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Abstracts on Cassava

(*Manihot esculenta* Crantz)

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INTRODUCTION

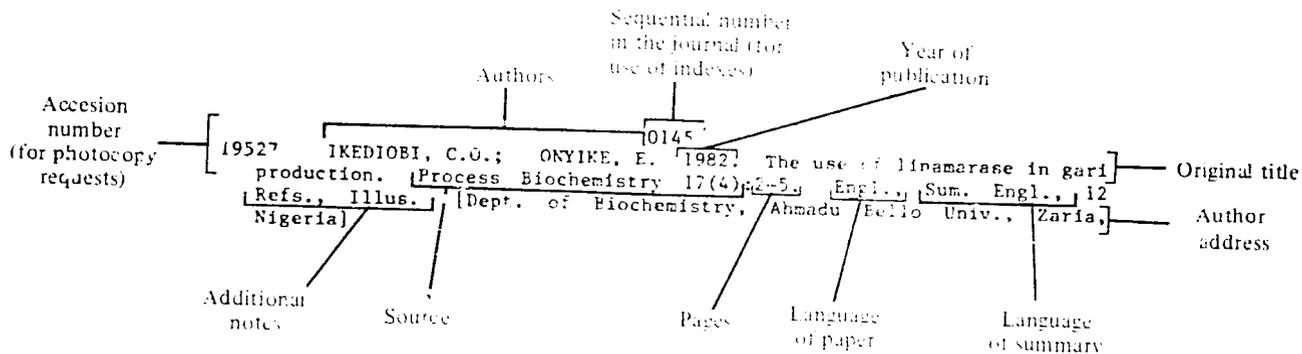
This journal of analytical abstracts, which replaces the former combination of abstract cards and yearly cumulative volumes, is designed to provide a specialized guide to the world's literature on cassava (*Manihot esculenta* Crantz), disseminating research results and ongoing activities related to the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

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COMPONENTS OF AN ABSTRACT



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. — Abstract

Abstractor
and/or translator

11

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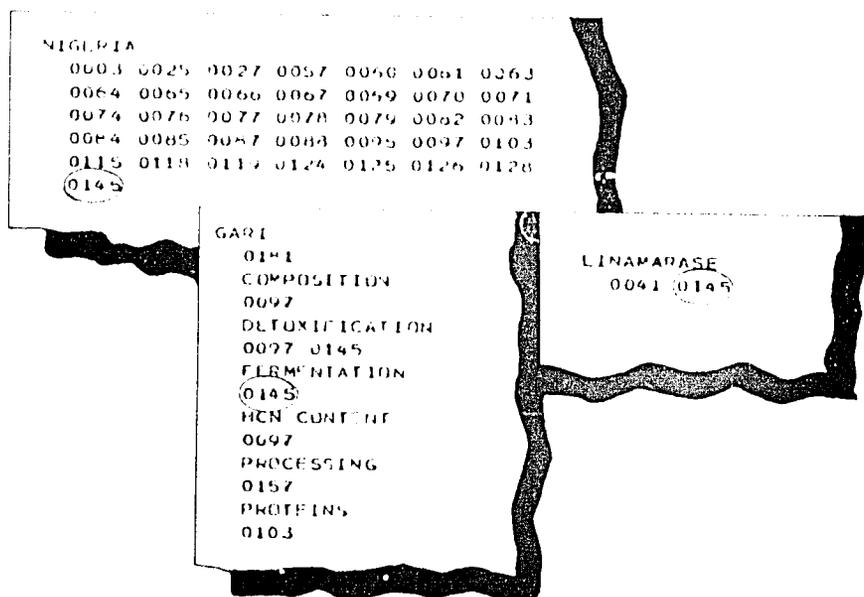
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A00 BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

0001

28131 JONES, P.G. 1986. Sampling for cassava production survey, Brazil. Cali, Colombia, Centro Internacional de Agricultura Tropical. Agro-Ecological Studies Unit. 9p. En., 4 Ref. Contiene 5 mapas en bolsillo.

Cassava. Production. Socioeconomic aspects. Ecology. Maps. Plant geography. Climatic requirements. Soil requirements. Development. Brazil.

The method used to sample the municipalities from cassava growing regions in order to carry out a cassava production survey in Brazil is described. In stage 1, a map of Latin American cassava production was used to select major zones of interest in the states of Pará, Maranhão, Pernambuco, Bahia, and Rio Grande do Sul. In stage 2, the limits of the chosen areas were transferred to a larger scale and subdivided into regions based on an interpretation of climate and soil data; 84 agroecozones were identified and within these, 1575 municipalities. In stage 3, a final list of 320 candidate municipalities resulted in 25 marked agroecozones. A random selection of 50 municipalities was made. Each one of the selected agroecozones is briefly described. (CIAT)

0002

29482 NASSAR, N.M.A.; CARMONA H., F. 1986. Collecting wild cassava in northern Mexico. Plant Genetic Resources Newsletter 65:29-30. En., Sum. Fr., Es., 3 ref.

Cassava. Taxonomy. Germplasm. Plant geography. Adaptation. Plant development. Mexico.

Wild species of *Manihot*, native to the north of Mexico, were collected in July-Aug. 1985. Seeds and cuttings of the following 9 species were collected in their natural habitat: *M. subpicata*, *M. rubricaulis*, *M. angustiloba*, *M. davidiae*, *M. aesculifolia*, *M. caudata*, *M. michaelis*, *M. chlorostriata*, and *M. pringlei*. Notes about geographic distribution, type of growth, and adaptation to adverse conditions were taken. (AS-CIAT)

B00 PLANT ANATOMY AND MORPHOLOGY

0003

29506 ALMEIDA, F.C.G.; HUANG, F.H.; WADDLE, B.A. 1984. Callus formation from leaves of cassava, *Manihot esculenta* Crantz. Ciencia Agronómica 15(1-2):41-43. En., Sum. Pt., 4 Ref., 11.

Cassava. Morphogenesis. Hybridizing. USA.

The development of callus in cassava as a prerequisite to morphogenesis and finally to somatic hybridization is reported. Sections of excised cassava leaves were placed on a solid modified Murashige and Skoog medium with 2 percent sucrose, 0.6 percent agar, 0.1 mg nicotinic acid/liter, 0.001 mg GA/liter, 0.005 mg benzyladenine/liter, and 1 of 4 concn. of 2,4-D (1.00, 0.10, 0.01, and 0.001 mg/liter). After 5 wk. of culture, 2,4-D concn. of 1.00 and 0.10 mg/liter proved to be the best for callus formation. (AS-CIAT)

0004

29568 CASSAVA PLANT type: an important factor for yield determination. 1985. Radix 7(1):14-15. En., 2 Ref.

Cassava. Root productivity. Plant anatomy. Spacing. Leaves. Plant development.

The following factors related to plant type that determine cassava root yield are briefly reviewed: branching habit, leaf life, size, and no., plant height, and HI. Characteristics of an ideal cassava var. to be used under good growing conditions include late branching at 6 and 9 mo. after planting, no side branches, large leaf size (approx. 500 square centimeters/leaf) at 4 mo. after planting, leaf longevity of 100 days, and 9 or more roots/plant when sown at a population of 10,000 plants/ha. (CIAT)

0005

29574 FUKUDA, C.; ROMEIRO, R. DA S. 1984. Estomas e resistencia de variedades de mandioca a bacteriose. (Stomata and resistance of cassava varieties to bacteriosis). Revista Brasileira de Mandioca 3(1):27-29, 31. Pt., Sum. Pt., En. [EMBRAPA/Centro Nacional de Pesquisa da Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cultivars. *Xanthomonas campestris* pv. *manihotis*. Stomata. Resistance. Plant tissues. Brazil.

Twenty-six cassava var. (5 resistant, 10 moderately resistant, and 11 susceptible to *Xanthomonas campestris* pv. *manihotis*) were studied regarding stomatal dimensions (length and width of the stomatal opening) and no. of stomata/leaf area unit. No correlation was found between var. resistance and no. of stomata/leaf area unit. Nevertheless, susceptible var. tended to have larger stomatal openings than resistant var. (AS) See also 0009 0019 0024 0032 0087 0090.

000 PLANT PHYSIOLOGY

0006

29011 VILLAMAYOR JUNIOR, F.G.; DESTRIZA, T. 1985. Moisture stress and its effect on cassava yield. Radix 7(1):5-6. En., [Philippine Root Crop Research & Training Center, Visca, Baybay, Leyte, Philippines]

Cassava. Water requirements (plant). Climatic requirements. Productivity. Cultivars. Adaptation. Plant physiology. Dry matter. Production. Development. Philippines.

Cassava cv. Golden Yellow was tested for drought stress tolerance under field conditions at the Philippine Root Crop Research and Training Center by comparing yield components of stressed and watered plants during a dry period that occurred between late Dec. 1982 and early 1983. Watered plants received 40 liters of water/plant during drought peaks. Yields were significantly higher for watered plants (3.4 kg/plant) compared with stressed plants (2.4 kg/plant). The lower total plant wt. of stressed plants (5.1 kg/plant vs. 6.8 kg/plant for watered plants) suggests that the DM accumulation was affected by moisture stress; however, the partitioning of assimilates was apparently not affected by moisture stress since HI was not affected (47 vs. 50 for stressed and watered plants, resp.). The results indicate that where the dry season lasts 5-6 mo. such as in the Ilocos region, cassava can greatly contribute to increase food production. (CIAT) See also 0073

C01 Plant Development

0007

29571 MELIS, R.J.M.; VAN STADEN, J. 1986. The effect of Alar (succinic acid 2,2-dimethylhydrazide) on the growth of cassava (*Manihot esculenta*) under subtropical conditions. *South African Journal of Plant and Soil* 3(1):49-51. En., Sum. En., Af., 8 Ref., 11. [Dept. of Crop Science, Univ. of Natal, P.O. Box 375, Pietermaritzburg, 3200 Republic of South Africa]

Cassava. Plant development. Productivity. Pruning. Growth. Adaptation. Temperature. South Africa.

The effect of Alar (succinic acid 2,2-dimethylhydrazide) and pruning on cassava was studied under subtropical conditions in Natal, South Africa. Alar application in early summer had little effect on shoot growth and did not increase yield. Pruning at the start of the 2nd growing season stimulated shoot growth and led to a low tuber growth rate. Alar reduced shoot growth but did not lead to an increase in tuber yield. (AS)

0008

29027 PEREIRA, J.F.; SPLITTERSCHEK, W.E.; CGREN, W.L. 1986. Photosynthesis in detached leaves of cassava. *Photosynthetica* 20(3):286-292. En., Sum. En., 10 Ref., 11. [Lab. of Plant Physiology, Univ. de Oriente, Josepín, Maracay, Venezuela]

Cassava. Photosynthesis. Cultivars. Metabolism. Leaves. Venezuela.

Net photosynthetic rates (PN) were measured in detached leaves of 5 cassava cv. The highest chlorophyll a, b, and (a + b) contents, 0.56, 0.49, and 0.99 g/square meter, resp., were in cv. 2191. PN per chlorophyll of cv. 2078 increased as leaves matured, while PN of all leaves of cv. 2191 was approx. 0.56 g (CO₂)/g (chlorophyll)/s. Cassava leaves showed a CO₂ compensation concn. of 10 cubic centimeters/cubic meter at 20 percent O₂ and of zero in a N atmosphere which indicated a C₃ species. For cv. 2112, PN was a function of the natural logarithm of the irradiance, and saturation with radiant energy was not found even at 2000 micromol/square meter/s (400-700 nm) at which the leaf PN was approx. 1 mg (CO₂)/square meter/s. The compensation irradiance was 68 micromol/square meter/s. On a per leaf area basis, young leaves of cv. 2062 showed a higher PN than old leaves while for cv. 2078 and cv. 2490 the highest PN was found in older leaves. Per whole leaf the 3 cv. were almost similar in PN. (AS)

0009

29008 ZAMORA, O.B. 1986. Photosynthetic productivity of cassava (*Manihot esculenta* Crantz) in the field. *Journal of the Australian Institute of Agricultural Science* 52(2):108-109. En.

Cassava. Field experiments. Photosynthesis. Cultivars. Plant physiology. Leaf area. Metabolism. Dry matter. Australia.

The results of 2 field trials and 1 glasshouse study to gain an understanding of the photosynthetic productivity of cassava are discussed. In trial 1, net canopy photosynthesis of cassava var. MAUS 7 (20,408 plants/ha) followed the shortwave solar radiation pattern throughout the day and continued to respond up to the max. of 800 W/square meter. It was concluded that, for most of the season, the cassava canopy is inefficient since upper leaves shade lower leaves which are adequate to intercept and convert available photosynthetic active radiation. In trial 2, MAUS 7 and MAUS 13 were compared regarding their photosynthetic productivity at 2 stages of growth and 3 plant populations (20,408, 40,000, and 81,632

plants/ha). Irrespective of var. and time of sampling, plants grown at high populations were taller, had faster rates of leaf turn-over, produced fewer laterals on the main stem, and had higher LAI and DM wt. No differences between var. were observed in net canopy photosynthesis. It was concluded that there must have been a decline in the photosynthetic capacity of leaves in stands at high populations. In trial 3 under glasshouse conditions, as leaves of MAus 7 aged, dark respiration rate, max. rate of net photosynthesis, and initial slope of the light response curves declined progressively, the response being greater for leaves in plants at high than at low population. Plants at high population also had a greater proportion of young leaves. (CIAT) See also 0002 0003 0004 0011 0013 0014 0016 0021 0032 0039 0045 0046 0052 0087 0092

003 Chemical Composition, Methodology and Analyses

0010

29498 HAMIR, N.A.BT.; LIAN, T.S. 1980. Perbandingan di antara cara-cara menentukan kandungan kanji di dalam ubi kayu (*Manihot esculenta* Crantz). (Comparisons of methods to determine starch content in cassava tubers). Teknologi Pertanian MARDI Bil. 1:30-34. Mal., Sum. Mal., 3 Ref., Il.

Cassava. Starch content. Roots. Analysis. Dry matter.

Four methods of determining starch content in cassava tubers were compared. The method that used DM content was easy to carry out, saved time, and did not require special facilities; however, the method using specific gravity measurements was faster and more suited to the rapid selection of hundreds of clones. Estimates from the 2 methods had high correlations with starch content estimates obtained by mechanical analysis. Mechanical analysis closely parallels the rate of starch extraction in factories and does not require special lab. facilities as compared with chemical analysis. (CIAT)

0011

27668 RAICH, J.; EWEL, J.; OLIVERA, M. 1985. Soil-CO₂ efflux in simple and diverse ecosystems on a volcanic soil in Costa Rica. Turrialba 35(1):33-42. En., Sum. Es., En., 46 Ref. [School of Forestry and Environmental Studies, Duke Univ., Durham, NC 27706, USA]

Cassava. Ecology. Efflux. Plant physiological processes. Insecticides. Carbon dioxide. Soil requirements. Temperature. Costa Rica.

Soil CO₂ efflux was measured from 9 ecosystems of Turrialba, Costa Rica, all on relatively fertile soil. The ecosystems ranged from 0.8 to 10 yr old and included a vegetation-free soil, monocultures of *Smilax arborea* and cassava, and successional communities containing 80 to over 150 species. CO₂ effluxes were based on replicated (n = 6 or 8) measurements at 4-h intervals for continuous 24-h periods, using closed chambers containing alkali absorbent. Mean CO₂ effluxes ranged from about 9 to 18 g/square meter/day; diurnal trends were inconsistent. Insecticides did not reduce rates of CO₂ evolution from the 2 ecosystems where they were applied. The vegetation-free soil yielded CO₂ at the slowest rate, but other differences among ecosystems were not clearly related to differences in vegetation age, stature, species richness, or fine-root surface area. Soil temp. did not account for differences in CO₂ efflux, but increased soil water was associated with faster CO₂ release, probably because it stimulated the activity of soil microorganisms and/or roots. Soil CO₂ efflux data from the tropics are tabulated. (AS)

0012

29583 RAMIREZ, H.; HUSSAIN, A.; ROCA, W.; BUSHUK, W. 1987. Isozyme electrophoregrams of sixteen enzymes in five tissues of cassava (*Manihot esculenta* Crantz) varieties. *Euphytica* 36:39-48. En., Sum. En., 19 Ref., Il. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Enzymes. Cultivars. Tissue culture. Plant tissues. Roots. Leaves. Stems. Petioles. Composition. Colombia.

Methodology, based on starch and polyacrylamide gel electrophoresis, was developed for determining isozyme electrophoregrams (patterns) of 16 enzymes of cassava var. as potential genotype markers. Extracts of 5 different tissues (root, stem, leaf, petiole, and bud) were examined. In general, the nodal portions of the shoots gave isozyme patterns with the largest no. of bands. Petiole extracts gave similar results but bud extracts gave poor patterns. The limited no. of var. that were examined could be distinguished by sequential classification on the basis of the isozyme patterns of acid phosphatase, esterase, glutamate oxaloacetate transaminase, and phosphoglucoseisomerase. (AS) See also 0008 0021 0048 0055 0060 0063 0079 0085 0096 0098 0099 0113 0115 0116 0128 0134 0143 0147 0148 0151 0152 0154 0167 0169 0175 0179 0184 0190

004 Plant Nutrition

0013

29009 CARVALHO, P.C.L. DE 1984. Acao do aluminio na cultura da mandioca (*Manihot esculenta* Crantz). (Action of aluminum in cassava). *Revista Brasileira de Mandioca* 3(1):1-5. Pt., Sum. Pt., En., 16 Ref. [Empresa Brasileira de Pesquisa Agropecuaria, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Nutrient uptake. Cultivars. Plant development. Root development. K. P. Ca. Mg. Brazil.

The effects of different concn. of Al (0, 2, 4, 8, 16, and 32 ppm) on nutrient absorption and growth of cassava cv. Cigana Preta was studied in a modified 1/5 Steinberg nutrient solution with pH adjusted to 4.0. Significant reductions were observed in root growth and aerial part development with 16 and 32 ppm Al. Even the lowest concn. of Al in the root growth medium reduced tissue concn. of P, Ca, and Mg, but did not affect K absorption. (AS)

0014

29439 KATO, O.R. 1987. Efeito de micorriza vesicular-arbusculares no crescimento e nutrição da mandioca (*Manihot esculenta*, Crantz) em solo adubado com doses crescentes de superfosfato triplo. (Effect of vesicular-arbuscular mycorrhizae on growth and nutrition of cassava, in soil fertilized with increasing doses of triple superphosphate). Tese Mestre. Lavra-MG, Brasil. Escola Superior de Agricultura de Lavras. 197p. Pt., Sum. Pt., En., 99 Ref., Il.

Cassava. P. Mycorrhizae. Cultivars. Inoculation. Plant development. Dry matter. Nutrient uptake. Ca. N. K. Zn. Cu. B. Composition. Brazil.

The effects of 4 levels of P (0, 200, 600, and 1800 kg/ha) and inoculation with vesicular-arbuscular mycorrhizae fungi (VAM) on the growth and nutrition of cassava cv. IAC 12 829 were assessed in a Dark Red Latossol

under glasshouse conditions from Oct. 1985 to Jan. 1986. Inoculation treatments were uninoculated control, inoculation with *Glomus clarum*, *Entrophospora colombiana*, and *G. clarum* + *E. colombiana*. Two soil treatments (fumigated and nonfumigated) were also used in a completely randomized design in a 4 x 4 x 2 factorial with 4 replications. Parameters assessed were percentage of root colonization, no. of VAM fungi spores, total no. of leaves and no. of leaves retained, av. height and diameter of the plant stems, fresh and dry wt. of roots and shoots, and nutrient concn. in shoots and roots. The percentage root colonization indicated that mycorrhizae symbiosis with cassava was present in plants growing in uninoculated, nonfumigated soil. This colonization was due to the presence of native populations of VAM fungi (*Acaulospora appendicula*). The rate of root colonization in fumigated and inoculated soil was 63.7 percent compared with the rate of colonization by native VAM species, 14.3 percent. These results indicate the high infectivity of the introduced fungal species. Inoculation with *G. clarum* was beneficial to the growth and nutrition of cassava. Positive effects were observed in the production of leaves, plant height, stem diameter, and accumulation of fresh and dry matter in the shoots and roots. To obtain 60 percent of the max. root DM production achieved in plants inoculated with *G. clarum*, it was necessary to add 269.07 kg P/ha and in uninoculated plants 1507.88 kg P/ha. The greatest effects on nutrient levels in plant tissues were obtained with the inoculation of *G. clarum* which caused higher levels of P and Cu in the roots and of P in the aerial part and lower levels of N, K, Zn, and B in the roots and of N, K, Ca, Zn, and B in the aerial part. The greatest benefits of inoculation with *G. clarum* were achieved with the addition of 200 kg P/ha and the least benefits with the addition of 1800 kg P/ha. Increasing P dosages increased P and Ca levels and decreased in N, K, Zn, Cu, and B levels in the plant tissues. *E. colombiana* was not effective in spite of the fact that positive results were observed in the development and levels of P in cassava plants without the addition of P. Cassava plants grown in the absence of VAM fungi showed poor development unless high rates of P were applied to the soil, indicating that the VAM symbiosis plays an important role in the growth and nutrition of cassava in tropical soils. (AS)

D00 CULTIVATION

D01 Soil, Water, Climate and Fertilization

0015

23785 BOLHUIS, G.G.; ROSANOW, M. 1972. Onderzoek inzake mogelijkheden cassavecultuur in Suriname. (Study on cassava cultivation and market possibilities in Suriname). Amsterdam, Holland, HVA-International bv, 66p. Nl., Sum. Nl., 22 Ref., 11.

Cassava. Cultivation. Cultivars. Yield. Research. Marketing. Cassava flour. Uses. Soil requirements. Adaptation. Fertilization. Rotation. Labor. Surinam.

An overview is presented of cassava cultivation and its market possibilities in Surinam. The historic development of cassava cultivation, including aspects such as the var. tested, yields, and past investigations, is briefly discussed. In addition, the market possibilities for CF are presented. The method of CF use in the Al industry, comparing it with rice flour, is described. Recommendations are given regarding cassava uses, suitable soil zones for cultivation in the country, climatic adaptation in specific regions, fertilization, crop

rotation, var., land preparation, labor requirements for different cultural practices, and future research topics. (CIAT)

0016

27679 COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION. 1983. Salt tolerance in cassava. In_____. Institute of Biological Resources. Annual Report 1982-83. Dickson, Australia. pp.30-31. En., 11.

Cassava. Salinity. Water requirements (plant). Irrigation. Plant development. Starch content. Planting. Soil requirements. Australia.

In greenhouse expt. 3-mo.-old cassava plants were grown in a porous medium in pots and sprayed with nutritive solutions containing NaCl at concn. ranging from 0 to 75 millimolar or approx. 4 times the expected soil salinity in irrigated regions in Murray river valley, Australia. The typical leaf burn symptoms associated with excessive salinity were more noticeable on the older leaves and increased in severity with increasing concn. of NaCl. The fresh wt. of leaves, stems, and roots decreased with increasing salinity. Shoot wt. was reduced significantly at salt concn. of 20 millimolar and root wt. was reduced by almost 50 percent at levels between 30-50 millimolar. The root starch concn., however, remained constant. It may be possible to maintain the starch yield/unit area by increasing the planting density when saline irrigation water is used. Compared with the performance of other plant species, cassava can be considered to have intermediate sensitivity to salinity, meaning that it would be possible to grow cassava with irrigation water of similar quality to that acceptable for grapevines. It may also be possible to use recycled waste water for its cultivation. (CIAT)

0017

29587 FIORETTO, R.A.; BRINROEL, O. 1987. Variacao sazonal nos resultados das análises químicas do solo, após a aplicacao de manipueira. (Seasonal variation in results of soil chemical analyses, after application of manipueira). Energia na Agricultura 2(1):32-37. Pt., Sum. Pt., En., 6 Ref.

Cassava. Soil fertility. Waste utilization. Cassava flour. Industrialization. E. Ca, Mg. Soil amendments. Brazil.

Highly polluting manipueira, a residual compound in CF industry, was applied at 0, 80, and 160 cubic meters/ha on a clay soil, classified as Terra Roxa Estruturada, in Betucatu (Sao Paulo, Brazil). To check the influence of manipueira on the chemical composition of the soil, samples were collected at 2 different depths (0-15 and 15-30 cm) in treated plots at 30, 60, 90, and 170 days after application. Plots receiving 160 cubic meters manipueira/ha showed higher potash (K(+)) disposal in the soil than with 80 cubic meters/ha, and both these treatments were higher than the check. At the highest application level, Ca and Mg tended to lixiviation. (AS)

0018

27681 INSTITUTO COLOMBIANO AGROPECUARIO. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1982. Yuca. (Cassava). In_____. Carimagua. Informe de Actividades 1979-1981. Bogotá. pp.220-233. Es.

Cassava. Research. Soil requirements. Germplasm. Cultivars. Cultivation. Adaptation. Productivity. Irrigation. Fertilization. Entomology. Diseases and pathogens. Development. Colombia.

A progress report is presented on the activities of the collaborative cassava research program carried out during 1979-81 in Carimagua, Colombia, by the Instituto Colombiano Agropecuario and CIAT. The basic focus is to

develop production technology for cassava on acid infertile soils. Research results on germplasm, soils, var. improvement, plant pathology and entomology, cultural practices, and regional trials are presented. The high tolerance of cassava to drought was confirmed in productivity trials; however, irrigation was found to increase yields of var. M Col 1684, known for its high yield potential but low vigor, by 48 percent. The highest starch yield was obtained with split applications of 100 kg K/ha. M Col 1684 and M Col 63E were found to be good parent materials due to their resistance to both bacterial blight and superelongation. CM 430-37, CM 440-5, CM 430-9, CM 91-3, and CM 523-7 are promising lines for the Carimagua ecosystem, while CM 516-18, CM 723-3, CM 841-163, CM 946-2, CM 951-6, and CM 996-6 performed well in tropical savannah conditions. (CIAT)

0019

29478 MACHADO, E.L. 1983. A mandioca: e sua cultura no Rio Grande do Sul. (Cassava: its cultivation in Rio Grande do Sul). Trigo e Soja no.69:4-43. Pt., 73 Ref., 11.

Cassava. Cultivation. Plant anatomy. Cyanogenic glucosides. Climatic requirements. Soil amendments. Fertilization. Timing. Cultivars. Herbicides. Harvesting. Pests. Cassava starch. Cassava chips. Alcohol. Sago. Dextrine. Glucose. Production. Postharvest technology. Brazil.

A comprehensive review of cassava cultivation in the state of Rio Grande do Sul, Brazil, is presented. Aspects such as plant anatomy, chemical composition of glucosides, mesologic and climatic zoning, soil conservation and soil amendment practices, fertilization, planting dates, var. selection, cultural practices, use of herbicides, harvesting, diseases and pests, and vegetative rest are discussed. Biomass production is also analyzed and the production of table flour, starch, cassava chips, alcohol, sago, dextrine, and glucose are discussed. A brief discussion is also included on cassava production in different countries and on a method for postharvest conservation with salt. Data is given on Brazil's production. (CIAT)

0020

28155 RUIZ M., L. 1984. Efecto de la inoculación con micorrizas sobre la respuesta de la yuca (*Manihot esculenta*) a la fertilización fosfórica. (Effect of mycorrhiza inoculation on the response of cassava to phosphoric fertilization). Ciencia y Técnica en la Agricultura. Viandas Tropicales 7(2):39-52. Es., Sum. Es., En., 5 Ref., 11. [Estación Experimental de Viandas Tropicales Fructuosa Rodríguez. Santo Domingo, Villa Clara, Ministerio de la Agricultura, Ciudad de La Habana, Cuba]

Cassava, pH. Soil fertility. P. K. Mycorrhizae. Fertilization. Dry matter. Field experiments. Colombia.

A greenhouse trial was carried out in an acid soil, poor in P (2.9 ppm Bray II) from Santander de Quilichao, Colombia, to evaluate the response of cassava to inoculation with *Glomus manihotis* and to P fertilization (0, 50, 100, and 500 kg/ha) in both sterilized and unsterilized soil. Inoculation with *G. manihotis* enhanced the extraction of P and K, increasing DM production 30-fold (from 1.15 to 33.96 g/plant) for the level of 100 kg P/ha in sterilized soil. The best treatments in relation to DM production were 100 and 500 kg P/ha (33.96 and 32.09 g/plant) in sterilized inoculated soil. It is recommended to establish this type of research work as well as other similar ones in the field to obtain more information about the role of mycorrhizae and their application in agriculture. (AS)

0021

26697 TENGAS, I.E.; URREA, G.A. 1985. Selección de especies forrajeras para corte adaptadas a suelos ácidos de baja fertilidad en un Ultisol de Colombia. (Selection of forage species for cutting adapted to low fertility acid soils in an Ultisol of Colombia). Turrialba 35(2):179-186. Es., Sum. Es., En., 32 Ref., 11.

Cassava. Forage. Adaptation. Soil fertility. pH. Fertilization. Dry matter. N. P. E. Ecology. Colombia.

The following fertilizer treatments were applied to Pennisetum purpureum cv. H504, Saccharum officinarum cv. Poj, Axonopus scoparius cv. Comun, Leucaena leucocephala cv. Cunningham, Cajanus cajan cv. Comun, and Manihot esculenta cv. M Col 22: (a) no fertilizer, (b) 150 kg dolomitic lime + 100 kg N + 44 kg P/ha, or (c) 2 t dolomitic lime + 200 kg N + 88 kg P + 42 K/ha + S, B, and Cu. Cuts were performed every 8 wk. during the dry season and every 6 wk. during the rainy season. The fertilizer increased the av. rate of LM production by 41-54 and 67-77 percent in treatments b and c, resp. The interaction with the species was significant. Although C. cajan and M. esculenta adapted well to the soil conditions, they were not persistent with the cropping system utilized. (CIAT)

0022

28109 VELASQUEZ R., E. 1983. Método sencillo, económico y eficiente para fertilizar la yuca. (A simple, economic, and efficient method to fertilize cassava). Fomaiap Divulga 1(13):30-31. Es., 11.

Cassava. Fertilization. Planting. Labor. Agricultural equipment. Venezuela.

A simple, economic, and efficient method to fertilize cassava in poor soils of Venezuela is briefly described. Cassava was fertilized using a combined seed and fertilizer drill. The results showed that it was possible to measure the field, trace the planting rows, and place the fertilizer under the sites where the cassava cuttings would be planted. Hand sowing was facilitated since the planter left a furrow where the cuttings could be placed 10-15 cm away from the fertilizer. Labor requirements were also reduced with this method. (CIAT)

0023

28193 VIJAYAKUMAR, K.R.; THOMAS, P.K.; UNNI, P.N. 1984. Effects of different water table depths and moisture regimes on the growth and yield of cassava Manihot esculenta Cranz. Agricultural Research Journal of Kerala 22(1):93-95. En., Sum. Mal., 4 Ref. [Centre for Water Resources Development & Management, Calicut 673 571, Kerala, India]

Cassava. Water requirements (plant). Plant development. Irrigation. Productivity. India.

The effect of 2 water table depths (80 and 150 cm) and 3 moisture regimes (0, 10, or 20 liters/5 days/plant) on the growth and yield of cassava was studied at the Centre for Water Resources Development and Management (Kerala, India). Growth and yield increased significantly with irrigation. There was also a significant interaction between water table depth and irrigation in causing yield difference. Yield reduction due to high water table was moderated by irrigation. (CIAT) See also 0001 0006 0007 0011 0013 0014 0026 0028 0029 0034 0038 0040 0042 0043 0046 0052 0054 0088 0094 0097 0132 0156 0198 0214 0221 0227

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

0024

28107 ACEVEDO, F. 1983. Modelo IV variedad de yuca Sardina y sus asociaciones. (Model IV cassava var. Sardina and its associations). Fonaiap Divulga 1(11):20-23. Es., Il.

Cassava. Cultivars. Agronomic characters. Plant anatomy. Cultivation. Intercropping. Venezuela.

The main morphological and agronomic characteristics of cassava var. Sardina are described and production recommendations are given for both sole cropping and associated cropping (maize, plantains, beans, and pigeon pea) for the Guarare-Boconó region of Venezuela. (CIAT)

0025

29072 BOCK, K. 1979. Handing-over notes: cassava programme. Nairobi, Kenya Agriculture Research Institute. Crop Virology Research Project. 12p. En.

Cassava. Cassava African mosaic virus. Adaptation. Research. Cassava programs. Planting. Timing. Cultivars. Kenya.

The status of cassava research activities and needs, especially pertaining to CAMD, in different research stations of Kenya, is reported. In the Coast Province, research is being conducted in Mtwapa, Msabaha, Matuga, and Shimo La Tewa, especially regarding CAMD-free bulking blocks, local var. plots, bulking plots from meristem culture-derived cassava, and field trials (crop rotation, time of planting/harvesting, and var. trials). Research in Eastern Province (Katumani and Marinduko) and in Western Kenya (Kakamaga and Muguga) is briefly reported. (CIAT)

0026

29432 CACERES A., L.A. 1986. Efeito da populacao sobre algumas caracteristicas em dez cultivares de mandioca (*Manihot esculenta* Crantz) em tres localidades da Colombia (Effect of plant population on certain characteristics in ten cassava cultivars in three localities of Colombia). Tese Mestre. Lavras-MG, Brasil, Escola Superior de Agricultura de Lavras. 117p. Ft., Sum. Ft., Es., Fn., 90 Ref., Il.

Cassava. Adaptation. Cultivars. Spacing. Cultivation. Field experiments. Root productivity. Soil requirements. Colombia.

Trials were carried out under field conditions at CIAT-Palmira, Media Luna (Magdalena), and Santander de Quilichao (Cauca) to determine the influence of plant densities on 10 cassava var. at the 3 localities as well as optimum plant density and some characteristics of agronomic importance to improve the efficiency of crop management. A split-plot randomized block design was used with 3 replicates. The var. composed the split plots and the 4 plant densities (5,000, 10,000, 15,000, and 20,000 plants/ha) the main plots. Fourteen characteristics were assessed: height and angle of 1st branching; no. of leaves/plant at 6 mo. and at harvest; LAI at 6 mo. and at harvest; plant height at harvest; no. of adequate cuttings; wt. of planting pieces per unit; wt. of aerial parts; root DM content (percentage); non-commercial root and total root wt.; and HI. It was noted that total root production, root DM content, and aerial part and cutting production were affected by locality, density, and var. Favorable soil and climatic conditions produced the best characteristics; heavy soils resulted in a greater production of smaller, non-commercial roots. Total root wt. and root DM content were favored by plant densities of 10,000-15,000

plants/ha. Among the var. tested the most notable were those that showed greater vegetative vigor due to the greater height at 1st branching and/or no. of leaves/plant. In order to obtain a balance between the parts of economic interest (roots and aerial parts) and an adequate production of cuttings, the best plant density is between 10,000-20,000 plants/ha, depending on the locality and the var. used. (AS)

0027

29507 EMPRESA DE ASSISTENCIA TECNICA E EXTENSÃO RURAL DO ESTADO DE MATO GROSSO. 1982. Diretrizes técnicas para o cultivo da mandioca. (Technical guidelines for cassava cultivation). Sinop-MT, Brasil. 19p. B.

Cassava. Cultivation. Harvesting. Cultivation systems. Pest control. Technology transfer. Brazil.

Technical recommendations resulting from a meeting of 32 researchers and technical assistance agents in Mato Grosso, Brazil, are given on cassava cultivation, diseases and pests, harvesting, and cropping systems. (CIAT)

0028

27669 FORSYTHE, W.; TAFUR, N. 1985. The effect of various methods of land preparation on soil resistance to penetration and yields of corn (*Zea mays* L.), cassava (*Manihot esculenta* Crantz) and sweet potato (*Ipomoea batatas* L.), in association. 1. Effect of cropping systems and land preparation on the soil. Turrialba 35(4):357-370. En., Sum. Es., En., 13 Ref., Il.

Cassava. Agricultural equipment. Land preparation. Intercropping. Soil physical properties. Plowing. Sweet potatoes. Costa Rica.

Soil resistance to penetration was determined when a Typic Dystrypept (Turrialba, Costa Rica) was plowed during the dry season (April 1975) and the wet season (June) using a 60 kW (75 h.p.) D4 Caterpillar trac tractor to plow and subsoil and a 50 kW (67 h.p.) 1753 Massey Ferguson tire tractor to plow. Determinations were also made when the soil was prepared by weeding and cleaning without the use of machinery. Each type of land preparation had subtreatments such as a bare plot, a plot covered with sugar cane trash mulch, a plot planted with maize, and a plot planted with cassava and sweet potato in association. Maize was planted in May and June and reaped in Oct., whereas the cassava in association with sweet potato was planted at the same time and reaped 10 mo. after. Soil resistance was significantly lowered by land preparation up to 0.1 m depth and by subsoiling up to 0.3 m depth. Soil prepared during the dry season had a significantly lower MC than soil prepared in the wet season, whose higher MC was attributed to puddling. These differences were discernable up until 14 wk. after preparing the dry soil and 6 wk. after preparing the wet soil. Effects were residual after these time limits. During the growing season soil resistance increased due to (1) drying during the dry season which caused up to a 5-fold increase; (2) human traffic which occurred under maize and cassava with sweet potato, up to 0.2 m depths; (3) settling time, as observed on the plots with no human traffic during the wet season. (AS)

0029

28103 INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES ET DES CULTURES VIVRIERES. 1982. Phytotechnie du manioc. (Cassava phytotechny). In _____, Rapport des Activités 1982. Guyane, Fiche d'Identification no.3. pp.20-23. Fr.

Cassava. Cultivars. Soil requirements. Intercropping. Weed control. Fertilization. Herbicides. French Guiana.

The results of research carried out on cassava during 1982 by the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres in French Guiana are mentioned. Aspects covered were the performance of improved var. in poor sandy soils, rotation of cassava with soybean, rice, and maize, and evaluation of herbicides. It was found that satisfactory cassava yields can not be obtained on unfertilized soils. On the other hand, it is not recommendable to plant soybean or maize in rotation with cassava. Finally, the application of a mixture of oxyfluorfen and dalapon is recommended to maintain the crop weed free up to harvest, and in case of infestations with monocotyledons, oxyfluorfen should be applied since it is less toxic. (CIAT)

0030

29436 KATO, H. 10 S.A. 1987. Efeito da poda e da época de colheita na produtividade, conservação e qualidade de raízes de mandioca (*Manihot esculenta* Crantz). (Effect of pruning and time of harvesting on the productivity, conservation, and quality of cassava roots). Tese Mestre. Lavras-MG, Brazil. Escola Superior de Agricultura de Lavras. 118p. Pt., Sum. Pt., En., 79 Ref., 11.

Cassava. Pruning. Storage. Cultivars. Deterioration. Biochemistry. Starch content. Moisture content. Fiber content. Root productivity. Brazil.

The effects of pruning and of the length of time roots were kept in the soil on the conservation and quality of cassava roots were determined. The differences between cv. regarding deterioration were also studied and the biochemical transformations that occur in the roots, with or without preharvest pruning, were identified. Cassava cv. Mantiqueira and IAC 12 829 were planted in Lavras (Minas Gerais, Brazil) in a randomized block design with split plots and 4 replications. The plots consisted of the interaction cv. x Harvesting period (0, 7, 14, 21, and 28 days after pruning) and the split plots contained the treatments nonpruned and pruned plants. Pruning was carried out 17 mo. after planting in those treatments including this practice, and harvesting was conducted at the aforementioned times in all the treatments, pruned and nonpruned. The production of roots, aerial part, and buds, physiological deterioration, MC, levels of starch, total sugars, total phenols, and fiber, cooking time, and polyphenoloxidase and peroxidase activities were assessed. Pruning of the aerial part up to 28 days before harvesting did not affect root production in the cv. tested and reduced the level of root physiological deterioration; these effects were more pronounced when pruning was performed 21 and 28 days before harvest. Regardless of pruning, the permanence of the roots in the soil reduced the level of root physiological deterioration. Cv. Mantiqueira was more resistant to physiological deterioration and had higher productions of roots, aerial part, and buds, higher MC and peroxidase activity, and lower polyphenoloxidase activity. In cv. Mantiqueira, polyphenoloxidase activity and the levels of total phenols and MC were also directly related with root physiological deterioration. Roots of pruned plants had lower polyphenoloxidase activity, MC, total sugars, and cooking time. Pruning did not affect root fiber content. (AS-CIAT)

0031

29077 KENYA. MINISTRY OF AGRICULTURE. COAST AGRICULTURAL RESEARCH STATION. 1983. Cassava variety trial, cassava time of planting/harvesting trial, cassava rotation trial. In_____. Annual Report 1983. Kenya. pp.41-46. En.

Cassava. Cultivars. Planting. Harvesting. Productivity. Inter cropping. Maize. Cowpea. Palatability. Kenya.

The results of 3 cassava trials conducted in Kenya are presented. Twelve cassava var. were tested in the var. trial of 1982-83. Mwakazanga (local) and F 279 M continued to be the top yielders with 36.0 and 33.9 t/ha, resp., followed by the local var. Kibandamero (33.5 t/ha). While the latter was high yielding and the most popular among local people, it is more fibrous than the rest. Mwakazanga is acceptable but it takes very long to cook (40 min) as well as 5543/156 (35 min) that has taste problems. Var 46106/27 with 31.34 t/ha showed the highest degree of acceptability, except for color. The results of 2 expt. on planting time/harvesting time indicated that the highest av. fresh root yield (34.35 t/ha) was obtained when cassava was planted during the long rains in April and harvested 18 mo. later. The highest yield (31.85 t/ha) for Oct. plantings (short rains) was obtained when cassava was harvested 12 mo. later. The av. yields for the long and short rains were 29.4 and 26.9 t/ha, resp. The cassava rotation trial with 4 treatments (CCCCC, XXCXC, XCCXC, and CCCCX, where C = cassava var. 5543/156 and X = maize or cowpea) over the period 1977-83 indicated that the highest cassava yields were obtained when cassava was preceded by a different crop, and the longer the land rests from cassava, the higher the cassava yields. (CIAT)

0032

27624 LAZO-CASTELLANOS, R.; BETANCOURT, F. 1985. Relación entre la procedencia de las estacas y los rendimientos en yuca en el peñaplano Camaguey-Tunas. (Relationship between origin of cassava cuttings and yields in the Camaguey-Tunas Peneplano). Ciencia y Técnica en la Agricultura, Viandas Tropicales 8(1):57-67. Es., Sum. Es., En., 11 Feb. [Estación Experimental de Viandas Tropicales, Camaguey, Ministerio de la Agricultura, Ciudad de La Habana, Cuba]

Cassava. Cuttings. Productivity. Clones. Root productivity. Plant anatomy. Plant development. Cuba.

The effect of the part of the cassava plant from which cuttings are obtained on the yields was studied at the Camaguey Tropical Root Crop expt. station, Cuba. Commercial clone Señorita was used. Cuttings were taken from plants that branched at 1.2 m. Treatments consisted of 20-cm-long cuttings taken from the main stem and from a portion of secondary and tertiary stems, for a total of 8 variants. There were no significant differences in sprouting percentage for the 2 yr studied (1982 and 1983). Days from planting to field coverage by foliage was significantly less in the plots planted with cuttings from the main stem compared with those planted with cuttings from secondary and tertiary shoots in both years. Commercial root yield showed no significant differences in 1982; however, in 1983 the yield reached with cuttings from the main stem was superior (P equal to or less than 0.05). (AS-CIAT)

0033

28108 MARCANO A., J.J. 1983. Mecanización del cultivo de la yuca. (Cassava mechanization). Fonaiap Divulga 1(13):18-22. Es., Il.

Cassava. Mechanization. Production. Cultivation. Agricultural equipment. Productivity. Economics. Venezuela.

The results of a trial to mechanize all cassava cultivation practices in the Valle de Aroa, Venezuela, are discussed. A 9-ha field was used in addition to a 1-ha check plot. Production costs were reduced by 30.7 percent for integrated mechanization compared with the semimechanized treatment. The double-row planter operates efficiently for furrow opening, planting, and hilling (4 ha/day) but not so efficiently for fertilizer application. The 4-row planter was efficient for all the above practices (8 ha/day). The modified subsoil attachment used for uprooting cassava was

more efficient than the inclined blade attachment. Cassava yields increased by 66.6 percent with integrated mechanization. Thus the objective of the project to reduce cassava production costs through adequate mechanization practices was met. The economic data of the project are given. (CIAT)

0034

29380 PAPUA NEW GUINEA. DEPARTMENT OF PRIMARY INDUSTRY. 1986. Cassava. Port Moresby. Farming Notes Series no.37. 15p. En., II.

Cassava. Production. Cultivation. Fertilization. Land preparation. Cultivars. Cropping systems. Disease control. Pest control. Harvesting. Productivity. Uses. Nutritive value. Recipes. Papua New Guinea.

Guidelines for cassava production in Papua New Guinea are briefly presented. Aspects dealt with include land selection, soil preparation, fertilization, variety, planting systems, pest and disease control, harvesting, yields, uses, and nutritional quality. Indications on how to prepare a cassava sweet are given. (CIAT)

0035

28158 FINO A., J.A.; FUENTES, B. 1984. Efecto de la fecha de plantación sobre la producción de estacas y raíces comerciales de yuca, con relación a la enfermedad superelongación (*Sphaeceloma manihoticola*). (Effects of planting date on the production of cassava cuttings and commercial roots, in relation to superelongation (*Sphaeceloma manihoticola*)). Ciencia y Técnica en la Agricultura. Viandas Tropicales 7(2):81-88. Es., Sum. Es., En., 3 Ref. [Estación Experimental de Viandas Tropicales Fructuoso Rodríguez, Santo Domingo, Villa Clara, Ministerio de la Agricultura, Ciudad de La Habana, Cuba]

Cassava. Clones. Timing. *Sphaeceloma manihoticola*. Cuttings. Root productivity. Cuba.

At the Fructuoso Rodríguez exptl. station (Santo Domingo, Cuba), the performance of plantations of cassava clone Montes de Oca, sown in Jan., Feb., March, April, May, and June, were evaluated to observe the damage caused by *Sphaeceloma manihoticola* in the production of cuttings and commercial roots. The Jan. planting was significantly superior to the others (March-June) in the no. of cuttings produced and in commercial root yield. It is recommended to plant cassava in Nov., Dec., and up to Jan. 15. (AS)

0036

28154 FINO A., J.A. 1984. Efecto de la selección y tratamiento químico al material de propagación de yuca (Manihot esculenta) sobre los rendimientos. (Effect of selection and chemical treatment of cassava planting material on yields). Ciencia y Técnica en la Agricultura. Viandas Tropicales 7(2):53-59. Es., Sum. Es., En., 4 Ref. [Estación Experimental de Viandas Tropicales Fructuoso Rodríguez, Santo Domingo, Villa Clara, Ministerio de la Agricultura, Ciudad de La Habana, Cuba]

Cassava. Clones. Cuttings. Root productivity. Propagation materials. Cuba.

Between 1978-79 the effect of the selection and chemical treatment of cassava cuttings on the yield of clone Señorita was evaluated at the Centro de Mejoramiento de Semillas Agrícolas Fructuoso Rodríguez (Santo Domingo, Cuba). The results obtained indicated that there was a significant difference between selected treated cuttings and the rest (selected untreated, nonselected treated, and untreated). It was possible to increase commercial root yields by more than 6 t/ha (selected treated

cuttings compared with nonselected untreated ones). Selection and disinfection of cuttings prior to their utilization is recommended. (AS)

0037

27645 PINO A., J.A.; FILIPIA, R. 1982. Obtención de material de propagación de yuca (*Manihot esculenta*) libre de añuble bacterial (*Xanthomonas campestris* f. *manihotis*) en Cuba. (Production of bacterial blight (*Xanthomonas campestris* f. *manihotis*) free cassava propagation material). *Ciencia y Técnica en la Agricultura. Viandas Tropicales* 6(2):69-76. Es., Sum. Es., En., 5 Ref. [Centro de Mejoramiento de Semillas Agámicas, Santo Domingo, Villa Clara, Ministerio de la Agricultura, La Habana, Cuba]

Cassava. Propagation materials. *Xanthomonas campestris* pv. *manihotis*. Cultivars. Disease control. Cuba.

An intensive production system for cassava propagation material was evaluated as a means for obtaining bacterial blight (*Xanthomonas campestris* f. *manihotis*)-free plants. From CMC-40 and CEMSA 5-28 plants showing slight damage (degree 1), 98.40 and 91.24 percent healthy shoots were obtained, resp., whereas 78.09 and 63.07 percent healthy shoots were obtained from Señorita and Finera plants showing degree 2 damage. The 2nd reproduction cycle with cuttings from healthy Finera plants grown from shoots produced 100 percent healthy plants over a 12-mo. cycle. The use of this intensive production system of cassava propagation material is recommended for producing basic seed. (AS)

0038

29308 KUNCE, N.V. 1949. Cassava. In..... The agriculture of the cultivation steppe of the lake, Western and Central Provinces, Tanganyika, Tanzania. Longman, pp.77-81. En., 11.

Cassava. Cassava programs. Production. Cassava mosaic virus. Adaptation. Cultivation systems. Soil fertility. Fertilization. Tanzania.

General aspects of cassava cultivation in Tanganyika (now Tanzania) are briefly described. These cover its place in native agriculture, soils, cultivation methods, yields and response to manuring, and diseases. Suggestions for controlling mosaic diseases (severe mosaic, mild mosaic, and brown streak) include: the use of disease-free planting material; the use of cassava var. with leaves that are unsuitable as a vegetable; planting on better soils and manuring; and planting mosaic-tolerant var. (CIAT)

0039

27627 BUJE M., L.; FORTHELEF R., J.M.; MARTINEZ M., B. 1985. Fertilización nitrogenada en la yuca para forraje. (Nitrogen fertilization in cassava for forage). *Ciencia y Técnica en la Agricultura. Viandas Tropicales* 8(1):69-82. Es., Sum. Es., En., 21 Ref., 11. [Centro de Mejoramiento de Semillas Agámicas Fructuoso Rodríguez, Santo Domingo, Villa Clara, Ministerio de la Agricultura, Ciudad de La Habana, Cuba]

Cassava. Cultivars. N. Fertilization. Field experiments. Productivity. Dry matter. Plant height. Forage. Cuba.

During 1983-84, N fertilization in cassava clone Finera was studied on a red ferrallitic soil in the area of the Centro de Mejoramiento de Semillas Agámicas in Caonajal (Villa Clara, Cuba). A randomized block design was used with 5 treatments (0, 100, 200, 300, and 400 kg N/ha/yr). Four harvests took place. N increased forage yields at all harvests. The best treatment (F equal to or less than 0.05) was 300 kg N/ha/yr with a

production of 18.57 t DM/ha/yr and an N utilization efficiency of 11.7 kg DM/kg N. There was a highly significant positive correlation ($r = 0.92$) between plant height and DM yield per harvest. (AS)

0040

29565 SOUTH AFRICAN CASSAVA ASSOCIATION. 1987. Recommendations for the planting and harvesting of cassava for the 1986/87 season. Empangeni, South Africa. 31p. En., 11.

Cassava. Propagation materials. Timing. Soil requirements. Climatic requirements. Rotational crops. Fertilization. Weeding. Pest control. Harvesting. Distribution. Labor. South Africa.

Recommendations for the production of cassava roots and good propagation material in South Africa are given regarding the selection of suitable land, particularly regarding loading facilities, soils, slope, climate, and previous crops. Land preparation, fertilization, and planting material, time, density, position, and depth are also indicated. Procedures for disease, pest, and weed control are given and different aspects of harvesting are discussed. (CIAT)

0041

29087 UGANDA. DEPARTMENT OF AGRICULTURE. 1960. Cassava: (Lango-Mogo; Acholi-Mogo) *Manihot utilisima*. In_____. The systems of agriculture practiced in Uganda. Uganda. pp.28-30. En.

Cassava. Cultivation systems. Production. Planting. Intercropping. Cassava African mosaic virus. *Zonocerus*. Ecology. Uses. Processing. Uganda.

Aspects of cassava cultivation and utilization in Lango and Acholi (Northern Province, Uganda) are briefly described. These include planting, intercropping, and food production. CAMD is considered the main disease and *Zonocerus* sp., the major pest. Scale insects are quite common in Lango. (CIAT)

0042

29089 UGANDA. DEPARTMENT OF AGRICULTURE. 1960. The West Nile systems of agriculture. In_____. The systems of agriculture practiced in Uganda. Uganda. pp.53-58. En.

Cassava. Cultivation systems. Statistical data. Intercropping. Socioeconomic aspects. Cassava programs. Ecology. Uganda.

The cropping systems found in the West Nile region of Uganda are briefly described. Surface area distribution of crops in 9 counties of the region in 1956 are presented in table form; data show that cassava predominated in area planted. Similarly, cassava acreage was always higher than for other crops every year during 1953-58. Four different crop rotation systems that include cassava as a component crop, practiced in the region, are described. (CIAT)

0043

28583 VAN WIJMEERSCH, P. 1986. Cassava (*Manihot esculenta*). In_____. Root crops production in Tonga. Suva, Fiji, Food and Agriculture Organization of the United Nations. RAS/83/001. Field Document 13. pp.48-53,77-79. En., 35 Ref.

Cassava. Research. Cultivars. Productivity. Planting. Timing. N. P. K. Spacing. Mechanization. Cuttings. Climatic requirements. Cassava chips. Fiji. Tonga.

Results of research on cassava carried out in Tonga during 1972-80 and 1981-84 are presented. During 1972-80, yield evaluations of cv. indicated that Mataki'eua and Lepa were superior (av. of 33.46 and 34.01 t/ha, resp.) to the rest, with the best planting dates being Aug. and Oct. Fertilization trials with Mataki'eua showed an increase in yield with increasing applications of N and K (34.19 and 32.68 t/ha for levels of 100 and 50 Kg N and K/ha, resp.), but no interaction or response to P was observed. During 1980-84, the collection of the country's cassava germplasm was initiated and 12 representative cv. are maintained. Planting method trials indicated that distances of 1.0 x 1.0 m or 1.2 x 1.2 m should be used in manual planting; an interrow distance of 0.8 m is recommended for mechanized plantings and manual weed control and 1.6 m with 2 cuttings/planting site for mechanized planting and weeding. Plants obtained from horizontally planted cuttings were harvested more easily, allowed mechanized planting, and favored survival in dry climatic conditions. The preparation and drying of cassava chips for animal feeding only appears to be feasible if the producer does it for his own animals. Additional research on these topics is suggested. (CIAT)

0044

27667 VILLAMAYOR JUNIOR, F.G. 1984. How to increase cassava yield with minimum inputs. *Radix* 6(1):1-3. En., 11. [Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte 7127-A, Philippines]

Cassava. Production. Cultivation. Productivity. Philippines.

Eight cultural cassava production practices to increase yields with min. inputs are briefly described: (1) use of high yielding cv.; (2) adequate soil preparation; (3) planting in well-drained soils; (4) planting of healthy and good quality stem cuttings; (5) planting at the onset of the rainy season; (6) adequate plant populations; (7) weed control; and (8) crop rotation or field fallowing. (CIAT)

0045

27671 VILLAMAYOR JUNIOR, F.G. 1983. Effect of *Cyperus rotundus* L. on the growth and yield of cassava. *Radix* 5(2):10. En., 11.

Cassava. Weeds. Weeding. Plant development. Productivity. Cultivars. England. Philippines.

The effect of different populations of *Cyperus rotundus* on the growth and yield of cassava cv. Golden Yellow was studied. Four treatments were applied: (1) control (weed-free); (2) 30 *C. rotundus* plants/square meter; (3) 60 plants/square meter; (4) unlimited no. of plants/square meter. Cassava plant height and canopy cover were not significantly affected by the weed, but cassava yield was significantly affected in treatment 4. Populations less than 60 plants/square meter did not affect cassava root no. or wt., Hl, and biological yield; thus, at this level cassava can compete well with *C. rotundus*. If this weed predominates, weeding can be postponed as long as its population does not exceed that level. (CIAT)

0046

28597 VRIES, C.A. DE 1985. Optimum harvest time of cassava (*Manihot esculenta*). Abstracts on Tropical Agriculture 10(1):9-14. En., 57 Ref.

Cassava. Harvesting. Productivity. Root productivity. Dry matter. Starch content. Fiber content. Growth. Temperature. Cultivars. Climatic requirements. Netherlands.

A review on optimum harvest time of cassava is given. Results of different expt. conducted to relate root yield and plant age, root DM content and plant age, starch content and plant age, sugar content and plant age, fiber content, DM and starch content determination, starch granule size, cv., temp., rainfall amount and distribution, and other factors with optimum harvest time are detailed. It appears that there is no general harvest time, but that it depends particularly on temp., cv., and rainfall distribution pattern. (CIAT) See also 0001 0004 0015 0016 0018 0019 0022 0023 0048 0050 0053 0067 0072 0074 0080 0086 0087 0090 0091 0094 0095 0096 0100 0101 0132 0171 0186 0194 0197 0198 0201 0213 0214 0221 0222 0223 0225 0226 0227 0228

D03 Energy Productivity and Yields

0047

29074 OMONDI, O.C. 1980. Cassava. In Kenya. Ministry of Agriculture. Coast Agricultural Research Station. Annual Report 1980. Kenya. pp.71-73. En.

Cassava. Cultivars. Productivity. Intercropping. Maize. Cowpea. Adaptation. Kenya.

Results of cassava research conducted during the 1979/80 cropping season at Coast Agricultural Research Station (Kenya) are presented. In the cassava var. trial, no significant yield differences between var. were observed; yields ranged between 27.0-35.2 t/ha. The top yielder was local var. Kilandamene, followed by Mwakazanga (34.8 t/ha) and then the exptl. hybrids. Intensive work to collect and evaluate local var. in the Coast Province is therefore proposed. A trial was initiated in Mtwapa in 1977 to study the effect of crop rotations (CCC, XCC, CYC, and XCC, where C = cassava and X = maize or cowpea) on cassava yields. No significant differences were observed between treatments. The highest av. cassava yield (15.0 t/ha) was observed in CYC and the lowest (10.7 t/ha) in XCC. Cassava bulking continued in Mpeketoni, and over 7000 cuttings were given for distribution. (CIAT) See also 0006 0007 0015 0018 0020 0023 0025 0026 0030 0032 0032 0034 0035 0036 0039 0043 0044 0045 0046 0048 0067 0080 0088 0090 0096 0097 0100 0113 0156 0191 0194 0196 0202 0203 0204 0205 0206 0207 0208 0209 0210 0211 0220 0221 0223 0224 0225 0226 0227 0229

D04 Postharvest Studies

0048

29462 CORREA, H.; KATO, M. DO S.A. 1987. Efeito da poda na conservacao e qualidade de raizes de mandioca. (Effect of pruning on cassava root conservation and quality). Informe Agropecuario 13(145):17-18. Pt., 4 Ref. [Depto. Agricultura/ESAL, Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Pruning. Deterioration. Postharvest technology. Productivity. Cultivars. Starch content. Sugar content. Brazil.

The positive effects of pruning on cassava root deterioration delay and root quality after harvesting are briefly reviewed. Prunings at 20-30 cm above the ground 3 wk. before harvesting have given the best results: no yield reductions, but increases in total sugars and moisture contents and reductions in starch content. Results of expt. carried out with cassava cv. Lagoa Brava, Branca de Santa Catarina, Gostosa, Pao de Chile, and IAC 14-18 are given. (CIAT)

0049

29461 KATO, M. DO S.A.; SOUZA, S.M.C. DE 1987. Conservacao de raizes após a colheita. (Postharvest root conservation). Informe Agropecuario 13(145):9-16. Pt., 19 Ref., Il. [EMBRAPA/UEPAE, Belem, Caixa Postal 130, 66.000 Belém-PA, Brasil]

Cassava. Postharvest technology. Cultivars. Storage. Resistance. Deterioration. Brazil.

Methods available to preserve cassava roots after harvesting are briefly reviewed. These include selection of resistant cv., storage in field silos, storage in moist sawdust, paraffin-dippings, refrigeration or freezing, chemical treatments, and storage in polyethylene bags. The physical-chemical composition of cassava cv., with different degrees of resistance to microbiological deterioration before and after its occurrence, is presented. Cv. Engana Ladrão was resistant. Cassava cv. Sonora, Branca de Santa Catarina, Guaxupe, and Mantiqueira also showed resistance to root physiological deterioration. (CIAT)

0050

27673 LOPEZ Z., M.; VASQUEZ B., E. 1985. Efecto del corte del tallo pre-cosecha en la conservación de las raíces tuberosas en tres variedades de yuca (*M. esculenta* Krantz). (Effect of preharvest cutting of stems on the conservation of the tuberous roots in three cassava varieties). Centro Agrícola 12(1):13-24. Es., Sum. Es., En., 6 Ref., Il.

Cassava. Roots. Deterioration. Pruning. Stems. Cultivars. Harvesting. Storage. Cuba.

Deterioration of cassava roots, harvested at different periods of stem pruning, was studied. The percentage of deterioration of 3 var. (Señorita, Señora Blanca, and Pinera), pruned to 50 cm above the ground at 7, 14, and 21 days before harvest was determined. The variation of deterioration percentage indicated that var. Señorita may be stored during more time (about 5 days) than Señora Blanca and Pinera when plants are pruned 14 days before harvest. (AS)

0051

28878 NTIBASHIRWA, S. 1986. Etude du conditionnement du manioc frais. (Study on the conditioning of fresh cassava). In Institut des Sciences Agronomiques du Burundi. Rapport Annuel 1986. (Septembre 1985-Aout 1986). Bujumbura, v.3, pp.242-257. Fr., 8 Ref., Il.

Cassava. Cassava roots (vegetable). Solar drying. Pressing. Peeling. Rasping. Bitter cassava. Cultivars. HCN content. Dry matter. Burundi.

In the Institut des Sciences Agronomiques du Burundi, various studies and trials were carried out on the conditioning of fresh cassava. The methodology used in the 1st expt. on conditioning is described, and the results of preliminary trials of fresh root reduction and of the reduction of MC in fresh cassava are given as well as those of a study of pressing, peeling, and grating fresh cassava. Another similar study of comparative chemistry was carried out on 2 bitter cassava var., Nakarasi and Criolina, to determine DM and cyanide levels. Finally, the methodology and results of various fermentation trials of fresh cassava are included: preliminary trials; follow-up of the trials without modifying the parameters; fermentation trials with and without addition of starch; effect of ambient temp. on fermentation; fermentation trial with addition of sugar; and fermentation trial of fresh, grated, pressed, and sun-dried cassava for 2 h. (CIAT)

0052

29567 QUEVEDO, M.A.; DATA, E.S.; DIZON, R.V. 1985. Appropriate packaging medium for cassava storage. *Radix* 7(1):6-7. En., 11 Ref., 11. [Philippine Root Crop Research & Training Center, Visca, Baybay, Leyte, Philippines]

Cassava. Cultivars. Storage. Roots. Deterioration. Sugar content. Packaging. Philippines.

Roots of cassava var. Golden Yellow were packed in boxes containing moist or dry sand, sawdust, or rice hull for a 45-day period to determine the best storage media. Cassava roots packed in moist sand or sawdust showed a significantly lower percentage of vascular streaking and root decay (less than 25 percent) than those packed in dry packaging media and moist rice hull (above 50 percent), proving that they were more suitable for cassava storage. Cassava roots were also sweeter than the newly harvested ones when coiled, which can be attributed to the increase in sugar content of roots during storage. (CIAT) See also 0030 0100

E00 PLANT PATHOLOGY

0053

29019 SILVEIRA, J.S.M.; PEREIRA, A.V. 1984. Anomalia de causa desconhecida em mandioca (*Manihot esculenta* Crantz) no Estado do Espírito Santo. 1. Sintomatologia. (Anomaly of undetermined cause in cassava in the state of Espírito Santo. 1. Symptomatology). *Revista Brasileira de Mandioca Agropecuária*, Caixa Postal 125, 29.145 Cariacica-ES, Brasil]

Cassava. Symptomatology. Plant development. Fertilization. Cultivars. Timing. Brazil.

In Espírito Santo, Brazil, an anomaly of an unknown nature was observed in cassava roots. Fertilization, origin of cuttings, cv., and harvesting dates were used to characterize the symptoms. Regardless of fertilization, cuttings from those plants affected by the anomaly showed slow growth; thin stems; and discolored, small, and sometimes twisted, leaves. Cuttings from healthy plants did not show symptoms until after 4 mo. and then only randomly. Initial symptoms were reduced growth of apexes and small, discolored, and sometimes twisted, leaves. Afterwards other plant parts were affected, and the anomaly was observed in other plants in the exptl. area. Symptoms in roots were: low wt.:vol. ratio; a whitish external pellicle; thick, lignified peel tightly adhered to the cambium; and green-yellowish streaks on the internal surface of the peel. Root growth was hindered after the appearance of symptoms. (AS) See also 0018 0074 0132

E02 Bacterioses

0054

29480 EMPRESA DE ASSISTENCIA TECNICA E EXTENSAO RURAL DE MATO GROSSO. 1985. Bacteriose da mandioca. (Cassava bacterioses). Mato Grosso, Brasil. 2p. Pt., 11.

Cassava. Bacterioses. Technology transfer. Disease control. Cassava products. Brazil.

The major symptoms of bacterioses in cassava are briefly described and illustrated; protective measures for the crop are given. Twenty-nine cassava by-products are listed. (CIAT)

0055

28392 HERNANDEZ, J.M.; LABERRY, R.; LOZANO, J.C. 1986. Observations on the effect of inoculating cassava (*Manihot esculenta*) plantlets with fluorescent pseudomonads. *Phytopathologische Zeitschrift* 117(1):17-25. En., Sum. En., De., 21 Ref., 11. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. *Erwinia carotovora*. Composition. Analysis. Roots. Disease control. *Pseudomonas*. Isolation. Colombia.

Some 136 isolates of fluorescent pseudomonads were isolated from the rhizosphere of cassava plants growing in 5 different ecosystems. Thirty-four percent of these isolates inhibited the causal agent of cassava stem rot, *Erwinia carotovora* pv. *carotovora*, in vitro. Plantlets, 1-mo.-old, produced by rooting the shoots of 4 cv. in distilled water, were inoculated with a suspension (1.1×10^9) cells/ml of each pseudomonad. Some isolates increased root wt. by 95 percent over uninoculated controls 2 mc. after planting when inoculated at planting and 15 and 30 days afterwards. Inoculated plants were free from symptoms of root pathogens and roots filled earlier than controls. Taxonomic studies showed that these bacterial isolates were either *Pseudomonas putida* (90 percent) or *P. fluorescens* (10 percent). (AS)

0056

29492 ROACH, P.M.; GARNETT, H.M. 1986. Suitability of cell suspension cultures for studying the interaction of cassava with the pathogen causing bacterial blight. *South African Journal of Science* 82(10):592-594. En., Sum. En., 9 Ref., 11.

Cassava. Cultivars. Bacterioses. Disease control. Cassava bacterial blight. South Africa.

A study was conducted to determine whether the pathogenic effect of *Erwinia* strains isolated from cassava plants was elicited in cassava cell suspension as such a model system could facilitate further studies on the pathogenic process. Plant cell suspensions of 2 cassava cv. showed almost complete cell death over 72 h when inoculated with 2 pathogenic strains of *Erwinia* at initial concn. of 10^3 , 10^5 , and 10^7 bacteria/ml. A 10-15 percent decrease in plant cell viability was noted when a nonpathogenic strain was used. Bacterial cell-free filtrates of *Erwinia* cultures added to the cell suspension cultures decreased plant cell viability when filtrates were prepared from the pathogenic strains, but not when a filtrate was prepared from a plant cell culture or from the nonpathogenic *Erwinia* strain. (AS) See also 0005 0037 0088 0091

203 Mycosea

0057

29028 BIGAWA, S. 1983. Les champignons contaminant le manioc frais dans la ville de Kisangani. (Fungi contaminating fresh cassava in the city of Kisangani). *Journal d'Agriculture Tropicale et de Botanique Appliquée* 30(3-4):193-196. Fr., Sum. Fr., En., 17 Ref. [Faculté des Sciences, Univ. de Kisangani, B.P. 132, Kisangani, Zaïre]

Cassava. Mycoses. *Aspergillus*. *Fusarium*. *Monilla*. *Mucor*. *Penicillium*. Cassava roots (vegetable). Zaïre.

Fungi found contaminating fresh cassava exposed to air were identified at 2 peripheric stations of Kisangani, Zaire, during the driest periods of the year. Genera found were *Aspergillus*, *Fusarium*, *Monilla*, and *Penicillium*. The *Fusarium* genus was the less frequent. (AS)

0058

29024 GOFFART, J.P. 1984. Variabilite de *Colletotrichum gloeosporioides* Perz. f. sp. *manihotis*, agent de l'antracnose du manioc (CAB). (Variability of *Colletotrichum gloeosporioides* Perz f. sp. *manihotis*, causal agent of cassava anthracnose) Mededelingen van de Faculteit Landbouwwetenschappen Rijksuniversiteit Gent 49(2):217-225. Fr., Sum. Fr., En., 10 Ref., 11. [Laboratoire de Phytopathologie, Univ. Catholique de Louvain, Place Croix du Sud, 3 1348 Louvain-la-Neuve, Belgique]

Cassava. *Glomerella eingulata*. Laboratory experiments. Cultivars. Belgium.

A collection of 36 isolates of *Colletotrichum gloeosporioides* f. sp. *manihotis* was studied to determine their morphological and physiological variability. The morphological instability of individual isolates was showed by the presence of sectors in culture. By polyacrylamide vertical gel electrophoresis and through nonreproducible results, the isolates were found to have different protein and esterase patterns, indicating physiological variability. Significant differences in virulence were also observed between isolates inoculated on cassava plants and cassava stem pieces. The differences found between cv. and between the same cv. at different ages were also significant. Lesions were small (5-13 mm) compared with other results reported. (AS)

0059

29528 GONZALEZ, M.S.; FONS, M. 1986. Revisión taxonómica de las especies de *Phyllosticta* sobre *Manihot*. (Taxonomic revision of *Phyllosticta* species on *Manihot*) *Ernstia* no.37:30-40. Es., Sum. Es., En., 11 Ref., 11. [Facultad de Agronomía, Univ. Central de Venezuela, Maracay 2101, Venezuela]

Cassava. *Phoma manihot*. *Phyllosticta*. Venezuela.

The new combination *Phoma manihot* González et Fons is proposed for the species *Phyllosticta manihot* Speg. and *Phyllosticta manihobae* Viégas, described on *Manihot*. *Phyllosticta manihotica* Sydow was found to be a true *Phyllosticta* species. Descriptions and illustrations of the studied fungi are presented. (AS)

0060

28159 MAKON, C.J.M.; OPINA, O.S.; MOLINA JUNIOR, A.B. 1984. Evaluation of crude plant extracts as fungicides for the control of *Cercospora* leafspot of mungbean (*Vigna radiata* (L.) Wilzeck). *Philippine Phytopathology* 20(1-2):27-38. En., Sum. En., 23 Ref., 11. [Dept. of Plant Pathology, Univ. of the Philippines at Los Baños, College, Laguna, Philippines]

Cassava. Tissue culture. Ecology. Composition. Disease control. Mycoses. Philippines.

Crude water extracts of 12 out of 43 plant species screened for their fungicidal properties in vitro showed inhibitory activity against *Cercospora cruenta*, causal agent of *Cercospora* leafspot of mung bean. The crude extracts of cassava, *Amaranthus spinosus*, *Euphorbia pulcherrima*, *Leucaena leucocephala*, and *Mirabilis jalapa*, applied either as protectants or eradicants, controlled the disease under greenhouse conditions. Although *A. spinosus* and *L. leucocephala* extracts significantly reduced the

development of the disease in the field, both extracts were inferior to benomyl in controlling the disease. (AS (extract))

0061

29370 RAM, C.; TUPINAMBA, E.A. 1986. Avaliacao de resistencia de mandioca a podridao radicular. (Evaluation of cassava resistance to root rot). Aracaju-SE, Brasil, Empresa Brasileira de Pesquisa Agropecuaria, Unidade de Execuciao de Pesquisas de Anlito Estadual de Aracaju, Pesquisa em Andamento no.7. 3p. Pt.

Cassava. Resistance. Cultivars. *Phytophthora drechsleri*. Brazil.

Ninety-nine cassava cv. were tested in Riberopolis (Sergipe, Brazil) for resistance to natural root rot infections by *Phytophthora drechsleri* under field conditions. A 1-5 evaluation scale (1 = resistant, 2 = moderately resistant, 3 = moderately susceptible, 4 = susceptible, 5 = highly susceptible) was used. Thirty-four cv. were rated 1 and 2, while 44, 14, and 7 cv., resp., were rated 3, 4, and 5. (CIAT)

0062

29493 TANI, Y.; VONGSUWANLERT, V.; KUINUANTA, J. 1986. Raw cassava starch-digestive glucoamylase of *Aspergillus* sp. N-2 isolated from cassava chips. Journal of Fermentation Technology 64(5):405-410. En., Sum. En., 13 Ref., 11.

Cassava. *Aspergillus*. Cassava starch. Culture media. Molds. Thailand.

A total of 108 black aspergilli strains isolated from cassava fields and factories in Thailand were screened for the activity of raw cassava starch-digestive glucoamylase. *Aspergillus* sp. N-2 was selected as the best producer and its extracellular glucoamylase production was studied. Conditions for the production were optimized for both liquid and solid cultures, and solid culture was found to be approx. 3 times more efficient than liquid culture. The culture filtrate showed strong glucoamylase activity at low pH (2.0) and high temp. (55 degrees Celsius), and could digest high concn. raw cassava starch. The glucoamylase activity was separated into 4 fractions (A, B, C, and D) by DEAE-Sephacel column chromatography. Fraction C was obtained in a homogeneous state with a mol. wt. of 92,000. Each fraction was characterized in terms of the properties of the glucoamylase activity and the efficiency of digestion of cooked and raw cassava starch. (AS)

0063

29520 VAINSTEIN, M.H.; ROITMAN, I. 1986. Cultivation of *Phytomonas francaei* associated with poor development of root system of cassava. Journal of Protozoology 33(4):511-513. En., Sum. En., 20 Ref. [Depto. de Biologia Celular, Univ. de Brasilia, 70.910 Brasilia-DF, Brasil]

Cassava. *Phytomonas francaei*. Symptomatology. Culture media. Brazil.

In the state of Espirito Santo, Brazil, a cassava disease was recently observed, and subsequently a high density of trypanosomatids was revealed in the latex of unhealthy plants. To better characterize this flagellate, *Phytomonas francaei*, an attempt was made to grow it axenically. Successful results were obtained using a biphasic medium containing rabbit blood in the solid phase and a defined medium as overlay. (AS) See also 0020 0035

E04 Viroses

0064

29035 GABRIEL, C.J. 1986. Detection of double-stranded RNA by immunoblot electrophoresis. *Journal of Virological Methods* 13(4):279-283. En., Sum. En., 15 Ref., Il. [United States Plant Introduction Station, Plant Genetics & Germplasm Inst., Agricultural Research Service, Dept. of Agriculture, Glenn Dale, MD 20769, USA]

Cassava. Viroses. Cassava mosaic virus, USA.

A procedure is described which permits the serological detection of double-stranded RNA (dsRNA) which has been electrophoretically transferred from agarose gels to Zeta-Probe blotting membranes. Cucumber mosaic virus replicative forms of RNAs 1-3 and cassava clone Secundina dsRNAs can be routinely detected from 1 g of leaf tissue. This procedure allows for the detection and size estimation of dsRNAs in crude nucleic acid preparations. (AS)

0065

29532 HOWARTH, A.J.; SOORMAN, E.M. 1986. Divergence and evolution of geminivirus genomes. *Journal of Molecular Evolution* 23(4):313-319. En., Sum. En., 32 Ref., Il. [Dept. of Plant Pathology, Univ. of Arizona, Tucson, AZ 85721, USA]

Cassava. Cassava latent virus. Genetics. Cytogenetics. USA.

The nucleic acid sequences of 3 geminiviruses with bipartite genomes and of 2 viruses having a single genome component were analyzed and phylogenetic relationships deduced. Sequences in coding and noncoding regions were considered at the nucleotide and amino acid levels by several methods. The results suggested that the viruses are phylogenetically related to different degrees. All the viruses contain in an intergenic region a consensus sequence (TAATATTAC) that is postulated to be required for a critical virus function, such as replication and/or transcription. Estimates of divergence in one putative gene that all of the viruses share were used to construct a phylogenetic tree. Among the bipartite-genome viruses, EGMV and tomato golden mosaic virus are more closely related than either is to CLV. The single-component viruses (maize streak and wheat dwarf viruses) and 1 of the 2 DNA components of the other 3 viruses were postulated to be distant relatives descended from a common ancestral sequence. (AS)

0066

27625 QUINTERO, S. 1985. Mosaico aucuba de la yuca (Cassava aucuba mosaic virus), un nuevo virus hallado en Cuba. (Cassava aucuba mosaic virus, a new virus found in Cuba). *Ciencia y Técnica en la Agricultura. Viandas Tropicales* 8(1):31-42. Es., Sum. Es., En., 24 Ref., Il. [Centro de Mejoramiento de Semillas Agámicas Fructuoso Rodríguez, Santo Domingo, Villa Clara, Ministerio de la Agricultura, La Habana, Cuba]

Cassava. Cassava aucuba mosaic virus. Symptomatology. Cuttings. Laboratory experiments. Cuba.

Samples of cassava from Yaguajay (province of Sancti Spiritus, Cuba) that showed a typical symptom of aucuba mosaic on all the leaflets were studied. Samples were analyzed in the electron microscope, by mechanical transmission, and by infected cutting. Extracts of diseased leaves, obtained by exudation and by immersion, shaded with Cr evaporation at a 30 degree angle of incidence, revealed the presence of great amount of

cylindric rigid virus particles that measured $133 + 3.3$ nm. All the mechanical inoculations were negative, but all the transmissions by cutting from infected plants were positive. It was concluded that this is a new virus, called cassava aucuba mosaic virus by the author. (AS)

0067

29069 SEIF, A.A. 1976. Studies on the epidemiology of cassava mosaic. In Kenya. Ministry of Agriculture. Annual Report of Scientific Division 1976. Kenya. pp.108-109. En.

Cassava. Cassava African mosaic virus. Cultivars. Productivity. Propagation materials. Aleyrodidae. Field experiments. Kenya.

Seven centrally placed CAMD-infected cuttings of cassava cv. 46106/27 were surrounded by concentric hexagons of 156 CAMD-free cuttings of the same var. to determine the dissemination rate of CAMD within plots. Likewise, 100 CAMD-free plants each of cv. 46106/27 and F279 were planted approx. 300 m downwind of cassava plots with high CAMD incidence to determine the dissemination rate into CAMD-free plots. Yield losses were also determined for both cassava var. Spread from infected to healthy plants was rapid and continued throughout the growing season; at harvest (14 mo.), 84 of the 156 plants (54 percent) were infected. Spread into CAMD-free plots was very slow and showed no build up during the season. Yield losses in 46106/27 were at a 70 percent level, while those of F279 were at the 86 percent level. Crop loss assessments suggested that the control of CAMD in the field in East African coastal areas is possible through the use of CAMD-free planting material, the roguing of infected plants, and by allowing a reasonable degree of isolation of clean plots from infected plots. Also, man was found to be a more efficient vector by his use of infected cuttings than the whitefly. (CIAT)

0066

29503 STANLEY, J.; TOWNSEND, R.; CURSON, S.J. 1985. Pseudorecombinants between cloned DNAs of two isolates of cassava latent virus. Journal of General Virology 66(5):1055-1061. En., Sum. En., 16 Ref., 11. [Dept. of Virus Research, John Innes Inst., Colney Lane, Norwich NR4 7UH, England]

Cassava. Cassava latent virus. Tissue culture. United Kingdom.

Infective clones of the Nigerian isolate of CLV have been obtained. The apparent mol. wt. of the capsid protein of this isolate is slightly higher than that produced in plants infected with cloned DNAs of the Kenyan isolate of CLV. Pseudorecombinant expt. using heterologous combinations of cloned RNAs have confirmed that the physical properties of the capsid protein are encoded on RNA 1 and at least some determinants of symptom induction are also located on this RNA. Comparison between the nucleotide sequences of the open reading frame encoding the 2 capsid proteins shows several nucleotide differences which affect the amino acid composition but which do not significantly alter the potential mol. wt. of the product. In vitro translation of Poly(A)+ RNAs shows that the differences in electrophoretic mobility are not due to differences in host-directed post-translational processing. (AS)

0069

29304 STOREY, H.H. 1937. Virus diseases of plants. The mechanism of transmission by insects. In East African Agricultural Research Station Amani. Tanzania. Annual Report 1937. Tanzania. pp.9-13. En.

Cassava. Diseases and pathogens. Cassava African mosaic virus. Bemisia. Phenacoccus. Disease transmission. Tanzania.

Observations of insect transmission of cassava viruses in Tanzania are briefly reported. Successful transmission of both severe and mild strains of CAMV by whiteflies (*Bemisia gossypiperda* and *B. nigeriensis*) was observed only if insects fed on young leaves that had not fully expanded. The vector of the brown streak virus remains to be found; whiteflies and mealybugs failed to transmit the disease. (CIAT) See also 0038 0041 0085 0095 0096

E05 Mycoplasmoses

0070

29017 FUKUDA, C.; PAGUIO, O. DE LA R.; LOZANO, J.C. 1984. Ocorrência de "filodia" em mandioca. (Occurrence of phyllody in cassava). Revista Brasileira de Mandioca 3(1):67-68. Pt., Sum. Pt., En., 2 Ref. [Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.390 Cruz das Almas-BA, Brasil]

Cassava. Mycoplasmoses. Brazil.

Phyllody, previously unreported in Brazil, was observed in several cassava cv. and hybrids planted in exptl. plots of the Centro Nacional de Pesquisa de Mandioca e Fruticultura in Cruz das Almas. The effect of the disease on production is not known; however, it poses a serious threat to the cassava breeding program. Studies to identify the causal agent, methods of transmission, and control of the disease are in progress. (AS)

0071

29015 SANTOS FILHO, H.P.; FERREIRA FILHO, J.R.; SILVA, A.F.G. DA; FUKUDA, C. 1984. Isolamento, caracterização e controle do fungo *Sclerotium rolfsii* Sacc. em mandioca. (Isolation, characterization, and control of the fungus *Sclerotium rolfsii* in cassava). Revista Brasileira de Mandioca 3(1):33-37. Pt., Sum. Pt., En., 6 Ref., 11. [Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. *Sclerotium rolfsii*. Disease control. Brazil.

Cassava stem pieces inoculated and colonized by the fungus *Sclerotium rolfsii* were placed in petri dishes containing 50 cubic centimeters of unsterilized soil at 60 percent field capacity. Petri dishes were treated with PCNB, TCMTB, and thiram to compare the effect of each product on mycelial development and sclerotia formation. PCNB was more efficient in controlling the fungus in the soil and in the stem pieces used as sources of inoculum. (AS)

E06 Nematodes

0072

29433 ATU, U.G.; OGBUJI, R.O. 1986. Root-knot nematode problems with intercropped yam (*Dioscorea rotundata*). Phytoprotection 67(1):35-38. En., Sum. En., Fr., 13 Ref. [Federal Univ. of Technology, School of Agriculture & Agricultural Technology, P.M.B. 1526, Owerri, Nigeria]

Cassava. Resistance. Intercropping. Cultivars. Nematodes. Planting. *Dioscorea*. Nigeria.

Ten intercrops traditionally planted with yams in southern Nigeria were tested for resistance to *Meloidogyne incognita* race 2. Results based on root gall indices and no. of juveniles recovered from soil and roots indicated that *Cochorus olitorus*, *Sphenostylis stenocarpa*, *Abelmoschus esculentus*, and *Cucurbita pepo* were highly susceptible; *Amaranthus caudatus*, *Citrullus vulgaris*, Zea mays, and *Manihot esculenta*, moderately susceptible; *Telfairia occidentalis*, resistant; and *Mucuna pruriens*, highly resistant. Susceptible intercrops planted on yam mounds resulted in greater damage on the harvested tubers. (AS)

FOO PEST CONTROL AND ENTOMOLOGY

0073

29479 GUTIERREZ, A.P.; SCHULTHEISS, F.; WILSON, L.T.; VILLACORTA, A.M.; ELLIS, C.K.; BAUMGAERTNER, J.V. 1987. Energy acquisition and allocation in plants and insects: a hypothesis for the possible role of hormones in insect feeding patterns. *Canadian Entomologist* 119:109-129. En., Sum. En., Fr., 44 Ref., 11. [Division of Biological Control, Univ. of California, Berkeley, CA, USA]

Cassava. Insect biology. Injurious insects. Plant physiology. Ecology. USA.

A distributed delay age structure model is presented for plants (among them cassava) and 2 insects (pea aphid and a ladybird beetle) that describes the dynamics of per capita energy (PE) acquisition and allocation patterns, and the within-organism subunit (e.g., leaves, fruit, oval) no. dynamics that occur during growth, reproduction, and development. A common acquisition (i.e. functional response) submodel is used to estimate the daily photosynthetic rate in the plant species and consumption rates in the insects. The focus of this work is to capture the essence of the common attributes between trophic levels. The models are compared with field or lab. data. A hypothesis is proposed for the observed patterns of insect reproduction. (AS)

0074

29516 HOEKANEN, H. 1985. Exploiter-victim relationships of major plant diseases: implications for biological weed control. *Agriculture, Ecosystems and Environment* 14(1-2):63-76. En., Sum. En., 47 Ref. [Agricultural Research Center, Inst. for Pest Investigation, S.F-31600 Jokioinen, Finland]

Cassava. Diseases and pathogens. Pest control. Weed control. Biological control. Vectors. Ecology. Finland.

Characteristic features of several catastrophic plant disease epidemics are reviewed and the pathogen-host relationships of tropical diseases are analyzed. The most serious or threatening plant diseases were generally found to involve pathogens originating from another host in a different geographical area, rather than from the cultivated crop plant within its native area. A crop-wide assessment similarly showed that of the important diseases of coffee over 60 percent, of maize over 40 percent, and of cassava over 25 percent do not even occur in the native continent of the crop plant. Lack of evolved interspecific homeostasis between the host plant and its newly-acquired pathogen appears to explain the destructive nature of these exploiter-victim relationships. Evolutionarily new relationships could be utilized in biological weed control to improve the present success rates and also to increase the array of possible control

agent species, particularly for the control of pests within their native area. (AS) See also 0018 0019 0027 0034 0040 0053 0088 0093 0096 0132

F01 Injurious Insects and their Control

0075

30145 BRUN, P.G.; MORAES, G.W.G. DE; SOARES, L.A. 1986. *Trichogramma marandobai* sp. n. (Hym., Trichogrammatidae) parasitoide de *Erinnyis ello* (Lep., Sphingidae) desfolhador da mandioca. (*Trichogramma marandobai* sp. n. (Hym., Trichogrammatidae), a parasitoid of the cassava leaf pest *Erinnyis ello* (Lep., Sphingidae)). Pesquisa Agropecuaria Brasileira 21(12):1245-1248. Pt., Sum. Pt., En., 13 Ref., Il. [Inst. de Ciencias Biológicas, Depto. de Bioquímica e Imunologia, UFMG, Caixa Postal 2486, 30.000 Belo Horizonte-MG, Brasil]

Cassava. *Trichogramma marandobai*. *Erinnyis ello*. Insect biology. Predators and parasites. Brazil.

Trichogramma marandobai n.sp. (Hymenoptera, Trichogrammatidae), an egg parasite of *Erinnyis ello*, is described. It is the 3rd species of *Trichogramma* found on this host in the state of Minas Gerais, Brazil. (AS)

0076

28314 LOBATON G., V.; JIMENEZ M., N.; MESTRA G., A. 1985. Manejo integrado del miriápodo *Orthoporus* sp. (Spirostreptida: Spirostreptidae) en yuca. (Integral management of the myriapod, *Orthoporus* sp (Spirostreptida: Spirostreptidae) in cassava). Bogotá, Instituto Colombiano Agropecuario. 16p. Es., Sum. Es., En., 3 Ref., Il.

Cassava. Insect control. Pest damage. *Orthoporus*. Colombia.

An integrated pest control plan for the myriapod *Orthoporus* sp., which is becoming a primary pest in several cassava growing zones of Sucre, Colombia, is presented. Losses of up to 80 percent of the planting material are reached. Management consists of: (a) cultural practices by burning the cassava stems that have not been selected for seed and by destroying the roots remaining after harvest; (b) reasonable chemical control by treating cuttings with chlordane or Aldrex 2, both at 1.25 percent, or by placing in the planting holes 3 g of carbofuran or of aldrin. In previously established crops, it is recommended to control *Orthoporus* with poisoned baits, prepared as follows: chopped cassava roots (2 kg), brown sugar loafs (2), and carbaryl (20 g). (AS (extract)-CIAT)

0077

29448 NEUENSCHWANDER, P.; MADOJEMU, E. 1986. Mortality of the cassava mealybug, *Phenacoccus manihoti* Mat.-Ferr. (Hom., Pseudococcidae), associated with an attack by *Epidinocarsis lopezi*. Bulletin de la Société Entomologique Suisse 59(1-2):57-62. En., Sum. En., 19 Ref.

Cassava. *Phenacoccus manihoti*. *Epidinocarsis lopezi*. Biological control. Predators and parasites. Nigeria.

Cassava mealybugs of different stages, which had been stung by an *Epidinocarsis lopezi* female, were inspected after 6 and 20 days. The killing power of the parasitoid was several times higher than the production of parasitoid off-spring. Host feeding and mutilation were responsible for 6-22 percent and 11-34 percent mortality, resp. Both were significantly more important on the younger hosts. Of the stung cassava mealybugs, 11-33 percent yielded live parasitoids. Reproduction was

significantly more successful on older cassava mealybugs; 30-56 percent of all cassava mealybugs survived a single oviposition attempt by the wasp. By contrast, mortality of the unstung control was 4-8 percent. In choice expt., 3rd instar cassava mealybugs were slightly but not significantly preferred. (AS)

0076

29510 NUÑEZ B., R. 1986. Estudio preliminar sobre algunos aspectos de la biología de *Erinnyis ello*, gusano del cuerno de la yuca (*Manihot esculenta* Crantz), en La Chontalpa, Tabasco. (Preliminary study about some aspects of the biology of the cassava horrworm (*Erinnyis ello*) in La Chontalpa, Tabasco). *Divulgación Científica (México)* 1(1):149-156. Es., Sum. Es., 4 Ref., Il.

Cassava. *Erinnyis ello*. Insect biology. Cultivars. *Trichogramma*. *Telenomus*. Predators and parasites. Mexico.

A preliminary study was carried out on some aspects of the biology of *Erinnyis ello*, one of the main problems of cassava cultivation in Tabasco, Mexico, to obtain basic information in order to establish an adequate program to combat this insect. Field and lab. studies were carried out at the Colegio Superior de Agricultura Tropical during the spring of 1983, and 140 eggs were collected for daily lab. observation. When the plants were 5 mo. old, samples were taken in 2 lots of 100 square meters planted with the cassava var MPAN-51 (Sabanera) and Ceiba (Criolla), in lineal transects of 10 m, to detect the oviposition preference of adults. Results show the following duration of larval development: 1st instar, 2.31 days; 2nd instar, 2.13 days; 3rd instar, 2.22 days; 4th instar, 3.00 days; and 5th instar, 3.27 days. The pupal stage lasted an av. of 15.6 days. Mean adult longevity was determined to be 12 days. Two parasite species emerged from the eggs under study, viz. *Trichogramma* sp. and *Telenomus* sp. An adult oviposition preference for var. MPAN-51 was also detected. (AS-CIAT)

0079

29455 OLAIFA, J.I. 1986. Toxicity of some insecticides to the grasshopper *Zonocerus variegatus* (Orthoptera:Pyrgomorphidae). *Insect Science and its Application* 7(2):135-138. En., Sum. En., Fr., 15 Ref. [Dept. of Plant Science, Univ. of Ife, Ile-Ife, Nigeria]

Cassava. Insecticides. Toxicity. *Zonocerus variegatus*. Insect biology. Analysis. Nigeria.

Twenty-one insecticides were tested in the lab. for acute toxicity by surface film contact method against the grasshopper *Zonocerus variegatus*, a major cassava pest in Southern Nigeria. Deltamethrin, cypermethrin, lindane, o, o-diethyl(p-methyl sulfinyl) p'-phosphorothioate, and dieldrin were highly potent. Moderately potent insecticides were propoxur, d-trans allethrin, isobenzan, isodrin, heptachlor, and rotenone. A toxic symptom common to all potent insecticides in the female was the opening and closing of ovipositor valves which remained wide open at death. Five insecticides--dieldrin, isobenzan, p, p'-DDT, chlorobenzilate, chlorfenethrol, and chlordimeform--induced cannibalism among the treated females. (AS)

0080

29569 VILLAMAYOR JUNIOR, F.G.; PEREZ, R. 1985. Yield performance of scale insect-infected cassava cuttings treated with insecticide. *Radix* 7(2):3-5. En., Il. [Philippine Root Crop Research & Training Center, VISCA, Baybay, Leyte, Philippines]

Cassava. Cuttings. Injurious insects. Insecticides. Insect control. Root productivity. Planting. Cultivars. Philippines.

