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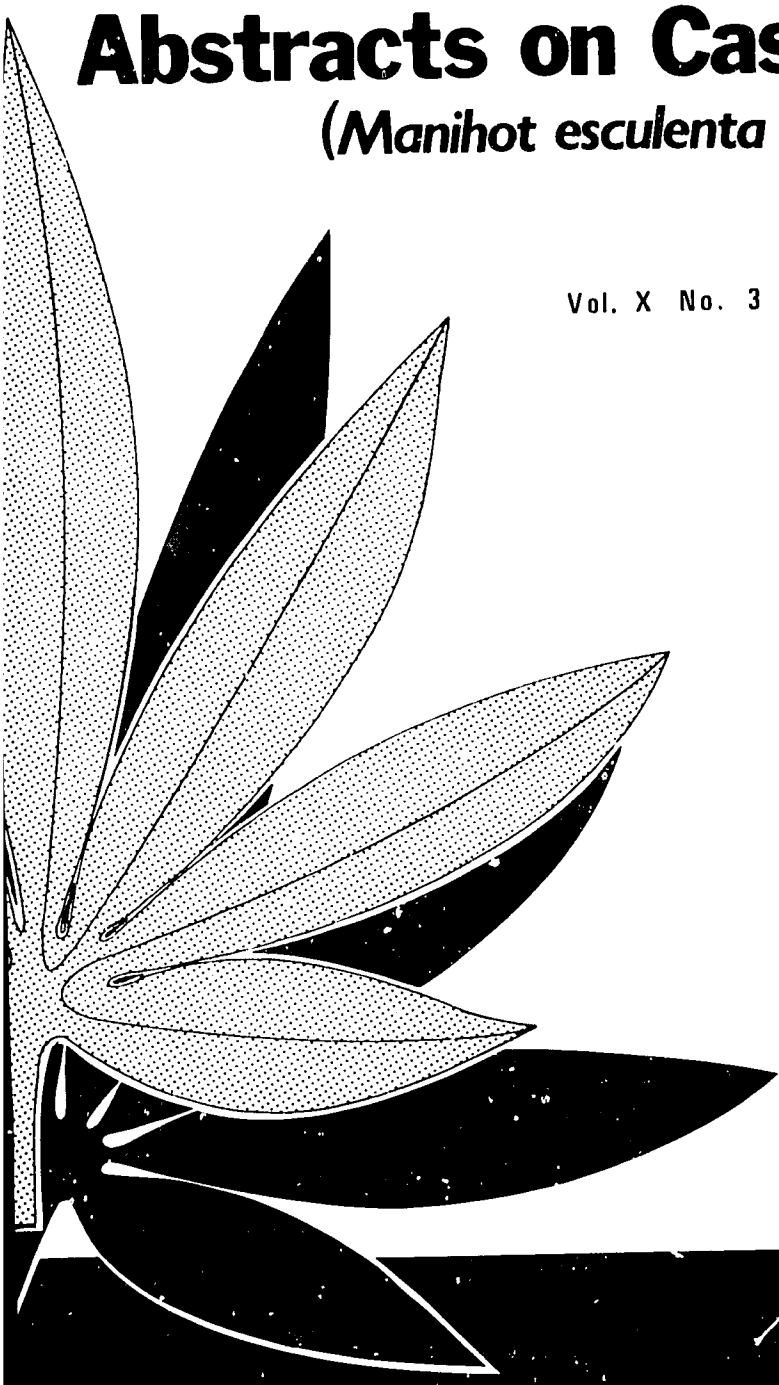
Abstracts on Cassava
(*Manihot esculenta* Crantz)

Vol. X No. 3 December, 1984



Centro Internacional de Agricultura Tropical

ABSTRACTS ON CASSAVA

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Vol. X | No. 3 | December, 1984

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INTRODUCTION

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

The abstracts report condensed information from journal articles, booklets, mimeographed reports, theses, manuals and other conventional and nonconventional material, categorized into broad disciplinary fields to facilitate rapid scanning. Additionally, abstracts are author and subject indexed to enable more comprehensive consultation.

When retrospective or exhaustive coverage of a topic is desired, mechanized bibliographic searches of the entire document collection can be provided by CIAT's Documentation Center. Abstracts of all articles that match the topic of interest are provided to users who request this search service. The full text of every article abstracted by the Documentation Center is also available, through the photocopy service.

