Guinea.

Different aspects of cassava growing are reviewed. These are related to taxonomy and breeding systems, origin, world distribution and that in Papua New Guinea, importance in subsistence agriculture and for markets, plant type and var., traditional propagation and cultural methods, food preparation and food value. Temp., rainfall, and soil requirements, planting

density, crop management, harvesting, postharvest handling, and storage are described. No major incidence of pests or diseases has been recorded in Papua New Guinea but leaf spot (Cercospora sp.) and anthracnose (Colletotrichum sp.) have been observed as well as cutworms (Agrotis sp.) and the cassava hornworm (Erinnyis ello). Among the major constraints and problems of cassava production are the lack of: information on its value as a food crop, germplasm, a hybridization program, a simple effective and an inexpensive mechanized harvesting system, and storage techniques. Several research centers and programs are listed and advances in research by national programs and priorities for further research are given. (Summary by EDITEC. Trans. by I.M.F.) J00

0180

19264 JONES, W.O. 1978. Cassava in Indonesia: preliminary observations. Stanford, California, Stanford University. 43p. Engl., 5 Refs.

Cassava. Consumption. Gaplek. Fresh roots. Cassava starch. Feeds and feeding. Marketing. Trade. Prices. Costs. Cultivation. Intercropping. Processing. Cassava programs. Indonesia.

The supply and demand potentials for cassava in Indonesia were surveyed as a preliminary step in formulating policies designed to increase the production and consumption of secondary food crops. Annual consumption of cassava reached 3.3 million tons as fresh roots, 3.6 million tons of fresh roots as gaplek, and 560,000 tons of fresh roots as starch and flour. Price elasticities and variations in consumption were studied in relation to the rise in prices of other commodities, such as rice. If rice prices are reduced or kept constant, the demand for cassava is reduced. Aspects described include the feed demand for cassava in Europe and Indonesia, marketing system for gaplek and fresh roots, credit systems, and rural wholesale markets. Regarding production, breeding and selection programs, use of fertilizers, cropping systems, extension programs, and evaluation are indicated. Three principal kinds of governmental intervention in the marketing of cassava products are considered. These deal with the institutional framework of the marketing system, market development, and processing. Requisites to impulse development in the different areas (production, marketing, processing) and long-term efforts are given. Complementary information is included in table form and 2 projects for developing agricultural marketing and production research are given. (Summary by EDITEC Trans. by I.M.F.) J00

0181

19263 KANEDA, H.; JOHNSTON, B.F. 1961. Urban food expenditure patterns in tropical Africa. Food Research Institute Studies 2(3):229-275. Engl., 53 Refs., Illus.

Cassava. Fresh roots. Gari. Dried roots. Consumption. Socio-economic aspects. Economics. Human nutrition. Africa.

Food expenditure patterns in different regions of Africa are analyzed and the relative importance of major food groups (among them, cassava and cassava products), according to their contribution of food calories, is emphasized. The principal sources of data and the cities studied are given and several of the limitations of the survey data are mentioned. The relationship between food expenditure and total income is examined and aspects related to the position of cereals, starchy root crops, and plantains in the expenditure patterns of urban African households are considered. Regional variations in food expenditure patterns are studied and these are examined under the structure or hierarchy of food prices.

Finally some observations concerning prospective changes in food consumption that are likely to be associated with economic development and the distribution between income categories are given. Urban and rural budget data are briefly studied regarding food consumption. In tropical Africa the continuing urbanization and rising incomes will lead to significant changes in food expenditure and consumption patterns in coming years. (Summary by EDITEC. Trans. by L.M.F.) J00

0182

18943 KER, A.D.R. 1979. Root crops. In _____. Food or famine: an account of the crop science program. Ottawa, Ontario, International Development Research Centre. IDRC-143e. pp.35-44. Engl., Illus.

Cassava. Research. Cassava programs. Africa. Asia. Colombia. Latin America.