Treated and untreated scale insect-infested cuttings of cassava var. Golden Yellow as well as clean cuttings were planted to determine whether soaking scale insect-infested cuttings in an insecticide solution (30 ml monocrotophos/20 liters of water for 5 min) before planting affects crop performance. Germination of healthy cuttings was 100 percent at 14 days after planting, while that of scale insect-infested cuttings was only 25-35 percent. The difference between treated and untreated cuttings at harvesting (210 days after planting) regarding final stand or survival was small (88.8 and 83.0 percent, resp.). Total root yields for healthy and treated cuttings were not significantly different (5.9 and 5.8 kg/4.5 square meters) but differed significantly from that of untreated infested cuttings (3.8 kg/4.5 square meters). On a per plant basis, yield was higher for the treated infested cuttings (1.10 kg/plant) followed by healthy and untreated infested cuttings (0.99 and 0.81 kg/plant, resp.), but differences were nonsignificant. Thus, scale insect-infested cuttings should be treated with insecticides before planting. (CIAT)

0081

28579 VILLEGAS G., A.; BELLOTTI, A. 1985. Biología, morfología y hábitos de *Lagocheirus araneiformis* Linne (Coleoptera:Cerambycidae) barrenador de la yuca en Palmira (Valle del Cauca). (Biology, morphology, and habits of the cassava stemborer *Lagocheirus araneiformis* (Coleoptera:Cerambycidae) in Palmira, Valle del Cauca). Acta Agronómica 35(4):56-67. Es., Sum. Es., En., 3 Ref.

Cassava. *Lagocheirus araneiformis*. Insect biology. Pest damage. Injurious insects. Colombia.

The life cycle, sexual and feeding behavior, and morphology of each stage of *Lagocheirus araneiformis*, a cassava pest in Palmira, Colombia, were studied. Under lab. conditions (28.4 degrees Celsius; 65 percent RH) the egg, larval, and pupal stages lasted 3.13, 53.79-87.60, and 7.60 days, resp. Females lived an av. of 45.65 days and males 71.85 days. Under field conditions the time to develop from egg to adult averaged 128.18 days. Females and males lived an av. of 91.62 and 89.72 days, resp. The females laid an av. of 150 eggs in 28.8 days. In the field *L. araneiformis* attacks recently planted cuttings as well as mature plants and stored cuttings. Mature plants are mainly attacked around the base of the main stem. In severe attacks, lodging occurs. Roots may also be attacked, and infested plant residues may play a role in dissemination of *L. araneiformis*. Infested plants can be recognized by sawdust around the base of the plant. (AS) See also 0041 0069 0201

F02 Rodents and other Noxious Animals

See 0072 0186

F03 Injurious Mites and their Control

0082

27678 COMMONWEALTH INSTITUTE OF BIOLOGICAL CONTROL. 1983. Cassava pests. In _____. Annual Report 1982-83. Slough, United Kingdom, Commonwealth Agricultural Bureaux. pp.7-9. En., 11.

Cassava. Biological control. Predators and parasites. *Pheracoccus manihoti*. *Apoanagyrus lopezi*. Mite control. *Mononychellus progressivus*. *Mononychellus tanajoa*. United Kingdom.

The research work carried out by the Commonwealth Institute of Biological Control during 1982-83 on cassava pests is briefly reported. No new natural enemies of *Pheracoccus manihoti* were detected so *Apoanagyrus lopezi* remains the most promising parasite. Work in the Neotropics on cassava mites is now limited to research on the relationship between cyanide glucoside content and the level of mite attack. It is now known that the mite problem in Africa is due to the inadvertent introduction of 2 South American species of the *Mononychellus* complex, since the presence of *M. progressivus* and *M. tanajoa* has been confirmed. A large complex of predators is present on the coast but in western Kenya native natural enemies appear to be scarce. *Gligota minuta* was released in both areas. (CIAT)

0083

29437 MacFARLANE, D. 1984. Key to spider mites (Tetranychidae) recorded on cassava in Africa, with a note on slide preparation. In Greathead, A.H.; Markham, R.H.; Murphy, R.J.; Murphy, S.T.; Robertson, I.A.D., eds. Integrated pest management of cassava green mite; regional training workshop in East Africa, 1984. Proceedings. Ascot, United Kingdom, Commonwealth Institute of Biological Control, pp.31-35. En., 2 Ref., 11.

Cassava. Insect biology. Injurious mites. *Eutetranychus*. *Oligonychus*. *Mononychellus*. *Tetranychus*. Africa.

A taxonomical key that allows the differentiation of African spider mites, recorded in cassava, from other common species that probably also infest this crop in Africa is presented. Spider mites include species of the following genera: *Eutetranychus*, *Oligonychus*, *Mononychellus*, and *Tetranychus*. Specimen preparation procedures for examination are given. (CIAT)

0084

29094 NYIRIA, Z.M. 1975. Cassava mites and meteorology. In Symposium on Research: the Backbone of Agriculture, 2, Kampala, Uganda, 1975. Proceedings. Kampala, Uganda Society of Agronomy. pp.101-109. En., 22 Ref.

Cassava. Injurious mites. *Mononychellus tanajoa*. *Tetranychus telarius*. *Tetranychus cinnabarinus*. Insect biology. Temperature. Ecology. Uganda.

Environmental factors influencing cassava mite development, migration, and dispersal are discussed, and the comparative biology of these pests (*Mononychellus tanajoa*, *Tetranychus telarius*, *T. cinnabarinus*, and other species) are reviewed. Results of studies on the effect of temp. and wind on the abovementioned aspects are discussed. (CIAT)

600 GENETICS AND PLANT BREEDING

0085

28142 GABRIEL, C.J.; WALSH, R.; NOELT, B.L. 1987. Evidence for a latent viruslike agent in cassava. *Phytopathology* 77(1):92-95. En., Sum. En., 21 Ref., 11. [United States, Plant Introduction Station, Glenn Dale, MD 20769, USA]

Cassava. Clones. Disease transmission. Analysis. Tissue culture. Cytology. Cytogenetics. USA.

Several species of double-stranded RNA (dsRNA) were found to occur in the cassava clone Secundina, which was thought to be virus-free. A large dsRNA molecule (6.6 x 10⁶ Mr = relative molecular mass) (L-dsRNA) was shown to be graft, but not mechanically transmitted and occurred primarily in a nuclear-rich fraction isolated from dsRNA-containing Secundina plants. Viruslike particles were not detected in plants containing the L-dsRNA using a var. of purification procedures. L-dsRNA was also found in 2 non-Secundina cassava introductions. Smaller dsRNAs (S-dsRNAs), ranging mainly between 0.61-0.41 x 10⁶ Mr, were also detected in some Secundina plants containing the L-dsRNA. The S-dsRNAs were not transmissible by mechanical inoculation or grafting. All dsRNAs could be eliminated by meristem-tip culture of infected plants. dsRNA analysis is recommended for indexing cassava for this latent viruslike agent. (A3)

001 Breeding, Germplasm, Varieties and Clones, Selection

0086

28196 BOSTER, J.S. 1984. Inferring decision making from preferences and behavior: an analysis of Aguaruna Jivaro manioc selection. *Human Ecology* 12(4):343-358. En., Sum. En., 25 Ref.

Cassava. Socioeconomic aspects. Cultivation systems. Cultivars. Selection. Peru.

The process of Aguaruna cassava selection was inferred by comparing the properties attributed to the var. with the actual frequency with which the var. occur in Aguaruna gardens, located in the Amazon basin in north central Peru. This model, opposed to cognitive models of natural decision making, thereby reduces the possibility that the reasons elicited from informants for their choices are instead post hoc rationalizations of decisions reached on other grounds. The use of a linear model can provide a more accurate description of a decision situation in which the diversity of alternatives is maintained for its own sake. The Aguaruna were able to give good reasons for preferring some cassava var. more than others and plant them accordingly. The overall balance between blind and intentional selection was tilted strongly toward the latter; however, they maintained a no. of rarer var. which could have been logically abandoned in favor of higher yielding var. This may indicate that the limitations of human reasoning may have adaptive significance. (CIAT)

0087

28393 BUENO, A. 1986. Comportamento de genótipos contrastantes de mandioca em diferentes sistemas de plantio. (Behavior of contrasting cassava genotypes in different planting systems). *Pesquisa Agropecuária Brasileira* 21(6):631-640. Pt., Sum. Pt., En., 15 Ref., 11. [Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 07, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Planting. Cultivation systems. Cultivars. Plant anatomy. Canopy. Productivity. Root productivity. Branching. Brazil.

Ten cassava cv. (5 high branching and 5 low branching) were evaluated under similar planting densities in single and double rows during 2 crop years in Cruz das Almas (Bahia, Brazil). A split-plot exptl. design was used with planting systems assigned to the main plots and cv. randomized in the subplots. The single row system was more efficient than the double row one since it promoted higher root yield due mainly to a larger no. of roots/plant formed in the single rows. Canopy yield was similar in both systems. High branching cv. showed, in both years, higher av. root yield

than did the low branching group; however, canopy yield was similar for both groups. Cv. BGM 001 (Aipim Bravo) and BGM 340 (CM 305/5) showed, resp., the highest and the lowest root yield, no. of roots/plant, and av. root wt. The most vigorous canopy was developed by cv. BGM 361 (Arrebenta Burro). Interactions involving cv. and planting systems were not significant for all variables, suggesting that planting systems did not influence the behavior of all cv., regardless of their branching habits. (AS)

0088

28581 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO NACIONAL DE PESQUISA DE MANDIOCA E FRUTICULTURA. 1985. Programa Nacional de Pesquisa de Mandioca. (National cassava research program). In_____. Relatório Técnico Anual 1984. pp.161-231. Pt., Sum. Pt., En., 17 Ref., Il.

Cassava. Research. Cultivars. Resistance. Biological control. Fertilization. Intercropping. Ecology. Cassava bacterial blight. *Sphaceloma manihoticola*. *Erinnyis ello*. Productivity. Brazil.

In 1984, 19 cassava-related research projects were conducted at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (Brazil). These emphasized the selection of pest- and disease-resistant cv., biological control of insect pests, more rational use of chemical fertilizers, and cassava intercropping with short-cycle crops. The evaluation of 4569 hybrids and/or cv. in 5 distinct ecosystems allowed the identification of resistance to CBB, especially important in the south, SE, and central west regions where the disease causes significant production losses. Programs for the systemic control of the superelongation disease (*Sphaceloma manihoticola*) in Mato Grosso and for the biological control of *Erinnyis ello* in an 800 ha-property in Bahia were also established. The application of vinhoto (a liquid residue from alcohol distillation) as fertilizer, up to 6 t/ha, in Mato Grosso has increased cassava production proportionately. The use of this subproduct proved to be economical. The direct soil manuring by animals (parcagem) has shown that cassava can be cultivated for 2 consecutive years in the same area, taking advantage of the residue of the 1st years without reducing nutrient concn. to levels considered critical for the crop. Cassava intercropped in double-row plantings was advantageous in terms of LER compared with monocropping. (AS)

0089

28080 ESQUINAS-ALCAZAR, J.T. 1985. Los recursos fitogenéticos de Paraguay. (Plant genetic resources of Paraguay). Plant Genetic Resources Newsletter no.64:38-41. Es., Sum. En., Fr.

Cassava. Plant breeding. Germplasm. Paraguay.

The current situation of plant genetic resources activities in Paraguay is described. Information is provided on national crop priorities, existing collections, conservation facilities, evaluation, and documentation and other activities. High priority was given to *Manihot esculenta*. (AS)

0090

26856 FRANCIS, C.A. 1986. Variety development for multiple cropping systems. CRC Critical Reviews in Plant Sciences 3(2):133-168. En., 141 Ref., Il. [Dept. of Agronomy, Univ. of Nebraska, Lincoln, Nebraska, USA]

Cassava. Cultivation systems. Cultivars. Plant breeding. Photoperiod. Temperature. Plant anatomy. Roots. Resistance. Experimental design. Productivity. Selection. Intercropping. Genetics. USA.

The principles that should be considered in developing crop var. for multiple cropping systems are discussed, especially regarding the characteristics of the system, species interaction, and genetic diversity and variability. Multiple cropping is defined as well as related terms. Important genetic traits discussed in relation to var. development for multiple cropping systems are var. maturity, photoperiod sensitivity, temp. sensitivity, plant morphology, root system, plant density response, insect and disease resistance, cv. uniformity, grain quality, and yield stability. Several alternatives in exptl. design for efficient evaluation within the breeding methodology are reviewed along with statistical methods (yield reduction, correlation analysis, analysis of variance, and selection methods). Cassava, as well as other crop species used in multiple cropping systems, is used as an example to illustrate the topics dealt with. (CIAT)

0091

29013 FUKUDA, C.; ROMEIRO, R. DA S.; FUKUDA, A.M.C. 1984. Avaliação de resistência de cultivares de mandioca a *Xanthomonas campestris* patovar *manihotis*. (Evaluation of cassava cultivar resistance to *Xanthomonas campestris* pv. *manihotis*). *Revista Brasileira de Mandioca* 3(1):7-12. Pt., Sum. Pt., En., 12 Ref. [Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brazil]

Cassava. Cultivars. Field experiments. Resistance. *Xanthomonas campestris*. Adaptation. Brazil.

A total of 270 cassava cv. were tested under field conditions in Felixlândia (Minas Gerais, Brazil) during 2 yr for resistance to *Xanthomonas campestris* pv. *manihotis*. Nine cv. were resistant, 47 moderately resistant, and 214 susceptible. Thirty-two cv. with different levels of resistance were retested under greenhouse conditions; of these, only 4 showed the same type of reaction as in the field. Differing environmental conditions and inoculation could account for the different responses. Further field testing is needed before recommending resistant cv. to farmers; the productivity and adaptability of each cv. should be evaluated in each region. (AC)

0092

29040 SÁTICA, E.J. 1983. Observaciones preliminares sobre la reproducción sexual en yuca (*Manihot esculenta*) y ocumo (*Xanthosoma* spp.). (Preliminary observations on sexual reproduction in cassava and *Xanthosoma* spp.). In *Universidad Central de Venezuela. Instituto de Genética. Informe de Investigación 1981*. Maracay, pp.67-69. En.

Cassava. Clones. *Xanthosoma*. Plant reproduction. Venezuela.

The results of field observations in Sanán Escho, Venezuela, on 216 cassava clones regarding flowering, fructification, and sexual seed production are reported. Male sterility was observed in clone UCV 2304, and pollen grain of 2 sizes (av. of 16.87 and 10.44 microns) in fertile clones. Fructification was observed in 6 sweet clones and 6 bitter clones. (CIAT)

0093

29484 JACKSON, G.V.H.; KING, R.; FIBREAN, I.D. 1984. Guidelines for the transfer of root crop germplasm. Suva, Fiji. Food and Agriculture Organization of the United Nations. BAS/83/001. Field Document no.6, 29p. En., Sum. En., 38 Ref. [Plant Protection Project, U.N.D.P., Private Mail Bag, Suva, Fiji]

Cassava. Germplasm. Quarantine measures. Tissue culture. Yams. Disease control. Pest control. Fiji.

General procedures are outlined for the exchange of elite germplasm of the major root crops between countries of the South Pacific and the introduction of material from outside the region, without spreading diseases and insect pests. Quarantine implications are stated for the transfer of plant germplasm as (1) vegetative planting material, seed, and pollen and as (2) tissue cultures, together with specific recommendations relating to the movement of taro, sweet potato, yam, and cassava. For all root crops the direct importation of germplasm as vegetative planting material is considered a high risk and use of intermediate (3rd country) quarantine is advised. Preferably germplasm transfers should be made as seed or as virus-indexed plantlets growing as tissue cultures. For some root crops, especially yam and cassava, the lack of reliable methods for virus disease indexing imposes severe restrictions on the movement of germplasm. The germplasm presently available as tissue cultures and that has been pathogen-tested is documented, together with the results of any evaluations made in the region. (AS)

0094

29018 LYRA, G. DE M.; FONSECA, F. DAS C.E. DA 1984. Competicao de cultivares e épocas de colheita de mandioca com diferentes adubacoes no Rio Grande do Norte. (Competition of cultivars and harvest dates for cassava with different fertilizations in Rio Grande do Norte). Revista Brasileira de Mandioca 3(1):59-65. Pt., Sum. Pt., En., 5 Ref. [Univ. Federal do Rio Grande do Norte, Caixa Postal 188, 59.000 Natal-RN, Brasil]

Cassava. Cultivars. Timing. Harvesting. Fertilization. Field experiments. P. Manure. Brazil.

Five expt. were carried out in Ceará-Mirim (Rio Grande do Norte, Brazil) to determine the appropriate harvesting time for the most frequently grown cassava cv. in the state. A randomized block design was used with 4 replications in split plots. Within the plots, 6 cv. (Alagoas, Amazonas, Campinas, Boinha Grande, Canela de Jacu, and Manivainha) were tested and in the split plots, 7 harvesting times (10, 12, 14, 16, 18, 20, and 22 mo. after planting). Each expt. received a different fertilization. Amazonas was the best cv. for all variables; 18 mo. after planting was chosen as the most appropriate date for harvesting. The expt. fertilized with manure plus P and complete chemical fertilization gave higher yields. (AS)

0095

29318 MSABANA, M.A.M. 1982. Review of national root and tuber crops improvement, Tanzania, Tanzania Agricultural Research Organization. 6p. En., 11 Ref.

Cassava. Cassava African mosaic virus. Cultivars. Mononychellus tanajoa. Production. Inter cropping. Poultry. Feeds and feeding. Tanzania.

Highlights of research on potato, cassava, and sweet potato in Tanzania are reviewed. The program continued pursuing a cassava var. with resistance to CAMV, one of the major cassava production constraints in the country. Local cassava var. Mzimbitala, Kanyanzige, Njema, Kongolo, and Dalama were selected for resistance to Mononychellus tanajoa, but were poor in root yield, susceptible to CAMV, or showed poor flowering. In Ukiriguru, cassava should be planted in Nov.-Dec. at 0.75 x 1.50 m spacing; 4 weedings at monthly intervals, beginning the 1st mo., are recommended. Cassava/maize and cassava/groundnut intercroppings showed favorable improved root yield and gross economic returns. Higher wt. gains and food conversion efficiency was obtained in broilers when fed with a meal containing cassava roots fermented in water for 7 days, which reduced HCN content. Recommendations on future research are given. (CIAT)

0096

29003 RAMASWAMI, N.; VIJAYAKUMAR, M.; SUNDARARAJAN, S. 1985. 'Co2' tapioca for food and industry. Indian Horticulture 30(3):21-22. En., II. [Faculty of Horticulture, Tamil Nadu Agricultural Univ., Coimbatore 641 003, India]

Cassava. Cultivars. Starch content. Productivity. Cassava African mosaic virus. HCN content. Cultivation. Pest control. Agronomic characters. India.

Cassava strain Co2, released in Tamil Nadu, India, is described. Salient features are summarized: starch content, 34.5 percent; av. yield, 37.6 t/ha; tolerant to CAMV; and HCN content of 150 micrograms/g in rind and 10 micrograms/g in pulp. Other morphological and agronomic characteristics are indicated as well as cultural practices and pest and disease management. (CIAT)

0097

28160 RODRIGUEZ M., S.; GARCIA, M. 1984. Comportamiento del rendimiento de diez clones de yuca en cuatro localidades. (Yield behavior of ten cassava clones at four locations). Ciencia y Técnica en la Agricultura. Viandas Tropicales 7(2):27-37. En., Sum. Es., Fr., 11 Ref., 11. [Estación Experimental de Viandas Tropicales Fructuoso Rodríguez, Santo Domingo, Villa Clara, Ministerio de la Agricultura, Ciudad de La Habana, Cuba]

Cassava. Adaptation. Productivity. Selection. Clones. Plant breeding. Ecology. Cuba.

The performance of 10 cassava clones at 4 different locations (1 in western, 2 in central, and 1 in eastern Brazil) was compared. Significant yield differences were found among genotypes, locations, and for the interaction genotype x location. Individual phenotypic stability was calculated and compared by 2 methods: Wricke (1962) and Eberhart and Russell (1960). Clone CEMSA 74-735 had the best perspectives due to its stability and adaptability to different environments, and its high yield potential. (AS)

0098

29016 SILVA, S. DE O. E.; NERY, C.R.S.; CAROSO, R.L.; DUETE, W.L.C. 1984. Comparação entre métodos de determinação de amido em mandioca. (Comparison of methods of starch determination in cassava). Revista Brasileira de Mandioca 3(1):53-58. Pt., Sum. Pt., En., 14 Ref. [Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Starch content. Cultivars. Analysis. Brazil.

Three methods (hydrostatic balance, MOHR, and IITA) were used to determine the starch contents of 668 cassava cv. of different ages; results were compared with the Fehling chemical method. The MOHR and IITA methods were highly correlated with the Fehling method; however, only the mean obtained by the former method was close to that obtained by the Fehling method thus showing a good estimation of starch content. The IITA method tended to overestimate root starch content. Starch contents determined by the hydrostatic balance method showed a low correlation with those obtained by the chemical method and therefore its use should be restricted, especially in those cases in which low starch content can be expected. (AS)

0099

29525 THAMBURAJ, S.; MUTHUKRISHNAN, C.R.; IRULAPPAN, I. 1985. Studies on sensitivity of cassava buds to gamma rays and EMS. South Indian

Horticulture 33(1):398-403. En., Sum. En., 7 Ref. [Dept. of Olericulture, Faculty of Horticulture, Tamil Nadu Agricultural Univ., Coimbatore 641 003, India]

Cassava. Cultivars. Starch content. HCN content. Plant breeding. India.

Studies were carried out at Tamil Nadu Agricultural U. (India) to develop cassava var. with high starch and low HCN contents with mutation breeding techniques. Single-budded cuttings of var. Co 1 and H. 1687 were treated with gamma rays and EMS separately. Optimum doses were 1.5-2.0 kR gamma rays and 12.5-25.0 millimolar EMS. (CIAT)

0100

29435 TUPINAMBA, E.A.; SANTOS, T.G. FOR 1986. Comportamento de tres cultivares de mandioca em fileiras duplas. (Performance of three cassava cultivars in double rows). Aracaju-SE, Brasil, Empresa Brasileira de Pesquisa Agropecuaria, Centro Nacional de Pesquisa de Coco. Comunicado Técnico no.5. 4p. Ft. [EMBRAPA/Centro Nacional de Pesquisa de Coco, Caixa Postal 44, 49.000 Aracaju-SE, Brasil]

Cassava. Cultivars. Spacing. Timing. Root productivity. Stem. Starch content. Adaptation. Brazil.

Cassava cv. Caravela, Cigana Preta, and Manao were used to determine the best planting distance between double rows, in 2 different cropping seasons (1978/79 and 1979/80) in Aracaju, Brazil. Plant populations were maintained at 11,500 plants/ha in 5 different arrangements: (1) 1.40 m between double rows x 0.60 m between rows in a double row x 0.80 m between plants; (2) 1.80 x 0.60 x 0.67 m, resp.; (3) 2.70 x 0.50 x 0.60 m, resp.; (4) 2.60 x 0.60 x 0.50 m, resp.; (5) 3.00 x 0.40 x 0.47 m, resp. Arrangement 3 showed the highest root and stem productions for both cropping cycles and all cv. The highest root yield for each cv. was 27.6 t/ha for Caravela in 1979/80, 17.0 t/ha for Cigana Preta in 1978/79, and 24.7 t/ha for Manao in 1978/79, all in arrangement 3. Starch content remained unchanged irrespective of planting arrangement. Planting arrangement 3, particularly when using cassava cv. Caravela, is recommended for cassava producing regions of Sergipe. (CIAT) See also 0002 0005 0008 0012 0018 0019 0021 0024 0026 0028 0029 0031 0032 0034 0035 0037 0039 0043 0045 0046 0047 0049 0050 0051 0052 0053 0058 0061 0070 0078 0080 0113 0185 0197 0214 0218 0219 0223 0226 0229

G02 Cytogenetics

See 0065

H00 NUTRITION

0101

28533 DURRANT, N. 1987. The pre-eminence of roots and tubers in the diets of the Caribbean peoples. Courier no.101:89-91. En., Sum. En.

Cassava. Cultivation systems. Marketing. Consumption Processing. Casave. Cassareep. Cassava flour. Production. Dioscorea. Sweet potato. Diets. Caribbean.

The status and trends of root and tuber (including cassava) production systems, marketing, consumption, and processing in the CARICOM (Caribbean Community and Common Market) member countries are discussed. In general,

data indicate that the preeminence of roots and tubers in the region tends to decrease. Traditionally, most root crops in the region are not subject to processing before final consumption, except for cassava which is processed into casave and carareep. Attempts to produce CF in Guyana and Jamaica to substitute wheat flour have not been successful. The status of research on root and tuber crops in the region and at the international level is briefly discussed, and it is indicated that root crop production in the CARICOM region appears to depend on the development of improved production and processing technology. (CIAT)

H01 Cassava Foods and Nutritive Value

0102

29508 ASSOCIACAO DE CREDITO E ASSISTENCIA RURAL DE SANTA CATARINA. 1986. Receitas caseiras com mandioca. (Household recipes with cassava). Florianópolis-SC, Brazil, Coordenacao de Economia Doméstica. 16p. Pt., 1 Ref.

Cassava. Human nutrition. Recipes. Uses. Cassava flour. Brazil.

Thirteen cassava household recipes from Santa Catarina, Brazil, and their methods of preparation are given. (CIAT)

0103

29459 CADORIN, M.A.; XAVIER, A. FO C.; MATOS, D. DE 1986. Mandioca: receitas e sub-produtos. (Cassava: recipes and by-products). Joinville-SC, Brazil, Prefeitura Municipal de Joinville. Furdacao Municipal 25 de Julho. 28p. Pt., 3 Ref.

Cassava. Human nutrition. Recipes. Uses. Cassava flour. Sweet cassava. Brazil.

Recipes and preparation methods for 2 cassava products (CF and sweet flour) and 58 Brazilian dishes are presented. (CIAT)

0104

29471 CEREDA, M.P. 1987. Tecnologia e qualidade do polvilho azedo. (Technology and quality of sour cassava starch). Informe Agropecuario 13(145):63-68. Pt., 34 Ref., 11. [Repto. Tecnologia dos Produtos Agropecuários, Faculdade de Ciências Agrônomicas/UNESP, 18.600 Botucatu-SP, Brasil]

Cassava. Cassava starch. Bakery products. Socioeconomic aspects. Brazil.

Production technologies and uses of sour cassava starch for baked goods in Brazil, particularly in Minas Gerais, are reviewed. Quality parameters are also indicated. Users clearly prefer sour starches from Minas Gerais, especially from Feira Alegre. (CIAT)

0105

29485 COOPERATIVA AGRICOLA E INDUSTRIAL SAN ALBERTO S.C.L. MUERTO PICO. s.f. Recetario Aldera, fécula impalpable de mandioca. (Aldera recipes with cassava starch). Puerto Rico, Imprenta Dinámica. 19p. Es.

Cassava. Cassava starch. Human nutrition. Recipes. Uses. Puerto Rico.

Fifteen recipes using cassava starch, produced by an agricultural and industrial cooperative in Puerto Rico, are given along with the resp. indications for preparation. (CIAT)

0106

28979 COUNTER, S.A. 1986. Audiological screening of Amerindians of the Suriname rainforest. *Scandinavian Audiology* 15(1):57-64. En., Sum. En., 13 Ref., 11.

Cassava. Diet. Socioeconomic aspects. Nutritive value. Uses. Ecology. Human health. USA.

Audiological screening tests were conducted among a remote, relatively noise-free population of Amerindians in the deep rainforests of Surinam. These preliminary tests were intended to examine the overall audiological health of the population as a function of age and sex. Tests were hampered by a variety of extraneous factors. The results from a sample of the population showed a range of hearing impairments similar to that seen in modern industrial societies, including conductive, mixed, and sensorineural hearing losses. Also, hearing sensitivity was found to deteriorate with age in both females and males, particularly at the higher frequencies (2, 4, and 8 kHz). This deterioration was slightly greater for males, who as hunter-gatherers regularly use shotgun for hunting. Impact noise from hunting guns is the only source of intense noise to which the Amerindian population is exposed with any regularity. The diet of the Amerindians includes cassava as the main carbohydrate staple, which has also been linked to sensorineural hearing loss in some populations. Further studies are necessary in order to determine the possible ototoxic effects of cassava. (AS)

0107

26878 DALYSON, J.C. 1979. Cyanide, cassava, and diabetes. *Lancet* 22(2):655. En., 4 Ref.

Cassava. Cyanides. Human health. Human nutrition. Zaire. Zambia.

Brief information is presented on the incidence of diabetes in an area on the Zaire-Zambian border, a predominantly cassava-eating zone. This is in marked contrast to the rest of Zambia where maize is the staple food and diabetes is uncommon. Over 80 percent of the men and 60 percent of the women had evidence of malnutrition. A dietary survey showed that the av. total caloric intake was 1439 per day, of which 1346 was from cassava. (CIAT)

0108

28399 GIUGLIANO, R.; SHRIMPTON, R.; MAKINPE, H.A.; GIUGLIANO, L.C. 1984. Estudos nutricionais das populações rurais da Amazônia. 7. Rio Negro. (Nutritional studies of rural populations of the Amazon region. 7. Rio Negro). *Acta Amazonica* 14(3-4):427-449. Pt., Sum. Pt., En., 30 Ref., 11. [Inst. Nacional de Pesquisas da Amazônia, Manaus, Caixa Postal 478, 69.000 Manaus-AM, Brazil]

Cassava. Human nutrition. Socioeconomic aspects. Diet. Women. Ecology. Ecosystems. Food security. Cassava flour. Human health. Brazil.

A nutrition survey was performed on a population inhabiting the banks of the Rio Negro (Amaná, Brazil), characterized as having poor mineral economies and low human population densities. All families having children under 6 yr of age along a 200-km stretch of river were included in the survey. Sixty families and 121 children, representing 4.8 percent of the total rural population of the municipality, were studied. All children were weighed and measured and subject to a clinical examination. Hemoglobin and hematocrit determinations were done in 60 children and in 78 children fecal samples analyzed for parasites. The mothers were weighed, measured, and interviewed, and in 42 of them hemoglobin and hematocrit determinations

were achieved. Living in conditions of minimal hygiene, the population generally consumed untreated river water. The still birth rate of 80/1000 births, the spontaneous abortion rate of 66.7/100 pregnancies, and the infant mortality of 93.2/1000 live births were all very high. Breast feeding was prolonged with an av. weaning age of 16 mo. and 72 percent of children being breast fed more than a year. Half of the mothers had introduced other foods by 6 mo. of age, principally a pap made from fermented CF. Some 65 percent of the children were malnourished, while 70 percent were found to be stunted and 18 percent wasted. In the 1st semester of life, only 15.8 percent of children were stunted but in the 2nd 6 mo. 63.6 percent were stunted. In spite of the prolonged breast feeding 25 percent of children in the 1st yr of life had diarrhea at the time of the examination. The major peaks for diarrhea were in the 2nd semester and the 2nd yr of life, when acute malnutrition (wasting) was also found to be most prevalent. Almost 85 percent of children examined had intestinal parasites, with *Ascaris*, hookworm, and *Trichiuris* affecting more than 60 percent. The most common clinical signs of deficiency for specific nutrients were those for Fe and possibly riboflavin and vitamin A. Mothers were more frequently obese than wasted, suggesting that energy or total food intake was not limiting in the population. Three quarters of the mothers had eaten fish in the previous 24 h and a half had eaten wild game, principally fresh water turtles. Milk products, cereals, and pulses were little consumed, with the staple food being fermented CF. The consumption of fruits was limited to bananas and the use of vegetables limited to that as condiments. (AS)

0109

29529 INSTITUTO NACIONAL DE INVESTIGACIONES AGROPECUARIAS. ECUADOR. 1986. Utilización de la yuca en la alimentación humana. (Cassava utilization in human nutrition). Quito, Ecuador, Estación Experimental Portoviejo. Programa de yuca. Tercer Festival Costumbrista Nacional, Quito, Ecuador, 1986. 12p. Es.

Cassava. Human nutrition. Dietary value. Food products. Ecuador.

Twenty-eight recipes that have cassava as an ingredient are given. Preparation procedures are included. (CIAT)

0110

29026 KAWAMURA, K.; TSUBOI, S.; IWAMURA, N.; IMANAKA, Y.; WADA, T.; KOHNO, N.; CRUZ, M.L. 1984. Development of a sensitive method for detection of aflatoxin B1 in foodstuffs. International Center for Medical Research Annals 4:153-165. En., Sum. En., 8 Ref., Il. [International Center for Medical Research, Kobe Univ. School of Medicine, Kobe 650, Japan]

Cassava. Aflatoxin. Food products. Maize. Groundnut. Indonesia. Philippines. Japan.

Aflatoxin B1 (AFB1) content of several foodstuffs from Indonesia, Philippines, and Japan were measured by high performance liquid chromatography using a micro-Porasil column and a micro-Bondapak column after the conversion of AFB1 to its water adduct AFB2a. Food samples were obtained over a 5-yr period. Compared with the data from Japan, the amount of AFB1 in food materials from Indonesia and the Philippines is generally larger, especially in peanuts, cassava, and maize. The amount of AFB1 in raw or unprocessed peanuts, cassava, and maize is also significantly smaller than the amount of AFB1 in their processed products. Mass spectral analysis of the material obtained after high performance liquid chromatography separation from food samples confirmed the presence of AFB1.

(AS) See also 0031 0034 0112 0114 0115 0116 0117 0118 0119
0120 0121 0122 0123 0124 0125 0126 0127 0128 0129 0130 0131
0134 0136 0137 0138 0139 0145 0149 0161 0162 0164 0170 0173
0182

H02 Nutritive Disorders in Humans

0111

28194 MOHAN, V.; MOHAN, R.; SUSHEELA, L.; SNEHALATHA, C.; BHARANI, G.; MAHAJAN, V.K.; RAMACHANDRAN, A.; VISWANATHAN, M.; KOHNER, E.M. 1985. Tropical pancreatic diabetes in South India: heterogeneity in clinical and biochemical profile. *Diabetologia* 28(4):229-232. En., Sum. En., 29 Ref. [5 Main Road, Royapuram, Madras 600013, India]

Cassava. Biochemistry. Human health. Malnutrition. India.

Clinical and biochemical studies were carried out in 33 patients with diabetes secondary to chronic calcific, non-alcoholic pancreatitis (tropical pancreatic diabetes) and in 35 Type 2 (noninsulin-dependent) diabetic patients and 35 nondiabetic subjects. Despite lower body mass indices, only 25 percent of patients with tropical pancreatic diabetes had clinical evidence of malnutrition. There was no history of cassava ingestion. Mean serum cholesterol concn. was significantly lower in the tropical pancreatic diabetic patients (P less than 0.01) in comparison with the Type 2 diabetic patients or nondiabetic subjects, due to a significantly decreased concn. of low density lipids cholesterol (P less than 0.01) and very low density lipids cholesterol (P less than 0.05). Basal and postglucose stimulated concn. of serum C-peptide were highest in those pancreatic diabetic patients (n = 11) who responded to oral hypoglycemic drugs, intermediate in the majority (n = 17), who were insulin dependent and ketosis resistant, and negligible in a small subgroup (n = 5) who were ketosis prone. The occurrence of microangiopathy in pancreatic diabetic patients was common and similar to that in Type 2 diabetic patients. Thus, tropical pancreatic diabetes in South India appears to be heterogenous with respect to level of nutrition, severity of glucose intolerance, B-cell function, response to therapy, and the occurrence of microvascular complications. (AS) See also 0107 0108 0116 0197

H03 Animal Feeding

0112

29524 AGUILERA S., R.C.; ARROYO L., A.; LOPEZ, J.; AVILA G., E. 1984. Harina de hojas de yuca (Mandhot esculenta) como fuente de proteína en dietas para pollos de engorda. (Cassava leaf meal as protein source in diets for broiler chicks). *Técnica Pecuaria en México* no.47:9-15. Es., Sum. Es., En., 12 Ref. [Centro Experimental Pecuario La Posta, Paso del Toro, Ver., Apartado Postal 898, Veracruz, Ver., México]

Cassava. Cassava leaf meal. Diets. Poultry. Substitutes. Feeds and feeding. Mexico.

Two expt. were conducted to partially replace SBM for high and low levels of CLM, with and without oil supplementation, resp., in sorghum + soybean + fish meal diets for broiler chicks. In the 1st trial, high levels (0, 5, 10, 15, and 20 percent) of CLM were included in isoproteic and isocaloric diets. Data obtained at the 9th wk. of age indicated (P more than 0.05)

that levels up to 15 percent CLM did not affect growth. Feed intake was higher (P less than 0.05) in chicks fed CLM. Feed conversion significantly increased (P less than 0.05) in diets including 15 and 20 percent CLM. In the 2nd trial low levels (0, 2, 4, and 6 percent) of CLM were included in isoproteic but not isocaloric, diets. Data obtained at the 9th wk. of age showed (P more than 0.05) similar results for all the parameters studied. (AS)

0113

29369 ALMEIDA, E.X. DE ; SALERNO, A.R. ; MENDONCA, R. ; TERNES, M. 1987. Parte aérea da mandioca na alimentacao animal. (Cassava aerial parts for animal feeding). Florianópolis-SC, Brasil, Empresa Catarinense de Pesquisa Agropecuaria. Pesquisa em Andamento no.75. 4p. Pt., 3 Ref., Il. [EMPASC-Estacao Experimental de Ituporanga, Caixa Postal 98, 88.400 Ituporanga-SC, Brasil]

Cassava. Feeds and feeding. Cultivars. Dry matter. Timing. Cuttings. Digestibility. Productivity. Forage. Brazil.

An expt. was conducted in Ituporanga Exptl. Station of the Empresa Catarinense de Pesquisa Agropecuária (Brazil) to study the effect of 2 cutting heights (10 cm from the ground and at the 1st branching) during 2 cycles on the quality of the aerial part of cassava cv. Mico for potential use in animal feeding. Trials were carried out during 4 different seasons of the year: Feb. 1986-Jan. 1987, March 1986-Feb. 1987, April 1986-March 1987, and May 1986-April 1987; cassava was planted on Nov. 2, 1985. Results are only available for the 1986 cropping cycle and show that DM contents of aerial parts were 18.0, 20.3, 24.9, and 24.0 percent for Feb., March, April, and May, resp. DM production/ha increased with later cuttings and when carried out at 10 cm height, but CP and digestibility decreased. Based on these results and taking into account that effects on root yields have not been measured yet, the best cutting treatment for increased productivity levels and forage quality is that applied during the 1st days of March and at 1st branching height. (CIAT)

0114

29458 BUDHAKA, B. ; ITHARATTANA, P. ; OORAIKUL, S. 1984. Economic analysis of the use of cassava product in livestock rations and its market prospects; cassava/nutrition project. Bangkok, Thailand, Ministry of Agriculture and Cooperatives. Khon Kaen University. International Development Research Centre. 76p. En., 24 Ref., Il.

Cassava. Diets. Poultry. Swine. Feeds and feeding. Costs. Marketing. Prices. Substitutes. Thailand.

The economic possibilities of using cassava for the animal feed industry were investigated using linear programming and a least cost ration model, based on data from the Khon Kaen U. (Thailand)/International Development Research Centre (Canada) Cassava Project. Results suggested that cassava-based rations are economically viable and price competitive with major cereals and grains available and used in the livestock feed industry. Among 10 cassava-based feed formulae applied for different age intervals of poultry and pigs, cassava could be substituted for other cereals in all feeds, except for layers 22-24 and 44-66 wk. old. More attention should be given and actions taken for the extensive use of cassava in the feed industry by policy makers. Cassava-based feed can play a more important role in market opportunities that exist in Asian countries; specific recommendations are provided for Thailand, especially regarding cassava mixed ration testing, and information and technology transfer to livestock raisers and feedmillers. (CIAT)

0115

29464 CARVALHO, V.D. DE ; KATO, M. DO S.A. 1987. Potencial de utilizacao da parte aérea da mandioca. (Potential utilization of the aerial part of cassava). Informe Agropecuário 13(145):23-28. Pt., 19 Ref. [EPAMIG, Caixa Postal 176, 37.200 Lavras-MG, Brasil]

Cassava. Animal nutrition. Cultivars. Uses. Composition. Leaves. Protein content. Starch content. Harvesting. Timing. Brazil.

Aspects of the potential utilization of the aerial part of the cassava plant for human and animal nutrition are reviewed. The physical and chemical characteristics of cassava aerial part and the effect of var. on its chemical composition are discussed; in general, the upper 3rd of the plant and the leaves produce high protein hays (20.00 and 24.98-31.90 percent, resp.), and the lower 2/3 produce high starch hays. The effect of harvesting age and other factors (pests, diseases, and nutritional deficiencies) on the chemical composition of the aerial part of the cassava plant are also discussed briefly. To obtain high protein hays from the aerial part of cassava, the upper 3rd of the plant should be preferred and harvested 12-16 mo. after planting. (CIAT)

0116

29467 CHAVES, J.G. 1987. Extrato proteico das folhas de mandioca. (Protein extract from cassava leaves). Informe Agropecuário 13(145):47-52. Pt., 21 Ref., 11. [CETEC, Caixa Postal 2306, Av. José Candido da Silveira, 2000, Horto, 31.170 Belo Horizonte-MG, Brasil]

Cassava. Leaves. Protein content. Human nutrition. Animal nutrition. Timing. Nutritive value. Composition. Analysis. Technology transfer. Plant anatomy. Brazil.

The extraction of the protein fraction of cassava leaves for use as a low fiber protein concentrate for human and animal nutrition is reviewed. The chemical composition of the aerial part of the cassava plant, as influenced by harvesting season, and of different parts of the plant is discussed. The general process of protein extraction from cassava leaves is described, and the nutritional value of the protein extract is discussed in terms of amino acid composition and results of biological tests. The stages (maceration, extraction of a raw juice, filtration, anaerobic fermentation, concentrate separation, and drying) and the equipment required to extract the protein fraction at the farm level are described. (CIAT)

0117

29441 CHRISTENSEN, K. 1986. Influence of different dietary concentrations of linoleic acid on the essential fatty acid (EFA) status and functional characteristics of porcine hepatic and cardiac mitochondria. Comparative Biochemistry and Physiology 85(2):419-425. En., Sum. En., 43 Ref. [Royal Veterinary & Agricultural Univ., Inst. of Animal Physiology, Thorvaldsensvej 40, DK-1871 Frederiksberg C, Copenhagen, Denmark]

Cassava. Diets. Swine. Feeds and feeding. Fat content. Animal physiology. Animal health. Denmark.

The effect of different dietary concn. of linoleic acid on the essential fatty acid (EFA) status and the functional characteristics of hepatic and cardiac mitochondria was investigated in pigs raised for 140 days from 10 to 105 kg live wt. on their resp. diets. Concn. were 0.2, 1.1, and 2.1 percent of GE in expt. 1 and 0.7, 1.6, and 2.3 percent of GE in expt. 2. The exptl. diet included CM at 300, 202, and 204 g/kg for expt. 1 and 201, 203, and 205 g/kg for expt. 2. As judged from the ratios of 20:3n9 to 20:4n6 of hepatic and cardiac mitochondrial total lipids, the pigs

receiving 0.2 percent of dietary GE as linoleic acid were EFA-deficient, while the pigs receiving 0.7 percent of dietary GE as linoleic acid were on the borderline of EFA deficiency. Mitochondrial protein yield and the functional parameters as measured in both hepatic and cardiac mitochondria with 2 substrates (pyruvate plus malate and succinate in the presence of rotenone) were not significantly (P greater than 0.05) affected by the different dietary concn. of linoleic acid. The findings indicate a slow turnover of EFA and a low desaturation/elongation activity of the associated enzymes in the pig. (AS)

0118

27672 CICCOCIA R., A.M.; SANCHEZ R., J.; PRITO A., O. 1986. Valor energético del follaje de yuca en la alimentación de pollos. (Energy value of cassava foliage for feeding chickens). Acta Científica Venezolana 37:83-88. Es., Sum. En., En., 28 Ref. [Depto. de Tecnología de Procesos Biológicos y Bioquímicos, Univ. Simón Bolívar, Apartado Postal 80659, Caracas, Venezuela]

Cassava, Foliage, Substitutes, Poultry, Diets, Venezuela.

Cassava foliage was evaluated as a source of energy partially replacing maize starch and soybean in rations for growing chicks. Diets with 3 levels of cassava foliage (2, 4, and 8 percent) were fed to male chicks (Delhalb 127) during 14 days. All diets were enriched with 0.46 percent met. Results indicated that the addition of cassava foliage up to a level of 8 percent (by wt.) did not reduce wt. gain, feed efficiency, PFR, and energy utilization of growing chicks. Cassava foliage presented a high ME value (4.40 Kcal/g), indicating that approx. 98 percent of the GE of the foliage (4.50 Kcal/g) was metabolized. Results indicated that cassava foliage is a good source of ME and that its use in chicken rations could be promoted. (AS)

0119

29655 CURTARELLI, N.M. 1985. Aproveitamento de raspa de mandioca e farelo de arroz integrais na alimentação de suínos em crescimento e acabamento. (Use of cassava chips and integral rice bran in growing and finishing pig nutrition). Tese Mestrado, Piracicaba-SP, Brasil, Escola Superior de Agricultura Luiz de Queiroz da Universidade de São Paulo, 173p. Pt., Sum. Pt., En., 79 Ref., 11.

Cassava, Cassava meal, Swine, Feeds and feeding, Animal nutrition, Diets, Cassava chips, Brazil.

Several levels of CM and rice bran were used in isoproteic diets for growing and finishing pigs. Twenty-seven Large-White x Wessex x Duroc crossbred gilts were allotted on the basis of body wt. in 3 lots in a 3 x 2 factorial (3 levels of CM and 3 levels of rice bran replacing maize-soybean in the basal diet) in a completely randomized block design with 9 treatments and 1 animal/plot. Treatments were as follows: T1, maize-soybean basal diet; T2, 15 percent CM; T3, 30 percent CM; T4, 15 percent rice bran; T5, 15 percent CM and 15 percent rice bran; T6, 30 percent CM and 15 percent rice bran; T7, 30 percent rice bran; T8, 15 percent CM and 30 percent rice bran; and T9, 30 percent CM and 30 percent rice bran. CM and rice bran replaced maize and SBM, maintaining 13 and 15 percent CP in growing diets (23.86-58.29 kg body wt.) and finishing diets (52.29-93.47 kg body wt.), resp. The diets were supplemented with vitamins, minerals, antibiotics, and an antioxidant. In the growing phase daily feed intake was depressed by CM (P less than 0.01) and rice bran (P less than 0.05) but there were no effects of these ingredients on av. daily gain and feed:gain ratio. Av. daily gain (P less than 0.01), daily feed intake, and feed:gain ratio (P less than 0.05) were depressed when rice

bran was added to finishing diets. In the growing-finishing phase, av. daily gain was depressed (P less than 0.05) by rice bran. Daily ration intake was lower (P less than 0.05) when CM and rice bran were added to the diets. Feed:gain ratio was not affected (P more than 0.05) by these ingredients. Up to 15 percent CM in the diet reduced loin-eye area but an increase was observed in back fat thickness when the diet contained 30 percent CM. Thus, rice bran and CM, alone or mixed, can be used up to 15 percent in diets for growing, finishing, and growing-finishing pigs. When rice bran and/or CM represented up to 30 percent in the diets the performance, loin-eye area, and back fat thickness were affected. (AS (extract))

0120

28575 DEVALAH, M.C.; RAJASHEKHARGOODA, R.; SUHAS, Y.; GOVINDAN, R. 1985. Growth and silk production in *Samia cynthia ricini* Boisduval fed on four different host plants. Indian Journal of Sericulture 24(1):33-35. En., Sum. En., 1 Ref. [Dept. of Sericulture, VAS, 6KVE, Bangalore-560 065, India]

Cassava. Feeds and feeding. Cassava leaves. Animal nutrition. Insect biology. User. India.

Changes in the larval wt., silk production, and silk gland wt. in relation to 4 host plants of the eri silkworm (including cassava) were evaluated and quantified. The studies conducted on the 5th instar of the silkworm (white race) revealed that max. larval wt. and max. silk gland wt. were recorded when fed *Ricinus communis* (4.648 plus or minus 0.617 and 0.926 plus or minus 0.151, resp.) while the lowest values were recorded on cassava-fed silkworms (1.861 plus or minus 1.099 and 0.416 plus or minus 0.312, resp.). Cocoon wt. and shell wt. were also max. on *R. communis* (2.116 and 0.292 g, resp.), followed by cassava (1.884 and 0.250 g, resp.). *R. communis* was found to be the best host plant. (CIAT)

0121

22453 DEVEGCWDA, G.; RAMAPPA, B.S.; SHASHIKUMAR, S.K. 1986. True metabolizable energy values of some feedstuffs in chickens. Indian Journal of Poultry Science 21(1):29-31. En., Sum. En., 9 Ref. [Dept. of Poultry Science, Univ. of Agricultural Sciences, Bangalore-560024, India]

Cassava. Animal nutrition. Poultry. Digestibility. Cassava meal. India.

Male broilers 8 wk. old were used to estimate the true ME values of solvent-extracted *Guizotia abyssinica* seed oilmeal, solvent-extracted sunflower oilmeal, maize oilmeal, silkworm pupae meal, meat meal, cassava pulp, sorghum, molasses, *Leucaena leucocephala* leaf meal, and lucerne leaf protein concentrate. The resp. values were 2266, 2408, 2702, 2435, 2326, 2106, 3513, 2059, 983, and 3225 kcal/kg. (AS)

0122

27547 DEVENDRA, C. 1983. Physical treatment of rice straw for goats and sheep and the response to substitution with variable levels of cassava (*Manihot esculenta* Crantz), *Leucaena* (*Leucaena leucocephala*) and *gliricidia* (*Gliricidia maculata*) forages. MARDI Research Bulletin 11(3):272-290. En., Res. Mal., En., 23 Ref. [Malaysian Agricultural Research & Development Inst., Serdang, Selangor, Malaysia]

Cassava. Cassava leaves. Substitutes. Feeds and feeding. Dietary value. Animal nutrition. Goats. Sheep. Malaysia.

The results of 5 balance studies with goats and sheep are presented concerning the utilization of rice straw, treated or untreated, and its substitution with cassava leaves, *Leucaena leucocephala* leaves, L.

leucocephala leaves plus stems plus pods, or Gliricidia maculata. Feeding freshly collected rice straw vs. stored older straw increased DM intake with older straw (46.3-55.2 g/W(0.75) kg) compared with fresh feed (40.5-41.0 g/W(0.75) kg). Goats significantly consumed more DM than sheep (P less than 0.05), and the digestibility of crude fiber and ash were significantly better in the older straw (P less than 0.05). Wetting the straw at 1 kg/liter of water reduced DM intake (59.9 vs. 51.6 g/W(0.75) kg) and DM digestibility significantly (P less than 0.05). Feeding chopped straw was associated with increased CP digestibility and N retention compared with long straw. The ME content of fresh (chopped), stored (chopped), or long rice straw were 6.09-6.19, 5.36-6.04, and 6.39 MJ/kg, resp. Substituting rice straw with 33-34 percent cassava leaves significantly (P less than 0.05) increased DM intake by 34-37 percent and also improved the digestibility of OM, CP, crude fiber, ether extract, and N-free extract (P less than 0.05). Substituting rice straw with 30 percent of either cassava or Leucaena leaves, Leucaena leaves plus stems plus pods, or G. maculata leaves gave no differences in DM intake; however, there were significant differences in OM, CP, ether extract, and N-free extract digestibility (P less than 0.05). Dietary energy supply, N, and mineral balance indicated that, in all instances, the effect of the substitution was to increase dietary ME, N, and also mineral supply (Ca, P, and Mg). The results emphasize the feeding value of especially cassava and Leucaena leaves for improving the dietary quality of basal roughage diets for ruminants. (AS)

0123

29521 FABBRO, R.; DELLA CASA, G.; ROSI, M.A.; BERGONZINI, E. 1985. Uso della manioca nell'ingrasso del suino pesante. (Use of cassava in fattening of heavy pigs). Annali dell'Istituto Sperimentale per la Zootecnia 18(2):139-152. It., Sum. It., En., 21 Ref.

Cassava. Swine. Diets. Substitutes. Protein content. HCN content. Italy.

A trial was carried out with 80 Landrace x Large White crossbred pigs (40 barrows and 40 gilts) to compare seven diets, 3 of which contained pelleted cassava (6.54 percent crude fiber, 5.52 percent ash, and 43 ppm HCN). Diets were (a) control, (b) 30 percent cassava up to about 100 kg and control diet from 100 kg to slaughter wt., (c) 30 percent cassava for the entire period, and (d) 75 percent cassava for all the entire period. The feed was weighed daily, fed wet at a 1:3 feed:water ratio, and weekly adjusted up to the residue appearance limit. At about 100 kg live wt., the protein content was modified in all diets. Initial live wt. and at slaughtering was about 46 and 152 kg, resp. Pig wt. was recorded at 28-day intervals. Sectioning of carcasses was carried out 24 h after slaughtering. No significant differences were observed among the groups in av. daily live wt. gain and in dressing percentage, percentage pluck, percentage ham, loin, lean cuts and fat cuts, longissimus dorsi area, and back fat thickness. The conversion ratio was lower in the group in which cassava has been substituted for the control diet after 100 kg live wt. The use of this type of cassava does not affect fattening performance. Sex significantly influenced most of the carcass characteristics studied. (AS)

0124

28317 GERHARD, L.F. 1986. Aproveitamento integral da mandioca na alimentacao dos suinos. (Integral utilization of cassava in swine feeding). Vera Cruz-RS, Brasil, Empresa de Assistencia Técnica e Extensao Rural do Rio Grande do Sul. 31p. Pt., Il.

Cassava. Cassava roots (vegetable). Swine. Diets. Dietary value. Animal nutrition. Economics. Drying. Technology. Brazil.

The utilization process of cassava roots and aerial parts, for small farmers, as an alternative for feeding pigs is described. A table formulating cassava-based rations (initial, growth, and finishing) was evaluated in a group of 9 Landrace piglets, weaned at 58 days. The gains of the animals in the 3 phases were 0.411, 0.814, and 0.685 kg/animal/day, resp. The costs of production of (1) cassava chip flour, (2) bran of cassava aerial parts, (3) soybean bran, (4) ground millet, and (5) a polyvitamin product. The costs of the following rations are given for each product: initial domestic, initial commercial, growing domestic, growing commercial, finishing domestic, and finishing commercial. Diagrams of the drying oven for cassava aerial parts and roots are included, with details of materials used and the cost. (CIAT)

0125

28561 GONZALEZ M., M. 1985. La mandioca en la formulación de las raciones alimenticias. (Cassava in the formulation of feed rations). *Avances en Alimentación y Mejora Animal* 26(6-7):220-225. Es.

Cassava. Cassava flour. Feeds and feeding. Diets. Swine. Poultry. Costs. Substitutes. Spain.

Using linear programming, exercises are presented to formulate cassava-based rations for pigs and poultry and compare them with the traditional cereal-based rations (especially barley in the EEC) in terms of their nutritional value and cost:benefit ratio. On the basis of the barley-based ration for pig feeding (ME = 3000 Kcal/kg, CF = 10.5 percent, crude fiber = 5.0 percent, lysine = 0.36, and met. + cystine = 0.39), the cost of a cassava + soybean ration at the same CP level (10.5 percent) could be further reduced by using a sunflower + cassava ration at the same CP level. A cassava-based ration, similar in crude fiber content (5.0 percent) to that of barley, was calculated using the mixture cassava + soybeans and cassava + sunflower, which was still low in ME. Therefore, an isocaloric ration at 3000 Kcal/kg was prepared using this same mixture, indicating that cassava can be used in the formulation of feed rations at lower costs than those of cereal-based rations. A final exercise, using various ingredients in pig and poultry feeding rations, demonstrated that definitely, and especially in the case of fattening pigs, savings are significant when cassava is incorporated into the rations. (CIAT)

0126

27636 LOUCHON, J. 1982. Utilization of cassava as a source of energy in pig feeding. In Jainudeen, H.R.; Omar, A.R., eds. *Asian Australasian Animal Science Congress, 1., Serdang, Selangor, Malaysia 1980. Animal production and health in the tropics: proceedings*. Selangor, Malaysia, Universiti Pertanian Malaysia Press. pp.293-299. En, Sum. En., 30 Ref.

Cassava. Feeds and feeding. Swine. Substitutes. Animal nutrition. Dietary value. Diets. Malaysia.

A literature review of work carried out during 1967-77 on cassava substitution for cereals in pig feeding is presented; data are also given on dried cassava root composition, energy value of cassava for pigs, and digestibility of cassava diets on growing and early weaned piglets. An expt. compared 5 diets to study the influence of a DL-met. supplementation in a 50 percent cassava diet, deficient in necessary S amino acids. Piglets weighing 20.7 kg and 72 days old were used to calculate feed consumption every 7 days until slaughter wt. (97 kg body wt.). No significant difference was found in feed conversion between castrated males and females. The addition of met. at levels of 0.08 and 0.16 percent significantly improved performance. Although cassava can entirely replace cereals, tallow has to be added and the level of soybean and wheat bran

increased. Cassava offers potential as a feed constituent for fattening pigs. (CIAT)

0127

29444 McALLAN, A.P.; WILLIAMS, A.P.; COCKBURN, J.E.; GRIFFITH, E.S.; LEWIS, P.E.; SMITH, R.H. 1986. The effects of different sources of nitrogen supplementation on the post ruminal flows of organic matter and different nitrogenous constituents in steers. *Archiv fuer Tierernahrung* 36(4-5):409-418. En., Sum. En., De., Ru., 28 Ref. [Animal & Grassland Research Inst., Hurley, Maidenhead SL6 5LR, England]

Cassava. Diets. Dietary value. Animal health. Nutritive value. Feeds and feeding. Substitutes. England.

Protozoa-free Friesian steers, equipped with simple rumen and abomasal cannulas, were given diets consisting of approx. equal proportions of ground, pelleted alkali-treated straw and a rolled barley + cassava mixture, supplemented with (1) urea + casein, (2) SBM, (3) normal white fishmeal, or (4) white fishmeal designated as being of low rumen degradability. The diets were isoenergetic and given in amounts to supply sufficient ME to support an av. growth rate of 0.5 kg/day. Rumen degradable N:ME values were estimated to be 2.08, 1.40, 1.90, and 1.66 for diets 1, 2, 3, and 4, resp. RNA, alpha-epsilon-diaminopimelic acid, and (35)S (added as sulphate) were used as bacterial markers. Chronic oxide and polyethylene glycol were given as flow markers and flows (g/24 h) at the abomasum of OM and nitrogenous constituents were calculated. Rumen vol. and ruminal liquid fractional outflow rates were measured using polyethylene glycol. Samples of mixed rumen bacteria separated from strained rumen digesta from animals receiving diet 1 contained significantly less diammonium phosphate (DAP)-N (0.322 g/kg DM) than those from animals receiving diets 2, 3, or 4 (0.530 g/kg DM). Mean rumen vol. (approx. 15 liters) and liquid fractional outflow rates (approx. 0.105/h) were similar on all diets but varied between animals OM intake digested in rumen was similar on all diets. Contribution of bacterial-N to the total nonammonia-N passing the abomasum, based on mean values derived from DAP and (35)S as markers, was 0.57, 0.47, 0.39, and 0.31 for diets 1, 2, 3, and 4, resp. Corresponding values based on RNA were 0.71, 0.50, 0.48, and 0.35, resp. Bacterial-N (RNA) flows at the abomasum were 31, 25, 26, and 20 g/day for diets 1, 2, 3, and 4, resp. Corresponding values for (35)S and DAP were 26, 24, 21, and 18 g/day, resp. Values derived from RNA flows were consistently and significantly higher (P less than 0.01) than those based on DAP or (35)S. Mean estimated efficiencies of bacterial protein synthesis (g bacterial-N/kg OM truly digested) were 15, 15, 14, and 12 for diets 1, 2, 3, and 4, resp. The proportion of infused (35)S that passed into the abomasum per day incorporated into bacterial protein was 0.45, 0.20, 0.28, and 0.23 for diets 1, 2, 3, and 4, resp. Values for diets 2, 3, and 4 were not significantly different from each other but were all significantly different from diet 1. (AS)

0128

28396 OLIVEIRA, J.P. DE 1984. Valor nutritivo do feno e da silagem da parte aerea da mandioca (*Manihot esculenta* Crantz) cv. IAC 12-829. (Nutritive value of hay and silage of the aerial part of cassava cv. IAC 12-829). Tese Mestrado, Minas Gerais-MG, Brasil, Escola Superior de Agricultura de Lavras. 66p. Pt., Sum. Pt., 64 Ref., 11.

Cassava. Cultivars. Nutritive value. Silage. Digestibility. Dry matter. Animal nutrition. Dietary value. Diets. Composition. Sheep. Stems. Leaves. Brazil.

To verify the nutritive value of hay and silage from the aerial part (total and upper 3rd) of the cassava plant, cv. IAC 12-829 was planted in 1981 in Curvelo (Minas Gerais, Brazil) and the aerial part was harvested at 12 mo. Hay and silage were made and apparent digestibility trials were conducted with rams. DM, CP, crude fiber, soluble carbohydrates, Ca, P, GE, and pH were determined. DM contents were similar between the different hay samples and between the different silage samples. Silage of the upper third of the plant showed higher CP and Ca values and the lowest crude fiber content. P contents and GE values were similar in all the treatments. The different hay samples showed similar soluble carbohydrate composition; the same held true for the silages. pH values were in the limit acceptable for a good silage. To study the nutritive value, 20 rams caged in individual metabolism stalls were used in a single trial, with a randomized block exptl. design and 4 treatments and 5 replications. The voluntary intake of DM, digestible DM, digestible protein, and digestible energy were determined. The coefficient of apparent digestibility of DM, CP, crude fiber, and GE was also determined as well as the index of nutritive value and N balance. The silage of the upper 3rd of the plant showed higher values for all of the parameters, except the coefficient of apparent digestibility of CP and N balance. The hay of the upper 3rd of the plant showed higher values for these last 2 parameters. (AS)

C129

29036 PARTIDGE, I.G. 1985. The digestion of diets containing manioc by young growing pigs. *Animal Feed Science and Technology* 12(2):119-123. En., Sum. En., 9 Ref. [National Inst. Research in Dairying, Shinfield, Reading, RG2 9AT, England]

Cassava. Diets. Cassava meal. Animal nutrition. Swine. Feed and feeding. Digestibility. United Kingdom.

Six pigs were fitted with a simple cannula in the terminal ileum. From 20 kg live wt., they were given cereal diets containing 0, 150, or 300 g cassava/kg in a changeover exptl. with 10-day periods. Ileal digesta and feces were collected during the 8th and 10th day of each period, and digestibility coefficients were calculated by the Cr2C3 ratio method. There were no significant differences in the ileal or overall digestibility of DM, energy, starch, or CP between the diets containing 0 and 150 g cassava/kg. The diet containing 300 g cassava/kg had lower ileal digestibility and higher overall digestibility than the other 2 diets. For the high cassava diet, the apparent absorption of energy from the large intestine represented 10.7 percent of the total absorption, compared with 3.2 percent for the diet without cassava. This may partly explain the poorer performance which has sometimes been observed with cassava diets formulated on the basis of digestible energy. (AS)

C130

29465 FERREIRA, J.P. 1987. Utilizacao de raspas e residuos industriais da mandioca na alimentacao bovina. (Utilization of cassava chips and industrial waste in cattle feeding). *Informe Agropecuario* 13(145):28-42. Pt., 50 Ref. [EPAMIG, Caixa Postal 176, 37.200 Lavras-MG, Brasil]

Cassava. Feeds and feeding. Cassava chips. Waste utilization. Nutritive value. Substitutes. Diets. Prices. Storage. Brazil.

The use of cassava chips and industrial wastes in animal feeding is reviewed. Emphasis is placed on their chemical composition and nutritional value, their use as a means of supplying urea to bovine cattle, the nutritional value of rations containing cassava chips, their use for fattening confined cattle and in the dairy cattle feeding. It is concluded that cassava chips can totally or partially substitute cereals, molasses,

and chopped sugarcane in cattle feeding. Cassava industrial wastes can be used as energy sources in animal feeding provided that they are adequately supplemented with protein sources and that transportation costs are not added to the product. Cassava chips can substitute maize or sorghum in diets for steers and dried cassava roots can replace rice in diets fed to dairy heifers. The use of cassava chips and wastes is determined by competitive prices compared with other energy sources. Cassava roots can be stored for 2-3 mo. if cassava chipping is impossible immediately after harvesting. (CIAT)

0131

29451 RAVINDRAN, V.; KORNEGAY, E.T.; RAJAGURU, A.S.B.; POTTER, L.M.; CHERRY, J.A. 1986. Cassava leaf meal as a replacement for coconut oil meal in broiler diets. Poultry Science 65(9):1720-1727. En., Sum. En., 19 Ref.

Cassava. Cassava leaf meal. Poultry. Feeds and feeding. Diets. Animal physiology. Dietary value. HCN content. Sri Lanka.

Eight feeding trials lasting 8 wk. were conducted to evaluate CLM as a replacement for coconut oil meal (COM) in tropical broiler diets. Diets containing 0, 10, 20, and 30 percent CLM that replaced COM were fed in trials 1 and 2. Broiler performance was improved at the 10 percent CLM level; however, 20 and 30 percent levels of CLM resulted in depressions in gain, feed intake, and feed efficiency. Liver and spleen wt. (percent of body wt.) increased linearly with increasing levels of CLM. Carcass pigmentation values, as measured by Roche color fan, favored CLM-based diets. Results of trial 3 showed that broilers can tolerate a level of 15 percent CLM without adversely affecting their growth. In trials 4 and 5, supplementation of met. improved the gains of birds fed the 20 percent CLM diet but had no beneficial effect when added to the basal diet. All response criteria were improved when 3 percent soybean oil was added to the basal or the 20 percent CLM diet in trials 6 and 7. Further addition of met. had no effect on the performance of birds fed the basal diet but improved growth of those fed the 20 percent CLM diet. In trial 8, gains of broilers tended (P less than 0.10) to decrease linearly with increasing levels of cyanide; however, gains were reduced only 4.6 percent at the highest level (200 ppm) of added cyanide, and there were no deaths. In conclusion, the use of a high level of CLM in broiler diets is limited by its bulkiness, low energy content, met. deficiency, and the presence of antinutritional factors. (AS)

0132

29572 REEVES, J. 1987. La yuca para alimentación animal. (Cassava for animal feeding). El Surco 92(3):8. Es., Il.

Cassava. Development. Feeds and feeding. Cultivation. Economics. Resistance. Colombia.

The importance of cassava, particularly in animal nutrition, is briefly discussed. The adaptability of cassava to infertile soils and low inputs, its production of more calories per land and labor unit than any other food crop, and its resistance to pests and diseases are highlighted. CIAT's objectives in Latin America and Colombia are presented. (CIAT)

0133

29466 TIESENHAUSEN, I.M.E.V. VON 1987. O feno e a silagem da rama de mandioca na alimentacao de ruminantes. (Hay and silage from cassava branches for ruminant feeding). Informe Agropecuario 13(145):42-47. Pt., 21 Ref., Il. [Depto. Zootecnia, ESAL, Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Feeds and feeding. Silage. Composition. Toxicity. Cattle. Protein content. Uses. Brazil.

The use of hay and silage from cassava branches for cattle feeding is briefly reviewed, with emphasis on chemical composition, toxicity, preparation, consumption, and exptl. silos. Hay and silage from cassava branches are excellent for ruminant feeding, especially if the upper third of the plant is used; for an improved protein content, the stem:leaf ratio should be less than 1. A final recommendation is that fresh branches should be chopped in an aerated site. (CIAT)

0134

29030 UMOH, I.B.; MADUAGWU, E.N.; ANOLE, A.A. 1986. Fate of ingested linamarin in malnourished rats. Food Chemistry 20(1):1-9. En., Sum. En., 18 Ref. [Dept. of Biochemistry, College of Medical Sciences, Univ. of Calabar, Nigeria]

Cassava. Linamarin. Animal nutrition. Diets. Animal health. Kwashiorkor. Riboflavin. Cyanogenic glucosides. Cyanides. Thiocyanates. Nigeria.

Pure linamarin at a dose level of 30 g/100 g body wt. was administered in food to a group of Wistar rats maintained on vitamin B2-deficient, sufficient, and excess diets for 5 wk. and to another group of kwashiorkor rats. Free and total cyanide, intact linamarin, and SCN levels were estimated in urine and feces obtained at 0-, 24-, 48-, and 72-h periods and in blood samples obtained in the 72nd h after the drug had been administered. There was no detectable cyanide or intact linamarin in the fecal samples. Vitamin B2-sufficient and excess groups of rats excreted higher total and free cyanide than the resp. vitamin B2-deficient groups. Most of the linamarin was degraded after the 1st 24 h. The rate of breakdown of the glucoside within the 1st 24 h was slowest for the zero and half normal vitamin B2 status, resp., as evidenced by its appearance in large quantities in the urine. The kwashiorkor rats, on the other hand, excreted less SCN than the controls. In addition, their control group excreted most of the (SCN-) in the 1st 24 h while the kwashiorkor rats excreted theirs in the 1st 48 h. Dietary protein deficiency prolongs the time of metabolism and hence increases the toxicity of cyanogenic glycoside in the body. It is also suggested that excessive exposure of malnourished humans to cyanide could be a contributory factor in the rampant cases of tropical ataxic neuropathy. (AS)

0135

26357 VIEIRA, J.R.R.; SANTOS, A.R. DOS 1981. Raspa de mandioca; racao para o rebanho e alcool para o Brasil. (Cassava chips; ration for animal nutrition and alcohol for Brazil). Fortaleza-CE, Brasil, Empresa de Assistencia Técnica e Extensao Rural do Ceará. 2p. Pt., 11.

Cassava. Animal nutrition. Feeds and feeding. Alcohol. Storage. Substitutes. Brazil.

The advantages of producing cassava chips for use in animal nutrition and alcohol production in the state of Ceará, Brazil, are indicated. When CF production is high, farmers can use part of their product for cassava chip production for animal nutrition or alcohol production. Cassava chips can be mixed in rations to increase beef, milk, and egg production, replacing maize which is, in turn, released for human consumption. Roots for cassava chip production can be left undried and stored for up to 6 mo. New lands can be incorporated into agricultural production by planting cassava, and new employments will be created. (CIAT)

0136

29431 VIVES, G.; SAAVEDRA, D. 1983. Evaluación de dos niveles de yuca fresca y dos de yuca secada al sol en raciones para cerdos en crecimiento y ceba. (Evaluation of two levels of fresh cassava and two of sun-dried cassava in rations for growing and fattening pigs). Tesis Ing. Agr. Panamá, Universidad de Panamá. 78p. Es., Sum. Es., 23 Ref., 11.

Cassava. Feeds and feeding. Swine. Animal nutrition. Substitutes. Dietary value. Cassava chips, Panama.

An expt. was carried out at the Centro de Enseñanzas e Investigaciones Agropecuarias of Tocumen, Panama, with 15 weaned pigs (8 females and 7 castrated males), all dewormed and weighed at the beginning of the expt. six were of the Yorkshire breed and 9 of a crossed sow and Landrace male, distributed randomly among the 3 exptl. groups. They consumed: (1) concentrate, (2) concentrate and fresh cassava, and (3) concentrate and sun-dried cassava. Initially, group 1 (check) received 4,302 kg concentrate and groups 2 and 3, 1,529 kg concentrate and 0,660 kg cassava. A statistical analysis was done with the data on wt., feed consumption, and feed efficiency and there was no significant difference in the av. daily consumption, av. daily gain, nor cumulative efficiency for none of the 3 groups. Thus, the rations with cassava are comparable in the nutritive aspect. Economic analysis showed a satisfactory profit for the expt. as a whole and an economic superiority for rations with fresh cassava. Less difference was noted between groups 2 and 3 than between them and the check group. Furthermore, group 2 was slightly superior nutritionally and group 3 was the most economic. No important sanitary, nutritional, nor toxic or physiological digestive problems were observed, suggesting good acceptance of both fresh and sun-dried cassava. (AS (extract)-CIAT)

0137

27640 WALDRHOOP, P.W.; RITCHIE, S.J.; REESE, G.L.; RAMSEY, B.E. 1984. The use of blends of cassava flour and extruded full-fat soybeans in diets for broiler chickens. Archivos Latinoamericanos de Nutrición 34(3):550-563. En., Sum. En., Es., 27 Ref. [Univ. of Arkansas, Division of Agriculture, 104 Animal Sciences Building, Fayetteville, AR 72764, USA]

Cassava. Cassava meal. Feed and feeding. Animal nutrition. Diets. Poultry. Protein content. Substitutes. USA.

The effects of blending different levels of a low-prussic acid CM with extruded full-fat soybeans in diets for growing broiler chickens were studied. The full-fat soybeans contributed oil which increased the energy content of the diet, aided in overcoming the dusty nature of cassava, and provided high-quality protein. CM replaced 1/3, 2/3, and all of the maize in diets with 0, 12.5, and 25.0 percent extruded full-fat soybeans. Diets were fed in pelleted form to broiler chickens for a 47-day feeding trial. Replacement of 1/3 of the maize with cassava had no adverse effects on body wt. gains with a reduction in wt. at higher levels at the end of the study. Feed utilization was reduced more severely than was anticipated; however, growth rate on the higher levels of cassava was reasonably good, indicating that producers might feed these diets for a slightly longer period of time and produce chickens more economically if CM were available at a cost significantly lower than that of maize. (AS)

0138

27603 WALKER, M. 1983. Cassava and tallow in diets for growing pigs. Animal Production 40(2):345-350. En., Sum. En., 21 Ref. [Agricultural Research Inst. of Northern Ireland, Hillsborough, Co. Down BT26 6DP, Northern Ireland]

Cassava. Diets. Swine. Field experiments. Feed and feeding. Dietary value. Substitutes. Northern Ireland.

In 2 expt. 480 and 360 pigs were housed in groups of 10 and given diets containing different proportions of cassava between 35-87 kg live wt. The cassava contained 672, 34, 57, and 39 g starch, crude fiber, total ash, and insoluble ash/kg DM, resp. The diets in the 1st expt. contained 0, 238, 475, or 713 kg cassava/t. In the 2nd expt. the different levels of dietary cassava (0, 150, 300, or 450 kg/t) were combined in a factorial design with different levels of tallow (0, 50, or 100 kg/t). The pigs were given quantities of food calculated to give isocaloric intakes on the assumption that air-dry cassava contained 14.2 MJ digestible energy/kg. The feeding scale increased with time to give a max. daily allowance of digestible energy of 31.8 MJ/pig. Relative to each MJ of digestible energy the calculated levels of lysine and of met. plus cystine in the diets were 0.64 and 0.49 g, resp. In both expt., increasing levels of cassava resulted in significant reductions in growth rate but had no effect on the conversion of food to live wt. or on carcass wt. In both expt., the diets with the highest inclusions of cassava produced pigs with the thickest back fat. The effect was not significant in the 2nd expt. but in the 1st expt. the differences were significant between diets with the highest and intermediate levels of cassava. There was a significant interaction between cassava and tallow on growth rate with the depression due to high levels of cassava being reduced when 100 kg tallow/t was included in the diet. The results of these growth expt. suggested that this type of cassava was of similar value to barley on an energy basis when used in diets based on barley and soybean meals. (AS)

0139

29511 YUSSOFF, S.M.; CHEAH, P.F.; ALIZ, T.M. 1984. Performance of post-weaning calves fed ad libitum and restricted diets. Kajian Veterinar 16(1):8-14. En., Sum. En., Mal., 16 Ref. [Inst. Haiwan, Kuala, Johor, Malaysia]

Cassava. Feeds and feeding. Calves. Cassava chips. Animal nutrition. Dietary value. Malaysia.

An expt. was conducted to determine the performance of 3-mo.-old postweaning calves subjected to 4 dietary treatments: (1) ad libitum feeding of calf starter ration containing 20 percent protein; (2) ad libitum feeding of urea-based dairy ration (16 percent protein); (3) restricted feeding of 1.5 kg calf starter; and (4) restricted feeding of 1.5 kg dairy ration. The calf starter ration was made up of palm kernel cake (10.0 percent), maize (55.5 percent), cassava chips (5.0 percent), SBM (15.0 percent), fish meal (12.0 percent), dicalcium phosphate (1.0 percent), salt (1.0 percent), and mineral premix (0.5 percent). The dairy ration was composed of palm kernel cake (solvent extracted, 25.0 percent), palm kernel cake (expeller pressed, 75.0 percent), maize (20.0 percent), cassava chips (15.0 percent), rice bran (11.0 percent), urea (1.5 percent), dicalcium phosphate (1.0 percent), salt (1.0 percent), and mineral premix (0.5 percent). The calves in each treatment group were given their resp. concentrate ration plus fodder provided ad libitum. Calves given ration 1 gained more than those calves on the other diets; however, they also incurred the highest cost of feeds/day and per kg gain. The next highest daily gain was achieved by calves given ration 3. Since the costs of feed/day was not significantly different among these 3 treatments, it can be concluded that restricted feeding of calf starter was more suitable for postweaning calves. Postweaning calves of 3-6 mo. of age performed better with a 20 percent protein starter ration compared with the adult ration of urea-based 16 percent protein dairy ration. (AS) See also 0021 0095 0141 0142 0164 0178 0180 0186 0193

1104 HCN Toxicity and Detoxification

0140

29037 AKINRELE, J.A. 1986. Hydrocyanic acid hazard during large scale cassava processing. *Tropical Science* 26(1):59-65. En., Sum. En., 30 Ref., 11. [Centre for the Development of Industry, 28 Rue de l'Industrie, 1040 Brussels, Belgium]

Cassava. Toxicity. Industrialization. Peeling. Grating. Factories. HCN. Human health. Development. Nigeria.

Considering that current efforts to modernize and increase the output of cassava products through mechanized processing could pose toxic hazards to process workers, an attempt was made to investigate and assess the potential of this hazard on the basis of existing operational activities. The most potent unit operation areas are those of peeling and grating of fresh cassava roots. The area around the grating machine had the highest concn. of HCN and the value approached the max. allowable limit for human health; previous studies have showed that exposure to 100-200 ppm HCN concn. in air for 30-60 min can cause death and with lesser amounts and longer exposures, chronic poisoning from HCN as well as other symptoms (headaches, nausea, and loss of appetite) may occur. It is recommended that a cassava processing factory should be designed to allow for ventilation of 75.0 cubic meters air/1 kg processed roots. (AS)

0141

29071 CARVALHO, V.L. II 1987. O Acido cianidrico em produtos de mandioca. (Hydrocyanic acid in cassava products). *Informe Agropecuario* 13(145):88-91. Pt., 4 Ref., 11. [EPAMIG, Caixa Postal 170, 31.700 Lavras-15, Brazil]

Cassava. HCN content. Drying. Silage. Cassava chips. Cultivars. Feed: and feeding. Processing. Brazil.

The effects of cassava leaf and root preparation methods and the type of drying and silage on HCN reduction are discussed. Washing after partial boiling of macerated leaves during 15 min. resulted in practically total reduction of HCN content. Results showed that for max. HCN level reduction, cassava roots for human consumption should be chopped into small pieces and boiled in sufficient water at a ratio of at least 5:1 (water:roots). In expt. on the effects of cassava chip size, drying method and temp. on HCN reduction, the following conclusion was reached: HCN reduction was greater in larger chips at a given drying temp. and lower at higher temp. for a given chip size. Root silage obtained from high HCN cassava cv. was observed to be safe for use in animal feeding since HCN is reduced to low levels. (CIAT)

0142

29457 FOMINYAN, B.T.; APEGBOLA, A.A.; OBE, C.I. 1988. The stability of cyanohydrins. *Food Chemistry* 17(3):271-276. En., 8 Ref., 11. [Dept. of Animal Science, Univ. of Ife, Ile-Ife, Nigeria]

Cassava. Cyanogenic glucosides. Toxicity. Fermentation. Human nutrition. Animal nutrition. Processed products. Nigeria.

Acetone cyanohydrin, a product of the hydrolysis of the cyanogenic glucoside linamarin found in cassava, and mandelonitrile were synthesized to investigate their stability at pH 2-9, with and without palm oil. Mandelonitrile hydrolysis was low (10-20 percent) at pH 4 and 5, and high (55-80 percent) as pH values increased from 7 to 9. Acetone cyanohydrin hydrolysis was very low (5-15 percent) at pH 3-7, and followed the same

pattern as that for mandelonitrile at pH 9, being irregular and difficult to explain at pH 8. Neither compound hydrolyzed in palm oil and hydrolysis in palm oil/buffer mixture was lower than in buffer alone. The implications of these results are discussed in terms of reactivity in the digestive tract. The stability of these products at low pH values and their extreme solubility in water can be used effectively in the processing of cassava by employing several water changes during fermentation. Also, using palm oil for frying cassava may remove residual cyanohydrins and make cassava products safer for consumption. (CIAT)

0143

29463 TELES, F.F. 1987. Técnicas de liberacao do HCN e toxidez cianogenica das mandiocas. (Techniques to release HCN from cassava and cyanogenic toxicity). Informe Agropecuario 13(145):18-22. Pt., 5 Ref., Il. [Depto. de Química/UFV, Caixa Postal 216, 36.570 Vicosa-MG, Brasil]

Cassava. HCN. Toxicity. Biochemistry. Cyanogenic glucosides. Enzymes. Brazil.

The toxicity-related problems of cassava and biochemistry of its cyanogenesis are reviewed, with reference to methods for releasing HCN from cassava. The possible functions of cyanogenic glycosides are also discussed briefly. The most common method to release HCN from cassava is to allow endogenous enzymes to release it after tissue maceration; other methods mentioned are refrigeration and extrusion. (CIAT) See also 0051 0107 0111 0123 0129 0131 0133 0134 0146 0197

100 PROCESSING, PRODUCTS AND USES

0144

28140 CEREDA, M.P. 1981. Estudos físico-químicos e microbianos da esterilizacao e da fermentacao da fécula da mandioca. (Physical-chemical and microbial studies of the sterilization and fermentation of cassava starch). Tese Livre-Docencia, Botucatu-SP, Brasil, Universidade Estadual de Sao Paulo. 159p. Pt., Sum. Pt., En., 114 Ref., Il.

Cassava. Cassava starch. Fermentation. Processing. Fermented products. Industrial microbiology. Brazil.

The influence of sterilization treatments on raw cassava starch characteristics was studied to develop a fermentation process with sterile substrate and to standardize and improve quality standards of fermented cassava starch. Commercial cassava starch was submitted to the following sterilization processes: (1) tyndallization by saturated steam (moist heat) for 30 min at 100 degrees Celsius, followed by cooling, repeated for 3 consecutive days; (2) dry heat at 150 degrees Celsius for 2 h; (3) disinfection with methyl bromide under vacuum at the concn. of 0.003 kg/liter; (4) gamma irradiation at doses of 0.5, 1.0, 2.0, 4.0, and 8.0 Mrad and microwave energy at doses of 1.0, 1.5, and 2.0 kW. Treated samples and the check were analyzed for their physical, chemical, and rheological characteristics, as well as for their microbiological content. Visual evaluations, sterilization tests, and assays of viability of fermentation were also made. After treatment only the methyl bromide-sterilized cassava starch was inoculated with 5 g of nontreated material and fermentation was done under lab. conditions at 30 degrees Celsius for a period of 30 days and periodically followed by the analysis of pH, titratable acidity, total reducing values, organic acids, sugar identification, and microorganism counts. Among the 5 treatments tested, the methyl bromide process was the only one that sterilized the raw

material with fewer modifications of its characteristics. Results also showed that bromide residues cause little, if any, interference in the process and that the sterile substrate can be used for further research on fermentation. (AS)

0145

29527 DIAFERIA M., R. 1986. Utilización de harina de yuca en panificación. (The use of cassava flour in bread making). Alimentaria. Técnicas en Alimentos y Bebidas 3(9):6-8. Es., Il.

Cassava, Cassava flour, Substitutes, Cultivars, Cassava meal, Cassava bread, Processed products, Uses, Costs, Consumption, Processing, Colombia,

The technical and economic feasibility of substituting CF for wheat flour in bread making in Colombia is briefly reviewed. The CM production process is briefly explained: washing, peeling, chipping, drying, milling, packing, and storage. The results of substitution trials for bread making, using cassava var. M Col 22, CM 976-15, M Col 1684, and M Ven 25, are briefly discussed. CF from M Col 22 was found to be the most suitable in terms of bread vol. and overall rating. The crop should be preferably harvested at 12 mo. and CF used at a 15 percent level of substitution. The use of CF as a substitute appears technically and economically feasible. At present, the price of CF is 92 percent that of wheat flour; however, the attitude of rejection of the milling sector should be overcome. (CIAT)

101 Cassava Starch and its Properties

0146

23241 ARGUEDAS G., P. 1981. Análisis del contenido de cianuro en el proceso de extracción del almidón de yuca. (Analysis of cyanide content in the cassava starch extraction process). Tesis Lic.Teen. Alimentos. San José, Universidad de Costa Rica, 118p. Es., Sum. Es., 63 Ref., Il.

Cassava, HCN content, Industrial starches, Industrialization, Cassava starch, Processing, Factories, Hydrolysis, Cyanogenic glucosides, Detoxification, Costa Rica.

The efficiency of cyanide extraction and distribution was determined in 2 cassava starch extraction factories located in Santa Eulalia (Alajuela, Costa Rica) during different stages of the process, consisting in grinding whole roots, separation by jet extractor of starch and fiber (residue), sedimentation (raw starch), and sun drying (white starch). The process was run through 6 times; 2 were preliminary to determine the stages to be analyzed, the sampling techniques, and the selection of analysis methods, and then 2 runs in each of the factories. The Chloramine-T plus pyridine-pyrazolone method was used for the spectrophotometric quantification of free cyanide and Sainas' methodology for starch determination (1973) was modified. Glucose was determined colorimetrically with the ferrocyanide method. Yield of extraction was very similar in both factories; in terms of wt., the relation end product:raw material ranged between 1:5-1:6. Percentage of starch recovered in the end product, with respect to that in the initial raw material, was between 61-78 percent (11-23 percent was lost in the residue). Variations in cyanide distribution found during the process showed the same tendencies in all runs performed. Percentage of free cyanide increased from 25 to 75 percent during the grinding stage. From 40-80 percent of the cyanide initially present in the raw material is eliminated in the water and from 5-11 percent in the residue. Raw starch contains only 3-8 percent of the initial cyanide. During sun drying stage, the concn. is reduced to levels between 0.4-5.0 ppm. On av. in all runs

performed, approx. 75 percent of the raw starch cyanide is released. The sedimentation and drying processes are responsible, together, for the elimination of 97 percent of total cyanide. (AS (extract)-CIAT)

0147

29042 CEREDA, M. P.; CATANEO, A. 1986. Avaliação de parâmetros de qualidade da fécula fermentada de mandioca. (Assessment of quality parameters of fermented cassava starch). Revista Brasileira de Mandioca 5(1):55-62. Pt., Sum. Pt., En., 9 Ref. [Facultad de Ciências Agrônomicas, Univ. Estadual Paulista, Campus de Botucatu, Caixa Postal 237, 18.600 Botucatu-SP, Brazil]

Cassava. Fermented products. Cassava starch. Analy is. Viscosity. Processing. Brazil.

Twelve commercial samples of fermented cassava starch from Minas Gerais, Paraná, and São Paulo (Brazil) were analyzed. The amount of water absorbed under standard conditions in a Farinograph-Bradender was adopted as reference. The relationships between this and other parameters (paste moisture, Bestwick viscosity, ash, fiber, titratable acidity, viscographic Bradender parameters, short-chain organic acids, and granulometry) were established for 41 variables. No significant correlations to water absorption were found, the same occurring with the organic acids contents. Several Bradender viscosity parameters had significant values (5 percent). The granulometric variables had the most significant r values. When regression analyses were made, the most promising results were obtained with the fractions retained in sieves no. Tyler 50, 70, 120, and 200 with $r(2) = 0.7502$ and $F = 4.28$ at percent level of significance). Industrial yield can be increased by using 4 vibratory sieves. (AS)

0148

29007 CEREDA, M. P. 1984. Esterilização de amido de mandioca (Mandioca utilisissima, HBK.). (Sterilization of cassava starch). Ciência e Tecnologia de Alimentos 4(3):129-137. Pt., Sum. Pt., En., 39 Ref., 11. [Facultad de Ciências Agrônomicas, Univ. Estadual Paulista, Campus de Botucatu, Caixa Postal 237, 18.600 Botucatu-SP, Brazil]

Cassava. Cassava starch. Fermentation. Sour starch. Analysis. Brazil.

Several sterilization procedures were applied to raw cassava starch to develop a sterile substrate for use in fermentation and thus improve the standard of quality of the natural fermented food product known as polvilho azedo (sour starch). Commercial cassava starch samples were submitted to (1) tyndallization with steam for 30 min on 3 consecutive days; (2) dry heat at 160 degrees Celsius for 2 h; (3) 0.03 percent methyl bromide treatment under vacuum; (4) gamma irradiation at 0.5-8.0 Mrad; (5) microwave energy at 1.0-2.0 kW. Treated samples and controls were analyzed for their physical, chemical, and rheological characteristics as well as for their microbiological content. Visual evaluations, tests for effectiveness of sterilization, and assays of viability of fermentation were also carried out. Method 3 had the greatest sterilization effect and the best subsequent fermentation; bromide residues caused little if any interference with fermentation. (AS)

0149

28148 CEREDA, M. P. 1983. Avaliação da qualidade de duas amostras de fécula fermentada de mandioca (polvilho azedo). (Quality assessment of two samples of fermented cassava starch). Boletim da Sociedade Brasileira de Ciência e Tecnologia de Alimentos 17(3):305-320. Pt., Sum. Pt., En., 18 Ref., 11. [Facultad de Ciências Agrônomicas, Univ. Estadual Paulista, Campus de Botucatu, Caixa Postal 237, 18.600 Botucatu-SP, Brazil]

Cassava. Fermented products. Biscuits. Industrial starches. Brazil.

Two samples of commercial fermented cassava starch, one from Paraná and the other from Sao Paulo, were analyzed in order to establish a quality standard for polvilho azedo, widely consumed in Brazil. The samples differed with respect to organic acid content, Brabender viscosity, biscuit yield and vol. The fermented starch that presented a higher biscuit vol. also showed the greatest variation under baking conditions; this starch showed a higher fiber content, lower ash content, and higher acidity (mainly due to butyric acid), as well as a lower Brabender viscosity with higher retrogradation power, less water absorption, and consequently lower biscuit yield. The higher yielding starch was chosen by the biscuit manufacturer under commercial conditions. The only differences between the biscuits made with the 2 samples were yield and vol. since the biscuits had similar appearances and chemical compositions. (AS)

0150

28139 CEREDA, M.P. 1973. Alguns aspectos sobre a fermentação da fecula de mandioca. (Some aspects of cassava starch fermentation). Tese Doutorado. Botucatu-SP, Brasil, Faculdade de Ciências Médicas e Biológicas de Botucatu. 93p. Pt., Sum. Pt., En., 99 Ref., Il.

Cassava. Industrial starches. Fermented products. Laboratory experiments. pH. Fiber content. Protein content. Cassava starch. Brazil.

The actual conditions of the fermented cassava starch industries in Brazil were studied as well as the fermentation of cassava starch in the lab., under similar conditions to those used in commercial production, to better control fermentation in order to upgrade the quality of fermented starch. The moisture, starch, protein, fiber, ash, ether extract, pH, titratable acidity, and cold viscosity of samples of both fermented and nonfermented commercial cassava starch were analyzed. Color, granulation, and contamination were also studied, and the organic acids present in commercial fermented cassava starch were determined. In lab. fermentation assays using commercial cassava starch, microorganisms were isolated and identified, and the pH, titratable acidity, organic acids, and reducing sugars determined during the fermentation process. Statistical analysis of the physical and chemical data showed a great variation among the samples studied, mainly regarding titratable acidity and pH, probably due to the lack of control during the processing of the fermented starch. In the lab., cassava starch fermentation showed varied patterns. Propionic, butyric, acetic, formic, succinic, and lactic acids were determined in both commercial and lab.-fermented cassava starch. No specific group of microorganisms was prevalent in the fermentations studied; however, some organisms appeared with greater frequency than others (*Bacillus subtilis* and *Leuconostoc citrovorum*). The reducing sugars were initially observed in small quantities and as the titratable acidity increased, these quantities also increased up to a certain point after which they showed irregular patterns. (AS)

0151

29496 FACETTI, F.S.; FACETTI, J.F.; FALABELLA, M. 1968. Composición inmediata de harina de mandioca del Paraguay. (Proximate composition of cassava flour from Paraguay). Revista de la Sociedad Científica del Paraguay 9(1-2):15-18. Es., Sum. En., 17 Ref., Il.