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

COMPONENTS OF AN ABSTRACT

Accesion number (for photocopy requests)

Authors

Sequential number in the journal (for use of indexes)

Year of publication

19527 IKEDIOBI, C.O.; ONYIKE, E. 0145 1982. The use of linamarase in gari production. Process Biochemistry 17(4):2-5. Engl., Sum. Engl., 12 Refs., Illus. [Dept. of Biochemistry, Ahmadu Bello Univ., Zaria, Nigeria]

Original title

Author address

Additional notes

Source

Pages

Language of paper

Language of summary

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

Keywords

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

Abstract

Abstractor and/or translator

Subject categories

HOW TO USE THE INDEXES

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

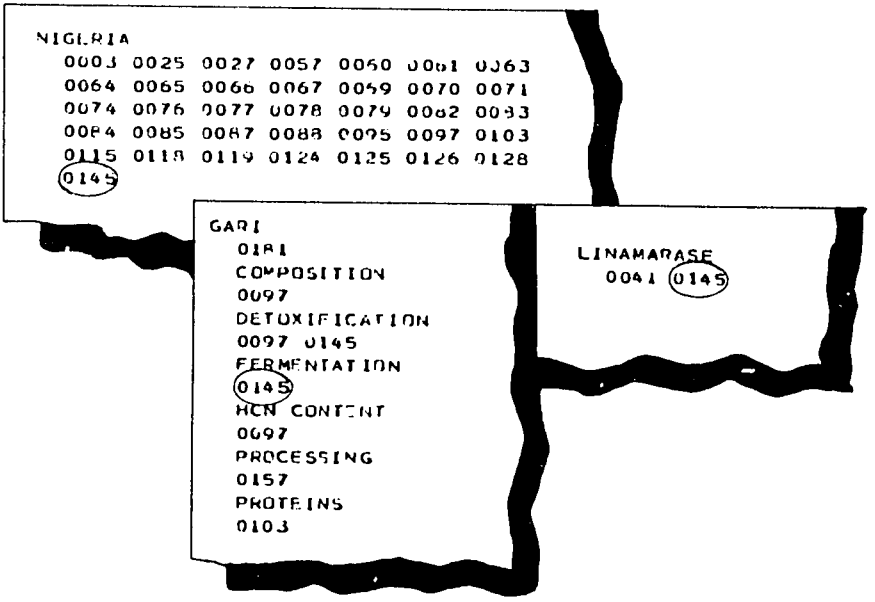
The last issue of the year contains cumulative author and subject indexes for the year.

Author Index

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

Subject Index

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



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6. UNESCO coupons, available at UNESCO offices all over the world

0353

21102 BOX, L.; DE LA RIVE BOX-LASOCKI, B. 1982. Bread of the earth: cassava cultivation, processing and consumption among Amerindians. In _____.; Doorman, F., eds. Man and Manihot. Volume 1. Case studies on cassava cultivators. Wageningen, Netherlands. Mededelingen van de Vakgroepen Sociologie van de Landbouwhogeschool, no.3. pp.1-36. Engl., Sum. Engl., 35 Refs., Illus. [Landbouwhogeschool, Hollandseweg 1, 6706 KN Wageningen, Netherlands]

Cassava. Ethnobotany. History. Plant geography. Maps. Cultivation. Planting. Harvesting. Processing. Cassava products. Nutritive value. Diets. Human nutrition. Casave. Cassava starch. Cassava flour. Socio-economic aspects. Labour. Caribbean. South America. Central America.

On the basis of anthropological and other data, Amerindian cassava cultivation and processing practices are described. Recent literature on cassava domestication suggests an independent development of at least 2 centers of dispersal. Meso America is suggested to be the area where sweet var. were 1st domesticated as part of a larger cropping complex including maize. The northern part of South America might have been the area where cultivation systems developed centered around the more poisonous or bitter var. Quantitative comparisons of different aspects of cassava cultivation as practiced by different tribes have been attempted. Estimates are made of man days required, areas cultivated, and the contribution of cassava to the diet. The role of the woman as the center of the cassava production unit and the association of cassava cultivation with nuclear-family farming is stressed. Changes in male and female labor patterns due to the introduction of new technology are discussed. (Author's summary) A00

0354

21101 BOX, L.; DOORMAN, F., eds. 1982. Man and Manihot. Volume 1. Case studies on cassava cultivators. Wageningen, Netherlands. Mededelingen van de Vakgroepen Sociologie van de Landbouwhogeschool, no.3. 166p. Engl., 83 Refs., Illus. [Landbouwhogeschool, Hollandseweg 1, 6706 KN Wageningen, Netherlands]

Cassava. History. Ethnobotany. Cassava products. Processing. Marketing. Socio-economic aspects. Cultivation. Costs. Colombia. Surinam. South America.