Support given to cassava research programs by the International Development Research Centre (IDRC) includes different activities such as the provision of funding to CIAT in Colombia and the International Institute of Tropical Agriculture (IITA) in Nigeria, for research in Canadian universities, and for several national programs in developing countries. Historical aspects of the setting up and development of different research programs are given and the multiple cassava research projects carried out in different regions of Latin America, Canada, Africa, and Asia by the responsible institutions are highlighted. Among main activities are plant breeding and germplasm selection programs, training programs for scientists, physiology studies and crop pathology, utilization of cassava in animal feed, conversion of cassava starch and inorganic N into microbial protein. IDRC's Information Sciences Division assisted CIAT in developing a Cassava Information Center which collects world literature on cassava and distributes it among interested researchers. (Summary by EDITEC. Trans. by L.M.F.) J00

0183

19212 PHILLIPS, T.P. 1983. An overview of cassava consumption and production. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.83-88. Engl., 16 Refs., Illus. [School of Agricultural Economics & Extension Education, Univ. of Guelph, Ontario N1G 2W1, Canada]

Cassava. Consumption. Production. Endemic goitre. Cretinism. Statistical data.

Economic aspects of cassava cultivation at a world level such as the use of cassava as a human food, geographical distribution of its production, comparison of projected consumption and production are reviewed in general as well as aspects related to cassava consumption and the incidence of endemic goitre and cretinism. Annual per capita consumption of cassava is greatest in Africa (102 kg/yr) while in Latin America it is substantially lower (35 kg/yr). In both regions, however, cassava is the 2nd or 3rd most important calorie source. Cassava is grown in 80 countries, 25 producing 90% of the world production. Brazil, Indonesia, Thailand, and Zaire account for 21.3, 11.2, 10.7, and 10.2%, resp. The different factors that stimulate or limit production in major cassava producing countries are described. Demand projections for cassava up to 1990 were made. Annual percentage increases in demand for cassava for human consumption were 2.4, 2.8, 1.7, 1.9, 2.2% at a world level, in Africa, Latin America, South Asia and SE Asia, resp., and 2.3, 3.1, 1.5, 3.0, 2.1, and 2.5% for Nigeria, Zaire, Brazil, Colombia, Indonesia, and Thailand, resp. Cassava processing is

important to preserve the harvested roots, thus increasing consumption and marketing alternatives. Finally, the relationship between the incidence of endemic goitre and the consumption of fresh cassava roots in Brazil was established. (Summary by EDITEC. Trans. by L.M.F.) J00

0184

19213 RENSHAW, D. 1983. Utilization of cassava in the European Community. In Delange, F.; Ahluwalia, R., eds. Cassava Toxicity and Thyroid: Research and Public Health Issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.89-92. Engl. [Cereals Division, Agriculture, Commission of the European Communities, Rue de la Loi 200, B-1049, Brussels, Belgium]

Cassava. Uses. Trade. Statistical data. Europe.

The increase in livestock production within the European Community in recent years has led to the use of cereal substitutes. The most important of these cereal substitutes are maize gluten, cereal and rice brans, and cassava, the import of which increased from 0.7 to 3.0, 1.2 to 2.0, and 2.0 to 6.5 million tons, resp., from 1974 to 1981. To balance the interest of livestock producers, cereal growers, and budget limitations, the Commission of the European Communities has proposed to narrow the gap between its own cereal prices and those of cereal substitutes, as well as to stabilize imports of these products at their present levels. Variations of imports of cereal substitutes from 1974 to 1981 are given as well as the imports of cassava by source. During this period, Thailand was the main exporter of cassava, increasing from 1.7 to an estimated 5.5 million tons and supplying between 84-96% of imports. Indonesia, the 2nd most important source of cassava, reached a record tonnage of 694,000 in 1979. Third in importance, China exported an av. of 5000 t/yr during 1974-76, fell to 1000 t in 1977 and 1978, but increased to 51,000 t in 1979 and 336,000 t in 1980. Other suppliers of cassava are Brazil, Malawi, India, and Tanzania. Major importing countries within the Community are Germany, the Netherlands, and Belgium/Luxembourg. These take at least 90% of the imports, with Germany and the Netherlands accounting for more than 70%. The United Kingdom and Italy are also interested in importing cassava. (Summary by EDITEC. Trans. by L.M.F.) J00

0185

18927 RIOS, P.; OSORIO, A. 1982. Estudio agroeconómico sobre la factibilidad de la producción de la producción de yuca (raíz), para ser utilizada como fuente de materia prima en la fabricación de alimentos concentrados para animales. (Agroeconomic study on the feasibility of cassava root production for use as a source of raw material in the elaboration of feed concentrates). Ministerio de Agricultura y Cría. In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no 31:325-424. Span., 17 Refs., Illus. [Univ. Central de Venezuela, Fac. de Agronomía, Apartado 4579, Maracay, Aragua, Venezuela]

Cassava. Production. Costs. Mechanization. Energy productivity. Harvesting. Income. Technology evaluation. Planting. Weeding. Pest control. Irrigation. Labour. Feeds and feeding. Venezuela.