Cassava. Cassava flour. Analysis. Cassava chips. Drying. HCN content. Biochemistry. Composition. Paraguay.

Tests were carried out with over 200 samples of CF, to determine MC, ash content, acidity, extractable glucides, maltose, and total N. Samples were

classified into 2 groups according to method of preparation: 1 group consisted of cassava chips dried 12-18 h on a stove, grinded, and sieved, while the other was of chips sundried for 3 days, then grinded and sieved. No HCN was found according to Indian Standards. Twenty samples, representative of 12,000 kg CF, were tested for phenols and tannic substances and the result was negative. Five frequency histograms are included. (CIAT)

0152

29023 LEE, S.Y.; SHIN, Y.C.; KIM, H.S.; BYUN, S.M. 1985. Ethanol fermentation of uncooked cassava starch. *Journal of Fermentation Technology* 63(1):51-56. En., Sum. En., 17 Ref., 11. [Dept. of Biological Science & Engineering, The Korea Advanced Inst. of Science & Technology, P.O. Box 150 Chongryang, Seoul 131, Korea]

Cassava. Fermentation. Cassava starch. Ethanol. Korea.

For the eventual alcohol fermentation of uncooked cassava starch, a saccharification process was examined consisting of steeping in 0.5 N HCl solution (sample wt./acid vol. = 1/2) at 60 degrees Celsius for 12 h, followed by the combined actions of alpha-amylase and glucoamylase. Scanning electron microscopy showed that the acid steeping helped change of the starch structure to a form more susceptible to alpha-amylase and glucoamylase. This acid steeping overrode the reported macerating effect of pectin depolymerase on raw cassava starch mash. The ethanol yield from cassava starch treated under the conditions described was 95 percent after fermentation for 3 days at 30 degrees Celsius with *Saccharomyces cerevisiae*. (AS)

0153

29519 MOORTHY, S.N. 1985. Effect of different types of surfactants on cassava starch properties. *Journal of Agricultural and Food Chemistry* 33(6):1227-1232. En., Sum. En., 23 Ref.

Cassava. Cassava starch. Analysis. Biochemistry. Laboratory experiments. Viscosity. Processing. India.

The effect of anionic, neutral, and cationic surfactants at 3 different concn. on cassava starch properties was studied. The I affinity of total amylose was reduced by 20-40 percent by all surfactants, with the highest reduction being observed for cetyltrimethylammonium bromide. The I affinity of soluble amylose was suppressed by 30-70 percent by all reagents except cetyltrimethylammonium bromide, which lowered the value to almost zero. There was no significant difference between the concn. 0.04 and 0.06 mol of surfactant/100 g of starch. Viscosity was stabilized by potassium stearate and potassium palmitate without greatly affecting the peak viscosity of 660 Brabender units of pure starch, but sodium lauryl sulfate and cetyltrimethylammonium bromide increased the peak viscosity to 900 and 780 Brabender units, resp., at 0.06-mol concn. and did not show stable viscosity during the holding period. Defatted and raw starch showed similar viscosity patterns on incorporation of surfactants. Pasting temp. was increased to over 90 degrees Celsius by potassium stearate, palmitate, and glyceryl monostearate, while the increase was only by 3-15 degrees Celsius over control (65 degrees Celsius) by the other 2 reagents. The swelling vol. of starch was reduced to nearly half the original value by potassium palmitate and stearate, while glyceryl monostearate did not change it noticeably. Sodium lauryl sulfate and cetyltrimethylammonium bromide increased the value by nearly 50 percent. Sol stability was improved considerably by all the reagents. The results are discussed in relation to structure of the surfactants. (AS)

0154

29443 NOPARATNARAPORN, N.; SASAKI, K.; NISHIZAWA, Y.; NAGAI, S. 1986. Stimulation of vitamin B12 formation in aerotically-grown *Rhodospseudomonas gelatinosa* under microaerobic condition. *Biotechnology Letters* 8(7):491-496. En., Sum. En., 16 Ref., 11. [Dept. of Microbiology, Faculty of Science, Kasetsart Univ., Bangkok 10900, Thailand]

Cassava. Culture media. Cassava starch. Vitamin B12. Industrial microbiology. Japan.

Photopigments and vitamin B12 formation of *Rhodospseudomonas gelatinosa* were enhanced by a stepwise change of the culture condition from aerobic (oxidation-reduction potential, ORP greater than +110 mV) to microaerobic condition (ORP = 0 to -200 mV). During the microaerobic culture in the malate-glutamate medium, delta-aminolevulinic acid synthetase increased 2- to 4-fold in 4 h with the increases in intracellular content of carotenoid, bacteriochlorophyll, and vitamin B12. Effects of light illumination on vitamin B12 formation could not be observed. Further, the production of SCP enriched with vitamin B12 and photopigments from cassava starch was done by changing aerobic to microaerobic culture; intracellular carotenoid, bacteriochlorophyll, and vitamin B12 increased from 230, 0, and 25 micrograms/g cell of aerobic culture to 310, 960, and 38 micrograms/g cell, resp. (AS)

0155

28571 BREMA, P.; RAMAKRISHNA, S.V.; RAO, J.M. 1986. Influence of composition of sugars in cassava starch hydrolysate on alcohol production. *Biotechnology Letters* 8(6):449-450. En., 2 Ref. [Regional Research Laboratory (CSIR), Trivandrum 695 019, India]

Cassava. Sugar content. Cassava starch. Alcohol. Analysis. India.

Two expt. were conducted to study the influence of cassava starch hydrolysate (CSH) sugar composition on alcohol production using *Saccharomyces cerevisiae* NCIM 3188 as the fermenting agent. In expt. 1, CSH was found to be composed of glucose, maltose, and trisaccharides in the following ratio: 45:18:27. The conversion efficiency for glucose alone ranged between 76-98 percent, while that of CSH only ranged between 52-74 percent. In expt. 2, glucose, maltose, a 1:1 mixture of glucose:maltose, and CSH were submitted to fermentation for conversion comparison. The strain was capable of utilizing either glucose or maltose whe. they were present alone, but in the mixture it utilizes glucose preferentially. Alcohol produced from the mixture was only 62.15 percent of the theoretical conversion compared with 95.3 and 84.3 percent for glucose and maltose alone, resp., and 58.62 percent for CSH. (CIAT) See also 0098 0104 0105 0172 0183 0192

102 Uses, Industrialization, Processing and Storage

0156

29010 ABENQJA, E.A.; DATA, E.S.; CAJUNO, R. 1985. Utilization of cassava solid by-products from alcohol production as soil ameliorant. *Radix* 7(1):3-4. En., [Philippine Root Crop Research & Training Center, Visca, Baybay, Leyte, Philippines]

Cassava. Waste utilization. Alcohol. Cultivars. Fertilization. Field experiments. Productivity. Soil amendment. Philippines.

In field expt. in the Philippines, (1) no fertilizer, (2) solid cassava by-products from alcohol production, (3) inorganic fertilizers, or (4) treatments 2 + 3, were applied to cassava var. Golden Yellow and maize. For cassava 70-20-0 kg NPK were applied per ha. Root yields were 22.28, 28.28, 32.72, and 25.72 t/ha for treatments 1, 2, 3, and 4, resp. It was concluded that, in general, solid cassava by-products can not increase cassava root yields significantly. (CIAT)

0157

29378 ALONSO, L. 1987. Estudio de varios sistemas para secado de trozos de yuca destinados al consumo humano. (Study of various drying systems of cassava chips destined for human consumption). Cali, Colombia, Centro Internacional de Agricultura Tropical. Sección Utilización. Programa de Yuca. 49p. Es., Sum. Es., 6 Ref., Il. Proyecto Cooperativo CIAT/IIT/Univalle-CIID, Producción y uso de harina de yuca para consumo humano. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Development. Drying. Cassava chips. Technology evaluation. Industrialization. Colombia.

Results are presented of a CIAT/Instituto de Investigaciones Tecnológicas/U. del Valle/International Development Research Centre collaborative project and of another joint CIAT/Integrated Rural Development Program (DRI) project on the establishment of cassava drying plants on Colombia's Atlantic Coast. Research was carried out on different types of cassava chips, available energy sources, and drying systems to produce a good product for human consumption. The drying systems were (1) natural drying on concrete floors, (2) natural drying on inclined trays, (3) artificial fixed bed batch drying, (4) artificial quasi continuous drying with removable trays in a hot air chamber, and (5) mixed drying--1st natural drying and then a final artificial stage. Of the Brazil-, Malaysia-, and Thai-type chips, the latter chips had significantly longer drying times. For the artificial fixed bed system, best loads were 200, 150, and 100 kg/square meter for the Brazil-, Thai-, and Malaysia-type chips, resp. Optimal loads for CIAT conditions were: inclined trays, 16 kg/square meter for Malaysia- and Brazil-type chips and 12 kg/square meter for Thai-type chips; concrete floors, 10 kg/square meter for all types. On the Atlantic Coast (Sucre), using a fixed bed system, a flat solar collector heated drying air by 5 degrees Celsius with a thermic efficiency of 63 percent. Coal had the least overall efficiency (25-35 percent) and the least operational costs due to its low price. In the trial with removable trays in chambers, for a work flow of 20 cubic meters/min/square meter, total drying times were 8.4-12.0 h. The adjusted consumption of coal/t of dried product was approx. 700 kg, about 40 percent more than the fixed bed batch system. Finally, all systems are compared regarding investment costs, energy consumption, and labor requirements, using 2700 kg fresh cassava/day. (CIAT)

0158

29375 ALONSO, L.; VIERA, M.A.; BEST, R.; FIGUEROA, F. 1986. Comparación de tres tipos de trozos de yuca en secado artificial. (Comparison of three types of cassava chips in artificial drying). Cali, Colombia, Centro Internacional de Agricultura Tropical. Sección Utilización. Programa de Yuca. 20p. Es., Sum. Es., 7 Ref., Il. Trabajo presentado en la 3a. Mesa Redonda Latinoamericana sobre Prevención de Pérdidas Postcosecha de Granos, Cali, Colombia, 1986. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Drying. Cassava chips. Technology transfer. Technology evaluation. Development. Colombia.

The drying of 3 types of cassava chips (Brazil, Malaysia, and Thailand) in a fixed bed dryer with air at 60 degrees Celsius and with different air flow rates (95, 127, 190, and 380 cubic meters/min/t of fresh cassava chips) was studied. The 3 types of chips did not show significant differences in terms of drying time and thermic efficiency of the process. The homogeneity in size and dimensions of Brazil-type chips offers advantages in the operation of the drying system as to the ease of turning and the use of loads up to 0.20 t/square meter; furthermore, it allows a more uniform drying. In general, the efficiency of the drying process increases with a reduction in the applied flow and the drying time is longer. (AS-CIAT)

0159

29376 ALONSO, L.; VIERA, M.A.; BEST, R. 1986. La investigación en el secado artificial de yuca como apoyo al desarrollo agroindustrial de la Costa Atlántica de Colombia: evaluación de varias fuentes de calor. (Research on artificial cassava drying as support to agroindustrial development of Colombia's Atlantic Coast: evaluation of various heat sources). Cali, Colombia, Centro Internacional de Agricultura Tropical. Sección Utilización. Programa de Yuca. 28p. Es., Sum. Es., 14 Ref., Il. Trabajo presentado en la 3a. Mesa Redonda Latinoamericana sobre Prevención de Pérdidas Postcosecha de Granos, Cali, Colombia, 1986. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Cassava chips. Drying. Technology evaluation. Costs. Trade. Colombia.

Research was done on artificial drying of cassava chips, with hot air, in a fixed bed dryer, using 4 sources of energy (solar captured through a flat collector, mineral coal, propane gas, and diesel fuel) and a comparison was made with natural drying on concrete floors. Drying with a solar collector was evaluated on the Colombian Atlantic Coast, during the annual dry season. The collector, with 30 square meters of absorbing area, heated an air flow of 106 cubic meters/min up to an av. temp. of 36 degrees Celsius, allowing an application of flows between 78-141 cubic meters/min/t fresh cassava chips, to obtain drying periods of 3 to 2 days. This system was not feasible for cassava drying. The use of the 3 combustibles to heat air, in units composed of burners and heat interchangers, permitted operation with flows applied at 130 and 190 cubic meters/min/t fresh chips and temp. of 50 and 60 degrees Celsius, to obtain drying periods between 5.5 and 10.0 h. Of the combustibles used, drying with mineral coal resulted in the least costs, both in equipment investment and in operation, followed by propane gas and diesel fuel. An economic analysis was done for a production project of 538 t dry cassava/yr, within the conditions of production and commercialization of cassava that existed on the Atlantic Coast during 1985. In this study, natural drying on concrete floors was compared with drying in a fixed bed with coal, under 4 investment alternatives. The 1st operates during 20 wk. of the dry season/yr, with natural drying. The 2nd does it for 35 wk. with the same system. The 3rd for 20 wk. with natural drying and 30 wk. with artificial drying, and the 4th operates 50 wk. with artificial drying. The profits, calculated with a computer, for the 4 alternatives were: 26.4, 37.0, 12.6, and 12.4 percent, resp. The use of an artificial dryer and mineral coal as energy source resulted profitable for the production of dry cassava all year round. (AS-CIAT)

0160

28318 BRASIL. MINISTERIO DA AGRICULTURA. COMISSAO TECNICA DE NORMAS E PADROES. 1982. Normas de identidade, qualidade, embalagem, armazenamento e

transporte da farinha de mandioca. (Standards for identification, quality, packing, storing, and transportation of cassava flour). Brasilia-DF. 23p. Pt.

Cassava. Cassava flour. Storage. Industrialization. Brazil.

The standards passed by the Brazilian Ministry of Agriculture regarding the identification, quality, packing, storing, and transportation of CF are presented. All related terms are defined and the classifications of CF into groups, subgroups, classes, and types are given, indicating that any CF could be declassified if undesired characteristics appear. The procedures for CF sampling and physicochemical analyses are given. The types of packing materials to be used as well as labelling, storage, and transportation requirements are indicated. (CIAT)

0161

29041 CABRERA L., J. 1986. Proyecto: utilización de harina de yuca. Subproyecto: evaluación técnico-funcional de harinas de yuca en panificación. Informe final. (Project: cassava flour utilization. Subproject: technical-functional evaluation of cassava flours in breadmaking. Final report). Bogotá, Colombia, Instituto de Investigaciones Tecnológicas. 64p. Es., Sum. Es., 16 Ref., Il.

Cassava. Cultivars. Harvesting. Timing. Cassava flour. Cassava bread. Breads. Colombia.

The influence that the var. of cassava (CM976-15, MCOL 22, MVEN 25, and MCOL 1684), its harvesting age (8, 10, 12, and 14 mo.), and the level of addition of CF to wheat flour had on physical and organoleptic characteristics of bread made with this type of compound flours, was studied. The following formulations were used in the breadmaking trials: (1) wheat flour 85 percent, CF 12 percent, and soybean flour 3 percent; (2) wheat flour 80 percent, CF 18 percent, and soybean flour 2 percent; (3) wheat flour 85 percent and CF 15 percent. Trials with formulation 1, using the 4 var. collected at 12 mo., indicated that the bread with the highest specific vol. (4.36 cubic centimeters/g) was obtained with MCOL 22. With this same var., breadmaking trials were done using flour from cassava collected at the 4 different ages. The results obtained indicate how the specific vol. of bread and its score improve with delayed time of collection. By comparing the 3 indicated formulations with var. MCOL 22, it was found with mixture 3 a bread with the best vol. and score (4.60 cubic centimeters/g and 86.5, resp.) was obtained. In other trials with mixture 3, bread with the best specific vol. (4.12-4.72 cubic centimeters/g with MCOL 22 vs. 3.99-4.21 cubic centimeters/g with MVEN 25) was obtained at all ages of collection, except at 14 mo., when no significant differences were found between the 2 var. It was also found that the age of collection of cassava had a notable effect on the specific vol. of bread; 12 mo. is the age that allows the best vol. in the 2 var. to be achieved. In assessing breads, those made with CF of var. MCOL 22 showed superior values (66.2-89.0) to those with var. MVEN (59.7-73.5). The effect of bitter taste appears to be related to cyanide content of the flours used; bread made with CF of MCOL 22 had only a cyanide level of 3 ppm, while that of MVEN 25 had a cyanide level of 32 ppm (at 24 h after baking). Finally, the diastatic activity of MCOL 22 and MVEN 25 was studied, that of the latter being superior at all ages of collection. A certain relationship appears to exist between the diastatic activity of CF and specific vol. of bread using these flours. (AS (extract)-CIAT)

0162

30148 CARRIZALES, V.; BARRIOS, O.; GONZALEZ, J. 1986. Mejoramiento tecnológico de la producción de cachirí bebida fermentada de yuca (Marihó)

esculenta Crantz) de origen indígena. (Technological improvement of cachiri production, an indigenous fermented drink made from cassava). Acta Científica Venezolana 37(3):318-324. Fs., Sum. Es., En., 3^o Ref., 11. [Fundación CIEPE, Apdo. 100, San Felipe, Estado Yaracuy, Venezuela]

Cassava. Cachiri. Fermented products. Technological package. Cassava flour. Fermentation. Venezuela.

A procedure for the production of cachiri, a fermented drink made from cassava and consumed by several indigenous communities of Venezuela, Surinam, and Guyana, is presented. The proposed technology used fresh cassava or CF as raw material. The process involved 3 basic stages: (1) liquefaction, in which alpha-amylase was used, at 85 degrees Celsius and pH 6.0; (2) saccharification, in which amyloglucosidase was used, at 60 degrees Celsius and pH 4.5; and (3) fermentation at 30 degrees Celsius and pH 4.5, using a Saccharomyces yeast. The fermented must was clarified, bottled, and pasteurized. The resulting liquid was of amber color, low acidity (0.289 g/100 ml), and with an ethanol level between 8.86-13.80 percent (vol./vol.) and total sugars content of 2.12 percent. Ethyl acetate and propyl, butyl, and amyl alcohol concn., among others, were similar to those found frequently in traditional wines. (AS)

0163

29530 CARRIZALES, V. 1980. Enriquecimiento proteínico de yuca a través de cultivo semisólido de *Aspergillus niger*. Yaracuy, Venezuela, Fundación Centro de Investigaciones del Estado para la Producción Agroindustrial. 28p. Fs., Sum. Es., 3^o Ref., 11. Trabajo presentado en el Seminario Nacional sobre la Problemática de la Producción de Yuca en Venezuela, Maracay, Venezuela, 1980.

Cassava. Cassava flour. *Aspergillus*. Protein content. Protein enrichment. Venezuela.

Protein enrichment of CF, using semisolid culture of *Aspergillus niger* at different initial concn. of ammoniacal N, was studied. In effect, a technique consisting of the use of a packed bed microfermenter, with a working vol. of 16 cubic meters, was developed. The bed consisted of gelatinized and granulated CF containing mineral nutrients and spores of *A. niger*. The fermented flour had a max. protein content of 11.66 percent wt., which is very attractive when compared with other conventional agricultural products in terms of protein productivity/ha/yr. Furthermore, the technical advantages that this process presents in relation to conventional ones are presented. (AS-CIAT)

0164

29565 CASSAVA: MORE than a famine reserve crop. 1985. Radix 7(1):1-3. En., Sum. En., 5 Ref., 11.

Cassava. Uses. Human nutrition. Feeds and feeding. Breads. Cassava products. Substitutes. Marketing. Food security. Philippines.

The numerous uses of cassava for human consumption, animal feeds, industrial purposes, and in bread making and baked goods are briefly indicated. The multiple uses of cassava, especially in industry, as a substitute for wheat flour and as an ingredient in animal feeds, and its entry into the export market, have raised its status of a famine reserve to one of a highly valued versatile crop. (CIAT)

0165

29572 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1986. Procesamiento de yuca en Colombia: la producción y uso de harina de yuca para consumo

humano. Informe de avance período noviembre 1984-octubre 1985. (Cassava processing in Colombia: production and use of cassava flour for human consumption. Progress report, November 1984-October 1985). Cali, Colombia, Instituto de Investigaciones Tecnológicas, Universidad del Valle. 85p. Es., 7 Ref., 11.

Cassava. Processing. Cassava flour. Costs. Technology evaluation. Breads. Industrialization. Socioeconomic aspects. Industrial machinery. Substitutes. Small-scale processing. Colombia.

The progress made during the 1st yr of an interinstitutional collaborative project among CIAT, the Instituto de Investigaciones Tecnológicas, and the U. del Valle, on the processing, production, and use of CF, is described. The 3 main areas of research were: economic studies, design and development of the processing plant, and breadmaking trials. Furthermore, a program of activities for the 2nd yr, in the 3 areas, is given, as well as a statement of past and projected expenses. Economic and technical information was partially generated to determine the feasibility of a CF industry on the Atlantic Coast of Colombia. In the area of economic studies, basic information was collected on: macro-analysis of the wheat market, cassava production and commercialization (survey), wheat mills (survey), bakeries and consumers (survey), and on-farm cassava production trials. Equipment was adapted and developed for small-scale rural processing of cassava tubers for flour. Trials on washing, peeling, chipping, drying, milling, and packing and storage were carried out and the results are discussed. Results of breadmaking trials using composite flours are also presented. (CIAT)

0166

28138 CEREDA, M.P.; FLORES, A.; VALLES, S.; ALBEROLA, J. 1986. Tratamiento anaerobio en dos fases de suspensiones amiláceas. 1. Fase acidogénica. (Two-stage anaerobic treatment of starch suspensions. 1. Acidogenic phase). Revista de Agroquímica y Tecnología de Alimentos 26(1):101-108. Es., Sum. Es., Fr., 14 Ref., 11. [Facultad de Ciencias Agronómicas, Univ. Estadual Paulista, Campus de Botucatu, Caixa Postal 237, 18.600 Botucatu-SP, Brasil]

Cassava. Waste utilization. Carbon dioxide. Cassava flour. Industrial microbiology. Fermentation. Brazil.

The acidogenic phase of anaerobic fermentation of concentrated suspensions of potato starch total COD of approx. 10-15 g/liter) was studied to explore the conditions under which the biometanization treatment of suspensions of similar composition, obtained as industrial residues of cassava processing, could be realized. First results indicate that at a temp. of 35 degrees Celsius, the acidification phase could be carried out in a discontinuous reactor at a rate of 1 load/wk. Using the natural flora present in a sample of CF as inoculant, the mean velocities of acidification for fermentation cycles approx. 5 days long varied between a min. of 0.68 g COD/lr/day and a max. of 1.81 g COD/lr/day. The gas produced is a mixture of hydrogen and carbon dioxide (approx. 90/10), the velocity of their generation in the distinct expt. being quite variable; the max. value obtained was 0.17 liter/lr/day, in an expt. lasting 4.5 days. (AS-CIAT)

0167

28143 CEREDA, M.P.; FIORETTI, A.M.C. 1982. Potencial de utilização da água residual de fecundarias. (Potential use of residual water from cassava flour plants). In Congresso Brasileiro de Mandioca, 20., Victoria-ES, Brasil, 1981. Anais. Cruz das Almas-BA, Brasil. pp.174-183. Pt., Sum. Pt., 26 Ref.

Cassava. Waste utilization. Cassava flour. Cultivars. Analysis. Ecology. Processing. Brazil.

The residual water of a CF factory, located in Santa Maria da Serra (Sao Paulo, Brazil), that uses cassava var. Branco de Santa Catarina was filtered and then analyzed to evaluate its potential use. The following mean composition (ppm) was determined using an atomic absorption spectrophotometer: P, 219.0; K, 1675.0; Ca, 226.0; Mg, 336.0; Fe, 22.0; Zn, 2.4; Cu, 1.0; and Mn, 1.5. Total N, determined using the micro-Kjeldahl method, was 0.15 percent and total reducer, determined by the Somogyi-Nelson method, were 5.2 g/100 ml, expressed in the form of glucose. The pH was 5.0 and the titratable acidity, 3.27 ml NaOH/100 ml. The C/N ratio of the liquid was 9.16 percent and the aerobic mesophyll count was 2.91×10^8 cells/ml, representing an abundant microflora which can provide microorganisms to degrade pollutants. It was concluded that the residual liquid could be used as raw material for bioconversions or as a culture media for fermentations. (CIAT)

0168

29533 COHEN DE SANCHEZ, B. 1982. Secado de yuca en secador rotatorio. (Cassava drying in a rotary drier). San Felipe, Venezuela, Fundación Centro de Investigaciones del Estado para la Producción Agroindustrial. 151p. Es., Sum. Es., 14 Ref., 11.

Cassava. Industrial machinery. Experiment design. Developmental research. Technology transfer. Processing. Venezuela.

A cassava dehydration process was conducted in a rotary drier under different operating conditions. Cassava gratings and chips were used as raw material. To obtain the gratings, cassava was washed, cut and grated and compressed in a hydraulic press. Thus, a greater area of contact with the flow of air was achieved and therefore a better dehydration. For the chips, cassava was washed, cut, and introduced into a mill, leaving the cassava in cubes. The dehydration process was carried out in a continuous rotary drum drier. Operational variables were: rotation speed of the drum (6 and 12 rpm) and air temp. (80, 100, and 120 degrees Celsius). The moisture of the resulting product was determined with the help of a balance and a vacuum stove. The highest degree of dehydration obtained was 10.1 percent moisture, achieved with a drum rotation speed of 6 rpm and an air temp. of 120 degrees Celsius at the entry of the drier; cassava gratings were used as raw material. The efficiency of the drier was 45 percent when gratings were used and 35 percent with chips. Energy consumption of the heating coil is 21.7 kwh for gratings and 25.5 kwh for cassava chips. (AS-CIAT)

0169

29469 CORREA, H. 1967. Raspa de mandioca em nível de fazenda. (Cassava chips at the farm level). Informe Agropecuario 13(145):58-60. Pt., 2 Ref., 11. [Depto. Agricultura/ESAL, Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Cassava chips. Composition. Mechanization. Technology evaluation. Storage. Brazil.

The production of cassava chips at the farm level, using common forage choppers or cassava chippers already available in the Brazilian market, is discussed. The chemical composition of cassava chips produced using these different equipments is presented. Cassava chips with 12 percent MC can be stored in a dry environment for up to 1 yr; for an improved utilization of cassava chips, these could be transformed into flour for later use in animal rations. (CIAT)

0170

29497 DATA, E.S.; DIAMANTE, J.C.; FORIO, E.F. 1986. Soy sauce production utilizing root crop flour as substitute for wheat flour (100 percent

substitution). *Annals of Tropical Research* 8(1):42-50. En., Sum. En., 5 Ref., 11. [Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte, Philippines]

Cassava. Substitutes. Fermentation. Soybeans. Cassava flour. Philippines.

Soy sauce yield was not affected by the substitution of wheat flour with root crop flour (sweet potato, cassava) as carbohydrate source for the fermentation microorganisms. Titratable acidity, pH, and NaCl content were not significantly affected by flour substitution while the protein content and amino N of root crop-based soy sauce were lower than those of sauce produced from wheat flour. Sensory evaluation showed that when soy sauce was used in preparing beef steak or as dip for broiled fish, root crop-based soy sauce was comparable to 1 commercial brand based on general acceptability scores. CF produced the lowest soy sauce yield, especially when uncooked. Cassava soy sauce was rated inferior to a commercial soy sauce in terms of color, aroma, and consistency. (AS)

0171

29523 EGUNJOBI, O.A.; CLAITAN, J.O. 1986. Response of *Meloidogyne incognita*-infected cowpea to some agro-waste soil amendments. *Nematropica* 16(1):33-43. En., Sum. En., En., 78 Ref. [Nematology Laboratory, Phytopathology Unit, Dept. of Agricultural Biology, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Fresh products. Soil amendments. Pest control. Waste utilization. Nigeria.

The use of cocoa pod husks, cassava peelings, and rice husks as soil amendments for the control of *Meloidogyne incognita* on cowpea cv. Ibe Brown were compared with carbendazim pesticide and NFE fertilizer application in field and greenhouse trials. Amending soil with cocoa pod husks proved virtually as effective as carbendazim application, reducing populations of *M. incognita*, crop damage, and galling index in the field. Improvements in cowpea productivity in cocoa pod husks and cassava peelings-amended soil were associated with *M. incognita* population depression as well as other unknown factors that may include some fertilizing properties of cocoa pod husks. Rice husks significantly reduced *M. incognita* populations, but also were a carrier for *Fusarium solitum*, *Colletotrichum lindemuthianum*, and *Phoma* spp. (AS)

0172

29473 EL-DASH, A.A. 1987. Utilizacao de mandioca na alimentacao humana e em outros produtos industrializados. (Cassava uses in human nutrition and in other industrial products). *Informe Agropecuario* 13(149):74-82. Pt., 6 Ref., 11.

Cassava. Human nutrition. Processed products. Industrialization. Food products. Uses. Cassava starch. Brazil.

The different uses of cassava in human nutrition (breads, baked goods, pasta, and pre-cooked foods) and in industrial products (alcohol) are described. Special reference is made to the fact that CF price, relative to wheat flour, is determinant in defining its use. Applications of cassava starch in the food industry (thickener, water retainer, binder, texture improver) and in sugar production are reviewed. Other industrial applications include foundry, mineralization, medicine, paper and textile industries, biodegradable detergents and plastics, and starch polymers. Modified cassava starches and their uses are reviewed including acid-modified starch, starch modified by intercrossing, phosphate starch, and oxidized starch. (CIAT)

28877 JOSIS, P.; LECLERCQ, D.; NTIBASHIRWA, S.; RURADUMA, C. 1986. Enrichissement en protéines du manioc par fermentation solide. (Protein enrichment of cassava by solid fermentation). In Institut des Sciences Agronomiques du Burundi. Rapport Annuel 1986. (Septembre 1985-Aout 1986). Bujumbura, v.3, pp.221-241. Fr., 11.

Cassava. Industrial microbiology. Fermentation. Nutritive value. Protein enrichment. Drying. Cassava flour. Mineral content. Cassava programs. Developmental research. Burundi. Uganda. Belgium.

A brief description is given of techniques to analyze the nutritive value of foods, used in the food technology lab. of the Institut des Sciences Agronomiques du Burundi. A detailed description is also given of the proceedings of the collaborative project of the Administration Générale Belge pour la Coopération au Développement and Uganda Creameries Ltd. for protein enrichment of cassava through solid fermentation. They are: quantification of the growth parameters of *Rhizopus oryzae* during fermentation; study of the consistency, purity, and viability of the inoculant; cassava drying; study of fermentations; problems of selecting fresh, grated, and dried cassava and analysis of CF; and sanitary aspects of fermentation in a controlled medium. (CIAT)

27656 LUCEN, F.; PANFAM, H.C.; WILSON, L.A. 1981. Factors influencing vascular discoloration of cassava (*Manihot esculenta* tubers during storage). In University of the West Indies. Faculty of Agriculture. Annual Report 1978-81. St. Augustine Trinidad, West Indies. pp.91-92. En.

Cassava. Deterioration. Storage. Cultivars. Trinidad and Tobago.

Because of the discoloration which begins in the vascular tissue of cassava (normally at sites of mechanical damage) and spreads rapidly through the tuber, tubers stored under tropical ambient conditions normally spoil within 2-5 days. In this project possible methods of prolonging tuber storage life are being investigated. Two expt. have carried out to date. In the 1st, the effects of defoliation and treatment with growth regulating chemicals on the storage of tubers from 2 local cv., Maracas Black Stick (MBS) and T01/72, were studied. Two wk. prior to harvest the plants were defoliated or sprayed with varying concn. of benzyladenine, IAA, or 2,4-D. In both cv. defoliation significantly decreased subsequent spoilage of tubers, and in MBS all 3 growth regulators were effective at particular concn. None of the chemicals improved the storage of T01/72. In the 2nd expt. tubers of MBS were stored in coconut bast at 3 moisture levels for 3 mo. The results indicate that bast with a moisture level of 80 percent gave the least spoilage, while there was considerable loss of fresh wt. when the tubers were stored in bast with only 13 percent moisture. (Full text)

29586 MOTTA, L.C.; CENEDA, M.P.; TAKAHASHI, M. 1987. Utilizacao da casca de mandioca (*Manihot esculenta*, Crantz) en digestao anaeróbia. (Utilization of cassava peels in anaerobic digestion). *Energia na Agricultura* 2(1):25-31. Pt., Sum. Pt., En., 15 Ref., 11.

Cassava. Cortex. Fresh products. Composition. Analysis. Uses. Brazil.

Studies were carried out to determine the feasibility of utilizing cassava peels in anaerobic digestion and to produce methane gas as a source of energy. Although the efficiency of the process is low, a high conversion to methane gas occurs. The peels had 64.78 percent of biodegradable

volatile solids. The production of gas was 0.43 liter/g volatile solids, with 54 percent methane. CN(-) was reduced by 85 percent. (CIAT)

0176

29512 NAIGEON, C. 1982. Congo: le Bdpa et l'INRA lancent le Fofofodu. (Congo: the BDPA and the INRA launch the fofofodu). Afrique Agriculture 83:22-23. Fr., Sum. Fr., Il.

Cassava. Atieke. Foffoo. Gari. Cultivars. Development. Technology transfer. Zaire.

Different forms of cassava consumption in various western and central African countries are listed, pointing out the need for industrial transformation of the root due to its difficult conservation as a fresh product. Of the major producing countries that have investigated solutions to this problem, Zaire stands out as an exporter of cassava paste. On the other hand, in 1981 the Congo built the 1st factory for the industrial transformation of cassava into foffoo. The advantages and disadvantages of soaked cassava and foffoo are compared. In western Africa (the atieke and gari zone), the adoption of sweet cassava var. has been successful, although this was not possible in central Africa. Finally, once the low productivity of sweet var. compared with bitter var., and the sticky consistency of foffoo are overcome, plans include the planting of 400 ha of sweet cassava in Mantumba, where the factory is. It is left to be seen if the new product, called fofofodu, will conquer the market in Brazzaville. (CIAT)

0177

28596 ORIAS, R.R.; CALUB JUNIOR, F.C. 1986. Evaluation of primary processing techniques on local cassava flour production using the pedal-operated hammer mill. Annals of Tropical Research 8(2):61-71. En., Sum. En., 6 Ref., Il. [Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Leyte, Philippines]

Cassava. Small-scale processing. Cultivars. Rasping. Drying. Costs. Technology evaluation. Philippines.

The primary techniques of (1) chipping and washing, (2) chipping without washing, (3) grating and pressing, and (4) grating without pressing were evaluated for cassava cv. Golden Yellow flour production using a pedal-operated hammer mill. As far as size reduction efficiency was concerned before drying, chipping of cassava roots was more efficient than grating (90 vs. 46 kg/h). Significant differences were observed for the different techniques regarding drying time of the products to 11-14 percent MC: 3 less than 2 less than 4 less than 1 (8, 15, 17, and 18 h, resp.). Regarding the milling performance (crude flour milling rate and fine flour milling efficiency) of the pedal-operated hammer mill on the 4 products, no significant differences were found between 1 and 2 (8.20 vs. 8.95 kg/h and 53.72 vs. 54.00 percent, resp.) nor between 3 and 4 (13.70 vs. 14.05 kg/h and 20.60 vs. 21.20 percent, resp.), but the differences between the chipping and grating groups were significant. The flour processing time/t roots for each technique was 2 less than 1 less than 4 less than 3 (267.79, 301.62, 403.90, and 435.68 h/t, resp.). Processing costs were higher for 3 followed by 4, 1, and 2. (CIAT)

0178

29576 OSPINA, B.; BEST, R. 1986. Secado natural de yuca para la alimentación animal: una nueva agroindustria en Colombia. (Natural cassava drying for animal feeding: a new agroindustry in Colombia). Cali, Colombia, Centro Internacional de Agricultura Tropical. 18p. Es., Sum. Es., 10 Ref.,

11. Trabajo presentado en el 4. Congreso Brasileiro de Mandioca, Santa Catarina, Brasil.

Cassava. Drying. Feeds and feeding. Industrialization. Small-scale processing. Production. Costs. Technology transfer. Technology evaluation. Trade. Colombia.

A collaborative project of the Colombian Integrated Rural Development Fund (DRI) and CIAT, aimed at establishing small agroindustrial firms to produce dry cassava on the Atlantic Coast of Colombia, is described. It began with the installation of a pilot plant for natural drying of cassava, with the collaboration of a group of 15 farmers. This plant operated on an exptl. basis in 1981 to obtain information about the efficiency of the process under the conditions existing on the Colombian Atlantic Coast and to determine the product's acceptability by the industry for balanced animal feeds. In 1982, during the project's 2nd phase, the pilot plant was operated semi-commercially, to obtain data on production costs; likewise, it showed the economical and technical feasibility of the process. In 1983, the 3rd Phase began, consisting in the replication of the project in other cassava producing areas of the region. In 1984 and 1985, the project has grown considerably, with 20 drying plants functioning in 1984 and 36 in 1985. It can be concluded that to establish small-scale natural cassava drying plants, the following requisites are essential: (1) selection of a processing technology that can be assimilated, controlled, and managed easily by farmers; (2) implementation of integrated programs of processing, production, and commercialization that reduce the risks and increase net incomes of farmers; and (3) provision of institutional support that is adequate in terms of technical assistance, credit facilities, management and fiscal training, and of advice in the formation and consolidation of cooperative and associative groups for agricultural production. (AS-CIAT)

0179

29513 PATEL, A.R.; PATEL, M.R.; PATEL, N.R.; SUTHAR, J.N.; PATEL, K.G.; PATEL, R.D. 1986. Morphology of some legume and tuber starches grafted with polyacrylonitrile. *Starch/Starke* 38(5):160-167. En., Sum. En., De., 5 Ref., 11. [Dept. of Chemistry, Sardar Patel Univ., Vallabh Vidyanagar 388 120, India]

Cassava. Biochemistry. Cassava starch. Analysis. India.

Morphological aspects of 3 legume and 3 tuber starches (among them cassava) and their graft copolymers with polyacrylonitrile prepared from granular and gelatinized states are reported. Scanning electron microscopy revealed that grafting characteristics of legume and tuber starches are quite different. In potato starch the hydrolyzed S-g-polyacrylonitrile product showed that the grafting has occurred in the interior. In case of sweet potato starch a little grafting occurred on the surface of depression while normal grafting might have taken place in the interior through the depression. Little grafting seems to have occurred inside the cassava starch granules; grafting is relatively more frequent on the surface of the granule. The grafting on legume starches has mainly occurred on the surface of granules. (AS)

0180

29449 QIU, X.; LI, L.; LIU, D.; XIUJILIE; LIAO, H.; CHENG, F. 1986. (Studies on degumming problem of raw silk. 3. Application of the boiling-off process of degumming silk glue with proteolytic enzyme S114). *Acta Microbiologica Sinica* 26(1):71-75. Ch., Sum. Ch., En., 3 Ref., 11.

Cassava. Enzymes. Industrial microbiology. Feeds and feeding. Hydrolysis. China.

The principle and application of degumming for cassava cocoons or cassah cocoons with proteolytic enzyme *Bacillus subtilis* S114 are described. Among the various proteolytic enzymes tested, S114 is the most desirable. The enzymatic degumming process with S114 has improved the quality, increased productivity, saved energy, and reduced production costs, and is therefore both satisfactory and economical. The optimum pH of proteolytic enzyme S114 on hydrolysis silk glue of cassava cocoon was found to be about 7-8, and the optimum temp. was about 55 degrees Celsius; enzyme activity was stable at 45 degrees Celsius for 60 min. (AS)

0181

29076 RAJA, K.C.M.; MATHEW, A.G. 1986. Effect of parboiling on hydration and sedimentation on characteristics of cassava (*Manihot esculenta* Crantz) chips. *Journal of Food Science and Technology* 23(1):39-41. En., Sum. En., 5 Ref. [Regional Research Laboratory, Trivandrum-695019, India]

Cassava. Cultivars. Cassava chips. Boiling. Cassava flour. India.

Studies were carried out with cassava var. Malayan-4 (M-4) to determine the hydration characteristics of plain and parboiled chips and the sedimentation characteristics of the flour prepared from both types of chips. Parboiling of cassava chips was found to affect the hydration behavior of chips both at room temp. (28-30 degrees Celsius) and cooking temp. (96-98 degrees Celsius). At room temp., equilibrium MC by soaking was attained after 8 h. Among the 3 samples studied, equilibrium MC by soaking was the highest (61.91 percent wet basis) for the sample that was parboiled by dipping in boiling water for 10 min. At cooking temp., water uptake during the initial period of 5 min of soaking was low. After 20 min the water uptake value of parboiled sample attained was higher (1.23) than plain dried sample (0.994). The sediment vol. of the flour prepared from parboiled cassava chips was also higher than the corresponding one prepared from plain dried chips. The sediment vol. also showed a direct relationship with equilibrium MC by soaking at room temp. (AS)

0182

29374 RIVERO, F. 1981. Sustitución parcial de la harina de trigo por la harina de yuca. (Partial substitution of wheat flour for cassava flour). San Felipe, Venezuela, Fundación Centro de Investigaciones del Estado para la Producción Agroindustrial. 156p. Es., 26 Ref., Il.

Cassava. Cassava flour. Substitutes. Breads. Cultivars. Viscosity. Storage. Uses. Venezuela.

The substitution of CF for wheat flour at 10, 20, and 30 percent levels in French bread making was investigated. Mixtures of Venezuelan commercial and exptl. cassava var. with different physical-chemical properties were used. Results of lab. expt. indicated that high-quality bread can be produced using 10-20 percent CF without requiring additional equipment. Differences observed in cassava var., especially regarding starch viscosity, had no significant effects on bread quality. CF can be adequately stored under conditions similar to those for other flours if produced with 10-12 percent MC. Additives had no significant effects on final bread quality and thus their use is not justified. (CIAT)

0183

29454 RYU, B.H.; KIM, W.S.; NAM, K.D.; LEE, I.K.; HA, M.S. 1986. Impurities formed from ethanol fermentation process among different materials and it's effective separation in large scale. *Korean Journal of Applied Microbiology and Bioengineering* 14(5):371-376. Ko., Sum. En., Ko., 19 Ref., Il. [Dept. of Food Science & Technology, College of Science & Technology, Busan San Ub. Univ., Il San Trading Co., Busan, Korea]

Cassava. Fermentation. Alcohol. Fermented products. Korea.

The results are given of a trial to determine the concn. of impurities such as methanol and fusel oil formed during fermentation of different materials. High concn. of methanol were formed in dried sweet potato and cassava during fermentation. High concn. of n-propanol oil were also formed in rice, dried sweet potato, maize, naked barley, and cassava. High concn. of I-butanol were found in cassava, maize, rice, dried sweet potato, and naked barley and of isoamyl alcohol in cassava, rice, dried sweet potato, maize, and naked barley, in decreasing order. Using continuous distillation of super-allospas type, collection ratios of n-propanol, iso-butanol, n-butanol, and isoamyl alcohol were as follows: 37.9, 28.6, 37.4, and 56.1 percent when 78.25, 68.54, 50.0, and 50.0 percent (vol./vol.) alcohol, resp., were used. Fusel oil and bad alcohol were placed into the recovery column and then separated directly by side cut of fusel oil partially from the plate of the tower bottom. Extra impurities were separated by fusel oil separator with 20.0 percent (vol./vol.) alcohol adjusted with water. (AS)

0184

29518 SAKAI, T.; NAKAGAWA, Y.; URITANI, I.; DATA, E.S. 1986. Occurrence of various kinds of metabolites in physiologically and microbially damaged cassava (*Manihot esculenta* Crantz) roots. *Agricultural and Biological Chemistry* 50(11):2905-2907. En., 8 Ref. [Suntory Inst. for Bioorganic Research, Shimamoto-cho, Mishima-gun, Osaka 618, Japan]

Cassava. Deterioration. Storage. Roots. Plant physiological processes. Biochemistry. Philippines.

Chips of physiologically and microbially damaged roots of cassava var. Golden Yellow, Hawaiian-5, and Okinawa were analyzed for stress metabolite composition using gas chromatography and mass spectrometry. The stress metabolites were classified into 2 groups by mass chromatography: 4 steroids and more than 20 diterpenoids. The major component with a molecular formula $C_{20}H_{28}O_3$ is most likely to be the principal bitter constituent in cassava roots after physiological and microbial deterioration; the 2nd major component had the molecular formula $C_{20}H_{30}O_3$. (CIAT)

0185

28511 SILVA, J.R. DA; FLORES, A.S.; SANTOS, A.R. DOS; LIMA, J.A.D. DE; SILVA, J.F. DA; CERQUEIRA, J.H.A. DE; LORDELO, J.C.C.; DINIZ, P.J.C.; LIMA, S.A.A.; SOUZA, S.P. DE; DANTAS, T.B. 1986. Casa-de-farinha. (Small-scale flour mill). Brasilia, Empresa Brasileira de Assistencia Técnica e Extensao Rural. Serie Didáctica no.10. 63p. Pt., 3 Ref., Il.

Cassava. Cassava flour. Industrialization. Processing. Technological package. Fermented products. Cultivars. Agricultural equipment. Brazil.

Recognizing the importance of the CF microagroindustry for low income rural populations in NE Brazil, and within a concept of appropriate technology, a description is given of localization, structural design (with detailed diagrams), and processes for making 3 types of CF: dry flour, flour obtained from fermentation in water, and Para or mixed flour (combination of dry and fermented flour). In addition, 3 annexes are included on standards for identification/quality/packaging/storage/transport and production flowcharts for dry and fermented flour. Tannin percentages in different parts of the roots of var. Vassourinha, Sao Pedro, and Barra Bonita are given. Machinery and equipment manufacturers in the states of Bahia, Ceara, Paraiba, and Rio Grande do Norte are listed. (CIAT)

0186

29474 TAKAHASHI, M. 1987. Aproveitamento da manipueira e de resíduos do processamento. (Utilization of cassareep and cassava processing wastes). Informe Agropecuario 13(145):83-87. Pt., 14 Ref., Il. [Depto. Tecnologia dos Produtos Agropecuários, Faculdade de Ciências Agrômicas/UNESP, 18.600 Botucatu-SP, Brasil]

Cassava. Waste utilization. Cassareep. Soil amendment. Herbicides. Nemátodes. Biomass production. Industrialization. Technological package. Brazil.

The uses of cassareep or waste water and other cassava processing wastes (peels and cassava mass or coarse flour) are reviewed. Peels can be incorporated into the soil as a source of OM or used as animal feed. Cassava mass can also be used in animal feeding due to its high starch content. Waste water has been tested as a source of OM for soil applications, as a nematocide and herbicide, and as a source for biomass production. The treatments of waste water are described; these include the use of sedimentation and filtration tanks, forced-air tanks and stabilization lakes, and anaerobic treatments with biodigesters. (CIAT)

0187

29487 TAN, D.L.S.; GUNDAYA, E.A. 1986. PRCRTC motorized grater. Baybay, Leyte, Philippines, Philippine Root Crops Information Service. PRIS Leaflet Series no.2. 4p. En., Il.

Cassava. Small-scale equipment. Small-scale processing. Rasping. Philippines.

A motorized root grater, developed by the Philippine Root Crop Research and Training Center for household use or home-based industry, is described. Photographs and diagrams are included. Details of materials, costs, capacity, and dimensions for its construction are also given. (CIAT)

0188

29486 TAN, D.L.S.; GUNDAYA, E.A. 1986. PRCRTC pedal-operated root crop chipper/grater. Baybay, Leyte, Philippines, Philippine Root Crops Information Service. PRIS Leaflet Series no.1. 4p. En., Il.

Cassava. Cassava chips. Small-scale equipment. Small-scale processing. Rasping. Development. Philippines.

A pedal-operated root crop chipper/grater, designed and developed by the Philippine Root Crop Research and Training Center, is described. Photographs of the machine and the resulting chips and grated roots are included. Details on materials, costs, capacity, and dimensions for its construction are also given. (CIAT)

0189

29488 TAN, D.L.S.; GUNDAYA, E.A. 1986. PRCRTC root crop flour finisher. Baybay, Leyte, Philippines, Philippine Root Crops Information Service. PRIS Leaflet Series no.3. 4p. En., Il.

Cassava. Cassava flour. Small-scale equipment. Small-scale processing. Development. Philippines.

A root crop flour finisher, designed and developed by the Philippine Root Crop Research and Training Center for village level production, is described. Photographs and diagrams are included. Details on materials, costs, capacity, and dimensions for its construction are also given. (CIAT)

0190

29470 VILELA, E.R.; JUSTE JUNIOR, E.S.G. 1987. Tecnologia de farinha de mandioca. (Cassava flour technology). Informe Agropecuario 13(145):60-62. Pt., 2 Ref., Il. [Depto. Ciencias dos Alimentos/ESAL, Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Cassava flour. Processing. Composition. Postharvest technology. Brazil.

General CF production techniques and quality standards in Brazil are briefly described. The 2 main groups of CF, namely unbaked CF (farinha d'agua) and CF, differ in their production processes; in the 1st, the washed roots are macerated before peeling, a step not followed in the 2nd. Unbaked CF is subdivided into fine and coarse, and CF into fine conditioned, fine, and coarse. Flours are also defined by color; white, yellow, and others. The physical and chemical compositions of CF types 1, 2, and 3 are given, as well as indications regarding type 4 and CF not complying with the classification standards. (CIAT)

0191

29468 VILELA, E.R. 1987. Tecnologia de producao de raspas de mandioca. (Cassava chips production technology). Informe Agropecuario 13(145):53-57. Pt., 7 Ref., Il. [Depto. Ciencias dos Alimentos/ESAL, Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Cassava chips. Drying. Mechanization. Productivity. Technology evaluation. Brazil.

The technologies available to produce cassava chips are reviewed, including both natural and mechanical drying methods. Regarding natural methods, the efficiency of drying chips in inclined trays or on cement floors is briefly discussed. Two mechanical methods, the D'Andrea and Hubrich processes, are described; the former method requires pressing (1) after washing, peeling, and chipping and (2) before drying. Chip yields reported varied between 30-40 percent. Quality parameters are given for cassava chips. (CIAT)

0192

29472 VILELA, E.R.; FERREIRA, M.E. 1987. Tecnologia de producao e utilizacao do amido de mandioca. (Cassava starch production technology and utilization). Informe Agropecuario 13(145):69-74. Pt., 10 Ref., Il. [Depto. de Ciencias dos Alimentos/ESAL, Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Cassava starch. Industrialization. Technology transfer. Factories. Development. Brazil.

Cassava starch production technologies in Brazil are described, and starch utilization is briefly reviewed. The types of equipment required for the general extraction process, depending on the industrial scale used, are indicated. Cassava starch uses are briefly indicated for the food, textile, and paper industries, among others. (CIAT)

0193

28535 WALTERS, P.R. 1987. Industrial uses of cassava. Courier no.101:74-77. En., Sum. En., Il. [Marketing & Economic Dept. of the Tropical Development & Research Inst., London, England]

Cassava. Industrialization. Statistical data. Trade. Cassava starch. Feeds and feeding. Fructose. America. Africa. Asia. Oceania. Europe.

The main industrial uses of cassava in the world are described, with indications on the world trade of these products. The balance of cassava

production is processed and used industrially for the manufacture of compound animal feed, especially in the EEC (mainly imported from Thailand), and of cassava starch (the main producers being Indonesia and Thailand followed by Brazil) for use in the food, textile, and paper industries. Cassava starch is also used in the manufacture of plywood, veneer, adhesives, glucose, and dextrine. Other uses briefly discussed are the production of ethanol, SCP, and high fructose sweeteners. (CIAT) See also 0010 0017 0019 0030 0034 0041 0043 0048 0049 0050 0051 0052 0054 0057 0100 0102 0103 0104 0105 0109 0110 0112 0113 0115 0116 0119 0120 0124 0125 0126 0128 0130 0134 0135 0136 0137 0138 0139 0140 0141 0142 0143 0146 0147 0148 0149 0151 0152 0153 0155 0194 0197 0210 0211 0212 0213 0215 0220

103 Industrial Microbiology

See 0049 0062 0150 0154 0162 0163 0166 0173 0180

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0194

29509 ACOSTA T., J. 1986. El cultivo de la yuca en México. (Cassava cultivation in Mexico). Divulgación Científica (México) 1(1):141-148. Es., Sum. Fr., 12 Ref.

Cassava. Cassava programs. Socioeconomic aspects. Production. Uses. Productivity. Statistical data. Mexico.

The importance of cassava cultivation in Mexico is analyzed on the basis of the use of cassava roots in human nutrition, as forage in animal feeding, and for different industrial uses. Cassava is considered an alternative to face the energy shortage in the country. (AS-CIAT)

0195

26642 ARANGO B., L.M. 1978. Mercedes de la yuca. (Cassava marketing). Bogotá, Colombia, Fundación Universidad de Bogotá Jorge Tadeo Lozano. 260p. Es., 39 Ref., 11.

Cassava. Cultivars. Economics. Marketing. Production. Socioeconomic aspects. Development. Statistical data. Colombia.

A survey was conducted in 1978 to analyze (1) cassava production in the region of Quindío, Colombia, which presents the highest av. cassava yield of the country (25 t/ha); (2) its marketing in Bogotá; and (3) the possible agroindustrialization alternatives. The cassava production system in Quindío is described in detail as well as the available infrastructure, wholesaler and retailer distribution systems in Bogotá, and consumer-related aspects. Cassava losses in the region were 9.6 percent (140,000 t) in 1974 due to inadequate infrastructure, a factor that rises cassava prices. The producer assumes most of the risks and receives less benefits; the consumer is in a similar situation since intermediaries, especially wholesalers, obtain most of the benefits. Due to its high quality, cassava from Quindío is well accepted by consumers in Bogotá, but because of the high prices imposed by intermediaries, its consumption has not grown to the expected level. It is recommended to: (1) plan cassava production at both the regional and national level; (2) industrialize cassava production; (3) improve the available infrastructure, train workers involved in the collection, packing, and transportation of cassava, continue harvesting cassava manually, and establish transportation rates;

(4) organize and regulate the wholesaler and retailer distribution infrastructure through government policies; and (5) create the need among consumers of a semiprocessed or processed cassava product. The taxonomy, cropping system, and diseases of cassava var. Chirosa are described. (CIAT)

0196

26875 ASHAKUL, T. 1983. Estimates of an acreage response model of five major annual crops in Thailand. Ph.D. Thesis, Boulder, University of Colorado. 167p. En., Sum. En., 82 Ref., 11.

Cassava. Production. Climatic requirements. Prices. Statistical data. Productivity. Cultivation systems. USA, Thailand.

The Dymmes 2-dimensional iteration estimation of a Nerlovian dynamic total supply response model was used to estimate supply response of each of the 5 major Thai annual crops: rice, cassava, maize, kenaf, and mung beans. Total planted area was used instead of total production as a dependent variable and the total acreage responses to a no. of factors were examined: deviation from mean seasonal rainfall, time trend variable, and changes in economic conditions or changes in crop prices. Relative harvest prices were used instead of absolute prices. In calculation of relative prices, current prices are deflated by prices of various alternative crops. Because the period under study is relatively short, the model is 1st estimated at the province level of aggregation in order to make a comparison of parameters across provinces. The pooled provinces data are then estimated in order to maximize degrees of freedom and to test hypotheses concerning structural differences across provinces. The data period used was from 1967 to 1981. It was found that the planted areas of all crops under study respond normally to price changes; however, this responsiveness, in general, is much lower than found in earlier studies. Acreage response to increase in price may be relatively low because of the gradual decrease in availability of good new agricultural land in Thailand. (AS)

0197

28582 BERLIN, B.; BERLIN, E.A. 1977. Ethnobiology, subsistence, and nutrition in a tropical forest society: the Aguaruna Jivaro. Berkeley, University of California, Language Behavior Research Laboratory. Studies in Aguaruna Jivaro Ethnobiology. Report no.1. 55p. En., 33 Ref., 11.

Cassava. Socioeconomic aspects. Cultivars. Ecology. Cultivation systems. Uses. Human nutrition. Toxicity. Diets. Processing. Peru.

The results of a survey conducted among the Aguaruna Jivaro native community, living in a dense tropical rainforest in north central Peru, are presented. Particular reference is made to their biological classification system, aboriginal strategies of horticulture, gathering, hunting, and fishing, and nutritional status of population. The Aguaruna, particularly women, are sweet cassava cultivators. Data indicate that 100 named cv. are known among them. Cassava cultivation systems and uses are described. Cassava constitutes a key component of the Aguaruna diet and is the source of most of the total caloric intake (80 percent). No toxic effects of cassava were observed due to the overall diet composition and cassava processing practices. (CIAT)

0198

28536 BOCCAS, E. 1987. Cassava, staple food crop of prime importance in the tropics. Courier no.101:72-72. En., Sum. En., 11.

Cassava. Food security. Human nutrition. Trade. Adaptation. HCN content. Uses. Research. Development.

The importance of cassava as a staple food crop in the tropics is briefly reviewed. Topics briefly dealt with are main producing countries and world trade, cassava plant characteristics, consumption, HCN content, uses, and worldwide research efforts. (CIAT)

0199

27682 CASSAVA ROOT production. 1984. World Food Trade and U.S. Agriculture, 1960-1983. August 1984:18. En.

Cassava. Trade. Production. Marketing. Food security. America. Africa. Asia. Oceania. Europe.

Cassava world trade is briefly analyzed for 1983. Cassava production figures are given for the major producing countries from 1979 through 1983. Brazil, Thailand, Indonesia, Zaire, and Nigeria appear as the largest cassava producers. (CIAT)

0200

27689 CASSAVA ROOT production. 1982. World Food Trade and U.S. Agriculture 1960-1982:16-17. En.

Cassava. Trade. Statistical data. Socioeconomic aspects. Economics. Production. America. Africa. Asia. Oceania. Europe.

Cassava world trade is briefly analyzed and production figures are given for the period 1972-82 and forecasts for 1983. Record cassava production in 1982 has caused slightly increased competition in world grain markets. Cassava production is expected to decrease slightly (3 percent) in 1983 compared with 1982 figures. (CIAT)

0201

28588 EMPRESA DE PESQUISA AGROPECUARIA DE SANTA CATARINA. 1984. Programa mandioca. (Cassava program). In _____, Relatório Técnico Anual 1982. Florianópolis-SC, Brasil. pp.89-93. Pt.

Cassava. Research. Cassava programs. Cultivars. Intercropping. Spacing. Cuttings. Resistance. Cassava bacterial blight. Erinnyis ello. Telenomus sp. Trichogramma. Anastrepha. Technology transfer. Technological package. Brazil.

The 1982 annual report of the cassava program of the Empresa Brasileira de Pesquisa Agropecuária de Santa Catarina, Brazil, is presented. The following projects are detailed: introduction and evaluation of cassava cv.; cassava/beans intercropping; storage and conservation of cassava stem cuttings using chemicals; var. resistance to CBB; biology and control of Erinnyis ello; population dynamics of cassava pests; research/extension/producer integration; green manure and chemical fertilization. Major results indicated that the highest LET (1.33) was obtained at 2.0 x 0.5 x 0.5 and 2.0 x 0.6 x 0.6 m spacings with double cassava rows in beans/cassava intercrops. The egg parasites Telenomus sp. and Trichogramma sp., the larval parasites Chryptophion sp. and Euphorocera sp., and the larval predators Polistes sp. and Calosoma sp., were identified as natural enemies of E. ello. Peak population levels of Anastrepha spp. were found to occur between Dec.-March in the Litoral Norte and Baixo Vale do Itajaí regions. Recommended technological packages proved superior to the traditional practices. (CIAT)

0202

28567 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1985. Cassava. FAO Production Yearbook 39:130-131. En., Fr., Es.

Cassava. Statistical data. Production. Productivity. Economics. Africa. America. Asia. Oceania. Europe.

Data on area harvested, yield, and production of cassava in the world, by regions (Africa, North and Central America, South America, Asia, and Oceania), and by countries are presented in table form for the years 1979-81, 1983, 1984, and 1985. (CIAT)

0203

28566 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1984. Cassava. FAO Production Yearbook 38:130-131. En., Fr., Es.

Cassava. Statistical data. Production. Productivity. Economics. Africa. Asia. America. Oceania. Europe.

Data on area harvested, yield, and production of cassava in the world, by regions (Africa, North and Central America, South America, Asia, and Oceania), and by countries are presented in table form for the years 1974-76, 1982, 1983, and 1984. (CIAT)

0204

28564 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1982. Cassava. FAO Production Yearbook 36:128-129. En., Fr., Es.

Cassava. Statistical data. Production. Productivity. Economics. Africa. Asia. America. Oceania. Europe.

Data on area harvested, yield, and production of cassava in the world, by regions (Africa, North and Central America, South America, Asia, and Oceania), and by countries are presented in table form for the years 1974-76, 1981, 1982, and 1983. (CIAT)

0205

28563 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1981. Cassava. FAO Production Yearbook 35:116-117. En., Fr., Es.

Cassava. Statistical data. Production. Productivity. Economics. Africa. Asia. America. Oceania. Europe.

Data on area harvested, yield, and production of cassava in the world, by regions (Africa, North and Central America, South America, Asia, and Oceania), and by countries are presented in table form for the years 1969-71, 1979, 1980, and 1981. (CIAT)

0206

28562 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1980. Cassava. FAO Production Yearbook 34:117-118. En., Fr., Es.

Cassava. Statistical data. Production. Productivity. Economics. Africa. Asia. America. Oceania. Europe.

Data on area harvested, yield, and production for cassava in the world, by regions (Africa, North and Central America, South America, Asia, and Oceania), and by countries are presented in table form for the years 1969-71, 1978, 1979, and 1980. (CIAT)

0207

29331 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1986. District and regional cassava production in Tanzania; 1984-85 and 1985-86. Tanzania, 5p. En., Dat.num.

Cassava. Cassava programs. Statistical data. Tanzania.

Statistics on area planted to cassava and cassava production in 19 regions of Tanzania, with a total of 75 districts, are given in table form for the years 1984-85 and 1985-86. (CIAT)

0208

28191 FRANCO, A.; CORREA, C.; RIVAS, I. 1985. Data appendices: cassava. In Centro Internacional de Agricultura Tropical. Trends in CIAT Commodities. Cali, Colombia, Internal Document Economics 1.10. 10p. En., Dat.num.

Cassava. Statistical data. Production. Productivity. Socioeconomic aspects. Development. Latin America. Caribbean. Asia.

Data are presented for Latin America and the Caribbean on: production, relative importance of cassava in the region, and per capita production levels; annual production growth rates from 1960 to 1983; growth rates in area by country (1960-83); and trends in yield levels by country. Data on some of these aspects for 14 Asian countries are also presented. (CIAT)

0209

28176 FRANCO, A.; CORREA, C. 1984. Data appendices: cassava. In Centro Internacional de Agricultura Tropical. Trends in CIAT Commodities. Cali, Colombia, Internal Document Economics 1.9. 9p. En., Dat.num.

Cassava. Statistical data. Production. Productivity. Socioeconomic aspects. Development. Latin America. Caribbean. Asia.

Data are presented for Latin America and the Caribbean on: production and relative importance of cassava in the region, annual production growth rates from 1960 to 1982, growth rates in area by country (1960-82), and trends in yield levels by country. Data on some of these aspects for 14 Asian countries are also presented. (CIAT)

0210

29531 GONZALEZ, B. 1979. Consideraciones agro-económicas sobre el uso de harina de yuca en la elaboración de pan francés. (*Agroeconomic considerations on the use of cassava flour for French bread making*). San Felipe, Venezuela, Fundación Centro de Investigaciones del Estado para la Producción Agroindustrial. 52p. 5s., 10 Ref.

Cassava. Cassava flour. Breads. Production. Costs. Prices. Consumption. Substitutes. Marketing. Productivity. Venezuela.

The agroeconomic limitations for the extensive use of CF for French bread making in Venezuela are discussed. Aspects studied included cassava production, production costs, prices, destination, and consumption. The current situation and trends of the CF plants are analyzed, as well as technical, sanitary, and legal aspects of substituting CF for wheat flour. The causes of the insufficient amounts of industrial cassava for the proper operation of CF plants are discussed. (CIAT)

0211

26734 ISAIZA, J. 1986. Potential use of cassava in Jamaica. Kingston, Jamaica, Instituto Interamericano de Cooperación para la Agricultura. 10p. En., 5 Ref.

Cassava. Development. Uses. Industrialization. Productivity. Prices. Technology transfer. Jamaica.

The strategy proposed to increase cassava production and yields in Jamaica, in order to substitute maize imports for animal feed production, is discussed. From a technical point of view, feed manufacturers have no objections to using cassava but its utilization will depend upon its price. Low av. yields (2.22 and 1.82 t bitter and sweet cassava/ha, resp.), price instability, official budgetary constraints, restricted resources for research, and the lack of cassava drying plants in Jamaica are the main problems that have to be addressed. The strategy proposed by the Interamerican Institute for Cooperation on Agriculture is divided into 4 main steps: (1) development of farmer efficiency for higher yields; (2) development of the necessary know-how for chipping and drying cassava; (3) development of dry cassava marketing mechanisms; and (4) achievement of a competitive price for cassava. (CIAT)

0212

28589 JANSSEN, W.G. 1986. Market impact on cassava's development potential in the Atlantic Coast region of Colombia. Doctoral Thesis. The Netherlands, Agricultural University of Wageningen. 369p. En., Sum. En., Nl., 172 Ref., 11.

Cassava. Marketing. Production. Consumption. Small-scale processing. Prices. Costs. Labor. Statistical data. Socioeconomic aspects. Development. Food security. Industrialization. Colombia.

The impact of markets on agricultural development was analyzed by means of a case study on cassava in the Atlantic Coast region of Colombia. In this region cassava is a small farm crop which faces severe market(ing) problems in the development process. Fresh cassava consumption, the traditional utilization, decreases because it has a high marketing margin, because it has to be bought on the day of consumption and because other products become more widely available. Two market improvement strategies for cassava are evaluated: (1) improvement of the traditional fresh cassava market by means of improved storage; (2) opening the market for dried cassava as an animal feed in order to replace sorghum. To study the impact of these strategies the role of cassava in the Atlantic Coast region is analyzed within a systems framework. The interactions that are found between production, marketing, and consumption are strong. Cassava production will be stimulated by the price stabilization that the establishment of a cassava drying industry will cause. The improvement of cassava's storage characteristics will decrease marketing costs, increase consumer convenience and, therefore, stimulate cassava consumption. Because of the interactions encountered, the impact of cassava market improvements cannot be measured in the market alone. An analysis of the cassava system that integrates production, marketing and consumption is needed. The integrated analysis is made by means of a multi-market, multi-farm type simulation model, which forecasts the impact of market improvement strategies given different assumptions on the development of the Atlantic Coast economy and on the cassava systems behavior. Cassava drying for animal feed is a strategy, that explicitly benefits cassava producers. Additionally Colombia could save on sorghum imports. Improvement of the fresh market would most benefit urban consumers. Considering the rural-urban migration problems of Latin America, cassava drying appears the most attractive strategy. Both market improvement strategies have very favorable rates of return. Market improvement projects might serve additionally as a diving board for further rural development efforts. Increased attention to the role of markets could contribute to fulfilling the goals of agricultural development and to balancing overall economic growth. (AF (extract))

0213

29495 MYERS, N. 1986. Economics and ecology in the international arena: the phenomenon of linked linkages. *AMBIO* 15(5):296-300. En., 36 Ref., Il.

Cassava. Economics. Ecology. Trade. Development costs. Cassava programs. Erosion. America. Africa. Asia. Oceania. Europe.

Illustrative examples of how economic phenomena exert ecological effects in remote sites (linked linkages) are presented. The case of cassava is briefly covered to explain how Thailand's significant share in cassava exports to the EEC is affecting the ecology of the country in places where a rapid decline in the forest cover is occurring due to expanding cassava cultivation, and where environmental repercussions, such as soil erosion and nutrient impoverishment and disruption of water systems, are most severe. (CIAT)

0214

28130 NDAMAGE, G.; MULINDANJABO, J.; ALVAREZ, M.N., eds 1985. Programme manioc - patate douce. (Cassava-sweet potato program). Rwanda, Institut des Sciences Agronomiques du Rwanda. Rapport Bisannuel 1984-1985. 35p. Fr., Il.

Cassava. Germplasm. Selection. Land preparation. Planting. Cuttings. Root productivity. Propagation. Development costs. Cassava programs. Developmental research. Adaptation. Technology transfer. Rwanda.

The antecedents, objectives, and most outstanding results of the cassava-sweet potato research program, initiated by the Institut des Sciences Agronomiques du Rwanda, in collaboration with the International Institute of Tropical Agriculture (Nigeria), and the International Development Research Center (Canada), are presented. In cassava, work was done on selection (germplasm introduction and evaluation, crossing blocks, collection maintenance, and selection: multilecational, var., and adaptability trials); cultural practices trials (effects of soil preparation and planting position of cuttings on development and yield), and multiplication and propagation of the best cassava var. Other activities included training courses and seminars, and visits by international researchers. The main limitations for the program during 1984-85 were the lack of personnel and sufficient vehicles for their movements to other exptl. stations. The perspectives for the program are given, and a list of personnel and of publications during this period is included. Finally, a table with the program's budget is presented. (CIAT)

0215

28591 POUZET, D.; GONDON, P. 1986. La recherche sur le manioc et l'autosuffisance alimentaire en Cote d'Ivoire. (Research on cassava and self-sufficiency in food in the Ivory Coast). *Agronomie Tropicale* 11(1):60-68. Fr., Sum. Fr., En., Es., 15 Ref., Il. [Agricongo, B.P. 785, Brazzaville, Republique Populaire du Congo]

Cassava. Trade. Development. Industrialization. Marketing. Production. Diseases and pathogens. Research. Food security. Ivory Coast.

The foreign trade of Ivory Coast is characterized, in particular regarding cereal imports (wheat and maize). Government plans are to develop root crops such as cassava, while maintaining cash crops for exports. The availability of cassava by-products to consumers is studied through a production-processing operation, based on mechanized cassava farming. The principal constraints found to cassava development are detailed. In the short term, processing and marketing are not sufficient to absorb production. Production is threatened by new biological problems (bacterial

diseases, mites, scale insects). In the medium term, a necessary intensified production will result in environmental deterioration (fertility, erosion, weeds). The development of this crop requires, therefore, further research. (IAS)

0216

29477 PRECOS AGROPECUARIOS em Minas Gerais. (Agricultural prices in Minas Gerais). 1987. Informe Agropecuario 13(145):97-93, 101-102, 105-107. Pt., Dat. num., Il.

Cassava. Prices. Statistical data. Marketing. Cassava programs. Brazil.

Mean prices and fluctuations of agricultural products, including cassava, in the state of Minas Gerais, Brazil, are given in table form, for the months of Oct. and Nov., 1986. As a whole, industrial cassava prices paid to producers in Nov. increased 49.41 percent. In Belo Horizonte, Uberaba, and Montes Claros, the av. sales price of cassava varied 9.05, -0.58, and 13.87 percent, resp., over this period. (CIAT)

0217

29460 REIS, A.J. 1987. Aspectos economicos da mandioca. (Economic aspects of cassava). Informe Agropecuario 13(145):2-8. Pt., 13 Ref., Il. [Depto. Economia Rural/ESAL. Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Economics. Productivity. Prices. Trade. Development. Brazil.

Macroeconomic aspects of cassava in the state of Minas Gerais, Brazil, are reviewed. A decreasing trend in cassava production was evidenced during the period 1980-84; likewise, cassava yields decreased in selected years between 1950-1984. A Cobb-Douglas type cassava supply function for the period 1948-84 indicated that only area planted and delayed production were significant as variables affecting cassava production in Minas Gerais. Cassava price fluctuations during the period 1976-85 are analyzed. Prices are higher during May-Nov. Profitability and commercialization aspects are reviewed as well as official credit policies for cassava production. (CIAT)

0218

28598 RUSSEL, B. 1984. Biotechnology in action: the case of cassava. Ceres no.102:20-22. En., Il.

Cassava. Technology transfer. Tissue culture. Germplasm. Cassava programs. Research. Africa.

A brief account is presented on how cassava international and national research and technology transfer efforts in Africa have evolved since 1971. Strategies used by the International Institute of Tropical Agriculture (IITA) to alleviate Africa's food crisis (transfer of improved cassava germplasm through tissue culture and strengthening of national cassava improvement programs) are stressed. (CIAT)

0219

29476 SALDANHA, J.A.L. 1987. No campo, a mandioca amarga. (Bitter cassava for planting). Informe Agropecuario 13(145):92-96. Pt., Il.

Cassava. Production. Bitter cassava. Cassava programs. Economics. Development. Brazil.

The Brazilian agricultural policies, particularly those that affect cassava production, and the progress achieved by the Sociedade Brasileira de Mandioca, are discussed from the viewpoint of its president, J.A.L. Saldanha. Subsidies to wheat imports and to cassava consumers, but not to

producers, are criticized. Solutions proposed by the Sociedade to improve cassava production conditions in the country are presented. (CIAT)

0220

28312 TITAPIWATANAKUN, B. 1981. Feasibility study on regional co-operative arrangements in tapioca. New York, United Nations Economic and Social Commission for Asia and the Pacific, Trade Co-operation Group, Project RAS/79/010. 107p. En., Sum. En., 21 Ref., 11.

Cassava. Statistical data. Trade, Marketing, Distribution, Prices, Development, Production, Oceania, Thailand.

World and regional cassava production, consumption, and trade are described, and an attempt is made at a future perspective. Likewise, the major problems related to the production, processing, marketing, and transportation of cassava in the producing/exporting countries of the ESCAP (Economic and Social Commission of the United Nations for Asia and the Pacific) region are identified. Policies adopted by these countries to solve these problems are analyzed. Finally, recommendations are made about regional cooperative measures. Among these are: price stabilization; formulation of a quality control scheme; establishment of an information center for production, trade, prices, and market conditions; research conducted in each country on the different aspects of cultivation and on new cassava-based food products; search for new markets for the cassava industry and identification of new var. and agronomic practices to improve productivity. Tables are included on area under cultivation and yields in the different countries, existing cassava factories in Thailand, starch imports, different uses of starch in Japan, prices, and a detailed map of the area planted to cassava in 1978-79. (CIAT) See also 0001 0006 0015 0018 0025 0026 0033 0038 0040 0042 0088 0093 0101 0106 0108 0114 0130 0132 0140 0145 0157 0158 0159 0164 0165 0167 0168 0169 0172 0173 0176 0177 0178 0187 0188 0189 0191 0192 0193 0221 0225 0228

K00 OTHER ASSOCIATED COMMODITIES

0221

27429 FLOREZ O., G.; MUÑOZ A., R.; ARIAS F., J. 1984. Evaluación del sistema de yuca (*Manihot esculenta* Crantz) intercalada con maíz (*Zea mays* L.) y frijol (*Phaseolus vulgaris* L.) en clima medio. (Evaluation of cassava intercropped with maize and beans in intermediate climate areas). Revista ICA 19(3):301-306. Es., Sum. Es., En., 11 Ref., 11. [Inst. Colombiano Agropecuario, Apartado Aéreo 51764, Medellín, Colombia]

Cassava. Intercropping. Cultivation systems. Productivity. Maize. Beans. Economics. Soil requirements. Colombia.

The economics of the production of different multiple cropping systems that use cassava as a constant crop was evaluated; the most efficient combinations were grouped according to the productivity viewpoint. For one cycle, the production and productivity of the multiple cropping system of cassava intercropped with maize, bush beans, and beans associated with maize was evaluated at the Tulio Ospina Exptl. Station (Antioquia, Colombia). The soil was alluvial, sandy loam, and of av. fertility. It was observed that the production of 30.6 t/ha of monocropped cassava did not decrease when intercropped per ha with 21,000 maize plants, 70,000 bush bean plants, and 14,000 climbing bean plants. Of the 6 multiple cropping systems studied, 4 increased production by an av. of 17.1 percent and 2 reduced it by 4 percent compared with monocropped cassava. Economic

indices of net income, av. profit on capital, and LER indicate that the different multiple cropping systems based on cassava are more efficient than the monocultures of the 3 species studied. The intercropping systems of cassava with maize, cassava with bush beans, cassava with maize and bush beans, and cassava with maize associated with climbing beans were the most efficient agronomically and economically for the av. climate representative of soils between 1200-1800 m.a.s.l. (AS (extract)-CIAT)

0222

29434 KIM, H.; BURESOVA, M. 1986. Growing winged bean on natural supports under the conditions of south Vietnam. *Agricultura Tropica et Subtropica* 19:225-236. En., Sum. En., 14 Ref.

Cassava. Intercropping. Cultivars. Cultivation systems. Winged beans. Spacing. Timing. Vietnam.

Preliminary trials were carried out with maize, cassava, sorghum, papaya, and banana in Hung Loc, South Vietnam, to assess their efficiency as natural support for winged bean. Cassava and maize performed best. In 1982, among 30 cassava cv. assessed, cv. Mi Gon scored highest. In 1983 Mi Gon was again planted at 120 x 100 cm and winged bean Long Khanh was sown at the same spacing, either simultaneously or 10, 15, 20, 25, or 30 days later. Optimum planting time for both crops was found to be simultaneous planting and optimum spacings recommended for cassava are 120 x 100 cm or 120 x 80 cm. (CIAT)

0223

29014 MATTOS, P.L. DE ; SCUZA, A. FA S.; CALDAS, R.C. 1984. Consorciacao de mandioca em fileiras duplas com soja. (Intercropping cassava in double rows with soybean). *Revista Brasileira de Mandioca* 3(1):21-25. Pt., Sum. Pt., En., 7 Ref., Il. [Empresa Brasileira de Pesquisa Agropecuaria. Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cultivars. Intercropping. Soybeans. Spacing. Productivity. Brazil.

Cassava cv. BCM 116 was planted in double rows in association with soybean cv. Tropical in 1982-83 at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (Cruz das Almas, Brazil). A randomized block design was used with spacings of 2.0, 2.5, and 3.0 m between double rows, and 0.5, 0.6, and 0.7 m between plants in each row and between the rows of the double-row planting system. Checks were cassava planted in single rows (1.0 x 0.6 m), with and without soybean as intercrop, cassava planted in double rows (2.0 x 0.6 x 0.6 m), and soybean. Data indicated that using soybean as an intercrop resulted in high efficiency for food production since there was no difference between the best treatment of cassava with or without the intercrop. The LER showed an advantage of up to 61 percent compared with the control. The best spacing for double rows was 2.0 x 0.7 x 0.7 m. (AS)

0224

28101 VEGA, L.E.; LEGUIZAMO, A.; VAN DIJK, K.; PATIÑO, H. 1985. Apeiba aspera y Cordia alliodora en el asocio inicial con Manihot esculenta y Musa sp. en Bajo Calima, Colombia. (Apeiba aspera and Cordia alliodora in the initial association with Manihot esculenta and Musa sp. in Lower Calima, Colombia). Bogotá, Colombia, Convenio Corporación Nacional de Investigación y Fomento Forestal-Holanda. Conif Informa no.3. 12p. Es., Sum. Es., En., 23 Ref., Il.

Cassava. Intercropping. Productivity. Forestry. Colombia.

To evaluate the production of cassava and banana, initially associated with the tree species *Apeiba aspera* and *Cordia alliodora* a trial was established in Nov. 1980 in alluvial soils of the Calima river near Buenaventura (Valle del Cauca, Colombia). This area is classified as tropical rain forest. Four tree-crop combinations were tested, trees were planted at 3.0 x 3.0 m, cassava at 1.5 x 3.0 m, and banana at 3.0 x 3.0 m. Each combination was replicated twice. The yield of cassava associated with *A. aspera* was 9.5 t/ha while with *C. alliodora* yields were of 7.9 t/ha. The banana crop was lost due to the strong attacks of *Erwinia carotovora*. After 5 yr, *A. aspera* showed better growth than *C. alliodora*. This last species had a weak, yellowish foliage, and less growth compared with trees on other sites in the same region. A total height of 9.7 m and a diameter of 15.3 cm was recorded for *A. aspera* when associated with cassava vs. 8.3 m and 10.2 cm, resp., when associated with banana. The cassava-*A. aspera* association was the most productive since *A. aspera* grew better than *C. alliodora* in any association and cassava production in this association was always higher. (AS)

K01 Rotational Schemes and Intercropping

0225

29490 MARTIN, M.P.L.D. 1984. Coconut agronomic and breeding research in Fiji. *Fiji Agricultural Journal* 46(2):1-7. En., Sum. En., 21 Ref.

Cassava. Research. Intercropping. Coconut. Cropping systems. Cultivars. Productivity. Income. Fiji.

The results of agronomic research and of genetic improvement of the coconut palm in Fiji since 1976 are reviewed. Trials of mature palms intercropped with annual crops indicated that rice, maize, taro, and cassava are apt for this cropping system. Cassava cv. Vulatolu (17.50 t/ha), Navolau (16.77 t/ha), and Beqa (16.71 t/ha) outyielded cv. Merelesita (14.37 t/ha) and Yabiadamu (7.93 t/ha) in intercrop with coconut. Yields were satisfactory, taking into account that the primary objective was to supplement the income from the main crop. (CIAT)

0226

29491 OSSOM, E.M. 1986. Effect of plant population on yield and weed infestation of cassava-maize intercropping. *Indian Journal of Agricultural Sciences* 56(10):732-734. En., 3 Ref.

Cassava. Cultivars. Spacing. Intercropping. Maize. Productivity. Weeds. Nigeria.

An expt. was conducted in Port Harcourt, Nigeria, to study the effect of plant population on yield and weed infestation of cassava var. 3575 when intercropped with maize var. FARZ 34. Maize population was maintained constant at 30,000 plants/ha while cassava populations tested were 20,000, 30,000 and 40,000 plants/ha. Cassava yields at the resp. plant populations, intercropped with maize, were 10,292, 9828, and 7464 kg/ha, compared with 9076 kg/ha for monocropped cassava. While monocropped maize yielded 2400 kg/ha, when intercropped it yielded 3280, 3120, and 1680 kg/ha at the 3 populations tested. Weed infestation was higher in monocrops than in intercrops. Results suggest that mixed cropping of cassava and maize at a combined plant population of 50,000 plants/ha is beneficial in increasing the total yield and reducing weed infestation. (CIAT)

0227

27670 TAFUR, N.; FORSYTHE, W. 1985. The effect of various methods of land preparation on soil resistance to penetration and yield of corn (*Zea mays* L.), cassava (*Manihot esculenta* Crantz) and sweet potato (*Ipomoea batatas* L.) in association. 2. Effect on yield. *Turrialba* 35(4):371-376. En., Sum. Es., En., 8 Ref.

Cassava. Land preparation. Plant development. Soil physical properties. Intercropping. Sweet potato. Productivity. Cultivation systems. Costa Rica.

Response of maize, sweet potato, and cassava to soil preparation was characteristic of each crop. Cassava did not respond significantly to soil preparation treatments. Possibly the tendency towards horizontal growth by the underground reserves makes them less susceptible to soil resistance effects. There was some significant negative correlation (-0.39**) between cassava and sweet potato yields, probably due to competition since they were grown in association. (AS (extract))

0228

28599 UNAMMA, R.P.A.; ENE, L.S.O.; ODURUKWE, O.S.; ENYINNNIA, T. 1986. Integrated weed management for cassava intercropped with maize. *Weed Research* 26(1):9-17. En., Sum. En., Fr., De., 21 Ref. [National Root Crops Research Inst., Umudike, P.M.B. 7006, Umuahia, Nigeria]

Cassava. Hoeing. Productivity. Intercropping. Herbicides. Cowpea. Maize. Costs. Nigeria.

Trials were conducted in the tropical rainforest zone of Nigeria from 1982 to 1984 to compare manual weeding with chemical and integrated weed control systems in cassava/maize intercrop. Uncontrolled weeds reduced cassava and maize component yields by 2-yr av. of 49 and 62 percent, resp., and their combined energy yield by 53 percent compared with 30,572 kcal/ha obtained from the control plots hand-hoed at 3 and 8 wk. after planting. Highest economic returns were obtained from using cowpea or Egusi melon. Integrated use of cowpea and preemergence application of alachlor at 2.0 or chloramben at 3.4 kg a.i./ha and preemergence application of either fluometuron or chloramben at 2.5 and 3.4 kg a.i./ha, resp., or their mixture gave more economic net returns than 2 hand hoeings. Under similar management level, intercropping cassava and maize resulted in 36-43 percent more land being made available to the farmer for other uses than sole cropping them. (AS)

0229

28135 VAZ, C.R. DE ; SILVA, K.P.U. ; GUNARATNA, L.R.P. 1982. Agronomic and economic studies of cassava-legume intercropping systems. *Tropical Agriculturist* 138:111-116. En., Sum. En., 9 Ref. [Central Agricultural Research Inst., Gannoruwa, Peradeniya, Sri Lanka]

Cassava. Cultivars. Intercropping. Legume crops. Productivity. Sri Lanka.

In Peradeniya, Sri Lanka, in 1979, cassava cv. Llanera and MU-22 (branching and nonbranching types, resp.) were intercropped with the following legumes in fertilized silt clay loam soils: *Vigna sinensis* subsp. *sequipedalis*, *Glycine max*, *Phaseolus mungo*, *P. aurcus*, and *V. unguiculata*. Cassava was planted at 90 x 90 cm and the legumes were sown 7.4-15.0 cm apart in 2 rows 30 cm apart between the cassava rows. Yields of Llanera and MU-22 were 11.07-15.38 and 8.74-10.68 t/ha, resp., when intercropped and 14.66 and 9.40 t/ha when grown alone. The highest cassava yields and financial return with both cv. were obtained with intercropping with *V. sinensis*

subsp. sequipedalis. Data on the yields of the intercropped legumes are presented. (CIAT) See also 0024 0028 0031 0040 0041 0042 0047 0088 0090 0095 0201

K02 Descriptive and Comparative Studies

See 0011 0101 0168 0171 0195 0196 0207 0213

Z00 GENERAL

See 0132 0200 0218

ABBREVIATIONS AND ACRONYMS

A	Angstrom(s)	DM	Dry matter
ABA	Abscisic acid	DNA	Deoxyribonucleic acid
ac	Acre(s)	EC	Emulsifiable concentrate
Af.	Afrikaans	EDTA	Ethylenediaminetetraacetic acid
a.i.	Active ingredient	EEC	European Economic Community
alt.	Altitude	e.g.	For example
AMV	Alfalfa mosaic virus	ELISA	Enzyme-linked immunosorbent assays
approx.	Approximate(ly)	EMS	Ethyl methane sulfonate
Ar.	Arab	En.	English
atm.	Atmosphere	EP	Preliminary Trials, CIAT
ATP	Adenosine 5'-triphosphate	Es.	Spanish
av.	Average	expt.	Experiment(s)
BAP	6-Benzylaminopurine	exptl.	Experimental
BBMV	Broad bean mosaic virus	Fr.	French
BCMV	Bean common mosaic virus	ft-ca	Foot candles (10.76 lux)
Bg.	Bulgarian	FYM	Farmyard manure
BGMV	Bean golden mosaic virus	g	Gram(s)
BGYMV	Bean golden yellow mosaic virus	G	Giga (10 ⁹)
BOD	Biochemical oxygen demand	GA	Gibberellic acid
BPMV	Bean pod mottle virus	gal	Gallon(s)
BRMV	Bean rugose mosaic virus	GE	Gross energy
BSMV	Bean southern mosaic virus	GERs	Glucose entry rates
BV	Biological value	GLC	Gas-liquid chromatography
BYMV	Bean yellow mosaic virus	Gr.	Greek
ca.	About (circa)	h	Hour(s)
CAMD	Cassava African mosaic disease	ha	Hectare(s)
CMV	Cassava African mosaic virus	HCN	Hydrocyanic acid
CBB	Cassava bacterial blight	HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
CBSD	Cassava brown streak disease	He.	Hebrew
CEC	Cation exchange capacity	Hi.	Hindi
CER	CO ₂ exchange rate	HI	Harvest index
CF	Cassava flour	hp	Horsepower
CGR	Crop growth rate	Hu.	Hungarian
Ch.	Chinese	IAA	Indoleacetic acid
CLM	Cassava leaf meal	IBA	Indolebutyric acid
CLV	Cassava latent virus	IBYAN	International Bean Yield and Adaptation Nursery, CIAT
CM	Cassava meal	Il.	Illustrations
cm	Centimeter(s)	in.	Inches
COD	Chemical oxygen demand	In.	Indonesian
concn.	Concentration	It.	Italian
CP	Crude protein	IU	International unit
Cs.	Czech	J	Joule
CSL	Calcium stearyl lactylate	Ja.	Japanese
CSW	Cassava starch wastes	kat	Katal (amount of enzymatic activity that converts 1 mole of substrate/s)
C.V.	Coefficient of variation	kcal	Kilocalorie(s)
cv.	Cultivar(s)	kg	Kilogram(s)
2,4-D	2,4-dichlorophenoxyacetic acid		
Da.	Danish		

De.	German	kJ	Kilojoule
km	Kilometer(s)	pp.	Pages
KNap	Potassium naphthenate	pphm	Parts per hundred million
Ko.	Korean	PPI	Preplanting incorporation
kR	Kiloroentgen(s)	ppm	Parts per million
La.	Latin	PSA	Potato sucrose agar
LAD	Leaf area duration	Pt.	Portuguese
LAI	Leaf area index	pv.	Pathovar
lat.	Latitude	Ref.	Reference
lb	Pound(s)	resp.	Respective(ly)
LD50	Mean lethal dose	Rf	Retardation factor-
LER	Land efficiency ratio		chromatography
LPC	Leaf protein concentrate	RGR	Relative growth rate
lx	Lux	RH	Relative humidity
M	Mega	RNA	Ribonucleic acid
m	Meter(s)	Ro.	Romanian
Mal.	Malty	rpm	Revolutions per minute
max.	Maximum	Ru.	Russian
MC	Moisture content	s	Second
ME	Metabolizable energy	SBM	Soybean meal
meq	Milliequivalent(s)	SCN	Thiocyanate
met.	Methionine	SCP	Single cell protein
mg	Milligram(s)	SDS	Sodium dodecyl sulfate
mho	Reciprocal ohm	Sk.	Slovak
min.	Minimum	Sn.	Slovene
min	Minute(s)	sp.	Species
ml	Milliliter(s)	spp.	Species
mm.	Millimeter(s)	SSL	Sodium stearyl-2-lactylate
mo.	Month	Sum.	Summary
mol. wt.	Molecular weight	Sv.	Swedish
m.p.	Melting point	t	Ton(s)
NAA	Alpha-naphthalene acetic acid	TDN	Total digestible nutrients
NAD	Nicotinamide adenine dinucleotide	temp.	Temperature
NADH	Nicotinamide adenine dinucleotide, reduced form	TIA	Trypsin inhibitor activity
NAR	Net assimilation rate	TIBA	2,3,5-Triiodobenzoic acid compound with N-methylmethanamine
NCE	Net CO ₂ exchange	TLC	Thin-layer chromatography
NE	Northeast	TMV	Tobacco mosaic virus
NER	Net energy ratio	Tr.	Turkish
Nl.	Dutch	TSH	Thyroid stimulating hormone
nm	Nanometer(s) (10 ⁻⁹ m)	UDIG	Uridine diphosphate glucose
no.	Number(s)	Uk.	Ukrainian
No.	Norwegian	UMS	Unmodified cassava starch
NPFs	Negative production factors	Ur.	Urdu
NPR	Net protein ratio	UV	Ultraviolet
NPU	Net protein utilization	var.	Variety(ies), varietal
NW	Northwest	VEF	Bean Team Nursery, CIAT
OM	Organic matter	VFA	Volatile fatty acids
oz	Ounce(s)	vol.	Volume
p.	Page	VPD	Vapor pressure deficit
P	Probability	vpm	Volume per million
Pa	Pascal(s)	vs.	Versus
PAN	Peroxyacetic nitrate	W	West, watt
PCHB	Pentachloronitrobenzene	wk.	Week
PDA	Potato dextrose agar	WP	Wettable powder
PER	Protein efficiency ratio	wt.	Weight
pH	Hydrogen ion concentration	yr	Year(s)
Pl.	Polish	/	Per

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(*Manihot esculenta* Crantz)

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INTRODUCTION

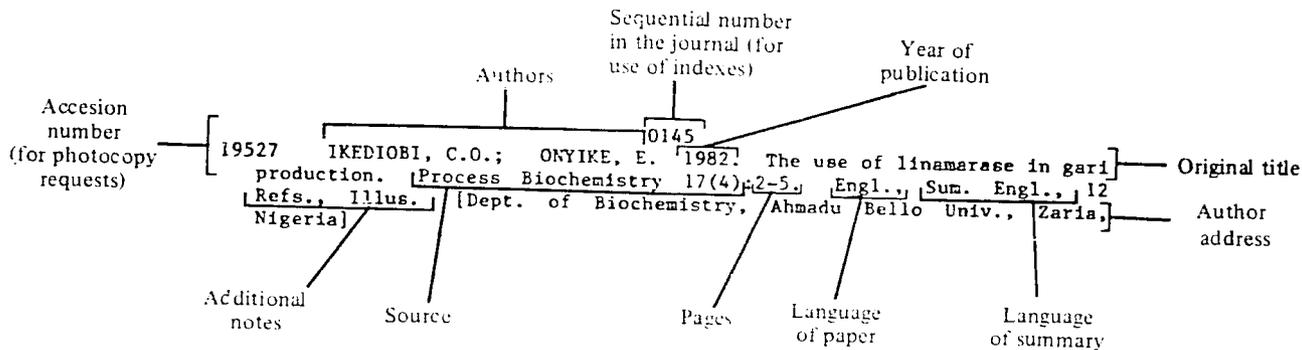
This journal of analytical abstracts, which replaces the former combination of abstract cards and yearly cumulative volumes, is designed to provide a specialized guide to the world's literature on cassava (*Manihot esculenta* Crantz), disseminating research results and ongoing activities related to the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

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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



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. — Abstract

Abstractor
and/or translator

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.