Studies are included on Amerindian cassava cultivation; the transition from subsistence to market oriented cultivation among Amerindians in Surinam; peasant and small farmers cultivation in Colombia; and peasant cultivation and small-scale processing and marketing in southern Colombia. (Summary by L.M.F.) A00

0355

21103 DOORMAN, F. 1982. From Matta to the market: consequences of market incorporation among Amerindian cassava cultivators in a Surinam village. In Box, L.; Doorman, F., eds. Man and Manihot. Volume 1. Case studies on cassava cultivators. Wageningen, Netherlands. Mededelingen van de Vakgroepen Sociologe van de Landbouwhogeschool, no.3. pp.37-70. Engl., Sum. Engl., 18 Refs., Illus. [Landbouwhogeschool, Hollandseweg 1, 6706 KN Wageningen, Netherlands]

Cassava. Sweet cassava. Bitter cassava. Ethnobotany. Socio-economic aspects. History. Cassava products. Processing. Labour. Marketing. Casave. Cassareep. Maps. Surinam.

The cultivation, processing, and marketing of bitter cassava among Amerindians in the coastal area of Surinam are described. The significance of sweet and bitter cassava culcivation for different ethnical groups in Surinam is also briefly discussed. Sweet cassava is cultivated on a very small scale by Javanese and East-Indian farmers, and is sold at high prices on the Paramaribo fresh food market. Bush Negroes and Amerindians cultivate and process bitter cassava for subsistence, and sell bitter cassava products, mainly cassava bread, on the market in Paramaribo. Currently there are no other market outlets where cassava, either processed or fresh, can be sold at favorable prices. This, in combination with the fact that supply and demand are fairly well attuned in the present market, leads to the conclusion that there is little scope for the expansion of cassava production. The Amerindians living in the village of Matta derive an important share of their income from the sale of bitter cassava products. However, the shift from production for subsistence to production for the market has until now not brought about significant changes in the agricultural system or the division of labor. Nevertheless, the workload of the people in Matta has increased. Men still perform their traditional activities in agriculture, but besides this, are also engaged in wage labor. Women spend much more time than formerly in harvesting and processing bitter cassava, sometimes with the help of their husbands. (Author's summary) A00

0356

21472 NASSAR, N.M.A.; TEIXEIRA, R.P. 1983. A quebra da dormencia da semente das especies selvagens da mandioca, Manihot spp. (Interruption of seed dormancy in wild Manihot species). Ciencia e Cultura 35(5):630-632. Port., Sum. Port., Engl., 6 Refs., Illus. [Depto. de Agronomía, Univ. de Brasilia, 70.919 Brasilia-DF, Brasil]

Cassava. Manihot. Seed. Germination. Brazil.

Two expt. were conducted to study the effect of alternation of temp. on the interruption of seed dormancy of 6 wild Manihot species (M. oligantha, M. anomala, M. longepetiolata, M. salicifolia, M. gracilis, and M. pentaphylla), collected in their natural habitats in Central Brazil. The 1st, using 200 seeds of M. anomala and M. oligantha, was replicated 4 times and used alternate temp. of 26°C for 16 h and 38°C for 8 h for 28 days; check seeds were maintained at lab. temp. of 18/22°C. The 2nd expt. tested seeds (200-300 each) of the other 4 species at the same alternate temp. for 35 days. Germination of wild species treated for 35 days was enhanced 9-25% compared with untreated seeds. (Summary by L.M.F.) A00

0357

21460 TURNER II, C.G.; MACHADO, L.M.C. 1983. A new dental wear pattern and evidence for high carbohydrate consumption in a Brazilian archaic skeletal population. American Journal of Physical Anthropology 61(1):125-130. Engl., Sum. Engl., 35 Refs., Illus. [Dept. of Anthropology, Arizona State Univ., Tempe, AZ 85287, USA]

Cassava. History. Ethnobotany. Human nutrition. Uses. Tooth wear. Brazil.

An apparently new type of dental wear pattern, lingual surface attrition of the maxillary anterior teeth (LSAMAT), has been found in 85% of 46 adult crania from a 3000-4200 BP Archaic site called Corondó near the Atlantic Ocean coast of Brazil. LSAMAT is associated with a high caries rate (60% of 77 adults; 11% of 1219 permanent teeth) in what on archeological grounds alone would be considered a mainly meat-eating population. It is suggested that both LSAMAT and caries resulted from eating some starchy plant like cassava. (Author's summary) A00

B00 PLANT ANATOMY AND MORPHOLOGY

0358

21149 EL-SHARKAWY, M.A.; COCK, J.H.; CADENA, G. DE 1984. Stomatal characteristics among cassava cultivars and their relation to gas exchange. Experimental Agriculture 20(1):67-76. Engl., Sum. Engl., 10 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Stomata. Photosynthesis. Transpiration. Carbon dioxide. Cultivars. Colombia.