Agroeconomic problems of cassava cultivation and the feasibility of its use in feed concentrates in the areas of the Lake Maracaibo watershed, the Eastern Plains, and part of the state of Bolivar (Venezuela) were studied, based on the hypothesis that energy productivity of cassava/ha is greater than that of sorghum and its cost is much lower. Levels of profitability

of the crop were determined and compared with those of other crops in addition to the restrictions and limitations to crop expansion. The agroeconomic study focused on on-farm production costs, production costs/t, practices that most affect costs (weed control, manual and mechanized harvest), and production costs of competitive crops (sorghum, groundnut, sesame seed, and black bean). Apparent energy production for cassava with 8.7-12 t/ha was 11.0-15.2 x 10^6 calories while sorghum with 1.8-2.4 t/ha produced 5.8-7.7 x 10^6 calories. Costs of 3 forms of production (manual harvest, mechanized harvest, and harvest with complete technology) were compared. On-farm profitabilities of cassava were estimated for the 3 levels of technology with different prices for fresh products and for the processing plant and were compared with the profitability of other crops. Among limitations for crop expansion, land availability is not a determinant factor; the problem of scarce labor can be resolved by applying technology and short-term and medium-term credit is proposed. Cassava productivity is directly related to the level of technology used. Weed control and manual harvest affect production costs. Energy (carbohydrate) production is greater with cassava. Further research is required for crop expansion. Improved cultural practices (land preparation; seeds; planting; fertilization; weed, pest, and disease control); harvesting, and irrigation practices are recommended as well as improvements in commercialization, transformation, and machinery services. A pilot project to stimulate cassava production on a national level is proposed. (Summary by EDITEC. Trans. by L.M.F.) 300

0186

19259 SANDERS, J.H.; LYNAM, J.K. 1981. New agricultural technology and small farmers in Latin America. Food Policy 6(1):11-18. Engl., Illus. [Purdue Univ., Krannert Building, West Lafayette, IN 47907, USA]

Cassava. Technology evaluation. Socio-economic aspects. Latin America.

Biased income distribution in agriculture resulting from the green revolution towards better agricultural regions and larger farmers has been justified by declining prices for rice and wheat, making consumers the main beneficiaries. Other food crops, such as beans and cassava, are insufficiently profitable to displace these basic grains or the export crops concentrated on these prime lands. Therefore, in most of Latin America beans and cassava are produced principally by small farmers in poorer resource areas. There are two arguments for focusing future agricultural technology towards these small farmers. The first is the private and public costs of the high rural-urban migration rates since the second world war. The efficiency of this migration process is low in either substantially increasing productivity or in improving nutrition of the rural migrants. Moreover, despite this rapid out-migration the relative size of the rural sector is still large and growing technological change could help by raising small farmers incomes, but to be successful governments would have to complement it with policy support. The second argument is related to the supply elasticity of prime agricultural land. Even with substantially increased yield from new technology beans and cassava will not break into these areas because there will be more profitable and marketable alternatives. Therefore, they will continue to be produced in poorer resource areas where the present labor intensive nature of production gives the small farmer a comparative advantage. Technological change could increase productivity without affecting this comparative advantage. (Summary by I.R.) 300

0187

11862 SILVA, J.R. DA 1979. O papel da assistencia técnica na producao de mandioca: impactos no PROALCOOL. (Role of technical assistance in

cassava production: impact on the Nacional Alcohol Program, PROALCOOL). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.351-355. Port.

Cassava. Alcohol. Cassava programs. Brazil.

The importance of the National Alcohol Program for Brazil is explained and the role that technical assistance plays in overcoming the problems that hinder its consolidation is highlighted. Priority is given to problems arising in cassava cultivation and to the need for resources and for training programs (accelerated since 1976) with the cooperation of organizations within the EMBRATER and EMBRAPA systems and of other entities of technical assistance, among them CIAT (theoretical and practical training). Major aspects of the technical assistance offered by the National Alcohol Program to cassava growers covered by this program are mentioned. (Summary by I.B. Trans. by I.M.F.) J00

0188

11788 SOUZA, R.F. 1979. O papel da pesquisa na producao da mandioca. Impactos no PROALCOOL. (The role of cassava production research. Impact of PROALCOOL). In Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informacao e Documentacao. pp.255-276. Port., 45 Refs.