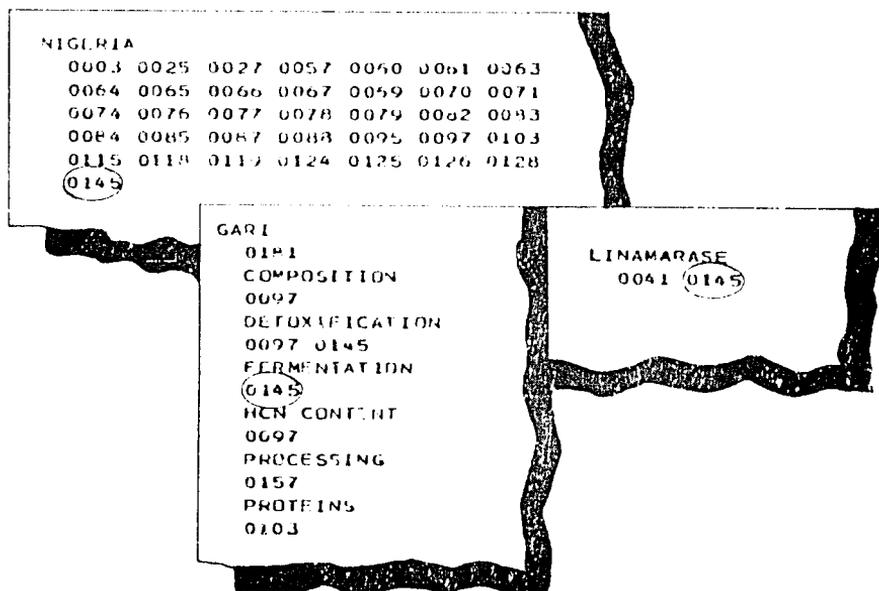
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A00 BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

0730

50143 BROWN, B.J.; EWEL, J.J. 1987. Herbivory in complex and simple tropical successional ecosystems. *Ecology* 68(1):108-116. En., Sum. En., 29 Ref., 11. [Inst. for Environmental Studies & Dept. of Botany, Univ. of Wisconsin-Madison, Madison, WI 53706, USA]

Cassava. Ecosystems. Maine. Leaves. Forage. USA.

To investigate the relationship between herbivory and floristic complexity, the losses to herbivores were measured in four 0.1- to 4.0-yr-old tropical ecosystems: (1) unmanipulated successional vegetation, (2) successional vegetation with higher plant diversity than the unmanipulated succession, (3) an ecosystem of investigator-controlled species composition, designed to imitate the physiognomy and species richness of the successional vegetation, and (4) monocultures of maize, cassava, and *Cordia alliodora*. Herbivory rates (loss of leaf area/day) were measured on dominant plant species in each system and these were aggregated over species to estimate rates for plant communities. Although herbivory rates varied widely among species, losses to herbivores in terms of mass of leaf tissue lost/unit of ground area were approx. equal in the 4 systems, 71.5-78.5 g/square meter/yr; cassava in monoculture presented a rate of leaf loss of 0.399 g/square meter/day. Ecosystems with greater plant species richness lost a lower proportion of available leaf area and exhibited lower temporal variability in herbivory. Species-rich ecosystems had relatively constant, predictable rates of herbivory due to counterbalancing of low rates on some species with high rates on others. The rate of herbivory on any species was strongly influenced by the nature of the surrounding vegetation. Although surrounding vegetation often conferred protection upon potential pest targets, in some cases a plant species experienced increased susceptibility to herbivores through association with other species. (AS)

B00 PLANT ANATOMY AND MORPHOLOGY

0731

28555 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Morfología de la planta de yuca (*Manihot esculenta* Crantz); unidad audiotutorial. (Cassava plant morphology; audiotutorial unit). Contenido científico Domínguez, C.E.; producción Fuentes de Piedrahita, C.I.; colaboración Herdrey, C.; Amaya, A.; Reyes, J.A. Cali, Colombia. 98 diap. color 5 x 5 cm.; 1 cassette 30 min.; guión 13p.; guía de estudio 44p. En., 11. También en inglés.

Cassava. Plant anatomy. Audiotutorial. Colombia.

The organs conforming the cassava plant are described and their development is indicated. Furthermore, the diversity of shape of the organs of different var. is compared. (AS-GIAT)

0732

30831 NASSAE, N.M.A.; GRATTAPAGLIA, D. 1986. Variabilidade de clones da mandioca em relação a fertilidade e aspectos morfológicos. (Variability of cassava clones in relation to fertility and morphological aspects). *Tarrialba* 36(4):555-559. Pt., Sum. Pt., En., 10 Ref. [Melhoramento de Plantas, Depto. de Agronomia, Univ. de Brasília, Brasília, Brasil]

Cassava. Cultivars. Plant fertility. Plant anatomy. Stems. Leaves. Flowers. Fruits. Seed. Plant reproduction. Brazil.

122

The variability of morphological characteristics during flowering was studied in 18 indigenous and improved cassava cv. Very little variation was found. Some characters of economic value such as dwarfism, hairy leaves, rugose stems, and spherical roots were absent. Two distinct categories were observed in relation to flower no./plant: (1) indigenous clones with a low no. of flowers; (2) improved clones, produced through breeding programs, with a high no. of flowers. Controlled inbreeding in the studied clones revealed the presence of genetic sterility in indigenous clones while a high fertility index was observed in improved clones. (AS)

COO PLANT PHYSIOLOGY

0233

28556 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. El cultivo de meristemas para la conservación de germoplasma de yuca in vitro; unidad audiotutorial. (Meristem culture for in vitro conservation of cassava germplasm; audiotutorial unit). Contenido científico Roca, W.M.; Beltrán, J.; producción Fernández G., F. Cali, Colombia. 99 diap. color 5 x 5 cm.; 1 cassette 38 min.; guión 16p.; guía de estudio 43p. Es., 11.

Cassava. Apical meristems. Tissue culture. Germplasm. Audiotutorial. Colombia.

The techniques used in cassava meristem culture are described in detail, from basic principles for germplasm conservation to conservation, maintenance, and renewal techniques. (AS (extract)-CIAT)

0234

28552 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1982. El cultivo de meristemas para el saneamiento de clones de yuca; unidad audiotutorial. (Meristem culture for the sanitation of cassava clones; audiotutorial unit). Contenido científico Roca, W.M.; Jayasinghe, U.; producción Fernández G., F.; colaboración Rodríguez, J.A.; Roca, J.; Mafla, G. Cali, Colombia. 61 diap. color 5 x 5 cm.; 1 cassette 26 min.; guión 8p.; guía de estudio 45p. Es., 11.

Cassava. Apical meristems. Tissue culture. Audiotutorial. Colombia.

The heat therapy process that follows meristem culture is described in detail; it has allowed successful mass sanitation of cassava clones, whether infected or suspected of being infected. (AS-CIAT)

0235

28553 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. El cultivo de meristemas de yuca; unidad audiotutorial. (Cassava meristem culture; audiotutorial unit). Contenido científico Roca, W.M.; producción Ceballos, L.F.; colaboración Rodríguez, J.A.; Roca, J. Cali, Colombia. 53 diap. color 5 x 5 cm.; 1 cassette 35 min.; guión 13p.; guía de estudio 40p. Es., 11.

Cassava. Apical meristems. Tissue culture. Audiotutorial. Colombia.

The participation of biotechnology research in the development of cassava cultivation is highlighted. The cassava meristem culture technique is explained; this technique is based on the principle of rapid multiplication of clonal individuals free of viruses and other diseases and insects. In addition, it enables the establishment of germplasm banks in reduced spaces and with a min. growth rate, under controlled environmental conditions. (AS-CIAT)

0236

30594 COCK, J.H.; RIAÑO, N.M.; EL-SHARKAWY, M.A.; LOPEZ F., Y.; BASTIDAS, G. 1987. C3-C4 intermediate photosynthetic characteristics of cassava (*Manihot esculenta* Crantz). 2. Initial products of $(^{14}\text{C})\text{CO}_2$ fixation. *Photosynthesis Research* 12:237-241. En., Sum. En., 18 Ref., Il. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Photosynthesis. CO_2 . Timing. Laboratory experiments. Analysis. Colombia.

Cassava, bean, and maize leaves were fed with $(^{14}\text{C})\text{CO}_2$ in light and the primary products of photosynthesis identified 5 and 10 s after assimilation. In maize, approx. $3/4$ of the labelled C was incorporated in C_4 acids, in beans about $2/3$ in phosphoglyceric acid, and in cassava approx. 40-60 percent in C_4 acids with 30-50 percent in phosphoglyceric acid. These data indicate that cassava possesses the C_4 photosynthetic cycle; however, due to the lack of typical Kranz anatomy appreciable C assimilation takes place directly through the Calvin-Benson-Bassham cycle. (AS)

0237

30593 EL-SHARKAWY, M.A.; COCK, J.H. 1987. C3-C4 intermediate photosynthetic characteristics of cassava (*Manihot esculenta* Crantz). 1. Gas exchange. *Photosynthesis Research* 12:219-235. En., Sum. En., 41 Ref., Il. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Photosynthesis. CO_2 . Timing. Plant anatomy. Leaves. Plant respiration. Temperature. Colombia.

The gas exchange characteristics of cassava were compared with 1 C_3 species (common bean) and 2 C_4 species (maize and *Amaranthus retroflexus*). Cassava leaf photorespiration, about 12 percent of max. net photosynthesis in normal air, and the CO_2 release in CO_2 -free air under intense light were lower than the values typically reported for C_3 species. The CO_2 compensation point of whole leaves (25 cubic centimeters/cubic meter of CO_2) was intermediate between C_3 and C_4 species values. Gas exchange was restricted to either the upper or lower surface of amphistomatous leaves by covering one side of the leaf with silicone grease. The CO_2 compensation point of the upper leaf surface was less than 6 cubic centimeters/cubic meter of CO_2 and the CO_2 release into CO_2 -free air in the light was essentially zero. On the lower leaf surface considerable CO_2 release occurred in both the light and the dark. The hypothesis presented to explain these results is the existence of an efficient CO_2 recycling mechanism in the palisade layer in the upper half of the leaf. Recent data indicates that cassava produces C_4 acids as primary products of photosynthesis; it is therefore proposed that this hypothesis is consistent with the possible existence of the C_4 photosynthetic pathway in the palisade layer of cassava leaves. The results and hypothesis are discussed in relation to the crop's adaptation to the environmental conditions where it is normally grown. The implications of variation in anatomical features such as stomatal distribution on both surfaces of the leaf are analyzed with a view to enhancing the potential productivity of cassava under stress conditions. (AS)

0238

29502 HOLGUIN H., P.; COLLAZOS C., R.; COCK, J.H. 1985. Fotosíntesis y otros parámetros fisiológicos en plantas de yuca *Manihot esculenta* Crantz infectadas con virus. (Photosynthesis and other physiological parameters in virus-infected cassava plants). *Acta Agronómica* 35(3):27-38. Es., Sum. Es., En., 10 Ref.

Cassava. Cassava latent virus. Caribbean mosaic virus. Frog skin disease. Leaves. Plant physiology. Plant respiration. Photosynthesis. Transpiration. Carbon dioxide. Stomata. Colombia.

The effect produced by CLV, the Caribbean mosaic virus, and frog skin disease on photosynthesis and some related physiological parameters in virus-infected cassava plants was studied. Diseased materials (cv. M Col 22 infected by CLV, Secundina infected by the Caribbean mosaic virus, and Quilcoce infected by frog skin disease) were planted in pots and measurements were initiated 45 days after planting with 3 measurements dates at 15-day intervals. Photosynthesis was significantly reduced ($P = 0.05$) from 29.79 percent in uninfected controls to 24.43 percent in CLV-infected plants, which can be partially explained by increases in resistance of the mesophyll tissue to CO_2 entry and some biochemical alteration caused in cells. Although CLV showed no symptoms on plants, it can affect productivity because of its direct effect on photosynthesis. Photosynthesis and transpiration were significantly reduced ($P = 0.05$ and $P = 0.01$, resp.) from 26.02 percent to 21.16 percent for the former parameter in undiseased and symptomatic Caribbean mosaic virus-infected plants, resp., and from 1.97 to 1.48 for the latter parameter in undiseased and the diseased plants, resp.; resistance to water vapor diffusion also increased significantly ($P = 0.05$) from 3.60 to 4.66 in undiseased and diseased plants, resp. The low photosynthetic rates in symptomatic plants, however, were directly related to cell distortions of leaf tissue that cause stomata malfunctioning. No direct effect of frog skin disease on photosynthesis was observed, but there was an effect on the relationship between the source-sink capacities; the ability of cassava roots infected by frog skin disease to store carbohydrates was reduced. (CIAT) See also 0232 0268 0315

C01 Plant Development

0239

30538 BOLAÑOS R., A.C. 1987. Análisis de crecimiento para tres formas de propagación en yuca (*Manihot esculenta* Crantz). (Growth analysis for three propagation methods in cassava). Tesis Biólogo-Botánico. Cali, Colombia, Universidad del Valle. 93p. Es., Sum. Es., 24 Ref., Il.

Cassava. Growth. Plant reproduction. Propagation. Cuttings. Seed. Germination. Developmental stages. Timing. Branching. Root development. Stems. Leaves. Leaf area. Foliage. Harvest index. Dry matter. Colombia.

An expt. was conducted in the lab. and in the field (CIAT) to evaluate the growth of cassava plants propagated by (1) cuttings, (2) sexual seed planted directly in the field, and (3) transplant from the greenhouse to the field. Plants from seeds and transplanted plants showed notable morphologic differences with respect to plants obtained from cuttings. Dry root yields (t/ha) at the end of the cycle were 12.7, 14.3, and 12.7 for treatments 1, 2, and 3, resp. Light interception in the canopy had max. values between days 95-252; these values averaged 187.0, 154.0, and 124.1 (J/square meter) for treatments 1, 2, and 3, resp. It was concluded that commercial production using sexual seed has a large potential in the future since yields can be equal or even greater compared with plants propagated through cuttings. Before this is feasible, however, further studies would be necessary in the areas of genetic improvement and agronomic management of the crop. (AS (extract)-CIAT)

0240

30481 BUENO, A. 1985. Behaviour of contrasting cassava genotypes grown under different spacing arrangements. *Revista Brasileira de Mandioca* 4(1):33-42. En., Sum. En., 7 Ref., Il. [EMBRAPA/Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 44.380, Cruz das Almas-BA, Brasil]

Cassava. Cultivars. Genotypes. Branching. Root productivity. Spacing. Brazil.

Five high branching and 5 low branching cassava genotypes were evaluated in double-row and single-row spacing arrangements during 2 yr at the Centro Nacional de Pesquisa de Mandioca e Fruticultura (Bahia, Brazil). A split-plot exptl. design was used with 3 replications. Spacing arrangements were assigned to the main plots and cv. were randomized in the subplots. With the same plant population, the double-row arrangement did not differ from the single-row arrangement. High branching cv. showed a higher mean root yield than low branching cv. BGM 001, a low branching genotype, had the highest root yield, the largest no. of roots/plant, and the heaviest root wt.; on the contrary, BGM 340, also a low branching type, had the lowest root yield, the smallest no. of roots/plant, and the lightest root wt. All genotypes tested, irrespective of their branching habits, behaved similarly in both spacing arrangements. (AS)

0241

30037 DAHNIYA, M.T. 1979. Defoliation and grafting studies of cassava (*Mandhot esculenta* Crantz) and sweet potatoes (*Ipomoea batatas* L.). Ph.D. Thesis. Nigeria, University of Ibadan. 188p. En., Sum. En., 84 Ref., Il.

Cassava. Defoliation. Pruning. Timing. Grafting. N. Fertilizers. Cuttings. Planting. Dry matter. Plant development. Root development. Root productivity. Roots. Nigeria.

Defoliation expt. were conducted to determine the effects of leaf harvesting on the yield and yield components of cassava and sweet potato, and grafting studies to investigate their source-sink relationships. Significantly less leaf material was obtained by defoliating the lower instead of the upper leaves of cassava var. Isunikankiyan and 58308. Root yields of both var. were not significantly affected by the pattern of defoliation but plants with lower leaves harvested tended to give higher tuber yields than those with upper leaves harvested. Root yield of var. Isunikankiyan was reduced by 76, 62, and 15 percent, resp., by defoliating the upper leaves at 1-, 2-, and 3-mo. intervals while var. TMS 30211 suffered a root yield reduction of 56, 34, and 32 percent, resp. It is recommended that the leaves of var. Isunikankiyan and TMS 30211 should be defoliated at 3- and 2-mo. intervals, resp. Generally, the percentage of total plant DM deposited in the roots decreased with an increase in the frequency of defoliation. In cassava, the 4 grafted var. showed varying source potentials and sink capacities. Var. TMS 30211 was best with a mean stock (sink) effect of 1451.23 g/plant and a mean scion (source) effect of 1487.05 g/plant. Var. Isunikankiyan was the poorest with a mean stock (sink) effect of 451.13 g/plant and a mean scion (source) effect of 620.4 g/plant. The results suggest that a large and active tuberous root sink coupled with an efficient source are important in determining cassava tuberous root yield. (AS (extract))

0242

30152 FUKAI, S.; HAMMER, G.L. 1987. A simulation model of the growth of the cassava crop and its use to estimate cassava productivity in northern Australia. *Agricultural Systems* 23(4):237-257. En., Sum. En., 25 Ref., Il. [Dept. of Agriculture, Univ. of Queensland, St. Lucia, Qld., Australia]

Cassava. Growth. Simulation models. Productivity. Field experiments. Planting. Timing. Temperature. Irrigation. Maps. Biomass production. Australia.

A simulation model of the growth of the cassava crop is described. It estimates crop establishment from temp. data, and weekly increment of total biomass and underground storage organ biomass from temp., solar radiation, pan evaporation, and rainfall data. The predictive ability of the model was tested using data from time of planting and irrigation expt. conducted in SE Queensland, Australia. The predicted values were close to those obtained in the field expt. The model was then used to estimate productivity at different locations in northern Australia. Two limiting factors for cassava production are low temp. in winter in the southern area and low rainfall in general. (AS)

0243

30805 MANRIQUE, L.A. 1987. Leaf area development and growth performance of cassava germplasm on a strongly acid Ultisol of Panama. *Journal of Plant Nutrition* 10(6):677-698. En., Sum. En., 10 Ref., 11. [Dept. of Agronomy & Soil Science, Univ. of Hawaii, Honolulu, HI 96822, USA]

Cassava. Soil requirements. pH. Aluminum. Plant development. Plant physiological processes. Plant assimilation. Leaves. Leaf area. Harvest index. Dry matter. Root system. Root development. Growth. Branching. Root productivity. Stems. Cultivars. Panama.

A field expt. using local cassava cv. was conducted on a Tropudult of Ocu, Panama, to study leaf area development and growth performance of cassava germplasm under extreme soil acidity conditions. Plants were grown under a soil Al (KCl-extractable Al) range of 4.0-5.7 cmol(p+)/kg. Under this high soil Al, LAI and DM production patterns of cassava cv. were closely similar to those reported for plants grown in less constraining conditions; however, the sink capacity in most cv. appeared to shift from roots to tops. Roots were weak competitors for assimilates, hence photosynthetic production was primarily aimed to develop and sustain canopy growth. This preferential distribution of assimilates to tops resulted in low HI values. The reduced sink size of roots appears to be attributable to the impairing effects of soil Al on root growth. (AS)

0244

30579 NASSAR, N.M.A.; O'HAIR, S.K. 1985. Variation among cassava clones in relation to seed germination. *Indian Journal of Genetics and Plant Breeding* 45(2):394-398. En., Sum. En., 7 Ref., 11. [Tropical Research & Education Centre, Univ. of Florida, IFAS, Homestead, FL 33031, USA]

Cassava. Cultivars. Seed. Germination. Timing. Brazil.

Seeds from 51 cassava clones were screened for germination at 15 and 30 days after planting. The germination for 44 entries that represented both common and diverse Brazilian clones was low, ranging from 0 to 30 and from 10 to 56 percent by 15 and 30 days after planting, resp. The germination for clones selected as early and good in germination ranged from 35 to 48 and from 60 to 80 percent by 15 and 30 days after planting, resp. The lack of variability among seeds of a given clone indicates that there is considerable homozygosity within clones. Selected clones showing early seed germination are being grown at the U. de Brasilia. (AS)

0245

30466 PINHEIRO, J.C.D. 1985. Estudo de plantio de sementes sexuais de mandioca. (Planting trial of cassava sexual seed). *Revista Brasileira de*

Mandioca 4(1):73-78. Pt., Sum. Pt., En., 5 Ref. [EMAPA, BR316, Km 376, Caixa Postal 12, 65.700 Bacabal-MA, Brasil]

Cassava. Seed. Germination. Laboratory experiments. Brazil.

The factors that influence the germination of sexual seeds of cassava and plant vigor were studied; likewise, an attempt was made to define a proper technique for seed sowing. The treatments used were: T0, plastic tray; T1, Styrofoam tray; and T2, amianthus tray. All contained sterilized and fertilized soil-sand, with heat-treated seed sown 1 cm deep and given normal irrigation. Other treatments were conducted in plastic trays under the same conditions but with 1 change per tray: T3, nonsterilized soil; T4, soil without sand; T5, nonheat-treated seed; T6, seeds sown at a depth of 2 cm; T7, unfertilized soil; and T8, excessive irrigation. The results indicated that the plastic tray was the best recipient for sexual seed germination since its physical characteristics favored a high level of germination and plant vigor. Plant performance in T0 and T6 indicated that they were the best methods for the production of vigorous plants from sexual seed without affecting germination. (AS)

0246

30570 STAMP, J.A.; HENSHAW, G.G. 1987. Somatic embryogenesis from clonal leaf tissues of cassava. *Annals of Botany* 59(4):445-450. En., Sum. En., 19 Ref. [Dept. of Viticulture & Enology, Univ. of California, Davis, CA 95616, USA]

Cassava. Tissue culture. Leaves. Plant development. Plant anatomy. Morphogenesis. Plant growth substances. USA.

Leaf lobes were isolated from palmate leaves of clonal cassava material growing in vitro or in glasshouse conditions and subjected to a 2-stage culture procedure involving incubation on Murashige and Skoog (MS2) basal medium supplemented with 2-12 mg 2,4-D/liter for 20 days (stage I) before transfer to MS2 basal medium supplemented with 0.01 mg 2,4-D and 0.1 mg BAP/liter (stage II medium). Embryogenetic tissues, foliose structures, and somatic embryos developed from leaf lobes at all stage I 2,4-D concn., except on those explants isolated from shoot tip cultures incubated on MS2 basal medium supplemented with 0.1 mg NAA and 1.0 mg BAP/liter. Leaf lobes isolated directly from glasshouse plants showed optimal embryogenetic competence when subjected to a stage I culture period of 17 days, although foliose structure initiation was optimal with shorter stage I durations. Leaf lobes of 2-4 mm length and those isolated from phyllotaxic leaf no. 4 and 5 showed the greatest embryogenetic competence. (AS)

0247

30571 STAMP, J.A. 1987. Somatic embryogenesis in cassava: the anatomy and morphology of the regeneration process. *Annals of Botany* 59(4):451-459. En., Sum. En., 29 Ref., 11. [Dept. of Viticulture & Enology, Univ. of California, Davis, CA 95616, USA]

Cassava. Tissue culture. Leaves. Plant development. Plant anatomy. Morphogenesis. Plant growth substances. USA.

Anatomical and morphological studies demonstrated that somatic embryos developed similarly on mature seed and clonal leaf explants of cassava cultured for 20-24 days on Murashige and Skoog (MS2) basal medium supplemented with 4.0 mg 2,4-D/liter (stage I) before transfer to MS2 basal medium supplemented with 0.01 mg 2,4-D and 0.1 mg BAP/liter (stage II medium). Within 7 days of inoculation on stage I medium, cell divisions occurred in the adaxial tissues of cotyledon-piece and leaf-lobe explants, and associated with this was the development of embryogenetic protusions

and ridges on the adaxial surface. Foliose structures and somatic embryo initials developed from these tissues on cotyledon, embryonic axis, and leaf-lobe explants and, when cultures were transferred to stage II medium, further somatic embryo development occurred. Somatic embryos apparently originated from groups of cells and were identified by the presence of a closed root axis, a shoot axis, and cotyledons of similar shape and veneration to those of zygotic embryos. Somatic embryos had no vascular connection with parental cultures. (AS) See also 0297 0260 0261 0265 0273 0274 0276 0287 0347

003 Chemical Composition, Methodology and Analyses

0248

29517 BRADBURY, J.H.; SINGH, H. 1986. Ascorbic acid and dehydroascorbic acid content of tropical root crops from the South Pacific. *Journal of Food Science* 51(4):975-978. En., Sum. En., 2 Ref., 11. [Chemistry Dept., Australian National Univ., Canberra, A.C.T. 2601, Australia]

Cassava. Ascorbic acid. Composition. Analysis. Australia.

The total vitamin C content (ascorbic acid + dehydroascorbic acid) was estimated by high performance liquid chromatography for sweet potato, *Colocasia esculenta*, *Alocasia macrorrhiza*, *Cyrtosperma chamissonis*, *Xanthosoma* spp., *Pisonera alata*, *P. esculenta*, and cassava. Mean values were 23.6, 15.1, 16.9, 15.7, 13.6, 27.5, 30.3, and 14.9 mg/100 g fresh wt., resp. Standard titrimetric and colorimetric methods gave results only for ascorbic acid, which were generally comparable with high performance liquid chromatography. Frying at 40 degrees Celsius caused loss of ascorbic acid, which was not quantitatively converted into dehydroascorbic acid. (AS)

0249

30849 CARVALHO, V.D. DE; PAULA, M.R. DE; JUSTE JUNIOR, E.S.G.; KATO, M. DO S.A. 1986. Características nutritivas de feno do terço superior e das folhas de cultivares de mandioca. (Nutritional characteristics of hay made from the upper third and leaves of cassava cultivars). *Revista Brasileira de Mandioca* 5(1):63-70. Pt., Sum. Pt., En., 13 Ref. [Empresa de Pesquisa Agropecuária de Minas Gerais, Caixa Postal 176, 37.200 Lavras-MG, Brasil]

Cassava. Uses. Foliage. Forage. Vitamin content. Mineral content. Protein content. Brazil.

Ten cassava cv. (Sonora, Branca de Santa Catarina, Mantiqueira, Mico, Engana Ladrão, IAC-1418, Guaxupé, Riqueza, Iracema, and IAC-12829) were assessed for the nutritional characteristics of leaves and the upper 3rd of the canopy for hay production. Aerial parts of 12-mo.-old plants were collected, and the total vitamin C, beta-carotene, protein, Ca, P, and Fe contents were determined. The hay from leaves had higher protein, total vitamin C, beta-carotene, and P contents, while that from the upper 3rd of the canopy had higher Ca and Fe contents. The mineral and vitamin composition of hay from leaves and the upper 3rd of the canopy differed among the different cv.; the hays were considered as one of the best vegetable sources of vitamin C, beta-carotene, and minerals (Ca, Fe, and P). (AS)

0250

30575 COHEN, R.D.; TOMLINS, K.J. 1986. Estimating aflatoxin levels in cassava: new technique developed by TDRI. *Cassava Newsletter* 10(2):1-4. En., 2 Ref., 11.

Cassava. Analysis. Toxicity. Aflatoxins. United Kingdom.

A new assay method and the procedures used by the tropical Development and Research Institute to estimate aflatoxin levels in cassava are described in detail. Three basic steps are involved: extraction of the sample, preparation of the sample extract, and quantification of the aflatoxin. (CIAT)

0251

FC603 IKORUN-ETIOBHIO, B.O.; ORAEDU, A.C.I.; UGOCHUKU, E.N. 1987. A simple procedure for the quantification of intact linamarin in cassava and its products. Journal of the Science of Food and Agriculture 41(1):81-86. En., Sum. En., 10 Ref. [Dept. of Biochemistry, Univ. of Benin, Benin City, Nigeria]

Cassava. Analysis. Laboratory experiments. Linamarin. HCN content. Nigeria.

A thin-layer chromatographic method coupled with a colorimetric technique for the quantitative determination of linamarin is described. The procedure is based on the measurement of HCN released by linamarase hydrolysis of linamarin isolated on the chromatogram. The released HCN is determined by a modified alkaline picrate method employing Conway vessels. The procedure is free from interferences associated with previously described methods and its sensitivity permits as little as 0.8 micrograms linamarin (0.09 micrograms HCN) to be determined. (AS)

0252

29456 PEREZ, U.D.; VILLAMAYOR JUNIOR, F.G. 1984. Relationships among specific gravity, dry matter and starch contents of cassava roots. National Science and Technology Authority Journal 9(2):18-22. En., Sum. En., 6 Ref., 11.

Cassava. Roots. Dry matter. Starch content. Statistical analysis. Cultivars. Philippines.

The relationships between specific gravity, DM, and starch content of roots of 28 different cassava accessions were studied at the Philippine Root Crop Research and Training Center. The percentage of starch, DM content, and specific gravity of roots of 10-mo.-old plants were determined. Regression and correlation analysis showed significant correlation between specific gravity and DM ($r = 0.82^{***}$), specific gravity and starch content ($r = 0.71^{**}$), and DM and starch content ($r = 0.99^{***}$). It appeared that the higher the specific gravity, the higher the starch and the DM contents. For rough estimates of the percentage of starch or DM content, the specific gravity method would be sufficient; however, for more accurate results, the determination of the percentage of root starch based on the percentage DM should be used. Three regression equations were formulated based on the data obtained. (AS) See also 0241 0257 0267 0293 0311 0324 0343 0347

C04 Plant Nutrition

0253

28546 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1981. Desórdenes nutricionales de la planta de yuca; unidad audiotutorial. (Nutritional disorders of the cassava plant; audiotutorial unit). Contenido científico Howeler, R.; producción Fuentes de Piedrahita, C.L. Cali, Colombia. 100

diap. color 5 x 5 cm.; 1 cassette 28 min., guión 19p.; guía de estudio 32p. Es., Il.

Cassava. Nutritional requirements. Fertilizers. Minerals. Toxicity. Audiotutorial. Colombia.

Both greenhouse and field symptoms of nutrient deficiency in cassava are described in detail. Toxicity symptoms of certain soil elements, as well as the effects of salinity and alkalinity on the crop, are reviewed. The presentation of the methodology used can serve as a model for similar work. (AS-CIAT)

0254

30028 GODFREY-SAM-AGGREY, W. 1976. Cassava (*Manihot esculenta*) fertilizer and nutritional studies in Sierra Leone, West Africa. Ph.D. Thesis. Gottingen, Federal Republic of Germany, Georg-August-Universität zu Gottingen. 201p. En., Sum. En., Del., 126 Ref., Il.

Cassava. Soil requirements. Nutritional requirements. N. P. K. Ca. Mg. Fertilizers. Fallowing. Agricultural lime. Potash. Root productivity. Composition. Sierra Leone.

Expt. were conducted on Njain upland soils (Oxisol, Orthoxic Palchumults) to (1) monitor the direct and residual effects of factorial fertilizers and NPK fertilizer ratios as well as the direct effects of N, P, K, and lime rates on cassava yield components and yields at sites with varying cropping intensities and (2) evaluate the economics of fertilizer use. The 3 cassava cutting types (basal, mid, and top stems) responded predominantly to different major fertilizer nutrients and nutrient ratios at sites intensively cropped after 2 yr and newly opened land after 6 yr of bush fallow. A comparison of the mean root yields of the planting sets showed no significant differences, except in the 1st residual NPK fertilizer ratio evaluation, where basal cuttings performed significantly better than midstem cuttings. N, P, and K, either singly or in various ratios, and Ca and Mg singly showed significant and economic responses. The time of harvest influenced the type of nutrient to be applied. The nutrient responses reflected the nutrient deficiencies at the sites with varying cropping intensities and all agreed with previously recorded data. N response was not observed when sulphate of ammonia was applied to soil with C:N 10 but occurred at sites with C:N ratios less than 10. Lime rates beyond 260 kg/ha showed no significant effects on yields but significantly depressed individual root wt. Lime rate of 260 kg/ha produced significant direct and residual yield increases with basal cuttings at the site after 6 yr of bush fallow. Basic slag (P), which contains 260 kg of active lime/ha, is recommended on the basis that it produced large and economic direct and residual effects in addition to inducing the optimum level of liming within pH 5.1-6.5. There appears to be a genotype x fertilizer interaction in cassava cv. Cececa and Nigeria, Ca and P being indicated as the 2 elements concerned, resp. Exchangeable K levels obtained at preplanting were not reliable indices for K responses. No K response was observed at the site after 6 yr of bush fallow. In the 1st direct fertilizer application at the site intensively cropped after 4 yr of bush fallow, variability in bark Mn appeared to be a significant contributor to variability in root yields after multiple regression analysis. This effect was related to N application; however, in the 2nd direct fertilizer application (3rd cropping cycle) variabilities in bark N, K, Mg, and Mn were found to contribute significantly to root yield variability. It is suggested that cassava should be cropped for 2 cycles to obtain the direct and residual fertilizer yields to make its production economic. After 2 cycles of cropping, a green manure fallow should be employed to improve soil nutrient-holding capacity. (AS)

0255

29526 MEYER, H.J.; VAN STADEN, J. 1986. Inorganic nutrient requirements of in vitro cultured *Manihot esculenta* explants. South African Journal of Botany 52(5):472-480. En., Sum. En., Afr., 20 Ref., 11. [UN/CSIR Research Unit for Plant Growth & Development, Dept. of Botany, Univ. of Natal, P.O. Box 375, Pietermaritzburg, 3200, Republic of South Africa]

Cassava. Nutritional requirements. Minerals. Root development. Shoots. Tissue culture. Cultivars. Plant tissues. South Africa.

Attempts to determine the optimum requirements for both macro- and micronutrients for the in vitro culture of cassava axillary bud explants are reported. Previous studies indicated that both the root and shoot growth of in vitro cultured bud explants of cassava could be improved by manipulating the concn. of a no. of inorganic constituents in the medium of Murashige & Skoog. Studies with cv. MVEN 25, MBRA 12, CMC 681.2, and CMC 1964 using both Murashige & Skoog and a devised medium indicated that each cv. apparently has its own specific nutrient requirements for in vitro culture. (AS)

D00 CULTIVATION

0256

29044 VILLAMAYOR JUNIOR, F.G. 1987. Cassava production technology. State of the art. Baybay, Leyte, Philippine Root Crop Research and Training Center. 23p. En., 86 Ref. Paper presented at the Root Crop Anniversary Symposium, Baybay, Leyte, 1987.

Cassava. Cultivation. Technology evaluation. Philippines.

The results of cassava studies conducted under field conditions worldwide are reviewed with emphasis on their applicability by the farmer, especially in the Philippines. Topics dealt with cover cassava adaptation, var., land preparation, selection and preparation of planting material, planting (time, position, depth, and density), weed control and cultivation, irrigation, fertilization, pest control, pruning, harvesting, and intercropping. The socioeconomic and marketing problems of cassava production are briefly discussed. (CIAT) See also 0382 0389

D01 Soil, Water, Climate and Fertilization

0257

30847 AZEVEDO, J.N. DE; DANTAS, J.P.; RIBEIRO, V.Q. 1986. Adubacao mineral no solo e por via foliar na cultura da mandioca. (Soil and leaf mineral fertilization in cassava). Revista Brasileira de Mandioca 5(1):15-21. Pt., Sum. Pt., En., 17 Ref. [EMBRAPA, Unidade de Execucao de Pesquisa de Ambito Estadual de Teresina, Caixa Postal 01, 64.000 Teresina-PI, Brasil]

Cassava. Fertilizers. N. P. K. Root productivity. Roots. Dry matter. Starch content. Root development. Brazil.

The effects of fertilization applied to the soil or to cassava leaves was studied on a medium-textured dystrophic red-yellow Latosol in Arica (Paraiba, Brazil). A 2(3) plus 1 factorial design was used with 5 replications in randomized blocks. N, P, and K were applied to the soil at 50, 80, and 40 kg/ha, resp., or to the leaves at 1/5 of these rates. An unfertilized check was included. The crop was harvested 12 mo. after

planting, and the fresh wt., DM wt., starch content, and diameter and length of the roots were recorded. N and K had no significant effect on the variables studied. P (applied both to the soil and to the leaves) and P x K (applied both to the soil and to the leaves) had significant effects on fresh root wt. and root DM. The effect of P applied to the soil was higher in the presence of soil-applied K. No differences were observed between application methods for N and K. (AS)

0258

30846 GOMES, J. DE C.; CARVALHO, P.C.L. DE 1986. Adubacao com macro e micronutrientes na cultura de mandioca em Inhambupe-BA. (Cassava fertilization with macro and micronutrients in Inhambupe, Bahia). Revista Brasileira de Mandioca 5(1):7-13. Pt., Sum. Pt., En., 16 Ref. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Fertilizers. N. P. K. Mn. Zn. Fe. Cu. B. Mo. Root productivity. Foliage. Starch productivity. Brazil.

The effects of N, P, K, Zn, Mn, Fe, Cu, B, and Mo on cassava productivity were evaluated in yellow Distroptic Latosol, medium texture, in Inhambupe (Bahia, Brazil). A randomized block design was used with 12 treatments and 4 replications. Treatments were complete (all nutrients), absence of each nutrient in presence of the others, combination of P + Zn, and control (unfertilized soil). Application rates were 40.0, 60.0, 40.0, 4.0, 4.0, 4.0, 4.0, 1.0, and 0.2 kg N, P, K, Zn, Mn, Fe, Cu, B, and Mo/ha, resp. P fertilization had a large effect on cassava yield; and positive tendencies were observed for N and Zn. Av. farmers' yields are usually less than 12 t roots/ha. Except for the treatment without P and the control (1.53 and 0.24 t roots/ha, resp.), all others yielded above 20 t roots/ha. Although results are from 1 crop year only, P fertilization was found to be essencial in these soils. (AS)

0259

29065 GRIMES, R.C.; CLARKE, R.T. 1962. Continuous arable cropping with the use of manure and fertilizers. East African Agricultural and Forestry Journal October 1962:74-80. En., Sum. En., 11 Ref.

Cassava. Cultivation systems. Dung. Fertilizers. Root productivity. Kenya.

A trial was conducted at the Matuga Exptl. Station (Coast Province, Kenya) to determine if crop yields could be maintained under continuous arable cropping, using manure and fertilizers. In sorghum, sweet potatoes, maize, and cassava, there were large responses to FYM and artificial fertilizers; however, the response was significant only for cassava in all years (1953-60). In cassava, annual application of 3 t of manure was slightly superior to the triennial 9-t application. Artificial fertilizers were as effective as FYM in sustaining crop yields. (CIAT)

0260

30155 HULUGALLE, N.R.; LAL, R.; OPARA-NADI, O.A. 1987. Management of plant residue for cassava (Manihot esculenta) production on an acid Ultisol in southeastern Nigeria. Field Crops Research 16(1):1-18. En., Sum. En., 24 Ref., 11. [IITA-SAFGRAD Project, B.P. 1783, Ouagadougou, Burkina-Faso]

Cassava. Soil requirements. Mulching. Tillage. Soil conservation practices. Soil physical properties. Wastes. Soil analysis. Growth. Plant height. Root development. Field experiments. Nigeria.

A study consisting of 2 expt. was conducted in SE Nigeria during 1983 and 1984 to determine whether cassava production on sandy, acid Ultisols could be improved by residue management techniques. One expt. studied the effect of location of *Eupatorium odoratum* mulch on soil properties and crop growth. A 2nd expt. studied the effect of tillage system and *E. odoratum* mulch on soil properties and crop growth. In both expt., mulch was applied at an annual rate of 12 t/ha (75 percent C) in a split application at planting and 150 days after planting. No fertilizer was applied during the expt. Concn. of mulch in the plant row resulted in values of within-row bulk density in the surface 0.10 m which were lower by 15 and 13 percent in 1983 and 1984, resp. Tillage in combination with mulch reduced bulk density in the surface 0.10 m by an av. of 10 and 9 percent in 1983 and 1984, resp. No significant differences were found among other treatments. Soil chemical properties were unaffected by treatments in both expt. Cassava root yield was unaffected by location of *E. odoratum* mulch. Both plowing and no-tillage when combined with mulch improved root yields. Cassava root yields of untilled plots were 16.8 and 12.7 t/ha during 1983-84, and 13.1 and 8.3 t/ha during 1984-85 in mulched and unmulched treatments, resp. Root yields of tilled plots were 14.5 and 13.1 t/ha during 1983-84, and 11.3 and 6.9 t/ha during 1984-85 in mulched and unmulched treatments, resp. (AS)

0261

30139 MARRIQUE, L.A. 1987. Response of cassava to liming on a strongly acid Ultisol of Panama. Communications in Soil Science and Plant Analysis 18(1):115-130. En., Sum. En., 1; Ref., 11. [Dept. of Agronomy & Soil Science, Univ. of Hawaii, 2500 Nole St. Harnaui 22, Honolulu, HI 96822, USA]

Cassava. Soil requirements. Agricultural lime. Aluminum. Soil analysis. Soil physical properties. Root productivity. Growth. Biomass production. pH. Plant tissues. Roots. Leaves. Stems. Panama.

A field expt. was conducted on a clayey, kaolinitic Typic Tropudult of Panama to study the dynamics of soil pH, exchangeable Ca and Al following lime application, and their subsequent effects on plant growth and yield of cassava cv. Brasilena. Increasing rates of CaCO₃ were applied to reduce percent Al saturation below 65, 60, 50, 30, and 0. Shortly after liming, both soil pH in 1 molar KCl and exchangeable Ca increased whereas KCl-extractable Al decreased with 2 Mg of CaCO₃ or more of lime. However, the ameliorating effect of liming was short-lived under the frequent rainstorms during the rainy season of 1984. Liming, while virtually eliminated Al saturation in this soil, failed to neutralize all exchangeable acidity and recurrent soil acidity was evident after 60 days. Cassava responded significantly to liming. Changes in soil pH and KCl-extractable Al after liming markedly affected plant growth and biomass production at key growth stages. Plant height at 60 days sharply decreased at either soil Al over 2.5 cmol (+)/kg or soil pH less than 4.3. Dry root wt. at 120 days decreased at soil Al over 2 cmol (+)/kg. The differences in magnitude of the slope parameter in regression equations expressing the relationship between dry wt. of plant tissues and soil Al, suggest that cassava tissues may have a differential sensitivity to soil Al. In this study, leaves and sink tissues (i.e., stems and roots) were most sensitive to soil Al at early growth and root enlargement stages, resp. (AS)

0262

30142 OPARA-NADI, N.; LAL, R. 1987. Effects of plant population on soil structure, soil moisture depletion and on yield of cassava (*Manihot esculenta*) on an Ultisol in Southeast Nigeria. Journal of the Science of Food and Agriculture 38(4):291-302. En., Sum. En., 20 Ref., 11. [International Inst. of Tropical Agriculture, Ibadan, Nigeria]

Cassava. Planting. Spacing. Soil physical properties. Soil moisture. Soil analysis. Root productivity. Rainfall. Analysis. Water requirements (plant). Nigeria.

The effects of 4 cassava populations (8, 10, 13, and 20 x 10(3) plants/ha) on soil physical properties, moisture retention characteristics, moisture potential profiles, and moisture depletion patterns were compared with uncropped plots receiving no cultivation of an Ultisol in the humid region in eastern Nigeria. The growing of cassava decreased the bulk density of 0-10 cm depth by 17 percent in comparison with the uncultivated soil (1.53 Mg/cubic meter). The bulk density of the 10-20 cm depth was higher for the cropped than the uncropped control plots. The moisture retention below a suction of pF 2.4 for 0-10 cm depth was less for the uncultivated control than for soil growing cassava. The reserve was found in moisture retention characteristics of the 20-40 cm depth especially for low suction ranges of pF below 0.8. The 0-10 cm soil layer of uncropped control dried more rapidly than the cropped soil. Below 10 cm, however, cassava depleted moisture reserves more rapidly than in uncropped control. The effect of plant population on soil moisture depletion was more conspicuous within than between rows. Significant differences in water flux and in water uptake from different horizons were observed among various population densities. The total water loss was the highest for the least plant population for the between-row zone, and for the highest population for the within-row zone. Plant population had no effect on root and stem yields. (AS)

0263

30589 PARDALES JUNIOR, J.R.; COTEJO JUNIOR, F.R.; NUÑEZ, E.M. 1984. Management of cassava in heavy and highly acidic soil. NSTA Technology Journal 9(3):4-8. En., Sum. En., 10 Ref., 11. [Philippine Root Crop Research & Training Center, Visca, Baybay, Leyte, Philippines]

Cassava. Soil requirements. Soil analysis. Agricultural lime. Root productivity. Intercropping. Philippines.

The influence of liming and production management on the productivity of cassava was studied on a heavy and strongly acidic soil in Capocan (Leyte, Philippines). Application of lime, regardless of the source of material (calcitic and rock phosphate), did not bring about significant differences in wt. and no. of marketable and nonmarketable tubers and fresh herbage yield of cassava over the unlimed control. The amount of Ca and Mg obtained from the young petiolar leaves of the unlimed plants were practically the same as that of the limed plants. Among production management systems, addition of OM brought about highly significant ($P = 0.01$) marketable tuber yield and significantly ($P = 0.05$) higher total tuber yield and fresh herbage yield over both monocropped and intercropped cassava. No significant effect was obtained for the no. of marketable and nonmarketable tubers and nonmarketable tuber wt. (AS)

0264

30546 SALES, F.J.M.; GOMES, N.G.; ALVES, V.P.O.; BARROS, R. 1982-1985. A saura do nordeste como agente de intemperismo propulsor da fertilidade do solo. (Atta opaciceps as a weathering agent increasing soil fertility). Fitossanidade no.6-9:42-56. Pt., Sum. En., Pt., 14 Ref., 11. [CCA/UFC, Caixa Postal 3038, 60.000 Fortaleza-CE, Brasil]

Cassava. Atta. Soil requirements. Soil physical properties. Dry matter. Plant development. Brazil.

Studies in Ceará, Brazil, indicated that *Atta opaciceps* acts as a weathering agent and boosts soil fertility. Plant germination and growth

were therefore enhanced. When cotton, cassava (Olho Verde), maize, and soybean were grown in soil taken from nests of the ant, their fresh wt. (compared with that of plants grown in standard agricultural soil) increased by av. of 24, 66, 11, and 56 percent, resp. (AS)

0265

23066 VINE, P.N. 1979. Growth and development of cassava (*Manihot esculenta*, Crantz) in relation to soil physical conditions. Ph.D. Thesis. Bridgetown, Barbados, University of the West Indies. 316p. En., Sum. En., 139 Ref., 11.

Cassava. Growth. Cultivars. Planting. Cuttings. Timing. Nutritional requirements. Root development. Soil physical properties. Soil analysis. Soil moisture. Soil requirements. Plant height. Field experiments. Fertilizers. M. F. E. Weeding. Rainfall data. Statistical analysis. Shoots. Plant development. Leaves. Harvest index. Jamaica.

Expt. on cassava root and shoot growth prior to storage root thickening were carried out with different var., planting angles, and nutrient applications in physically favorable medium. Horizontal planting delayed root development compared with vertical and slant planting. Field expt. were carried out with cassava var. T0773, planted sequentially at 3 sites with different soil types, each site having both untilled plots and flat, plowed, and retooled plots. Harvesting was done at 140 and 180 days after planting, corresponding approx. to the end of the wet season and the middle of the dry season, resp. Weekly measurements of soil MC and penetrometer resistance produced data for air-filled pore space and available water. Increasing resistance at prime pil rooting depth between $4.0 \times 10(5)$ N/square meter and $19.4 \times 10(9)$ N/square meter in presence of both adequate soil air and soil water reduce storage root fresh wt. by up to 88 percent. For both hard and soft soils, storage root fresh wt. was practically zero below 9.0 to 10.5 percent air space. Growth from 0 to 140 days after planting in the worst aerated treatment was minimal, but improved rapidly when dry season conditions removed this limitation. The most favorable soil physical conditions permitted initiation and development of 16 storage roots/plant (mean no.), with 30-35 storage roots or several plants. Initiation of storage roots was found to be possible even at the unexpectedly late stage of 140-180 days after planting following removal of severe aeration restriction. Equations for the dependence of storage root yield on soil physical factors, and equations relating components of crop growth to each other and to soil physical factors, were inferred. (AS (extract)) See also 0240 0243 0245 0248 0271 0288 0281 0397

E02 Cultivation Practices: Propagation, Planting, Weed Control and Harvesting

0266

30854 BESSA, J.M.G.; LIMA, J.A.D. DE; CESAR, F. 1986. Plantio de mandioca em fileiras duplas: uma prática viável em Pernambuco. (Cassava planting in double rows: a feasible practice in Pernambuco). Revista Brasileira de Mandioca 5(1):103-110. Pt., Sum. Pt., En., 4 Ref. [IPA-Sede, Caixa Postal 1022, 50.000 Recife-PE, Brazil]

Cassava. Planting. Root productivity. Brazil.

Demonstration units, supervised by the Brazilian national extension service, were conducted on private farms to evaluate the behavior of the double-row cassava planting system under real crop conditions and the consequent acceptance of this method by the farmers. Sixty-one

demonstration units of 0.5-1.0 ha were established in 1980-82. Only 34 percent had root production equal to or higher than 50 percent of av. productivity of the state (10.0 t/ha); 27 percent were between 50-90 percent that av., 11 percent between 100-149 percent, 15 percent between 150-199 percent, and 12 percent over 200 percent. Cassava planted in double rows facilitates the crop rotation, allowing simultaneous plantings and better weeding. This method is therefore quickly adopted. (AS)

0267

30477 CARVALHO, V.D. FE; PAULA, M.B. PE; STEINER, E.; JUSTE JUNIOR, G. 1985. Efeito da época de colheita no rendimento e composicao química de feno da parte aérea de 12 cultivares de mandioca. (Effect of harvesting time on yield and chemical composition of hay from the aerial part of ten cassava cultivars). Revista Brasileira de Mandioca 4(1):43-59. Pt., Sum. Pt., En., 11 Ref. [Empresa de Pesquisa Agropecuária de Minas Gerais, Caixa Postal 176, Lavras-MG, Brazil]

Cassava. Cultivars. Harvesting. Timing. Productivity. Foliage. Forage. Starch productivity. Protein content. Fiber content. Water content. Brazil.

To select optimum harvesting time and cv. for hay production, the productivity of the upper 3rd and the lower 2/3 of the aerial part of cassava was determined as well as the hay production and chemical composition of 12 different cv. harvested 8, 12, 16, 20, and 22 mo. after planting. The cv. showed the highest yields of high-protein hay at 12 and 16 mo. after planting. Cv. Engana Ladrao and Guaxupé, at 12 mo. after planting, and Engana Ladrao, Guaxupé, Iracema, and IAC 1418, at 16 mo. after planting, were considered the best. The use of the lower 2/3 of the aerial part was best at 20 mo. after planting. At this time, the cv. showed high hay yields, with higher protein and starch contents and lower fiber contents. Cv. Engana, Engana Ladrao, and Iracema were selected as the best cv. for hay production; cv. Iracema could also be used as a source of starch due to high starch productivity and content. (AS)

0268

28550 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1980. Multiplicación acelerada de material genético promisorio de yuca; unidad audiotutorial. (Rapid multiplication of promising cassava genetic materials; audiotutorial unit). Contenido científico Cook, J.H.; Toro, J.C.; Roca, W.M.; producción Fernández O., F. Cali, Colombia. 75 diap. color 5 x 5 cm.; 1 cassette 26 min.; guión 12p.; guía de estudio 28p. Es., 11.

Cassava. Propagation. Cuttings. Audiotutorial. Colombia.

The materials required and the steps followed to carry out rapid, simple, and low-cost propagation of cassava planting material are described; this propagation is based on 2-budded stem cuttings or on single leaf-bud cuttings. (AS-CIAT)

0269

28544 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1979. Manejo y control de malezas en el cultivo de la yuca. (Weed management and control in cassava crops; audiotutorial unit). Coordinación de producción Fuentes de Piedrahita, C.L.; asesoría científica Bell, J.; Lehnert, D. Cali, Colombia. 86 diap. color 5 x 5 cm.; 1 cassette 35.30 min.; guión 16p.; guía de estudio 36p. Es., 11.

Cassava. Weeding. Audiotutorial. Colombia.

127

Field results related with weed management and control in cassava crops are presented: critical competition period, planting density depending on crop management, crop-selective herbicides, and precautions with residues from other herbicides in the soil. (AS-CIAT)

0270

28542 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. s.f. Selección y preparación de estacas de yuca para siembra; unidad audiotutorial. (Selection and preparation of cassava cuttings for planting; audiotutorial unit). Coordinación de producción Ceballos, L.F.; asesoría científica Lozano, J.C.; Toro, J.C.; Castro, A.; Bellotti, A.C. Cali, Colombia. 65 diap. color 5 x 5 cm.; 1 cassette 27 min.; guión 18p.; guía de estudio 26p. Es., Il.

Cassava. Cuttings. Selection. Planting. Audiotutorial. Colombia.

Information is presented that allows the cassava grower to obtain better quality planting material. (AS-CIAT)

0271

29006 HAHN, S.K. 1984. Utilization, production constraints and improvement potential of tropical root crops. In Hawksworth, D.L., ed. Conference on Advancing Agricultural Production in Africa, 1., Arusha, Tanzania, 1984. Proceedings. Farnham Royal, England, Commonwealth Agricultural Bureaux. pp.91-97. En., 12 Ref.

Cassava. Cultivation. Production. Intercropping. Cultivation systems. HCN content. Cassava products. Productivity. Weeds. Cultivars. Mulching. Nigeria.

A revision is presented of the accumulated experience at the International Institute for Tropical Agriculture in Ibadan, Nigeria, since its establishment in 1967, with regard to different aspects of cassava cultivation and production: production constraints due to diseases and pests, var. improvement, biological control, agronomic practices, land preparation, cultivation under shade, soils, seed material, association with other crops (cassava/maize, cassava/melon/maize, cassava/peanuts, and cassava/cowpeas), consumption of the leaves as vegetable, weed control, continuous production in the same plot, HCN content, and the processing system for different cassava-based products. Cultivation under shade affected yield in wt. and no. of roots/plant. In association with maize, cassava produced, on the av., 10 t/ha. Imperata cylindrica is reported among the weeds that produce major losses in yield due to competition. Cassava is presented as a crop that is tolerant to the prevailing drought conditions in some regions of Africa. (CIAT)

0272

30052 KISSIEDU, A.F.K. 1978. The effect of age at harvesting and fertilizer NPK application on tuber yield of cassava (*Manihot esculenta* Crantz) under southern savanna conditions in Ghana. Accra, Ghana, Crops Research Institute. Council Scientific and Industrial Research. 13p. En., Sum. En., 13 Ref., Il.

Cassava. Harvesting. Timing. Fertilizers. Savannas. N. P. K. Root productivity. Ghana.

The effect of age at harvesting and fertilizer NPK application on root yield of 2 cassava cv. (Ankra and Katawia) was examined in a double split-plot design expt. in Chawu and Kpeve in the southern savanna zone of Ghana. Cv. Ankra outyielded Katawia at both sites of the expt. Yield levels at the various stages at harvesting for the 2 cv. were irregular but

yield trends exhibited tendencies for increase in yield with increasing age. The yield of cv. Ankra was max. at the age of 15 mo. and declined immediately thereafter while cv. Katavia attained its max. root yield at 17 mo. and appeared to maintain an almost uniform yield up to 20 mo. Apart from cv. and age of the crop, marked seasonal variations might influence the food quality of cassava roots. The results also showed that the general trend of fertilizer effect on yield tended to be negative beyond the age of 15 mo. (AS)

0273

30125 MONTEIRO, D.A.; LERENZI, J.O.; VALLE, T.L.; PEREIRA, A.S. 1984. Producao de semente de mandioca em plantas com um e dois ciclos vegetativas. (Cassava seed production in plants with one and two growth cycles). *Bragantia* 43(3):667-672. Pt., Sum. Pt., En., 3 Ref. [Secao Raizes e Tuberculos, Inst. Agronomico, 13.100 Campinas-SP, Brasil]

Cassava. Seed. Pruning. Cuttings. Planting. Production. Cultivars. Brazil.

In 1980-81, production of cassava seed was evaluated in plants with 1 and 2 growth cycles. Plants with 2 growth cycles were cultivated without pruning or pruned to a height of 10 cm. Plants with 1 growth cycle yielded, on av., 31.70 seeds/plant. Plant with 2 growth cycles, pruned or not, yielded 23.39 and 64.64 seeds/plant, resp. Although best results were observed with the unpruned plants, field operations such as spraying, crop management, and fruit bagging were more difficult due to the tall and overlapping plants. These difficulties, however, may not occur when the crops are grown on poor soils. (AS) See also: 0229 0241 0242 0259 0265 0276 0279 0378 0396 0397

D03 Energy Productivity and Yields

0274

30126 PERFIRA, A.S.; LORZENI, J.O.; MONTEIRO, D.A. 1984. Reguladores de crescimento na producao de mandioca. (Growth regulators in the production of cassava). *Bragantia* 43(3):673-(76. Pt., Sum. Pt., En., 6 Ref. [Secao Raizes e Tuberculos, Inst. Agronomico, 13.100 Campinas-SP, Brasil]

Cassava. Plant growth substances. Root productivity. Foliage. Brazil.

GA, IAA, NAA, and vitamin B1 were evaluated as growth regulators on cassava in 2 field expt. in Campinas (Sao Paulo, Brazil). Although the treatments used did not increase root and stem yields significantly, GA at 50 ppm tended to increase root yields when cassava cuttings were dipped or when they were soaked during 1 h, or when 2-mo.-old plants were sprayed. (AS)

0275

29505 SILVA, M.S.E.; MARCHEZAN, F.; AUPE, M.J. DA S. 1985. Avaliacao e multiplicacao de clones e cultivares de mandioca em Santa Maria, RS. (Nota prévia). (Evaluation and multiplication of cassava clones and cultivars in Santa Maria, RS (Advance note)). *Revista do Centro de Ciencias Rurais* 15(3):211-212. Pt.

Cassava. Cultivars. Productivity. Root productivity. Agronomic characters. Brazil.

Results are presented of a trial conducted with 55 cassava clones and cv. to determine those with higher productive capacities and superior agronomic characteristics, at the Federal U. of Santa Maria (Rio Grande do Sul, Brazil). Root productivity varied between 8.6-67.8 t/ha in a 7-mo. growth

cycle. MG-94, S18-7, and Mariva were the highest yielding cv. with 31.7, 31.4, and 67.8 t/ha, resp. The trials, however, were severely affected (100 percent leaf loss) by a hailstorm when the plants were 90 days old. (CIAT)

0276

30820 TAH, S.L. 1985. Correlations studies on the performance of some cassava varieties at five locations. MARDI Research Bulletin 13(2):178-185. En., Sum. En., Mal., 6 Ref., 11.

Cassava. Cultivars. Germplasm. Identification. Rainfall. Root productivity. Plant height. Germination. Harvest index. Starch content. HCN content. Starch productivity. Field experiments. Malaysia.

Sixteen cassava var. were tested at 6 sites at 5 different localities in Malaysia. Var. Black Twig, Medan, and Bangkok were shown to be highly adaptable, each emerging among the 5 top yielding var. in 4 of the 6 sites. Yields were highest at 4 of the 6 sites in Serdang, and lowest in Pontian. Peat soils in Jalan Kebun and Pontian produced roots with relatively lower starch contents than roots on the mineral soils in Serdang, Satiawan, and Bukit Selambau. Correlation studies among the sites revealed strong repeatability of fresh root and starch yields among mineral soil sites and among peat sites. It appears, therefore, that initial stages of selection of high yielding clones for current and potential cassava production areas may be confined to 1 site located on mineral soils and another on peat, precluding the expensive practice of preliminary evaluation of clones over a wide range of environments. Germination was also related among the sites on mineral soils, but not at all on the peat sites. It would appear that high starch content may be selected for at any location since it is highly correlated among all the sites tested. (AS) See also 0242 0243 0258 0262 0266 0287 0272 0273 0287 0293 0311 0312 0314 0316 0317 0354 0390 0396

D04 Postharvest Studies

0277

30944 ANKERAH, E.K.; OSEI-YAW, A. 1981. The storage of cassava (*Manihot esculenta*) root tubers in sawdust medium contained in matted coconut palm fronds. Accra, Ghana, Food Research Institute, Council for Scientific and Industrial Research. 9p. En., Sum. En., 4 Ref., 11.

Cassava. Storage. Roots. Foofoo. Gari. Organoleptic examination. Small-scale equipment. Ghana.

A cassava storage structure was designed and constructed from matted coconut palm fronds. The structure remained in good condition in the field (Lagon, Ghana) for about 6 mo. The structure was used to evaluate the storage performance of cassava roots in moist sawdust medium. Roots stored for about 50 days. Organoleptic tests showed that the roots were not suitable for making fufu and a local dish 'ampesi' made with cooked vegetable, but were useful for gari and dough. (AS)

0278

30804 BRUMIBHAMON, O. 1986. Glucoamylases of a fungus isolated from a rotting cassava tuber. MIRCEN Journal of Applied Microbiology and Biotechnology 2(4):473-482. En., Sum. En., Es., Fr., 17 Ref., 11. [Dept. of Biotechnology, Faculty of Agro-Industry, Kasetsart Univ., Bangkok 10900, Thailand]

Cassava. *Aspergillus*. Enzymes. Deterioration. Thailand.

Glucosylase produced by *Aspergillus niger* H-9 (isolated from rotting cassava roots in Thailand) when cultured on rice bran-SBM was purified and characterized. Two types of glucosylases were identified. The purified glucosylases were found to be homogenous on 7.5 percent polyacrylamide gel disc electrophoresis. The mol. wt. of glucosylase I and II were 59,400-72,600 and 43,000-52,600, resp. The Km values of glucosylase I and glucosylase II were 12.5 and 6.25 mg glucose/ml when soluble starch was used as substrate. The optimal pH of both enzymes was 4.0-5.0. The optimum temp. for the activities of glucosylase I and glucosylase II were 60 and 70 degrees Celsius, resp. Both enzymes were stable in the pH range 3.0-6.0 and temp. stable below 50 degrees Celsius. Both glucosylases were active on various kinds of starch and dextrin including raw starch. Glucosylase II was, however, found to hydrolyse raw starch better than glucosylase I. (AS) See also 0334 0347 0361

E00 PLANT PATHOLOGY

0379

0599 LOZANO, J.C. 1987. Alternativas para el control de enfermedades en yuca. (Alternatives for cassava disease control). Cali, Colombia, Centro Internacional de Agricultura Tropical. Rep. Es. 34 Ref. Trabajo presentado en la Reunión de Trabajo sobre Intercambio de Germoplasma, Cuarentena y Mejoramiento de Yuca y Batata, CIAT-CIP, 1987. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Disease control. Cultivation. Cuttings. Planting. Selection. Weeding. Rotational crops. Resistance. Colombia.

The different alternatives for disease control in cassava, reported as efficient and that could be taken into account when designing technological packages for cassava production, are summarized. These are cultural control (crop rotation, planting on furrows, elimination of crop residues, distance between plants, selection of planting material, weeding, and use of irradiation), var. control, chemical control, biological control, eradication, and quarantine measures. Tables are also included with the results obtained from the application of the different control measures mentioned. There is a need for technological packages for the integrated control of cassava diseases, which should be revised periodically and by regions, to make adjustments according to the ecological circumstances. (CIAT)

0380

30138 PACUMABÁ, R.F. 1987. A screening method for detecting resistance against cassava bacterial blight disease. *Phytopathologische Zeitschrift* 119(1):1-6. En., Sum. En., Pe., 6 Ref., 11. [Dept. of Plant & Soil Science, Alabama A & M Univ., Normal, AL 35762, USA]

Cassava. *Xanthomonas campestris* pv. *manihoti*. Resistance. Selection. Cultivars. Symptomatology. Field experiments. Zaire.

Inoculation of the CBB pathogen by using a modified pair of tongs on 1-mo.-old cassava shoots in the glasshouse and in the field (Mankawa, Zaire) resulted in symptoms within 24-48 h on susceptible cassava lines 02864 and M'pelongu. Gum exudates on inoculated young stems and dieback appeared 7-13 and 20-25 days later, resp. No symptoms of CBB were observed on cv. Kadanga Malembu. Symptom development and CBB ratings on 3-mo.-old cassava shoots in the glasshouse and in the field were not consistent.

Inoculation of CBB pathogen on 521 cassava shoots (1-mo.-old) using the tongs method gave 81 and 82 resistant and moderately resistant plants, resp. The tongs method is an excellent field-screening technique for detecting resistance to CBB on 1-mo.-old cassava shoots. (AS)

E03 Mycoses

0281

30537 ESTRADA C., B.L. 1985. Estudio de la pudrición de la raíz de la yuca causada por *Helicobasidium purpureum*, en el Municipio de Sansare El Progreso, Guatemala. (Study of cassava root rot caused by *Helicobasidium purpureum*, in the municipality of Sansare El Progreso, Guatemala). Tesis Ing.Agr. Guatemala, Universidad de San Carlos de Guatemala. 59p. Es., Sum. Es., 15 Ref., Il.

Cassava. Roots. Deterioration. Etiology. *Helicobasidium purpureum*. Disease control. Guatemala.

An expt. was carried out in the municipality of Sansare, Guatemala, to identify the causal agent of the root rot that occurs in cassava crops, as well as to estimate the level of damage and to propose some alternatives for its control. The cassava plant in its different stages of growth was utilized. Three culture media were used to identify the causal agent: PDA, V8-agar, and cassava-dextrose-agar. To these, lactic acid in concn. of 5, 10, and 15 drops/liter was added. The development of the pathogen was also tested in the cassava tuber, which was inoculated with the pathogen's interwoven mycelium. This cassava was placed in a dark humid chamber as well as under natural light. Field samples were taken at La Laguna, duly confirming the absence of the disease. The 12 selected plants were planted in pots and inoculated with mycelium. The organism was identified as *Rhizoctonia crocorum* (*Helicobasidium purpureum*). A survey indicated that the highest percentages of infestation were in the localities of Buena Vista, Los Cedros, and El Pino, and the village of Santa Barbara (33.34, 24.14, and 20.00 percent, resp.). The least affected areas were San Felipe La Tabla, Posa Verde, El Aguaje, and Sansare (5.12, 6.84, 8.50, and 8.50 percent, resp.). The percentage of the total planted area affected was 13.36. Starch production from healthy and affected roots was also studied, and the results indicated that the production from healthy roots was 4.5 kg vs. 0.87 kg for affected roots. It was considered that the best method of control is crop rotation or the incorporation of resistant var. (AS (extract)-CIAT)

0282

30853 FUKUDA, C.; SOUZA, L.D.; FERRO, A. DE S. 1986. Ocorrência do superalongamento da mandioca na região de Sinop, no Estado de Mato Grosso, e recomendações para seu controle. (Occurrence of cassava superelongation in the Sinop region, state of Mato Grosso, and recommendations for its control). Revista Brasileira de Mandioca 5(1):95-101. Pt., Sum. Pt., En., 6 Ref., Il. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. *Sphaceloma manihoticola*. Disease control. Brazil.

The incidence of superelongation, caused by *Sphaceloma manihoticola*, in 490 cassava plantations in the Sinop region, Brazil, was determined; control measures were also established. Results showed that 9.6 percent of the evaluated plantations (approx. 905 ha) were infected by the disease. From 2 to 100 percent of the plants were infected. Var. Cuiabana and Branca de Santa Catarina, the most cultivated in the region, had the lowest disease

severity indexes. Phytosanitary measures were taken to control the disease; interdiction of areas where the disease occurs; restricted outgo of infected plant material; and establishment of inspection stations. Crop rotation, selection of cuttings, technical assistance, financial support, and use of resistant var. were other control measures recommended. (AS)

0283

30140 MAKAMBILA, C.; BAKALA, L. 1986. Les pourridiés a *Armillaria* sp., *Sphaerostilbe repens* B. et Br. et *Phaeolus manihotis* Heim sur le manioc (*Manihot esculenta* Crantz). (Cassava root rot diseases caused by *Armillaria* sp., *Sphaerostilbe repens*, and *Phaeolus manihotis*). *Agronomie Tropicale* 41(3-4):258-264. Fr., Sum. Fr., En., Es., 25 Ref., Il. [Dept. of Biologie et Physiologie Végétales, Univ. Marien Ngouabi, B.P. 69, Brazzaville, Congo]

Cassava. *Armillaria*. *Sphaerostilbe repens*. *Phaeolus manihotis*. Congo.

Armillaria sp., *Sphaerostilbe repens*, and *Phaeolus manihotis*, the principal causal organisms of the root rot diseases found on cassava in the Congo People's Republic, were studied. The differentiation of a no. of organs by the pathogens was observed on an infected section of cassava root placed in an exptl. device consisting of a transparent plexiglass box containing water. *Armillaria* sp. differentiated carpophores, "subterranea" rhizomorphs, and other unidentified organs. *S. repens* differentiated rhizomorphs and cecremia. These organs were not observed in *P. manihotis*. Carpophore production by *Armillaria* sp. from infected roots is important for the systematic study of root rot pathogens, particularly *Armillaria* sp., in the Congo People's Republic and Central Africa where it remains the principal causal organism of root rot diseases. (AS) See also 0278

E04 Viroses

0284

30156 ELLIOTT, M.S.; ZETTLER, F.W. 1987. Cassava common mosaic virus infections of chaya (*Cnidoscolus aconitifolius*) in Yucatan, Mexico. *Plant Disease* 71(4):353-356. En., Sum. En., 6 Ref., Il. [Dept. of Plant Pathology, Univ. of Florida, Gainesville, FL 32611, USA]

Cassava. Cassava common mosaic virus. Isolation. Mexico.

A study was conducted to determine the incidence of cassava common mosaic virus (CCMV) in chaya (*Cnidoscolus aconitifolius*) and whether chaya viral isolates from Yucatan, Mexico, are similar to one from Florida, USA. CCMV was detected in 23 of 33 samples of chaya collected at 14 of 17 locations in Yucatan in Aug. 1985, and the isolates were serologically indistinguishable from the Florida strain. Cassava is not likely to be the source of CCMV inoculum for chaya in Yucatan, because of the absence of CCMV in the cassava samples tested. (CIAT)

0285

30151 FARGETTE, D.; THOUVENEL, J.C.; FAUQUET, C. 1987. Virus content of leaves of cassava infected by African cassava mosaic virus. *Annals of Applied Biology* 110(1):65-73. En., Sum. En., 22 Ref., Il. [Laboratoire de Virologie Végétale, Inst. Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM), B.P. V51, Abidjan, Cote d'Ivoire]

Cassava. Cassava African mosaic virus. Leaves. Analysis. Symptomatology. Aleyrodidae. Ivory Coast.

CAMV was detected in cassava leaves by ELISA. Some normal constituents of cassava leaves interfered with virus detection but leaf extracts of *Nicotiana benthamiana* did not. The symptom pattern was determined early in the growth of a leaf and subsequently changed little. CAMV was found only in the yellow or yellow green areas of the mosaic pattern. Virus content of the leaves increased with increasing symptom intensity, but decreased with leaf age and CAMV was not detected in mature leaves. Most whiteflies were found on young growing cassava leaves and the no. decreased progressively with leaf age. This distribution will aid both the acquisition and inoculation of the virus. (AS)

0286

30823 LENNON, A.M.; AITON, M.M.; HARRISON, B.D. 1987. Purification and properties of cassava green mottle, a previously undescribed virus from the Solomon Islands. *Annals of Applied Biology* 110(3):545-555. En., Sum. En., 16 Ref., Il. [Scottish Crop Research Inst., Invergowrie, Dundee DD2 5DA, United Kingdom]

Cassava. Cassava green mottle virus. Etiology. Solomon Islands.

A sap-transmissible virus obtained from cassava with a green mottle disease occurring at Choiseul, Solomon Islands, was transmitted to 30 species in 12 plant families and was readily seed-borne in *Nicotiana clelandii*. In cassava plants infected by inoculation with sap, the 1st leaves to be infected systemically developed a mottle with some necrosis whereas leaves produced subsequently were symptomless but contained the virus. Most other species developed chlorotic or necrotic local lesions and systemic mottle or necrosis. This was followed, in several species, by production of small symptomless virus-containing leaves. The virus was cultured in *N. clelandii*; *Chenopodium quinoa* was used for local lesion assays. Leaf extracts from infected *N. clelandii* were infective after dilution to 10(-5) but usually not at 10(-6), after heating for 10 min at 60 degrees Celsius but not at 65 degrees Celsius, and after storage at 20 degrees Celsius for at least 12 days. The virus has isometric particles of 26 nm diameter which sediment as 3 components, all containing a protein of mol. wt. of approx. 53 000. The 2 fastest sedimenting components resp. contain single-stranded RNA of mol. wt., estimated after glyoxylation, approx. 2.9 x 10(6) and 2.3 x 10(6). Both RNA species are needed for infection of plants. In tests with antiserum prepared to purified virus particles, the virus was detected in cassava and *N. clelandii* by gel-diffusion precipitin tests, by immunosorbent electron microscopy, and by ELISA. Despite its similarity to nepoviruses, the virus did not react with antisera to 18 members of the group. It was named cassava green mottle virus and is considered to be a previously undescribed nepovirus. (AS)

0287

30129 MJIMBA-KANKOLONGO, A.; PHUTI, K. 1987. Relationship of cassava mosaic severity in planting material to mosaic development, growth and yield of cassava in Zaire. *Experimental Agriculture* 23(2):221-225. En., Sum. En., Es., 16 Ref. [Programme National Manioc, B.P. 11635 Kinshasa 1, Zaire]

Cassava. Cassava African mosaic virus. Plant development. Propagation materials. Cuttings. Root productivity. Plant height. Stems. Pest damage. Zaire.

The performance of a CAMD-susceptible cassava clone was assessed over 2 successive years for disease development, plant vigor, and yield of fresh tuberous roots in M'Vuazi, Bas-Zaire. Cuttings from plants with different CAMD infection levels were used. There was a significant increase in mosaic incidence and severity, and in the proportion of leaves showing

disease symptoms in the subsequent crop as the levels of CAMD primary infection in planting material increased. Plant height and stem diameter were also adversely affected and the yield of plants from severely affected cuttings was reduced by 60-70 percent. (AS)

0288

29301 OTIM NATE, G.W.; INCOF, A. 1986. Effect of cassava spacing, time of planting and number of shoots on the incidence and severity of the African cassava mosaic disease. Uganda, Serere Research Station. 10p. En., Sun. En., 8 Ref., 11. Paper presented at the 3rd Symposium ISTRC-AB, Umudike, Nigeria, 1986. [Unconf., Serere Agricultural Research Station, P.O. Soroti, Uganda]

Cassava. Cuttings. Planting. Timing. Spacing. Cassava African mosaic virus. Vectors. Uganda.

The effects of spacing and time of planting and spacing and no. of shoots of cassava on the incidence and severity of CAMD were studied in 2 split-plot expt. Cassava canopy temp., RH, whitefly population, CAMD incidence and severity were recorded at 2-mo. intervals beginning 4 and ending 14 mo. after planting. Cassava canopy temp. significantly increased with increased spacing, while RH was not affected by any of the treatments. Whitefly population and the incidence and severity of CPD increased with further delay in cassava planting, and reached highest levels on cassava planted in Aug. Similarly, CAMD incidence increased with further increase in cassava spacing and was significantly decreased by increase in no. of cassava shoot/plant. The effects of the treatments on CAMD are discussed. (AS)

0289

30141 PACHEBARA, R.P. 1987. A method for selection of tolerance to African cassava mosaic virus. Phytopathologische Zeitschrift 118(4):312-316. En., Sun. En., De., 13 Ref. [Dept. of Natural Resources & Environmental Studies, Alabama Agricultural & Mechanical Univ., P.O. Box 183, Normal, AL 35762, USA]

Cassava. Cassava African mosaic virus. Cultivars. Selection. Resistance. Zaire.

Detopping hastened the appearance of mosaic symptoms in shoots of cassava cuttings infected with CAMV. The degree of plant recovery from severe mosaic after each detopping was the basis for evaluation of CAMV tolerance. In field screening, detopping of cassava shoots infected with CAMV is recommended for selection of tolerance to the virus. One detopping of CAMV-infected shoots was sufficient to analyze tolerance level reliably. Out of 521 lines only 1 was found to be tolerant, while 144 lines were found to be moderately tolerant. These included the lines Gimbi MA 235, (029452 x 3119)S MA 219, and Endanga Malombe previously described as resistant to CAMV. (AS) See also 0238-0302

E06 Nematodes

0290

30319 FREITAS, O.M.B.L. DE; MOURA, R.M. 1986. Comportamento de cultivares de mandioca (*Manihot esculenta* Crantz) em relação ao parasitismo de *Meloidogyne incognita* M. Javanica (Nematoda, Heteroderidae) e comparacoes com os tecidos de ácido cianídrico. (Performance of cassava cultivars in relation to parasitism of *Meloidogyne incognita* and *M. Javanica* (Nematoda, Heteroderidae) and comparisons with hydrocyanic acid levels). *Nematologica*

146

Brasileira 10:109-131. Pt., Sum. Pt., En., 39 Ref. [Laboratorio Nacional de Referencia Vegetal, Ministerio da Agricultura, Recife-PE, Brasil]

Cassava. Cultivars. Nematodes. Roots. HCN content. Resistance. Leaves. Stems. Brazil.

The performance of 11 cassava cv. related to parasitism by *Meloidogyne incognita* and *M. javanica* was studied under greenhouse and lab. conditions. The analysis of resistance and/or susceptibility was made according to criteria adapted by the International Meloidogyne Project. A classification system for the host was also established based on the reduction of the reproductive rate (percentage) in relation to the highest rate observed for each nematode species on the cv. chosen as the standard in susceptibility. Different types of reactions were observed; susceptibility was more common than resistance. Cv. Mandiocaol showed resistance to both nematode species, whereas cv. Retroz 1 and Retroz 14 were resistant only to *M. incognita*. From the epidemiological viewpoint, cv. Mandiocaol, Pará, Preta Legítima, Retroz 1, and Retroz 14 were considered as poor hosts for *M. incognita* and cv. Bahia Preta, Mandiocaol, Pará, Retroz 1, and Rosa Branca for *M. javanica*. No relationship was found between resistance and/or susceptibility to *M. incognita* and *M. javanica* and HCN levels in the different parts of cassava plants. Storage roots of the tested cv. did not present root-knot symptoms. (AS)

FOO PEST CONTROL AND ENTOMOLOGY

0291

30482 LE RU, B.; FABRES, G. 1987. Influence de la température et de l'hygrométrie relative sur la capacité d'accroissement et le profil d'abondance des populations de la cochenille du manioc, *Phenacoccus manihoti* (Hom., Pseudococcidae), au Congo. (Influence of temperature and relative humidity on the growth rate and incidence of mealybug populations, *Phenacoccus manihoti* (Hom., Pseudococcidae) in Congo). *Acta Oecologica Oecologia Applicata* 8(2):165-174. Fr., Sum. Fr., En., 21 Ref., Il. [ORSTOM, B.P. 181 Brazzaville, R.P. du Congo]

Cassava. *Phenacoccus manihoti*. Insect biology. Insect population. Congo.

Demographic parameters of the cassava mealybug (*Phenacoccus manihoti*) were estimated at different temp. (20, 25, and 30 degrees Celsius) and RH regimes (50, 75, and 100 percent). Temp. appears to be the factor that most influences development time and capacity for increase. Simulations of the increase of mealybug populations were derived from exptl. results and compared with the gradation profiles observed during 3 yr at the same site of Congo. Variations of size seem to be primarily related to the thermic conditions prevailing during the outbreak. An early pullulation, starting under the influence of low temp. (July), will increase slowly, with well-defined steps between the 1st generations; whereas a late pullulation, occurring under the effect of higher temp., will develop more steeply, with a rapid succession of generations. (AS)

0292

29446 SANTOS, C.D.; TERRA, W.R. 1985. Physical properties, substrate specificities and a probable mechanism for a beta-D-glucosidase (cellobiase) from midgut cells of the cassava hornworm (*Erinnyis ello*). *Biochimica et Biophysica Acta* 831(2):179-185. En., Sum. En., 25 Ref. [Depto. de Bioquímica, Inst. de Química, Univ. de Sao Paulo, Sao Paulo, Caixa Postal 20780, 01498, Brasil]

Cassava. *Erinnyis ello*. Entomology. Brazil.

Some of the physical and kinetic properties of a soluble cellobiose from midgut cells of larvae of *Erinnyis ello*, which is active of beta-D-glucosides, beta-D-galactosides, beta-D-fucosides, and beta-D-xylosides, are described. *E. ello* midgut cells display a beta-D-glucosidase with Mr 129 000 and pI 6.8. The enzyme hydrolyzes beta-D-glucosides, beta-D-galactosides, and beta-D-fucosides at the same active site, as inferred from expt. involving thermal inactivation, different inhibitors, and the competition between substrates. The enzyme is almost inactive on a thioglycoside. Delta-gluconolactone is a strong (Ki 0.85 micromole) inhibitor of the enzyme. The hydrolysis of the beta-D-glucosidic bond catalyzed by the beta-D-glucosidase occurs without inversion of configuration, with a reaction constant p close to zero. These data support the assumption that the mechanism of the reaction catalyzed by the beta-D-glucosidase involves the protonation of the substrate glycosyl oxygen, and the intermediary formation of a carbonium ion, which is attacked by water from the front side. (AS) See also 0264 0361 0394

F01 Injurious Insects and their Control

0293

30147 AYANRU, D.K.G. 1987. Effects of mealybug (*Phenacoccus manihoti*) infestation on cassava yield components and plant tissue quality. Tropenlandwirt 88:5-10. Fr., Sum. En., De., 18 Ref. [Dept. of Microbiology, Univ. of Benin, PMB 1154 Benin City, Nigeria]

Cassava. *Phenacoccus manihoti*. Pest damage. Plant tissues. Analysis. Stems. Defoliation. Root productivity. Carbohydrate content. N. Protein content. Metabolism. Nigeria.

Half of the stands of cassava clone TM5 41044 planted in field plots in Ugbouro, Nigeria, in June 1963 were treated at 3-wk. intervals against mealybugs (*Phenacoccus manihoti*), using fenitrothion. At 10 mo., sprayed and unsprayed plants were evaluated for mealybug infestations, canopy height, and stem diameter, and harvested for yields and assessment of quality. Unsprayed plants were completely defoliated and reduced (23 percent) in canopy height, while sprayed ones were free from infestation symptoms. Dry stem and root yields of infested cassava were reduced significantly ($P = 0.01$) by 39 and 60 percent, resp., as compared with those of noninfested plants. Stem tissues of infested stands were less succulent than those of noninfested, while the reverse was true for root tissues. Stems and roots of nondefoliated as compared with defoliated cassava were depleted in total carbohydrates (28.41 vs. 19.06 percent and 70.72 vs. 65.13 percent, resp.) and ME contents (415 vs. 278 and 1033 vs. 951 kcal/kg, resp.). On the contrary, tissues of infested plants contained enhanced protein contents (over 88 percent). The dietary and other implications of augmented or depleted assimilates and anabolites in the tissues, and their induction mechanisms are discussed. (AS)

0294

30483 BASTOS, J.A.M.; FLEHTMANN, C.H.W. 1982-1985. Síntomas e danos do ácaro do tanajoá na manicoba. (Symptoms and damage caused by the tanajoaba mite in Ceara rubber). Fitossanidade no.6-9:102-105. Pt., Sum. En., 1 Ref., Il. [CNPq, Caixa Postal 2071 JA, 60.000 Fortaleza-CE, Brasil]

Cassava. *Monorychellus tanajoa*. Pest damage. *Manihot glaziovii*. Brazil.

The feeding damage caused by the tetranychid mite *Mononychellus tanajoa* to the foliage of the Ceara rubber plant (*Manihot glaziovii*) is described. (CIAT)

0295

30577 FABRES, G.; KIYINDOU, A. 1985. Comparaison du potentiel biotique de deux coccinelles (*Exochomus flaviventris* et *Hyperaspis senegalensis hottentotta*, Col. Coccinellidae) prédatrices de *Phenacoccus manihoti* (Hom. Pseudococcidae) au Congo. (Compared biotic potential of two coccinellid species, *Exochomus flaviventris* and *Hyperaspis senegalensis hottentotta* (Col. Coccinellidae), predators of *Phenacoccus manihoti* (Hom. Pseudococcidae) in Congo). *Acta Oecologica Oecologia Applicata* 6(4):339-348. Fr., Sum. En., Fr., 15 Ref., 11. [IBEAS, Campus Universitaire, Avenue de l'Université, 64000 Pau, France]

Cassava. *Phenacoccus manihoti*. Predators and parasites. Insect biology. Biological control. Congo.

Cultures of *Exochomus flaviventris* and *Hyperaspis senegalensis hottentotta*, the 2 main coccinellid predators associated with the cassava mealybug *Phenacoccus manihoti* in Congo, were used in the lab. to study their biotic potential. Data on life cycle, duration of development instars, sex ratio, fecundity, and length of female life are given. The Laughlin's capacity for increase was calculated for each species: 0.05 for *E. flaviventris* and 0.07 for *H. senegalensis hottentotta*, with net reproductive rates, resp., of 66.6 and 123.7. The variations of the abundance of the predators were followed in a cassava field and compared with the population dynamics of the mealybug throughout the dry season of 1979. The 2 species show great differences in their fecundity, duration of adult life, and time of their intervention during the pest outbreak. Several hypothesis are discussed to explain the low biotic potential of *E. flaviventris* and the failure of *H. senegalensis hottentotta* to increase its population soon enough to play a role in the regulation of the pest. (AS)

0296

30468 FARIAS, A.R.N. 1985. *Hyaliodor vitreus* Distant, 1884 (Hemiptera:Miridae), um predador de *Vatiga illudens* (Drake, 1773) (Hemiptera:Tingidae) em mandioca, na Bahia. (*Hyaliodor vitreus* (Hemiptera:Miridae), a predator of *Vatiga illudens* (Hemiptera:Tingidae) in cassava in Bahia). *Revista Brasileira de Mandioca* 4(1):123-124. Pt., 4 Ref. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. *Vatiga illudens*. Predators and parasites. Brazil.

Field observations of cassava crops in Cruz das Almas (Bahia, Brazil) detected a biological control agent preying on *Vatiga illudens*, a cassava pest increasing in importance and mainly occurring during the dry seasons. Adult specimens of the predator were identified as the species *Hyaliodor vitreus*. The damage caused by the pest is briefly described and distinctive morphological characteristics of the predator are mentioned. (CIAT)

0297

30484 FURSCH, H. 1987. Neue afrikanische scymnini-arten (Coleoptera Coccinellidae) als freilebende von Manihot-Schadlingen. (New African Scymnini species (Coleoptera:Coccinellidae) as predators of Manihot pests). *Revue de Zoologie Africaine* 100(4):387-394. De., Sum. De., En., 14 Ref., 11. [Universität Passau, Postfach 25 40, D-8390 Passau, West Germany]

Cassava. *Phenacoccus manihoti*. Predators and parasites. Biological control. Africa.

Three new Seymniini species are described as predators of the Manihot pests: *Nephus phenacoccephagus*, *Diomus hennesseyi*, and *Clitostethus neuenschwanderi*. Determination is made easier by differential diagnoses and numerous figures. All known facts about the biology of *Clitostethus* sp. were taken into account. (AS)

0298

30154 JAMES, B.D. 1987. The cassava mealybug *Phenacoccus manihoti* Mat-Ferr (Homiptera: Pseudococcidae) in Sierra Leone: a survey. *Tropical Pest Management* 33(1):61-66. En., Sum. En., 9 Ref., 11. [Dept. of Zoology, Fourah Bay College, Univ. of Sierra Leone, Freetown, Sierra Leone]

Cassava. *Phenacoccus manihoti*. Pest damage. Maps. Biological control. Sierra Leone.

A survey was undertaken in Sierra Leone to map the distribution of the cassava mealybug (*Phenacoccus manihoti*) and to identify ways in which it was spread (naturally and by humans). These features would then become inputs to a control program. The pest was found to be firmly established in the western part of the country and is progressively extending to the provincial areas. All available cassava var. are susceptible to the insect, and the damage is especially significant on the late-planted crop. Biological control, for example by ground release of exotic hymenopteran parasitoids in the dry season, is recommended as a long lasting strategy to undermine the pest's status as a constraint to food production. (AS)

0299

30464 KRAAIJEVELD, A.R.; VAN ALMHEEN, J.J.M. 1986. Host-stage selection and sex allocation by *Epidinocarris lopezi* (Hymenoptera: Encyrtidae), a parasitoid of the cassava mealybug, *Phenacoccus manihoti* (Homoptera: Pseudococcidae). *Mededelingen van de Faculteit Landbouwwetenschappen Rijksuniversiteit Gent* 51(3a):1067-1078. En., Sum. En., 10 Ref., 11. [Subfaculteit Biologie, Rijksuniversiteit Leiden, Kaiserstraat 63, P.O. 9515, 2300 RA Leiden, Nederland]

Cassava. *Phenacoccus manihoti*. Predators and parasites. Entomology. Laboratory experiments.

Host-stage selection and sex allocation of *Epidinocarris lopezi* were investigated to aid in an evaluation of *E. lopezi* as a biological control agent. *E. lopezi* females were offered host-patches consisting of various cassava mealybug stages. Parasitoid and mealybug behavior was observed, parasitized mealybugs were reared, and their growth recorded. *E. lopezi* preferred 3rd instar mealybugs relative to 2nd and 4th. First instar and adult mealybugs were the least preferred stages. *E. lopezi* females can discriminate between parasitized and unparasitized hosts and usually reject the former. The wasp marks parasitized hosts externally. Most females emerged from 3rd instar mealybugs, less from 4th instars, and least from adults. Second instar mealybugs produced almost exclusively males (survival in 1st instar mealybugs was negligible). Mealybug size at time of parasitization was not correlated with size of the emerging wasp; however, mealybugs containing female larvae grew larger before mummifying than mealybugs with male larvae. This growth pattern was most apparent in 3rd instars, less so in 4th, and absent in adult mealybugs. Mummy size predicts the size of the emerging wasp well. For female wasps size is correlated with fitness. In the cultures larger females are more often inseminated than smaller. Moreover, larger females have greater success in piercing the host's skin, and live longer without food than smaller females. *E. lopezi* appears to maximize the fitness of her offspring by preferring and allocating the highest percentage of females to 3rd instar mealybugs. (AS)

0300

30590 LAL, S.S.; PILLAI, K.S. 1980. Efficacy of certain pesticides in the control of thrip *Retithrips syriacus* on cassava. *Indian Journal of Plant Protection* 8(1):29-35. En., Sum. En., 12 Ref., 11.

Cassava. Thrips. Insect control. Insecticides. India.