Stomatal characteristics among field-grown cassava cv. of the CIAT germplasm bank at Palmira, Colombia, were surveyed and their relation to photosynthesis and transpiration of both leaf surfaces was evaluated. Several cv. were found to possess clusters of functional stomata around the veins on the upper leaf surface and 2 cv. (M Col 88 and M Col 90) have significant no. of stomata (83-140/mm^2) dispersed over the entire upper leaf surface. Stomatal density on the lower leaf surface ranged from 322-553/mm^2 among cv., with a relative stomatal area of 3.4-6.1%. The CO_2 uptake by the upper leaf surface (27% of total) and the transpiration loss (32% of total) corresponded closely to the ratio of relative stomatal areas on the upper and lower leaf surface of cv. M Col 88. (Author's summary) B00

See also 0451

C00 PLANT PHYSIOLOGY

0359

21481 EL-SHARKAWY, M.A.; COCK, J.H. 1984. Water use efficiency of cassava. 1. Effects of air humidity and water stress on stomatal conductance and gas exchange. Crop Science 24(3):497-502. Engl., Sum. Engl., 32 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Plant physiology. Photosynthesis. Stomata. Water use. Transpiration. Water stress. Colombia.

Measurements of CO_2 and H_2O exchange of attached cassava leaves in water stressed and control plants of cv. M Col 90 and M Col 88 were made at various leaf-air vapor pressure differences (VPD) (0.8-4.5 kPa). Apparent photosynthesis and transpiration were sharply reduced by increase in VPD above 1.8-2.0 kPa in both stressed and nonstressed plants. This trend coincided with changes in leaf conductance over similar ranges of VPD. The rapid closure of stomata in dry air was independent of bulk leaf water potential. Furthermore, the response was completely reversible in humid air after short exposure to dry air, suggesting a direct response to changes in air humidity. Water use efficiency decreased as VPD increased over the range of 1-4 kPa. The significance of the stomatal response to humidity is discussed in relation to water use efficiency in long dry periods. (Author's summary) C00

0360

21482 EL-SHARKAWY, M.A.; COCK, J.H.; HELD K., A.A. 1984. Water use efficiency of cassava. 2. Differing sensitivity of stomata to air humidity in cassava and other warm-climate species. Crop Science 24(3):503-507. Engl., Sum. Engl., 24 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Plant physiology. Photosynthesis. Stomata. Leaves. Transpiration. Colombia.

Measurements of CO_2 and H_2O exchange and the calculated leaf conductance of attached leaves in well-watered plants were conducted over a range of leaf-air vapor pressure differences (VPD) (1.0-4.0 kPa) to compare the response of cassava with that of other warm-climate species. Species tested were cassava, andropogon (Andropogon gayanus), beans, siratro (Macroptilium atropurpureum), rice, eucalyptus, amaranth weed (Amaranthus retroflexus), and grain sorghum. Plants were grown in pots outdoors at the CIAT headquarters, Palmira, Colombia. All except andropogon showed a decrease in leaf conductance with increase in VPD. The degree of stomatal sensitivity decreased as follows: cassava more than siratro, amaranthus, eucalyptus, bean more than sorghum, rice more than andropogon. The greater sensitivity in cassava was associated with reduction in transpiration and stable leaf water potential at large VPD. In other less sensitive species, transpiration increased and bulk leaf water potential decreased at large VPD. The response of cassava to changes in VPD resulted in higher water use efficiency compared with other C_3 species. This may contribute to the comparative advantage of cassava when grown under conditions of limited availability of water. The water use efficiencies of the C_4 species (sorghum, andropogon, amaranthus) were higher than those of the C_3 species. This greater water use efficiency of C_4 species was attributed mainly to the higher photosynthetic rates of the C_4 species rather than to a lower transpiration rate. (Author's summary) COO

0361

20773 KUMAR, A.; SANWAL, G.G. 1982. Starch phosphorylase from tapioca leaves: absence of pyridoxal phosphate. Archives of Biochemistry and Biophysics 217(1):341-350. Engl., Sum. Engl., 61 Refs., Illus. [Dept. of Biochemistry, Lucknow Univ., Lucknow, U.P., India]

Cassava. Biochemistry. Leaves. Enzymes. Cassava starch. Analysis. India.

Starch phosphorylase from cassava leaves was purified to homogeneity, using the technique of ammonium sulfate fractionation, heat treatment, DEAE-cellulose chromatography, filtration through Sephadex G-100 and Sephadex G-200, and DEAE-Sephadex chromatography. The enzyme has a mol. wt. of 450,000, as determined by gel filtration through Sephadex G-200 and contains 22 sulfhydryl groups/mole of the enzyme protein. Apparently, pyridoxal 5'-phosphate is not a prosthetic group of the enzyme. The kinetic data show a sequential type of the reaction mechanism. The enzyme activity is inhibited by tyrosine [K_i (inhibition constant) = 2.15 mM]. (Author's summary) COO

0362

21470 SAN JOSE, J.J.; BERRADE, F. 1983. Transfer of mass and energy in a cassava community (Manihot esculenta Crantz cv. Cubana). 2. CO_2 exchange in a savanna climate. Annals of Botany 52(4):521-533. Engl., Sum. Engl., 43 Refs., Illus. [Centro de Ecología, Inst. Venezolano de Investigaciones Científicas, Apartado 1827, Caracas 1010-A, Venezuela]

Cassava. Photosynthesis. Carbon dioxide. Leaf area. Plant respiration. Plant assimilation. Savannas. Climatic requirements. Venezuela.