Cassava. Alcohol. Cassava programs. Brazil.

Information on cassava, including historico-geographic data, economic importance of the crop, and data on production and area planted, is given. Factors that have favored crop expansion and potential productivity are analyzed. The causes of the low productivity in Brazil (12-13 t/ha, varying widely over regions and crop cycles) are indicated. Suggestions on how to improve its use as raw material for the elaboration of alcohol (immobilization or fixation of aminoglucosidase and genetic improvement of Saccharomyces cerevisiae) are given. The role institutions play in research on cassava is highlighted; results obtained and projects of the National Cassava Research Program, promoted by the Empresa Brasileira de Pesquisa Agropecuaria in 1975 and initiated in 1976, are given. Information available on cassava production and utilization is examined and social benefits and the objectives of the National Alcohol Program are discussed. (Summary by I.B. Trans. by L.M.F.) J00

0189

18940 TORO B., G. 1982. Aspectos económicos del desarrollo yuquero en Venezuela. (Economic aspects of cassava development in Venezuela). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no.31:663-676. Span. [IICA, Fondo Simón Bolívar, Apartado 55, Coronado, Provincia de San José, Costa Rica]

Cassava. Cassava programs. Industrialization. Venezuela.

The economic situation of cassava production and industrialization in Venezuela is described. Plans up to 1980 regarding the increase of these 2 economic factors were not fulfilled according to the Operative Plan of the Agricultural Sector of the Ministry of Agriculture and Animal Husbandry (MAC) in 1975. A feasibility study carried out by the MAC and the Instituto Interamericano para la Cooperación Agrícola in 1981 found that there currently exists a technical possibility of using dehydrated cassava as

food on a world level, meanwhile food processing plants demand that the price of each ton of cassava does not exceed by 80% that of sorghum and that MC is not over 12%. Regarding root production, unfavorable aspects such as the use of rudimentary technology and late-maturing var. (12 mo.) were found. Statistics on production should be updated, early-maturing var. should be released to farmers, and comparative studies on energy production with other crops should be promoted. (Summary by EDITEC. Trans. by L.M.F.) J00

0190

18944 VILLANUEVA, M.R. 1982. Prospects and problems of producing alcohol from root crops: the Philippine experience. Scientia Filipinas 2(1): 28-35. Engl., Illus.

Cassava. Alcohol. Industrialization. Philippines.

Concepts on the feasibility of using root crops to produce alcohol in the Philippines are given. In order to do so, the area planted to cassava must be expanded by 75%. The process of converting root crops into alcohol entails 4 steps: preparation, conversion, fermentation, and distillation. Cassava can produce 4500 l of alcohol/ha/yr, compared with sugarcane and sweet potato that yield 5025 and 7812 l/ha/yr, resp. Cassava alcohol is less energy efficient than sugarcane alcohol and a separate economic analysis must be done locally to establish the feasibility of cassava alcohol production in the Philippines. Cassava, sugarcane, and sweet potato are compared regarding different agronomic aspects: production, management practices, soils, growth cycle, storage. Current data indicate that there are more problems associated with the processing aspect than there are in producing raw materials. Since industrialized processing of root crops depends on a constant supply of tubers, production should be technified and government policies favoring industrial development should be implemented; production, processing, and marketing should be coordinated. (Summary by EDITEC. Trans. by L.M.F.) J00

See also 0028 0101 0140 0147 0149 0152 0153 0156 0173

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0191

18971 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Prácticas culturales. (Cultural practices). In _____. Programa de Yuca. Informe Anual 1981. Cali, Colombia. pp.173-188. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in English.

Cassava. Cassava programs. Intercropping. Beans. Defoliation. Light. Timing. Root productivity. Starch content. Weeds. Cuttings. Storage. Germination. Colombia.