Tests were performed with 24 pesticides during 1976-78 against the thrip *Retithrips syriacus*, a cassava pest in Kerala, India. Among 21 pesticides tested during 1976, 15 were promising and reevaluated during 1977. Eleven pesticides found promising were retested during 1978. Final results showed that monocrotophos and leptophos at 0.03 percent and demeton methyl and fenitrothion at 0.05 percent were superior in controlling *R. syriacus*. The pesticides from the viewpoint of effectiveness (based on 3 yr of systematic study) can be scored as follows: monocrotophos, leptophos, demeton methyl, fenitrothion, formathion, dicrotophos, hexinphos, thiometon, dimethoate, and thiodanone. (AS)

0301

30178 MURIBA-KANEKLONGO, A.; TERRY, E.R.; ADENIJI, M.O. 1987. A disease-like injury on cassava caused by *Pseudotheraptus devastans* Dist. (Heteroptera: Coreidae). *Tropical Pest Management* 33(1):35-38. En., Sum. En., 10 Ref., 11. [National Programme Manioc, B.P. 11635 Kinshasa 1, Zaire]

Cassava. *Pseudotheraptus devastans*. Pest damage. Injurious insects. Nigeria.

A disease-like injury on cassava due to feeding by *Pseudotheraptus devastans* is described. Exptl. data reveal that cassava plants are more severely damaged by males than females. Observations indicate the existence of a preferential feeding habit of *P. devastans* for certain clones, and there were linear relationships between the no. of lesions and the insect population, with some relationship to duration of feeding. (AS)

0302

29055 MUNTHALI, N.C. 1984. The effect of pests on cassava production by subsistence farmers in the Zomba-Nsanjalima area of Zomba, Malawi. In Greenhead, A.B.; Markham, E.B.; Murphy, E.J.; Murphy, S.T.; Robertson, I.A.P., eds. *Integrated pest management of cassava green mite: regional training workshop in East Africa, 1984*. Proceedings. Ascot, United Kingdom, Commonwealth Institute of Biological Control, pp.87-93. En., Sum. En., 5 Ref., 11.

Cassava. Pests. Cassava African nematode virus. Termites. *Mononychellus tanajoa*. Root productivity. Maps. Malawi.

The effects of pest incidence on cassava production by subsistence farmers were studied in Zomba, Malawi. Sixteen gardens (av. size, 0.25 ha) were planted to var. Mchilingano (18-mo. growth cycle); data on the effect of CAMV on var. Mangochela (6-mo. growth cycle) are also presented. Av. planting density was 9046 plants/ha. High incidence of the cassava green mite (*Mononychellus tanajoa*), an unidentified termite species, and CAMV was found. While termites killed about 15 percent of planted cuttings, CAMV reduced root yield by about 80 percent. The effect of the green mite is still to be evaluated, and *Zonocerus elevaris* can completely destroy a crop when present. It is recommended that cuttings killed by termites be replaced, and disease-free cuttings be used. (CIAT)

0303

30806 NEUMENSWANDER, P.; HENNESSEY, R.D.; HERREN, H.R. 1987. Food web of insects associated with the cassava mealybug, *Phenacoccus manihoti*

Matile-Ferrero (Hemiptera: Pseudococcidae), and its introduced parasitoid, *Epidinocarsis lopezi* (De Santis) (Hymenoptera: Encyrtidae), in Africa. *Bulletin of Entomological Research* 77(2):177-189. En., Sum. En., 39 Ref., 11. [International Inst. of Tropical Agriculture, P.M.B. 5320, Ibadan, Nigeria]

Cassava. *Phenacoccus manihoti*. Predators and parasites. Maps. Africa.

About 130 species of parasitoids and predators are reported, most of them for the 1st time, to be associated directly or indirectly with the cassava pest *Phenacoccus manihoti* and its parasitoid, *Epidinocarsis lopezi*, newly introduced into Africa as a biological control agent. About 20 species are common. The species are grouped in 11 guilds, which include the indigenous hyperparasitoids, which originally attacked parasitoids of other mealybugs, the predators with which *E. lopezi* competes for the same food source, and their antagonists. (AS)

0304

30479 SALES, F.J.M.; ALVES, V.P.O.; GOMES, H.G.; ALVES, M.T. 1982-1985. Vulnerabilidade de algumas culturas a saúva do nordeste. (Vulnerability of some crops to the northeastern leaf-cutting ant). *Fitossanidade* no.6-9:73-80. Pt., Sum. En., 3 Ref., 11. [CCA/UFC - Caixa Postal 3038, 60.000 Fortaleza-CA, Brazil]

Cassava. *Atta*. Pest damage. Resistance. Brazil.

Studies in an area of Ceará, Brazil, with 7.91 nests of *Atta opaciceps*/ha, showed that cassava cv. Ginc Verde, cotton IAC-19, and maize Centralmex were the least vulnerable crops, with 16.12, 23.84, and 33.52 percent damage, resp., 80 days after planting. These data indicate the possibility of coexistence between *A. opaciceps* and these crops. (AS)

0305

30810 VAN DRIESCHE, R.G.; BELLOTTI, A.; HERRERA, C.J.; CASTELLO, J.A. 1987. Host feeding and ovipositor insertion as sources of mortality in the mealybug *Phenacoccus herreni* caused by two encyrtids, *Epidinocarsis diversicornis* and *Acerophagus coccoides*. *Entomologia Experimentalis et Applicata* 44(1):97-100. En., Sum. En., Fr., 8 Ref. [Dept. of Entomology, Univ. of Massachusetts, Amherst, MA 01003, USA]

Cassava. *Phenacoccus herreni*. Biological control. Predators and parasites. Entomology. Colombia.

Rates of mortality of the cassava mealybug *Phenacoccus herreni* from host feeding and piercing (ovipositor insertion and its consequences) by 2 parasitoids, *Epidinocarsis diversicornis* and *Acerophagus coccoides*, are reported. Female *E. diversicornis* killed cassava mealybugs through host feeding and piercing. Parasitoids fed on 9 percent of 592 hosts in which ovipositor insertion was achieved. For hosts which were attacked but not fed on, mortality in the 1st 72 h was significantly greater than that of controls and was highest in the 1st nymphal instar. No host feeding by *A. coccoides* was observed in 494 attacks. Mortality due to piercing was significantly greater than control values, but did not differ between host life stages. (AS)

0306

30132 VAN DRIESCHE, R.G.; BELLOTTI, A.; HERRERA, C.J.; CASTILLO, J.A. 1987. Host preferences of two encyrtid parasitoids for the Columbian *Phenacoccus* spp. of cassava mealybugs. *Entomologia Experimentalis et Applicata* 43(3):261-266. En., Sum. En., Fr., 13 Ref. [Dept. of Entomology, Univ. of Massachusetts, Amherst, MA 01003, USA]

Cassava. *Phenacoccus manihoti*. Predators and parasites. Entomology. Colombia.

In a choice test among 6 life stages of *Phenacoccus herreni*, *Epidinocarsis diversicornis* used its antennae to examine adult and 3rd stadium females more than other stages and preferentially attempted to oviposit in these plus 2nd stadium females. Success of ovipositor insertion was unaffected by host stage. The outcome of these behaviors was preferential oviposition by *E. diversicornis* in the large female host stages. *Acerophagus coccis* also preferentially examined larger female mealybugs (2nd and 3rd stadium nymphs and adults) more than other stages and successfully inserted its ovipositor in these stages more often than in 2nd stadium male nymphs and male cocoons, resulting in a similar preference in this species for larger female host stages. When given a choice between adult female hosts of 2 species, *P. herreni* and *P. gossypii*, *E. diversicornis* exhibited a clear preference for *P. herreni* whereas *A. coccis* preferred *P. gossypii*. (AS) See also 0285

F03 Injurious Mites and their Control

0307

30808 BRAUN, A.R.; GUERRERO, J.M.; BELLOTTI, A.C.; WILSON, L.T. 1987. Evaluation of possible nonlethal side effects of permethrin used in predator exclusion experiments to evaluate *Amblyseius limonicus* (Acari: Phytoseiidae) in biological control of cassava mites (Acari: Tetranychidae). *Environmental Entomology* 16(4):1012-1018. En., Sum. En., 18 Ref., 11. [CIAT, Apartado Aéreo 6712, Cali, Colombia]

Cassava. Mite control. *Mononychellus progresivus*, *Tetranychus urticae*. Acarioides. Biological control. Mite Biology. Colombia.

A study was conducted to determine the importance of nonlethal effects when permethrin is used in the field to exclude predators of the cassava mite complex, namely *Amblyseius limonicus*, an important predator of *Mononychellus progresivus* and *Tetranychus urticae*. Lab. and field tests provided no evidence for phytostimulation, change in cassava nutritional quality, or increased spider mite fecundity; however, abundance of nontarget arthropods was significantly reduced in permethrin-treated field plots. A possible repellency effect of permethrin on *M. progresivus* was suggested under lab. conditions. Implications of repellency and lowered abundance of nontarget species for field use of permethrin as a predator exclusion agent are discussed. (AS)

0308

28547 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1982. Acaros presentes en el cultivo de la yuca y su control; unidad audiotutorial. (Mites present in cassava crops and their control; audiotutorial unit). Contenido científico Bellotti, A.C.; Reyes, J.A.; Guerrero, J.M.; producción Fernández O., F. Cali, Colombia. 99 diap. color 5 x 5 cm.; 1 cassette 33 min.; guión 23p.; guía de estudio 36p. Es., 11.

Cassava. Injurious mites. Mite control. Audiotutorial. Colombia.

Extensive information is presented on the biology and control of the different mite species attacking cassava. Integrated control is explained in detail; in this way better advantage is taken of the natural factors available and unnecessary applications of acaricides are avoided. (AS-CIAT)

0309

30826 GUTIERREZ, J. 1987. The cassava green mite in Africa: one or two species? (Acari: Tetranychidae). Experimental and Applied Acarology 3(2):163-168. En., Sum. En., 24 Ref., 11. [ORSTOM c/o I.A.M., 3191, Route de Mende, 34060 Montpellier Cedex, France]

Cassava. Mononychellus progresivus. Africa.

Parallel courses of research in South America and Africa with respect to the Mononychellus complex, in particular the cassava green mite (Acari: Tetranychidae), are examined. Strong arguments indicate that a single taxonomic unit corresponding to the species Mononychellus progresivus Doreste, 1981, was introduced in 1971 to Africa from South America. (AS)

0310

30127 LAL, S.S.; PHILLAI, K.S. 1984. Relative efficacy of certain pesticides against red mites, Tetranychus neocaledonicus Andre' and Tetranychus cinnabarinus (Boisd.) on cassava in Kerala. Indian Journal of Entomology 46(3):303-309. En., Sum. En., 14 Ref. [Central Tuber Crops Research Inst., Trivandrum-695017, India]

Cassava. Tetranychus neocaledonicus. Tetranychus cinnabarinus. Insecticides. India.

Eighteen pesticides were evaluated under 3 field trials in Kerala, India, against red spider mites (Tetranychus neocaledonicus and T. cinnabarinus) on cassava during 1976-77. Monocrotophos, dimethoate, dicofol, phosalone, and ethion were reevaluated during 1977-78 under 2 field trials. The treatments were replicated 3 times in a randomized block design. Mite populations were recorded before and 2, 7, 15, and 30 days after treatment. Monocrotophos at 0.03 and 0.05 percent was significantly superior to phosalone, ethion, and dimethoate at 0.05 percent and dicofol at both conen. Dicofol at 0.03 percent was ineffective both in initial and residual effects. (AS) See also 0302

600 GENETICS AND PLANT BREEDING

601 Breeding, Germplasm, Varieties and Clones, Selection

0311

30848 BUENO, A. 1986. Avaliacao de cultivares de mandioca visando a selecao de progenitores para cruzamentos. (Evaluation of cassava cultivars to select parents for crossbreeding). Revista Brasileira de Mandioca 5(1):23-54. Pt., Sum. En., Pt., 18 Ref., 11. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brazil]

Cassava. Cultivars. Selection. Genetics. Genotypes. Root productivity. Foliage. Harvest index. Roots. Starch content. Statistical analysis. Brazil.

Cassava cv. were screened over 4 crop years (1980-85) in Cruz das Almas (Bahia, Brazil) to select superior cv. to be used as parents in crossbreeding programs. Of 146 initial cv., 12 were selected. All expt. were randomized complete blocks, but in 1980-81 and 1981-82, split plots were used and cv. were evaluated with and without chemical fertilization. The last crop year harvesting was carried out at both 12 and 20 mo. after planting. Fertilization had a positive effect on root and aerial part yields but did not affect HI or starch content. Genetic variance was

overestimated when calculations were based on data from only 1 yr, due to the magnitude of the effect of the yr. x cv. interaction. Cv. performance should not be judged by its behavior in only 1 yr. Selection was equally efficient in fertilized and unfertilized soil. Root and aerial part yields were more influenced by environmental variation than HI and starch content. The cv. Var. 77 and M Mex-59 produced high root yields at 12 mo. after planting. Maria Pau and Arreventa Burro showed high starch contents at 12 and 20 mo. Cv. Maria Pau, Aipim Bravo Branco, IAC 5-66, and M Mex-59 showed high root yields increments at 20 mo. after planting, but only Maria Pau kept a high starch content. Aipim Bravo Branco, Maria Pau, Paulo Rosa, Var. 77, and Maracaça were recommended for cultivation, and M Mex-59, CM 42479, Arreventa Burro, and IAC 5-6 were selected as parents for crossbreeding. (AS)

0312

30852 BUENO, A. 1986. Número adequado de ambientes para avaliar cultivares de mandioca. (Adequate number of environments to evaluate cassava cultivars). Revista Brasileira de Mandioca 5(1):83-93. Pt., Sum. Pt., Enl., 8 Ref., Il. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cultivars. Genetics. Genotypes. Root productivity. Foliage. Brazil.

An attempt was made to estimate the magnitude of a range of variation in several expt. assessing cassava cv. conducted over several years and locations (Bahia, Brazil, and the Amazonic region); from these estimates, the optimum no. of environments and replications necessary for a precise definition of the yield potential of a cv. was calculated. Data were obtained from the literature. The magnitude of each variance component was determined by adequate handling of values and expected values of the mean squares in the joint analyses. The adequate no. of environments was calculated by estimating the variance of a cv. mean for several combinations of year, location, and replication. Most of the total phenotypic variation among cv. in both regions was due to nongenetic causes. In Bahia the variance of cv. x yr interaction was high and in the humid tropics, cv. x location and cv. x location x yr interactions were more important. For Bahian environmental conditions, evaluation in 1 location must be conducted over at least 4 yr with 4 replications. In the Amazonic region, cv. evaluation should be conducted in 2 locations over 4 yr with 4 replications. This is the min. requirement for cassava cv. recommendation in any edaphoclimatic region. (AS)

0313

30597 BUENO, A. 1986. Principais cultivares de mandioca indicadas para o Centro Sul. (The most important cassava cultivars for the central south region of Brazil). Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Mandioca e Fruticultura. Circular Técnica no.11. 26p. Pt., 10 Ref. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cultivars. Identification. Selection. Brazil.

The main results obtained between 1980-85 in cassava breeding for the central-western, southeastern, and southern regions of Brazil are summarized. The following cv./clones were outstanding in the resp. Brazilian states: Distrito Federal: IAC 12-829, Iracema, and Mantiqueira; Mato Grosso: Variedade 77 and Aipinzinho; Minas Gerais: Aipim Gigante, IAC 12-829, and Branca de Santa Catarina; São Paulo: Branca de Santa Catarina, Iracema, and IAC 576-70; Espírito Santo: Juliao Roxo, Pao do Chile Sul, Veada, and Unha; Rio de Janeiro: Manjari and Surui; Santa Catarina: Mico,

Aipim Gigante, and Mandim Branca; and Rio Grande do Sul: clone MG 94. Selected data on yields, agronomic characteristics, and composition of the var. are provided. (CIAT)

0314

30480 BUENO, A.; FUKUDA, W.M.G.; CARFOSO, E.M.R.; DANTAS, J.L.L. 1985. Selecao de genótipos de mandioca no trópico úmido. (Selection of cassava genotypes in the humid tropics). Revista Brasileira de Mandioca 4(1):107-116. Pt., Sum. Pt., En., 11 Ref. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380, Cruz das Almas-BA, Brazil]

Cassava. Genotypes. Cultivars. Selection. Harvest index. Roots. Foliage. Root productivity. Brazil.

During 1978-83, 400 introduced cassava genotypes at the Centro de Pesquisa Agropecuária de Trópico Úmido in Belem (Para, Brazil) were screened. Results showed that in the 1st yr the variability among genotypes for root, canopy, and total plant wt. was larger than it was for HI, which was less affected by environmental variations. Cv. means were larger than clone means, but cv. variances were smaller. Several clones showed larger root yields than the best cv. In the 2nd year the selected population showed larger means and variances for the wt. of roots, canopy, and total plant, as compared with the original population. Some cv. showed high root wt. in both years; however, only 1 clone had stable behavior across years, suggesting a significant genotype x environment interaction. In the 3rd yr none of the selected genotypes yielded more than cv. Jurará, but several of them were better than Tataruana, especially clones CPM 11-01 and CPM 16-06. Percent starch and consequently starch yield, of clone CPM 11-01 was higher than those of cv. Jurará. (AS)

0315

28551 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1982. Intercambio internacional de clones de yuca in vitro; unidad audiotutorial. (International exchange of in vitro cassava clones; audiotutorial unit). Contenido científico Roca, W.M.; producción Fernández O., F.; colaboración Rodríguez, J.A.; Maña, G. Cali, Colombia. 72 diap. color 5 x 5 cm.; 1 cassette 29 min.; guión 13p.; guía de estudio 30p. Es., 11.

Cassava. Tissue culture. Germplasm. Audiotutorial. Colombia.

The procedure followed for shipping and receiving cassava germplasm among countries is described in detail; precautions that should be taken with the material until plant establishment is achieved in the field are also given. (AS-CIAT)

0316

30476 DANTAS, J.L.L.; ANJO, A. 1985. Estimativas do coeficiente de determinacao genotípica e progresso genético para mandioca em programas de selecao no reconeavo baiano. (Estimation of the coefficient of genotypic determination and genetic progress for cassava in selection programs in the Bahian "Reconeavo"). Revista Brasileira de Mandioca 4(1):61-71. Pt., Sum. Pt., En., 15 Ref. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brazil]

Cassava. Genetics. Genetic variability. Selection. Genotypes. Root productivity. Foliage. Harvest index. Brazil.

The genotypic variability of cassava germplasm regarding traits of agronomic value was evaluated to estimate genetic parameters and to verify the efficiency of the selection process. Data were obtained in var. trials

under field conditions in Cruz das Almas (Bahia, Brazil) in 1980-81 and 1981-82. A randomized complete block design was used with 4 replications having different fertilizer treatments. Broad genotypic variability for several agronomic characters was observed; this could be explored in cassava breeding programs. From the joint analysis of 56 genotypes selected in 1980-81 and later tested in 1981-82, the effects of year and of the interaction treatment x year were highly significant for the 6 traits studied. Selection percentage of less than 15 percent should be avoided when selection for root production is based on exptl. observation for a single crop year. The existence of residual genetic variability among genotypes selected in the 1st cycle was verified by estimates of the coefficients of genotypic determination before and after the selection process. (AS)

0317

30467 FUKUDA, W.M.G.; BUENO, A. 1985. Análise de estabilidade em cultivares de mandioca. (Analysis of stability in cassava cultivars). Revista Brasileira de Mandioca 4(1):15-26. Pt., Sum. Pt., En., 13 Ref., Il. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, Cruz das Almas-BA, Brazil]

Cassava. Cultivars. Genotypes. Selection. Adaptation. Root productivity. Brazil.

The stability of root and aerial part production of 11 cassava cv. was studied during 5 yr (1977-78, 1979-80, 1980-81, and 1981-82) at the Centro Nacional de Pesquisa de Mandioca e Fruticultura in Cruz das Almas (Bahia, Brazil). A completely randomized design was used with 2 replications. The interaction cv. x yr was significant only for root production. The crop years of 1979-80 and 1981-82 were the least favorable for root and aerial part production; environmental indexes were below zero. The stability parameters considered were the mean or regression coefficient and the variance of the deviations from linear regression. Over 50 percent of the cv. showed mean root yields higher than the overall mean. Regression coefficient values varied from 0.2101 to 1.379. Deviations from linear regression varied from 1.5660 to 69.6388, suggesting that the yields of some cv. had good predictability. The coefficients of determination were approx. 90 percent for most cv. When all stability parameters were considered, cv. BGM 120 (Paulo Rosa), BGM 141 (Variedade 77), and BGM 198 (Maracana) showed higher stability for root production and capacity to adapt in low yielding environments. It was concluded that for the selection of stable cassava cv. all 3 stability parameters should be considered. (AS)

0318

27662 LORENZI, J.C.; MONTEIRO, P.A.; FERREIRA, A.S. 1985. Mandioca (para indústria): IAC 12-829. (Cassava (for industrial purposes): IAC 12-829). Agronomico 37(2):96. Pt.

Cassava. Cultivars. Identification. Industrialization. Brazil.

The botanical and agronomic characteristics of the improved cassava cv. IAC 12-829 (to be used as a raw material for industrial purposes in Brazil) are summarized. Outstanding characteristics are its high productivity (39.1 t/ha in exptl. conditions), higher starch content and lower toxicity than other traditional cv. used in industries, improved soil coverage (thus providing better weed and soil erosion control), and reasonable resistance to CBB. Additionally, the root size and shape of this cv. meet industrial requirements and yields are 50 percent higher than those produced by the currently cultivated var. Branca de Santa Catarina. (CIAT)

30812 NG, Q. 1986. Germplasm collection and conservation at IITA. PGRC/E-ILCA Germplasm Newsletter no.13:33-36. En., [IITA, P.M.B. 5320, Oyo Road, Ibadan, Nigeria]

Cassava. Germplasm. Genetics. Plant breeding. Nigeria.

An account is given of the germplasm collection at the International Institute for Tropical Agriculture (Nigeria) and the methods for its conservation. Of the more than 29,000 accessions of 15 crops, 3000 are of root and tuber crops; of these, 2000 are of *Manihot esculenta* and another 48 of wild *Manihot* spp. The distribution of germplasm between 1978-84 to the different continents (over 50 countries) is listed. (CIAT)

0320

30133 VILELLA, O.V.; PEREIRA, A.S.; LORENZI, J.O.; VALLE, T.L.; MONTEIRO, D.A.; RAMOS, M.T.B.; SCHMIDT, N.C. 1985. Competicao de clones de mandioca selecionados para mesa e industria. (Competition among cassava clones selected for table and industrial uses). *Bragantia* 44(2):559-568. Pt., Sum. Pt., En., 9 Ref. [Estacao Experimental de Pindamonhangaba, Inst. Agronomico, Caixa Postal 28, 13.100 Campinas-SP, Brazil]

Cassava. Cultivars. Selection. Root productivity. Human nutrition. Industrialization. Brazil.

From 1981 to 1984, 40 cassava clones, derived from several intervarietal crossings, were evaluated for root yields and other characteristics. Four trials were carried out in Campinas and 4 in Pindamonhangaba (Sao Paulo, Brazil) in completely randomized block designs with 4 replications. Each trial had 13 treatments, 3 of them as checks. Thirteen promising clones were selected and retested again in another trial at both localities, using the same methodology. Although none of the clones outyielded the checks (SRT 59 - Branca de Santa Catarina, IAC 12-829, and ICA Mantiqueira), IAC 576-70 (from the cross SRT 797 - Ouro do Vale x IAC 14-18) had good characteristics comparable with those of sweet cassava. A new trial in Campinas in 1983-84 compared this clone with other sweet cassava var.; SRT 454 - Guaxupé was used as check. Results showed that, in relation to sweet cassava var. presently cultivated, IAC 576-70 presented agricultural and culinary advantages: top plant architecture, greater productivity, resistance to CBB, acceptable root appearance and cooking quality, and yellow flesh. (AC)

0321

27663 VILELLA, O.V.; PEREIRA, A.S.; LORENZI, J.O.; VALLE, T.L.; MONTEIRO, D.A.; RAMOS, M.T.B.; SCHMIDT, N.C. 1985. Mandioca (para mesa): IAC 576-70. (Cassava (for food): IAC 576-70). *Agronomico* 37(2):97. Pt.

Cassava. Cultivars. Identification. Human nutrition. Brazil.

The botanical and agronomic characteristics of the improved cassava cv. IAC 576-70 (to be used as food in Brazil) are summarized. Outstanding characteristics are its higher productivity (21.4 t/ha) compared with other traditional food cv. (46 percent more than Jacana and 590 percent more than Guaxupé), reasonable resistance to CBB, less cooking time, attractive external appearance of roots, absence of HCN, and ease of harvest. (CIAT)
See also 0233 0234 0268 0276 0280 0289 0290 0381 0390

G02 Cytogenetics

See 0232

152

H00 NUTRITION

See 0382

H01 Cassava Foods and Nutritive Value

0322

30527 NAGASHIMA, N.; YAMADA, S.; SAWAYAMA, S.; KAWABATA, A. 1986. (Factor analysis for the sensory attributes of Kuzuyu puddings by the semantic differential method). Japanese Journal of Nutrition 44(3):131-141. Ja., Sum. En., Ja., 11 Ref., 11.

Cassava. Cassava starch. Uses. Food products. Organoleptic examination. Palatability. Analysis. Japan.

To investigate the sensory attributes of Kuzuyu puddings made of several kinds of starch (cassava, potato, waxy maize, and arrowroot), factor analyses were conducted on the results of sensory evaluation by the semantic differential method, which used 20 items on appearance, palatability, and preference. The profile of sensory attributes obtained by this method showed the greatest similarity between cassava and waxy maize and then between waxy maize and arrowroot. A significant correlation between the intensity and preference of sensory attributes was recognized for the pudding in terms of appetite-tempting, glossiness, transparency, mildness, aftertaste, and smoothness in the order listed. The 1st factor to characterize the intensity of sensory attributes was the overall preference image and palatability, the 2nd factor appearance, and the 3rd factor viscosity. The total contribution ratio was 80.2 percent from the 1st to the 3rd factors. From tests of significant difference by the multiple comparisons between paired samples in each factor, the profile of each starch was clearly recognized. The 1st factor for preference of sensory attributes was palatability and overall evaluation, the 2nd factor appearance, and the 3rd factor viscosity. The total contribution ratio was 79.5 percent from the 1st to the 3rd factors. From tests of significant difference by the multiple comparisons between paired samples in each factor, it was found that cassava was preferred most in palatability and overall evaluation, followed by waxy maize, potato, and arrowroot in this order in the overall evaluation. (AS)

0323

30471 OFENG-GYANG, K.; MBACHU, J.J. 1987. Changes in the ascorbic acid content of some tropical leafy vegetables during traditional cooking and local processing. Food Chemistry 23(1):9-17. En., Sum. En., 11 Ref., 11. [CESTAM International, 2 Res. Chateau de Courcelle, 160 Avenue de General Leclere, 91190 Gif-Sur-Yvette, France]

Cassava. Cassava leaves (vegetable). Ascorbic acid. Cooking. Processing. Africa.

The ascorbic acid content of 6 tropical leafy vegetables (*Vernonia amygdalina*, *Pterocarpus soyauxii*, *Manihot esculenta*, *Xanthosoma sagittifolium*, *Colocasia esculenta*, and *Amaranthus hybridus*) and changes in the vitamin content during traditional West African cooking were measured. Cassava ascorbic acid content ranged from 32.9 to 35.0, 27.7 to 28.1, 18.4 to 22.0, and 5.8 to 7.5 mg/100 g fresh wt. for 0, 5, 10, and 15 min cooking time. Ascorbic acid loss during cooking is also recorded. (CIAT)

0324

30829 TRAVAGLINI, M.M.E.; TRAVAGLINI, D.A.; AGUIRRE, J.M. DE 1984. Avaliação da qualidade protéica de cereais processados do tipo desjejum em combinação com uma bebida em pó a base de extrato de soja. (Evaluation of protein quality of breakfast cereal/soybean milk preparations). Boletim do Instituto de Tecnologia de Alimentos 21(4):503-510. Pt., Sum. Pt., En., 12 Ref.

Cassava. Cereals. Composition. Dietary value. Brazil.

The protein quality of 5 commercial breakfast foods (A, oats; B, rice; C, maize; D, oats, wheat, and cassava; E, oats, rice, and maize) combined with soybean milk was evaluated by determining the PER in recently weaned Wistar rats. Moisture, protein, fat, ash, fiber, and carbohydrate contents of each product are indicated. PER values of A, C, and E were over 80 percent that of the check (casein); corresponding values for D and B were 68 and 36 percent, resp. The low value of B suggests that it might have undergone severe heat treatment during processing. Results indicate that the combination with soybean milk improved the protein quality of these cereal foods. (CIAT)

0325

30596 WEBBER, E. 1951. Cassava. In Webber, E. Cooking with unusual foods. London, Sidgwick & Jackson, pp.12-13. En.

Cassava. Human nutrition. Recipes. Bakery products. United Kingdom.

The necessary ingredients and the method of preparation of cassava biscuits are given. Other uses of cassava for human consumption are also mentioned. (CIAT) See also 0261 0326 0321 0343 0346 0348 0356 0368 0375 0377

H02 Nutritive Disorders in Humans

0326

30475 LOEROU, A. 1986. Etiopathogénie des diabetes sucrés acquisitions récentes. (Advances in the etiopathogenic study of diabetes mellitus). Revue Française d'Endocrinologie Clinique Nutrition et Métabolisme 27(3):227-237. Fr., Sum. Fr., En., 29 Ref. [Service de Médecine interne, Professeur B.Y. BÉDA, B.P. V-3, Abidjan, Côte d'Ivoire]

Cassava. Human health. Diabetes. Malnutrition. Etiology. Human nutrition. Ivory Coast.

Diabetes mellitus is composed of many syndromes with hyperglycemia as common basement. Insulin dependent diabetes is often associated with particular HLA antigens and auto-immune factors (mainly type Ib). Among exogenous etiopathogenic factors, viruses seem to be the most important. Noninsulin dependent diabetes is also related to exogenous and genetic factors except for HLA antigens. Maturity onset diabetes in the young (Mody) is a particular, noninsulin dependent, familial diabetes occurring in the young and often associated with chlorpropamide alcohol flush, a neurovegetative phenomenon depending on hypersensitivity to endogenous opioid peptides such as enkephalins. Chronic pancreatitis, idiopathic hemochromatosis, and some endocrine diseases are unfrequent causes of diabetes mellitus. Nutritional diabetes (PFC syndrome and "J" diabetes) seems to be relatively important in some tropical countries and related to undernutrition and cassava. Extreme insulin resistance syndromes are exceptionally involved into diabetes pathogeny. (AS)

0327

30468 TEUSCHER, T.; BAILLOD, P.; TEUSCHER, A.; ROSMAN, J.B. 1987. Absence of diabetes in a rural West African population with a high carbohydrate/cassava diet. *Lancet* 1(8536):765-768. En., Sum. En., 26 Ref., Il. [Dept. of Pediatrics, Hospital Cantonal, Univ. of Geneva Medical School, 1200 Geneva 4, Switzerland]

Cassava. Diabetes. Human health. Human nutrition. Etiology. Togo.

Of the 1038 inhabitants of the West African village of Agbave, 1028 (99 percent) and a random sample of 353 (12.4 percent) of the population of 2850 in Kati, another West African village, were screened for diabetes. Also recorded were their anthropometric data, dietary habits, possession of antibodies to malaria, and serum IgG concn. About 85 percent of the study population consumed cassava roots at least once a day. The mean (SD) capillary random blood glucose concn. was 5.1 (1.1) mmol/liter in men and 5.1 (0.6) in women. The mean (SD) body mass index was 20.2 (1.8) in men and 20.7 (2.3) in women. The mean blood glucose was similar whether cassava was consumed once daily, more than once daily, or less than once daily. None of the 1381 subjects examined had diabetes. This finding suggests that a high carbohydrate/cassava intake (84 percent of a mean daily supply of 1916 calories) combined with a low protein consumption (8 percent of caloric supply) does not cause diabetes. This does not support the World Health Organization hypothesis that malnutrition-related diabetes exists, at least not in this West African rural population. (AS)

H03 Animal Feeding

0328

30563 BAHRI, S. 1984. Kadar tiocianat pada kambing dan kemungkinannya untuk menduga keracunan sianida. (Thiocyanate concentrations in blood of goats fed cassava). *Penyakit Hewan* 16(28):207-211. En., Sum. En., 10 Ref., Il. [Balai Penelitian Penyakit Hewan, Bogor, Indonesia]

Cassava. Toxicity. Thiocyanates. Animal health. Goats. Indonesia.

The range of SCN levels in sera from 63 goats consuming a small amount or no cassava leaves was 0.9-7.1 micrograms/ml and the mean 4.2 micrograms/ml. SCN levels for 97 goats that always consumed leaves ranged from 6.7 to 34.0 micrograms/ml, and the mean was 14.1 micrograms/ml. Increased SCN levels were detected 20 min after eating bitter cassava leaves. SCN levels in groups of goats that consumed the same ration showed little variation. Therefore, in a case of cyanide poisoning of a goat, the diagnosis can be made by determining the serum SCN level of the animal. (AS)

0329

30144 BARBOSA, A.S.; VIANA, L. DE S.; SANTOS, E.C. DOS; BARBOSA, R.B. 1986. Mandioca e derivados nas racoes de suínos em crescimento-terminação e sua influencia na composição de ácidos graxos do toucinho. (The effects of cassava and cassava by-products in growing-finishing pig rations on the fatty acid composition of pork fat). *Arquivo Brasileiro de Medicina Veterinária e Zootecnia* 38(6):943-953. Pt., Sum. Pt., En., Fr., Es., 10 Ref., Il. [Escola de Veterinária da Univ. Federal de Minas Gerais, Caixa Postal 567, 30.161 Belo Horizonte-MG, Brasil]

Cassava. Swine. Feeds and feeding. Cassava flour. Cassava meal. Animal nutrition. Substitutes. Brazil.

A comparative study was carried out in Minas Gerais, Brazil, to study the effects of replacing maize in growing-finishing pig rations with CF, dried ground cassava roots, and CM, at levels of 50 and 100 percent, on the fatty acid composition of pork fat. A randomized exptl. design was used with 7 treatments and 3 replicates (4 pigs/group for a total of 84 pigs). Myristic acid content was low in the treatment with 50 percent CF and palmitic acid increased in that with 100 percent CM (P equal to or less than 0.05). Linoleic acid decreased in treatments with 100 percent CF or CM and in the check treatment (maize), but increased in the 50 percent dried ground cassava root treatment (P equal to or less than 0.05). It was difficult to detect variations in the composition of fatty acids present in small quantities in pork fat when using GLC. (AS)

0330

30851 CARVALHO, V.D. DE; SILVA, A.T. DA; CLEMENTE, E. 1986. Efeito da suplementacao de racoes a base de fubá com feno da parte aérea de mandioca em alguns parametros nutricionais de ratos. (Effect of supplementing corn meal-based rations with hay from the aerial parts of cassava on some nutritional parameters of rats). Revista Brasileira de Mandioca 5(1):77-82. Pt., Sum. Pt., En., 9 Ref., 11. [EPAMIG, Caixa Postal 176, 37.200 Lavras-MG, Brasil]

Cassava. Foliage. Forage. Nutritive value. Laboratory animals. Brazil.

The effect of supplementing corn meal-based diets with increasing levels of hay from the upper 3rd part of the cassava canopy (0, 10, 15, 20, 30, 40, and 100 percent) on the nutritional characteristics of rats was determined. A casein check ration was also included. Results indicate that 20 percent cassava hay was the best level of supplementation; rats had better wt. gains and higher food efficiency ratio values. Levels above 20 percent caused harmful effects: with 30 percent rat wt. decreased, at 40 percent wt. loss occurred, and at 100 percent animal death. (AS)

0331

28548 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1983. La utilización de las raíces de yuca en la alimentación de cerdos; unidad audiotutorial. (Utilization of cassava roots in swine nutrition; audiotutorial unit). Contenido científico Gómez, G.; Valdivieso G., M.; producción Fernández O., F. Cali, Colombia. 37 diap. color 5 x 5 cm.; 1 cassette 19 min.; guión 12p.; guía de estudio 20p. Es., 11.

Cassava. Roots. Uses. Feeds and feeding. Animal nutrition. Audiotutorial. Colombia.

Precise information is presented on the composition of swine rations, based on ensiled or sun-dried cassava roots, and on amounts to be given according to the growth stage of the animals. (AS-CIAT)

0332

30470 JANSSEN, E. 1981. Ergebnisse mehrjähriger Untersuchungen von importierten Einzelfuttermitteln auf chlorierte Kohlenwasserstoffpesticide. (Results of analyses carried out for several years to detect chlorinated hydrocarbon pesticides in animal feeds). Landwirtschaftliche Forschung 34(3):81-87. De., Sum. De., En., Fr., 4 Ref.

Cassava. Cassava meal. Feeds and feeding. Legal aspects. Analysis. Federal Republic of Germany.

From 1976 to 1980, 1795 samples of imported animal feeds, including cassava, were analyzed for chlorinated hydrocarbons. Of the samples, 8.5 percent showed residue levels of 1 or more pesticides above official

German tolerance values, whereas another 7.6 percent was contaminated with 50 percent of the threshold values. Of these samples, most contaminations were caused by DDT. Main suppliers of highly contaminated samples were countries from South America, followed by Asian and African countries. The results show that future control of imports is necessary for the animal feed industry and agriculture. (AS)

0333

29445 LONGE, O.G. 1984. Effects of increasing the fibre content of a layer diet. *British Poultry Science* 25(2):187-193. En., Sum. En., 33 Ref. [Dept. of Animal Science, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Diets. Poultry. Cortex. Cassava starch. Feeds and feeding. Nutritive value. Animal nutrition. Nigeria.

The fiber content of a basal diet fed to laying hens was increased from 149.2 to 218.6-292.3 g/kg by the inclusion of various fibrous farm wastes and by-products at 200 g/kg diet. The fibrous ingredients lowered the ME of the basal diet from 11.82 to 9.31-11.21 MJ/kg. Utilization (g food/kg egg) of the basal diet was not significantly different from values for diets containing maize cob, cassava, (peel or starch), or maize starch residues. The diet containing maize cob supported a performance similar to that of the basal diet, despite a lower energy content (10.08 MJ/kg). Diets containing cowpea shell, cassava peel, or sawdust, with lower energy contents, and those containing maize starch residue, palm kernel meal, or dried brewers grains, with higher energy contents, were not as good. The diet containing cassava starch residue supported similar egg production to the basal but egg size was smaller. Inclusion of some of the fiber sources caused slight decreases in yolk cholesterol, although this could not be correlated with dietary fiber content. Additional dietary fiber caused slight increases in gizzard wt. but this was also not simply related to dietary fiber content. (AS)

0334

30157 NAHDI, S.; NUSRAMI, M. 1986. Studies on the incidence of *Rhizopus* and its toxin in cattle feed from Andhra Pradesh, India. *International Journal of Tropical Plant Disease* 4(1):85-91. En., Sum. En., 10 Ref.

Cassava. *Rhizopus stolonifer*. *Rhizopus nigricans*. Cassava flour. Cassava chips. Storage. India.

Rhizopus stolonifer and *R. nigricans* were frequently isolated from mixed feed samples (obtained from large- and small-scale manufacturing units) stored in gunny bags and also from their ingredients, particularly CF and cassava chips. *Rhizopus* toxin was identified and recorded for the 1st time in India in *Rhizopus*-infested samples. The usual storing structure (gunny bags) should be avoided or in case of use, stored at lower temp. (below 22 degrees Celsius). (AS)

0335

30548 PANDITHARATNE, S. 1984. Ensiling characteristics, digestibility and palatability of tropical grasses as affected by growth stage, chopping length and additives. Ph.D. Thesis. Blacksburg, Virginia Polytechnic Institute and State University. 125p. En., Sum. En., 95 Ref., Il.

Cassava. Cassava meal. Uses. Feeds and feeding. Silage. Analysis. Sri Lanka.

Research was conducted in Sri Lanka to study the effects of growth stage, chopping length, and additives on ensiling characteristics of *Panicum maximum* Ecotype-A and NB-21 (*Pennisetum purpureum* x *Pennisetum americanum*).

In the 1st study, the forages were harvested 1, 2, and 3 wk. after growth, chopped, and ensiled in small lab. silos alone or with additions of CM, coconut oil meal, and formic acid. Cutting grass at 1 wk. increased (P less than 0.05) acetic and lactic acids of silage, compared with 3 wk. Addition of CM and coconut oil meal increased (P less than 0.05) lactic acid and decreased (P less than 0.05) pH and acetic acid of silage, compared with the control. The effects were greater for CM. (AS (extract))

0336

30586 RAHARJO, Y.C.; CHEEKE, P.R.; PATTON, N.M.; SUPRIYATI, K. 1986. Evaluation of tropical forages and by-product feeds for rabbit production. 1. Nutrient digestibility and effect of heat treatment. Journal of Applied Rabbit Research 9(2):56-66. En., 54 Ref. [Rabbit Research Center, Oregon State Univ., Corvallis, OR 97331, USA]

Cassava. Rabbits. Domestic animals. Uses. Forage. Digestibility. Feeds and feeding. Animal nutrition. Indonesia.

Tropical forages, including woody legumes, nonwoody legumes, grasses, and cassava tops, were evaluated as rabbit feeds as to nutrient content and digestibility. There were dramatic differences in the digestibility of protein and energy between tropical legumes and grasses. Cassava tops had crude protein, gross energy, and crude fiber comparable to woody legumes. Sun drying and steam pelleting did not change the composition of the forages, except for a considerable increase of neutral detergent fiber in Calliandra and cassava tops. Most of the grasses were almost useless as sources of nutrients. It is suggested that tropical grass be supplemented with concentrates in diets for rabbits. (CIAT)

0337

30902 RAVINDRAN, V.; KORNEGAY, E.T.; RAJAGURU, S.B.; NOTTER, D.R. 1987. Cassava leaf meal as a replacement for coconut oil meal in pig diet. Journal of the Science of Food and Agriculture 41(1):45-53. En., Sum. En., 24 Ref. [Dept. of Animal Science, Univ. of Peradeniya, Peradeniya, Sri Lanka]

Cassava. Cassava meal. Leaves. Feed components. Feeds and feeding. Swine. Diets. Digestibility. Metabolism. Food energy. Protein content. HCN content. Animal nutrition. Sri Lanka.

Two feeding trials were conducted to evaluate CLM as a replacement for coconut oil meal (COM) in tropical pig diets. In each trial, 36 pigs (initial wt., 14.5 kg) were fed diets containing 0, 133, 267, and 400 g CLM/kg, substituted for equal amounts (wt./wt.) of COM in a 179 g/kg protein basal diet. An extra-period Latin square changeover design with 2-wk. periods was used. Av. daily gain and feed efficiency were improved when diets containing 133 g CLM/kg were fed, which may be attributed to the higher lysine content of CLM. Daily gain and feed efficiency of pigs fed diets containing 267 g CLM/kg were similar to those on the basal diet. Poor performance of pigs fed the 400 g CLM/kg diets may be explained by the low energy content and the presence of antinutritional factors, such as cyanide and tannin, in CLM. Two balance trials were conducted using 16 barrows (initial wt., 37.2 kg). Apparent digestibility coefficients for DM, energy, protein, cell contents, cell wall, and hemicellulose were depressed, whereas those for ash and lignin were improved as CLM was substituted for COM. The data indicate that cassava leaf protein is utilized efficiently, although other nutrients in CLM are not as digestible as those in COM. (AS)

0338

30801 RENUKARADHYA, K.M.; VARGHESE, T.J. 1986. Protein requirement of the carps, *Catla catla* (Hamilton) and *Labeo rohita* (Hamilton). Proceedings of the Indian Academy of Sciences 95(1):103-107. En., Sum. En., 15 Ref., 11. [Univ. of Agricultural Sciences, College of Fisheries, Mangalore 575002, India]

Cassava. Fish. Uses. Feed constituents. Animal nutrition. India.

In order to determine the optimum protein requirement in the feeds for *Catla catla* and *Labeo rohita*, isocaloric pelleted feeds containing 20, 30, 40, and 45 percent protein were formulated using casein as the main source of protein; other ingredients were rice bran, groundnut oilmeal, cassava powder, cellulose, and minerals. Cassava powder was included at 28.70, 18.00, 6.70, and 0.78 percent, resp. The best growth of *C. catla* and *L. rohita* was observed when fed on feeds containing 30 percent protein and poorest when fed on the feed containing 45 percent protein. The results revealed that the protein requirement of both *C. catla* and *L. rohita* was around 30 percent. It also indicated that more than the optimum level of protein in feeds has an adverse effect on the growth of the species investigated. (AS)

0339

30666 RODRIGUEZ O., A.; VELEZ C., J. 1987. La yuca, alternativa energética para la alimentación bovina. (Cassava, an energy alternative for bovine nutrition). *Cebú* 19(239):16-18, 20-21. Es., 11.

Cassava. Cattle. Roots. Feeds and feeding. Animal nutrition. Colombia.

A literature review on the use of cassava as an alternative energy source in livestock feeding, with particular reference to its combination with other feedstuffs, is given. Preferred var. in Colombia and their corresponding yields are listed. Studies indicate that dehydrated cassava can partially substitute maize in poultry rations and can replace maize as an energy supplement in rations for beef cattle in the tropics. Dehydrated cassava and cocoa husks are lightly superior to maize in milk production in the tropics. Furthermore, the N in urea is more efficiently used by rumen microorganisms for amino acid and vitamin synthesis, when the energy source is starch. The advantages of partially replacing sugarcane molasses by cassava, in various feed combinations, are discussed. (CIAT)

0340

30536 SCAPINELLO, C. 1984. Utilizacao do feno de rama de mandioca na alimentacao de coelhos em crescimento. (Use of cassava branch hay in growing rabbit rations). Tese Mestrado. Lavras, Minas Gerais, Escola Superior de Agricultura de Lavras. 80p. Pt., Sum. Pt., En., 51 Ref., 11.

Cassava. Rabbits. Forage. Foliage. Feeds and feeding. Digestibility. Nutritive value. Animal nutrition. Brazil.

The digestibility of hay made from the upper 3rd of the canopy of 15-mo.-old plants of cassava var. Mantiqueira was assessed in growing White New Zealand rabbits. The performance and several carcass characteristics of the rabbits were evaluated. In the digestibility trial, sixteen 50-day-old rabbits were kept in cages in a randomized 2 x 2 factorial design (2 rations x 2 sexes), with 8 animals/treatment (4 males and 2 females). Each animal constituted a replicate. Apparent digestibility of DM, OM, CP, crude fiber, and crude energy coefficients of cassava hay were 41.29, 41.95, 43.72, 33.77, and 36.63 percent, resp. Sex had no effects on the digestibility of cassava hay. Results showed that the hay made from the upper 3rd of the cassava canopy has a substantial nutritive value for

rabbits. To verify the effects of the levels of cassava hay in the rations (0, 10, 20, and 30 percent) on performance and carcass characteristics, 32 White New Zealand rabbits, 50-70 days old, were allocated in a randomized block design per sex, with 8 animals/block. A 4 x 2 factorial scheme (4 rations x 2 sexes) was used with 2 replicates/block. Each animal was a replicate. The inclusion of cassava hay did not cause any significant effects on performance and carcass characteristics. A tendency was observed, however, of better performance in animals fed with rations containing 20 percent hay. (AS)

0341

30807 TAYLOR, J.A.; PARTRIDGE, I.G. 1987. A note on the performance of growing pigs given diets containing manioc. Animal Production 44(3):457-459. En., 8 Ref. [AFRC Inst. for Grassland & Animal Production, Church Lane, Shinfield, Reading RG2 9AQ, England]

Cassava. Pellets. Swine. Fattening. Feeds and feeding. Animal nutrition. United Kingdom.

The results are presented of an expt. with 4 isonitrogenous and isoenergetic diets (0, 150, 300, and 450 g cassava/kg), fed to 80 pigs in 20 replicates. In a separate trial, 8 groups of 8 pigs (2 groups for each one of the 4 diets) were fed dry pelleted diets ad libitum. There was no evidence of digestive disorders or other health problems in any of the exptl. animals. For the pigs fed ad libitum, there was an apparent decrease in both av. daily food and av. daily gain at the level of 450 g cassava/kg (without statistical analysis). The only significant differences in carcass measurements between treatments in the restricted feeding trial were those of dressing proportion, although there was no trend with increasing levels of cassava. There appeared to be no loss in performance or carcass quality with cassava levels up to 300 g/kg in the diet. With greater amounts, food intakes may be reduced in ad libitum feeding, with a resulting loss in performance. (CIAT)

0342

30578 WEE, K.L.; NG, L.T. 1986. Use of cassava as an energy source in a pelleted feed for the tilapia, *Oreochromis niloticus* L. Aquaculture and Fisheries Management 17(2):129-138. En., Sum. En., 30 Ref., 11. [Asian Inst. of Technology, P.O. Box 2754, Bangkok 10501, Thailand]

Cassava. Roots. Fish. Nutritive value. Feeds and feeding. Dietary value. Animal nutrition. Thailand.

The nutritive value of cassava as an energy source in a pelleted tilapia diet was assessed. Four isonitrogenous diets containing 15, 30, 45, and 60 percent cassava were formulated and fed to groups of *Oreochromis niloticus* for 10 wk. Good growth and food utilization efficiencies were obtained with all diets; there was a trend of improved growth and food utilization with increased cassava incorporation in the diet although there were no significant differences (P less than 0.05) in food conversion ratio, PER, or apparent NPU between the exptl. diets. No nutritionally related pathology was observed in fish fed high cassava levels. Increased incorporation of cassava led to an increase in the carcass fat content although it was within the acceptable limits for tilapia. Phytoplankton growth occurred in all exptl. tanks due to the fertilization effects of uneaten feeds and feces as the water within the exptl. tank system was not exchanged; the contribution of phytoplankton to the nutrition of the exptl. fish was not quantified but was considered to be min. since the phytoplankton biomass was approx. an order of magnitude less than in fertilized systems. (AS) See also 0249 0267 0393

HO4 HCN Toxicity and Detoxification

0343

30134 SUNDARESAN, S.; NAMBIAN, B.; EASWARI AMMA, C.S. 1987. Bitterness in cassava in relation to cyanoglucoside content. Indian Journal of Agricultural Sciences 57(1):37-40. En., Sum. En., 6 Ref. [Central Tuber Crops Research Inst., Trivandrum, Kerala 695 017, India]

Cassava. Bitter cassava. Cyanogenic glycosides. HCN content. Boiling. Solar drying. Cultivars. Palatability. Roots. Cassava roots (vegetable). Processed products. Organoleptic examination. India.

In a sensory evaluation of 38 cassava strains bitterness was found to be related to cyanoglucoside content. The cyanoglucoside content ranged from 320 to 1100 micrograms cyanide/g in the very bitter tubers, and from 27.5 to 77.5 micrograms cyanide/g in the nonbitter tubers. Boiling in water for 30 min and crushing fresh tubers and sundrying for 6 h reduced bitterness and also reduced the cyanoglucoside content. When very bitter cassava tubers (glucoside content 410-1100 micrograms cyanide/g) were crushed and sundried, the samples became nonbitter and cyanoglucoside content was reduced to very low level (6.9-16.7 micrograms cyanide/g), indicating that bitterness is associated with the cyanoglucoside levels in cassava tubers. (AS) See also 0250 0271 0328

IO0 PROCESSING, PRODUCTS AND USES

IO1 Cassava Starch and its Properties

0344

30598 CEREDA, M.P. 1987. Alternativas de uso industriais para amido de mandioca. (Alternative industrial uses for cassava starch). Botucatu-SP, Brasil, Universidade Estadual de Sao Paulo. 22p. Pt., 26 Ref. Trabajo presentado al 1o. Encontro Nacional da Mandioca e Derivados, Paranavai-PR, Brasil, 1987.

Cassava. Cassava starch. Uses. Analysis. Composition. Modified starches. Processing. Brazil.

The possibilities offered by cassava starch are analyzed and discussed. Chemical, physical, and organoleptic properties of this product are briefly described and its different uses are mentioned. The various procedures used to modify starch are detailed, including the uses and characteristics of the end product. A table is included with the functional properties of cassava starch pastes compared with other starches (maize, waxy maize, high-amylose maize, sweet potato). Recommendations include a publication on the characteristics of cassava products and their option for industrialization and commercialization, as well as surveys on nontraditional cassava products and on the current situation of selected products. Pilot projects should be established next to the factories. (CIAT)

0345

30585 IWUNZE, M.O.; NNODIMERE, R.A. 1986. An evaluation of cassava starch as a gelling material for electrochemical salt bridges. Starch/Starke 35(6):193-194. En., Sum. En., De., 1 Ref., 11. [Modibbo Adama College, Univ. of Maiduguri, P.M.B. 2076, Yola, Africa]

Cassava. Cassava starch. Gelatinization. Industrial starches. Nigeria.

Cassava starch was investigated for its potential use as a gelling material for electrochemical salt bridges. Different electrolytes, KCl, NH₄, and NH₄NO₃, were mixed with the starch and the resulting voltage of a Zn-Cu Cell in which it is used as a salt bridge was measured. The observed voltage agreed with the theoretical voltage within 3.6 percent error. It was observed that the starch and ammonium nitrate electrolyte produced a better blend, gave more reproducible values, and has the lowest resistance of all the other electrolyte-starch mixtures. (AS)

0346

30153 KUME, T.; TAMURA, N. 1987. Change in digestibility of raw starch by gamma-irradiation. *Starch/Stärke* 39(3):71-74. En., Sum. En., De., 15 Ref., Il. [Takasaki Radiation Chemistry Research Establishment, Japan Atomic Energy Research Inst., Takasaki, Gunma 370-12, Japan]

Cassava. Cassava starch. Digestibility. Analysis. Japan.

Irradiation effect on digestion of raw starch by glucoamylase has been investigated as a basic research for application of radiosterilization on uncooked starch fermentation. The digestibility of raw cassava starch decreased with an increase in dose while that of other starches such as wheat, maize, sweet potato, and potato were little changed by irradiation. Cassava starch granules coagulated by irradiation and were sedimented rapidly in suspension. The coagulation of irradiated cassava starch granules can be dispersed completely by ultrasonic treatment. These results show that the decrease in digestion of raw cassava starch depends on the coagulation of starch granules but other factors also contribute because the recovery of digestibility by ultrasonic treatment was not complete. (AS) See also 0322 0365 0367 0370

102 Uses, Industrialization, Processing and Storage

0347

30584 AKEREDOLU, F. 1987. Shrinkage in dehydration of *Manihot utilisaima* and *Dioscorea rotunda*. *Drying Technology* 5(1):107-128. En., Sum. En., 15 Ref., Il. [Dept. of Chemical Engineering, Univ. of Ife, Ile-Ife, Nigeria]

Cassava. *Dioscorea*. Drying. Analysis. Statistical analysis. Laboratory experiments. Composition. Nigeria.

The shrinkage in dehydration of 2 Nigerian root crops, *Manihot esculenta* and *Dioscorea rotunda*, was investigated. Samples of each foodstuff were dried with hot air, and the surface areas and MC of the products were determined. Surface area of both foodstuffs decreased steadily during the drying period; the area at equilibrium MC was about half the initial value, depending upon the drying-air conditions. There was an indication that some rupture of the internal structure of the foodstuffs occurred during drying. Data were found to be adequately represented by a uniform drying shrinking model in which the decrease in vol. of the drying sample is assumed to be equivalent to the vol. of moisture removed. (AS)

0348

30045 ANKRAH, J.A.A. 1982. An assessment of the traditional methods of storing cassava. B.Sc. Thesis. Legon, Accra, University of Ghana. 73p. En., Sum. En., 28 Ref., Il.

Cassava. Storage. Roots. Technology evaluation. Deterioration. Timing. Organoleptic examination. Starch content Palatability. Ghana.

A study was conducted to assess the traditional methods used in Ghana of storing cassava. Three methods were used: (1) reburial, (2) reburial using straw, and (3) blanching followed by reburial. Var. Asram asia (a 6-mo. var.) was used. Physical characteristics of the roots (during the storage period) were assessed in terms of primary and secondary deterioration, presence of white fungal hyphae (*Fomes lignosus*), molds and fungi, cuts or bruises. Organoleptic tests on color, texture, flavor, and sweetness of roots were done during the storage period. Starch content and MC were also determined. Evaluations were carried out after every 2 wk. of storage and the results analyzed using analysis of variance. Results from the organoleptic tests showed that both the type of storage system (treatment) and the storage period had significant effects on color, flavor, and sweetness of samples. Although the type of treatment affected the texture significantly, the storage period did not. Method 2 had the longest storage period (8 wk.), followed by methods 1 (6 wk.) and 3 (2 wk.). Results from starch and moisture determinations showed an inverse relationship between the variables. Generally there was a rise in starch content confirmed by the sweetness of the samples (from taste panel). (AS)

0349

30811 ATTASAMPUNNA, P.; SOMCHAI, P.; EUR-AREE, A.; ARIJARIYASRIPONG, S. 1987. Production of fuel ethanol from cassava. *MIRCEN Journal of Applied Microbiology and Biotechnology* 3(2):135-142. En., Sum. Fr., Es., En., 2 Ref., 11. [Thailand Inst. of Scientific & Technological Research, 196 Phahonyothin Road, Bangkok 10900, Thailand]

Cassava. Ethanol. Fermentation. Thailand.

Ethanol production from fresh cassava roots using a low-temp. process was evaluated on a pilot-plant scale. The application of low-temp. cooking to cassava starch followed by a dual enzyme action resulted in an ethanol yield comparable with that of a traditional high-temp. cooking process. Pressurized distillation gave a satisfactory recovery efficiency of ethanol but was slightly lower than that obtained from atmospheric pressure distillation. Over 40 percent of the normal steam consumption was saved by adopting the low-temp. cooking and pressurized distillation systems in the cassava-to-ethanol process. The yield of anhydrous ethanol varied with the starch content in fresh cassava roots and was in the range of 185-200 liters/t. (AS)

0350

30463 CARVALHO, V.D. DE; CHALFOUN, S.M.; JUSTE JUNIOR, E.S.G. 1985. Métodos de armazenamento na conservação de raízes de mandioca. 1. Efeito da embalagem de polietileno e serragem úmida associados a tratamentos químicos nas deteriorações pós-colheita e qualidade das raízes. (The effect of storage methods on fresh cassava root preservation. 1. Effect of packing in polyethylene bags and moist sawdust, associated with chemical treatments, on postharvest deterioration and quality of roots). *Revista Brasileira de Mandioca* 4(1):79-85. Pt., Sum. Pt., En., 6 Ref. [Empresa de Pesquisa Agropecuária de Minas Gerais, Caixa Postal 176, Lavras-MG, Brasil]

Cassava. Roots. Storage. Packaging. Deterioration. Timing. Analysis. Brazil.

Roots of cassava cv. Mantiqueira were packed in polyethylene bags and moist sawdust after treatment with 0.6 percent maneb, 0.25 percent ascorbic acid, and water for 5 min to determine the effect of these treatments on physiological (PD) and microbiological (MD) deterioration and quality of cassava roots. Polyethylene bag treatments had the best PD control. Treatment with 0.25 percent ascorbic acid and 0.6 percent maneb decreased PD in packed roots. Packing, in particular when associated with 0.6

percent maneb, delayed the beginning of MD. Roots showed good cookability and quality until 27 days after harvest for polyethylene bags. 21 days for moist sawdust associated with ascorbic acid and maneb; 12 days for moist sawdust without chemical treatment; and 5 days for nonpacked roots treated with maneb and water. (AS)

0351

28554 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1983. Almacenamiento de raíces frescas de yuca; unidad audiotutorial. (Storage of fresh cassava roots; audiotutorial unit). Contenido científico Wheatley, C.; producción Fernández O., F. Cali, Colombia. 86 diap. color 5 x 5 cm.; 1 cassette 36 min.; guión 11p.; guía de estudio 35p. Es., 11.

Cassava. Roots. Storage. Deterioration. Audiotutorial. Colombia.

Information is presented on the agents that cause rapid deterioration of cassava roots. In addition, a description is made of the techniques a farmer can use to delay rotting and thus reduce marketing risks and increase end product quality. (AS-CIAT)

0352

28549 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1983. Secamiento natural de la yuca para la alimentación animal; unidad audiotutorial. (Natural cassava drying for animal nutrition; audiotutorial unit). Contenido científico Gómez, G.; Best, R.; producción Fernández O., F. Cali, Colombia. 54 diap. color 5 x 5 cm.; 1 cassette 26 min.; guión 11p.; guía de estudio 27p. Es., 11.

Cassava. Solar drying. Audiotutorial. Colombia.

Precise instructions are presented for natural cassava sun drying. The necessary climatic conditions and the infrastructure and equipment required to carry out the procedure at the farm level are described. This procedure allows a greater amount of dried cassava to be produced, which has a market in animal feed industries. (AS-CIAT)

0353

30476 DAUBRESSE, P.; NTIBASHIRWA, S.; GHEYSEN, A.; MEYER, J.A. 1987. A process for protein enrichment of cassava by solid substrate fermentation in rural conditions. Biotechnology and Bioengineering 29(8):962-968. En., Sum. En., 37 Ref., 11. [Burundi Agricultural Sciences Inst., B.P. 795, Bujumbura, Burundi]

Cassava. Protein enrichment. Fermentation. Fermented products. Protein content. Amino acids. Starch content. Fiber content. Ash content. Mineral content. Sugar content. Technological package. Burundi.

An artificial static process for protein enrichment of cassava by solid-state fermentation, developed in lab. and tested on pilot units in Burundi, provides enriched cassava containing 10.7 percent of DM protein vs. 1 percent before fermentation. Cassava chips, processed into granules of 2 to 4 mm in diameter, are moistened (40 percent water content) and steamed. After cooling to 40 degrees Celsius, cassava is mixed with a nutritive solution containing the inoculum (*Rhizopus oryzae*, strain MUCI 28627) and providing the following per 100 g DM: 3.4 g urea, 1.5 g KH_2PO_4 , 0.8 g $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, and 22.7 g citric acid. For the fermentation, cassava, with ca. 60 percent MC, is spread in a thin layer (2-3 cm thick) on perforated trays and slid into an aerated humidified enclosure. The incubation lasts approx. 65 h. The production of protein-enriched cassava is 3.26 kg DM/square meter of tray. The effects of the variation of the

nutritive solution composition and the inoculum conservation period on the protein production are also discussed. (AS)

0354

30545 ESPINOSA P., M.; ROJANO A., J. 1987. Obtención de alcohol etílico a partir de cuatro variedades de yuca, (*Manihot esculenta*, Crantz). (Obtainment of ethyl alcohol from four cassava varieties). Montería, Colombia, Universidad de Córdoba. 219p. Es. Sum. Es., 31 Ref., 11.

Cassava. Ethanol. Cultivars. Selection. Starch productivity. Processing. Colombia.

Fresh root yield, amount of root DM, and ethyl alcohol production from cassava root starch were evaluated in a trial carried out at the U. de Córdoba (Colombia). Four improved var. (Meal 1684, Venezolana, Manihot-Ica P11, and Manihot-Ica P12) were selected and planted on 0.25-m-high ridges, 1.0 m apart, at a density of 10,000 plants/ha. A randomized block design with 4 treatments (cassava var.) and 8 replications (blocks) was used, for a total of 32 exptl. plots (each plot of 40 square meters). Basic agronomic practices were followed; 20-cm-long, straight-cutted cuttings were used and no fertilizer was applied. Starch extracted from the roots (95 percent av. purity) was subjected to acid hydrolysis by the Roxas method and glucose-rich molasses (the base of must) was obtained. The var. with the highest fresh root yield was Manihot-Ica P11 (26.46 t/ha), while Venezolana had the highest starch and alcohol yields (8.23 t/ha and 1012 liters/ha, resp.). (AS (extract)-CIAT)

0355

29504 FIGLIETTO, A.M.C. 1987. Viabilidade de cultivo de *Trichosporon* sp em manipueira. (Feasibility of culturing *Trichosporon* sp. on manipueira). Tese Mestrado. Botucatu-SP, Brasil, Universidade Estadual Paulista Julio de Mesquita Filho. 102p. Ri., Sum. Pt., En., 70 Ref., 11.

Cassava. Carcinog. Waste utilization. Yeast production. Industrial microbiology. Brasil.

To establish the viability of using industrial wastes as nutrient source, *Trichosporon cutaneum* strain 7906 was cultured in CF waste (manipueira) under the following conditions: culture in semisolid medium, immersed aerated shake culture, and surface culture. Depending on expt. objectives, analyses were made of biomass dry wt. and lipid content, carbohydrate levels, free cyanide percentage in the medium, and COD. Culture in semisolid medium was eliminated because satisfactory results were not obtained. The highest dry wt. percentage was obtained after 6 days of culture at pH 4.5; afterwards, at pH 5.5, after 34 days of culture, the greatest production of cell lipid was observed. To determine the need for supplementation in the culture medium, yeast extract, rice bran, vitamins (biotin, thiamine, riboflavin, and vitamin E) were used. The addition of rice bran to the medium gave the best results in terms of biomass production; however, it caused problems like obstruction of the equipment and separation of the produced biomass. The production in immersed and surface culture was similar; however, the former was better from the economic viewpoint. To supplement the enzymatic deficiencies of strain 7906, several amylolytic enzymes were used once manipueira was a starchy medium (5-10 percent). The enzymatic combination selected as efficient regarding biomass and lipid production was glucoamylase + plant amylase. The culture of *T. cutaneum* strain 7906 in manipueira did not effectively remove cyanide and COD in this waste product, mainly because an efficient method of removing the produced biomass has not been determined, without the remaining content causing a significant increase of the organic content of the medium. (AS (extract))

0356

30573 GERONA, G.R. 1986. Technology keeps cassava free of aflatoxin for four months. *Cassava Newsletter* 10(2):8. En.

Cassava. Cassava chips. Storage. Aflatoxin. Philippines.

A brief report of an on-going study in the Philippines indicates that cassava chips dried to a MC of 10-12 percent and placed in jute sacks are still free of aflatoxins after 4 mo. of storage under normal room conditions (temp., 29-30 degrees Celsius; RH, 85-90 percent). (CIAT)

0357

30473 HO, Y.C.; GHAZALI, H.M. 1986. Alcohol production from cassava starch by co-immobilized *Zymomonas mobilis* and immobilized glucoamylase. *Pertanika* 9(2):235-240. En., Sum. En., Mal., 17 Ref., Il. [Dept. of Food Science, Faculty of Food Science & Technology, Univ. Pertanian Malaysia, 43400 Serdang, Selangor, Malaysia]

Cassava. Cassava starch. Alcohol. Fermentation. Analysis. Malaysia.

Simultaneous saccharification and fermentation of dextrinized cassava starch to glucose and alcohol, resp., were carried out by co-immobilized *Zymomonas mobilis* and immobilized glucoamylase. Calcium alginate-entrapped cells and immobilized glucoamylase (4:1 ratio) gave an alcohol productivity of 0.30 g/g wet wt. cells/h in a batch fermentation process. For continuous fermentation, 54.3 g/liter alcohol was produced at a dilution rate of 0.3/h. A total of 60 percent of the initial activity was lost within 3 days and, thereafter, the system entered a slowly decreasing phase of alcohol production. (AS)

0358

30583 KIM, K.H.; PIYARAT, W. 1986. Drying characteristics of mineral fish on drum dryers. *Korean Journal of Food Science and Technology* 18(5):351-356. En., Sum. En., Ko., 7 Ref., Il. [Dept. of Biotechnology, Ajou Univ., Suwon, Korea]

Cassava. Cassava flour. Uses. Food products. Korea.

The effects of drum spacing, steam pressure, and drum speed on drying rate of minced fish on both single and double drum dryers were studied. Starch powder mixed with minced flesh allowed a better adherence of flesh to rotating drums by reducing relative oil contents. CF was used as starch source at 2.5, 5.0, and 10.0 percent to determine the min. amount of starch required without disturbing the drying pattern. CF up to 2.5 percent was found to be satisfactory for aiding in sheet formation at the doctor blade. Data on suitable operating conditions, production rates, and overall heat transfer coefficient are given. (CIAT)

0359

30535 KREAMER, R.G. 1986. The government's role in promoting small-scale entrepreneurship. In Kreamer R.G. *Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa*. Ithaca, New York, Cornell University, Department of Agricultural Economics, International Agricultural Economics Study Series. A.E. Research 86-3J. pp.107-115. En.

Cassava. Gari. Small-scale processing. Development. Cassava programs. Technology. Ghana.

The role of the Ghana Government in promoting small-scale entrepreneurship related to gari processing is discussed. Future demand for improved

technology is analyzed. The activities of the Technology Consultancy Centre (U. of Science and Technology) are described; its main focus is on the development of intermediate technology. The Center has had considerable impact on Kumasi's small-scale industrial sector. From 1972 to 1983, 21 lathes and 44 other machine tools were introduced. Firms such as SIS and AGRICO were found to be capable of manufacturing any scale of processing system. (CIAT)

0360

30534 KREAMER, R.G. 1986. Transformation of the gari industry: impact of new technology on small-scale equipment manufacturers. In Kreamer, R.G. Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa. Ithaca, New York, Cornell University. Department of Agricultural Economics. International Agricultural Economics Study Series A.E. Research 86-30. pp.91-105. En.

Cassava. Gari. Small-scale equipment. Small-scale processing. Technology evaluation. Socioeconomic aspects. Ghana.

The contribution of small-scale equipment manufacturers to the development of Ghana's gari industry was assessed. Data were collected in Kumasi's 3 informal industrial areas (Suame Magazine, Anloga Light Industrial Area, and Asafe) during June-Oct. 1985. The characteristics, products, and equipment of these manufacturers were compared, as well as methods of pricing and payment, bottlenecks to production, aspects of credit, and sales. The case studies of an Asafe workshop owner and of SIS Engineering Ltd. in Kumasi are discussed. The latter produced its 1st cassava grater in 1975 and the screw press in 1983. The reasons for SIS's success and the demand for food processing equipment are discussed in detail. (CIAT)

0361

30588 KUMAR, G.A.; KARNAVAR, G.K. 1986. Reproductive biology of the stored product pest *Anaererus fasciulatus* (Coleoptera:Anthribidae). Entomon 11(4):309-310. En., Sum. En., 2 Ref. [Dept. of Zoology, Univ. of Kerala, Kariavattom, Trivandrum, India 695 581]

Cassava. Cassava chips. Storage. *Anaererus fasciulatus*. Insect biology. India.

One-year-old market samples of dry cassava chips collected during the Indian monsoon season, before the arrival of new stock, showed 44.30 plus or minus 16.66 insects/150 g. Female *A. fasciulatus* reached maturity within 4-7 days and males within 3 days of emergence. Mature adults showed characteristic mating behavior. Vitellogenic oocyte differentiation could be noticed from the 3rd day of adult emergence. (AS)

0362

30485 MADIGAN S.J., F.C.; SEALZA, J.S. 1986. The cassava industry in Bukidnor province. Philippine Studies 34:317-337. En., 6 Ref.

Cassava. Cassava starch. Factories. Socioeconomic aspects. Industrialization. Philippines.

The main characteristics of the cassava starch factory of the Philippine Agro-Industrial Corporation are briefly described as to components, suppliers, capacity, area devoted to cassava production and fluctuations for the period 1980-82, commercialization, procedure for starch obtention, employment, taxes, and prices. Results of economic analyses at both macro and micro levels are also included and discussed as well as those of demographic analysis which considered the effects of cassava industry on rates of fertility and mortality. Comments on the demand-side of the

population-development relationship are also included. Finally, the benefits and problems of the cassava industry are summarized. It was concluded that the future of this industry is somewhat doubtful due to foreign competitors who produce tubers more efficiently. In addition, if not regulated, the waste products of such an agribusiness may cause environmental pollution. (CIAT)

0363

30587 MITCHELL, D.A.; GREENFIELD, P.F.; DOELLE, H.W. 1986. A model substrate for solid-state fermentation. *Biotechnology Letters* 8(11):827-832. En., Sum. En., 11 Ref., 11. [Biotechnology Unit, Univ. of Queensland, St. Lucia, Qld. 4067, Australia]

Cassava. Cassava starch. Cassava chips. Fermentation. Industrial microbiology. Australia.

A model substrate consisting of cassava starch embedded in kappa-carrageenan was used to mimic the growth of *Rhizopus oligosporus* on cassava tubers. Growth on the model substrate was similar to that during solid-state fermentation of the actual cassava. Protein production and starch utilization, however, were slower on the model substrate. (AS)

0364

29430 MORAES, A.A. 1966. Localização ótima de fábricas de farinha de mandioca no Mato Grosso do Sul. (Optimum location of cassava flour factories in Mato Grosso do Sul). *Tese Mag.Sc. Vicosa-MG, Brasil, Universidade Federal de Vicosa*. 62p. Pt., Sum. Pt., 22 Ref., 11.

Cassava. Industrialization. Costs. Factories. Distribution. Production. Cassava flour. Socioeconomic aspects. Brazil.

Using a linear programming model, the potential locations, production levels, distribution costs, and no. of CF factories in the state of Mato Grosso do Sul, Brazil, were determined. The best option is to install 2 factories, one in Dourados, which also offers noneconomic advantages due to its urban infrastructure and port, and the other in Ivinhema or in Ponta Porã. While in the municipality of Dourados, rural parcels, including small farms, are oriented toward export crops like soybean and wheat, in Ivinhema, a traditional producer of staples like beans, maize, and cassava, the capacity to transform cassava already exists. Furthermore, in Dourados the soil is more clayey, thus making harvesting more difficult, while in Ivinhema (the 2nd major cassava producing municipality in the region) the soil is more porous and of sandy clay structure. Productivity in the 2 municipalities are 12 and 22 t/ha, resp. Ivinhema also offers social advantages, in terms of better vertical (producer-industry) integration and would result in less urban migration. The option of a factory in Iguatemi gave the highest costs of distribution. This study should be useful in developing an agroindustrial policy for the state. (AS (extract)-CIAT)

0365

30541 PETERS R., M. 1982. Obtención de alcohol a partir de yuca. (Obtainment of alcohol from cassava). *Tesis Lic. Teen. Alimentos, San Jose, Universidad de Costa Rica*. 82p. En., Sum. En., 30 Ref., 11.

Cassava. Cassava starch. Uses. Alcohol. Fermentation. Processing. Costa Rica.

Enzymatic hydrolysis of cassava starch was performed, followed by alcoholic fermentation using yeast to establish an efficient method for obtaining alcohol from cassava. In addition, optimum yield conditions for alcoholic fermentation were determined. An alpha-amylase (Termamyl 60 L.)

was used in the liquefaction of the starches and an amyloglucoside (AMG, 150 L.) in the saccharification process, using as substrate cassava var. Valencia ground with 30 percent total solids. A distillery yeast with a high fermentation potential was used for fermentation. During the process, the pH and the concn. of magnesium sulphate, ammonium phosphate, and a vitamin complex were varied. When pH ranged from 4 to 5, the max. fermentation efficiency was achieved at 54.8 percent, corresponding to pH 4.5. Magnesium sulphate was evaluated at that pH and at different concn., the most appropriate being 1 g/liter. With this ingredient there was a notable increase in fermentation efficiency. Ammonium phosphate was tested at different concn. with excellent results. The 2 g/liter concn. led to a fermentation efficiency of 88.6 percent. The other variable, a vitamin complex, composed of riboflavin, niacin, and thiamin, was used at different concn. with results being similar to those when the complex was not included. (AS-CIAT)

0366

29450 PRASAD, K.V.S.V.; NEELAKANTAN, S. 1985. Prepackaging of cassava for extension of shelf life. South Indian Horticulture 33(2):136-139. En., 5 Ref.

Cassava. Packaging. Storage. Roots. Deterioration. Timing. Starch content. India.

The storage characteristics of 3 Indian cassava var. (ME 116, Co. 1, and Malavella) were studied; roots were carefully harvested, without bruises, at physiological maturity. Six roots of each var. were packed in polyethylene bags (gauge 150; 25 x 40 cm). The bags were perforated to provide ventilation at a rate of 1 percent of the surface area. The bags were closed with a twine thread and stored at room temp. conditions. Quality characteristics (color, vascular streaking of cut surface, appearance, smell, and shelf life) were examined every 12 h using a panel of 10 judges on a hedonic scale from 1 to 5. Wt. losses and starch content were estimated. Control roots of all var. had a 48-h shelf life. Packaging in ventilated polyethylene bags resulted in acceptable shelf life of 120, 96, and 84 h for ME 116, Co. 1, and Malavella, resp. Packaging in bags prevented excessive wt. losses in all var., which ranged between 17.1-24.0 percent for all controls; in the nonventilated treatment, losses were 2.40, 3.27, and 3.39 percent, while the ventilated roots showed losses of 8.87, 5.83, and 5.50 percent for ME 116, Co. 1, and Malavella, resp. Ventilated bags increased root shelf life; an acceptable max. shelf life of 120 h was obtained for var. ME 116 at a temp. of 21-26 degrees Celsius and a RH of 72-78 percent. No mold attack was observed. (CIAT)

0367

30576 RAJA, K.C.M.; RAMAKRISHNA, S.V.; MATHEW, A.G. 1987. Effect of steam-hydrothermal treatment (SHTT) on the physico-chemical properties of cassava (*Manihot esculenta* Crantz). Journal of the Science of Food and Agriculture 39(1):59-71. En., Sum. En., 16 Ref., 11. [Regional Research Laboratory, Trivandrum-695019, India]

Cassava. Cassava chips. Temperature. Steam treatment. Analy. . Cassava flour. Cassava starch. India.

The effect of steam-hydrothermal treatment (SHTT) on functional properties of cassava was studied using fresh roots of cv. Malayan-4 (M-4). Fresh slices were steam processed for 5, 10, and 20 min at atmospheric pressure. Plain-dried samples were also prepared for comparison. SHTT samples were found to have higher rehydration capacity, equilibrium MC by soaking, and sedimentation vol. at room temp. (28-30 degrees Celsius) These samples also showed a lower amylose content than plain-dried samples. Electrolytes

like sodium chloride, sodium sulphate, and sodium phosphate at 1.0 N concn. changed the sedimentation vol., especially of SHTT samples. Paste stability of steam-processed samples at cooking temp. (95 degrees Celsius) was relatively higher than plain-dried ones. Among the 3 SHTT samples, that steam-processed for 10 min showed the highest paste consistency and setback ratio. X-ray diffraction pattern of flour prepared from SHTT samples indicated a clear shift from crystalline to a partially amorphous state. Infrared spectra of cassava starch and flour samples were generally identical. (AS)

0368

30581 RAJA, K.C.M. 1986. Texture characteristics of cassava-wheat dough and sensory properties of chapathi. Journal of Food Science and Technology 23(2):77-79. En., Sum. En., 6 Ref. (Food Division, Regional Research Laboratory, Trivandrum 695019, India)

Cassava. Cassava flour. Analysis. Wheat flour. Organoleptic examination. Bakery products. India.

Results of textural studies conducted with wheat, cassava, and wheat-cassava dough samples are given and the evaluation of organoleptic qualities of chapathi (a type of Indian bread) prepared with them is discussed. Roots of cassava cv. 'Malayan' were used. Parboiling the fresh cassava slices increased firmness and cohesiveness of the dough. Incorporation of plain CF to wheat flour at levels of 30 percent improved the color and appearance of chapathi, but scored less in hand feel, mouth feel, and taste compared with chapathi prepared from whole wheat flour. Blending of parboiled CF with wheat flour improved the organoleptic qualities of the product. (AS)

0369

30809 SRIKANTA, S.; JALEEL, S.A.; GHILDYAL, N.P.; LONSANE, B.K.; KARANATH, N.G. 1987. Novel technique for saccharification of cassava fibrous waste for alcohol production. Starch/Stärke 39(7):234-237. En., Sum. En., De., 9 Ref., 11. [Fermentation Technology & Bioengineering Discipline, Central Food Technological Research Inst., Mysore 570013, India]

Cassava. Waste utilization. Alcohol. Cassava starch. Hydrolysis. India.

A novel technique, involving the hydrolysis of starch present in cassava fibrous waste in shallow layers in stainless steel trays, was developed to facilitate the use of higher slurry concn. The use of slurry containing 30 percent solids, 4 percent sulphuric acid, 30 min saccharification time at 121 degrees Celsius resulted in the complete conversion of the starch into reducing sugars. The spent residue, after separation of the hydrolysate, contained about 24 percent of the total sugars formed and these were recovered to the extent of 90-94 percent by using a counter-current extraction technique. A large-scale saccharification of a 75 kg batch gave 75 liters pooled hydrolysate containing 15 percent reducing sugars. An overall process efficiency of 76.4 percent was observed with the fermentation of hydrolysate pooled with the counter-current extract for alcohol production; however, fermentation of the whole saccharified pulp without the separation of the hydrolysate and acid-enzyme hydrolysis of the waste gave lower efficiencies. (AS)

0370

30136 SRIKANTA, S.; JALEEL, S.A.; SREEKANTIAH, K.R. 1987. Production of ethanol from tapioca (*Manihot esculenta* Crantz). Starch/Stärke 39(4):132-135. En., Sum. En., De., 7 Ref., 11. [Discipline of Microbiology & Fermentation Technology, Central Food Technological Research Inst., Mysore 570013, India]

Cassava. Ethanol. Cassava flour. Cassava roots (vegetable). Cassava starch. Fermentation. India.

Ethanol production from fresh cassava tubers, CF, and cassava starch was studied by a simultaneous saccharification and fermentation procedure. A 20 percent enzyme-liquefied slurry showed about 2-3 percent reducing sugars, which increased to 10 percent on enzymic saccharification for 4 h. Alcoholic fermentation of this hydrolysate with *Saccharomyces cerevisiae* var. *ellipsoideus*, yielded 8-9 percent alcohol showing about 95 percent fermentation efficiency. Large-scale fermentation of CF by this process also showed a fermentation efficiency of 90 percent, thereby indicating the economic viability of the process. (AS)

0371

30131 TWIDDY, D.R.; CROSS, S.J.; COOKE, R.D. 1987. Parameters involved in the production of lactic acid preserved fish-starchy substrate combinations. *International Journal of Food Science and Technology* 22(2):115-121. En., Sum. En., 12 Ref., 11.

Cassava. Uses. Fermented products. Lactic acid. Asia.

Preliminary studies based on a minced fish-salt-glucose system indicated that a rapid lactic acid fermentation i.e., pH decrease to less than 4.5 in the 1st 48 h, proved difficult to achieve. The use of rice or cassava as carbohydrate alternatives was evaluated with or without a 1-day prefermentation (prior to admixing with the fish). Different carbohydrate:fish proportions were studied in the range 20-100 percent wt./wt. of minced fish. The use of prefermented cassava (20 percent wt./wt.) resulted in consistent, rapid fermentations, the pH decreasing to less than 4.5 and the lactic acid bacteria:spoilage ratio exceeding 4 log cycles of growth within 48 h. The use of added low mol. wt. sugar (e.g., 2 percent wt./wt. glucose) in addition to the cassava is necessary to prevent undesirable pH increase after the 1st 2 days of fermentation. Inoculation studies with the common food pathogens *Staphylococcus aureus*, *Salmonella typhimurium*, *Clostridium sporogenes*, and *Escherichia coli* indicated that these pathogens rapidly disappear during fermentation. (AS) See also 0250 0271 0277 0278 0318 0320 0344 0345 0376 0382 0384 0385 0386 0386

I03 Industrial Microbiology

0372

30146 ACABAL, A.D.; ROSARIO, E.J. DEL 1986. Effects of pH on glucoamylase production by *Aspergillus awamori* NRRL 3112 in an airlift fermenter. *Annals of Tropical Research* 8(4):157-163. En., Sum. En., 12 Ref., 11.

Cassava. *Aspergillus*. Cassava flour. Fermentation. Enzymes. Philippines.

The effects of pH on batch production of glucoamylase by *Aspergillus awamori* NRRL 3112 in a 3.5-liter airlift fermenter were determined using a mixture of CF and rice bran (1:2 wt. ratio) as substrate. Highest production of the enzyme was noted on the 4th day of incubation when the pH of the medium was maintained at 5.5. The volumetric and specific activities of glucoamylase were 124.4 IU/ml and 10.3 IU/mg protein, resp. (AS)

0373

30814 ACABAL, A.D. 1983. Production of glucoamylase by *Aspergillus awamori* NRRL 3112 in an airlift fermenter. M.Sc. Thesis. College, Laguna,

University of the Philippines at Los Baños. 164p., En., Sum. En., 125 Ref., II.

Cassava. Industrial microbiology. Fermentation. Enzymes. Cassava flour. Protein content. Industrial machinery. Starch content. Ethanol. Rhizopus. Aspergillus. Philippines.

Production of glucoamylase by *Aspergillus awamori* NRRL 3112 in an airlift fermenter was optimized using a mixture of CF and rice bran as substrate. The substrate was prehydrolyzed with acid and the pH was adjusted with ammonium hydroxide. In batch production, max. enzyme activity was observed on the 4th day under the following conditions: incubation temp., 30 degrees Celsius; solids level, 20 percent (wt./vol.); pH of medium, 5.5; 10 percent (vol./vol.) inoculum size with initial spore count of $7.20 \times 10(5)/\text{ml}$ in the culture medium; and aeration, 0.8-1.0 vvm. The volumetric activity, protein content, and specific activity were 124.4 IU/ml, 12.0 mg/ml, and 10.3 IU/mg protein, resp. The pH of medium was maintained by automatic addition of either 6N ammonium hydroxide or 2N sulfuric acid. Increasing the solids level as well as the inoculum size did not improve enzyme production but resulted in lower glucoamylase activity. The production at room temp. and pH 5.5 showed max. volumetric activity of 118.7 IU/ml on the 4th day of incubation. Moreover, the addition of phosphates to the medium during production at room temp. helped eliminate the use of an automatic pH controller. No significant difference in volumetric activity was observed, thus making the method of production more economical. Max. volumetric activity after 4 days of incubation was 110.0 IU/ml. In 1-stage continuous production at a dilution rate of 0.067/h using the optimum conditions in the batch process, a continual decrease in volumetric and specific activities were noted during the entire incubation period. The decrease could be due to mycelial washout or catabolite repression. Concn. of crude glucoamylase solution at 52 degrees Celsius under reduced pressure (70 mm Hg) showed low enzyme recovery (47.3 percent). Prolonged exposure of the enzyme at 52 degrees Celsius probably denatured some of the glucoamylase. Partial purification of glucoamylase using fractional protein precipitation at varying ethanol concn. was conducted. The highest volumetric activity and specific activity were obtained in the 70-60 percent fraction, the degree of purification of which was about 7-fold. Max. recovery of enzyme activity was also observed at this fraction. Total recovery of glucoamylase activity was 44.69 percent based on the activity of the crude enzyme. The loss of enzyme activity could be due to denaturation by ethanol. The preparation of solid glucoamylase with high gravimetric activity has been described. Total recovery of enzyme activity was about 88 percent. The activities of 2 commercial glucoamylases are reported. (AS)

0374

30543 CALAPARIDO, M.R. 1983. Screening and evaluation of amylolytic yeasts from bubod on different starches. Mag.Sc. Thesis. College, Laguna, University of the Philippines at Los Baños. 117p. En., Sum. En., 60 Ref., II.

Cassava. Industrial microbiology. Yeast production. Isolation. Cassava starch. Enzymes. Hydrolysis. Philippines.

Eighty-five amylolytic yeasts were isolated from bubod (rice wine starter) samples from Baguio City, Philippines. Fifteen isolates were selected after determining the degree of starch hydrolysis (diameter of clear zone produced after the application of dilute I solution) and submitted to further evaluation to determine the amount of glucose produced using the Nelson-Somogyi method. Isolates no. 408, 656, and 750 showed the highest amylase activities. *Saccharomycopsis fibuligera* 501Y was used as reference

strain; its saccharifying activity showed very little difference with that of the local isolate (no. 750). Selected strains were identified according to Lcllder's systematic way of classification. Isolates no. 408 and 656 were identified as *S. fibuligera* and isolate no. 750 as *S. capsularis*. A higher amylase formation was observed in the 3 isolates and the reference when grown in modified amylase production media using cassava starch as C source. Cassava starch was found to be a better amylase inducer than sweet potato starch. Amylase formation was max. at the stationary phase of cell growth on all strains. A 3-fold increase in the saccharifying activities of the partially purified crude enzymes was observed. The reference strain, TUA 501Y, had the highest hydrolytic ability in cassava starch (52 percent) followed by isolate no. 750 (50 percent). The saccharifying activities of the different strains in cassava and sweet potato starch, in decreasing order were: TUA 501Y more than isolate no. 750 more than isolate no. 656 more than isolate no. 408. Glucose was the only sugar detected during the hydrolysis of cassava and sweet potato starches by the different crude enzyme preparations. Hence, the selected strains and the reference are high glucoamylase producers. (AS)

0375

29371 J. SLS, P.; LECLERCQ, D.; RORADUMA, C. 1987. Qualités et utilisations du manioc enrichi en protéines par fermentation fongique. (Quality and uses of protein-enriched cassava by fungal fermentation). Bujumbura, Institut des Sciences Agronomiques du Burundi. Service de Biotechnologie Alimentaire. 31p. Fr., Sum. En., Fr., 15 Ref. Project Technologie Manioc (Convention AGCD-UCL D24-92).

Cassava. Protein enrichment. Fermentation. Industrial microbiology. Nutritive value. Toxicity. Analysis. Composition. Processing. Human nutrition. Burundi.

Since 1977 the Institut des Sciences Agronomiques du Burundi has studied protein enrichment of cassava through controlled fungal fermentation. A simple technique, based on traditional cassava fermenting methods in Burundi, Rwanda, and Zaire, is described; CF with 16-11 percent protein is produced. Protein enrichment is based on the ability of the soil fungus *Rhizopus oryzae* to turn inorganic N (urea) into fungal protein N when mixed with the cassava substratum and then fermentation. Dried cassava chips with 40 percent MC were steamed at 80 degrees Celsius for 1.5 h. After cooling down to 40 degrees Celsius, a solution containing *R. oryzae* spores, 30 g urea, 13 g K_2PO_4 , 7 g $MgSO_4$, and 20 g citric acid was added per kg dry cassava. Cassava, spread in layers approx. 2 cm thick on perforated trays, was allowed to ferment for about 48 h. The nutritive value and toxic side effects of the CF were investigated in chemical analyses and expt. with animals in Belgium and Burundi. Results indicated a remarkable nutritive value and no risks. (CIAT)

0376

30582 NOPARATNARAPORN, F.; THAKULNALLEUMTAI, S.; SILVEIRA, R.G.; NISHIZAWA, Y.; NAGAI, S. 1987. SCP production by mixed culture of *Rhodocyclus gelatinosus* and *Rhodobacter sphaeroides* from cassava waste. Journal of Fermentation Technology 65(1):11-16. En., Sum. En., 14 Ref., 11. [Dept. of Microbiology, Faculty of Science, Kasetsart Univ., Bangkok 10900, Thailand]

Cassava. Protein enrichment. Waste utilization. Industrial microbiology. Vitamin B12. Cassava starch. Enzymes. Hydrolysis. Thailand.

The amylolytic enzymes produced by *Rhodocyclus gelatinosus* hydrolyzed cassava starch mainly to maltose and a small amount of glucose. The organism used maltose at the specific growth rate of 0.15 liter/h, but in the presence of glucose, maltose consumption rate was retarded. Therefore,

a series of mixed cultures was conducted with *Rhodobacter sphaeroides* P47, which showed a high growth rate of 0.24 liter/h on glucose and contained 29.5 micrograms vitamin B12 and 0.49 mg carotenoid/g cell compared with 18.4 micrograms and 0.23 $\mu\text{g/g}$ cell, resp., of *R. gelatinosus*. Mixed cultures with 3 different inoculum ratios of the 2 organisms, based on cell no., all gave higher growth yields and vitamin B12 and carotenoid contents in the total cell mass than single cultures. When the inoculum ratio of *R. gelatinosus* to *R. sphaeroides* P47 was over 1.0, the culture time was shortened due to the synergistic effect of sugar consumption. Therefore, it was suggested that the mixed culture of these 2 organisms would be practically profitable for more nutritive SCP production from cassava waste. (AS)

0377

30542 RUBICO, S.M. 1983. Fungal protein production using cassava (*Manihot esculenta* Crantz) flour as substrate. Mag.Sc. Thesis. College, Laguna, University of the Philippines at Los Baños. 121p. En., Sum. En., 68 Ref., 11.

Cassava. Cassava flour. Industrial microbiology. *Aspergillus*. Isolation. Fermentation. Protein content. Sugar content. Protein enrichment. Philippines.