The energy balance approach was applied to calculate the CO_2 flux above and within a cassava community, growing during a savanna wet season in the Venezuelan Llanos. Data of the response of CO_2 exchange to diurnal changes in the savanna environment were integrated to a growth analysis of the cassava crop. The C budget of the entire community was calculated at

different development stages. Results indicate that CO_2 uptake in cassava appears to follow a linear net radiation response curve, dependent on crop age. The max. net CO_2 uptake decreased from 0.195 $MJ/m^2/day$ at max. leaf area development (Aug.) to 0.028 $MJ/m^2/day$ 2 mo. later. These rates represent 41 and 19% gross assimilation. Data of energy conversion efficiency show that at a max. leaf area development, the crop fixed 2.2 and 0.9% R_i (total incoming radiation) as gross and net photosynthesis, resp. As the season proceeded, net photosynthesis decreased to 0.1, whereas gross photosynthesis decreased to 0.7, which indicates that DM lost by respiration is one of the determining factors in the seasonal trend of efficiency changes. The comparison of growth characteristics calculated for cv. Cubana, growing during consecutive years in the same exptl. site, indicate that yearly variability in DM accumulation is due to the wide range of environmental conditions present during the savanna wet season. Operational factors acting depressively on the cassava C budget and affecting DM production were also analyzed. (Author's summary) COO

0363

21148 TSUNO, Y.; TANIYAMA, T.; SUPRAPTO, H. 1983. The photosynthesis and estimation of productivity of cassava. Japanese Journal of Crop Science 52(4):484-492. Engl., Sum. Engl., Jap., 13 Refs., Illus. [Faculty of Agriculture, Tottori Univ., Koyama, Tottori 680, Japan]

Cassava. Photosynthesis. Leaf area. Light. Temperature. Stomata. Productivity. Analysis. Indonesia.

In the province of Lampung, Indonesia, the photosynthetic rate of a single cassava leaf under natural conditions was measured and the rate of DM production of cassava plants was estimated using the formula devised by Monsi and Saeki. From the results obtained, the capacity of DM production was estimated by deducting the respiratory rate of each organ from the photosynthetic rate. The light saturated value of the net photosynthetic rate for cassava ranged from 10 to 13 mg $CO_2/dm^2/h$, while the max. value measured by means of the improved half leaf method was 18 mg $CO_2/dm^2/h$. The extinction coefficient (k) of the cassava canopy was 0.7 and optimum LAI in gross photosynthesis showed 4-5. In addition, optimum LAI in the net photosynthetic rate was estimated around 3.5 and the max. dry wt. produced at this LAI was 102.0 kg/ha/day. However, in the case of a higher photosynthetic rate for a single leaf, dry wt. ought to increase more. (Author's summary) COO

See also 0358 0396 0400 0404 0405 0411

C01 Plant Development

0364

20744 LOWE, S.B.; MAHON, J.D.; HUNT, L.A. 1982. Early development of cassava (Manihot esculenta). Canadian Journal of Botany 60(12):3040-3048. Engl., Sum. Engl., Fr., 25 Refs., Illus. [TCG Materials Limited, P.O. Box 1390, Brantford, Ontario, Canada N3T 5T6]

Cassava. Plant physiology. Root development. Shoots. Plant development. Dry matter. Starch content. Roots.

Root development and plant DM distribution were observed for 16 wk. after planting in cassava grown from stem cuttings in controlled environment chambers with a day/night temp. of 32/27°C. During an initial phase lasting

6 wk., axillary shoots and adventitious roots regenerated, while the original cutting lost wt., and total wt. remained constant. During the 2nd phase from the 6th to the 16th wk. there was growth of all plant parts including root tubers. Tuber growth accounted for 46% of plant DM accumulated over the final 2 wk. of the study. Roots arising from the base of the cutting were more numerous than nodal roots and produced a proportionately greater no. of tuhers. Differentiation of secondary tissues started at 4 wk. and root thickening was visible to the naked eye at 6 wk. Tuber initiation occurred over the 6-16 wk. period in some of the thickened roots and resulted from production of enlarged storage parenchyma cells in place of secondary xylem fibers along part of the root axis. At 8 wk., these thickenings became visible to the naked eye as tubers, distinguishable from the thinner neck region, which continued to produce normal secondary xylem with little storage tissue. Other roots thickened uniformly along the root axis, by normal secondary growth, and did not initiate tubers. Root tubers grew in size by continued production of storage tissue, increasing tuber width but not length, accompanied by a decrease in sugar content and increase in starch content. (Author's summary) C01