Studies indicated that cassava can be intercropped with beans at late stages of development (9 mo. after planting) without modifying the cassava canopy or affecting root or starch yields and a small bean yield (500-800 kg/ha) can be obtained. When cassava was defoliated simultaneously with

bean trials (7, 8, and 9 mo. after cassava planting) and the effects of 1 and 2 defoliations at different intervals after bean planting (0, 15, or 30 days; 0 and 30 days; 15 and 45 days; 30 and 60 days) were compared, cassava yields tended to show a greater reduction by early than by late defoliations. This effect was significant when 2 instead of 1 defoliations were carried out. Defoliation reduced cassava yield by 15% on the av. Starch content was 35.3, 34.0, 34.8, and 32.8% in roots of undefoliated cassava and 33, 66, and 100% in defoliated cassava. To obtain higher bean yields without drastically affecting those of cassava it is recommended to: (1) interplant beans with 9-mo.-old cassava and sufficient moisture should be available during the 1st 60 days; (2) make 2 defoliations of cassava (one at planting and one 4 wk. later) at an intensity of 67%. In weed control studies it was found that Cyperus rotundus exerts an allelopathic effect on cassava; M Col 22 yielded 17.2% less in plots infested with C. rotundus and 10% less in machete-weeded plots. In addition to adequate agronomic practices, an integrated control system using early chemical inputs combined with cultural control (e.g., through intercropping) may deal adequately with this problem. Research to develop a technology for storage and poststorage handling of cassava planting material was continued. Results indicate that cassava planting material stored for a long period can be upgraded by soaking stakes for 1-4 h in a nutrient solution. Fungicide treatment of stored stakes resulted in a stand establishment and good yields. (Summary by EDITEC. Trans. by L.M.F.) K01

0192

19983 GALVAO, E.U.P.; CESAR, J.; HOMMA, A.K.O. 1980. Comparacao entre cultivos solteiros e consorciados (mandioca, feijao, arroz e milho) em terra firme, do Estado do Amazonas. [Comparison of pure stands and associated crops (cassava, bean, rice, and maize) grown on firm soil in Manaus, state of Amazonas, Brazil]. Manaus-AM, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Unidade de Execucao de Pesquisa de Ambito Estadual. Circular Técnica no.03. 12p. Port., Sum. Port., 5 Refs.

Cassava. Beans. Rice. Maize. Intercropping. Productivity. Cassava flour. Income. Brazil.

In expt. carried out during the 1975-76 crop year on a Yellow Latosol, clay texture, in Manaus, AM, Brazil, cassava, rice, bean, and maize crops were evaluated in pure stand and in associated crops. Combinations among crops gave 15 different planting systems, carried out in a randomized block design with 3 replications. Neither fertilization nor soil amendment was carried out. Fluctuations in crop yields in associated cropping systems were assessed and the advantages that they represent for the farmer are discussed. Estimated indices include total food production, productivity, LER, and economic efficiency. Highest gross returns were obtained, in descending order, with the combinations cassava x bean, cassava x maize, cassava x maize x bean, cassava in monoculture, cassava x rice x maize, and cassava x maize. Lowest productivity corresponded to bean in the treatment cassava x rice x bean and the lowest profitability occurred in rice x maize intercropping. The importance of associated cropping is emphasized since this practice is not widespread among farmers of this region. (Author's summary. Trans. by L.M.F.) K01

0193

19987 ROSETE, F.S. 1981. Nutrient uptake and productivity of cassava (Manihot esculenta Krantz) and mungbean (Vigna radiata Wilzeck (L.)) intercrop as influenced by nitrogen application, temporal, and spatial arrangements. Ph.D. Thesis. College, Laguna, University of the Philippines at Los Baños. 185p. Engl., Sum. Engl., 49 Refs., Illus.

Cassava. Intercropping. Timing. Mungbean. Nutrient absorption. Dry matter. N. P. K. Planting. Spacing. Plant height. Root productivity. Analysis. Mineral content. Income. Economics. Philippines.