Preliminary screening for fungal protein production was conducted using 39 strains of fungi isolated from bubod (rice wine starter) and rotten cassava, including 2 strains of *Aspergillus oryzae* and 2 strains of *A. awamori*. Four potential isolates were chosen (BU2, St3, 35, and 36) and used to achieve optimum conditions of CF concn. (1, 2, and 3 percent), N concn. (0, 0.15, and 0.30 percent), N source (NH_4NO_3 , NH_4SO_4 , and urea), pH (3.5, 4.0, control 6.0-7.0), spore concn. (10(6), 10(7), and 10(6) count/ml), and fermentation time (17, 41, 48, and 72 h). The best condition was then used for fungi culture in a 2-l fermenter. Parameters measured were dry cell wt., residual sugar, carbohydrate conversion efficiency, protein content, and protein yield. Growth of fungi isolates was improved when the following nutrients were all present in the medium: C source (CF), N source, phosphate solution, and metal solution. CF at 3 percent was found to be the optimum level because at higher concn., a thick viscous paste was formed on gelatinization that prevented efficient mixing. Cell wt. increase was observed for every 1 percent increase in CF concn. Cell protein content increased significantly with increasing N concn. Improved cell yield was also observed; however, the difference between 0.15 and 0.30 percent N was not significant. Urea was found to be the best N source based on all parameters measured. Fungi can grow on a wide range of pH (3.5-6.7) without much effect on their efficiency and activity. No significant differences were observed when the different spore concn. were used. As cell wt. increased, a corresponding decrease in residual sugar was observed. Fermentation must end after 48 h when protein content is max. and fungal growth is almost stationary. The efficiency of fungal protein production was remarkably improved when grown in a 2-liter stirred fermenter compared with the use of shake flask. Based on protein yield, isolate 35 was the best followed by BU2, 35, and St3. Isolates BU2 and St3 were identified as *A. japonicus* and *A. petrakii*, resp. Before using isolates 35 and 36, they were already identified as strains of *A. awamori*. (AS) See also 0355 0363

J00 ECONOMICS AND DEVELOPMENT

0378

30021 DAHNIYA, M.T. 1985. Farming systems research in Sierra Leone: some

practical lessons. Sierra Leone, Njala University College. Department of Agronomy. 18p. En., Sum. En., 6 Ref. Paper presented at the Workshop on Methodologies, Practical Approaches and Potential Contribution of Farming Systems Research for Rural Development in Sub-Saharan Africa, Njoro, Kenya, 1985.

Cassava. Cultivation. Cassava programs. Technology evaluation. Production. Socioeconomic aspects. Developmental research. Sierra Leone.

The Adaptive Crop Research and Extension (ACRE) Project, sponsored by USAID, the Government and University of Sierra Leone, is reviewed. Its main objective is to increase the agricultural productivity of small farmers through adaptive crop research, crop demonstrations, and an effective extension service. The results obtained from station research are used to design simple on-farm adaptive research trials; based on these trials, on-farm demonstrations are developed for the benefit of farmers. The organization, problems, and achievements of research, demonstrations, and extension activities are highlighted. Practical lessons learnt include the need for some initial survey prior to the commencement of field operations, the rejection of high yielding crop var. because of certain preferences such as tuber peel and petiole color, the depression of prices as a result of bumper crop harvests, the dislike of farmers for thinning crops, and the inclusion of plots in field trials. The high cost of the present extension system is emphasized. It has been demonstrated that small-scale farmers are willing to accept innovation if their needs are satisfied. (AE)

0379

19877 FARIAS, A.B.N.; SOUZA, A. DA S.; FUKUDA, C.; SOUZA, M. DA P.N. DE; ALMEIDA, P.A. DE; MATTOS, P.L.F. DE; FUKUDA, W.M.G. 1986. Mandioca: resumos informativos. (Cassava: informative abstracts). Brasilia, Brasil. Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Mandioca e Fruticultura. Mandioca: resumos informativos, 14. v.2,262p. Pt., 633 Ref.

Cassava. Bibliography. Brazil.

Summaries are given of 633 research papers on different aspects of cassava, compiled by the Centro Nacional de Pesquisa de Mandioca e Fruticultura, of the Empresa Brasileira de Pesquisa Agropecuária (Cruz das Almas, Brazil). Aspects dealt with were fertilization, general aspects of the crop (botanics, climate, and cultural practices), economics, physiology, phytochemistry, phytosanitation, plant breeding, nutrition and uses, production systems, and technology. Subject, author, and geographic indexes are also included. (CIAT)

0380

36855 GATTI, E.U. 1986. A política agrícola e a composição da produção e utilização de mão-de-obra na agricultura paulista na década de setenta. (Agricultural policies and composition of produce and labor utilization in agriculture in Sao Paulo in the 70's). Informacoes Economicas no.11:29-37. Pt., 1 Ref.

Cassava. Production. Socioeconomic aspects. Statistical data. Brazil.

The effects of agricultural policies on produce composition and labor utilization throughout the period 1968/70 to 1980/82 in the state of Sao Paulo, Brazil, are analyzed. The expansion of some agricultural activities in 1968/70-1974/76, especially those providing raw material for exportable industrial products, occurred at the expense of area planted to crops for domestic consumption; cassava area, for example, was reduced in 47,721 ha

out of the total agricultural area substituted in the period (1,292,212 ha). A small increase in cassava area (499 ha) was observed again in the period 1974/76-1980/82, particularly at the expense of rice and pasture areas. The general effects of agricultural policies on labor use and distribution are discussed. (CIAT)

0381

29577 HAHN, S.K. 1984. Tropical root crops; their improvement and utilization. Ibadan, Oyo State, Nigeria, International Institute of Tropical Agriculture. 30p. En., Sum. En., 38 Ref., 11. Based on a paper presented at Conference on Advancing Agricultural Production in Africa, Arusha, Tanzania, 1984.

Cassava. Production. Plant breeding. Cultivation. Cassava programs. Intercropping. Cassava products. HCN content. Gari. Root productivity. Africa.

A general review is given of the production constraints of different tropical root crops (cassava, yam, sweet potato (*Colocasia* and *Xanthosoma*) in Africa, and the advances in this field are presented. The main biological factors limiting cassava production are diseases (CAMD and CBB) and pests (cassava mealybug and green spider mite). Advances are reported on the var. improvement carried out at the International Institute of Tropical Agriculture (Nigeria), directed toward (1) the production of plants with lower HCN content, high yield potential, and disease resistance; (2) the introduction of natural enemies for biological pest control, particularly *Apoanagrus lopezi*; (3) management of cultural practices such as: land preparation, use of shade, fertilization, planting material, intercropping systems (cassava/maize, cassava/peanuts, and cassava/cowpea), leaf harvest, weed control, and continuous cassava production on the same field. Finally, cassava processing systems used to reduce HCN content are reviewed. (CIAT)

0382

29046 HOLTZMAN, J.S. 1986. Annotated bibliography of cassava production, marketing, processing and consumption in Africa with particular attention to Zaire. Worcester, MA, Settlement and Resource Systems Analysis Cooperative Agreement. 42p. En., 95 Ref.

Cassava. Bibliography. Production. Marketing. Processing. Human nutrition. Zaire. Africa.

The importance of cassava as a food crop in Zaire is highlighted and the situation of research of this crop is analyzed and discussed. Bibliographic references up to 1985 covering different aspects of cassava are included with their resp. abstract. Particular emphasis was given to literature relevant to Zaire. The bibliographic material was divided into 5 groups: selected general reference material; cassava production, marketing, processing, and storage in African countries other than Zaire; socioeconomic studies of cassava production, marketing, and processing in Zaire; re-research on cassava production; and cassava consumption and nutrition. (CIAT)

0383

30529 KREAMER, R.G. 1986. Cassava, the food of the urban poor. In Kreamer, R.G. Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa. Ithaca, New York, Cornell University. Department of Agricultural Economics. International Agricultural Economics Study Series. A.E. Research 86-30. pp.5-12. En., 11.

Cassava. Production. Costs. Ghana.

An overview is presented of cassava as a crop in Ghana, with a discussion of: yields of cv. Ankra; adaptability to soil and moisture conditions; production costs (labor and other inputs), with returns to labor compared with those of sweet potato, maize, and millet; storage and processing (for gari and kokonte); uses and demand in the country. In 1955, cassava constituted 38 and 46 percent of the urban diet in Kumasi and Secondi-Takoradi, a situation that is still prevalent. (CIAT)

0384

30532 KREAMER, R.G. 1986. Gari processing: improved technology. In Kreamer, R.G. Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa. Ithaca, New York, Cornell University. Department of Agricultural Economics. International Agricultural Economics Study Series. A.E. Research 86-30. pp.41-66. En. 11.

Cassava. Gari. Processing. Technology evaluation. Mechanization. Women. Marketing. Prices. Income. Socioeconomic aspects. Ghana.

The effects of improved technology on the gari industry in the Ashanti and Brong-Ahafo regions (Ghana) are analyzed. The mechanical cassava grater used in these areas is described as well as a high-vol. technology system in Accra. Two case studies of these technologies, in Ayigya-Kumasi and Anloga-Kumasi, are compared. Details of these women-managed organizations to process gari are given. The various steps from the arrival of raw material to fermentation and roasting are also discussed. Socioeconomic production factors, related to the adoption of new technology and quality considerations, and the operating costs and revenue of Anloga-Kumasi processors are also presented. (CIAT)

0385

30526 KREAMER, R.G. 1986. Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa. Ithaca, New York, Cornell University. Department of Agricultural Economics. International Agricultural Economics Study Series. A.E. Research 86-30. 138p. En., 56 Ref., 11.

Cassava. Gari. Technology evaluation. Marketing. Small-scale processing. Cassava programs. Ghana.

The manner in which Ghanaian entrepreneurs have increased food availability through improvements in cassava processing, eliminating many of the bottlenecks associated with organizing the delivery of fresh cassava to processing centers, and improving cassava processing technology, is examined. The focus is on the gari industry of Ghana, particularly in the area of Kumasi, and the impact of 2 technological innovations: the mechanical cassava grater and the manual screw press, built locally. Samples, case studies, and surveys of the cassava marketing and processing chain and of Kumasi's informal industrialists were used to collect socioeconomic data. Policy implications for promoting small-scale technological change are discussed. Individual papers are recorded in this publication under the following consecutive no.: 0359 0360 0383 0384 0386 0387 0388. (CIAT)

0386

30531 KREAMER, R.G. 1986. Gari processing: the traditional method. In Kreamer, R.G. Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa. Ithaca, New York, Cornell University. Department of Agricultural Economics. International Agricultural Economics Study Series. A.E. Research 86-30. pp.29-40. En., 11.

Cassava. Gari. Processing. Technology evaluation. Ghana.

The traditional method of gari processing in Ghana, as well as the use of improved technology such as the mechanized cassava grater and the wingnut screw press, are discussed. Case studies of 2 processing enterprises managed by women in Bonwire, an Ashanti village near Kumasi, and Ayeasu, near Techiman, are given. In each case study, the choice of technology, types of gari made, supply of cassava, and gari marketing are discussed. A concluding analysis of the industry's future is also made. (CIAT)

0387

30530 KREAMER, R.G. 1986. Production and consumption of cassava in Ghana. In Kreamer, R.G. Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa. Ithaca, New York, Cornell University. Department of Agricultural Economics. International Agricultural Economics Study Series. A.E. Research 86-30. pp.13-27. En., 11.

Cassava. Production. Consumption. Gari. Prices. Statistical data. Maps. Ghana.

The production and consumption of cassava in the Ashanti (Kumasi) and Brong-Ahafo (Techiman) regions of Ghana are discussed in detail. Data on production, area, and yields from 1950 to 1984 are presented as well as the national av. wholesale price (1980-85). Recommendations on soil preparation, planting (time, material, and spacing), and harvesting are given. Gari consumption in the regions is discussed and the marketing structures in Kumasi and Techiman are indicated. (CIAT)

0388

30533 KREAMER, R.G. 1986. Transformation of the gari industry: impact of new technology on the marketing chain. In Kreamer, R.G. Gari processing in Ghana: a study of entrepreneurship and technical change in tropical Africa. Ithaca, New York, Cornell University. Department of Agricultural Economics. International Agricultural Economics Study Series. A.E. Research 86-30. pp.67-89. En., 11.

Cassava. Gari. Technology. Processing. Marketing. Maps. Prices. Costs. Socioeconomic aspects. Income. Industrialization. Ghana.

The evolution of the gari marketing systems in Anloga-Kumasi and Techiman (Ghana) due to technical innovations is reviewed. The origin and development of the Kumasi processing center are discussed and the reasons for the emergence of the industry in Techiman are given. Criteria for organizing a center are included. The delivery system is described and marketing costs are analyzed. At 42 percent, transportation costs are more than twice the percentage contribution of the contractor's net margin, and 50 percent greater than the producer's price. Data on contractor's net income from cassava deliveries are also included. Tuobodum and Asuoyi, 2 villages in the Techiman area, are used as examples of organized processing centers. Furthermore, the impact of technology on traditional and new markets and on marketing returns is analyzed. (CIAT)

0389

30824 MANDAC, A.M.; GENESILA, M.P.; FLINN, J.C. 1986. Developing technology for upland farms in Northern Mindamo, Philippines. Philippine Journal of Crop Science 11(2):69-79. En., Sum. En., 9 Ref., 11. [Dept. of Agricultural Economics, International Rice Research Inst., Los Baños, Laguna, Philippines]

Cassava. Technological package. Cultivation. Upland farming. Socioeconomic aspects. Farm size. Rotational crops. Fallowing. Statistical data. Labor. Income. Technology evaluation. Philippines.

Upland farmers' production systems in Northern Mindanao, Philippines, are described and the implications of the results for developing new crop technologies at the site are discussed. The dominant cropping patterns over a sample of 202 farms in Claveria, Misamis Oriental, were maize-maize, rice-fallow, maize-fallow, cassava, and perennial crops such as coffee, cacao, and coconut. Potential socioeconomic constraints to adoption of improved technologies are considered: (a) a weak market position; (b) scarce labor, power, and investment cash; and (c) the weak economic position and the lack of freedom in resource use among tenant cultivators. Desired characteristics of new crop technologies for upland farms may include: (a) increased labor and power productivity; (b) low debt requirement; and (c) low-risk technology. (AS)

0390

30056 MSABANA, M.A.M. 1980. A review of cassava research in Tanzania. Mwanza, Tanzania, Agricultural Research Institute. 19p. En., Sum. En., 30 Ref., 11.

Cassava. Germplasm. Cultivars. Root productivity. Planting. Spacing. Weeding. Inter cropping. Manure. Groundnut. Cowpea. Income. Cassava programs. Research. Tanzania.

Local and introduced var. have been assembled at Ukiriguru, Naliendele, and Uyoie (Tanzania) for evaluation on high tuberous root yield/unit area and resistance to pests and diseases. Selected high yielding var. were evaluated over seasons and locations around Lake Victoria; Mzimbitala and Lionge performed best in tuberous root yield/unit area (41.5 and 30.7 t/ha, resp.). Var. having field resistance to both CAMD and cassava brown leaf spot were selected in Naliendele. Selections made at Ukiriguru were mostly for resistance to green cassava mites. Five local var. (Mzimbitala, Njema, Dalama, Kanyanzige, and Kinsole) were recommended as mite resistant. Host nonpreference and antibiotic were postulated as mechanisms of resistance to green cassava mites. Tuberous root yield losses of 50-80 percent caused by green cassava mite infestation can be prevented, using mite-resistant var. Limited planting materials of mite-resistant var. are multiplied in Ukiriguru and distributed free. The acceptability of the mite-resistant var. to farmers is yet to be known; however, it is certain that some mite-resistant var. are poor in tuberous root yield and flowering. Hybridization programs for plant breeding may be developed eventually, provided flowering is not a limiting factor. The recommended spacing for monocropping cassava in areas around Lake Victoria is 75 cm within ridges 150 cm wide. The best spacing in Morogoro varied from 68 to 81 cm, depending on the var., grown on ridges 90 cm wide. Consecutive weeding 4, 10, and 16 wk. after planting in monocropped cassava were necessary for better tuberous root yield/unit area in Ukiriguru. Inter cropping cassava with groundnuts has the potential to give good cash returns/unit area. Cassava products can be used in formulating rations for broilers, layers, and dairy cows. Properly formulated cassava-based diets did not limit palatability or feed conversion efficiency; however, broiler ducks did not respond well to cassava-based diets. Fermentation in water for 7 days was the most efficient method of reducing prussic acid content in cassava products. (AS (extract))

0391

29481 SUGETTE, M. TO S.L. 1981. Levantamento bibliográfico sobre mandioca. (Bibliographic survey on cassava). Fortaleza-CF, Brasil. Empresa de Assistência Técnica e Extensão Rural do Ceará. Serie Bibliográfica no.2. 37p. Pt.

Cassava. Bibliography. Brazil.

A total of 243 bibliographic references on cassava available in the library of the Empresa de Assistencia Técnica e Extensao Rural do Ceará (Fortaleza, Brazil) up to 1981 are listed in alphabetical order of the author. (CIAT)

0392

29573 VORASTRISUNTHORN, A., trad. 1986. Tapioca: few choices available. Bangkok Bank Monthly Review 27(6):260-264. En., 11.

Cassava. Cassava chips. Pellets. Statistical data. Costs. Trade. Thailand.

Thailand exports 95 percent of its tapioca, with the EEC as its most important market, importing 7.32 MT of tapioca products valued at approx. Baht 17,726 million. Tapioca from Thailand enjoys a price advantage compared with other products in the European animal feed industry. Tapioca imports were reduced during 1982-86, due to a change in legislation, which placed a 28 percent duty on vol. over a certain quantity. France and Italy, major producers of feed barley, had campaigned for such a reduction in imports. The difficulties encountered in renegotiating the agreement are discussed. (CIAT) See also 0256 0359 0360 0362 0364

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0393

30817 GIBSON, T. 1987. Northeast Thailand. A ley farming system using dairy cattle in the infertile uplands. World Animal Review no.61:36-43. En., 18 Ref., 11. [Dept. of Agriculture, Univ. of Queensland, St. Lucia, Qld. 4067, Australia]

Cassava. Cultivation systems. Rotational crops. Macroptilium. Stylosanthes. Fertilizers. F. S. E. Dairy cattle. Feeds and feeding. Socioeconomic aspects. Productivity. Thailand.

The results of a pilot ley farming extension project using dairy cattle in the infertile uplands of NE Thailand over a 5-yr period are discussed. Cassava, one of the few crops that can be grown in these upland infertile soils, was found to yield more when planted after a ley crop such as *Macroptilium atropurpureum* cv. Siratro or *Stylosanthes hamata* cv. Verano and fertilized rotational schemes in 1980, 1981, and 1982 were 7.0 and 7.1 t/ha, resp., for cassava/cassava/cassava; 5.3 and 8.3 t/ha, resp., for cassava/Siratro/Siratro (grazed legume); 7.7 and 10.5 t/ha, resp., for cassava/Siratro/Siratro but the 2nd Siratro pasture was mown; and 9.3 and 12.9 t/ha, resp., for cassava/Siratro/Siratro but both legume pastures mown. In 1983 in 1-yr ley treatments (1980 and 1981), the cassava/cassava rotations with and without fertilization yielded 13 and 11 t/ha, resp., while the Siratro/cassava rotations yielded 28 and 17 t/ha, resp. Cassava yields in 1983 and 1984 were further reduced to 9.1 and 4.4 t/ha, resp., with fertilization in 1980-81, and to 10.1 and 4.2 t/ha, resp., with no fertilization in continuous cropping systems. Low-cost milk production was considered feasible in Thailand on legume pastures and farm-grown feed, such as cassava. (CIAT)

0394

30544 GOLD, C.S. 1987. Crop diversification and tropical herbivores: effects of intercropping and mixed varieties on the cassava whiteflies, *Aleurotrachelus socialis* Bondar and *Trialeurodes variabilis* (Quaintance),

in Colombia. Ph.D. Thesis. Berkeley, University of California. 372p. En., Sum. En., 205 Ref., 11.

Cassava. Cultivars. Intercropping. Cowpea. Maize. Beans. *Aleurotrachelus socialis*. *Trialeurodes variabilis*. Insect biology. Colombia.

The effects of intercropping and mixed var. on the population dynamics of the cassava whiteflies *Aleurotrachelus socialis* and *Trialeurodes variabilis* were investigated under outbreak conditions in Colombia. Intercropping a regional cassava var. with cowpea reduced egg populations of both species of whitefly. These reductions were residual, persisting up to 6 mo. after the harvest of the cowpea. Mixing this regional cassava var. with cassava var. CMC 40 reduced populations of *T. variabilis* but did not affect populations of *A. socialis*. Predators showed a numerical response and were more abundant in monocultures, while the rates of parasitism were equal in all treatments. Mortality of whitefly immatures was also similar between systems. Thus, the natural enemies hypothesis was rejected as a mechanism explaining reduced herbivore load in cassava/cowpea intercrops. Treatment effects, therefore, were most influential on the behavior and host plant selection of adult whiteflies. Intercropping of cassava and cowpea may have provided an associated plant resistance to whiteflies during the period that the intercrop was present but this mechanism cannot explain the reductions in whitefly populations that were encountered long after the removal of the cowpea. Instead, it appeared that intercrop competition caused a reduction in cassava size or vigor which persisted through the remainder of the trial. In a 2nd trial, adult populations of *T. variabilis* were shown to be strongly correlated with the size of individual cassava plants. Thus, whitefly populations were a function of host plant selection and/or tenure time which, in turn, was related to host plant condition. These results provide an additional explanation to current theory in explaining herbivore reduction in diversified cropping systems. (AS (extract))

0395

30047 EISSIEDU, A.F.E. 1976. Improving the rotational system in the southern savanna zone of Ghana. 1. The effect of preceding cropping on yield of some major field crops. Accra, Ghana. Crops Research Institute. Council for Scientific and Industrial Research. 10p. En., Sum. En., 8 Ref.

Cassava. Rotational crops. Soil fertility. Maize. Cowpea. Tobacco. Root productivity. Ghana.

The effect of preceding cropping on the yields of maize, cassava, cowpea, and tobacco was examined in sequential trials conducted in Ohawu and Pokuase (Ghana). A split-plot design, replicated 3 times, was used with 1st-yr cropping as the main plot and 2nd yr cropping as subplots. The effect of the various 1st-yr crops on the yield of the 2nd-yr crops differed significantly at both sites except with maize in Pokuase. In Ohawu, maize and cassava tended to be resequentially compatible, each being suitable to the other as preceding crop. Cowpea yield was suboptimal but yields of succeeding maize and cassava were significantly high. There was a significant interaction between the effects of 1st- and 2nd-yr crops on the yield of 2nd-yr maize in Ohawu. At this location 1st-yr cropping of tobacco-fallow and 2nd-yr cassava tended to be the best preceding cropping sequence for 3rd-yr maize; whereas 1 yr previous cropping of cassava favored maize that followed, 2 yr successive cassava lowered the yield of maize that succeeded. (AS)

0396

30850 MATTOS, P.L.P. DE; SOUZA, A. DA S.; CALDAS, R.C. 1986. Cassava intercropped with peanuts. *Revista Brasileira de Mandioca* 5(1):71-76. Pt.,

Sum. Pt., En., 8 Ref., 11. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380, Cruz das Almas-BA, Brasil]

Cassava. Intercropping. Groundnut. Spacing. Planting. Root productivity. Starch productivity. Brazil.

During 1982-83, a trial was conducted to determine (1) the most adequate spacing for cassava cv. BGM 116 intercropped with peanut cv. Maranhao and (2) the effect of peanut on cassava yield at the Estacao Exptl. de Fruticultura Tropical in Cerriceao do Almeida (Bahia, Brazil). A randomized block design was used. Treatments were cassava planted in double rows spaced at 2.0, 2.5, and 3.0 m, with 3, 4, and 5 rows of peanuts, resp., between the double rows. Intercropping cassava planted in double rows with 2 peanut crops in subsequent years showed higher yields than intercropping peanuts with cassava spaced at 1.0 x 0.6 m. The best spatial arrangements for improved root yield were 2.0 and 2.5 m with 3 and 4 rows of peanuts between the double rows. For peanuts, the best results were obtained when it was grown as a pure crop or when intercropped with cassava planted at 3.0 x 0.7 x 0.7 m and at 2.5 x 0.7 x 0.7 m, with 5 and 4 rows, resp., between the double rows. (AS)

0397

30130 TSAY, J.S.; FUKAI, S.; WILSON, G.L. 1987. The response of cassava (*Manihot esculenta*) to spatial arrangement and to soybean intercrop. Field Crops Research 16(1):19-31. En., Sum. En., 20 Ref., 11. [The Asian Vegetable Research & Development Center, P.O. Box 42, Shanhua, T'ai-nan 74103, Taiwan]

Cassava. Intercropping. Spacing. Soybeans. Dry matter. Plant height. Root productivity. Leaf area. Solar radiation. Growth. Temperature. Light. Australia.

The response of cassava to row spacing and plant population density (0.62 plants/square meter in 180-cm rows; 1.23 plants/square meter in 90-, 180-, 270-, and 270- plus 90-cm rows (i.e., paired rows); and 2.46 plants/square meter in 90- and 180-cm rows), and to soybean intercrop at 2 row spacings of cassava (90 and 270 cm) - - studied at a high lat. (27 degrees S) in SE Queensland, Australia, where low temp. limits a growing season to 9 mo. Detailed observations were made in sole crops on leaf canopy structure and light penetration in the 3 row spacings at the medium density to allow an estimation of light availability for an intercrop between cassava rows. The low plant density or the 270-cm row plants produced the lowest total DM and root yield at harvest, while the 2 higher densities or the 2 narrower rows produced similar total and tuber dry wt. Intercropped cassava produced a similar tuber yield to the sole crop at the corresponding spatial arrangement, but total DM was lower in the former. LAI was similar among the 90-, 180-, and 270-cm row spacings in sole crops throughout the growth period; however, leaf area was unevenly distributed horizontally for a longer time as row spacing increased. This resulted in light penetrating the interrow space for a longer period in wider rows in sole crops, more than 50 percent full sunlight reaching soil level for 90, 120, and 130 days after planting in the 90-, 180-, and 270-cm rows, resp. This light environment would be available for an intercrop if cassava growth is not affected by the intercrop. The results for cassava intercropped with soybean show that in fact cassava growth was reduced by the associated soybean, and hence light available for the soybean growth would have been more than that estimated above. (AS) See also 0263 0271 0279 0381 0389 0390 0395

ABBREVIATIONS AND /CRONYMS

A	Angstrom(s)	DM	Dry matter
ABA	Abscisic acid	DNA	Deoxyribonucleic acid
ac	Acre(s)	EC	Emulsifiable concentrate
Af.	Afrikaans	EDTA	Ethylenediaminetetraacetic acid
a.i.	Active ingredient	EEC	European Economic Community
alt.	Altitude	e.g.	For example
AMV	Alfalfa mosaic virus	ELISA	Enzyme-linked immunosorbent assays
approx.	Approximate(ly)	EMF	Ethyl methane sulfonate
Ar.	Arab	En.	English
atm.	Atmosphere	EP	Preliminary Trials, CIAT
ATP	Adenosine 5'-triphosphate	Es.	Spanish
av.	Average	expt.	Experiment(al)
BAF	6-Benzylaminopurine	exptl.	Experimental
BBMV	Broad bean mottle virus	Fr.	French
BCMV	Bean common mosaic virus	ft-ca	Foot candles (10.75 lux)
Bg.	Bulgarian	FYM	Farmyard measure
BGMV	Bean golden mosaic virus	g	Gram(s)
BGMVY	Bean golden yellow mosaic virus	G	Giga (10 ⁹)
BOF	Biochemical oxygen demand	GA	Gibberellic acid
BPMV	Bean pod mottle virus	gal	Gallon(s)
BuMV	Bean rugose mosaic virus	GE	Gross energy
BSMV	Bean southern mosaic virus	GERs	Glucose entry rates
BV	Biological value	GLC	Gas-liquid chromatography
BYMV	Bean yellow mosaic virus	Gr.	Greek
ca.	About (circa)	h	Hour(s)
CMB	Cassava African mosaic disease	ha	Hectare(s)
CNV	Cassava African mosaic virus	HCl	hydrocyanic acid
CBB	Cassava bacterial blight	HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
CBSD	Cassava brown streak disease	He.	Hebrew
CEC	Cation exchange capacity	Hi.	Hindi
CER	CO ₂ exchange rate	HI	Harvest index
CF	Cassava flour	hp	Horsepower
CGR	Crop growth rate	Ho.	Hungarian
Ch.	Chinese	IAA	Indoleacetic acid
CLM	Cassava leaf mottl	IBA	Indolebutyric acid
CLV	Cassava latent virus	IBYAN	International Bean Yield and Adaptation Nursery, CIAT
CM	Cassava mottl	Il.	Illustrations
cm	Centimeter(s)	in.	Inches
COD	Chemical oxygen demand	In.	Indonesian
concn.	Concentration	It.	Italian
CP	Crude protein	IU	International unit
Cr.	Crush	J	Joule
CSL	Calcium stearyl lactylate	Ja.	Japanese
CSW	Cassava starch waste	kat	Katal (amount of enzymatic activity that converts 1 mole of substrate(s)
C.V.	Coefficient of variation	kcal	Kilocalorie(s)
cv	Cultivar(s)	kg	Kilogram(s)
2,4-D	2,4-dichlorophenoxyacetic acid		
Da.	Danish		

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INTRODUCTION

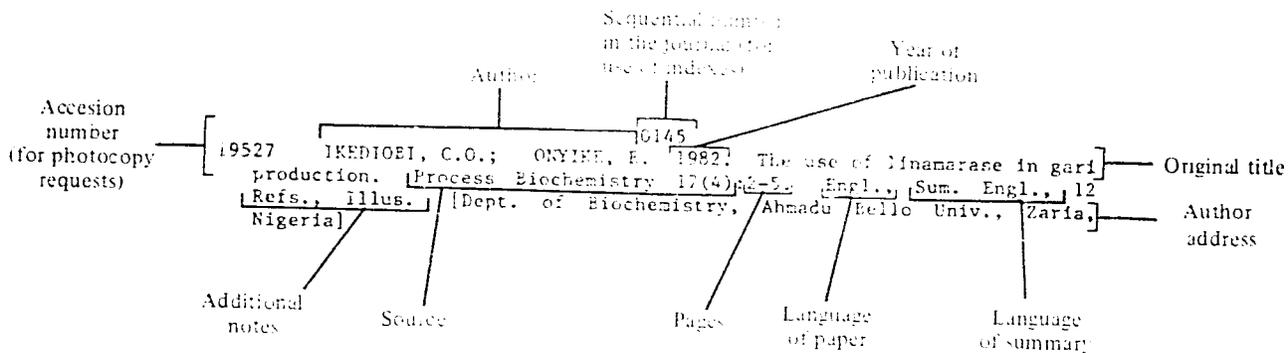
This journal of analytical abstracts, which replaces the former combination of abstract cards and yearly cumulative volumes, is designed to provide a specialized guide to the world's literature on cassava (*Manihot esculenta* Crantz), disseminating research results and ongoing activities related to the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

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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 Frijol.

COMPONENTS OF AN ABSTRACT



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.

————— **Abstract**

[AS]
|
Abstractor
and/or translator

2/16

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.

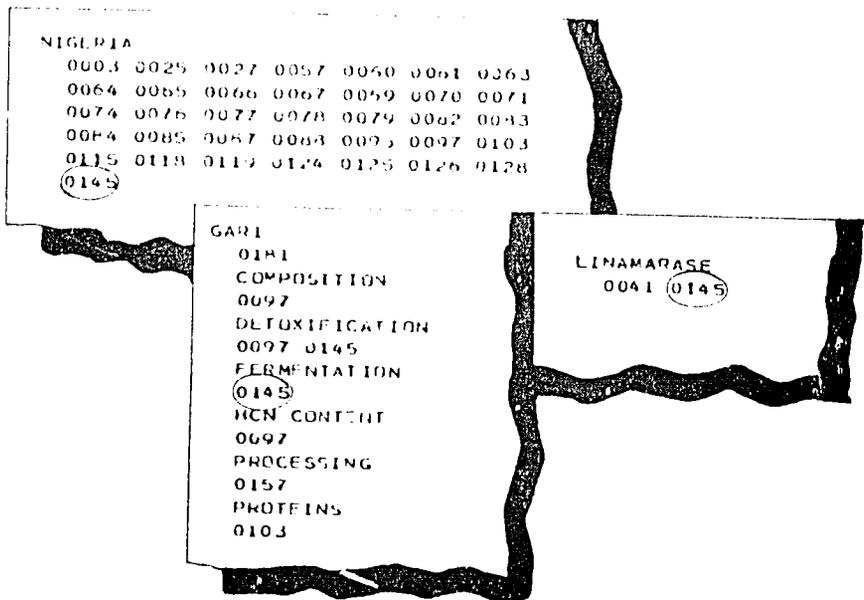
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Subject Index

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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AOO BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

0398

29336 CARTER, S.F. 1987. Collecting and organizing data on the agro-socio-economic environment of the cassava crop: case study of a method. In Bunting, A.H., ed. Workshop on agro-ecological characterization, classification and mapping, Rome, 1986. Agricultural environments: proceedings. Wallingford, United Kingdom, Commonwealth Agricultural Bureaux International, pp.11-29. En., Sum. En., 20 Ref., 11. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Plant geography. Ecology. Maps. Climatic requirements. Soil physical properties. Surveys. Productivity. Socioeconomic aspects. South America. Colombia.

A method is suggested for defining microregions within a larger region in which a particular crop, in this case cassava, is important. The method will help research workers and institutions to identify research priorities and develop appropriate technical options for greater and more profitable sustained output for particular regions. The method begins with a small-scale distribution map of the crop under study. Areas where the crop is produced are then described in simple agroecological terms. Specific regions are identified for study from these maps, in conjunction with other policy considerations. Secondary data analysis, Rapid Rural Survey, and Settlement Pattern Survey are used to define spatial variations in the more important constraints which limit output locally. Microregions are then defined by overlaying maps which show the geographic distributions of these constraints. As a case-study, a method of analyzing the production of cassava on the north coast of Colombia is described. (AS) See also 0411 0541

COO PLANT PHYSIOLOGY

0399

29915 ASHOKAN, P.K.; BAI, E.K.L.; NAIR, R.V. 1986. Canopy spread of and light infiltration through cassava (*Manihot esculenta* Crantz) canopies. Agricultural Research Journal of Kerala 24(1):83-85. En., Sum. Ann., 4 Ref. [College of Horticulture Veerianikkara 680 654, Trichur, Kerala, India]

Cassava. Canopy. Light. Intercropping. Plant development. Cultivars. Planting. Spacing. Timing. Leaves. India.

The extent of canopy spread of 6 cassava var. (M4, H 1687, H 2304, H 3641, H 312, and Col), planted on mounds 90 x 90 cm apart, was estimated as well as the light infiltration through the cassava canopy with advancing age, both over the mound and in the interspaces. At 45, 75, 90, 120, and 270 days after planting, av. canopy spread was 66.5, 98.3, 109.6, 113.8, and 114.2 cm, resp. The percentage light infiltration over the mound ranged from 39.1 to 18.0 and in the interspaces from 100 to 26.1 in the interval 45-120 days after planting. Var. differences for canopy spread were not significant but those for percentage light infiltration were. Var. M4 allowed the highest light transmission, followed by Col. Results indicate that intercroppings should be sown farther from the mounds. (CIAT)

0406

32027 BAJAJ, Y.P.S. 1977. Clonal multiplication and cryopreservation of cassava through tissue culture. Crop Improvement 4(2):198-204. En., Sum. En., 15 Ref., 11.

Cassava. Tissue culture. Apical meristems. Shoots. Cryopreservation. Culture media. Laboratory experiments. Germplasm. India.

An in vitro method for the clonal propagation of cassava plants from segments of shoots, vegetative buds, and meristems is described. Shoots and callus have also been regenerated from meristems frozen at -196 degrees Celsius. The feasibility of employing these methods for the conservation and international exchange of germplasm is discussed. (AS)

0401

32205 EL-SHARKAWY, M.A.; COCKE, J.H. 1988. Características fotosintéticas de la yuca. (Photosynthetic characteristics of cassava). Yuca boletín Informativo 12(1):13-15. Es., Il. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Photosynthesis. Plant physiological processes. Carbon dioxide. Leaves. Colombia.

Research results obtained at CIAT on the photosynthetic characteristics of cassava are presented; these suggest that cassava could be an atypical C3-type species evolving towards a C4-type plant. Evidence is provided based on research with palisade cassava tissues, CO2 recycling in cassava, and survival mechanisms. (CIAT)

0402

30592 EL-SHARKAWY, M.A.; COCKE, J.H. 1987. Response of cassava to water stress. Plant and Soil 106:335-360. En., Sum. En., 17 Ref., Il. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Cultivars. Water stress. Growth. Transpiration. Water requirements (plant). Leaves. Leaf area. Defoliation. Root system. Root development. Root productivity. Timing. Biomass production. Colombia.

The response of cassava cv. M Col 1684 and CM 507-37 (a hybrid of M Col 1684 x M Col 1438) to water stress was studied using a drainage field lysimeter at CIAT-Santander de Quilichao (Colombia) in 1983,84. The water stress treatment was initiated 90 days after planting and lasted 3 mo., when plants were allowed to recover. Six harvests were carried out at 51, 90, 140, 182, 274, and 345 days after planting and parameters measured were LAI, fallen leaves, total biomass, and fresh root yield. At the onset of the dry period, cassava reduced its leaf area (produced fewer and smaller leaves and shedded older leaves) which could be a means of reducing water loss by transpiration; however, reduction of leaf area also reduced CGR. Upon recovery, cassava rapidly regenerated new leaves and the LAI of previously stressed plants became higher than in nonstressed plants, leading to a greater accumulation of assimilates in the roots during the few months of recovery. It was concluded that a single plant type, such as that of CM 507-37, can yield well under both stress and nonstress conditions (16 and 19 t dry roots/ha in less than 1 yr for this cv.), provided that the genotype has slightly higher than optimal LAI (close to 5.0 in the case of this cv.) under nonstress conditions and diverts more DM into an extensive fibrous root system. (CIAT)

0403

32224 MABANZA, J. 1987. Improvement of cassava (*Manihot esculenta*) by in vitro culture (Abstract). In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre, p.35. En. [Direction Generale de la Recherche Scientifique et Technique, B.P. 2499, Brazzaville, Congo]

Cassava. Plant tissues. Tissue culture. Congo.

Since cassava was introduced to Africa, it has adapted and become broadly diversified. The Congolese program for the selection of bacteria-resistant cassava has recorded a wide range of genetically rich material, indicating that national research programs should conserve or improve the well-adapted local vegetable resources. In this study, in vitro culture expts. were performed on cassava. Results showed that cassava could easily be manipulated in vitro. It was demonstrated that entire cassava plants could be produced from young tissues such as stem meristems and cotyledons. Cellular fusions were also achieved with cells and protoplasts (cassava cells are highly allofusible). A somatic embryogenesis can now be obtained from protoplasts. It was shown that in vitro culture techniques can be used to improve local cassava var. (Full text)

0400

31649 MAEAME, M.; AKORODA, M.O.; BABIN, F.E. 1987. Effects of reciprocal stem grafts on cyanide translocation in cassava. Journal of Agricultural Science (Australia) 109(5):605-608. En., 12 Ref. [International Inst. of Tropical Agriculture, I.C.M.B. 5320, Ibadan, Nigeria]

Cassava. Analysis. Grafting. HCN content. Leaves. Roots. Timing. Cultivars. Selection. Nigeria.

Reciprocal and self-grafts of mature and healthy stems of 3 improved cassava var. (TMS 30001, TMS 50572, and TMS 50395 with low, moderate, and high HCN conen., resp.) were conducted to study their HCN content in leaves at 3, 6, and 9 mo. after planting and in roots at harvest. Leaf and root HCN assessments confirm the predominant influence of scion (leaf or shoot) as a source of HCN that is accumulated in roots. However, the C.V. ($r(2) = 0.233$) was small and thus measurement of leaf HCN is not a reliable method for selecting roots with low HCN. There appeared to be no relation between root HCN and plant age. The greater variability of HCN content among scions (C.V. = 39.1 percent) than among stocks (C.V. = 12.3 percent) indicates that scion HCN production greatly influences but is not the only determinant of HCN conen. in roots. As expected, TMS 50395 roots contained the most HCN in both scion (7.22 mg/100 g) or stock (5.44 mg/100 g). For edible cassava leaves, screening of genotypes based on direct assessment of leaf HCN is important. Low HCN in roots should be selected on the basis of accurate root HCN determination in early breeding generations using peeled roots. (CIAT)

0405

31690 SZABAIOS, L.; NARVAEZ, J.; ROCA, W.M. 1987. Técnicas para el aislamiento y cultivo de protoplastos de yuca (*Manihot esculenta* Crantz). (Techniques for isolation and culture of cassava (*Manihot esculenta* Crantz) protoplasts). Cali, Colombia, Centro Internacional de Agricultura Tropical. Unidad de Investigacion en Biotecnologia. Documento de trabajo no.23. 46p. En., En., 14 Ref., 11.

Cassava. Tissue culture. Protoplasts. Leaves. Shoots. Isolation. Laboratory experiments. Culture media. Analysis. Colombia.

The procedures and materials required for isolation, purification, and culture of leaf and shoot-tip and somatic embryo derived cassava protoplasts are detailed, based on the results of a research program performed in CIAT's Biotechnology Research Unit during 1984-86. (CIAT) See also 0573

C01 Plant Development

0406

30836 FUKUDA, W.M.G.; CERQUEIRA, L.L. 1986. Efeito da temperatura sobre a germinação de sementes de mandioca. (Effect of temperature on cassava seed germination). Revista Brasileira de Mandioca 5(2):13-21. Pt., Sum. Pt., En., 6 Ref., 11. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Germination. Seed. Temperature. Timing. Mulching. Brazil.

The effect of air and soil temp. on the germination of cassava seeds was studied under field conditions at the U. Federal da Bahia in Cruz das Almas (Brazil), in May, 1986. Three replicates of 400 seeds each were sown in seedbeds, covered or not with plastic. Av. air and soil temp. from 30 to 33 degrees Celsius were observed to increase the cassava seed germination and assured a germination rate of 85 percent. (AS)

0407

31671 HOWLER, R.R.; STEVENSON, F.; SAIF, S. 1987. Practical aspects of mycorrhizal technology in some tropical crops and pastures. Plant and Soil 100(1):249-283. En., Sum. En., 36 Ref., 11. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Mycorrhizae. Inoculation. Plant development. Growth. Fertilizers. P. Nutrient uptake. Root productivity. Dry matter. Soil physical properties. Colombia.

Greenhouse and field expt. were conducted on the effect of vesicular-arbuscular mycorrhiza (VAM) on the growth of cassava, various tropical grass and legume species, as well as beans, coffee, and tea. A large no. of VAM fungal species were evaluated for effectivity in increasing cassava growth and P uptake in acid low-P soils. The effectivity of VAM species and isolates was highly variable and dependent on soil pH and fertilizer applications, as well as on soil temp. and humidity. Two species, *Glomus manihoti* and *Entrophospora colombiana*, were found to be most effective for a range of crops and pastures, at low pH and at a wide range of N, P, and K levels. At very low P levels nearly all crops and pasture species were highly mycorrhizal dependent, but at higher soil P levels cassava and several pasture legumes were more dependent than grass species. Mycorrhizal inoculation significantly increased cassava and bean yields in those soils with low or ineffective indigenous mycorrhizal populations. In these soils cassava root yields increased on the av. 20-25 percent by VAM inoculation, both at the expt. station and in farmers' fields. VAM inoculation of various pasture legumes and grasses, in combination with rock phosphate applications, increased their early growth and establishment. Agronomic practices such as fertilization, crop rotations, intercropping, and pesticide applications were found to affect both the total VAM population as well as its species composition. While there is no doubt about the importance of VAM in enhancing P uptake and growth of many tropical crops and pastures grown on low P soils, much more research is required to elucidate the complicated soil x plant x VAM interactions and to increase yields through improved mycorrhizal efficiency. (AS)

0408

31660 RAMANUJAM, T.; BIRADAR, R.S. 1987. Growth analysis in cassava (*Manihot esculenta* Crantz). Indian Journal of Plant Physiology 30(2):144-153. En., Sum. En., 19 Ref., 11. [Central Tuber Crops Research Inst., Trivandrum-695 017, India]

Cassava. Growth. Analysis. Dry matter. Root productivity. Cultivars. Roots. Leaves. Stems. Branching. Petioles. Shoots. Leaf area. Biomass production. Harvest index. India.

Growth and productivity of 14 cassava cv. were studied using growth analysis. The high yielding cv. recorded significantly higher values of specific leaf wt. (SLW), NAR, and CGR when compared with low yielding cv. The highest dry biomass and fresh root yields obtained were 26.3 and 42.2 t/ha; resp. The profusely branching types accumulated more DM in shoots (52.6-64.2 percent) than the nonbranching types (33.5-41.8 percent) resulting in low HI. The pooled analysis suggested that the root yield was significantly and positively correlated with SLW ($r = 0.86^{**}$), petiole length ($r = 0.84^{**}$), NAR ($r = 0.78^{**}$), and CGR ($r = 0.73^{**}$). The results of the path analysis indicated that the biomass had max. direct and indirect influence on yield. (AS)

0409

31650 STAMP, J.A.; HENSHAW, G.G. 1987. Secondary somatic embryogenesis and plant regeneration in cassava. Plant Cell, Tissue and Organ Culture 10(3):227-233. En., Sum. En., 15 Ref., 11. [Dept. of Viticulture & Enology, Univ. of California, Davis, CA 95616, USA]

Cassava. Morphogenesis. Culture media. Tissue culture. Cultivars. Plant development. United Kingdom.

Somatic embryos isolated from mature seed-derived cotyledon cultures of cassava underwent direct secondary somatic embryogenesis or plant development under appropriate incubation conditions. Isolated somatic embryos were subjected to a 2-stage culture procedure similar to that which induced their development on cotyledon explants. This involved incubation for 24-30 days on Murasige and Skoog basal medium supplemented with 2-8 mg 2,4-D/liter (Stage I medium) before transfer to medium supplemented with 0.01 mg 2,4-D and 0.1 mg BAP/liter (Stage II medium). Under these conditions, secondary somatic embryos developed directly from the cotyledons and shoot-tip region of primary somatic embryos by a developmental process morphologically very similar to that occurring on zygotic cotyledon explants. Apical shoot extension and adventitious root formation occurred when somatic embryos were isolated from parental cultures and incubated on Stage II medium. Somatic embryo-derived plants growing in greenhouse conditions appeared morphologically normal when compared with non-regenerated plants. (AS) See also 0399 0410 0424 0431 0432 0435 0436 0440 0563 0572 0574

C03 Chemical Composition, Methodology and Analyses

0410

31664 ESECHIE, E.A. 1987. Total nonstructural carbohydrate distribution in cassava during growth in a rainforest zone, Nigeria. Tropical Agriculture (Trinidad) 64(4):340-342. En., Sum. En., 8 Ref. [Faculty of Agriculture, Univ. of Benin, Benin City, Nigeria]

Cassava. Growth. Carbohydrate content. Leaves. Stems. Roots. Analysis. Timing. Sucrose. Maltose. Fructose. Starch content. Nigeria.

Changes in the nonstructural carbohydrates in the leaves, stem, and roots (tubers) of cassava during growth were examined. From the 5th mo. after planting, monthly samples were taken for analysis up to the 9th mo. when the tubers matured and were harvested. Generally, the nonstructural carbohydrate components increased appreciably in concn. as the plant

24

matured. Sucrose formed the bulk of the sugars, with maltose presenting the least concn. in all plant parts at the different stages of growth. The other sugars were glucose and fructose. Starch accounted for the highest proportion of the nonstructural carbohydrates and was predominant in the tubers. (AS)

0411

31661 GRATTAPAGLIA, D.; NASSAR, N.M.A.; DIANESE, J.C. 1987. Bioanálise de espécies brasileiras do gênero *Manihot* baseada em padrões de proteína da semente. (Biosystematics of Brazilian *Manihot* spp. based on seed protein patterns). *Ciência e Cultura* 39(3):294-300. Pt., Sum. En., Pt., 24 Ref., 11. [Bioplanta Tecnologia de Plantas Ltda, Caixa Postal 1141, 13.100 Campinas-SP, Brasil]

Cassava. *Manihot*. Seed. Protein content. Electrophoresis. Analysis. Laboratory experiments. Brazil.

Soluble seed protein of 19 *Manihot* species was electrophoretically resolved by SIS-polyacrylamide gel electrophoresis. Species analyzed were *M. esculenta*, *M. zehneri*, *M. granami*, *M. pilosa*, *M. corymbifera*, *M. pohillii*, *M. glaziovii*, *M. pseudoglaziovii*, *M. sprunosa*, *M. brachyandra*, *M. reptans*, *M. alutacea*, *M. fruticulosa*, *M. pentaphylla*, *M. stipularis*, *M. salicifolia*, *M. caerulea*, *M. caerulea caerulea*, *M. leptophylla*, and *M. neuzana*. The profiles revealed a banding pattern which varied in no., distribution, and intensity of bands, reflecting the wide morphological and geographical range observed in the genus. The analysis showed *M. pilosa* to be the closest species to the cultivar. Electrophoretic evidences of introgression in the genus were obtained with *M. caerulea*. A similarity matrix was set up in an attempt to quantify the affinity among species. (AS)

0412

32092 HIDAJAT, E.B. 1987. Histochemical localization of some enzymes in cassava callus (*Manihot esculenta* Crantz). *Cytologia* 52(3):671-678. En., Sum. En., 8 Ref., 11. [Biology Dept., Bandung Inst. of Technology, Bandung, Indonesia]

Cassava. Cuttings. Callus. Plant tissues. Enzymes. Analysis. Laboratory experiments. Indonesia.

Histochemical localization of 2 enzymes in cassava callus showing root- and shoot-like structures was carried out. Localization of peroxidase by the benzidine reaction showed granules in cells next to meristemoids, around root initials and tracheids and at the callus margin. They were also found close to the provascular region of the shoot-like structure and parenchyma cells of its head. Phosphatase localization using the lead sulfide procedure showed black deposits in cells around the meristemoids and meristematic core of the stalk in the shoot-like structure and in the vicinity of its base. They occur also in some cortical cells of the root and marginal cells of the callus. (AS)

0413

29794 HUSSAIN, A.; RUSHOK, W.; RAMIREZ, H.; ROCA, W.M. 1987. Polyacrylamide gel electrophoresis procedures for cultivar identification of field bean, cassava and pasture legumes. Cali, Colombia, Centro Internacional de Agricultura Tropical. Working Document no.22. 21p. En., Es., 6 Ref. [Food Science Dept., Univ. of Manitoba, Winnipeg, Canada, R3T 2N2]

Cassava. Electrophoresis. Cultivars. Identification. Laboratory experiments. Analysis. Colombia.

The procedures for cv. identification of beans, cassava, and pasture legumes by using polyacrylamide gel electrophoresis are described; this technique can determine cv. differences indirectly by comparing the products of gene activity, i.e., by using proteins as genotype markers. The corresponding procedure for cassava cv. identification is described which includes the preparation of the material, the sample, and the gel, electrophoresis, and staining. (CIAT)

0414

29793 FUSFAIN, A.; RAMIREZ, B.; ROCA, W. A. 1986. Manual práctico para la detección electroforética de isoenzimas y otras proteínas. (Practical handbook for electrophoretic detection of isoenzymes and other proteins). Cali, Colombia, Centro Internacional de Agricultura Tropical. Documento de trabajo no.19. 68p. Fs., 73 let., 11. [Dept. of Plant Science, Univ. of Manitoba, Canada]

Cassava. Electrophoresis. Enzymes. Proteins. Laboratory experiments. Biochemistry. Colombia.

Procedures for the electrophoretic detection of isoenzymes and other proteins contained in cassava, beans, and legumes are described. Diagrams illustrating the construction and assembly of equipment required to conduct starch gel and polyacrylamide gel electrophoresis and protein electrophoresis are included. The preparation of the starch and polyacrylamide gels, buffer solutions, and sample solutions is described in detail. Procedures for sample cutting, voltage application time and values, and staining of the main enzymes under study (acid phosphatase, catalase, esterase, lipase, and peroxidase) are specified. Protein electrophoresis is a much simpler procedure, since protein bands are not influenced by the equipment used in extraction procedures or by the physiological state of the plant material. Total proteins, water-soluble proteins (albumins), salt-soluble proteins (proteins), alcohol-soluble proteins (glucans), acetic acid-soluble proteins (glutenins), and insoluble or residual proteins can be extracted by these methods. The general procedure for protein extraction consists in mixing 0.4 N sodium chloride and centrifuging until the desired protein is obtained; electrophoresis using basic and acid polyacrylamide gels is described. An analysis is presented of electrophoretic patterns, which can be made by using samples of known identity or through visual intensity measurements. (CIAT)

0415

30841 JESUS, V.C. DE; MORAES, C.F. DE; TELES, F.F.F.; SEDIYAMA, C.S. 1986. Teor de ácido cianídrico nas folhas e raízes de dez variedades de mandioca Manihot esculenta Crantz, durante o primeiro ciclo. (Level of hydrocyanic acid in the leaves and roots of ten cassava varieties planted during the first crop cycle). Revista Brasileira de Mandioca 5(2):83-90. Pt., Sum. Pt., En., 17 let., 11. [Empresa de Pesquisa Agropecuária da Bahia, S.A., Caixa Postal 1222, Ondina 40.000 Salvador-BA, Brasil]

Cassava. HCN content. Cultivars. Leaves. Roots. Brazil.

Ten cassava var. were evaluated as to their potential for integrated use without cyanide toxicity risk. Only var. Rosa had low leaf and root HCN contents (below 100 ppm) from 5 to 10 mo. after planting. Var. Pao do Chile, Alpin Quintal, and Manteiga only had similar root HCN contents. Results indicate that the use of cassava leaves in human and animal nutrition can be risky if the toxicity and plant cycle of each var. are not considered. (AS)

0416

30842 JESUS, V.S. DE; MORAES, C.F. DE; TELES, F.F.F.; SEDIYAMA, C.S. 1986. Teor de carboidrato em raízes e caules de dez variedades de mandioca (Manihot esculenta Crantz), durante o primeiro ciclo. (Level of carbohydrates in roots and stems of ten cassava varieties planted during the first crop cycle). Revista Brasileira de Mandioca 5(2):91-98. Pt., Sum. Pt., En., 16 her. [Empresa de Pesquisa Agropecuária da Bahia, S.A., Caixa Postal 1222, Ondina, 40.000 Salvador-BA, Brazil]

Cassava. Carbohydrate content. Cultivars. Roots. Stems. Timing. Brazil.

The acid-digestible carbohydrates in 10 Brazilian cassava var. 5 to 10 mo. after planting were determined in a trial carried out at the U. Federal de Viçosa (Minas Gerais, Brazil). The percentage of acid-digestible carbohydrates in the stems varied more than that of the roots. The level of acid-digestible carbohydrates (kg/plant) in both organs indicated that the best time for integral use of the plant was from 7 to 10 mo. after planting, especially for var. Manteiga which was similar to var. Rosa, Alpin Quintal, and Fracquinha but with a higher level of acid-digestible carbohydrate in the roots. (AS)

0417

31678 PENTLATO, M. DE V.O.; MINAZZI, R.N.; ALMEIDA, L.B. DE 1986. Carotenóides e atividade pró-vitamina A de folhas de hortaliças consumidas no Norte do Brasil. (Carotenoids and pro-vitamin A activity of vegetable leaves consumed in northern Brazil). Revista de Farmácia e Biotecnologia da Universidade de São Paulo 22(2):97-102. Pt., Sum. Pt., En., 14 her. [Faculdade de Ciências Farmacêuticas da Univ. de São Paulo, Caixa Postal 50780 São Paulo-SP, Brazil]

Cassava. Leaves. Plant pigments. Vitamin A. Analysis. Composition. Brazil.

The carotenoid contents with vitamin A activity (alpha and beta-carotenes) of the leaves of 16 vegetables consumed in Santarém (Para, Brazil) were determined by chromatography and spectrophotometry. Analyses were performed during the rainy and dry seasons of 1984 and 1985. Cassava and okra leaves showed the highest carotenoid values (25,148 and 19,483 IU/100 g, resp.) in the dry season, while in the rainy season the highest value was found in cassava, followed by Hibiscus sabdariffa and Hibiscus acetosella (18,072, 17,040, and 13,995 IU/100 g, resp.). (AS)

0418

30821 PEFEIRA, J.A.M.; QUEIROZ, D.M. DE; BALPASQUALE, V.A. 1984-1985. Estudo de difusão de umidade em cilindros de mandioca. (Study on moisture diffusion in cassava cylinders). Revista Brasileira de Armazenamento 9-10(1-2):45-48. Pt., Sum. Pt., En., 11 her., II. [Centroinar, Campus da UFV, Caixa Postal 270, 36.570 Viçosa-MG, Brazil]

Cassava. Water content. Plant physiological processes. Mathematical model. Temperature. Drying. Brazil.

A computer program was developed to solve the equation of moisture diffusion in cylindrical bodies of cassava (3.5 cm long x 1.2 in diameter) by the Crank-Nicolson method of finite differences. Coefficient values of moisture in cassava were obtained based on exptl. drying values found in the literature. Studies were carried out to determine the influence of temp. and MC on the moisture diffusion coefficient in cassava. It was concluded that the adjustment of the model to the exptl. drying data could be improved by making the coefficient of diffusion a function of temp. and MC of the product. (AS)

0419

32087 RIZK, A.-F.M. 1987. The chemical constituents and economic plants of the Euphorbiaceae. Botanical Journal of the Linnean Society 94(1-2):293-325. En., Sum. En., 161 Ref., 11. [Chemistry Dept., Faculty of Science, Qatar Univ., P.O. Box 2713, Doha, Qatar]

Cassava. Euphorbiaceae. Composition. Cyanogenic glucosides. Qatar.

A chemical review of the different classes of compounds which have been isolated from the Euphorbiaceae (other than the diterpenoids) is given, including triterpenoids and related compounds (sterols, alcohols, and hydrocarbons), phenolic compounds (flavonoids, lignans, coumarins, tannins; phenanthrenes, quinones, phenoic acids, etc.), alkaloids, cyanogenic glucosides, and glucosinolates. A summary of the industrial and medicinal uses of members of the Euphorbiaceae is provided, including cassava as food plant. (AS) See also 0404 0474 0483 0487 0488 0495 0501 0562 0569

CO4 Plant Nutrition

0420

30825 ISLAM, A.K.M.S.; ASHER, C.J.; EDWARDS, D.G. 1987. Response of plants to calcium concentration in flowing solution culture with chloride or sulphate as the counter-ion. Plant and Soil 98(3):377-395. En., Sum. En., 34 Ref., 11. [Dept. of Agriculture, Univ. of Queensland, St. Lucia, Qld. 4067, Australia]

Cassava. Ca. Culture media. Nutritional requirements. Mineral content. Mineral deficiencies. Growth. Productivity. Australia.

Solution Ca concn. required for the growth of a range of plant species, including cassava cv. Nina and S. Aur 14, were determined in 2 expt. in which plants were grown in flowing solution culture at constantly maintained Ca concn. ranging from 0.5 to 3690 micromolar. Calcium chloride was used as the Ca source in the 1st expt., calcium sulphate was used in the 2nd. At calcium concn. of 10 micromolar and below, all species developed Ca deficiency symptoms. The severity of the deficiency was more pronounced in the dicotyledons (cassava) than in the monocotyledons; however, cassava was much more tolerant than all other dicotyledons and equally as tolerant as rice, the most tolerant monocotyledon. Solution Ca concn. required for 90 percent of max. yield were generally lower for monocotyledons (30 micromolar) than for dicotyledons (7-770 micromolar) when Ca chloride was used as the Ca source. When calcium sulphate was used, 7 out of 11 species, including 3 monocotyledons, required external Ca concn. of 1200 micromolar and above. The results are discussed in relation to effects of solution composition and the choice of counter-ions on plant response to Ca and other macronutrient cations. It is concluded that yield depressions due to toxicity of excesses of chloride, and possibly other counter-ions, can lead to serious underestimation of limiting external cation concn. for plant growth. (AS)

DOO CULTIVATION

0421

32086 SECRETARIA DE AGRICULTURA Y RECURSOS HIDRAULICOS. MEXICO. s.f. Areas potenciales para el cultivo de yuca. (Potential areas for cassava

production). México, Dirección General de Distritos y Unidades de Temporal. Subdirección de Estudios y Proyectos. 102p. Es. Contiene 76 mapas.

Cassava. Production. Cultivation. Maps. Mexico.

Based on known phenological, edaphic, and climatic requirements of cassava and on soil and climatic data of Mexican areas, the potential regions for cassava production were identified. Seventy-six color-coded maps of Mexican locations are provided showing where cassava can be produced in adequate and marginal soils through mechanized, animal-drawn, and manual systems. Potential surface area figures are given per state and per district. The potential for solar drying of cassava per state and per district is also given. (CIAT) See also 0433 0540 0545

D01 Soil, Water, Climate and Fertilization

0422

32038 BOISSEZON, P. DE; FOMELON, P. 1986. Effets de l'apport de fumier sur les caractéristiques chimiques d'un sol ferrallitique ivoirien. (Effects of manuring on the chemical characteristics of a ferrallitic soil in Ivory Coast). Cahiers ORSTOM (Serie Pedologie) 22(3):329-355. Fr., Sum. Fr., En., 3 Ref., 11. [ORSTOM, Centre de Bondy, 70-74, route d'Aulnay, 93140 Bondy, France]

Cassava. Nutritional requirements. Dung. Plowing. Land preparation. Soil analysis. Fallowing. Soil requirements. Soil physical properties. Ivory Coast.

The effects of 4 rates of FYM and 3 plowing depths on the chemical characteristics of a ferrallitic soil planted to cassava in Ivory Coast were studied. Plowing had contrary effects on the organic and mineral CEC of the plowed soil layer. After harvesting cassava, 17 mo. after fallowing and manuring with 30 t/ha, the enrichment in OM and exchange bases was still significant, particularly in the soil layers which were plowed. A mathematical model of 1st-order kinetics was fitted for OM evolution and humification in the plowed layer and subsoil. Increased organic C content in the plowed layer was short-lived and 1/6 of the humus resulting from the decayed plant matter went to the subsoil. Mineral losses due to leaching and cassava were higher than the input resulting from the fallow-Panicum maximum incorporation, except for K. To maintain the initial level of exchange bases, 12 t manure/ha seem necessary. An accurate evaluation of the changes in N levels due to the different amounts of manure was not possible. Likewise, the inaccurate measurement of CEC concealed the effect of manuring on the no. of exchange sites in the plowed layer. (AS (extract))

0423

31674 CADAVID L., L.F.; HOWLER, R.H. 1987. El problema de la erosión en los suelos de Mondomo, Cauca, Colombia dedicados al cultivo de la yuca y sus posibles soluciones. (The problem of soil erosion in cassava producing regions in Mondomo, Cauca, Colombia and possible solutions). Cali, Colombia, Centro Internacional de Agricultura Tropical. 129p. Es., Sum. Es., 36 Ref., 11.

Cassava. Erosion. Soil conservation practices. Land preparation. Cultivation. Fertilizers. Planting. Intercropping. Beans. Mulching. Cultivars. Root productivity. Soil physical properties. Soil water. Rainfall data. Colombia.

Various management practices are presented to minimize erosion risks or counteract damage already existing when planting cassava while improving regional yields of this crop. To this end, a series of trials were established in the towns of Mondomito, Tres Quebradas, and Agua Blanca (Cauca, Colombia), and soil losses due to erosion were quantified. The best management alternatives were compared with traditional ones, and fresh cassava root yields (t/ha) were measured. In slopes less than 15 percent, no significant differences were found among the land preparation methods (mechanical traction, animal traction (oxen), or manual labor (small boxes with pike and/or hoe). In this type of soil, and if erosion risks have not yet begun, min. tillage or zero tillage complemented with the use of a chemical fertilizer is recommended. In areas with marked slopes, presenting some degree of erosion, treatment with oxen was the best in terms of yield in all trials, but proportionately implied more soil loss due to erosion, especially when no chemical fertilization is used. If this system is complemented with chemical fertilization and maize mulching (2 t/ha), yields are good and erosion risks are reduced by 40-60 percent. With the method of zero tillage and/or small boxes -- depending on the degradation of these soils, its previous management, and its productivity -- acceptable yields can be obtained and erosion risks are minimized. The best treatment to counteract soil losses due to erosion was planting cassava alternately with strips of introduced grasses such as *Brachiaria decumbens*, *B. humidicola*, or King Grass, or cassava and strips of native grass. Yields, however, were very low due to the strong competition. Excellent yields were only obtained in association with *Axonopus scoparius* and depending on the type of management used. Another effective alternative is planting cassava alternately with beans (var. Carioca), while with crops such as cowpea, erosion risks are very high (losses of 52-106 t/ha of dry soil over 14 mo. in Mondomito). These techniques or management systems help increase regional av. cassava yields in Mondomito and prevent erosion risks, or tend to restore part of what has been lost. (AS (extract)-CIAT)

0424

30554 EUSUMA, L. 1962. (Effects of sources of N, P and K fertilizers on the growth and yield of cassava). Mag.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 110p. Thai., Sum. En., Thai., 50 Ref., 11.

Cassava. Fertilizers. N, P, K. Growth. Productivity. Field experiments. Foliage. Roots. Leaves. Mineral content. Starch content. Analysis. Harvest index. Root productivity. Thailand.

From May 1978 to May 1979, a field expt. was conducted on a Sattahip soil series in Amphur Epiracha (Cholburi Province, Thailand) using different sources of N, P, and K. A 3 x 4 x 2 factorial design of N x P x K in randomized complete blocks was used. Thirty treatments were applied which consisted of 4 checks (0-0-0, 0-P-K, N-0-K, and N-0-P) and 26 complete fertilizer grades including 2 mixed fertilizer grades (15-15-15 and 17-17-17). Each treatment was replicated 3 times. Fertilizer rates used were 8 kg each of N, P, and K/rai (6.25 rai = 1 ha) in split applications (at 1 and 4 mo. after planting) and placed in bands 15.2-17.8 cm long, 7.6-10.1 cm deep, and 15.2-20.3 cm apart from each plant. Plot size was 5 x 6 square meters with 1 x 1 square meter spacing. At 3, 4, 6, 8, 10, and 12 mo. after planting, data was collected on plant height, fresh and dry top wt., fresh and dry root wt., no. of roots/plant, HI, and leaf N, P, and K contents. At harvest, and in each plot, the fresh top and root wt., total no. of roots, HI, and starch content were recorded. Plant height, fresh and dry top wt., fresh and dry root wt., no. of roots/plant, and HI at the different growth stages were not significantly affected by the different sources of N, P, and K. However, as compared with the other fertilizer treatments, plants receiving the 2 complete fertilizer grades

(15-15-15 and 17-17-17) produced greater fresh and dry top and root wt. Application of diammonium phosphate and monoammonium phosphate seems to be superior to triple superphosphate and rock phosphate. Plants in plots receiving diammonium phosphate and monoammonium phosphate produced greater top and root yields (fresh and dry wt.) than those from plots receiving rock phosphate and triple superphosphate. Besides, plants receiving diammonium phosphate, monoammonium phosphate, and triple superphosphate resulted in higher leaf P contents than those receiving rock phosphate. At harvest, it was found that fresh top and root wt., total no. of roots, HI, and starch contents in fresh roots were not markedly affected by any application of different sources of N, P, and K fertilizers; the mixed fertilizer grades, however, generally produced greater fresh top and root wt. than those obtained from plants receiving each or all other fertilizer treatments. Diammonium phosphate and monoammonium phosphate seemed to be superior to rock phosphate and triple superphosphate. Furthermore, it was also found that generally fertilized plants gave higher HI values than those unfertilized. The effects of sole source of N, P, and K fertilizers or their combinations on fresh root starch content were not pronounced and consistent. Generally, roots of unfertilized plants contained higher starch contents than those of fertilized plants. (AS)

0425

30557 MCNEOL, P. 1982. (Laterite gray podzolic, and low humic gley topeosequence in Chanywat Ebon Kaen). M.Ag.Sc. Thesis, Bangkok, Thailand, Kasetsart University. 150p. Thai., Sum. En., Thai., 45 Ref., 11.

Cassava. Upland farming. Soil analysis. Soil physical properties. Cultivation. Thailand.

The physicochemical properties and mineralogy of 7 soil profiles of laterite, gray podzolic, and low humic gley soils on a topeosequence in Chanywat Ebon Kaen (Thailand) were studied and classified according to the 1975 US Soil Taxonomy System. Cassava and leuca have been the main upland crops in the upper and middle parts of the topeosequence while the lower area has been under continuous rainfed paddy condition. Results showed that these soils were deep, sandy loam to loamy sand texture with low fertility that had developed from old alluvium of predominantly quartz sand and some kaolinitic clay mineral with minor anatase as unweatherable component. Soils on the upper and middle parts of the slope are well drained with moderate to strongly acid reaction, but the soils in the lower area of the topeosequence are poorly drained and only slightly acid to slightly alkaline in reaction. Montmorillonite was found only in this lower area and its amount increased with depth. The soils in the upper and middle parts of the slope were classified as coarse-loamy, siliceous, isohyperthermic (xic) Pseudoglec and coarse-loamy, siliceous, isohyperthermic Ustoxic Dystrupept, resp. The lowest lying soil, however, was classified as coarse-loamy, siliceous, isohyperthermic Aeric Tropoqualfs. Recommended cultural practices should therefore include proper soil and water managements as well as the use of both chemical and organic fertilizers. (AS)

0426

32222 NGEVE, J.M. 1987. Performance of improved cassava clones in the sandy, lateritic soils of the southern lowlands of Cameroon (Abstract). In Terry, E.R.; Akoroda, M.O.; Arene, O.F., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. p.35. En. [Inst. de la Recherche Agronomique, Nkolobisson, R.P. 2067, Yaoundé, Cameroon]

Cassava. Cultivars. Soil requirements. Leaves. Root productivity. Cameroon.

Cassava yield trials conducted in 3 environments in the Central Province of Cameroon showed that superior clones performed best, yielding over 20 t/ha at each location. These clones outyielded local cv. Higher yields appeared to be associated with tolerance to CAMD. In Ntui, a severe outbreak of CBB in 1985 drastically reduced the yields of most clones, possibly because these clones were developed in Nkolonisson, an area free of CBB. The need to test improved clones for their tolerance to major diseases and pests before their release is stressed. Of the 8 clones tested in farmers' fields, clone 1005 had the highest root and leaf yields and was preferred by all growers participating in the trial. (Full text)

0427

32210 NJKEU, E.O.; ODURUKWE, S.O. 1987. Evaluation of nitrogen fertilizer sources and rates for a cassava-maize intercrop. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.30-33. En., Sum. En., 15 Ref., 11. (National Root Crops Research Inst., Umudike, P.M.B. 7006, Umuania, Nigeria)

Cassava. Intercropping. Maize. Fertilizers. N. Root productivity. Nigeria.

Three readily soluble N fertilizers (sulphate of ammonia, calcium ammonium nitrate, and urea) and 2 slow-release forms (sulphur-coated urea of 11 and 30 percent dissolution rate in 7 days) were each tested at 4 rates on a cassava/maize intercrop for 2 cropping seasons in the high rainfall zone of Nigeria. Cassava plots that were treated with calcium ammonium nitrate produced significantly higher root and starch yields than those that received sulphate of ammonia and the 2 slow-release forms. Urea was the 2nd best N source, although plots treated with urea did not yield significantly higher than other plots. Maize dressed with urea produced significantly higher grain yields than those that received N from other sources. Increasing the rate of N applied up to 100 kg/ha produced a higher significant increase in maize grain yield and a nonsignificant depression in cassava root yield. Total energy yield from calcium ammonium nitrate-treated plots were significantly the highest. The results indicate that 100 kg N/ha in the form of calcium ammonium nitrate or urea is best for cassava/maize cultivation in this high rainfall zone. (AS)

0428

30559 SOMKIB, B. 1982. (Measuring the effect of weather on some economic crop production in some provinces of Thailand). Mag.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 133p. Thai., Sum. En., Thai., 29 Ref., 11.

Cassava. Climatic requirements. Statistical analysis. Productivity. Thailand.

The effect of weather on some economic crops (lowland rice, maize, sugarcane, soybean, cassava, kenaf, and cotton) in some provinces of Thailand was studied. The technological advances associated with the production of these crops were also analyzed. The time series data for 11 yr were used, and Bernard Cury's model and multiple regression analysis applied. The yields of lowland rice in Changwat Phrae and Petchaboon, that of maize in Changwat Loei, Makornratchasima, and Supanburi, that of sugarcane in Changwat Supanburi and Kanchanaburi, and that of kenaf in Changwat Udornthani, Khonkan, and Loei were significantly affected by the weather. Results showed that when the aridity index increased, the crop yields also increased. Weather had no significant effects on the yield of

the other crops (soybean, cassava, and cotton). The analysis of technological advances revealed that only the yields of lowland rice and sugarcane had increased significantly over time. (AS)

0429

30574 WARGIONO, J. 1986. Effects of nitrogen, phosphorus and potassium fertilizers on the yield of continuously-cropped cassava. Cassava Newsletter 10(1):3-5. En., II.

Cassava. Cultivation systems. Fertilizers. N. P. K. Nutritional requirements. Analysis. HCN content. Mineral content. Roots. Stems. Leaves. Root productivity. Soil impoverishment. Indonesia.

The effects of N (0, 60 and 120 kg/ha as urea), P (0, 30, and 60 kg/ha as triple superphosphate), and K (0, 50, and 100 kg/ha as K sulphate) fertilization on yield and yield stability of continuously cropped cassava, grown on poor Latosols of Gunung Kidul and Wonogiri in Central Java, were investigated during 3 cropping seasons (1976-77 to 1978-79). All P was applied at planting, while N and K were applied in split rates, 1/3 at planting and 2/3 2 mo. later. In the 1st season, N (60 kg/ha) increased fresh top wt. significantly at both sites, but top wt. decreased successively in the 2nd and 3rd cropping seasons; N also tended to increase in leaves and roots and K in stems. No further significant increase was observed at N rates higher than 60 kg/ha. The same held true for a K rate of 50 kg/ha which also increased K in leaves and stems, but reduced N in roots. The root yield response to N at both locations increased with each subsequent planting, but absolute yields decreased year after year. No response to P was observed at either location, probably due to the formation of vesicular-arbuscular mycorrhizae. Thus, continuous cassava cropping can drastically decrease soil productivity since av. yields decreased each year. A positive correlation was observed between applied N and root HCN content. K fertilizer appears necessary when exchangeable K is significantly lower than the critical level of 40 ppm. An av. root yield of 25 t/ha in this expt. removed soil nutrients estimated in 102 kg N, 35 kg P, and 170 kg K. (CIAT) See also 0431 0432 0496 0539 0543 0557 0566 0577 0578

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

0430

30828 AKORODA, M.O.; OYINLOLA, A.F.; GEBREMESKEL, T. 1987. Plantable stem supply system for IITA cassava varieties in Oyo State of Nigeria. Agricultural Systems 24(4):305-317. En., Sum. En., 7 Ref., II. [Agronomy Dept., Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Technology transfer. Stems. Propagation materials. Cultivars. Selection. Nigeria.

The system for supplying stems of improved cassava var. suitable for planting from the International Institute of Tropical Agriculture (IITA) was surveyed for Oyo State, Nigeria. The adoption of these var. during 1976-85 related to the supply of planting materials was examined. Based on completed questionnaires, visits to 21 of the 24 local government areas or Oyo State, official documents, and personal communications, it was found that the effective distribution of suitable stems to the majority of cassava farmers did not begin until the 2nd half of the study period. The required capacity and rate of multiplication of IITA cassava var. were found inadequate and var. have not been introduced into some localities

due to a poor stem supply system. A large potential exists for further adoption of IITA var. 1 if farmers can obtain more stems suitable for planting. The short supply of suitable stems to farmers was identified as the chief obstacle to a wider dissemination, adoption, and use of IITA-improved cassava for meeting the food needs of cassava-dependent rural farm families in Oyo State. A greater catalytic role is recommended for IITA to ameliorate the stem supply situation. (AS)

0431

31646 HAMMER, G.L.; HOBMAN, F.R.; SHEPHERD, R.K. 1987. Effects of planting time and harvest age on cassava (*Manihot esculenta*) in northern Australia. 1. Crop growth and yield in moist environments. *Experimental Agriculture* 23(4):401-414. En., Sum. En., Es., 18 Ref., 11. [Agronomy Dept., Kansas State Univ., Manhattan, KS 66506, USA]

Cassava. Planting. Harvesting. Timing. Root productivity. Dry matter. Growth. Canopy. Harvest index. Climatic requirements. Australia.

A range of planting times, with sequential harvests to age 24 mo., was used to determine crop growth and yield of cassava at 2 locations, one having a humid tropical climate and the other humid subtropical, in Queensland, Australia. Yield was doubled during the 2nd yr at the subtropical site. At the tropical site yield was very high after 1 yr, but root rots occurred in the 2nd yr. The DM percentage of storage roots fluctuated seasonally and was highest during the cooler months when canopy vigor was lowest. Known or inferred environmental controls of the yield-determining factors of growth rate, growth duration, and partitioning to harvestable organs were used to interpret the results and thus derive guidelines for timing of planting and harvesting in moist environments. (AS)

0432

31647 HOBMAN, F.R.; HAMMER, G.L.; SHEPHERD, R.K. 1987. Effects of planting time and harvest age on cassava (*Manihot esculenta*) in northern Australia. 2. Crop growth and yield in a seasonally-dry environment. *Experimental Agriculture* 23(4):415-424. En., Sum. En., Es., 8 Ref., 11. [South Australian Dept. of Agriculture, P.O. Box 411, Loxton, South Australia 5333, Australia]

Cassava. Planting. Harvesting. Timing. Root productivity. Dry matter. Growth. Canopy. Harvest index. Irrigation. Climatic requirements. Australia.

Two expt., one irrigated and one dryland, were conducted at a site having a seasonally dry, tropical climate in Queensland, Australia. A range of planting times, with sequential harvests to age 24 mo., was used to study cassava growth and yield. Very high yields of 35-45 t DM/ha were recorded for the irrigated expt. Water limitation restricted yields to 15-26 t in the dryland expt. Known or inferred environmental controls of the yield determining factors of growth rate, growth duration, and partitioning of assimilates to harvestable organs were used to interpret the results and thus derive general guidelines for the timing of planting and harvesting in seasonally dry environments. (AS)

0433

30558 JUMLONG, J. 1982. (Weed competition studies and chemical control in cassava). Mag.Sc. Thesis, Bangkok, Thailand, Kasetsart University. 85p. Thai., Sum. Thai., En., 34 Ref.

Cassava. Weeds. Weeding. Herbicides. Timing. Root productivity. Thailand.

Expt. on weed competition and herbicide application in cassava were conducted at Sriracha Research Station (Cholburi, Thailand) from Nov. 1976-July 1980. In weed competition studies during the dry season (mid-Feb.), weed control could be delayed only up to 75 days after planting, and an initial weed-free period of 105 days was needed. Preliminary studies on preemergence application of herbicides during the dry season (late Nov.-April) revealed that the herbicides which gave satisfactory weed control and did not cause phytotoxic effects on cassava plants were napropamide, cyanazine, and alachlor at the rates of 0.75 and 1.50 kg/ha; thiobencarb, butachlor, and methoprotrotyne at 1.50 and 3.00 kg/ha; diuron and tritauralin at 0.50 and 1.00 kg/ha; linuron at 1.00 and 2.00 kg/ha; metolachlor, flucmeturon, thiobencarb P, nitrofen, and oxadiazon at 1.00, 2.00, 3.00, 4.00, and 0.80 kg/ha, resp. Diuron, thiobencarb, linuron, cyanazine, alachlor, and metolachlor were applied alone and in combinations in the wet season expt. (July). Only diuron at 0.50 kg/ha and thiobencarb at 1.50 kg/ha were found effective and did not cause root yield reduction. Diuron combined with metolachlor or alachlor provided much better weed control and produced higher yields compared with the hand-weeded check. Linuron at 0.50 kg/ha in mixture with alachlor or metolachlor also resulted in good weed control and with a root yield comparable with the check. An expt. on newly developed herbicides showed that oryzalin at 0.75 and 1.50 kg/ha and fluridone at 0.20 kg/ha were effective enough on the prevailing weeds and thereby a good plant growth was encouraged. Oxyfluorfen at 0.3 kg/ha was found slightly phytotoxic to the plant during initial growth stages but did not reduce yield. Fluridone and oxyfluorfen tended to show a narrow margin of safety in the crop. (AS)

0434

31698 LUBINI, A. 1988. Vegetation adventice et postculturale de Kisangani et de la Tshopo (Haut-Zaïre). (Adventitious and postcultural vegetation in Kisangani and Tshopo (Upper Zaïre)). Bulletin du Jardin Botanique National de Belgique 56(3-4):315-348. En., Sum. En., 10 Ref. [Laboratoire de Biologie Végétale, Institut Supérieur Pédagogique de la Gombe, B.P. 281, Kinshasa, Zaïre]

Cassava. Weeds. Zaïre.

Weed communities occurring in a no. of crops (among them cassava) and in postcultural situations in the areas of Kisangani and Tshopo, Zaïre, were found to belong to 1 alliance, 18 associations, and 1 subassociation. Associations were grouped into those belonging to crops, fallow areas, and secondary forests, and subdivided according to soil type and predominant species. Main species associated with cassava were *Bidens pilosa* and *Crassocephalum montuosum*, and *Paspalum conjugatum* and *Mariscus alterifolius*. (CIAT)

0435

32056 OPARA-NADI, O.A.; LAL, R. 1987. Effects of no-till and disc plowing with and without residue mulch on tropical root crops in southeastern Nigeria. Soil and Tillage Research 9(3):231-240. En., Sum. En., 10 Ref., 11. [International Inst. of Tropical Agriculture, Ibadan, Nigeria]

Cassava. Land preparation. Plowing. Mulching. Growth. Root productivity. Soil analysis. Root development. Nigeria.

Field expt. were conducted on an Utisoi in southern Nigeria to study the effects of no tillage and disc plowing, with and without residue mulching, on soil properties and the growth and yield of cassava and yam. Plowing to a depth of 10 cm and then applying mulch decreased soil bulk density. On the no-till plots, those with mulch had the greatest soil moisture retention at low suctions; those without mulch had low moisture retention

for suction exceeding 0.1 bar. Cassava plants in plowed plots were more vigorous than those in no-till plots, and mulching decreased plant height of cassava in the initial stages and increased plant height at about 38 wk. after planting. The root length density of cassava was 0.32 cm/cubic centimeter for no-till plots vs. 0.16 cm/cubic centimeter for plowed plots. Mulch application, however, significantly increased root length density of cassava in no-till plots only. Cassava root yield was more in no-till than in plowed plots, and application of mulch increased cassava root yield. (AS (extract))

0436

32057 OPARA-KADI, O.A.; LAL, R. 1987. Influence of method of mulch application on growth and yield of tropical root crops in southeastern Nigeria. *Soil and Tillage Research* 9(3):217-230. En., Sum. En., 18 Ref., 11. [International Inst. of Tropical Agriculture, Ibadan, Nigeria]

Cassava. Mulching. Growth. Root productivity. Root development. Soil physical properties. Soil analysis. Nigeria.

The effects of 4 methods of mulch application on growth and yields of yam and cassava were studied on an Ultisol in Onne (Port Harcourt, SE Nigeria). Treatments consisted of 2 different methods of applying 12 t dry mulch/ha, which were compared with an unmulched control. The 2 methods were complete surface mulch, row zone mulch, and mulch incorporated in the top 10-15 cm layer with the 2nd hoeing. Mulching had a significant effect on soil bulk density under cassava but not under yam. Application of mulch in the row zone and mulch incorporation in the top layer decreased soil bulk density of the 0-10 cm layer by 9 and 8 percent, resp., in comparison with the unmulched control. The least infiltration rate, however, was observed for the mulch incorporated treatment due to formation of surface seal. During the dry season, the cumulative water loss from the soil was least for the complete surface mulch treatment. Soil chemical properties were also more favorable for complete surface mulch treatment. Density of feeder roots of cassava was high for the complete surface mulch and mulch incorporated treatments. Feeder root density of yam was lower than that of cassava and mulching had no effect. The highest tuber yield of yam was obtained for surface mulching. Cassava root yield, however, was not significantly affected by mulching. (AS)

0437

32223 SAUTI, R.F.N. 1987. Effect of plant density on the yield and yield components of cassava in Malawi (Abstract). In Terry, E.P.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada. International Development Research Centre. p.35. En. [Makoka Research Station, Thandwe, Malawi]

Cassava. Planting. Spacing. Root productivity. Malawi.

Cassava var. x plant density trials were conducted for 3 seasons in Mkondezi, and for 1 season in Vinthukutu, in northern Malawi. In Vinthukutu in the 1982/83 season, increased cassava densities neither increased yields nor reduced final plant populations at harvest. As density increased from 21,000 to 63,000 plants/ha, however, there was a significant reduction in the total no. of roots harvested/plot for both cassava var. In Mkondezi, results for the 1982/83 and 1983/84 seasons showed that higher densities did not increase yields. In the 1984/85 season, however, higher densities significantly reduced yield. Also in Mkondezi, there were significant differences in the no. of roots harvested/plot between the 1982/83 and 1983/84 seasons and between var. in

the 1984/85 season. Increased plant densities significantly reduced the no. of roots harvested/plot in the 1983/84 and 1984/85 seasons but not in the 1982/83 season. The importance of these results with respect to the availability and quality of planting materials in Malawi is discussed. (Full text)

0426

30839 SILVA, P.R.F. DA; CERETTA, C.A. 1986. Sistemas de cultivo de mandioca. 1. Monocultivos em fileiras simples e duplas. (Cassava cropping systems. 1. Sole cropping in single and double rows). Revista Brasileira de Mandioca 5(2):55-63. Pl., Sum. Il., En., 14 Ref., Il. [Dpto. de Fitotecnia da Universidade Federal do Rio Grande do Sul, Caixa Postal 776, 90.001 Porto Alegre-RS, Brazil]

Cassava. Spacing. Agronomic characters. Root productivity. Root development. Starch productivity. Starch content. Roots. Foliage. Harvest index. Plant height. Branch.

Cassava cropping systems in single and double rows were compared in relation to root yield and other agronomic characteristics of the crop in Guaita (Rio Grande do Sul, Brazil) in 1984-85. Cassava Paraguaia R-18 was planted in single rows spaced at 1.2 x 0.6 m and in double rows spaced at 2.0 x 0.6 m and 2.8 x 0.6 m. No significant differences in root yields between the single- and double row systems were found. Aerial part yields in single rows were 13 and 24 percent higher than those of double rows spaced at 2.0 and 2.8 m, resp. Among other characteristics evaluated, there were no differences in starch percentage and yield, no. of roots/plant, HI, aerial part: root ratio, and root length and diameter. Root wt. and diameter were superior in the double row spacing of 2.8 m. On av., the HI was only 31 percent, showing higher aerial part growth in detriment of root yield. (AB)

0439

32221 UDEALOH, A.; EEFERIMA, F.O.C. 1987. Effect of time of cutting back cassava stems on the yield and quality of roots (Abstract). In Terry, E.R.; Akoroda, M.O.; Arone, G.F., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.34-35. En. [National Root Crops Research Inst., Umudike, P.M.B. 7006, Umuahia, Nigeria]

Cassava. Cuttings. Selection. Root productivity. Nigeria.

In traditional farming systems, cassava harvesting involves first cutting back the stems and then, some days later, harvesting roots. The effect that the time of cutting back the cassava stems had upon cassava performance was therefore studied. Cassava clone TMX 20211 was planted in the field and cut back once during the study period at 3, 6, 9, and 12 mo. after planting. The control was left uncut. Cutting back cassava stems significantly reduced root yield by 14.3 percent. Yields from plots cut back at 9 mo. after planting (37.7 t/ha) and 12 mo. after planting (38.1 t/ha) were not significantly different from the control (40.9 t/ha) but were significantly higher than those plots cut back at 3 mo. after planting (31.3 t/ha) and 6 mo. after planting (33.1 t/ha). Plant height and mean no. of roots/plant were similarly affected by the treatments. Root mean wt., LAI, and root quality, however, were not significantly affected. (Full text) See also 0399 0407 0422 0423 0440 0452 0458 0532 0535 0539 0541 0542 0543 0557 0559 0562 0563 0565 0568 0572 0574 0575 0576 0578

D03 Energy Productivity and Yields

0440

32202 FURTADO, M.J. 1987. Producao de forragem em seis cultivares de mandioca (*Manihot esculenta* Crantz), no Estado do Espirito Santo. (Forage production of six cassava cultivars in the state of Espirito Santo). Tese Mestrado. Lavras-MG, Brasil, Escola Superior de Agricultura de Lavras. 80p. Pt., Sum. Pt., En., 62 Ref., 11.

Cassava. Forage. Productivity. Root productivity. Cultivars. Pruning. Harvesting. Timing. Dry matter. Protein content. Planting. Spacing. Plant height. Stems. Leaves. Canopy. Carbohydrate content. Starch content. Harvest index. Brazil.

The forage production of cassava cv. Pao Pedro Mirim, Cacau Branco, Pao do Chile, Vassourinha, Palma Rosa, and Chagas was studied from Nov. 1984 to May 1986 in Cachoeiro de Itapemirim (Espirito Santo, Brazil). The effects of pruning the green parts at 4 mo. of age and the harvest age (12 and 18 mo. after planting) of forage and root yields were assessed. A randomized block design in a $2 \times 2 \times 2$ factorial was used with 24 treatments and 4 replications. Planting distances between rows and between plants were 0.80 and 0.50 m, resp. By the time of pruning, the av. production was 25,3t t forage/ha, with 19.70 percent DM (17.92 percent soluble carbohydrates and 12.66 percent CP); the performance of cv. Pao do Chile was outstanding. The technique of pruning did not affect root production of plants harvested 12 mo. after planting but reduced root yield and starch content by 37.5 and 3.6 percent, resp., in plants harvested at 18 mo. after planting. (AS)

0441

30842 SOUZA, A.P. DE; ESTABEN, M. TO C.E. 1986. Competicao de cultivares de mandioca comidos em uma pequena propriedade do municipio do Rio Azul, Parana. (Comparison of cassava cultivars in a competition trial carried out on a small farm in the municipality of Rio Azul, Parana). Revista Brasileira de Mandioca 1(1):99-106. Pt., 12 Ref.

Cassava. Cultivars. Root productivity. Starch productivity. Stems. Roots. Foliage. Starch content. Harvest index. Plant height. Plant development. Brazil.

Fourteen cassava cv. were evaluated for root, forage, and starch yield in Rio Azul (Parana, Brazil). Cv. giving root yields higher than the av. of the trial (15.86 t/ha) were Franca de Santa Catarina, IAC 12829, Palma de Umuarama, Mio, Palma, Amarela Frut, and Alpin Gigante (with 26.44, 20.89, 19.89, 19.39, 17.83, 17.39, and 17.00 t/ha, resp.). Outstanding cv. for stem productivity were Franca de Santa Catarina, Palma de Ivaí, Palma de Umuarama, Vassourinha, Alpin Gigante, and Palma (with 25.50, 21.78, 20.00, 19.55, 19.37, and 17.94 t/ha). Cv. Palma de Ivaí, Palma de Umuarama, Franca de Santa Catarina, and Alpin Gigante showed statistically superior stem height and diameter. Starch content ranged between 25.16-29.23 percent, the av. for all cv. being 27.92 percent and the highest starch yielder being Palma de Umuarama. (CIAT)

0442

31653 ZAFFARONI, E.; DINIZ, M. DE S.; SANTOS, F.B. DOS 1987. Yield stability of sole and intercropping systems in the Northeast of Brazil. Pesquisa Agropecuaria Brasileira 22(4):393-399. En., Sum. En., Pt., 9 Ref., 11. [Univ. Federal da Paraíba, Centro de Ciências Agrárias, Depto. de Fitotecnia, Caixa Postal 58397 Areia-PB, Brasil]

Cassava. Monocropping. Intercropping. Statistical analysis. Root productivity. Brazil.

Yield stability was analyzed by computing the coefficients of variation and using the regression technique (an adaptation of the procedure frequently used to examine the stability of individual genotypes over a range of conditions). These procedures were used to analyze the yield stability of cassava, maize, cotton, and dry beans under sole and intercropping systems in the state of Paraíba, in northeastern Brazil. The C.V. were always higher in monocropping than in intercropping for the 4 crops. Maize and dry beans had the same slopes, while the coefficients of regression in cassava and cotton were higher than 1 for sole crops and statistically different from intercropping systems which had b values lower than 1 and hence were considered more stable. The advantage of intercropping in improving yield stability was more striking when the yields were negatively affected by the intercropping. (AS) See also 0408 0424 0427 0429 0431 0432 0435 0436 0437 0458 0536 0549 0663 0572 0573 0574 0576 0577 0578 0579

D04 Postharvest Studies

0443

32028 BOOTH, R.G. 1984. Root crops, fruits and vegetables. 4. Post-harvest handling and storage. *Agribusiness Worldwide* September-October 1984:12-13,16-17. En., 11.