See also 0386 0390 0394 0395 0417 0453 0454 0508

C03 Chemical Composition, Methodology and Analyses

0365

21199 EL TINAY, A.H.; BURENG, P.L.; YAS, E.A.E. 1984. Hydrocyanic acid levels in fermented cassava. Journal of Food Technology 19(2):197-202. Engl., Sum. Engl., 9 Refs. [Dept. of Biochemistry, Faculty of Agriculture, Shambat, Sudan]

Cassava. Roots. Fermentation. HCN content. Timing. Cortex. Sudan.

The extent of HCN loss during the fermentation of cassava tubers selected from both sweet and bitter var. by the traditional method used in southern Sudan (whole unpeeled tubers) was compared with the fermentation of peeled tubers and crushed pulps, with or without the addition of water. Although traditional fermentation lasts 3-4 days, in this study fermentation was allowed to proceed for 8 days. Loss of cyanide from the whole tubers was 80-87% after 8 days and only 51-53% after 4 days. Loss of cyanide from whole sweet tubers was not significant after 5 days. The loss of cyanide from the peeled tubers was comparable with that of the whole tubers after 8 days of fermentation. However, there was a marked decrease in free cyanide the 1st day of fermentation of the peeled tubers compared with whole tubers. The loss in cyanide in the crushed pulp, which occurred primarily the 1st day, appears to be due to the action of endogenous linamarase rather than hydrolysis by fermentation. When water was added to the crushed pulp the reduction in cyanide was 83-91%, with a marked decrease in bound cyanide the 1st day of fermentation. Autohydrolysis is enhanced by addition of water to the crushed pulp. (Author's summary) C03

0366

21415 FUKUBA, H.; IGARASHI, O.; BRIONES, C.M.; MENDOZA, E.M.T. 1984. Cyanogenic glucosides in cassava and cassava products: determination and detoxification. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies

Press. pp.225-234. Engl., Sum. Engl., 17 Refs., Illus. [Inst. of Environmental Science for Human Life, Ochanomizu Univ., Otsuka, Bunkyo-ku, Tokyo 112, Japan]

Cassava. Roots. Leaves. Analysis. HCN content. Detoxification processes. Processing. Cassava products. Post-harvest technology. Philippines.

The total and free cyanide contents of the storage roots and leaves of 11 cassava var. were analyzed using a quantitative enzymatic assay. In 5 var. tested, the root cortex had total cyanide levels ranging from 180 to 720 micrograms/g fresh wt., 2-6 times higher than in the parenchyma. Cyanide concn. generally increased from the proximal to the distal end in the cortex; the gradient was not apparent in the parenchyma. Cassava leaves had total cyanide levels 2.6-27.3 times as high as in roots, from 189 to 2466 micrograms/g fresh wt. Boiling, steaming, and soaking-boiling of 1 cm^3 cassava roots for 10 min (sufficient to cook the samples) reduced the total cyanide levels, on the av., by only 50%. Increasing the heating/boiling time further reduced total cyanide to 70-80%. Soaking alone up to 24 h reduced total cyanide by only 14%, but followed by 10 min boiling, the process resulted in 60 and 100% reduction of total and free cyanide levels, resp. Microwave treatment decreased total cyanide by 56%. Cassava leaves boiled for up to 1 h lost from 65 to 85% of their total cyanide although the residual levels were still toxic. Var. differences were observed in the reduction of cyanide in roots and leaves by the various treatments. Native pastries like nilupak, hinalo, bibingka, and suman obtained from local markets in the Philippines were found to contain 27-84% micrograms of total cyanide/g. Addition of a soaking step to the traditional way of preparing suman resulted in a product with low and harmless level of total cyanide. (Author's summary) C03

0367

21413 IWATSUKI, N.; KOJIMA, M.; DATA, E.S.; VILLEGAS-GODOY, C.D.V. 1984. Changes in cyanide content and linamarase activity in cassava roots after harvest. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.151-161. Engl., Sum. Engl., 21 Refs., Illus. [Faculty of Agriculture, Nagoya Univ., Chikusa, Nagoya, Aichi 464, Japan]

Cassava. Roots. HCN content. Linamarase. Biochemistry. Deterioration. Timing. Plant tissues. Cyanides. Post-harvest technology. Philippines.