Three expt. were conducted at the Exptl. Farm of the Tarlac College of Agriculture, Tarlac, Philippines, from July 1980 to May 1981. The 1st determined the total nutrient uptake of cassava and mungbean planted in monoculture and as intercrops when different levels of N (0, 50, 100, and 150 kg/ha) were applied. Significant differences were observed in the total uptake of N, P, and K by the cassava and mungbean monocrops and intercrops. Likewise, the interactions of the cropping systems and N applied showed significant differences. N uptake was highest in the cassava-mungbean intercrop; however, 150 kg N/ha significantly excelled the other subtreatments. As regards the DM wt./plant, the cassava monocrop was significantly highest. Likewise, the 150 kg N/ha produced the highest DM wt./plant, although no significant differences existed among the subtreatments. The DM wt. of the plants/ha in the cassava monocrop was significantly highest. Moreover, 150 kg N/ha significantly affected the DM accumulation of the plants/ha with 0 kg N/ha exhibiting the lowest. Grain yield was expressed as individual crop yield and as LER; all LER values were above 1.0, indicating a positive effect of intercropping cassava with mungbean. The application of 150 kg N/ha produced the highest gross return in all the cropping systems employed and gave the highest monetary advantage for the cassava-mungbean intercrop. In the 2nd expt., the time of overlap period was employed to determine its effects on the cropping systems used. Growth and yield parameters of the 2 cassava var. were not significantly affected. The time of overlap period significantly affected plant height, DM wt./plant, no. of pods/plant, length of pods, no. of seeds/pod, wt./mature pod, and seed wt./pod of mungbean. Significant differences were observed between the cassava var. Golden Yellow and Lakan regarding plant height and diameter of tuber. Var. Lakan in monocrop and in intercrop was significantly taller than var. Golden Yellow. As regards tuber diameter, var. Lakan was again significantly better. Both var. failed to show yield differences. A positive effect of intercropping mungbean with cassava was observed by all the LERs of more than 1.0. Intercropping cassava with mungbean 7 days after cassava planting gave the highest LER. Likewise, the 28 days gave the highest monetary advantage. The effects of spatial arrangements on cassava-mungbean intercrop and monocrops were observed in the 3rd expt. Cassava plant height, DM wt./plant and per hectare, shoot:root ratio, no. of tubers/plant, length and diameter of tubers, and fresh tuber wt. were not significantly affected. Double rows (2 x 0.5 m) with row interval of 1.0 m gave the heaviest (DM wt.) cassava plants and the lightest were found in triple rows (3 x 0.5 m) with interval row spacing of 1.0 m and the single row (control) for DM wt./ha. (Extracted from author's summary) K01

0194

19509 UHL, C.; CLARK, H.; CLARK, K. 1982. Successional patterns associated with slash-and-burn agriculture in the upper Río Negro region of the Amazon Basin. Biotropica 14(4):249-254. Engl., Sum. Engl., Span., 14 Refs. [Inst. Venezolano de Investigaciones Científicas, Centro Ecológico, Apartado 1827, Caracas, Venezuela]

Cassava. Shifting cultivation. Colombia.

Plant succession during and following slash-and-burn agriculture near the town of San Carlos de Río Negro in southern Venezuela was studied. Weeds established just as readily in plots with Manihot esculenta (the principal crop plant of the region) as in plots where M. esculenta had been removed. Repeated farm-plot weedings caused woody plants to decline in no. and

biomass and herbaceous plants to increase. Forbs and grasses dominated immediately following farm site abandonment, but by 1 yr these had begun and fast-growing successional woody species (particularly Vismia spp.) were common. Standing crop biomass at 1 yr was 773 g dry wt./m^2. Several microhabitat types were present on abandoned farm sites. Grasses and forbs showed no microhabitat preference, whereas successional woody individuals had their best establishment near slash and under fruit trees. (Author's summary) K01

See also 0069 0173 0180

ABBREVIATIONS AND ACRONYMS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
Afr.	Afrikaans
a.i.	Active ingredient
alt.	Altitude
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 oxigen 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)
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
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(s)
COD	Chemical oxigen 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(s)
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
Ital.	Italian
IU	International unit
J	Joule
Jap.	Japanese
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilocalorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate
kR	Kiloroentgen(s)
l	Liter(s)
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	Alpha-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
RGR	Relative growth rate
RH	Relative humidity
RNA	Ribonucleic acid
Rom.	Romanian
Russ.	Russian
s	Second
SBM	Soybean meal
SCN	Thiocyanate
SCP	Single cell protein
SDS	Sodium dodecyl sulfate
Sk.	Slovak
sp.	Species
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	Tobbaco 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)
/	Per
%	percent(age)
>	More than, greater than
<	Less than
≤	Equal to or less than
≥	Equal to or greater than
±	Plus or minus

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