Cassava. Postharvest technology. Postharvest losses. Storage.

General concepts and recommendations for postharvesting handling and storage of fruits, vegetables and root crops, including cassava, are given. Priorities of root crop storage are discussed; among these are the protection from factors that could kill the crop (excessive heat or cold, chemicals, physical damage), minimization of moisture and nutrient loss, and maintenance of adequate storage life. Precautions in root crop harvesting are indicated and bulk storage methods are briefly described. Estimates of harvest losses of vegetables, fruits, and root crops in developing countries are given, indicating a 10 percent loss of a total production of 103,486 t cassava. (CIAT)

0444

30837 CAMPOS, A.D.; EATC, M. DO S.A.; CARVALHO, V.P. DE 1986. Efeito de diferentes espessuras da embalagem de polietileno na conservação e qualidade de raízes de mandioca. (Effect of using polyethylene packaging of different thickness on the conservation and quality of cassava roots). *Revista Brasileira de Mandioca* 5(2):23-33. Pt., Sum. Pt., En., 16 Ref., 11.

Cassava. Roots. Storage. Deterioration. Postharvest technology. Packaging. Sugar content. Starch content. Brazil.

The effect of packing roots of cassava cv. Baiana in polyethylene bags of different thickness (50, 100, and 150 microns) on their conservation and quality was studied. Harvested roots were packed in the bags and then stored at room temp.; unpacked roots were used as control. Treatments were replicated 4 times, with 5 roots/replicate. Observations were made at 0, 3, 6, and 9 days of storage. Root wt. loss occurred during storage, increasing with the length of storage, except with bags 150 microns thick. Polyethylene bags decreased root wt. loss, regardless of thickness. No correlation was found between root MC and the degree of physiological deterioration. Storage time significantly affected cooking quality of

235

roots but packing in polyethylene bags did not. A significant correlation was found between cooking quality and degree of physiological deterioration for the check and bags 50 and 100 microns thick. Results indicate that although the use of polyethylene bags decreased physiological deterioration and root wt. loss, the use of this method is limited for cv. Baiana due to the poor cooking quality of roots 3 days after harvest. (CIAT)

0445

32215 CHINSMAN, B.; FLAGAN, Y.S. 1987. Postharvest technologies of root and tuber crops in Africa: evaluation and recommended improvements. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.122-134. En., Sum. En., 8 Ref., 11. [African Regional Centre for Technology, Dakar, Senegal]

Cassava. Postharvest technology. Small-scale processing. Processing. Gari. Cassava chips. Cassava flour. Nutritive value. Composition. Socioeconomic aspects. Senegal.

The main causes and extent of root and tuber postharvest losses are summarized, the major postharvest technologies are evaluated, and a project to increase the availability of root crop products, based on an integration of production and postharvest activities, is recommended. Yams and cassava are emphasized, being by far the most important root and tuber crops both in terms of quantity and as a staple in the African diet. (AS)

0446

31694 FRESH CASSAVA conservation goes commercial. CIAT International 7(1):9-11. 1988. En., 11.

Cassava. Cassava roots (vegetable). Storage. Packaging. Distribution. Postharvest technology. Marketing. Colombia.

The successful experiences of the commercial use of a fresh cassava conservation technology that allows the product to be preserved fresh for 2 wk. or more are reviewed, and a new marketing system developed for small-farmer cooperatives in Barranquilla, Colombia, which have increased their profits substantially, is described. The simple conservation technology consists in placing freshly harvested roots (2-3 h after harvest) into polyethylene bags and treating them with a safe thiabendazole-based fungicide. The projections of similar projects in other Colombian cities and countries such as Ecuador and Paraguay are briefly discussed. (CIAT)

0447

31216 NUMFOR, F.A.; LYONGA, S.N. 1987. Traditional postharvest technologies of root and tuber crops in Cameroon: status and prospects for improvement. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.135-139. En., Sum. En., 16 Ref. [Ministry of Higher Education & Scientific Research, P.O. Box 1457, Yaoundé, Cameroon]

Cassava. Postharvest technology. Survey. Research. Cameroon.

To outline priority research areas in root crop postharvest technology in Cameroon, a survey of existing root crop handling and processing techniques was undertaken. The cultivation of cassava, cocoyams, yams, and sweet potatoes was found to be widespread in all regions of the country; however,

large-scale commercial production or processing units were rare. Farm holdings are generally small and harvesting patterns range from single harvest to harvest as needed. Elaborate storage structures are lacking. Relative to cereals, root crop losses to pests are minimal; the greater proportion of postharvest losses is due to poor handling, physiological factors, and pathological factors. Only cassava is traditionally transformed into numerous products; the other root crops are generally consumed as basic vegetables. The young leaves of cassava, cocoyams, and sometimes sweet potatoes are used as human food, but only sweet potato vines and tubers are fed to animals. This survey indicated that postharvest technology research on root crops in Cameroon should emphasize the development of simple efficient storage techniques, the improvements of existing handling and processing methods with special regard to hygiene and quality standards, the development of industrial products from tubers, the formulation of new competitive fast foods, the development of animal feeds, and the collection of more scientific data on root crops with respect to var. and environmental factors. (AS)

0448

30566 WINARNO, A.; SOEKARTO, S.T.; WIJANDI, S.; NOER, A.; SITOMPUL, H.H. 1979. Mempelajari kepoayan ubi kayu (*Manihot esculenta* Crantz) dan peranannya dalam pencegahan. (Study on color change after harvest of cassava, its organoleptic effect and how to prevent it). Bulletin Penelitian dan Pengembangan no.3:63-65. In.

Cassava. Roots. Harvesting. Organoleptic examination. Postharvest technology. Indonesia

See also 0521

E00 PLANT PATHOLOGY

See 0539 0562

E03 Mycoses

0449

30832 LAKSHMANAN, P.; NAIR, M.C. 1985. Comparative studies on the morphology and pathogenicity of four isolates of *Rhizoctonia solani*. Madras Agricultural Journal 72(7):388-393. En., Sum. En., 4 Ref. [Tamil Nadu Agricultural Univ. Research Centre, Vellore-632 001, India]

Cassava. *Rhizoctonia solani*. Symptomatology. India.

Rhizoctonia solani isolated from rice compared well in its morphology with other isolates of *R. solani* from cowpea, Jack (*Canavalia ensiformis*) and cotton. The pathological reactions of these 4 isolates varied; the one from rice was able to infect all 14 plant species tested, including *Manihot esculenta* and *Allium cepa* which are new records. On cassava, the rice isolate produced typical leaf blight symptoms within 5 days of inoculation; the other isolates produced no symptoms. (AS (extract))

0450

32214 VAN DER BRUGGEN, P.; MARAITE, H.; HAHN, S.K. 1987. An in vitro cassava-inoculation method for the selection of anthraenose-resistant cultivars. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development

Research Centre. pp.113-116. En., Sum. En., 13 Ref. [Université Catholique de Louvain, 3 place Croix de Sud, B-1348, Louvain-La-Neuve, Belgium]

Cassava. *Glomerella manihotis*. Inoculation. Cultivars. Resistance. Selection. Laboratory experiments. Nigeria.

The development of natural anthracnose lesions was compared with that of lesions artificially inoculated with *Colletotrichum gloeosporioides*. The in vitro inoculation method produced the same symptoms as the natural infections; anthracnose lesions developed either toward cankers defined by a layer of lignified cells that isolated the tissues colonized by the pathogen, or toward an invasion of the stem (necrosis of the top that is similar to the symptoms of bacterial wilt). This in vitro method provides a fast and easy way of selecting cassava cv. resistant to *C. gloeosporioides* and of studying resistance mechanisms. (AS) See also 0474 0532

E04 Viroses

0451

32055 MUNIYAPPA, V.; RAJESHWARI, R.; BHARATHAN, N.; REDDY, D.V.R.; NOLT, B.I. 1987. Isolation and characterization of a geminivirus causing yellow mosaic disease of horsegram (*Macrotyloma uniflorum*) (Lam.) Verdc.) in India. *Journal of Phytopathology* 119(1):81-87. En., Sum. En., De., 17 Ref., 11. [Dept. of Plant Pathology, Univ. of Agricultural Sciences, Hebbal, Bangalore 5600 24, India]

Cassava. Horsegram yellow mosaic virus. *Bemisia*. Disease transmission. Laboratory experiments. Cassava African mosaic virus. India.

Horsegram yellow mosaic disease was shown to be caused by a geminivirus: horsegram yellow mosaic virus (HYMV). The virus could not be transmitted by mechanical sap inoculation. Leaf dip and purified virus preparations showed geminate virus particles measuring 15-18 x 30 nm. An antiserum for HYMV was produced and in ELISA and immunosorbent electron microscopy (ISEM) tests HYMV was detected in leaf extracts of field-infected bambara groundnut, French bean, groundnut, lima bean, mung bean, pigeon pea, and soybean showing yellow mosaic symptoms. *Bemisia tabaci* fed on purified HYMV through a parafilm membrane transmitted the virus to all the hosts listed above but not to *Ageratum conyzoides*, okra, cassava, cowpea, *Croton bonplandianus*, *Lablab purpureus*, *Malvastrum coromandelianum*, and tomato. No reaction was obtained in ELISA and ISEM tests between HYMV antibodies and extracts of plants decreased by whitefly-transmitted agents in India such as *A. conyzoides* yellow mosaic, okra yellow vein mosaic, *C. bonplandianus* yellow vein mosaic, *M. coromandelianum* yellow vein mosaic, tomato leaf curl, and cassava mosaic. HYMV was also not found to be related serologically to EGMV. (AS)

0452

32212 OTIM-NAPE, G.W.; INGOOT, D. 1987. Effect of cultural practices on the African cassava mosaic disease and its vector, *Bemisia tabaci*. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.105-108. En., Sum. En., 10 Ref., 11. [Serere Agricultural Research Station, Soroti, Uganda]

Cassava. Cassava African mosaic virus. *Bemisia*. Cuttings. Planting. Spacing. Timing. Uganda.

The effects of plant spacing, planting time, and no. of cassava shoots on the incidence and severity of CAMD were studied in 2 split-plot expt. Cassava canopy temp., RH, whitefly (*Bemisia tabaci*) population, and CAMD incidence and severity were recorded bimonthly from 4 to 14 mo. after planting. Cassava canopy temp. significantly increased with wider spacing, but RH was not affected by any treatment. The whitefly population and the incidence and severity of CAMD increased with delayed planting and reached a peak for cassava planted in Aug. CAMD incidence also increased with wider spacing and decreased significantly with increases in the no. of cassava shoots/stand. The effects of the treatments on CAMD are discussed. (AS) See also 0474 0532

F00 PEST CONTROL AND ENTOMOLOGY

F02 Rodents and other Noxious Animals

0453

32252 ADAM, F. 1986. Report on cassava mealybug and cassava green mites in some African countries: Togo. In Herren, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture. pp.145-146. En.

Cassava. *Phenacoccus manihoti*. Insect control. Pest damage. Togo.

Cassava was the most important crop in Togo in 1982 (372,000 t). Production now is being reduced by the cassava mealybug, which appeared in 1980 in the eastern part of the Maritime Region in the zones of Aneho, Aklakou, Avévé, Tabligbo, and Vogon. From there infestations spread to the eastern and southern parts of the Plateaux Reg. In 1982 heavy infestations were found in this region near Kpalimé and Atakpamé. Isolated infestations occurred also in the Central Region. Insecticidal treatments have been unsuccessful. Le Service de la Protection Végétaux has recommended to producers that they: (1) avoid the transfer of cuttings from uninfested to infested zones; (2) burn infested stems after harvest; (3) plant only uninfested cuttings; (4) plant early in the rainy season. The cassava green mite was discovered in June 1980 in Adangbo in the Maritime Region. Since then it has become more numerous in almost all zones where cassava is cultivated. (Full text)

0454

32242 ATACHI, P. 1986. Report on cassava mealybug and cassava green mites in some African countries: Benin. In Herren, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture. p.135. En. [Project de Defense des Cultures, c/o INUD, B.P. 506, Cotonou, Benin]

Cassava. *Phenacoccus manihoti*. Benin.

The production of cassava in Benin in 1980 was 971,000 t. *Phenacoccus manihoti* was 1st observed in 1978 near Dangbo and Sakété (Ouémé Province), and it rapidly spread throughout almost all of the country. Damage is now most severe in the southern provinces of Ouémé, Mono, Atlantic, and Zou, where cassava is most important. (Full text)

32240 BELLOTTI, A.C.; VARELA, A.A.; REYES, J.A. 1986. Observations on the biology and behavior of *Phenacoccus herreni* and *P. gossypii* on cassava. In Herren, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture. pp.116-127. En., Sum. En., 7 Ref., 11. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. *Phenacoccus herreni*. *Phenacoccus gossypii*. Pest damage. Insect biology. Africa.

The biology and ecology of *Phenacoccus herreni*, a major pest of cassava in certain areas of South America are reported. *P. herreni* has the potential to cause severe cassava crop damage in areas where prolonged dry periods exist. Additional notes are given on *P. gossypii* of minor importance, occurring in low populations or very sporadically. Life cycle studies show that *P. herreni* is bisexual. Oviposition will not occur unless there is copulation with the male. The female passes through 3 instars before reaching the adult stage; the total duration of the female life cycle is 49.5 days. The male has 4 nymphal instars before the winged, adult stage. No feeding however, takes place after the 2nd instar; the 3rd and 4th instars are the prepupal and pupal stages. Female oviposition is initiated 3 days after copulation; an av. of 773 eggs were oviposited during an 18-day period. Indications are that *P. herreni* populations can increase rapidly under favorable environmental conditions and in an abundance of host plants. Dispersal is primarily by wind and by the carrying of infested plant parts by man. Susceptible cv. react to infestation by becoming stunted; the growing shoot tip takes on a cabbage-like appearance. Heavy infestations will result in plant stunting, defoliation, deformation of the growing shoot, shortening of the internodes, and distortion of stems. Plant recuperation is stimulated with the onset of the rainy season, but persistent severe deformations of stems and branches can be noted. The presence of a toxin is indicated. (AS)

31669 CARRERO G., N.S. 1986. Evaluación de algunos factores determinantes de eficiencia de *Cleothera notata* (Col:Coccinellidae) como predador del piojo harinoso de la yuca *Phenacoccus herreni* (Hom:Pseudococcidae). (Evaluation of some efficiency determining factors of *Cleothera notata* (Col:Coccinellidae) as predator of the cassava mealybug *Phenacoccus herreni* (Hom:Pseudococcidae)). Tesis Biólogo. Cali, Colombia, Universidad del Valle. 90p. Es., Sum. Es., 20 Ref., 11.

Cassava. *Phenacoccus*. Biological control. Predators and parasites. Insect biology. Laboratory experiments. Temperature. Colombia.

The efficiency of the biological control of *Phenacoccus herreni* by the predator *Cleothera notata* was evaluated. The biological cycle of *C. notata* was observed at 3 different temp. (22, 25, and 30 degrees Celsius) in environmental chambers under lab. conditions; reproductive rate, min. threshold, and thermic constant were determined and compared with the resp. values for *P. herreni*. The specimens were colonized and handled in petri dishes, using the prey's ovisacs as feed and oviposition sites. *C. notata* was found to go through 4 larval instars; from the beginning of the egg phase until the adult stage 42.3, 33.2, and 26.2 days elapse at 22, 25, and 30 degrees Celsius, resp. Longevity of the female at 22 degrees Celsius was 49.1 days with a total oviposition of 31.6 eggs/female; at 25 degrees Celsius, longevity of the female was over 162 days with a total of 118 eggs/female, and at 30 degrees Celsius, longevity was 88.2 days with a total of 33.2 eggs/female. The percentage of egg eclosion was 47.8,

74.97, and 60.1 percent at 22, 25, and 30 degrees Celsius, resp. The min. threshold and the thermic constant for predator and prey were, resp., 17.8 and 17.0 degrees Celsius and 375.2 and 307.5 degrees-days. The preoviposition period at 22, 25, and 30 degrees Celsius lasted 10.9, 6.5, and 2.8 days, resp. (AS (extract)-CIAT)

0457

32251 DIAGNE, D. 1986. Report on cassava mealybug and cassava green mites in some African countries: Senegal. In Herron, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture. p.145. En. [Ministère du Développement Rural, B.P. 486, Dakar, Senegal]

Cassava. *Phenacoccus manihoti*. Senegal.

In Senegal the cassava mealybug was initially reported in 1976 in the area of Sine-Saloum near the Gambian border. It is now causing its greatest damage in the coastal region of Louga, where 70-80 percent of Senegal's cassava is planted. In that area many peasants have abandoned the culture of cassava. It is becoming more and more difficult to obtain even small quantities of uninfested cuttings for planting. Damage in other regions is less severe but still important. Yield losses were estimated at about 75-80 percent. Attempts to control the pest with insecticides have been unsuccessful. (Full text)

0458

32225 EMEHUTE, J.K.U.; EGWUATU, R.I. 1987. Effect of planting time on cassava yield and the populations of cassava mealybug (*Phenacoccus manihoti*) and associated parasitoids (Abstract). In Terry, F.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. p.117. En. [National Root Crops Research Inst., Umudike, P.M.B. 7006, Umuahia, Nigeria]

Cassava. Planting. Timing. *Phenacoccus manihoti*. Root productivity. Insect biology. Predators and parasites. Nigeria.

The effect of planting time on the populations of cassava mealybug (*Phenacoccus manihoti*) and associated parasitoids was studied in relation to the cassava yield. Yield differences were significant (P equal to or greater than 0.05) between early and late planting. Plots planted early (March to mid-July) had well established plants and lower populations of *P. manihoti*. Root and stem yields decreased with increasing populations of *P. manihoti*. The parasitoids *Epidinocarsus lopezi* and *Tetrastichus* sp. showed a density-dependent relationship with *F. manihoti*. Two hyperparasites, *Prochilonaurus insolitus* and *Chartocerus* sp., were identified as factors that decrease the effectiveness of *P. manihoti* parasitoids. (Full text)

0459

32205 GOLD, C.; BELLOTTI, A.; ALTIERI, M. 1988. Efectos de la asociación de cultivos en las poblaciones de la mosca blanca de la yuca. (Effects of crop association on whitefly populations in cassava). Yuca Boletín Informativo 12(1):7-10. En., Il.

Cassava. *Aleurotrachelus socialis*. *Trialeurodes variabilis*. Insect control. Cultural control. Intercropping. Cowpea. Maize. Colombia.

7/1/88

The effects of planting cassava cv. MCol 2257 in association with cowpea and maize on *Aleurotrachelus socialis* and *Trialeurodes variabilis* populations at different stages of the crop cycle (establishment, preharvesting, postharvesting, and maturity) were studied at the exptl. station of the Instituto Colombiano Agropecuario in Nataima (Tolima, Colombia). Egg counts of both whitefly species were significantly reduced in cassava/cowpea, but not in cassava/maize, although whitefly populations in the latter were consistently lower than in monocropped cassava. The cassava var. mixture (MCol 2257 and CMC-40) reduced *T. variabilis* population but not that of *A. socialis*. Yield losses in the cassava/cowpea association were 12 percent, while those in the other associated systems and monocropped cassava were 60 percent. Whitefly population reductions in the cassava/cowpea association were residual, lasting up to 6 mo. after the cowpea was harvested. While crop associations appear to be beneficial for pest reduction in small farming systems, this reduction will depend on the site, the crop cycle, and the diversity of relationships within the insect complex. (CIAT)

0460

32089 HERREN, H.R.; NEUENSCHWANDER, P.; HENNESSEY, R.D.; HAMMOND, W.N.O. 1987. Introduction and dispersal of *Epidinocarsis lopezi* (Hym., Encyrtidae), an exotic parasitoid of the cassava mealybug, *Phenacoccus manihoti* (Hom., Pseudococcidae), in Africa. *Agriculture, Ecosystems and Environment* 19(2):131-144. En., Sum. En., 28 Ref., 11. [International Inst. of Tropical Agriculture, P.M.B. 5320, Ibadan, Nigeria]

Cassava. *Phenacoccus manihoti*. Predators and parasites. Insect biology. Nigeria.

The history of the spread of the cassava mealybug (*Phenacoccus manihoti*) and *Epidinocarsis lopezi*, a South American parasitoid, in Africa is traced up to Dec. 1985. *E. lopezi* was imported into Nigeria for control of *P. manihoti*. It was multiplied in an insectary at the International Institute of Tropical Agriculture in Ibadan, and 1st released in 1981/82. Within 3 yr it dispersed over 200,000 square kilometers in SW Nigeria, occupying between 70-98 percent of all fields. By Dec. 1985, a total of over 50 releases in 34 regions had been made in 12 African countries. *E. lopezi* was already established in 28 regions, and in some cases *E. lopezi* spread across international borders. It now occupies 650,000 square kilometers in 13 countries; 420,000 square kilometers in West Africa, 210,000 square kilometers in Central Africa, and several small disjunct territories, covering a range of ecological zones (Sudan savannah, Guinea savannah, equatorial rain forest, highlands). (AS)

0461

30572 KIYINDOU, A.; FABRES, G. 1987. Etude de la capacité d'accroissement chez *Hyperaspis raynevali* (Col.: Coccinellidae) prédateur introduit au Congo pour la régulation des populations de *Phenacoccus manihoti* (Hom.: Pseudococcidae). (Capacity for increase in *Hyperaspis raynevali* (Col.: Coccinellidae), a predator introduced to Congo for biological control of *Phenacoccus manihoti* (Hom.: Pseudococcidae)). *Entomophaga* 32(2):181-189. Fr., Sum. Fr., En., 18 Ref., 11. [ORSTOM-DGRS, Brazzaville, BP 181, Congo]

Cassava. *Phenacoccus manihoti*. Predators and parasites. Insect biology. Congo.

The effect of thermohygrometric conditions on the length of the different developmental stages of the coccinellid *Hyperaspis raynevali*, predator of the cassava mealybug *Phenacoccus herreni* in French Guyana, was studied under lab. conditions to determine its ability to control mealybug

populations prior to field releases. *H. raynevali* was introduced into Congo for the control of *P. manihoti*. The Laughlin's capacity for increase (rc) is higher than the rc of the local species *Exochomus flaviventris* and *Hyperaspis senegalensis hottentotta*. Under lab. conditions (temp. 26 degrees Celsius, moisture 70 percent), rc equalled 0.081 with $R_0 = 271.7$ and $T_c = 69$. The development rate is much lower at temp. lower than 25 degrees Celsius and a high embryonic mortality is recorded at temp. ranging from 20 to 30 degrees Celsius. (AS)

0462

32248 KOUACOU, N'DA 1986. Report on cassava mealybug and cassava green mites in some African countries: Ivory Coast. In Herren, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture. p.143. En. [Ministry of Agriculture, B.P. 2049, Abidjan, Ivory Coast]

Cassava. *Phenacoccus manihoti*. *Moronychellus tanajoa*. Ivory Coast.

In Ivory Coast cassava is the 3rd most important crop after plantain and yam. Cassava mealybug was 1st observed in Touba and in Bouaké in the 1979 dry season. Green mite was 1st discovered in the 1981 dry season in the central region of the country. (Full text)

0463

32244 MALIBOUNGOU, J.C. 1986. Report on cassava mealybug and cassava green mites in some African countries: Central African Republic. In Herren, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture. p.137. En., [ISDR, Bombaki, B.P. 909, Bangui, Central African Republic]

Cassava. *Phenacoccus manihoti*. Central African Republic.

The cassava mealybug was discovered in Central African Republic in 1976 near the Zairian border. It has since spread throughout the savanna regions in the east and the west of the country, and it has also spread through a part of the southwestern corner. Although precise information on damage is not available, it is clear that yield losses have been severe and that in the affected regions the price of cassava consequently has doubled. Cassava green mites are also present, but no details on yield losses are available yet. (Full text)

0464

32211 NEUENSCHWANDER, P.; HAMMOND, W.N.O.; HERREN, H.R. 1987. Biological control of the cassava mealybug (*Phenacoccus manihoti*) by the exotic parasitoid, *Epidinocarsis lopezi*. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.98-104. En., Sum. En., 26 Ref., 11. [International Inst. of Tropical Agriculture, P.M.B. 5320, Oyo Road, Ibadan, Nigeria]

Cassava. *Phenacoccus manihoti*. Biological control. Insect control. Predators and parasites. Maps. Nigeria.

The activities of the Africa-wide Biological Control Project on *Epidinocarsis lopezi* are reviewed. Since its accidental introduction into

Africa, the cassava mealybug (*Phenacoccus manihoti*) has spread through about 70 percent of the cassava belt. From South America, the area of origin of *P. manihoti*, the specific parasitoid *E. lopezi* was introduced into Nigeria. Since 1981, it has been released in 12 countries. The potential efficiency of *E. lopezi* is exhibited by its remarkable spread and establishment. By Dec. 1985, the parasitoid was established in 13 African countries covering 650,000 square kilometers. In SW Nigeria, *P. manihoti* population declined after the 2 initial releases and stayed low. During the same period, populations of indigenous predators of *P. manihoti*, mainly coccinellids, and indigenous hyperparasitoids of *E. lopezi* declined because of a reduced supply of food and hosts, resp. The efficiency of *E. lopezi* was investigated experimentally by physical and chemical exclusion methods. In 2 sleeve cage expt., *P. manihoti* populations were 7.0 and 2.3 times lower on artificially infested cassava tips covered with open sleeves than on cassava tips with closed sleeves, which excluded natural enemies. Similarly, *P. manihoti* populations were higher in fields where parasitoids were excluded chemically than in fields with natural enemies (200 vs. 10/tip). These results are discussed in view of the special suitability of biological control for subsistence farming in Africa. (AS)

0465

32249 FEWU, S.K. 1986. Report on cassava mealybug and cassava green mites in some African countries; Liberia. In Herren, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical Agriculture. p.144. En.

Cassava. *Phenacoccus manihoti*. Liberia.

Cassava, after rice, is the 2nd most important food crop in Liberia. In 1975 about 90,400 households were engaged in its production on 76,000 acres (Statistical Handbook of Liberia, 1976, Ministry of Agriculture). It is grown throughout the country both as a pure crop and as an intercrop with rice or other food crops such as eddoes, pepper, or bitterballs. Both leaves and tubers are consumed. The plant is also grown as livestock food. The cassava mealybug was 1st discovered in Liberia on August 30, 1982, in Payneville, near Monrovia. Most of the cassava fields visited in that area were infested. A survey revealed its presence in the 3 principal cassava-producing coastal areas of Montserrado, Grand Cape Mount, and Grand Bassa. The other 6 areas were not surveyed, but a countrywide survey is planned for the coming dry season. About 15 percent of the cassava farmers in the coastal areas have abandoned their crops, because of tuber losses estimated at 30 percent and losses in leaf yield estimated at 25 percent. No totally defoliated fields have been found. (Full text)

0466

32085 PORTER, R.A. 1988. Evaluation of germplasm of cassava (*Manihot esculenta* Crantz) for resistance to the mealybug (*Phenacoccus herreni* Cox & Williams). Ph.D. Thesis. Ithaca, NY, Cornell University. 117p. En., Sum. En., 99 Ref., 11.

Cassava. Genotypes. Cultivars. Resistance. *Phenacoccus herreni*. Inheritance. Pest damage. Symptomatology. Root productivity. Cuttings. Chemical control. Colombia.

Clonal cassava germplasm accessions were evaluated for resistance to the mealybug *Phenacoccus herreni*, and the effects of a mealybug attack on several cassava genotypes in protected and infested plots were studied in yield trials to identify plant growth parameters associated with resistance. Expt. were carried out at 2 sites in Colombia: Palmira (1986)

and Carimagua (1985-86 and 1986-87). Variation among genotypes was very highly significant (P equal to or less than 0.001) for damage rating in all 3 expt. Broad-sense heritabilities among lines evaluated peaked at 0.45-0.59 in trials with more than 1 plant/plot, indicating that selection on the basis of damage ratings was reliable. Tall, late-branching, vigorous genotypes tended to show less damage. Pubescence of the meristem was not significantly correlated with damage ratings. Yields of infested small plots were negatively correlated with their damage ratings. There were no significant correlations for damage ratings in the different expt., suggesting a large genotype x environment interaction. Levels of resistance were moderate. Even in the most resistant genotypes, mealybugs fed and apparently reproduced, and damage ratings continued to increase over time. In yield trials at both sites, mealybug infestation was found to reduce plant growth and survival and subsequent root yield and cutting yield. Plants not killed by the attack were usually able to recover after a period of high rainfall by producing new shoots, but root yield was less than in plots free of mealybugs. Stem dieback was a good predictor of root yield loss, when recovery occurred, and was therefore useful as an indicator of resistance. Plant mortality, when high, however, was a good indicator of root yield. Tolerance is suggested as the primary mechanism of resistance. (AS)

0467

32203 SCHMITT, A.T. 1988. Uso de Baculovirus erinnyis para el control biológico del gusano cachón de la yuca. (Using Baculovirus erinnyis for the biological control of the cassava hornworm). Yuca Boletín Informativo 12(1):1-4. Es., Il.

Cassava. Erinnyis ello. Biological control. Predators and parasites. Brazil.

High control levels of Erinnyis ello by Baculovirus erinnyis, obtained in cassava expt. in Brazil, are reported. Recommendations for B. erinnyis sprays in E. ello-infested cassava crops are also given. B. erinnyis should be applied when a population of 5-7 small (2nd-3rd instar) E. ello larvae/plant is detected. The B. erinnyis virus suspension in water is prepared by macerating and filtrating infected larvae that have recently died. The recommended rate/ha is 18 g dead larvae (= 20 ml of liquid obtained from larvae) or the product of the maceration of approx. 10 large (7-9 cm long) or 22 medium (4-6 cm long) larvae. Spraying should be done early in the morning or late in the afternoon. Damage to cassava by infected larvae stops 3-4 days after spraying. Advantages of B. erinnyis sprays include reduced production costs and risks of environmental pollution; efficient E. ello control; ease of application; reduced insecticide sprays; high dispersion capacity of the virus; easy preparation of the dose; and persistence of the virus in soil and plants. (CIAT)

0468

32057 SOUZA, J.C. DE; REIS, P.R. 1986. Pragas da mandioca em Minas Gerais. (Cassava pests in Minas Gerais). Belo Horizonte-MG, Brasil, Empresa de Pesquisa Agropecuária de Minas Gerais. Boletim Técnico no.22. 32p. Pt., 30 Ref., Il. [EPAMIG/CHSM Caixa Postal 176, 37.200 Lavras-MG, Brasil]

Cassava. Injurious insects. Injurious mites. Productivity. Pest damage. Insect control. Mite control. Biological control. Resistance. Cultural control. Insecticides. Acaricides. Brazil.

This illustrated handbook of cassava insect pests in Minas Gerais, Brazil, includes descriptions and bionomic notes, damage caused; and control measures of insects attacking roots (*Pseudococcus* sp.), stems (*Coelosternus rugicollis* and *Anastrepha* sp.), shoots (*Neosilba perzei*), leaves

(*Jatrophia brasiliensis*, *Vatiga illudens*, *Aleyrothrixus aepim*, and *Bemisia tuberculata*), leaves and shoots (*Erinnyis ello* and *Scirtothrips manihoti*). Data are also given for the mite *Mononychellus tanajoa*. Biological, cultural, and chemical control of these pests are recommended when applicable. (CIAT)

0469

32204 WONGKOBRAI, A. 1988. Insectos plaga de la yuca en Tailandia. (Insect pests of cassava in Thailand). Yuca Boletín Informativo 12(1):5-7. Es.

Cassava. *Tetranychus truncatus*. *Lepidiotia stigma*. *Dorythenes bugueti*. *Coptotermes*. *Aonidomytilus albus*. Injurious insects. Injurious mites. Productivity. Pest damage Insect control. Mite control. Biological control. Cultural control. Insecticides. Acaricides. Predators and parasites. Thailand.

The biology of and the damage caused by the main cassava insect pests in Thailand are described. These are *Tetranychus truncatus*, *Lepidiotia stigma*, *Dorythenes bugueti*, *Coptotermes gestroi* and *Coptotermes* spp., and *Aonidomytilus albus*. Chemical, biological, and cultural control measures are given for each pest when applicable. (CIAT) See also 0532 0539 0543 0562

F03 Injurious Mites and their Control

0470

32069 BELLOTTI, A.C.; MESA, N.; SEPFRANO, M.; GUERRERO, J.M.; HERRERA, C.J. 1987. Taxonomic inventory and survey activity for natural enemies of cassava green mites in the Americas. *Insect Science and its Application* 8(4-6):845-849. En., Sum. En., Fr., 9 Ref. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. *Mononychellus tanajoa*. Predators and parasites. Biological control. Central America. South America. Colombia.

A taxonomic inventory is under way in South America to identify the major natural enemies of the cassava green mite, *Mononychellus tanajoa*. Special emphasis is being given to the Phytoseiidae, important predators of phytophagous mites feeding on cassava. Several insect predators and more than 40 species of Phytoseiidae have been identified in Colombia; *Typhlodromalus limonicus* and *Neoseiulus anonymus* are the most frequently found species. Selected aspects of the binomic studies on *T. limonicus* and *N. anonymus* are presented, and methods of rearing numerous phytoseiid species are discussed. Five species are being reared at CIAT and have been sent to the International Institute of Tropical Agriculture in Nigeria. Surveys for natural enemies will include most cassava-growing areas of Central and South America. Selection of exploration sites and timing of explorations will be guided by matching agrometeorological zones in the country of origin with those in the proposed country of introduction. Duration of dry periods, rainfall patterns, and temp. are particularly important considerations in the matching. (AS)

0471

32226 EZULIKE, T.O. 1987. Resistance of cassava cultivars to green spider mite (*Mononychellus tanajoa*) infestation (Abstract). In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis; proceedings. Ottawa, Canada, International Development Research Centre. p.118. En.

[National Root Crops Research Inst., Umudike, P.M.B. 7006, Umuahia, Nigeria]

Cassava. Cultivars. *Monorychellus tanajoa*. Resistance. Nigeria.

Twenty-one cassava cv. selected after field screening for tolerance to *Monorychellus tanajoa* were artificially infested with *M. tanajoa* in the greenhouse to confirm their resistance. Of 21 selected cv., the mean mite damage scores showed TMS 4(2)1425 to be the most tolerant to *M. tanajoa* infestation, followed by 74/538, Anti-Ota, 73/93, 30195, and 1531. These cv. supported fewer mites and 4 of them, TMS 4(2)1425, 73/93, 74/538, and Anti-Ota, had surface hairs on their leaves--an attribute of resistance. Mite damage and mite density were not correlated with variations in leaf HCN content. This factor, therefore, does not contribute to mite resistance in cassava. (Full text)

0472

30555 GANOK, U 1982. (Preliminary study on the biology of cassava red mite *Tetranychus truncatus* Ehara (Acarina: Tetranychidae) and the predaceous mite *Amblyseius (Amblyseius) longispinosus* (Evans) (Acarina: Phytoseiidae)). Mag.Sc. Thesis, Bangkok, Thailand, Kasetsart University. 80p. Thai., Sum. En., Thai., 59 ref., 11.

Cassava. *Tetranychus truncatus*. Mite biology. Biological control. Temperature. Photoperiod. Predators and parasites. Thailand.

The cassava red mite (*Tetranychus truncatus*), a serious cassava pest, completed its life cycle in about 9 days at 30-32 degrees Celsius and 65-70 percent RH. *T. truncatus* was found on many plant species in the cassava crop. The predaceous mite *Amblyseius (Amblyseius) longispinosus*, one of the most important natural enemies of *T. truncatus*, developed its life cycle within 7 days under the same conditions as *T. truncatus*. Female longevity of *A. longispinosus* was much longer than that of *T. truncatus*. The relationship between *T. truncatus* and *A. longispinosus* was studied in 3 different tests. The best relationship was obtained when the initial ratio of female *T. truncatus*:female *A. longispinosus* was 5:3. The results showed a significant difference between the populations of *T. truncatus*, with and without the predator, in every test. Temp., RH, and day length had no effect on both mite species. The relationship between phytophagous mites and natural enemies in cassava was highly significant. RH had a significant effect on the phytophagous mites, but temp. and day length did not. The environments had little effect on the natural enemies. The best egg hatching percentages for both *T. truncatus* and *A. longispinosus* were obtained at 30 degrees Celsius, 65 percent RH, and a light period of 12 h 45 min. (AS) See also 0453 0462 0468 0469 0532 0543 0562

600 GENETICS AND PLANT BREEDING

See 0413

601 Breeding, Germplasm, Varieties and Clones, Selection

0473

32234 GUTIERREZ, A.P.; YANINEK, J.S. 1986. An ecological perspective of plant breeding. In Herren, H.R.; Hennessey, R.N., eds. International Workshop on Biological Control and Host Plant Resistance to Control the Cassava Mealybug and Green Mite in Africa, Ibadan, Nigeria, 1982. Proceedings. Ibadan, Nigeria, International Institute of Tropical

260

Agriculture, pp.32-46. En., Sum. En., 12 Ref., 11. [Division of Biological Control, Univ. of California, Berkeley 94720, USA]

Cassava. Plant breeding. Resistance. Africa.

The interplay between the genetics for energy allocation strategy and population ecology is illustrated, and the importance of interdisciplinary research for solving plant breeding problems is shown. Possible constraints to yield maximization are also indicated. Short-term solutions have caused more harm than good: when breeders maximize yields by breeding out the crops' ability to compensate for pests, this lost ability is replaced with pesticides. In the case of cassava, massive inputs of pesticides do not appear to be economical; hence, biological control and breeding for horizontal resistance appears more reliable. An understanding of cassava's energy allocation strategies is essential to understand the interaction of this crop with its introduced herbivores, natural enemies, and any resistance breeding program. (AS (extract))

0474

32213 MUMBA-KANELONGO, A.; MUYILO, G.; MAHUNGU, N.M.; PANDEY, S.J. 1987. Strategies of Programme National Manioc (PRONAM) of Zaire in screening cassava for resistance to major diseases. In Terry, E.R.; Akoroda, M.O.; Arene, O.R., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, Ed. Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre, pp.109-112. En., Sum. En., 13 Ref., 11. [Programme National Manioc, Kinshasa, Zaire]

Cassava. Cassava programs. Plant breeding. Cultivars. Resistance. Selection. Cassava African mosaic virus. *Xanthomonas campestris* pv. *manihotis*. *Glomerella manihotis*. Zaire.

The various strategies and procedures of Programme National Manioc (PRONAM) of Zaire in screening cassava for resistance to major diseases (CBB, CAMD, and anthracnose) are discussed. PRONAM has developed some good disease-resistant, high yielding var. that are recommended to farmers for general cultivation. (AS (extract))

0471

31667 OCAMPO N., C.R. 1988. Identificación de genes marcadores en yuca (*Manihot esculenta* Crantz). (Identification of marker genes in cassava). Tesis Biólogo Genético. Cali, Colombia, Universidad del Valle, 126p. Es., Sum. Es., 55 Ref., 11.

Cassava. Plant breeding. Inheritance. Genetics. Plant anatomy. Leaves. Stems. Roots. Phenotypes. Clones. Temperature. Electrophoresis. Colombia.

Considering the reduced no. of characteristics identified as marker genes in cassava and the usefulness of these genes as a tool in plant breeding, a study on the hereditary transmission of a group of morphological characteristics that only present 2 contrasting phenotypes was carried out to prove whether they are controlled by marker genes. Furthermore, an independent segregation trial was conducted among some of the marker genes. The phenotypic stability of the angle formed by zigzagged internodes with plant age (vegetatively propagated) and of albinism in plantlets with an environmental component (temp.) was also assessed. Finally, it was determined whether a correlation exists between the contrasting phenotypes of 2 of these morphological characteristics with 1 or more bands of the electrophoretic patterns of the alpha-beta-esterase isoenzyme of root tips. Plant material used was from CIAT's cassava germplasm bank, a plot of cassava hybrids, segregating F1 and F1C1 populations of cassava breeding

trials, and an exclusive F1 trial. Gene markers were identified (simple monogenetic inheritance) for the morphological characteristics albinism in plantlets, zigzagged internode, color of stem collenchyma, and color of thickened root parenchyma. It was suggested that violin-shaped leaf lobules were controlled by a dominant gene having incomplete penetration and variable expression. Moreover, the gene for the color of the stem collenchyma was found to segregate independently from the gene of the leaf lobule diameter and the gene of the color of the thickened root parenchyma. Regarding the environmental effect on the expression of these genes, a constant temp. of 35 degrees Celsius did not inhibit the expression of albinism in plantlets. Instead, due to plant age, the zigzagged internodes showed variable expression. Finally, a phenotypic correlation was found between the electrophoretic patterns of the alpha-beta-esterase isoenzyme of root tips and the color phenotypes of the stem collenchyma and of the parenchyma of thickened roots in 17 cassava clones. (AS (extract)-CIAT)
See also 0400 0450 0543 0552

H00 NUTRITION

0476

26188 PACHICO, D.; SERE, C. 1985. Food consumption patterns and malnutrition in Latin America: some issues for commodity priorities and policy analysis. In Centro Internacional de Agricultura Tropical. Trends in CIAT Commodities. Cali, Colombia, Internal Document Economics 1.10. pp.27-53. En., Sum. En., 25 Ref.

Cassava. Human nutrition. Consumption. Malnutrition. Income. Marketing. Development. Diets. Research. Cassava meal. Fresh products. Socioeconomic aspects. Statistical data. Brazil. Paraguay. Latin America. Colombia.

Salient aspects of food and nutrition in Latin America regarding intraregional variations in diets and the influence of urbanization on food consumption habits, the nature and extent of malnutrition in the region, the influence of economic factors (incomes, growth, trade, and external debt) on food consumption and policy alternatives for ameliorating malnutrition, and tentative implications for a nutrition-oriented research agenda, are reviewed and discussed. Within this framework, the importance of cassava, as well as other agricultural commodities, is discussed; for example, in Brazil and Paraguay it is a major supplier of calories, particularly in NE Brazil where CM is the leading expenditure for the poorest 3rd of families. Cassava is a major component of rural diets and its consumption is greater in low-income urban families than in high-income urban families. Data indicate that CF is considered as an inferior good while fresh cassava is considered as a normal good. Small farm producers tend to dominate in the production of commodities with a relatively inelastic demand, such as cassava. (RA) See also 0547 0558

H01 Cassava Foods and Nutritive Value

0477

30834 AIDOO, K.F. 1986. Lesser-known fermented plant foods. Review. Tropical Science 26(4):249-258. En., Sum. En., 29 Ref. [Dept. of Bioscience & Biotechnology, Applied Microbiology Division, Univ. of Strathclyde, 204 George Street, Glasgow G1 1XW, United Kingdom]

Cassava. Human nutrition. Fermented products. Cassava beer. Cassava meal. Dried roots. Nutritive value. Africa. Amazons. Brazil. Peru. Ecuador.

Some of the less familiar fermented foods which are important in the diet of people in the developing countries are reviewed. The following cassava-based products are covered: farinha puba (a coarse, cream-colored flour) consumed in the Amazonian regions of Brazil, Peru, and Ecuador; kokonte, consumed in savannah Africa; and masato (cassava beer), produced in the Amazons. Methods of preparation, microbiology, biochemical changes, and also the nutritional values of these fermented products, among others, are presented. (AS)

U478

32206 FIRMEN, A. 1988. Preparación tradicional de alimentos con yuca en Costa de Marfil. (Traditional preparation of cassava-based foods in Ivory Coast). Yuca Boletín Informativo 12(1):10-12. Es., Il.

Cassava. Food products. Foofoo. Atieke. Cassava flour. Tapiocas. Ivory Coast.

Different ways of preparing cassava in Ivory Coast are described. Cassava roots are eaten either fresh (boiled) or processed into different food products (foutou, foofoo, CP, and tapioca). From fermented cassava, placali, bensiké, N'Bede-papa (cassava cake), Bito, N'bete gboko, atteupkou, fresh atieke, and garl are obtained. (CIAT)

U479

32079 LOWIE, O. 1979. Energy values of cassava, maize and guinea corn starches and their residues for chicks. Nigerian Journal of Agricultural Sciences 1(1):27-30. En., Sum. En., 19 Ref.

Cassava. Cassava starch. Waste utilization. Chicks. Animal nutrition. Metabolism. Animal physiology. Nigeria.

Starches with CP were isolated from maize, guinea corn, and cassava (0.77, 1.43, and 0.47 percent DM, resp.), leaving residues with 13.50, 17.06, and 3.10 percent CP and 9.01, 10.89, and 6.73 percent crude fiber. Chickens 2 to 5 wk. old were given either a practical reference diet with 20 percent CP or 1 of 6 diets in which starch or residue at 30 percent replaced equal percentages of glucose in the reference diet. The ME value of maize, guinea corn, and cassava starches was 3.67, 3.51, and 3.88, resp., and for the residues 1.86, 1.72, and 1.31 kcal/g. Body wt. gain was 228, 305, 279, 226, 345, 347, and 179 g for the reference diet, maize starch, guinea corn starch, cassava starch, and the resp. residues. All differences were significant except between the reference and cassava starch diets. Feed intake was 3.06 and 2.46 g/g gain, resp., for the diets including cassava starch and cassava starch residues, compared with 3.32 g/g gain for the reference diet. Tables are included with proximate composition of the 6 products tested and their GE and ME values. (CIAT)

U480

31693 MARQUES, J.F.; EL-DASH, A.; VIEIRA, L.F.; CHANG, Y.K. 1984. Impactos economicos e tecnologicos na politica de substituição parcial da farinha de trigo por sucedaneos. (Economic and technological impact of a policy of partial substitution of wheat flour for alternative flours). Rio de Janeiro-RJ, Brasil, Empresa Brasileira de Pesquisa Agropecuária. 52p. Pt., Il.

Cassava. Legal aspects. Technology evaluation. Cassava flour. Substitutes. Wheat flour. Composite flours. Bakery products. Prices. Production. Consumption. Brazil.

Industrial tests were conducted in Brazil with composite flours (including CP) as partial substitutes of wheat flour for producing bread and various

bakery products; the economic and technological impact that a policy of this nature would have was analyzed. Results showed that it is technically feasible, with minor adjustments in equipment, to produce CF for bread-making purposes for partial substitution (20-25 percent) of wheat flour. Given the regional limitations that exist for raw material production, it appears more suitable for CF to substitute wheat flour in North, NE, and Central West Brazil. If wheat flour subsidies were removed, the prices of wheat flour-based products would rise drastically but this effect would be ameliorated by partial substitution with alternative flours such as CF at current price levels. (CIAT)

0481

32062 OJOFEITIMI, E.; OLUFOKUNBI, B. 1986. Food preferences: an implication for nutrition education and agricultural production. Food and Nutrition Bulletin 8(4):11-13. En., 18 Ref. [Univ. of Ife, Ile-Ife, Nigeria]

Cassava. Survey. Consumption. Nutritive value. Human nutrition. Composition. Analysis. Protein content. Fat content. Fiber content. Carbohydrate content. Ash content. Food energy. Socioeconomic aspects. Nigeria.

The food preferences of 172 final year students at 3 health-related institutions in Ile-Ife (Oyo State, Nigeria) were determined. Students were asked to rate some commonly available tuber and meat foods in the order in which they would prefer to eat them and would recommend them to others. About 70 percent ranked white yam as 1st choice, while about 18 percent ranked cassava 1st, although other tubers (water yam, yellow yam, and red cocoyam) have a greater nutritive content than yam. Cocoyam, yellow yam, and water yam have higher digestible true protein than both; they are also richer in water-soluble vitamins and carotene content. The data indicated that the participants, who will subsequently have direct contact with the community, either knew very little about the nutritive content of some of the locally available foods or did not reflect their knowledge in their preferences. (CIAT)

0482

30567 KOCANNA S., R. 1982. Kerupuk singkong. (Cassava crisps). Bulletin Penelitian dan Pengembangan Teknologi Pangan 4(13):27-35. In., 11.

Cassava. Food products. Indonesia.

0483

31665 SALGADO, J.M.; SANTOS, A.C. 1986. Estudo do concentrado proteico da folha de mandioca. Obtencao, analises quimicas e suplementacao com aminoacidos. (Study of cassava leaf protein concentrate. Preparation, chemical analysis, and supplementation with amino acids). Arquivos Latinoamericanos de Nutrición 36(3):483-494. Pt., Sum. Pt., En., 14 Ref. [Escola Superior de Agricultura Luiz de Queiroz, Univ. de Sao Paulo, Depto. de Química, Area de Nutricao Humana, Piracicaba, Caixa Postal 13.400-SP, Brasil]

Cassava. Leaves. Protein content. Processing. Laboratory experiments. Laboratory animals. Composition. Amino acids. Dry matter. Fiber content. Ash content. Diets. Concentrates. Dietary value. Animal physiology. Digestibility. Brazil.

A cassava leaf protein concentrate was prepared by introducing some new procedures to well-known methods: (1) with adjustment of pH and without centrifugation; (2) without adjustment of pH and without centrifugation; (3) same as (1) but with 10 min centrifugation; (4) same as (2) but with 10 min centrifugation. The chemical composition of the different protein

concentrates is given. Although method 4 gave the highest protein content, method 2 was used due to the ease and rapidness of extraction. The nutritive value (PER, digestibility, NPU, and BV) of diets fed to Wistar rats (21-23 days old) containing cassava leaves or cassava leaf concentrate was determined. Both protein concentrate and cassava leaves were supplemented with 0.5 percent met. and 0.7 percent lysine, alone or combined. Protein content (N x 6.25) of concentrate and leaves was 34.0 and 25.2 percent, resp. Rats given the protein concentrate or leaves alone lost wt. The addition of either met. or lysine alone did not improve rat growth. A better response was obtained when both met. and lysine supplemented the test materials, as indicated by biological criteria. PER, true digestibility, and BV. Histological tests of different animal organs examined proved to be normal. (AS) See also 0448 0487 0500 0503 0510 0511 0521 0522 0525 0536 0541

H03 Animal Feeding

0484

30561 BASYA, S.; NURAINI, M. 1979. Penggunaan bungkil kacang tanah dengan dedak padi, jagun atau lempung gaplek dalam susunan makanan penguat sapi perah muda. (Utilization of peanut waste cake, rice bran, corn, and cassava flour in ration formulas of young dairy cattle). Lembaran Lembaga Penelitian Peternakan Bogor 9(1):9-14. In., Sum. In., 15 Ref.

Cassava. Cassava meal. Feeds and feeding. Dairy cattle. Diets. Indonesia.

0485

32081 EAKPITAKUMRONG, P. 1985. (Effect of different protein supplement methods in growing pigs fed cassava silage as the energy source). M.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 86p. Thai., Sum. Thai., En., 62 Ref., 11.

Cassava. Silage. Animal nutrition. Piglets. Diets. Animal physiology. Costs. Protein content. Thailand.

Four dietary treatments were assessed in a completely randomized design with 3 replications and 2 piglets/exptl. unit (1 castrated male and 1 female): (1) broken rice (control); (2) dry cassava; (3) wet ensiled cassava; and (4) dry ensiled cassava. Initial av. live wt. of the pigs was 29 kg. At the end of the 84-day exptl. period live wt. av. were 49, 55, 49, and 53 kg for treatments 1, 2, 3, and 4, resp., while av. daily wt. gain were 585, 654, 581, and 634 g, resp. Differences in daily wt. gain among treatments were not statistically significant. In another expt. 4 feeding methods were assessed in a randomized complete block design with 3 replications and 2 piglets/exptl. unit (1 castrated male and 1 female): (1) control (conventional method) ad libitum; (2) protein supplement diet mixed with wet ensiled cassava ad libitum; (3) protein supplement diet fed separately from wet ensiled cassava ad libitum; and (4) protein supplement diet separately fed in limited quantities but wet ensiled cassava fed ad libitum. Initial av. live wt. of the pigs was 23 kg. The av. live wt. of the pigs at the end of 85-day exptl. period were 59.90, 50.27, 58.73, and 50.00 kg for methods 1, 2, 3, and 4, resp., and av. daily wt. gains were 705, 597, 691, and 588 g, resp. Statistically significant (P less than 0.05) differences were observed for av. daily gains between methods 1 and 3 and between methods 2 and 4. Av. daily wt. gain and feed consumption rate were highly correlated. The analysis of feed cost/gain, amount protein consumption, PER, and body fat composition are also included. (AS)

0486

29515 FABBRI, R.; DELLA CASA, G.; ROSI, M.A.; BERGONZINI, E. 1986. Uso della manioca nell'alimentazione del suino pesante. (Use of cassava in the feeding of heavy pigs). Rivista di Suinicoltura 27(5):91-95. It., Sum. It., En., 21 Ref.

Cassava. Swine. Feed mixtures. Maize meal. Animal nutrition. Fattening. Composition. Italy.

Four groups of 20 male and female Landrace x Large White pigs (mean live wt. of 46 kg) were given a liquid mixed feed based on maize, without or with cassava at 30 or 75 percent, or with 30 percent cassava up to 100 kg live wt. only. Mean daily gains were 660, 676, 659, and 644 g and feed intake 3.83, 3.72, 4.08, and 3.93 kg/kg gain, resp. Slaughter values did not differ among the different groups. (CIAT)

0487

32037 GÉOFFROY, F. 1984. Le manioc: intérêt fourrager et problèmes spécifiques. (Cassava, its significance as a forage plant and specific problems). In Réunion Interinstitute INRA, ORSTOM, GERDAT, Cayenne, Suzini, 1981. Prairies guyanaises et élevage bovin. Résultats préliminaires. Paris, France, Institut National de la Recherche Agronomique. Colloques de l'INRA no.24, pp.203-218. Fr., Sum. Fr., En., 32 Ref., 11. [INRA, Centre de Recherches Agronomiques Antilles-Guyane Station de Recherches Zootechniques 97170 Petit-Bourg, Guadeloupe]

Cassava. Uses. Forage. Roots. Leaves. Stems. Productivity. Composition. Dry matter. Fat content. Protein content. Nutritive value. Toxicity. Detoxification processes. Harvesting. Foliage. Silage. French Guiana.

Cassava productivity, feed value, and chemical composition is compared with those of other tropical forage plants. Although it contains to a certain extent an agent toxic for livestock, several detoxification processes exist; for French Guiana silage appears to be the only one that can be considered. Crop management techniques (choice of var., cultivation, pathology, harvesting, and ensilage) should soon be released. (AS)

0488

31696 GOMEZ, G.; VALDIVIESO, M.; SANTOS, J. 1988. Cassava whole-root chips silage for growing-finishing pigs. Nutrition Reports International 37(5):1081-1092. En., Sum. En., 12 Ref. [2815 Rue Sans Famille, Raleigh, NC 27607, USA]

Cassava. Silage. Roots. Cassava chips. Animal nutrition. Swine. Diets. Molasses. Nutritive value. Bone meal. Fish meal. Cottonseed meal. Animal physiology. Colombia.

Three expt. were carried out to evaluate cassava whole-root chips silage (CWRS) with growing-finishing pigs. Weaned, 60- to 70-day-old pigs were fed the exptl. diets until a body wt. of 90-95 kg, except in expt. 2 in which insufficient amount of CWRS forced the trial to end when pigs averaged about 80 kg body wt. Expt. 1 consisted of 1 individual and 1 group feeding trial, and expt. 2 and 3 were both individual feeding trials. The diets used in expt. 1 were as follows: (1) sorghum + a protein supplement based on SBM, (2) CWRS + protein supplement mixed, and (3) CWRS + protein supplement fed separately. Those of expt. 2 were: (1) sorghum + protein supplement based on SBM and cottonseed meal, (2) CWRS + protein supplement based on SBM-cottonseed meal, (3) CWRS + protein supplement based on SBM and fishmeal, and (4) CWRS + protein supplement based on cottonseed meal-fishmeal. Expt. 3 diets were: (1) sorghum + protein supplement based on SBM-cottonseed meal, (2) CWRS + protein supplement

supplied daily, (3) CWRS fed daily + protein supplement supplied every other day, (4) CWRS + 10 percent sugarcane molasses + protein supplement supplied daily, and (5) CWRS + 10 percent sugarcane molasses fed daily and protein supplement fed every other day. In all expt., diet 1 was fed in automatic feeders whereas CWRS diets were fed in open troughs. In the individual feeding trial of expt. 1, pigs fed diet 2 had lower (P less than 0.05) body wt. gain and feed intake than those fed the control diet 1, but higher (P less than 0.05) performance than those fed diet 3. In the group feeding trial, however, practically all 3 groups performed similarly (P greater than 0.05). In expt. 2, pigs fed CWRS in combination with any of the protein supplement evaluated showed similar (P less than 0.05) results to those fed diet 1. In expt. 3, pigs fed diets 4 and 5 reached the final live body wt. 10 and 17 days earlier (P less than 0.05), resp., than the other exptl. groups. The addition of sugarcane molasses to CWRS improved (P less than 0.05) the feed/gain ratio when compared with the control diet and tended (P greater than 0.05) to be superior to CWRS-based diets (2 and 3) with no addition of sugarcane molasses. Similar results were obtained when the protein supplement was fed daily or every other day. These results indicate that CWRS kept in piles for at least 4-6 mo., if properly supplemented, produced satisfactory results when fed to growing-finishing pigs. (AS)

0489

31695 GOMEZ, G.; TELLEZ, G.; CAICEÑO, J. 1987. Effects of the addition of vegetable oil or animal tallow to broiler diets containing cassava root meal. Poultry Science 66(4):726-731. En., Sum. En., 26 Ref. [2813 Rue Sans Famille, Kalidigh, NC 27607, USA]

Cassava. Cassava meal. Tallow. Feed mixtures. Diets. Dietary value. Poultry. Feeds and feeding. Animal nutrition. Animal physiology. Colombia.

Two expt. were carried out to evaluate the effects on broiler performance of increasing by 5 percent the ME level of diets containing CM (0, 20, and 30 percent) by adding either vegetable oil (expt. 1) or animal tallow (expt. 2). The CM used was detoxified by sundrying whole root chips of a bitter cv. (CMC-84) on a concrete floor. All exptl. diets were supplied in mash form. Supplementary vegetable oil or animal tallow did not affect (P more than 0.05) growth rate. Feed conversion (feed/gain) was improved (P less than 0.05) during the starter (0-28 days) period as well as at the end of the expt. (56 days). Body wt. gain, feed consumption, and feed conversion were not affected (P more than 0.05) by any of the dietary treatments during the finishing (28-56 days) period of both expt. Diets containing 20 percent CM produced somewhat higher (P more than 0.05; expt. 1) or significantly higher (P less than 0.05; expt. 2) final body wt. (AS)

0490

32217 TEWE, O.O. 1987. Cassava peel utilization in poultry diets. In Terry, E.R.; Akoroda, M.O.; Arene, O.R., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre, pp.150-151. En., Sum. En., 10 Ref. [Dept. of Animal Science, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Cortex. Waste utilization. Poultry. Animal nutrition. Animal physiology. Eggs. Nigeria.

Three trials with broilers and layers assessed their performance on diets based on cassava peels. In trial 1, diets contained 0, 7.5, 15.0, 22.5, and 30.0 percent cassava peels as a replacement for maize for broilers.

Cassava peel increased feed intake, reduced body wt. gain, and reduced nutrient utilization. In trial 2, diets containing 0, 7.5, 15.0, and 22.5 percent cassava peel with or without food energy (palm oil) or protein supplementation were fed to broilers. Nutrient supplementation of the cassava peel diets did not greatly affect the biological performance of the birds. In trial 3, the inclusion of up to 27 percent cassava peels in the diet of layers at the expense of maize gave satisfactory feed intake, egg production, and feed/unit egg produced. In each trial, the economy of feed conversion was better on the cassava peel diets than on the maize control diet. (AS)

0491

32083 UNNANUNTANA, A. 1985. (Nutritive values and digestibility of sugarcane top silage treated with different additives in sheep). M.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 110p. Thai., Sum. Thai., En., 42 Ref.

Cassava. Cassava chips. Feed mixtures. Nutritive value. Digestibility. Sheep. Animal nutrition. Thailand.

An expt. was carried out to evaluate the nutritive values and the digestibility of sugarcane top silage with different kinds and levels of additives, among them cassava chips, for a total of 60 treatments. Using Murdoch's method (1962), the 3 best treatments were (1) sugarcane tops with 0.5 percent urea and 15.0 percent cassava chips on wet basis; (2) sugarcane tops with 0.5 percent urea and 10.0 percent molasses on wet basis; and (3) sugarcane tops with 0.5 percent urea and 15.0 percent liquid glucose by product on wet basis. Results of the digestibility trial using sheep are also included. Percentage digestibility of OM, CP, crude fiber, and GE for treatment 1 were 54.48, 60.78, 50.51, and 64.73, resp. (AS (extract)) See also 0440 0483 0501 0515 0531 0537

HO4 HCN Toxicity and Detoxification

0492

32091 RAVINDRAN, V.; KORNEGAY, E.T.; RAJAGURU, A.S.B. 1987. Influence of processing methods and storage time on the cyanide potential of cassava leaf meal. *Animal Feed Science and Technology* 17(4):227-234. En., Sum. En., 16 Ref. [Dept. of Animal Science, Univ. of Peradeniya, Sri Lanka]

Cassava. Cassava leaf meal. Leaves. Protein content. HCN content. Detoxification processes. Drying. Storage. Animal nutrition. Sri Lanka.

The effects of 3 processing methods (drying, chopping, and wilting), their combinations, and the storage time on the HCN potential (NCHp) and the CP content of CLM were evaluated at the U. of Peradeniya, Sri Lanka. Limited observations were also made on the effects of processing treatments on the tannin content of CLM. Fresh cassava leaves contained an av. of 1436 mg HCNp/kg DM and simple drying (sun or oven) eliminated almost 90 percent of the HCNp. A combination of chopping and 3-day wilting before drying proved most effective, lowering the cyanide potential of the final product to about 55 mg/kg DM. The processing treatments had little effect on the CP and tannin contents of CLM. The HCNp and CP content of CLM declined by 58.2 and 10.6 percent, resp., during an 8-mo. postprocessing storage. The results demonstrate that low-cyanide CLM, which is safer for use as an animal feed, could be produced using simple processing methods. (AS) See also 0415

100 PROCESSING, PRODUCTS AND USES

101 Cassava Starch and its Properties

0493

30830 ABRAHAM, T.E.; KRISHNASWAMY, C.; RAMAKRISHNA, S.V. 1987. Effect of hydrolysis conditions of cassava on the oligosaccharide profile and alcohol fermentation. *Starch/Starke* 39(7):237-240. En., Sum. En., De., 8 Ref., 11. [Division of Food, Regional Research Laboratory, CSIR, Trivandrum-695 019, India]

Cassava. Cassava starch. Hydrolysis. Analysis. Glucose. Ethanol. India.

Various hydrolysis procedures for saccharification of cassava starch were tried to maximize glucose content in the hydrolysate. The malto-oligosaccharide profiles from high performance liquid chromatography analysis of hydrolysates prepared by acid, acid-enzyme, and enzyme-enzyme showed that the hydrolysate prepared by acid contains malto-oligosaccharides up to DP10 (10 glucose units), whereas with acid-enzyme and enzyme-enzyme process their presence is negligible. A commercial hydrolysate showed less amount of glucose and various sugars up to DP10. The fermentability of hydrolysates was compared and enzyme-enzyme hydrolysate is found to be best. (AS)

0494

30833 DESCAMPS, O.; LANGEVIN, P.; COMBS, D.H. 1986. Physical effect of starch/carrageenan interactions in water and milk. *Food Technology* 40(4):81-86,88. En., 7 Ref., 11. [Satia, S.A., Food Applications Research Center, Usine de Baupte, 50500 Carentan, France]

Cassava. Cassava starch. Carrageenan. Viscosity. Temperature. Gelatinization. Food thickeners. Uses. USA.

The interactions between starch and carrageenan in water and in fresh milk, through evaluation of viscosity were studied. The different textures obtained with starch/carrageenan combinations in milk were also characterized by an Instron testing machine and used to produce ultra-high temp. treated dairy desserts and low-starch pudding formulations. Kappa-carrageenan, iota-carrageenan, and lambda-carrageenan and waxy maize, cassava and potato starches (primarily modified) were used. Results indicate that starch x carrageenan interactions may be useful for tailoring food texture requirements at low cost; low calorific values are achieved by reducing starch contents. Additionally starch/carrageenan combinations can lower the viscosity during heat treatment on plate heat exchangers. Cassava starch achieved its full thickening capacity when heated to 95 degrees Celsius in the presence of iota-carrageenan, whereas it normally required heating to 100 degrees Celsius in order to gelatinize. (CIAT)

0495

31645 FRANCO, C.M.L.; PRETO, S.J. DO R.; CIACCO, C.F. 1987. Studies on the susceptibility of granular cassava and corn starches to enzymatic attack. 1. Study of the conditions of hydrolysis. *Starch/Starke* 39(12):432-435. En., Sum. En., De., 8 Ref., 11. [Inst. de Biociencias, Letras e Ciencias Exatas, UNESP, Caixa Postal 136, 15055, Sao José do Rio Preto-SP, Brasil]

Cassava. Cassava starch. Hydrolysis. Enzymes. Timing. Sugar content. pH. Brazil.

The susceptibility of starch granules to enzymatic hydrolysis was studied. Cassava and maize starches were hydrolyzed by bacterial alpha-amylase with

and without amyloglucosidase under several conditions of incubation. The highest percentage of hydrolysis was obtained in the presence of both enzymes. Elimination of the soluble hydrolysis products by dialysis increased the degradation of the starch granules, especially with cassava starch. (AS)

0496

32061 MUMBECK, P.; ELIASSON, A.C. 1987. Influence of pH and ionic strength on the viscoelastic properties of starch gels. A comparison of potato and cassava starches. Carbohydrate Polymers 7(4):291-300. En., Sum. En., 14 Ref., 11. [Dept. of Food Technology, Univ. of Lund, Box 124, S-22100 Lund, Sweden]

Cassava. Cassava starch. Composition. Laboratory experiments. Gelatinization. Viscosity. Sweden.

The influence of pH and electrolytes on the viscoelastic properties of potato and cassava starch gels was investigated using a cone-and-plate rheometer run in the oscillatory mode. Neither pH nor electrolytes (NaCl, NH₄Cl, KCl, CaCl₂, or CdCl₂) affected the viscoelastic properties of cassava starch gels, the contrary being true for potato starch gels. The actual low electrolyte concn. had no effect on gelatinization temp. or enthalpy of the starches. The chemical compositions of cassava, potato, and wheat starches are compared. (CIAT)

0497

30553 SATTAPORN, S. 1982. (Bacterial amylases production for cassava starch hydrolysis). Mag.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 140p. hal., Sum. En., Thai., 90 Ref., 11.

Cassava. Cassava starch. Hydrolysis. Analysis. Processing. Laboratory experiments. Timing. pH. Temperature. Industrial microbiology. Biochemistry. Enzymes. Glucose. Thailand.

Amylase production from bacterial strains to be used in cassava starch degradation was studied. Out of 296 samples collected from various sources, 332 isolates were found to have amylase activity. In the final selection process, a strain with high enzyme activity (*Bacillus subtilis* PR1) was isolated from a sample of fermented rice starch obtained from Nakhonratchasima province, Thailand. Strain *B. subtilis* PR1 was further studied and compared with a standard strain, *B. amyloliquefaciens* IAM B1512. The highest amylase activity of *B. subtilis* PR1 was observed when it was grown in a medium containing peptone as N source and 7 percent cassava starch as C source, with pH 7.0 and temp. between 30-35 degrees Celsius. Aeration was provided by shaking at 300 rpm, after adding 2 percent inoculum. The enzyme activity of *B. subtilis* PR1 was highest at the 60-h stationary phase (100 units/ml) compared with that of *B. amyloliquefaciens* B1512 (81 units/ml) when incubated under the same conditions, except temp. (37 degrees Celsius). The optimum pH of the enzymes obtained from both strains for degradation of cassava starch was 6.0 at 50-55 degrees Celsius and the pH stability ranged between 6.0-7.5 at 45 degrees Celsius within 20 min. At higher temp. the enzyme activity decreased. The growth of *Bacillus* strains in the fermenter was also studied. Enzyme activity for *B. subtilis* PR1 occurred under the following conditions: 10 percent inoculum, pH 7.0 at 33 degrees Celsius with 300 rpm shaking (0.5 vvm of oxygen). The highest activity was 397 units/ml within 64 h. The activity of *B. amyloliquefaciens* strain B1512, under the same conditions except with a temp. of 37 degrees Celsius, was 270 units/ml within 60 h. After fractionation from ammonium sulfate 70 percent, the activities of these partially purified enzymes from *B. subtilis* PR1 and *B. amyloliquefaciens* B1512 increased 9 and 6 fold, resp. However, when

freeze-dried, the enzyme activities decreased by 26 and 24 percent, resp., for *B. subtilis* PR1 and for *B. amyloliquefaciens* B1512. When these partially purified enzymes were used for degradation of 70 g of boiled and unboiled cassava starch/liter dissolved in pH 6.0 phosphate buffer, the enzyme activity from *B. subtilis* PR1 in boiled starch was 334 units/ml and in unboiled starch 43 units/ml while from *B. amyloliquefaciens* B1512, it was 336 and 23 units/ml, resp. These results showed that the enzymes from both strains were able to hydrolyze boiled starch better than unboiled starch. Furthermore, the *B. subtilis* PR1 enzyme was able to degrade a similar amount of unboiled starch compared with that of *B. amyloliquefaciens* B1512. (AS)

0498

31651 SINGH, V.; ALI, S.Z. 1987. Comparative acid modification of various starches. *Starch/Starke* 39(11):402-405. En., Sum. En., De., 18 Ref., Il. [Discipline of Grain Science & Technology, Central Food Technological Research Inst., Mysore 570013, India]

Cassava. Cassava starch. Modified starches. Laboratory experiments. Analysis. India.

Eight starches (maize, sorghum, finger millet, waxy and nonwaxy rice, chickpea, cassava, and potato) were acid modified with 0.5 N HCl at 50 degrees Celsius. Alkali fluidity no. increased progressively with time of modification, and was highest in cereal followed by root, legume, and tuber starches; however, reduction in the no. av. molecular wt., was in the reverse order. Potato starch had the highest av. mol. wt. among the nonwaxy native starches and showed the greatest fall upon modification, whereas cereal starch had the least av. mol. wt. in native form and showed the least fall. In fact, there was a clear proportionality between the av. mol. wt. of native starch and the extent of its hydrolysis under any given set of conditions. This relationship could be expressed by 2 intersecting lines, one for grams and one for root and tuber starches. When acid-modified starches were recovered and dried without neutralization, hydrolysis still continued strongly in potato starch and slightly in cassava, finger millet and sorghum starches. Other starches showed no change. (AS)

0499

31663 SINGH, V.; ALI, S.Z. 1987. Estimation of phosphorus in native and modified starches. Improvement in the molybdovanadophosphoric acid method. *Starch/Starke* 39(8):277-279. En., Sum. En., De., 9 Ref., Il. [Discipline of Grain Science & Technology, Central Food Technological Research Inst., Mysore-570013, India]

Cassava. Cassava starch. Modified starches. P. Analysis. Mineral content. India.

The spectrophotometric method for estimation of P based on molybdovanadophosphoric acid complex was improved for its sensitivity (8-10 fold) by reducing the reagents concn. to 1/3 and measuring the absorbance as its lambda max (355 nm). The range of the method is brought down to 0.5 to 7.0 micrograms/ml for 1 cm light path. P content of potato starch remained unchanged upon acid modification or oxidation with hypochlorite. Maize and cassava starch, on the other hand, lost about 30-40 percent of their P upon acid modification. The difference probably lays in the state of P in the resp. starch granules. (AS) See also 0479 0501 0531

102 Uses, Industrialization, Processing and Storage

0500

31662 AJIBOLA, O.O. 1987. Mechanical dewatering of cassava mash. Transactions of the American Society of Agricultural Engineers 30(2):539-542. En., Sum. En., 7 Ref., 1l. [Agricultural Engineering Dept., Univ. of Ife, Ile-Ife, Nigeria]

Cassava. Gari. Pressing. Water content. Mathematical model. Nigeria.

Important factors in the dewatering of cassava mash were identified. The final MC of dewatering mash was affected only by the applied pressure. The solid content of the expressed liquid did not change significantly during dewatering and was unaffected by such factors as the applied pressure (72-789 kPa), screen porosity (2.9-34.5 percent), and material depth (12-35 cm). Mathematical models are presented which predict dewatering responses. (AS)

0501

32012 AJIBOLA, O.O.; IGE, M.T.; MAKANJUOLA, G.A. 1987. Preliminary studies of a new technique of cassava mash gelatinization Journal of Agricultural Engineering Research 36(2):97-100. En., Sum. En., 5 Ref.

Cassava. Gari. Gelatinization. Temperature. Composition. Analysis. Nigeria.

A technique using steam for gelatinizing fermented cassava mash was investigated. The mash which was dewatered to about 50 percent MC (wet basis) was heated to between 88-94 degrees Celsius by steaming. The steamed product when dried had characteristics which compared favorably with 5 samples of gari produced by conventional techniques. The technique could provide the basis for an alternative technology for gelatinizing fermented cassava mash for gari production. (AS)

0502

30844 BARRIOS R., J.R. 1986. El casabe venezolano. (The Venezuelan casave). Revista Brasileira de Mandioca 5(2):105-111. Pt., 3 Ref., 1l.

Cassava. Casave. Small-scale processing. Productivity. Composition. Venezuela.

The different stages in the process of preparing Venezuelan casave are described: receipt, cleaning, washing, and grating of roots; pressing of the moist mass; grating of the pressed mass; sieving of the moist flour; cooking of the cakes; packing and marketing. The av. casave yield from 5 cassava var. was 29 percent. A bromatological analysis of cassava from 6 cassava var. was: CP, 1.04 percent; crude fiber, 2.52 percent; fat, 0.38 percent; ash, 1.05 percent; and N-free extract, 94.96 percent. (CIAT)

0503

31688 CASTILLO, S., C.A.; HERNANDEZ E., W. 1985. Estudio del secado natural de tres tipos de trozoa de yuca. (Study of natural drying of three types of cassava chips). Tesis Ing.Agr. Cali, Colombia, Universidad del Valle. Universidad Nacional de Colombia. 119p. Es., Sum. Es., 25 Ref., 1l.

Cassava. Cassava chips. Solar drying. Timing. Water content. Detoxification processes. HCN content. Small-scale equipment. Labor. Statistical analysis. Colombia.

Two natural drying techniques using 3 types of cassava chips (Thai, Brazilian, and Malaysian) and 6 different loading rates were compared at

CIAT-Palmira, between Aug. 1984 and July 1985: densities of 10, 12, and 14 kg/square meter were used on concrete floors, and densities of 10, 12, 14, 16, 18, and 20 kg/square meter on inclined trays. Brazilian and Malaysian-type chips had shorter drying times than Thai-type chips. Drying time was reduced by dehydrating chips on inclined trays and, furthermore, the dried product had a better aspect. Drying time increased as the loading rate increased. During the drying process, the MC of the chips and the environmental conditions of the site were determined. Labor requirements to dry 1 t of fresh cassava on inclined trays was 7.4 h-man. (AS-CIAT)

0504

29337 CORREA, H. 1987. Mandioca. (Cassava). ANPL. Informativo da Assistência Nestlé aos Produtores de Leite 22(72):4-5. Pt., Il. [ESAL, Caixa Postal 37, 37.200 Lavras-MG, Brasil]

Cassava. Cassava chips. Small-scale equipment. Brazil.

Two methods for chipping cassava roots at the farm level for animal feeding are briefly described. The 1st method consists in using a grass chopper and the 2nd, a cassava chipper. The chemical compositions of both types of chips obtained are compared. CP, mineral, and fiber contents vary for both methods: 2.66 vs. 4.33, 2.68 vs. 1.95, and 3.07 vs. 1.83 percent DM, resp. (CIAT)

0505

30827 FIOREZE, R.; ROSSI, S.J.; KLUPPEL, R.P. 1984-1985. Simulacao de secagem de camadas espessas de raspas de mandioca. (Deep-bed drying simulation of cassava chips). Revista Brasileira de Armazenamento 9-10(1-2):19-22. Pt., Sum. Pt., En., 6 Ref., Il. [NUPPA/UFPB, Caixa Postal 208, 58.000 Joao Pessoa-PB, Brasil]

Cassava. Drying. Cassava chips. Simulation model. Brazil.

The Thompson mathematical model was used to predict the drying of thick layers of grated cassava; the model represents heat and mass exchange between the product and the drying air. Data obtained from a lab.-scale dryer with electrically heated air, was used to verify the model. The drying of beds 50 cm thick with air at different temp., flow rates, and moistures was then simulated. Results are presented in graphic form. (AS (extract))

0506

30547 GROPI, J. 1986. Schadstoffaspekte. Eine ironisch ernate Betrachtung. (Aspects of toxic substances. Ironically serious reflexions). Kraftfutter 69(3):86-88,90-91. De. [Institut für Physiologie, Physiologische Chemie und Ernährungsphysiologie: Tierärztliche Fakultät der Universität München, Veterinarstraße 13.8000 München 22]

Cassava. Toxicology. Legal aspects. Feeds and feeding. German Federal Republic.

0507

32053 HIROSE, S.; DATA, E.S. 1985. (Studies on the cassava drying). Japanese Journal of Tropical Agriculture 29(4):213-220. Ja., Sum. En., Ja., 1 Ref., Il. [Dept. of Land Development, College of Agriculture and Veterinary Medicine, Nihon Univ. Setagaya-ku, Tokyo 156, Japan]

Cassava. Cassava chips. Solar drying. Water content. Timing. Labor. Philippines.

Expt. on solar drying of cassava chips of cv. Golden Yellow were carried out at the Philippine Root Crop Research and Training Center. Cassava roots were cut into 1- and 3-cm thick chips which were dried at loading rates of 10 and 15 kg/square meter of drying floor. Drying was conducted on a concrete floor in the sun for about 7-8 h/day. The relationship between drying rate and some climatic factors was examined to obtain data for processing good quality chips. Small chips loaded at the low rate were to dry more quickly than the large ones loaded at the high rate. A clear relationship existed between the decreasing rate of MC in the solar energy base (percentage/cal) and the saturation deficit. MC decreased rapidly with the increase of the saturation deficit when chip size and loading rate were the same. Energy utilization efficiency for chip drying was estimated from the thermal energy caused by the evaporation of water in the chips and from the solar energy radiated on chip surface; it ranged from 10 to 23 percent, depending upon the loading rate and chip size. Results indicated that the solar energy utilization for drying in the 15-kg lot was higher than in the 10-kg lot, and higher in small chips than in large ones, indicating that small chips (1 cm thick) must be loaded and spread evenly over the surface of the concrete floor (with no empty spaces) to obtain effective drying results. Max. loading rate on concrete floors seemed to be about 15 kg/square meter. The preparation of the 1-cm chips took 2.5 times longer than the 3-cm chips, when chopping was done manually. Thus the chopping method as well as chip size must be studied not only for chip quality but also for labor cost. (AS (extract))

0508

30565 HUBEIS, M. 1980. Evaluasi penempatan Gilham SS '79 di perusabuan taploca desa Cimahpa. (Evaluation of the placing of a Gilham SS '79 on the tapioca industry in Cimahpar village). Bulletin Penelitian dan Pengembangan Teknologi Pangan 2(2):21-23. In.

Cassava. Tapiocas. Indonesia.

0509

29334 MOLINEROS F., M. DEL C.; RENGIFO O., P.; LUENGAS L., O. 1986. Estudio de reducci3n de tama1o de trozos de yuca seca utilizando un molino de martillos. (Study on dry cassava chip size reduction using a hammer mill). Tesis Ing.Agr. Cali, Universidad del Valle. Universidad Nacional de Colombia. 178p. Es., 18 Ref., Il.

Cassava. Cassava chips. Industrial machinery. Processing. Cassava flour. Colombia.

The best conditions for using a hammer mill to reduce dry cassava chip size, with or without peels, for CF production were studied in Colombia. The highest CF yields were obtained when screen sizes and peripheral hammer speeds used were 4.76-3.17 mm and 56.6-66.0 m/sec, resp. The use of dry cassava chips with peels is recommended; all soil residues should be eliminated by washing in water. (CIAT)

0510

31659 OKEREKE, G.U.; NWOSU, V.C. 1987. Crop storage losses in southern Nigeria caused by the activities of micro-organisms. *Marcen Journal of Applied Microbiology and Biotechnology* 3(3):201-210. En., Sum. En., Fr., Es., 42 Ref. [Dept. of Horticulture & Plant Protection, Anambra State Univ. of Technology, P.M.B. 01660, Enugu, Anambra State, Nigeria]

Cassava. Storage. Deterioration. Gari. Foofoo. Cassava chips. Nigeria.

The present storage system of food crops in Nigeria is reviewed. Microbiological activities leading to spoilage and loss of 3 major food

crops grown in southern Nigeria (maize, cassava, and yam) are discussed. Among factors found to influence the infestation and growth of microorganisms in these crops during storage, moisture is especially significant. To aid in its preservation, cassava is usually processed into more shelf-stable products such as gari, foofoo, and cassava chips. These processed products, in spite of their relatively shelf-stable nature, are still subject to microbial infection if improperly handled and stored. It is concluded that much work needs to be done in Nigeria to improve storage conditions. (AS (extract))

0511

32064 PETERSEN, H. 1985. Pneumatische entladung von schwerfließenden futtermitteln aus schuten. (Compressed-air system for unloading feedstuffs with poor flow characteristics from barges). Mühle und Mischfuttertechnik 122(38):514-515. De., 11.

Cassava. Distribution. Unloaders. Industrial machinery.

Stationary equipment for continuous, dust-free unloading of 1500-t vessels is described and illustrated. A special feature is a hydraulically operated rotating 4-blade tool incorporated in the suction nozzle feed system. Mean performance is given for a no. of products, among them cassava, for different ship sizes. For cargo loads of 1000 and 700 t cassava, mean performance was 85 and 70 t/h, resp. (CIAT)

0512

32254 REGEZ, P.F.; AB'ENENE IFEBE 1987. Techniques traditionnelles de transformation de manioc au Zaïre. 1. Preparations pour usage domestique. (Traditional processing techniques of cassava in Zaïre. 1. Products for domestic use). Microbiologie-Aliments-Nutrition 5:51-59. Fr., Sum. En., 30 Ref., 11. [Laboratoire de Microbiologie Alimentaire, Ecole Polytechnique Fédérale, CH-8092 Zurich, Suisse]

Cassava. Processing. Survey. Cassava pastes. Foofoo. Cassava roots (vegetable). Sweet cassava. Bitter cassava. Uses. Storage. Zaïre.

Traditional processing techniques and recipes were studied to determine where a fermentation step could be introduced without considerably changing the organoleptic aspects of well-known cassava foods. Through a survey in all regions of Zaïre, 70 recipes of traditional preparations of cassava foods for domestic use were identified. These are described and divided into 4 categories: fresh cassava roots, cooked cassava, cassava paste, and cassava porridge. For each category, a large flow sheet of the different processing techniques is included. The different products are compared regarding no. of recipes/region, use of bitter and sweet cassava roots, mixtures with other foodstuffs, nutritional importance, and shelf life. The results show a var. of traditional processing techniques. As more research is undertaken to improve the nutritional value of cassava by improvements in technology and microbiology, it is recommended that priority be given to the study of established traditional techniques, if the products are to be acceptable to the local population. (AS (extract))

0513

32255 REGEZ, P.F.; MULUMBA, N. 1987. Techniques traditionnelles de transformation de manioc au Zaïre. 2. Preparations commercialisées. (Traditional processing techniques of cassava in Zaïre. 2. Products for commercial use). Microbiologie-Aliments-Nutrition 5:123-128. En., Sum. En., 14 Ref. [Laboratoire de Microbiologie Alimentaire, Ecole Polytechnique Fédérale, CH-8092, Zurich, Suisse]

Cassava. Foofoo. Chickwangué. Gari. Beverages. Fermentation. Small-scale processing. Zaire.

A total of 132 cassava products, produced and sold in the local markets in Zaire, are described; products are grouped into 6 categories: cassava flour and paste (foofoo), cassava bread (chickwangué), cassava puree, cassava cakes, cassava semolina (gari), and fermented cassava beverages. Flow sheets have been developed and the different products are compared regarding no. of recipes/region, use of bitter and sweet cassava roots, mixtures with other foodstuffs, nutritional importance, and shelf life. Since any improvement of the nutritional value of commercialized cassava products would have a major impact for the local people, it is suggested to reinforce and encourage the existing techniques of fermentation and mixing with cereals. Only with a good knowledge and use of traditional processing techniques can modifications through technology and microbiology be successful. (AS)

0514

32077 RIOS, J.L. 1984. Casa de farinha: alternativa de producao do mandiocultor do Reconcavo-Bahia. (Cassava mill: an alternative of production for cassava producers in Reconcavo, Bahia). Revista de Economia Rural 22(4):447-456. Pt., Sum. Pt., En., 13 Ref. [Escola de Medicina Veterinaria, Univ. Federal da Bahia, Caixa Postal 40.000 Salvador-BA, Brasil]

Cassava. Cassava flour. Small-scale processing. Socioeconomic aspects. Survey. Brazil.

A survey on household cassava mills in the Reconcavo region (Bahia, Brazil) indicated that cassava mills are an appropriate alternative for small farmers. The technological innovations that can be adapted by small producers (both owners and tenant farmers) were studied. Improved technologies increased the weekly production of CF for daily consumption by owners but decreased the production of tenant farmers. Therefore the technological changes in the production system in cassava mills had collateral effects on the social, economic, and cultural relationships of the families involved. (AS)

0515

32093 RYU, B.H.; NAM, K.D. 1987. Large scale alcohol fermentation with cassava slices at low temperature. Korean Journal of Applied Microbiology and Bioengineering 15(2):75-79. En., Sum. En., 20 Ref., 11. [College of Engineering, Pusan Sanub Univ., Dal Yon-Dong, Pusan 608, Korea]

Cassava. Alcohol. Fermentation. Temperature. Timing. Glucose. Composition. Sugar content. Korea.

The possibility of large-scale alcohol fermentation from cassava slices was studied in both low and high temp. cooking systems 90 and 120 degrees Celsius, resp.). The same amounts of saccharifying and liquefying enzymes were used for cooking at both temp. At low temp. cooking, conversion of glucose consumed in fermented mash to alcohol was 0.468 g alcohol/g glucose which was a higher yield than that obtained at high temp. (0.463 g alcohol/g glucose). (AS)

0516

31668 SATIN, M. 1988. Bread without wheat. New Scientist 118(1610):56-59. En., 11.

Cassava. Cassava bread. Organoleptic examination. Socioeconomic aspects. Human nutrition.

The economic, political and nutritional advantages of producing bread without wheat, using instead cassava and sorghum, in developing countries are discussed. A method of preparation of cassava bread, which remains fresh for 8-9 days is presented. In spite of the fact that cassava bread can be made, the existence of a simple technology of this kind in itself is not enough to change government policies. (CIAT)

0517

31676 VIERA, M.A. 1987. Diseño de una planta para la producción de trocitos de yuca. Proyecto Cooperativo CIAT/II/Univalle-CIID. Producción y uso de harina de yuca para consumo humano. (Design of a plant for the production of cassava chips). Cali, Colombia, Centro Internacional de Agricultura Tropical. Sección de Utilización. Programa de Yuca. 89p. Es., Sum. Es., 5 Ref., 11. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Cassava chips. Industrialization. Drying. Solar drying. Processing. Factories. Economics. Costs. Labor. Colombia.

A preliminary design is presented of a pilot plant for the production of small dry cassava chips. The plant was designed to have a processing capacity of 1 t end product/day, using a batch production process which consisted of reception, selection, washing, chipping, drying, pregrinding, and storage. The conversion rate of raw materials (cassava roots) into end product was 2.75. The end product (dry cassava chips) is projected to be sold to wheat mills to be converted into flour for breadmaking, in ratios of 15 percent CF and 85 percent wheat flour, or to be used in composite flours with other raw materials for preparing soups, porridges, pasta, and other foodstuffs. The pilot plant would be located on the Atlantic Coast of Colombia. It requires 4 operators and 2 managers. The elements in the process and the distribution in the plant were arranged in a U-flow pattern to minimize the handling of materials and facilitate its operation. An economic study was carried out to determine the profitability of 2 pilot plant models: I, production of 140 t/yr during 40 wk. of operation with natural drying; II, 240 t/yr during 40 wk. of operation (a 20 wk.-dry period under natural drying and the rest of the period under artificial drying). Plant I requires an investment of Col\$4,600,000, estimated for the last quarter of 1986, has total production costs/dry product of Col\$35,722, and has a profitability of 25.6 percent. Plant II requires an investment of Col\$6,100,000, total production costs/end product are of Col\$36,972, and has a profitability of 34.8 percent. Plant models were analyzed to establish which parameters have more influence on the project's profitability. These were the cost of raw materials, the conversion factor, and the selling price of the product. (AS-CIAT) See also 0478 0479 0504 0506 0507 0508 0529 0532 0539 0547 0548 0555

103 Industrial Microbiology

0518

32054 AMUND, O.O.; OGUNSINA, O.A. 1987. Extracellular amylase production by cassava-fermenting bacteria. Journal of Industrial Microbiology 2(2):123-127. En., Sum. En., 11 Ref., 11. [Dept. of Biological Sciences, Univ. of Lagos, Lagos, Nigeria]

Cassava. Enzymes. Fermentation. Industrial microbiology. Nigeria.

Fermentation of cassava roots was accompanied by a gradual decrease in pH, increased amylase activity in the steep liquor, and increased microbial load and lactic acid concentration. Amylase-producing bacterial strains associated with cassava fermentation were isolated and identified as

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Bacillus subtilis, *B. licheniformis*, and *B. cereus*. The pH optima for the partially purified enzymes of these organisms were 7.0, 5.5, and 7.5, while their temp. optima were 30, 37, and 80 degrees Celsius. There was no significant difference in amylase activities when starch, dextrin, amylopectin, glucose, and maltose were used as growth substrates. (AS)

0519

30590 FLOCCARI, M.E.; MENDEZ, B.S. 1986. Formación y regeneración de protoplastos de una cepa nativa de *Clostridium acetobutylicum*. (Formation and regeneration of protoplasts from a native strain of *Clostridium acetobutylicum*). Revista Argentina de Microbiología 18(1):49-51. Es., Sum. Es., En., 11 Ref. [Laboratorio de Genética Bacteriana, Depto. de Química Biológica, Facultad de Ciencias Exactas y Naturales, Ciudad Universitaria, Pabellón 2, 1428, Buenos Aires, Argentina]

Cassava. *Clostridium acetobutylicum*. Industrial microbiology. Argentina.

A modified method was developed for the formation and regeneration of protoplasts from a native strain of *Clostridium acetobutylicum*, isolated from cassava roots in Misiones, Argentina. Protoplasts were obtained by lyszyme treatment in a hypertonic solution and were regenerated in a hypertonic and enriched solid medium. The frequency of reversion to the bacillary form obtained varies between 10-15 percent. (AS-CIAT)

0520

31675 MOTTA, L.C. 1985. Utilizacao de residuos de industrias de farinha de mandioca em digestao anaerobica. (Use of cassava flour industrial wastes in anaerobic digestion). Tese Mestre Agr. Botucatu-SP, Brasil, Universidade Estadual Paulista Julio de Mesquita Filho. 130p. Pt., Sum. Pt., En., 107 Ref., 11.

Cassava. Waste utilization. Cassareep. Cortex. Composition. Industrial microbiology. Fermentation. Temperature. Anaerobic digestion. Analysis. Brazil.

The viability of treating 2 cassava residues (cassareep and cassava peels), alone or in combination, was studied. Both were mixed, resp., in the following proportions: 0:100, 50:50, 63:37, 75:25, and 100:0; they were then submitted to anaerobic digestion by batch fermentation in 5000-ml capacity reactors. The gas collected was measured by acidified saline solution displacement. Reactors were loaded daily with 1.6 g volatile solids/liter of reactor, with a hydraulic retention time of 20 days. The temp. used was 35 degrees Celsius. Parameters recorded were pH, alkalinity, volatile acidity, organic load, rate of conversion from volatile solids to gas, and methane content. Rate of reduction in the effluent and methane content in the biogas were used as parameters to evaluate the efficiency of residue treatments. Results indicated that there is a possibility for effective reduction in the pollution and toxic power (linamarin) of both cassava residues, when treated alone or in combination by anaerobic processing. The combination of cassareep with cassava peels was advantageous because it increased the mixture alkalinity and gave a suitable pH. The av. rate of conversion from OM to gas ranged from 0.43 to 0.65 liters gas/g volatile solids/liter reactors added, producing biogas with 50-57 percent methane. Cyanide content was reduced in both residues with a max. value of 97.9 percent, indicating there was not an inhibition in the anaerobic digestion of the residues. The reducing pollution index obtained ranged from 51 to 73 percent for volatile solids and from 42 to 68 percent in COD, indicating that the process had not yet been optimized. The best mixture for residue treatment was 63 percent cassareep combined with 37 percent cassava peel; however, due to the little

difference between this combination and cassareep alone, and considering factory operations, it is recommended that only cassareep be submitted to anaerobic digestion in a first stage. (AS)

0521

30562 ODUNFA, S.A.; SHASORE, S.B. 1987. Saccharification of cassava peels waste for microbial protein enrichment. *Acta Biotechnologica* 7(1):23-29. En., Sum. En., 21 Ref., 11. [Dept. of Botany & Microbiology, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Cortex. Waste utilization. Protein enrichment. Industrial microbiology. Carbohydrate content. Nigeria.