The changes in cyanide content and linamarase activity in various root tissues of cassava cv. Golden Yellow were investigated in relation to storage and physiological and microbial deterioration. The blocks incubated under room conditions quickly showed symptoms of physiological deterioration similar to those occurring under natural conditions. After 1 wk. of storage of whole roots or 3-day-incubation of tissue blocks, the total cyanide content increased in all tissues parts. Cyanide content and visible deterioration increased during storage; the degree of the increase was most pronounced in the white parenchyma tissue, 2-3 mm thick, next to the cortex (called A-part). On the other hand, linamarase activity changed in all root parts during storage and the appearance of deterioration. In the A-part of whole roots, the enzyme activity increased as deterioration extended during 1 wk. of storage, but decreased when the root blocks were incubated for 3 days. Free cyanide constituted a very small portion of the total cyanide and did not change markedly. (Author's summary) C03

0368

21463 LIAN, T.S.; HAMIR, N.A. 1981. Spectrophotometric quantification of Guignard's sodium picrate test. MARDI Research Bulletin 9(1):35-41. Engl., Sum. Mal., Engl., 12 Refs., Illus. [Cassava Unit, Field Crops

Branch, Malaysian Agricultural Research & Development Inst., Serdang, Selangor, Malaysia]

Cassava. Laboratory experiments. Cyanides. HCN content. Analysis. Roots. Malaysia.

The Guignard's sodium picrate test was quantified by the use of standard cyanide solutions extending over the range of 0-400 micrograms HCN and spectrophotometric measurements. A comparison between the quantitative method so developed and the usual visual classification is presented. Results showed that a highly significant correlation was obtained between the spectrophotometric readings (absorbance) and the known cyanide concn. Variation increased at the higher concn. By being able to measure changes in color intensity by spectrophotometric means, it is possible to estimate the cyanide content of the plant tissue in units of mg/kg material. The use of the quantitative method of estimating cyanide content may be extended to cover other plant tissues, such as cassava leaves. (Summary by L.M.F.) C03

0369

21449 MADUAGWU, E.N. 1983. Differential effects on the cyanogenic glycoside content of fermenting cassava root pulp by beta-glucosidase and microbial activities. Toxicology Letters 15(4):335-339. Engl., Sum. Engl., 11 Refs., Illus. [Dept. of Biochemistry, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Cyanogenic glycosides. Linamarase. Biochemistry. Pulp. HCN content. Analysis. Fermentation. Nigeria.

The degradation of cyanogenic glycosides was studied in spontaneously fermenting cassava root pulp and in fresh pulp samples pretreated to prevent either endogenous beta-glycosidase activity, fermentation, or both. The rate of disappearance of the glycosides, as measured by HCN production in situ, in membrane-sterilized media or in samples containing 1% sodium iodoacetate, was comparable with the untreated control in which 85% of the substrate was broken down within 72 h. Pretreatment of the fresh pulp with the beta-glucosidase inhibitor 1,5-gluconolactone (1%) markedly reduced the rate of disappearance of the cyanogens while inclusion of glucose in this test medium at the 3% level appeared to induce some hydrolysis. Loss of bound (glycosidic) cyanide in sterilized medium containing the glucosidase inhibitor was negligible. The results suggest that the contribution of the fermentation process in cyanide detoxification of pulped cassava roots is minimal. (Author's summary) C03

0370

21416 MENDOZA, E.M.T.; KOJIMA, M.; IWATSUKI, N.; FUKUBA, H.; URITANI, I. 1984. Evaluation of some methods for the analysis of cyanide in cassava. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.235-242. Engl., Sum. Engl., 13 Refs., Illus. [Inst. of Plant Breeding, Univ. of the Philippines at Los Baños, Laguna 3720, Philippines]

Cassava. Cyanides. HCN content. Analysis. Roots. Laboratory experiments. Post-harvest technology. Philippines.

Three spectrophotometric methods for the analysis of cyanide in cassava root extracts were compared. Results showed that the pyridine-barbiturate and pyridine-pyrazolone methods gave consistently similar values while the alkaline picrate method gave 2-10 times greater values. Distillation

followed by analysis of the trapped cyanide by the pyridine-barbiturate method resulted in cyanide values similar to those obtained by the direct analysis of cyanide in the reaction mixture by the pyridine-barbiturate method. Isotachoelectrophoretic analysis gave results similar to those obtained by the pyridine-pyrazolone method. Among the methods of cyanide analysis studied, the pyridine-barbiturate method seems to be the best for the following reasons: sensitivity (0.2-1.4 micrograms cyanide or absorbance of 0.1-0.8); specificity for cyanide; stability of reagents; short time of analysis (10-15 min); stability of color; and simplicity of analysis. (Author's summary) C03

See also 0364 0381 0383 0387 0391 0399 0400 0402 0403 0406 0407 0410 0411 0449 0450 0451 0452 0456 0457 0460 0508

C04 Plant Nutrition

See 0381 0449

D00 CULTIVATION

0371

20764 AGBOOLA, S.A. 1979. Root crops. In _____. An agricultural atlas of Nigeria. Oxford, Oxford University Press. pp.53-65. Engl., Illus.