A fermentation medium for the production of alpha-amylases was formulated to effect saccharification of the starch in cassava waste peels, which were found to constitute up to 55 percent of the original root and contain 41.8 percent carbohydrate, 1.1 percent protein, 12.5 percent ether extract, 4.9 percent total ash, and 20.8 percent crude fiber. Peels were also enriched with microbial protein. Amylase-producing microorganisms (*Aspergillus fumigatus*, *A. flavus*, *A. niger*, and a *Pseudomonas* sp.) were isolated from rotten cassava root discs buried in the soil at different locations; the level of reducing sugar was 20.5 mg/ml. Generally the levels of saccharification were higher when the waste media were supplemented with different N sources. The CP yield in the cassava peel waste media by different microorganisms varied from 5.6 to 17.5 percent. The highest protein yield was in the waste medium fermented by *A. fumigatus*, followed by *A. niger*, *B. subtilis*, and *Pseudomonas* sp. in decreasing order. (AS)

0522

32088 PAJE, N.F.; RAYMONEG, A.K.; DALMACIO, L.F.; SAKAL, H. 1986. Amylase activity of local strain of *Streptococcus bovis* on raw cassava starch. *Philippine Journal of Science* 115(2):129-138. En., Sum. En., 14 Ref., 11. [Inst. of Biological Sciences, UPLB College, Laguna 5720, Philippines]

Cassava. Cassava starch. Enzymes. Industrial microbiology. Glucose. Maltose. Hydrolysis. Analysis. Philippines.

The amylase activities of 51 bacterial isolates from bovine rumen were determined. The top 3 amylase-producing isolates were characterized and identified as *Streptococcus bovis*. Their activity and digesting ability on raw cassava starch were determined. The amylase of the highest producing isolate (no.17) was partially purified and greater hydrolytic activity than the enzyme from a known strain TUA 148 (55 vs. 24 percent) was observed. Main products (glucose, maltose, and maltotriose) observed after hydrolysis of raw cassava starch were identified by paper chromatography. Max activity was observed after 10 h of incubation with a final pH of 6.0; this also coincided with the peak of growth measured by optical density readings. (AS) See also 0506

JOO ECONOMICS AND DEVELOPMENT

0523

32218 ALVAREZ, M.N.; MULINDANCABO, J. 1987. Cassava production in Rwanda: state of the art. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. *Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch*, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.160-163. En., Sum. En.,

4 Ref., 11. [International Inst. of Tropical Agriculture, P.M.B. 5320, Oyo Road, Ibadan, Nigeria]

Cassava. Production. Land preparation. Planting. Harvesting. Marketing. Consumption. Human nutrition. *Monorchellus tanajoa*. *Phenacoccus manihoti*. Cassava African mosaic virus. *Cercospora*. Uses. Rwanda.

A survey of cassava production in Rwanda was conducted to provide insight into production practices and the limitations of the existing genetic pool. Aspirations of cassava farmers were also identified. The establishment of a multiplication system for the supply of healthy planting material is recommended. (AS)

0524

32039 AMBUHL, H.J.; CASAGRANDE, J.C.; JAYASENA, W.G.; SYRES, J.D.; TELLO R., C. 1985. Smallholder farming systems in the South East Mulanje area of Mulanje rural development project Malawi. Wageningen, The Netherlands, International Course for Development Oriented Research in Agriculture. Bulletin no.18. 78p. En., Sum. En., 30 Ref., 11.

Cassava. Farming systems. Farm size. On-farm research. Questionnaires. Socioeconomic aspects. Cultivation systems. Intercropping. Rotational crops. Soil conservation. Developmental research. Malawi.

Constraints for the improvement of the main farming systems in SE Mulanje area, Malawi, are analyzed. Predominant food crops are maize and cassava. Research and extension areas of interest in smallholding farming systems also were identified and evaluated. Farm size, land tenure, labor, crop and animal production, off-farm activities, sales and purchases, and input use are given for the different systems, based on data collected in surveys. Parameters including soil fertility, cropping patterns, crop husbandry, input use, off-farm activities and extension are analyzed and discussed. Continuous cropping of cassava and maize has resulted in soil degradation, and thus farmers have substituted maize for more cassava or cash crops and have searched for increased off-farm activities. Research priorities should concentrate on developing improved intercropping systems, crop rotations, and improved maize and cassava var. (CIAT)

0525

31683 BANYA, G.S. 1987. Increased food production on the small farms, experiences from Eastern IADP in Sierra Leone. In Holmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.178-191. En., Sum. En., 7 Ref.

Cassava. Technology evaluation. Farming systems. Technology transfer. On-farm research. Farm size. Intercropping. Rice. Maize. Costs. Labor. Productivity. Income. Statistical data. Sierra Leone.

Experiences of the Eastern Integrated Agricultural Development Project (IADP) of Sierra Leone, 1 of the 7 IADP's of the country that aim towards increased food production on small farms, are reported. The target area, objectives, technology packages being developed, and impact of improved technology transfer on crop production are described. Five crop rotations, including cassava among other crops, have been developed for the upland farming system areas. The agro-economic performance of the upland rice + cassava + maize cropping system in Kenema during the 1983 and 1984 cropping seasons is indicated. The model has been found to be productive and profitable, and farmers have shown interest in it. (CIAT)

0526

30556 BENCHAMAS, P. 1982. (Effectiveness of extension methods of Kaset Tumbols in Nakornrachasima province). Mag.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 126p. Thai., Sum. En., Thai., 21 Ref.

Cassava. Technology evaluation. Technology transfer. Socioeconomic aspects. Questionnaires. Thailand.

The efficiency of the extension methods used by Kaset Tumbols was determined in 150 Kaset Tumbols and 120 farms in Nakornrachasima Province, Thailand, and the problems encountered are analyzed. Questionnaires and interviews were used to collect data. Of Kaset Tumbols in the study, 85.33 percent were male, on av. 24.56 yr old, with secondary technical diplomas in agricultural education, and working for 1.0-3.5 yr. Each was responsible for approx. 11.5 villages or about 801-1100 farm families. Rice had been promoted as main crop by 95.33 percent of Kaset Tumbols; cassava, maize, peanut, and mungbean were secondary crops. Interviewed farmers attributed the agricultural knowledge and information they had to Kaset Tumbols who visited their homes or farms with other extension methods. This knowledge was considered useful in improving their farming. The problems reported by Kaset Tumbols were: delayed delivery of materials for farm demonstration, faulty timing of farm visits, and lack of agricultural documents for distribution. (AS)

0527

30818 CHANDRA, S. 1986. Tropical root crops and their potential for food in the less developed countries. Food Reviews International 2(2):143-169. En., Sum. En., 38 Ref., 11. [Development Studies Centre, Australian National Univ., Canberra, Australia]

Cassava. Productivity. Consumption. Uses. Nutritive value. Economics. Developmental research. Statistical data. Papua New Guinea. Fiji. Japan. India. Zambia. Brazil. Oceania.

The production and consumption of tropical root crops (including cassava) by major world regions and individual countries are analyzed. Data is given on area harvested, production, yields, and main producers in 1984. The nutritional value of tropical root crops and their use are discussed; a review of several nutritional studies done in India, Zambia, Brazil, and the South Pacific is given. The importance of root crops to the economies of Papua New Guinea, Fiji, and Japan is considered. Finally, general conclusions and recommendations for research and development in tropical root crops are made in agronomy, production systems, germplasm, breeding, diseases and pests, storage, utilization, and marketing. (CIAT)

0528

31630 COMITE ECONOMIQUE ET SOCIAL DE LA CEE. 1980. Manioc: nécessité de stabiliser les importations. (Cassava: the need to stabilize imports). Producteur Agricole Français 56(266):9-10. Fr., 11.

Cassava. Trade. Statistical data. Animal nutrition. Europe.

The main reasons for the increase in EEC imports of several substitute foodstuffs (among them cassava) for animal feed during 1978 are analyzed. The economic consequences of decreasing the use of cereals in animal rations in ECC countries are also discussed. Recommendations are given on elements to be considered for the stabilization of imports of substitute products. Statistics are presented on the evolution of substitute foodstuffs imports from 1966 to 1978 and on the use of cereals in animal rations from 1970 to 1978 in the EEC. (CIAT)

0529

32035 DALTON, G.E.; AMANKWA, E.H.U. 1973. Tobacco production in South-east Ghana. In Dalton, G.E.; Parker, R.N. Agriculture in South east Ghana, 2. Special studies. Berkshire, England, University of Reading. Department of Agricultural Economics and Management. Development Study no.13. v.2,pp.78-86. En.

Cassava. Economics. Labor. Prices. Ghana.

The tobacco industry in Ghana is analyzed; factors affecting its production and its economic attraction relative to other crops, particularly maize and maize/cassava, are discussed. Returns from tobacco in 1970 are compared with those from maize and maize/cassava in 2 villages of SE Ghana, Wute and Tadzewu, showing that at current prices tobacco is less attractive than maize/cassava. Labor requirements and net returns to labor are detailed for each cropping system. (CIAT)

0530

31654 DIAZ D., R.O. Intensive training course on research for cassava production, Cali, Colombia. 1978. 1978. Cassava production in Colombia: a technical description. In Domínguez, C., comp. Intensive Training Course on Research for Cassava production, Cali, Colombia, 1978. Papers presented. Cali, Colombia, Centro Internacional de Agricultura Tropical. v.2,pp.457-492. En., Sum. En., 2 Ref., 11.

Cassava. On-farm research. Cultivation. Cultivation systems. Intercropping. Productivity. Seed. Economics. Costs. Labor. Prices. Income. Soil physical properties. Bacterioses. Mycoses. Injurious insects. Weeds. Uses. Colombia.

A study was conducted by CIAT to cover different aspects of the cassava crop: (1) production processes; (2) factors associated with low yields, and (2) production costs and other economic indexes. A group of cassava farmers distributed in 5 different regions of Colombia were visited during different stages of the cassava growth cycle to obtain information on production and planting systems; types of soils used; insects, diseases, weeds, and water problems; inputs used and production costs for each one of the studied zones. At the farms surveyed most of the production activities are performed with hand labor. Around 40 percent of the farmers planted cassava intercropped with other crops, maize being the most important. Weed control is one of the most important activities in the cassava production process. The majority of the soils are acid and loam textured. Diseases caused by *Cercospora* spp. were the most important at almost all plantations under 1200 m of alt. and Phoma leaf spot was the main disease causing yield losses at more than 1200 m.a.s.l. Insects were found at all regions surveyed, of which thrips were the most frequent. Gall midges, mites, whiteflies, fruit flies, tingids, horn worms, and leaf-cutter ants were the most important. Broad-leaved weeds, in particular ferns, were the most frequent at all zones. Machinery was used for land preparation and very little for other labors. Insecticides, especially for leaf-cutter ant control, were the most common chemical input. Seed size increased as alt. decreased. Av. yields from the survey were less than 7 t/ha, although yields ranged from 0 to more than 40 t/ha. Use of labor for cassava production averaged at 86 man-days/ha. The variable production costs for 1977 were estimated at Col\$4000/ha and Col\$640/t and the total cost at Col\$6000/ha and Col\$1000/t cassava produced. The proportion of family labor used by the farmers for the cassava production process was of 42.4, 19.9, 67.4, 48.0, 52.0, and 45.1 percent for the zones of Cauca, Valle and Quindío, Tolima, Meta, Atlántico and Magdalena, and total farmers costs, resp. The av. price paid to the cassava farmers was of Col\$1540/t cassava for processing, and the starch obtained was sold only in 2 zones. One-third of the farmers sold their cassava before harvesting and the

majority had no transportation means. The importance of this type of information for research workers in charge of establishing simple, inexpensive technologies which could be adopted to different ecosystems and cultural levels is stressed. (AS)

0531

32209 HAHN, S.K.; MAHUNGU, N.M.; OTOO, J.A.; MSABABA, M.A.M.; LUTALADIO, N.B.; DAHNIYA, M.T. 1987. Cassava and the African food crisis. In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. pp.24-29. En., Sum. En., 25 Ref., 11. [International Inst. of Tropical Agriculture, P.M.B. 5320, Oyo Road, Ibadan, Nigeria]

Cassava. Human nutrition. Production. Cultivation. Nigeria. Africa.

The potential and constraints to cassava production in the African farming and food systems are reviewed and related to the current African food crisis and to the future food production needs of the continent. (CIAT)

0532

32013 HUBSCH, C.; CHAIR, S.K. 1986. Major domesticated food crops. In Hansen, A.; McMillan, D.E., eds. Food in Sub-Saharan Africa. Boulder, USA, Lynne Rienner Publications Inc. pp.177-206. En., 16 Ref., 11.

Cassava. Plant geography. Maps. Production. Consumption. Composition. Analysis. Cultivation. HCN content. Processing. Uses. Africa.

The nutritional characteristics, geographical distribution, and production requirements and constraints of the major food crops in Africa are reviewed, both by category (cereal grains, farinaceous crops, and legume grains) and by individual species. Cassava is among the specific food crops discussed; over 1/3 of the world distribution is now in Africa, the largest producing country being Zaire followed by Nigeria and Tanzania. General cultural practices and processing are briefly described. Several food products are mentioned. The geographical distribution of these crops was found to depend on cultural preferences and adaptation of the crop to ecological zones (rainfall, temp., and soils). Root crops, principally cassava, and bananas and plantains are the major staples in the wetter regions. (CIAT)

0533

31684 HOPKINSON, D. 1987. The North Western Province Area Development Project, Zambia. In Holmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.192-195. En., Sum. En.

Cassava. Shifting cultivation. Farming systems. Costs. Planting. Timing. Cultivation. Intercropping. Zambia.

The physical environment, socioeconomic setting, main farming systems, problems, approaches, and early results of the North Western Province Area Development Project of Zambia are described. There are 2 traditional subsistence systems based on shifting cultivation and with no use of purchased inputs: sorghum-based and cassava-based systems. Both of these systems are similar in their characteristics; cassava has a long planting season (Oct.-Feb.) with a different intercrop as the season passes (maize, vegetable, sweet potatoes, beans), use of mounds, only weeded once at 12-18 mo., and complete dependence on hand cultivation. Cassava is also a

component of the sorghum-based system. Land is generally cultivated for 2 cycles of cassava before being abandoned, but fallows may be as short as 5 yr. The project aims at producing packages to make crop production economically attractive, enhance land fertility, and reduce shifting cultivation. The release of improved var. for widespread testing has not been possible. (CIAT)

0534

31687 IKOGBO, B.N. 1987. Increased production through low-cost food crops technology at IITA. In Holmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.358-366. En., Sum. En., 7 Ref.

Cassava. Cassava programs. Research. Plant breeding. Socioeconomic aspects. Technology evaluation. Productivity. Diseases and pathogens. *Phenacoccus manihoti*. *Mononychellus tanajoa*. Resistance. Biological control. Harvesting. Agricultural equipment. Humid tropics, Nigeria, Africa.

The mandate region of the International Institute of Tropical Agriculture (IITA) in the humid tropics of West and Central Africa is described as to climate, soils, vegetation, and socioeconomic conditions. Physical, biological, and socioeconomic constraints to increased food production are analyzed. Appropriate strategies and technologies for production improvement are outlined. Progress in research and training activities are presented. Regarding cassava, improved var. give yields of 20-50 t/ha in 12-15 mo., many are resistant to CHB, CAMD, and anthracnose, and tolerant to the cassava mealybug and the cassava green mite, among other characteristics. A hand-operated cassava harvester is mentioned among others as an appropriate technology developed for low resource farmers. Regarding emerging technologies in IITA's work special reference is made to cassava tissue culture and the Africa-wide *Phenacoccus manihoti* and *Mononychellus tanajoa* biological control programs. (CIAT)

0535

32228 IKPI, A.E.; GEBREMSKEL, T.; HAHN, N.D.; EKPERE, J.A. 1987. Socioeconomic and utilization considerations in cassava production: a basis for agronomic and genetic research (Abstract). In Terry, E.R.; Akoroda, H.O.; Arene, O.R., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre, p.154. En. [Dept. of Agricultural Economics, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Production. Socioeconomic aspects. Food security. Survey. Nigeria.

The results of a socioeconomic survey on cassava of 150 farmers from 15 villages in the Oyo Local Government Area of Nigeria are summarized. The decision-making roles of household members in the cassava enterprise are unclear; however, the roles appear highly differentiated and are specific for the various aspects of cassava production, processing, and marketing. The survey showed that cassava was consumed at least once a day in the av. household, that cassava consumption patterns varied with the season and the family income, and that cassava contributed to household food security when other food staples were scarce or too expensive. The versatility of cassava enhanced its potential contribution to food security. The survey also showed that cassava farming was a profitable enterprise. Labor and transportation were the most costly resources for the rural farmer in cassava production and processing, accounting for 37.3 and 35.7 percent of the total cost, resp. Overall, 72 percent of labor came from within the family and 28 percent came from hired help. Women and children were

responsible for 71 percent of the labor. The economic implications of this division of labor are discussed. (Full text)

0536

32066 INTERNATIONAL RICE RESEARCH INSTITUTE. 1985. Socioeconomic aspects of farming systems. In International Rice Research Institute. International Upland Rice in Indonesia, 1985. Monitoring tour. Report. Manila, Philippines, pp.37-38. En.

Cassava. Socioeconomic aspects. Farming systems. Indonesia.

Socioeconomic aspects of farming systems in Indonesia are mentioned. Large differences were found by farmers between the buying and selling prices of cassava over short distances, where the marketed surplus is larger and there are processing industries. This indicates either very high transportation costs or the existence of localized monopolies. (CIAT)

0537

31680 IVY, P. 1987. Technical and environmental limitations to increasing food crop production under sub-humid and semi-arid East and Southern African environments and possible solutions. In Holmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.86-99. En., Sum. En., Il.

Cassava. Cultivation. Cultivation systems. Harvesting. Timing. Ecology. Soil requirements. Climatic requirements. Water requirements (plant). Technology evaluation. Productivity. Costs. Africa.

Technical and environmental limitations to increasing food crop production under sub-humid and semi-arid East and Southern African environments are discussed, and possible solutions proposed. Major technical problems are limited application of manure and fertilizers and inadequate plowing depth and planting dates; environmental constraints are inadequate growing season length, drought periods during the growing season, soil erosion and fertility. Estimated yield ranges (with constraints) according to the length of the growing period and under low and high input levels are given for 7 of the more important food crops in the region, including cassava. General feasible solutions discussed for increasing food crop production in the region include breeding for drought resistance; intercropping/alley cropping; use of manure, compost, and inorganic fertilizers; mechanical and vegetative protection of arable land; soil moisture conservation; and fully integrated farming systems. (CIAT)

0538

31670 JUMAH, A. 1980. Prospects for cassava in domestic and international markets. Laxenburg, Austria, International Institute for Applied Systems Analysis. 22p. En., 26 Ref., Il. [Inst. of Agricultural & Nutritional Economics Agricultural Univ. of Vienna, Peter Jordan-Strasse 82, A-1190 Vienna, Austria]

Cassava. Marketing. Trade. Economics. Technology transfer. Production. Maps. Statistical data. Uses. Consumption. Africa. South America. North America. Caribbean. Asia. Oceania.

The role of cassava in both developing and developed countries and the implications for technological development in cassava producing countries are reviewed, so as to serve as a policy guide for both the agricultural and industrial sectors of the developing producing countries. It is concluded that cassava cultivation should be encouraged through the provision of economic incentives in countries where the crop has a comparative advantage, with major investments in infrastructure and

appropriate technology as well as new initiatives by commercial traders and bankers. Domestic marketing, distribution, and processing would have to be supported financially. The role of technology in cassava production cannot be overemphasized, as it would improve the efficiency of labor involved in cassava production as well as cassava yield and quality. Cassava export prospects exist both in the EEC with the recent entry of Spain and Portugal, and in the USSR where grain production is erratic due to climatic reasons, in Japan and in the newly industrialized countries of South Korea and Taiwan. (CIAT)

0539

31666 KOLLER, B. 1986. Schaffen neue technologien arbeitserleichterungen fur die frauen? Beispiel: kassava-reiben in Sierra Leone. (Creation of a new technology to improve work perspectives of women. The case of gari in Sierra Leone). Entwicklung und Landlicher Raum 20(6):16-18. De., Sum. De., En., 1 Ref. [Hans-Thoma-Strabe 5, 6000 Frankfurt am Main 70, Germany]

Cassava. Women. Gari. Marketing. Income. Technology transfer. Industrialization. Socioeconomic aspects. Sierra Leone.

Women in rural areas of Sierra Leone are subsistence farmers. They produce, among others, rice, vegetables, and cassava, the 2nd most important staple food after rice. Only processing of cassava to gari, and its marketing, offers a relatively secure income to women. Cassava/gari has become more important as a cash crop with the increasingly unstable provision of rice. In town areas, motor-driven rasps facilitate the production process of gari. Financially potent men buy the cassava crop from the women, use new gari production technology, and thus achieve advantages in production for themselves. In the long run, this will mean a shifting of the gari production into the town and into the hands of the men. The women's program of a project of technical cooperation has therefore tried to obviate this process by direct assistance of the women producers of cassava and gari. Access to groups of women to credits enabled them to buy an expensive, motor-driven cassava rasping machine. Difficulties encountered in the introduction of improved technology are discussed as well as the control measures necessary to insure that women are not pushed aside in their traditional branches of production. (AS extract)

0540

31679 KYOMO, M.L.; KESWANI, C.L. 1987. Structure and distribution of land and corresponding yields of field food crops in Eastern and Southern Africa. In Holmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.54-69. En., Sum. En., 15 Ref.

Cassava. Land use. Farm size. Production Tanzania. Angola.

The different types of farm holdings in Eastern and Southern Africa are described. Emphasis is given to 9 Southern African Development Coordination Conference countries: Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe. Data on yields of main food crops and other selected characteristics are presented for each country. Production data for cassava as a major staple per type of farming unit are given for Angola (1981) and Tanzania (1983/84); data on area planted and yields are also included for Tanzania. (CIAT)

0541

32060 LAESHI, F.R.; PAL, T.K. 1986. Trend of area, production and productivity of cassava in India. Agricultural Situation in India 41(8):609-614. En., 4 Ref.

Cassava. Land use. Production. Productivity. Statistical data. Uses. India.

The change in trends and growth rates of area under cultivation, production, and productivity of cassava in India were studied. The effect of factors such as area and productivity and their interaction on the total crop production was also determined. Although there are differences from state to state, overall, Kerala has dominated in area and production of cassava. High growth rates of production in Tamil Nadu through increased productivity, and in Andhra Pradesh through area expansion, have been offset by a negative growth rate of production in Kerala. There appears to be little chance of the trend of cassava area and production improving in Kerala; however, the wide range of end uses of cassava in the starch and starch-based industries and the potentials of cassava as an alternative source in alcohol production and in animal feed formulations have, in recent years, generated an interest in this crop in some states where cassava is of little importance at present. If this interest is translated into actual production the present declining trend in cassava production can be expected to be reversed. (CIAT)

0542

32227 MAHUNGU, N.M.; KIALA, K. 1987. New priorities in cassava selection in Zaire (Abstract). In Terry, E.R.; Akoroda, M.O.; Arene, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis; proceedings. Ottawa, Canada, International Development Research Centre. p.119. En., [Programme National Manioc, Kinshasa, Zaire]

Cassava. Cassava programa. Research. Zaire.

Since 1974 and the creation of Programme National Manioc (PRONAM), cassava selection procedures have been reactivated in Zaire. The principal objectives of the program are the production of high yielding var. that are resistant to diseases and pests. At present, apart from these initial selection criteria, particular attention is being given to the quality of the roots in terms of HCN content, dry wt., and the organoleptic qualities of products consumed as vegetables. Photosynthetic effectiveness of leaves at low sun exposures, morphologies suitable for intercropping, and the speed of growth of the clone at a young age have also been considered selection criteria in the present program. The methodology used to evaluate these various criteria is discussed. (Full text)

0543

31682 OJOMO, O.A. 1987. The agricultural development projects (ADP) in Nigeria. In Holmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.171-177. En., Sum. En.

Cassava. Development. Technology transfer. Seed. Root productivity. Marketing. Nigeria.

The objectives, organization, management, implementation, achievements, and constraints of the Nigerian agricultural development projects are described; special reference is made to the Oyo North Agricultural Development Project. Improved cassava planting material is mentioned as 1 of the minikit components distributed to participating farmers. Yield improvements from 1983 to 1985 as a result of the project are shown for cassava and other crop components; for cassava, there was a 12 percent increase from 1983 to 1984. In spite of the cassava production

improvements, a major constraint has been the excess production for which there are no markets. (CIAT)

0544

32084 POOKERD, P. 1985. (An economic analysis of field crop production and crop substitution for cassava in Nakhon Ratchasima Province). M.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 103p. Thai., Sum. Thai., En., 20 Ref.

Cassava. Costs. Income. Prices. Land use. Labor. Thailand.

Using a linear programming model, the costs and returns of cassava and possible substitute crops for the Nakhon Ratchasima Province (Thailand) were studied. The area allocated to each substitute crop in order to maximize returns to farmers was also determined. The following factors were taken into account: 3,358,737 rai (6.25 rai = 1 ha) of field crop land; 32,412,480 man-days of household labor; max. 1,566,700 rai for cassava planting; min. 177,100 rai for red-hybrid sorghum planting; min. 3400 rai for mung bean planting; min. 187,500 rai for maize planting, and min. 7000 rai for kenaf planting. Price sensitivity of cassava, red hybrid sorghum, and mung bean was then analyzed. It was found that the area allocated to different field crops in Nakhon Ratchasima, computed from the basis model, is as follows: 1,566,700 rai of cassava, 3400 rai of mung bean, 177,100 rai of red-hybrid sorghum, 1,604,600 rai of maize, and 7000 rai of kenaf. The results also indicated that there was no labor problem in monthly field crop production. The price sensitivity analysis showed that when the price of cassava was reduced to 0.41 Baht/kg (40 percent reduction) maize would be grown as a substitute of cassava and, in case the price of red-hybrid sorghum increased to 3.29 Baht/kg (40 percent increase) or that of mung bean to 7.70 Baht/kg (10 percent increase), then farmers would grow the resp. crop at 1,417,100 rai. It was recommended that the government allow the price of cassava to be adjusted by the market mechanism. If the price of cassava decreased to 0.41 Baht/kg, farmers would no longer grow cassava but maize instead. Likewise, the government should recommend farmers to grow red-hybrid sorghum and mung bean when the price of both crops increased to 3.29 and 7.70 Baht/kg, resp. (AS (extract))

0545

30838 PORTO, M.C.M. 1986. Reflexos da política agrícola na cultura da mandioca no Brasil. (Considerations on Brazil's agricultural policy regarding cassava cultivation). Revista Brasileira de Mandioca 5(2):35-53. Pt., Sum. Pt., En., 4 Ref., Il. [EMBRAPA, Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 077, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cassava programs. Production. Statistical data. Consumption. Economics. Marketing. Maps. Brazil.

The importance of cassava as a food, forage, and industrial crop in Brazil is analyzed with respect to the low priority it has been given compared with other industrial, energy, and export crops. Data on cassava root production and acreage in Brazil during the past 40 yr were compared and yields were found to decrease, particularly after 1972. The factors land, credit, and market are considered; cassava has received less credit than other food crops, such as rice, beans, and maize, or industrial/export crops, such as sugarcane and soybean. The markets are also limited since cassava roots are mainly destined for the flour market, which is currently stable. Likewise, the per capita availability of roots is decreasing (89.73 kg/person/yr in 1978 to 76.7 kg/person/yr in 1982). (AS)

0546

30552 PUSADDEE, K. 1982. (The tapioca starch markets and utilization in Thailand). Mag.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 118p. Thai., Sum. En., Thai., 27 Ref., 11.

Cassava. Cassava starch. Consumption. Trade. Marketing. Industrialization. Uses. Statistical data. Food products. Economics. Prices. Thailand.

The cassava starch industry in Thailand was studied as well as its local demand and the trend of export markets. Long a labor-intensive cottage industry, it has now developed into a modern labor-saving industry along with new technology. Existing cassava starch processing can be classified into 2 categories: old and new techniques. In 1980, 125 cassava starch factories were recorded. Most cassava starch products are exported to Japan, USA, Taiwan, Singapore, and Hong Kong. Cassava starch is also used as a major or supplementary raw material in industries. Estimates in terms of percentage of the total domestic consumption were as follows: MSG industry, 22.12 percent; paper industry, 15.58 percent; textile industry, 9.37 percent; plywood industry, 0.99 percent; food industry, 27.34 percent; and others about 8.91 percent. The rest was used for direct human consumption. The total demand for cassava starch is assumed to be equal to the total production or equal to the sum of the total quantity exported and the total quantity consumed domestically. In 1980, export demand and domestic demand were about 59.62 and 40.38 percent, resp., of the total production. The total domestic demand can be divided into industrial demand (84.31 percent) and direct human consumption demand (15.69 percent). The results of the price elasticities indicate that the elasticity of export demand with respect to export price (f.o.b. Bangkok) is -0.390, the elasticity of domestic demand with respect to real wholesale price is -0.339, the elasticity of industrial demand with respect to wholesale price is -0.298, which are all inelastic. The elasticity of direct human consumption with respect to real wholesale price, however, is elastic and equal to -1.159. The future development of the cassava starch industry greatly depends on new export markets and enhanced domestic use. (4S)

0547

30564 RAHAJU, W.P. 1981. Diskual ubi jalar. (A discussion on cassava). Bulletin Penelitian dan Pengembangan Teknologi Pangan 3(1):9-70. In.

Cassava. Production. Indonesia.

0548

31691 SANABRIA P., H.E.; TRONCOSO S., M. 1982. Estado actual y perspectivas del cultivo de la yuca en los Municipios de Falan, Fresno y Mariquita (Tolima). (Present situation and prospects of cassava cultivation in the municipalities of Falan, Fresno, and Mariquita (Tolima)). Tesis Ing.Agr. Ibagué, Colombia, Universidad del Tolima. 95p. Es., Sum. Es., 11 Ref.

Cassava. On-farm research. Survey. Socioeconomic aspects. Farm size. Cultivation. Marketing. Incomes. Consumption. Prices. Costs. Distribution. Cultivars. Productivity. Labor. Statistical data. Colombia.

A technical, economic, and social study was conducted of the present situation of cassava cultivation in the municipalities of Fresno, Falan and Mariquita (Tolima, Colombia) in order to design a developmental program adjusted to the crops prospects in the region. In this coffee-growing zone, cassava plays an important role in agricultural diversification since conditions are optimum for its cultivation. Cassava is grown in the traditional fashion, without considering planting season, var., phytosanitary practices, nor fertilization. Although no agronomic

practices are conducted, cassava is 1st regarding income return; if agronomic practices were performed, this profitability would be much higher. A hindrance to reaching this objective is the lack of markets for the product; cooperatives, wholesale provision markets, or industries that purchase the production at prices that give the crop a certain stability are nonexistent. Most of the production is sold on-farm to middlemen, thus avoiding the transportation of cassava to market places, which is expensive and difficult due to the lack of good roads. Additionally, the selling of the production in marketplaces results in higher costs and therefore, profits are substantially reduced. Farmers need more guarantees and credit facilities. These zones are characterized for having very young populations, with an intermediate educational level. Most agricultural activities are small-scale. Data available on land distribution show a high percentage of farms of 20 ha and less; this implies a low net benefit/farm. The prevailing land tenancy system is that of owners, but tenants and settlers also exist. Almost none of these farmers belong to social organizations due to the deficient organization among themselves. (AS (extract)-CIAT)

0549

27638 SANINT, L.R.; RIVAS, L.; DUQUE, M.C.; SERE, C. 1984. Food consumption patterns in Colombia-A cross sectional analysis of the DANE DRI 1981 household survey. In Centro Internacional de Agricultura Tropical. Trends in CIAT Commodities. Cali, Colombia, Internal Document Economics 1.9. pp.31-63. En., 8 Ref.

Cassava. Consumption. Income. Economics. Human nutrition. Statistical data. Colombia.

Quantitative information on Colombian consumption of different foods (among them cassava) is presented by region, urban or rural sector, and income strata in terms of physical amounts, contribution to protein and calorie supply, and expenditure share. The study was based on a cross sectional survey of 9000 households undertaken by the Depto. Nacional de Planeación and the Depto. Administrativo Nacional de Estadística during the last trimester of 1981. Data are also included on the estimation of income, price and cross-price elasticities for various types of foods of particular relevance to CIAT research by income strata. (CIAT)

0550

25789 SEGUY, L.; BOUZINAC, S. 1980. Une démarche expérimentale d'élaboration de systèmes de production utilisables par les petits paysans (Région du Cacaïs au Maranhao, Brésil). (Experimental procedure to work out production systems for small farmers (Cacaïs region of Maranhao, Brazil)). Paris, France, Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières. 50p. F., Swa. Fr., Il.

Cassava. Cassava programs. On-farm research. Rotational crops. Rice. Technology transfer. Technology evaluation. Socioeconomic aspects. Mechanization. Land preparation. Economics. Cultivars. Herbicides. Root productivity. Brazil.

Research strategies were designed to provide in the short term alternative production systems for small farmers in Cacaïs (Maranhao, Brazil); cassava was included as a rotational crop and as an associated systematized crop. Both farmers and researchers participated in the design. Of the 2 production systems compared, the 1st was devoted to improve nonmechanized agriculture with a min. of investment in production media, and the 2nd, more advanced, involved little manual mechanization associated with mechanized land preparation. Each model includes a major component involving agroeconomical aspects of production (agroclimatic factors,

cropping schedules, production costs, net balance, and workday appraisal) and support satellites in which the problems detected in the central component are adjusted (var. breeding, fertilization, and crop protection). Among significant results obtained, the following alternatives are highlighted: nonmechanized cassava cultivation using traditional var. but no fertilizer or herbicide application; mechanized cassava cultivation; mechanized cassava cultivation with min. tillage, use of traditional var., no fertilization, and herbicide application; cassava in nonmechanized associated systematized cropping; with use of improved var. and fertilizers, and application of herbicides; and cassava in nonmechanized associated systematized cropping, with use of improved var., no fertilization, and herbicide application. The most profitable practice from the viewpoint of workday appraisal was found to be cassava in pure culture (nonmechanized or mechanized). Var. Betanca Barro was outstanding, with yields of 30 t/ha, without input. No response of cassava to N or P fertilization was observed in the 1st yr. Finally, preemergence application of flumeturon (5 kg/ha) gave effective weed control. (CIAT)

0551

31681 SHAG, F.M. 1987. The role of the small farming sector in food crops production in Tanzania. In Helmer, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.146-155. En., Sum. En., 18 Ref.

Cassava. Production. Productivity. Farming systems. Socioeconomic aspects. Statistical data. Cassava African mosaic virus. *Mononychellus tanajoa*. Tanzania.

The small farming sector of Tanzania, which accounts for 80 percent of the total food crops production on approx. 4 percent of the total land area, is described. Major production constraints are identified and future improvement strategies are recommended for the sector. Cassava is identified as 1 of the major food crops grown by the small farming sector. CAMD and *Mononychellus tanajoa* are specific biological factors limiting cassava production, in addition to others which apply to all crops such as unreliable and/or poor rainfall distribution, failure of farmers to adapt to changing environmental conditions and to adopt new technologies, low prices, lack of irrigation facilities, insufficient selection of suitable var., large postharvest losses, poor research-extension-farmer linkages, poor extension services, and poor supply of inputs. (CIAT)

0552

31549 TESTART, A. 1982. Les tubercules son-ils aux céréales comme la sauvagerie est à la civilisation? (Are tubers to cereals as savagery is to civilization?). *Journal d'Agriculture Traditionnelle et de Botanique Appliquée* 29(3-4):349-354. Fr., Sum. Fr., En., 4 Ref.

Cassava. Economics. Socioeconomic aspects. Cultivation. Storage. Development.

The reasons of social inequalities, classes, and the State, observed among cultivators of cereals and not among cultivators of tuber crops, were investigated, and a hypothesis raised in relation to hunters-gatherers was tested. This hypothesis asserted that intensive food storage is one of the main bases for the development of social inequalities. (CIAT)

0553

31655 TORO M., J.C. 1978. Suggested guidelines for conducting regional trials. In Domínguez, C., comp. Intensive Training Course on Research for Cassava Production, Cali, Colombia, 1978. Papers presented. Cali, Colombia,

Centro Internacional de Agricultura Tropical. v.1, pp.389-407. En., 4 Ref. También en Español.

Cassava. On-farm research. Field experiments. Technology evaluation. Planting. Harvesting. Timing. Seed. Spacing. Land preparation. Weeding. Insect control. Diseases and pathogens. Injurious insects. Injurious mites. Dry matter. Starch content. Cultivars. Selection. Colombia.

A complete set of guidelines is provided for conducting cassava regional trials. In addition to general guidelines on site selection, exptl. design, planting and harvesting time, and others, specific recommendations are given on technology to be used for the different agronomic practices required, data collection, disease and insect damage evaluations, trial methodology, and strategies for selecting promising var. (CIAT) See also 0398 0446 0447 0476 0480 0481 0523 0525 0526 0566 0575 0578

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0554

31656 CAETANO, L.F.; SILVEIRA, A.J. DA; VIEIRA, C.; CARDOSO, A.A.; TELES, F.F.F. 1984. Comportamento de cultivares de mandioca e de feijao em plantio consorciado. (Performance of cassava and bean cultivars in associated cropping). Revista Ceres 31(174):120-135. Pt., Sum. Pt., En., 15 Ref., 11. [Central de Experimentacao e Pesquisas de Linhares, 29.00 Linhares-ES, Brasil]

Cassava. Intercropping. Beans. Planting. Spacing. Root productivity. Plant height. Stems. Foliage. Roots. Dry matter. Plant development. Harvest index. Cultivars. Brazil.

A cassava/bean associated cropping trial was carried out in Coimbra (Minas Gerais, Brazil) using a (3 x 2 x 2) + 2 factorial: 1, 2, and 3 rows of beans planted between the cassava rows; 2 bean cv. (Negrito 897 and Preto Sessenta Dias 53) and 2 cassava cv. (Branca de Santa Catarina and Iracema) were used in addition to 2 treatments (cassava cv. in sole cropping). Bean cv. were also planted as sole crops, but in separated plots. Cassava was spaced at 1.40 m between rows and 0.40 between plants within the rows. Bean planting density was 15 seeds/m. Bean cv. Preto Sessenta Dias 53 was harvested 65 days after planting, while cv. Negrito 897 was harvested at 90 days and cassava at 9 mo. The reduction of cassava root production, caused by bean cv., averaged 25.1, 39.6, and 48.2 percent with 1, 2, and 3 bean rows, resp. Bean yield increased from 17.3 to 37.9 percent with increasing no. of rows, resp. Cv. Preto Sessenta Dias 53 yielded less and competed less with cassava, possibly due to its early maturity and low plant height. Cassava/beans associated cropping was efficient, giving LERs above unity. (AS)

0555

30840 CERETTA, C.A.; SILVA, P.R.F. DA 1986. Sistemas de cultivo de mandioca. 2. Consorciada com girassol. (Cassava cropping systems. 2. Intercropping with sunflower). Revista Brasileira de Mandioca 5(2):65-81. Pt., Sum. Pt., En., 38 Ref., 11. [EMPASC-CPPP, Caixa Postal 151, 89.800 Chapec6-SC, Brasil]

Cassava. Intercropping. Sunflower. Monocropping. Spacing. Root productivity. Foliage. Harvest index. Land use. Plant height. Timing. Brazil.

To evaluate the efficiency of different cassava-sunflower intercropping systems, a field expt. was conducted during the 1984/85 crop year in Guafiba (Rio Grande do Sul, Brazil). The systems were: sunflower sole cropping (0.7 x 0.285 m) (a); cassava sole cropping, spaced at 1.2 x 0.6 m (b); 2.0 x 0.6 x 0.6 m (c), and 2.8 x 0.6 x 0.6 m (d); cassava/sunflower intercropping with 1 (e), 2 (f), and 3 (g) rows of sunflower planted between cassava rows sown at the same spacings of system (b), (c), and (d), resp. The decrease in sunflower grain yield in the intercropping system varied from 25 to 38 percent in relation to sunflower sole cropping due to cassava competition, reduced density, and different plant arrangements. On av., cassava root and aerial part yields in the cassava/sunflower intercropping system decreased 49 and 40 percent, resp., in relation to cassava sole cropping, due to sunflower competition. The LER were 1.28, 1.16, and 1.19 for the cassava/sunflower intercropping systems (e), (f), and (g), resp. Results indicate that sunflower was the dominant crop in the intercropping system. (AS)

0556

32220 EYUHAN, H.C.; IFEORIGU, J.E.G. 1987. Effect of cassava introduction time into maize on intercrop yields (Abstract). In Terry, E.R.; Akoroda, M.O.; Arere, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre, p.34. En. [International Inst. of Tropical Agriculture, P.M.B. 5320, Oyo Road, Ibadan, Nigeria]

Cassava. Intercropping. Maize. Planting. Timing. Nigeria. Zaire.

The time of planting for cassava is flexible; however, maize must be planted within a narrow time span to maximize biological yield. In a cassava/maize intercrop, cassava establishment through maize may be limited by shading and an early cessation of rain. To determine the flexibility of cassava planting time, cassava was introduced through maize in 2 environments in Nigeria and Zaire. More efficient land use was attained with cassava/maize intercropping regardless of the time of cassava introduction. Early introduction (planting on the same day to 5-8 wk. delay) resulted in no cassava yield reduction. The limits to cassava introduction time appear to be related to the duration of rainfall. Maize yield was not affected by the cassava var. or the date of cassava introduction. (Full text)

0557

31685 FISHER, H.M. 1987. On-farm research with complex mixed and multiple cropping patterns. In Holmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.233-239. En., Sum. En., 6 Ref., 11.

Cassava. On-farm research. Cultivation systems. Relay cropping. Maize. Spacing. Africa. Nigeria.

Four techniques are described which have been found useful for on-farm research with the complex cropping patterns of West Africa. Ideas are offered on how to identify, describe, analyze, and improve cropping patterns. Example diagrams of cropping patterns including cassava are given on how to illustrate crop relationships in time and space. An example of a step-wise design of an on-farm trial using fertilization and improved var. in the maize/cassava relay cropping pattern is presented. (CIAT)

0558

32219 IKEORGU, J.E.G.; ODURUKWE, S.O. 1987. Increasing the productivity of cassava-maize intercroops with groundnuts (*Apios hypogea*) (Abstract). In Terry, E.R.; Akoroda, M.O.; Arone, O.B., eds. Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, 3d, Owerri, Nigeria, 1986. Tropical root crops; root crops and the African food crisis: proceedings. Ottawa, Canada, International Development Research Centre. p.34. En. [National Root Crops Research Inst., Umudike, P.M.B. 7006, Umuhia, Nigeria]

Cassava. Intercropping. Maize. Groundnut. Planting. Spacing. Nigeria.

Studies were initiated in 1983 to investigate the effects of intercropping cassava, maize, and groundnuts in a low fertility soil on the yield of the component species, the gross economic returns, and the total productivity of the land. Where the groundnut population did not exceed 100,000 plants/ha, cassava/maize and cassava/groundnut intercroops yielded as much cassava root as did cassava alone. Cassava root yield decreased by 20 percent in a cassava/maize/groundnut intercrop where the groundnut population was equal to or greater than 100,000 plants/ha. The low maize yields in mixed cropping systems were attributed to the 50 percent of sole crop population used. The yield of maize grain/plant did not differ between cropping systems. Groundnut populations of 50,000 and 200,000 plants/ha caused significantly low pod yields of 67 and 78 percent, resp., when intercropped with cassava/maize. The corresponding reduction in groundnut yield at 100,000 plants/ha was only 10 percent. This study indicated that a cassava/maize/groundnut intercrop is more productive than cassava/maize or cassava/groundnut intercroops, provided the groundnut population is less than 100,000 plants/ha. (Full text)

0559

32065 INTERNATIONAL RICE RESEARCH INSTITUTE. 1985. Cropping systems. In International Rice Research Institute. International Upland Rice in Indonesia, 1985. Monitoring tour. Report. Manila, Philippines, pp.19-20. En., 11.

Cassava. Intercropping. Groundnut. Cowpea. Rice. Sumatra.

A new cropping pattern recently introduced in the poor, acid soils and wet climate of Lampung, Sumatra, is described. First maize is planted in Oct. (beginning of the wet season) and 2 wk. later upland rice; cassava is then planted 1 mo. later (Nov.) between maize plants in every other row of maize (400 x 50 cm spacing). After rice is harvested, peanuts are planted, and after peanuts, cowpea or ricebean. The introduced cropping pattern is illustrated in a rainfall x mo. histogram and has given high, stable yields and increased 3 times farmer profits. (CIAT)

0560

32082 KLINTONG, S. 1985. (Nutrient content of *Eucalyptus camaldulensis* Dehnh. and agricultural crops planted in agroforestry system). M.Sc. Thesis. Bangkok, Thailand, Kasetsart University. 91p. Thai., Sum. Thai., En. 53 Ref.

Cassava. Intercropping. Eucalyptus. Forestry. Canopy. Leaves. Roots. Mineral content. P. N. Ca. Mg. K. Biomass production. Nutrient J s. Thailand.

Twenty-four sample agroforestry plots (20 x 20 square meters in size) were temporarily set up in Srisakael Province (Thailand) using treatments with 4

replications. *Eucalyptus camaldulensis* was the primary crop and 6 crops (upland rice, maize, mung bean, groundnut, kenaf, cassava) as treatments. Soil analysis indicated that the soils were acidic and infertile (0.93-1.58 percent OM, 0.3-0.8 percent N, 0.3-48.0 ppm P, and 4-24 ppm K). Soil Ca and Mg levels tended to be relatively high. In general, surface soil (0-15 cm) was more fertile than the subsoil (15-30 cm). Except for P, nutrient concn. were found highly significant for both different parts of the same crop and different crops of each plant component. Higher nutrient concn. were observed in aerial parts compared with the resp. root systems. For cassava, leaf concn. were higher than stem concn., which in turn were higher than root concn. N concn. was higher than Ca which was higher than Mg and K; P concn. was the lowest. Of the intercrops, mung bean contained the max. percentages of these 5 elements (21.37), followed by groundnut, kenaf, maize, cassava, and upland rice (19.84, 12.02, 11.42, 11.21, and 7.90, resp.). Max. total biomass was recorded for cassava (1407 kg/rai), followed by upland rice, mung bean, maize, groundnut, and kenaf (606, 600, 475, 334, and 172 kg/rai, resp.). Nutrient losses due to harvesting of cash crops, estimated from their biomass and nutrient concn., showed that the amounts of these 5 elements lost were 11.83, 10.75, 9.54, 5.89, 3.16, and 1.15 kg/rai for cassava, groundnut, mung bean, upland rice, maize, and kenaf, resp. Cash crops recommended on the basis of benefit:cost ratio were upland rice, followed by mung bean, groundnut, cassava, maize, and kenaf. (AS (extract))

0561

32207 LEJHNER, D.E. 1988. Proyecto de siembra de yuca en franjas en Benin, Africa Occidental. (Strip cassava planting, project in Benin, West Africa). Yuca Boletín Informativo 12(1):12-13. Es., Il.

Cassava. Cultivation systems. Benin.

A project to plant cassava in alternate strips with *Leucaena leucocephala* or *Cajanus cajan* in Benin is briefly described. The project aims at developing crop management practices that provide mulch for the crop, preserve soil moisture, reduce water stress, provide nutrients, and control weeds. (CIAT)

0562

30835 MATTOS, P.L.P. PE; SOUZA, A. DA S.; CALDAS, R.C. 1986. Cultivo consorciado de mandioca com cowpea. (Cassava intercropped with cowpea). Revista Brasileira de Mandioca 5(2):7-11. Pt., Sum. Pt., En., 5 Ref. [EMBRAPA-Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380, Cruz das Almas-BA, Brasil]

Cassava. Intercropping. Cowpea. Spacing. Root productivity. Starch productivity. Brazil.

To increase farmer incomes, new spatial arrangements of cassava (cv. BCM 116) intercropped with cowpea (cv. Pituiaba) were tested during 1982-83 at Estacao Exptl. de Fruticultura Tropical in Conceicao de Almeida (Bahia, Brazil). A randomized block design was used and treatments consisted of cassava planted in double rows spaced at 2.0, 2.5, and 3.0 m, intercropped with 4, 5, and 6 rows of cowpea, resp. Cassava planted in double rows and intercropped with 2 cowpea crops in subsequent years had higher yields than when intercropped in single rows (1.0 x 0.6 m). The best spatial arrangements for cassava root yield were 2.0 x 0.5 x 0.5 m and 2.0 x 0.7 x 0.7 m with 4 rows of cowpea. Best results for cowpea were obtained in pure crops and when intercropped with cassava spaced at 2.0 x 0.6 x 0.6 m, 2.0 x 0.5 x 0.5 m, and 2.0 x 0.7 x 0.7 m with 4 rows between the double rows. (AS)

0563

30438 MBA, C.A. 1985. Inter cropping cassava (*Manihot esculenta* Crantz) and cowpea (*Vigna unguiculata* (L.) Walp.) at different planting patterns in South-Western Nigeria. Dr.Sc.Agr. Thesis. Berlin, West Germany. Institute of Crop Science. Technical University Berlin. 132p. En., Sum. En., De., 77 Ref., 11.

Cassava. Inter cropping. Cowpea. Planting. Spacing. Growth. Plant height. Root productivity. Leaf area. Roots. Dry matter. Nigeria.

Three field expt. on cassava-cowpea in inter cropping were carried out at the International Institute of Tropical Agriculture in Ibadan, Nigeria, from Dec. 1981 to Nov. 1983 during the dry, major, and minor rainy seasons. Branching cassava var. TME 30572 was intercropped either with the determinate cowpea var. TVx 3236 or with the indeterminate cowpea var. TVx 948-01F at different planting patterns: within row, alternate rows, and alternate double rows. Sole crops of cassava and cowpea at 10,000 and 50,000 plants/ha, resp., were planted as control. Cowpea var. complete their life cycle in about 3 mo. while the cassava var. generally becomes due for harvest as from 12 mo. after planting. The effect of the different planting patterns on the component crops and the extent the inter crop cassava overcame the adverse cowpea competition of the early growth phase were determined. During the intercropping period, sequential harvesting and observation dates were chosen using the cowpea growth stages as criteria. After the cowpea harvest, sampling dates were set at 3-mo. intervals. In addition to the field trials, a container expt. was set up in which cowpea plants were removed at 25, 35, 45, 60, 80, and 90 days after planting. The expt. was harvested at 90 days. Results indicated that growth and yield were influenced by weather conditions, especially the water regime. Apparently, high rainfall was more conducive for the vigorous cowpea growth and that consequently caused more suppression of cassava. The reduction of cassava total DM yield was related to the close planting distances. Under optimum water regime, competition for the aboveground growth resources, presumably light, was more pronounced. But, under limited water supply, the competition for water was prominent; cowpea used its deep and extensive root system to explore effectively the available soil moisture to the detriment of cassava. After cowpea harvest, the ability of cassava to overcome the early growth competition depended on the extent of the growth suppression it suffered earlier. In addition, it appeared that plant growth vigor in alternate double row intercropping determined whether the root systems of both crops interacted effectively or not. This, in turn, determined whether intercropping was beneficial or not. These reflected on cassava fresh storage root yields at final harvest. None of the methods of yield assessment seemed to have satisfactorily indicated yield advantage of the intercropping. A combination of relevant models is, therefore, essential for the conclusive yield advantage to be identified. (AS (extract))

0564

31657 MENDOZA, T.C. 1986. Light interception and total biomass productivity in sugarcane intercropping. Philippine Journal of Crop Science 11(3):181-187. En., Sum. En., 16 Ref., 11. [Dept. of Agronomy, College of Agriculture, Univ. of the Philippines, Los Baños, College, Laguna, Philippines]

Cassava. Inter cropping. Sugarcane. Fertilization. N. P. K. Light. Spacing. Productivity. Philippines.

In this study involving sugarcane intercropped with soybean, mung bean, peanut, maize, sweet potato, and cassava, the observation that

intercropping leads to significantly higher total productivity was found to be true only under the two following conditions. Firstly, computed on a per month basis, the DM productivity was only higher during the full growth duration of the intercrop. This was attributed to the slow growth feature of sugarcane within the 1st 2-3 mo. The early built-up of LAI due to the faster growth of intercrops shortened considerably the time for the crop canopies to intercept incoming radiation. Secondly, even in compatible intercrop combinations, greater biomass productivity was only true under low to av. fertilizer and cultivation input application for sugarcane but not in the medium high to high level of input application. (AS)

0565

31673 MUÑOZ A., F. 1987. Influencia del número de tallos y de la distancia de siembra entre plantas de yuca, sobre el rendimiento en asocio con maíz. (Influence of stem number and planting distance of cassava on yields in associated cropping with maize). Tesis Ing.Agr. Palmira, Colombia, Universidad Nacional de Colombia. 143p. Fa., Sum. Es., En., 43 Ref., 11.

Cassava. Intercropping. Maize. Monocropping. Stems. Planting. Spacing. Root productivity. Leaf area. Plant height. Harvest index. Colombia.

The effect of the no. of cassava stems on yields when grown in association with maize, in different spatial arrangements, was studied at CIAT-Palmira. Cassava var. CMC-40 and maize hybrid B-211 were used. Three exptl. factors were studied: cassava planting distance (0.8, 1.0, and 1.2 m); cropping system (sole cropping and in association); and no. of cassava stems (free growth, 2 and 1). A split-plot design with 4 replicates was used, and leaf area and plant height were measured monthly for both maize and cassava; crop yields were estimated at harvest. The reduction in the no. of cassava stems reduced cassava yields, although not significantly. Planting distance affected cassava yields differently in both cropping systems: in monocropped cassava highest yields were obtained at the closest planting distance (0.8 m), whereas in association with maize highest cassava yields were obtained at the intermediate distance (1.0 m), probably due to the different leaf area development patterns in each system. Cassava plants in association had greater leaf area development than monocropped plants, and therefore the competition between plants was greater and greater interplant distances were required for increased yields. Root rot was significantly reduced in those treatments in which the no. of stems was reduced to 1. Maize leaf area, plant height, and yield were not significantly affected by the competitor due to cassava when both species were intercropped. The LER/LER values of associated cropping systems were always above 1. (AS (extract)-CIAT)

0566

31686 NANGOTI, N.J.K. 1987. Objectives and achievements of on-farm demonstrations and trials of improved production technology of field crops in Eastern and Northern Uganda. In Hclmes, J.C., ed. Improving food crop production on small farms in Africa. Rome, Food and Agriculture Organization of the United Nations. pp.282-288. En., Sum. En., 6 Ref.

Cassava. On-farm research. Technology evaluation. Intercropping. Cowpea. Groundnut. Planting. Uganda.

The objectives of the Adaptive Research Program in Eastern and Northern Uganda are presented, as well as results of the 1986 trials conducted at different sites. In the cassava/cowpea-groundnut intercropping trial in Oburin, Akoboi, and Kamod, broadcast planting of the grain legume (traditional method) was compared with row planting (improved method).

While cassava yield results are pending, row planting of grain legumes more than doubled the yield of the broadcast-sown plots. Measurements of cassava plant height indicated, however, that row planting with cowpeas in particular reduced cassava growth more than broadcast sowing. The results so far indicate that row sowing will be more profitable than broadcast sowing. The on-farm trial program for 1987 is briefly described in which a cassava plant population density trial will be conducted. (CIAT)

0567

31644 NUREÑA S., M. 1980. Evaluación de sistemas de cultivos múltiples e intercalados en maíz, arroz, soya y yuca en Tingo María. (Evaluation of multiple cropping and intercropping systems with maize, rice, soybeans, and cassava in Tingo Maria). Avances en Investigación no.4:1-19. Es., 3 Ref.

Cassava. Intercropping. Maize. Rice. Beans. Monocropping. Planting. Root productivity. Harvesting. Timing. Peru.

The effects of the associated cropping systems used by farmers of the Tingo Maria region (Peru) on the yields of the component crops (among them cassava) in expt. planted in July 1977 at the Tulumayo Exptl. Station were studied. Seven cropping system treatments were investigated, 3 of which included cassava var. La Negra; maize/rice/cassava/beans and maize/beans/cassava/rice in association, and monocropped cassava. Three different monocropped cassava planting systems were also studied, namely, on the flat, on ridges and in mounds. No significant differences in fresh root yields were observed between the traditional planting system on the flat (28.6 t/ha) and planting on ridges or in mounds (31.3 and 35.3 t/ha, resp.). No statistically significant differences were found between root yields of the 3 cropping systems: maize/beans/cassava/rice yielded 31.55 t/ha followed by monocropped cassava with 28.83 t/ha and maize/rice/cassava/beans with 21.45 t/ha. Of the 7 systems, these 3 were the most productive and efficient; however, planting 1 of either association would allow farmers to obtain other crops for consumption and additional income before harvesting cassava (9 mo. growth cycle). (CIAT)

0568

30815 SAJISE JUNIOR, G.E. 1983. Effect of intercropping and tillage practices on crop productivity and soil conservation. M.Sc. Thesis. College, Laguna, University of the Philippines at Los Baños. 124p. En., Sum. En., 85 Ref., 11.

Cassava. Intercropping. Mung bean. Land preparation. Soil physical properties. Soil impoverishment. Erosion. pH. Food energy. Cultivation systems. Productivity. Soil water. Soil conservation. Costs. Income. Economics. Philippines.

The effect of the cropping pattern (monoculture and intercropping with mung beans) and tillage practice (conventional and furrow tillage) on cassava, sugarcane, and maize productivity, surface runoff, and soil and nutrient losses was investigated at La Granja Exptl. Station in La Carlota City (Negros Occidental, Philippines) between July 1981-May 1982. Cassava was found to be the crop most tolerant to acid soils, significantly outyielding the others in calorie production (58.78 M/ha) when monocropped, and together with maize, also significantly reduced soil, water and nutrient losses. While monoculture resulted in significantly higher calorie yields, intercropping was found to give higher LER values and lower soil, water, and nutrient losses; the lowest values were for cassava-furrow tillage, cassava intercrop, furrow-intercrop, and cassava intercrop-furrow tillage. Vol. and percent runoff were found to be significantly low in cassava-conventional tillage and maize intercrop. The highest net return/ha was for the cassava intercrop-furrow tillage combination. (A3)

0569

31677 SATJANATA, S.; PARTOHARDJONO, S. 1985. Increasing the production of food crops in the upland areas in Indonesia. Indonesian Agricultural Research and Development Journal 7(3-4):49-53. En., 6 Ref., 11. [Bogor Research Institute for Food Crops, Ministry of Agriculture, Bogor, Indonesia]

Cassava. Intercropping. Maize. Rice. Groundnut. Soybean. Technology transfer. Technology evaluation. Planting. Spacing. Fertilizers. Productivity. Indonesia.

The process of technology transfer is discussed. Problems and objectives of field trials and the formulation of a technological package involving an intercrop pattern of maize + upland rice or cassava followed by groundnut and cowpea are discussed. General recommendations are given for different cropping patterns in terms of crop combinations, spacing, no. of seeds/hill, and fertilization rates. Demonstration plots (0.1 ha) and farms (3-5 ha) are described. Cropping patterns formulated and av. yields obtained before and after the introduction of an intensification program in Java are examined; percentage increase for cassava in the upland rice + maize + cassava cropping system followed by soybean or groundnut was 67.8. The formation of a farmers group in North Sumatra is mentioned; area cultivated and food production have increased. (CIAT)

0570

30845 SCHIOCCHET, M.A. 1986. Mandioca consorciada com milho, feijão ou arroz de sequeiro no Oeste Catarinense. (Cassava intercropped with maize, beans, and upland rice in western Santa Catarina). Revista Brasileira de Mandioca 5(2):113-114. Pt., 1 Ref. [Empresa Catarinense de Pesquisa Agropecuária, S.A., Caixa Postal D 75, 89.800 Chapecó-SC, Brasil]

Cassava. Intercropping. Maize. Beans. Rice. Cultivation systems. Root productivity. Spacing. Brazil.

The effect on yields of intercropping cassava in single (0.60 x 1.20 m) or double (0.60 x 0.60 x 0.80 m) rows with maize in double or single rows or beans or upland rice in triple, double, or single rows, was evaluated in Chapecó (Santa Catarina, Brazil) in 1984-85. Single rows of intercrops were always planted within single cassava rows, while multiple rows were planted within double cassava rows. No rice yields were obtained due to water deficiencies during the expt. Cassava yield reductions varied depending on the intercrop and plant density; the higher the density of the intercrop, the higher the competition for cassava and the lower the yields of the intercrop. The most competitive intercrop was maize: from 27,134 kg roots/ha obtained from cassava monocrops in double rows, intercropped maize in double and single rows reduced cassava yields to 13,700 and 14,275 kg/ha, resp. The best intercropping systems with cassava in terms of LER were with beans (1.28, 1.26, and 1.33 for cassava with beans in single rows and cassava with beans in double and triple rows, resp.; cassava yields were 21,980, 18,261, and 16,208 kg/ha, resp.). Monocropped cassava yields in single rows (28,708 kg/ha) were similar to those of monocropped cassava in double rows. (CIAT)

0571

29522 ZAËRA, A.N.; POMIER, M.; TAFFIN, G. DE 1986. Premiers résultats d'une expérience d'association cocotiers-cultures vivrières en Moyenne Côte d'Ivoire. (Initial results of an intercropping experiment of coconut with food crops in central Ivory Coast). Oléagineux 41(8-9):381-387. Fr., Sum. Fr., En., Es., 3 Ref., 11.

Cassava. Intercropping. Rotational crops. Coconut. Income. Ivory Coast.

A multisite coconut/food crop intercropping expt. was set up in 1982, in collaboration with 4 planters in Ivory Coast. Results indicate that in spite of a few practical problems, intercropping for 2 yr can favor coconut growth and development when food crops are correctly maintained and young coconuts protected from rodent attack. Recommended crops for intercropping are yam, cassava, sweet potato, groundnut, and maize. In the 2nd yr, Pueraria javanica is sown as a catch crop under maize which terminates intercropping. Well managed, intercropping will be financially rewarding for the farmer. Special extension efforts are, however, necessary at the farmer level. Aftereffects of food crops on nut production will be observed. (AS) See also 0399 0423 0442 0459 0533 0534 0539 0542 0545 0559

ABBREVIATIONS AND ACRONYMS

A	Angstrom(s)	DM	Dry matter
ABA	Abscisic acid	DNA	Deoxyribonucleic acid
ac	Acre(s)	EC	Emulsifiable concentrate
Af.	Afrikaans	EDTA	Ethylenediaminetetraacetic acid
a.i.	Active ingredient	EEC	European Economic Community
alt.	Altitude	e.g.	For example
AMV	Alfalfa mosaic virus	ELISA	Enzyme-linked immunosorbent assays
approx.	Approximate(ly)	EMS	Ethyl methane sulfonate
Ar.	Arab	En.	English
atm.	Atmosphere	EP	Preliminary Trials, CIAT
ATP	Adenosine 5'-triphosphate	Es.	Spanish
av.	Average	expt.	Experiment(s)
BAF	6-Benzylaminopurine	exptl.	Experimental
BBMV	Broad bean mosaic virus	Fr.	French
BCMV	Bean common mosaic virus	ft-ca	Foot candles (10.76 lux)
Bg.	Bulgarian	FYM	Farmyard manure
BGMV	Bean golden mosaic virus	g	Gram(s)
BGYMV	Bean golden yellow mosaic virus	G	Giga (10 ⁹)
BOD	Biochemical oxygen demand	GA	Gibberellic acid
BBMV	Bean pod mottle virus	gal	Gallon(s)
BRMV	Bean rugose mosaic virus	GE	Gross energy
BSMV	Bean southern mosaic virus	GERs	Glucose entry rates
BV	Biological value	GLC	Gas-liquid chromatography
BYMV	Bean yellow mosaic virus	Gr.	Greek
ca.	About (circa)	h	Hour(s)
CAMD	Cassava African mosaic disease	ha	Hectare(s)
CMV	Cassava African mosaic virus	HCM	Hydrocyanic acid
CBB	Cassava bacterial blight	HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
CBSD	Cassava brown streak disease	He.	Hebrew
CEC	Cation exchange capacity	Hi.	Hindi
CER	CO ₂ exchange rate	HI	Harvest index
CF	Cassava flour	hp	Horsepower
CGR	Crop growth rate	Hu.	Hungarian
Ch.	Chinese	IAA	Indoleacetic acid
CLM	Cassava leaf mottle	IBA	Indolebutyric acid
CLV	Cassava latent virus	IBYAN	International Bean Yield and Adaptation Nursery, CIAT
CM	Cassava meal	il.	Illustrations
cm	Centimeter(s)	in.	Inches
COD	Chemical oxygen demand	In.	Indonesian
concn.	Concentration	It.	Italian
CP	Crude protein	IU	International unit
Cs.	Czech	J	Joule
CSL	Calcium stearyl lactylate	Ja.	Japanese
CSW	Cassava starch wastes	kat	Katal (amount of enzymatic activity that converts 1 mole of substrate/s)
C.V.	Coefficient of variation	kcal	Kilocalorie(s)
cv.	Cultivar(s)	kg	Kilogram(s)
2,4-D	2,4-dichlorophenoxyacetic acid		
Da.	Danish		

De.	German	kJ	Kilojoule
km	Kilometer(s)	pp.	Pages
KNap	Potassium naphthenate	pphm	Parts per hundred million
Ko.	Korean	PPI	Preplanting incorporation
kR	Kiloroentgen(s)	ppm	Parts per million
La.	Latin	PSA	Potato sucrose agar
LAD	Leaf area duration	Pt.	Portuguese
LAI	Leaf area index	pv.	Pathovar
lat.	Latitude	Ref.	Reference
lb	Pound(s)	resp.	Respective(ly)
LD50	Mean lethal dose	Rf	Retardation factor-
LER	Land efficiency ratio		chromatography
LPC	Leaf protein concentrate	RGR	Relative growth rate
lx	Lux	RH	Relative humidity
M	Mega	RNA	Ribonucleic acid
m	Meter(s)	Ro.	Romanian
Mal.	Malay	rpm	Revolutions per minute
max.	Maximum	Ru.	Russian
MC	Moisture content	s	Second
ME	Metabolizable energy	SBM	Soybean meal
meq	Milliequivalent(s)	SCN	Thiocyanate
met.	Methionine	SCP	Single cell protein
mg	Milligram(s)	SDS	Sodium dodecyl sulfate
mho	Reciprocal ohm	Sk.	Slovak
min.	Minimum	Sn.	Slovene
min	Minute(s)	sp.	Species
ml	Milliliter(s)	spp.	Species
mm	Millimeter(s)	SSL	Sodium stearyl-2-lactylate
mo.	Month	Sum.	Summary
mol. wt.	Molecular weight	Sv.	Swedish
m.p.	Melting point	t	Ton(s)
NAA	Alpha-naphthalene acetic acid	TDN	Total digestible nutrients
NAD	Nicotinamide adenine dinucleotide	temp.	Temperature
NADH	Nicotinamide adenine dinucleotide, reduced form	TIA	Trypsin inhibitor activity
NAS	Net assimilation rate	TIBA	2,3,5-Triiodobenzoic acid compound with N-methylmethanamine
NCE	Net CO ₂ exchange	TLC	Thin-layer chromatography
NE	Northeast	TMV	Tobacco mosaic virus
NER	Net energy ratio	Tr.	Turkish
Nl.	Dutch	TSH	Thyroid-stimulating hormone
nm	Nanometer(s) (10 ⁻⁹ m)	UDPG	Uridine diphosphate glucose
no.	Number(s)	Uk.	Ukrainian
No.	Norwegian	UMS	Unmodified cassava starch
NPFs	Negative production factors	Ur.	Urdu
NPR	Net protein ratio	UV	Ultraviolet
NFU	Net protein utilization	var.	Variety(ies), varietal
NW	Northwest	VEF	Bean Team Nursery, CIAT
OM	Organic matter	VFA	Volatile fatty acids
oz	Ounce(s)	vol.	Volume
p.	Page	VPD	Vapor pressure deficit
P	Probability	vpm	Volume per million
Pa	Pascal(s)	vs.	Versus
PAN	Peroxyacetic nitrate	W	West, watt
PCNB	Pentachloronitrobenzene	wk.	Week
PDA	Potato dextrose agar	WP	Wettable powder
PER	Protein efficiency ratio	wt.	Weight
pH	Hydrogen ion concentration	yr	Year(s)
Pl.	Poish	/	Per

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0223 0224 0225 0226 0227 0228 0263

0271 0381 0390 0394 0396 0399 0423

0427 0442 0459 0524 0525 0530 0533

0554 0555 0556 0558 0559 0560 0562

0563 0564 0565 0566 0567 0568 0569

0570 0571

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0040 0279 0389 0393 0395 0524 0550

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0066 0113 0265 0270 0273 0279 0412

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0214 0239 0241 0268

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0032 0035 0036 0080 0214 0241 0287

0439 0466

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0043 0201 0288 0452

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0140 0143

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0019 0134 0142 0143 0146 0251 0419

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0072 0101 0347

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0030 0048 0049 0174 0278
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0050 0052 0184 0281 0348 0350 0351
0366 0444

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0034 0093 0279 0281
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0037 0054 0055 0056
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0060 0071 0282

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0146 0487 0492 0503

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0069 0085 0451

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0001 0006 0017 0018 0025 0038 0042
0103 0132 0140 0146 0157 0158 0160
0164 0165 0168 0172 0173 0176 0178
0185 0186 0187 0188 0189 0192 0193
0194 0195 0198 0199 0201 0207 0208
0209 0211 0212 0213 0214 0215 0216
0217 0218 0219 0220 0227 0318 0320
0359 0360 0362 0364 0373 0376 0381
0385 0388 0390 0474 0476 0503 0504
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0543 0545 0546 0550 0552

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0122 0123 0124 0125 0126 0128 0129
0131 0133 0136 0137 0138 0139 0328
0329 0333 0336 0337 0339 0341 0393
0479 0480 0485 0486 0488 0489 0490
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0239 0244 0245 0276 0406
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0013 0239 0241 0243 0255 0257 0260
0265 0402 0435 0436 0438

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0151 0157 0158 0169 0181 0188 0191
0334 0356 0361 0363 0367 0445 0477
0488 0491 0503 0504 0505 0507 0509
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0159 0392

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0326 0327

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0051 0124 0177 0178 0343 0347 0352
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0141 0151 0157 0158 0159 0191 0503
0505 0507 0517
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0151 0173
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0337 0483 0489
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0134 0476
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0106 0128 0130 0333 0488

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0001 0011 0021 0041 0042 0060 0073
0074 0084 0097 0106 0108 0213 0230
0398 0537
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0082 0167 0197

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0113 0128 0336 0340 0483 0491
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0121 0129 0337
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0411 0413 0414 0475

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0084 0120 0291 0292 0295 0299 0305
0306 0361 0394 0455 0456 0458 0460
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0088 0201

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0213 0423 0568

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0488
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0021 0039 0051 0057 0095 0112 0113
0114 0117 0119 0120 0122 0124 0125
0126 0127 0128 0130 0131 0132 0133
0135 0136 0139 0141 0163 0164 0173
0178 0180 0193 0230 0249 0267 0323
0329 0330 0331 0332 0333 0335 0336
0337 0338 0339 0340 0341 0342 0343
0353 0370 0375 0376 0377 0392 0393
0440 0446 0484 0485 0486 0487 0488
0489 0491 0506 0512 0521

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0142 0144 0148 0152 0162 0166 0170
0183 0349 0357 0363 0365 0370 0371
0372 0373 0513 0515 0518 0520
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0173 0353 0375 0377

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0019 0135 0144 0147 0149 0150 0152
0155 0156 0162 0183 0185 0349 0353
0354 0355 0357 0365 0369 0370 0371
0373 0374 0477 0493 0515

FIELD EXPERIMENTS
0009 0020 0026 0039 0067 0091 0094
0138 0156 0242 0260 0265 0276 0280
0424 0553

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0043 0225
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0093
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0527

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0074

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0338 0342

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 0232

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 0087 0118 0239 0258 0274 0311 0312
 0314 0316 0399 0424 0432 0438 0441
 0554 0555 0560
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 0240 0267 0530 0340 0440 0487

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 0337 0481 0568

FOOD PRODUCTS
 0104 0109 0110 0149 0161 0163 0164
 0165 0172 0173 0176 0182 0210 0277
 0322 0325 0353 0358 0359 0360 0368
 0375 0376 0377 0381 0384 0385 0386
 0387 0388 0445 0478 0480 0482 0494
 0500 0501 0510 0513 0521 0539 0546

FOOD SECURITY
 0109 0164 0198 0199 0212 0215 0535

FOOD THICKENERS
 0494

FOODFOO
 0176 0277 0478 0510
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 0512 0513

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 0021 0039 0113 0230 0249 0267 0330
 0356 0340 0440 0487

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 0239 0244 0245 0406
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 0239 0244 0406

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 0002 0018 0089 0093 0214 0218 0233
 0276 0315 0319 0390 0400

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 0272 0277 0348 0359 0386 0395 0529
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 0384 0385 0388
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 0383 0387
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 0450
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 0122 0328
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 0007 0046 0239 0242 0243 0260 0261
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 0281
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 0019 0040 0094 0115 0161 0267 0272
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 0051 0096 0099 0123 0131 0198 0251
 0271 0276 0381 0532
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 0141 0151 0503
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 0290 0337 0404 0415 0429 0492
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0118 0119 0123 0124 0125 0126 0127
 0128 0129 0130 0131 0134 0137 0138
 0142 0164 0172 0173 0197 0198 0320
 0321 0325 0326 0327 0330 0333 0337
 0340 0342 0375 0382 0445 0476 0477
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 0180
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 0225 0384 0388 0389 0390 0476 0525
 0530 0539 0544 0548 0549 0568 0571

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 0023 0096 0099 0111 0120 0121 0153
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 0343 0361 0366 0367 0368 0369 0370
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 0110 0328 0336 0412 0429 0448 0482
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 0300 0301 0305 0456 0466 0468 0530
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 0394 0459
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 0469
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 0075 0078 0088 0201 0292 0467
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 0455
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 0077 0082 0291 0293 0295 0297 0298
 0299 0303 0306 0453 0454 0457 0458
 0460 0461 0462 0463 0464 0465 0523
 0534
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 0394 0459
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 0079

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 0083 0308 0468 0469 0553
 MONONYCHELLUS TANAJOA
 0082 0084 0095 0294 0302 0462 0470
 0471 0523 0534 0551
 TETRANYCHUS CINNABARINUS
 0084 0310
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 0307

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 0014 0407 0450

INSECT BIOLOGY
 0073 0075 0078 0079 0081 0083 0084
 0120 0291 0295 0361 0394 0455 0456
 0458 0460 0461

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 0011 0079 0080 0300 0310 0468 0469

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 0024 0029 0041 0042 0072 0088 0090
 0095 0201 0222 0224 0225 0227 0263
 0271 0381 0399 0442 0524 0530 0533
 0555 0560 0564 0568 0571
 BEANS
 0221 0394 0423 0554 0567 0570
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 0031 0047 0228 0390 0394 0459 0559
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 0031 0047 0221 0223 0228 0229 0390
 0394 0396 0423 0459 0554 0558 0559
 0562 0563 0566 0567 0569 0570
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 0031 0047 0221 0226 0228 0390 0394
 0427 0459 0525 0556 0558 0565 0567
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 0525 0559 0567 0569 0570
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 0285 0326 0422 0462 0478 0571
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 0211 0265

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 0110 0154 0322 0346 0527

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 0025 0031 0047 0067 0259

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 0015 0389 0525 0529 0530 0544 0548
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 0040
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 0022
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 0330 0483

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 0055 0058 0062 0063 0066 0150 0153
 0154 0236 0245 0251 0284 0299 0347
 0374 0377 0400 0405 0409 0411 0412
 0413 0414 0420 0450 0451 0456 0483
 0496 0497 0498

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 0371

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 0034 0227 0422 0523 0553 0568
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 0028
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 0550
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 0214 0423 0435 0550

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 0540 0541 0544 0555

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 0476
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 0208 0209
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 0208 0209 0476

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 0009 0239 0243 0397 0402 0408 0563
 0565

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 0004 0005 0008 0012 0230 0232 0237
 0238 0239 0243 0246 0247 0261 0265
 0399 0411 0402 0426 0475
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 0285 0404 0405 0408 0410 0417 0424
 0429
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 0115 0483 0487 0492
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 0290 0404 0415 0429
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 0424 0429 0560
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 0128
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 0115 0116 0337 0440 0483 0487 0492
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 0417

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 0332 0480 0506

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 0469

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 0397 0399 0564

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 0013 0017 0560
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 0254

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 0302 0437
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 0122 0126 0139 0357 0559
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 0276

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 0410 0522

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 0258

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 0294 0411

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 0294

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 0094
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 0259 0422

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 0001 0242 0298 0302 0303 0387 0388
 0398 0421 0464 0532 0538 0545

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 0114 0164 0178 0195 0198 0199 0200
 0212 0213 0215 0216 0217 0220 0382
 0446 0506 0523 0528 0538 0543 0545
 0548
 CASSAVA CHIPS
 0159 0392
 CASSAVA FLOUR
 0015 0101 0210 0480
 CASSAVA MEAL
 0332 0476
 CASSAVA STARCH
 0193 0546
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 0384 0385 0388 0539
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 0392

 MATHEMATICAL MODEL
 0418 0500

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MECHANIZATION
 0033 0169
 LAND PREPARATION
 0550
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 0043
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 0191 0384

MEXICO
 0078 0112 0284
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 0002
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 0421
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 0194

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 0420

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 0013 0014 0017 0020 0021 0043 0094
 0253 0254 0255 0257 0258 0265 0272
 0393 0407 0420 0424 0429 0499 0560
 0564

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 0307 0472

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 0082 0308
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 0307 0468 0469

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 0544 0498 0499

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 0442 0555 0565 0567

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 0083

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 0309
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 0307

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 0082 0084 0095 0302 0462 0470 0523
 0551
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 0294
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 0471 0534

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 0003 0246 0247 0409

MUCOR
 0057

MULCHING
 0260 0271 0406 0423 0435 0436

MUNG BEAN
 0568

MYCOPLASMOSES
 0070

MYCORRHIZAE
 0014 0020 0407

MYCOSES
 0035 0057 0058 0059 0062 0083 0163
 0278 0372 0373 0377 0530
 DISEASE CONTROL
 0060 0071 0282
 RESISTANCE
 0061 0088

NEMATODES
 0072 0186 0290

NETHERLANDS
 0046

NIGERIA
 0072 0077 0079 0134 0140 0142 0171
 0226 0228 0241 0251 0260 0262 0293
 0301 0333 0345 0347 0404 0410 0427
 0430 0435 0436 0439 0450 0458 0460
 0464 0471 0479 0490 0500 0501 0510
 0518 0521 0556 0557 0558 0563
 GERMLASM
 0319
 MARKETING
 0543
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 0271 0531 0535
 SOCIOECONOMIC ASPECTS
 0481 0534

NITROGEN
 0014 0021 0039 0043 0241 0254 0257
 0258 0265 0272 0293 0424 0427 0429
 0560 0564

NORTH AMERICA

0002 0003 0064 0065 0073 0078 0085
 0090 0106 0112 0137 0194 0196 0230
 0246 0247 0284 0421 0494 0538

NOXIOUS ANIMALS

0041 0067 0069 0072 0073 0075 0077
 0078 0079 0080 0081 0082 0083 0084
 0088 0095 0186 0201 0264 0285 0290
 0291 0292 0293 0294 0295 0296 0297
 0298 0299 0300 0301 0302 0303 0304
 0305 0306 0307 0308 0310 0394 0453
 0454 0455 0456 0457 0458 0459 0460
 0461 0462 0463 0464 0465 0466 0467
 0468 0469 0470 0471 0523 0530 0534
 0551 0553

NUTRIENT UPTAKE

0013 0014 0407

NUTRITIONAL REQUIREMENTS

0094 0241 0253 0254 0255 0257 0258
 0259 0265 0272 0393 0407 0420 0422
 0423 0424 0427 0429 0569

OCEANIA

0009 0016 0034 0043 0093 0193 0199
 0200 0202 0203 0204 0205 0206 0213
 0220 0225 0242 0248 0363 0420 0432
 0527 0538

OLIGONYCHUS

0083

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0524 0525 0530 0548 0550 0553 0557
 0566

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0343 0348 0448
 CASSAVA FLOUR
 0368 0516
 CASSAVA MEAL
 0277
 CASSAVA STARCH
 0322
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 0277

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0076

PACKAGING

0052 0350 0366 0444 0446

PALATABILITY

0031 0322 0343 0348

PANAMA

0136 0243 0261

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 0034
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 0527

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0151
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 0476
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 0476

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0051 0140

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0341 0392

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0057

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0477 0567
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 0086 0197

PEST CONTROL

0011 0027 0034 0037 0040 0054 0055
 0056 0060 0071 0074 0076 0079 0080
 0082 0093 0096 0171 0279 0281 0282
 0300 0307 0308 0310 0453 0459 0464
 0468 0469 0553

PEST DAMAGE

0076 0081 0287 0294 0298 0301 0304
 0453 0455 0466 0468 0469
 DEFOLIATION
 0241 0293 0402

PESTS

0005 0018 0019 0025 0035 0037 0038
 0041 0045 0054 0055 0056 0057 0058
 0059 0060 0061 0062 0063 0064 0065
 0066 0067 0068 0069 0070 0071 0072
 0073 0074 0075 0077 0078 0079 0080
 0081 0082 0083 0084 0088 0095 0096
 0163 0186 0201 0215 0226 0238 0264
 0271 0278 0280 0282 0284 0285 0287
 0288 0289 0290 0291 0292 0293 0294
 0295 0296 0297 0298 0299 0300 0301
 0302 0303 0304 0305 0306 0307 0308
 0310 0372 0373 0377 0394 0433 0434
 0451 0452 0453 0454 0455 0456 0457
 0458 0459 0460 0461 0462 0463 0464
 0465 0466 0467 0468 0469 0470 0471
 0474 0523 0530 0534 0551 0553

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0012 0408

PH
0020 0021 0243 0568
CASSAVA STARCH
0150 0495 0497
SOIL ANALYSIS
0261

PHENACOCCLUS
0069 0456

PHENACOCCLUS GOSSYPII
PEST DAMAGE
0455

PHENACOCCLUS HERRENI
0305 0455
RESISTANCE
0466

PHENACOCCLUS MANIHOTI
0077 0082 0291 0295 0297 0299 0303
0306 0454 0457 0458 0460 0461 0462
0463 0465 0523
INSECT CONTROL
0453
BIOLOGICAL CONTROL
0464
PEST DAMAGE
0293 0298
RESISTANCE
0534

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0475

PHILIPPINES
0045 0052 0060 0080 0110 0156 0170
0177 0184 0187 0188 0189 0252 0256
0263 0356 0372 0373 0374 0377 0507
0522 0564 0568
MARKETING
0164
PRODUCTION
0006 0044
SOCIOECONOMIC ASPECTS
0362 0389
STATISTICAL DATA
0389

PHOMA MANIHOT
0059

PHOSPHORUS
0013 0014 0020 0021 0043 0094 0254
0257 0258 0265 0272 0393 0407 0424
0429 0499 0560 0564

PHOTOPERIOD
0090 0472

PHOTOSYNTHESIS
0008 0009 0236 0237 0238 0401

PHYLLOSTICTA
0059

PHYSIOLOGY
0002 0004 0006 0007 0009 0013 0014
0016 0023 0032 0045 0046 0053 0073
0092 0117 0131 0227 0232 0238 0239
0241 0242 0243 0246 0247 0260 0261
0264 0265 0287 0399 0402 0407 0408
0409 0410 0420 0424 0432 0435 0436
0441 0479 0483 0485 0488 0489 0490
0554 0563

PHYTOMONAS FRANCAI
0063

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0061

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0485

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0243

PLANT FERTILITY
0232

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0001 0002 0398 0532

PLANT GROWTH SUBSTANCES
0246 0247 0274

PLANT HEIGHT
0039 0260 0265 0276 0287 0397 0438
0440 0441 0554 0555 0563 0565

PLANT PHYSIOLOGICAL PROCESSES
0011 0013 0014 0184 0237 0238 0243
0401 0402 0407 0418

PLANT PIGMENTS
0417

PLANT REPRODUCTION
0092 0232 0239

PLANT RESPIRATION
0237 0238

PLANT TISSUES
0005 0261 0293 0412 0412

TISSUE CULTURE
 0012 0233 0234 0235 0255 0400 0403
 PLANTING
 0016 0025 0031 0041 0072 0242 0265
 0270 0273 0279 0523 0556 0566
 COSTS
 0214 0533
 LABOR
 0022
 ROOT PRODUCTIVITY
 0004 0026 0080 0087 0214 0240 0241
 0266 0390 0423 0432 0440 0458 0554
 0563 0567 0570
 SPACING
 0026 0043 0100 0201 0222 0223 0226
 0262 0288 0396 0399 0437 0438 0440
 0452 0553 0554 0555 0557 0558 0567
 0563 0564 0565 0569
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 0095 0112 0114 0118 0121 0125 0131
 0137 0333 0479 0489 0490
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 0075 0077 0078 0082 0295 0296 0297
 0299 0303 0305 0306 0456 0458 0460
 0461 0464 0467 0469 0470 0472
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 0051 0500
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 0114 0130 0196 0210 0211 0212 0216
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 0167 0168 0185 0189 0190 0197 0212
 0323 0344 0354 0359 0360 0382 0384
 0385 0386 0388 0445 0483 0497 0502
 0509 0512 0514 0532

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 0181 0343
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 0051 0124 0141 0151 0157 0158 0159
 0173 0178 0191 0343 0347 0352 0418
 0492 0503 0505 0507 0517
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 0173 0183 0349 0353 0357 0363 0365
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 0088 0091 0094 0138 0150 0153 0154
 0156 0168 0173 0198 0201 0214 0215
 0218 0225 0236 0242 0245 0251 0260
 0265 0276 0280 0284 0299 0347 0374
 0377 0378 0390 0400 0405 0409 0411
 0412 0413 0414 0420 0424 0447 0450
 0451 0456 0476 0483 0496 0497 0498
 0524 0527 0534 0542 0553

RESISTANCE
 0049 0072 0090 0091 0132 0279 0290
 0450 0473
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 0005 0061 0088 0201 0280 0289 0474
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 0265 0402 0435 0436 0438

ROOT PRODUCTIVITY
 0004 0025 0030 0032 0035 0036 0046
 0080 0087 0100 0214 0240 0241 0243
 0254 0257 0258 0259 0261 0262 0263
 0266 0272 0274 0275 0276 0287 0293
 0302 0311 0312 0314 0316 0317 0320
 0381 0390 0395 0396 0397 0402 0407
 0408 0423 0424 0426 0427 0429 0432
 0433 0435 0436 0437 0438 0439 0440
 0441 0442 0458 0466 0543 0550 0554
 0555 0562 0563 0565 0567 0570

ROOT SYSTEM
 0243 0402

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 0429 0520
BIOCHEMISTRY
 0184
DETERIORATION
 0050 0052 0184 0281 0348 0366
DIETARY VALUE
 0343
DRY MATTER
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 0563
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 0333 0342 0487 0488
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 0184 0241 0252 0257 0261 0277 0281
 0290 0311 0314 0351 0333 0339 0342
 0343 0348 0350 0351 0366 0404 0408
 0410 0415 0416 0424 0429 0438 0441
 0444 0448 0475 0487 0488 0490 0520
 0521 0554 0560 0563
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 0241 0261 0408 0410 0424 0441 0554
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 0487 0488
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 0052 0410 0444
 ROTATIONAL CROPS
 0040 0279 0389 0393 0524 0571
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 0395
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 0359 0360 0385 0445 0502 0514
 SOCIOECONOMIC ASPECTS
 0001 0042 0086 0104 0106 0165 0194
 0195 0197 0200 0208 0209 0212 0360
 0362 0364 0378 0380 0388 0389 0393
 0398 0445 0476 0481 0514 0516 0524
 0526 0534 0535 0536 0548 0550 0551
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 0108 0384 0539
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 0020 0021 0026 0029 0038 0040 0171
 0221 0243 0254 0260 0261 0262 0263
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0397

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0148

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0007 0040 0056 0255

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0026 0027 0029 0030 0033 0048 0049
0053 0054 0055 0059 0061 0063 0070
0071 0075 0076 0081 0086 0087 0088
0089 0091 0092 0094 0097 0100 0102
0103 0104 0108 0109 0113 0115 0116
0118 0119 0124 0128 0130 0132 0133
0135 0141 0142 0144 0145 0147 0148
0149 0150 0151 0157 0158 0159 0160
0161 0162 0163 0165 0166 0167 0168
0169 0172 0175 0178 0182 0185 0186
0190 0191 0192 0195 0197 0201 0210
0212 0216 0217 0219 0221 0223 0224
0231 0232 0233 0234 0235 0236 0237
0238 0239 0240 0244 0245 0249 0253
0257 0258 0264 0266 0267 0268 0269
0270 0272 0274 0275 0279 0282 0290
0292 0294 0296 0304 0305 0306 0307
0308 0311 0312 0313 0314 0315 0316
0317 0318 0320 0321 0324 0329 0330
0331 0339 0340 0344 0350 0351 0352
0354 0355 0364 0379 0380 0391 0394
0396 0398 0401 0402 0405 0406 0407
0411 0412 0414 0415 0416 0417 0418
0423 0438 0440 0441 0442 0444 0446
0450 0459 0460 0467 0468 0470 0475
0476 0477 0480 0483 0487 0488 0489
0495 0502 0503 0504 0505 0509 0514
0517 0519 0520 0527 0530 0538 0545
0548 0549 0550 0553 0554 0555 0562
0565 0567 0570

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0170 0223 0397 0569

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0035
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0088

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0283

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0131 0229 0335 0337 0492

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0010 0016 0030 0046 0048 0096 0098
0099 0100 0115 0252 0257 0276 0311
0348 0353 0366 0373 0410 0424 0438
0440 0441 0444 0553

STARCH PRODUCTIVITY
0396 0438 0562
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0267 0276 0354 0441
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0258
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0252 0265 0311 0347 0428 0442 0503

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0042 0193 0194 0195 0196 0200 0202
0203 0204 0205 0206 0207 0208 0209
0212 0216 0220 0380 0387 0389 0392
0476 0525 0527 0528 0538 0541 0545
0546 0548 0549 0551

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0367

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0440 0487

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0005 0236

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0030 0049 0050 0052 0130 0135 0160
0169 0174 0182 0184 0277 0334 0348
0350 0351 0356 0361 0366 0443 0444
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0164 0165 0170 0182 0210 0329 0480

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0410

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0211 0214 0218 0357 0388 0430 0538

0539 0543

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0162 0185 0186 0201 0353 0389

TECHNOLOGY EVALUATION

0157 0158 0159 0165 0169 0177 0178

0191 0256 0348 0360 0378 0384 0385

0386 0389 0480 0525 0526 0534 0537

0550 0553 0566 0569

TECHNOLOGY TRANSFER

0027 0054 0116 0158 0168 0176 0178

0192 0201 0211 0214 0218 0430 0525

0526 0538 0539 0543 0550 0569

TELENOBUS

0078 0201

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0007 0011 0046 0084 0090 0237 0242

0367 0397 0406 0418 0456 0472 0475

0494 0497 0501 0515 0520

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0310

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0084

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0469 0472

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0307

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0062 0278 0342 0349 0376 0424 0425

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0017 0130 0156 0166 0167 0171 0186
0355 0369 0376 0479 0490 0520 0521

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0503 0507
GARI
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0006 0016 0023 0262 0402 0537

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0402

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0019 0029 0040 0045 0186 0265 0269
0279 0390 0433 0550 0553
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0228

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