Cassava. Cultivation. Maps. Production. Nigeria.

Problems of increased root crop production in Nigeria are described. Despite its comparatively recent introduction, cassava has emerged as the food crop with highest potential, and it is cultivated in all ecological zones. It was introduced by emancipated slaves from Brazil, the West Indies, and Sierra Leone to Lagos, Badagry, Abeokuta, and Ijebu (south) and into coastal towns. Social, economic, physical, and psychological factors together with its versatile agronomic features played their parts in the spread of the crop (Manihot utilissima and M. palmata, of which there are many var., Ohupon, Panya, Ofop iwa, Idileruwa, Gbokogbaala, and Gbayekete). The most important cassava producing areas are located in the 9 southern states (75% of total area with 419,985 ha in 1970-71 and av. yields of 17,094 kg/ha). The general pattern of south-to-north gradation in cassava production is explained in terms of (1) the periods at which the crop was introduced and adopted; (2) the changes in cropping patterns; (3) the length of fallow, the crop being important in areas of shortened fallow; (4) land use problems; (5) production/consumption/supply patterns, especially around Lagos, and the distance factor (transportation costs); (6) diffusion and rate of adoption. The yam/cassava land-use ratios are analyzed and maps are provided. (Summary by I.B.) D00

0372

21403 BARTOLINI, P.U.; HIROSE, S. 1984. Root crop survey in Visayas (Leyte and the Camotes Islands, Cebu) A. Leyte survey. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.9-21. Engl., 7 Refs., Illus. [Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte 7127-A, Philippines]

Cassava. Cultivation. Intercropping. Socio-economic aspects. Productivity. Production. Maps. Philippines.

The Eastern Visayas (Leyte and Samar) has the widest area planted to root crops in the Philippines, cassava being 2nd to sweet potatoes in terms of area and production. Root crops grown, their location, cultural management practices, and cropping systems are described. Problems of root crop farmers are listed. Cassava is grown on large-scale farms, mainly in the NW part of Leyte. Starch factories use fresh cassava roots as raw material, and sometimes dried cassava chips in times of shortage. Cassava starch from fresh roots is more profitable than from cassava chips, as starch yield is higher and the resulting starch is white and of better quality and texture. Farmers practice crop rotation, planting a quick crop like maize before cassava; cassava is also intercropped with peanut or mung bean as well as with coconut trees and bananas. (Summary by I.B.) DOO

0373

21404 BARTOLINI, P.U.; HIROSE, S.; SAWAYAMA, S. 1984. Root crop survey in Visayas (Leyte and the Camotes Islands, Cebu). B. The Camotes Islands survey. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.23-29. Engl., Illus. [Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte 7127-A, Philippines]

Cassava. Cultivation. Intercropping. Production. Maps. Philippines.

Root crops, particularly cassava and sweet potato, are cultivated on the Camotes Islands in almost the same manner as in many areas of Philippines. Land is prepared using a carabao-drawn implement, plowed twice to keep the area weed-free, and ridges are formed. Stakes (25-cm-long) from the middle portion of cassava stems are used as planting material, spaced 75 x 100 cm and planted horizontally. No fertilizers or chemical pest control are used. Cassava is harvested after 8-10 mo. Many cassava plants infected by leaf spot (Cercospora sp.) were found in Polo Island, an important cassava growing area. Processing and cooking methods are described. (Summary by I.B.) DOO

0374

21486 BUENO, A.; GOMES, F.P. 1983. Estimativa do tamanho de parcela em experimentos de mandioca. (Estimation of plot size in experiments with cassava). Revista Brasileira de Mandioca 2(2):39-44. Port., Sum. Port., Engl., 8 Refs. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Field experiments. Statistical analysis. Experiment design. Plot size. Research. Brazil.

Data from 4 trials evaluating cassava cv., carried out at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, BA (Brazil) were used for estimating optimum size of plots with border rows. All variables were measured separately in each one of the 4 rows of the useful plot area. Intraclass correlation coefficients among plot rows, and the optimum no. of rows necessary to minimize the mean variance of a treatment were calculated. The correlation coefficients were low and varied for all the agronomic characteristics and expt., indicating the difficulty of obtaining a single coefficient for general use. The no. of lines/plot calculated also varied, and it was not possible to determine an optimum plot size for all exptl. conditions; however, only in a few cases the plot

had to have more than 16 plants. It seems that for more uniform environmental conditions a smaller plot could be used without affecting precision. (Author's summary) D00

0375

21107 DOMINGUEZ, C. 1983. Historia, avances y espectativas del cultivo de la yuca. (History, advances, and expectations of cassava cultivation). In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.1-12. Span., 12 Refs. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. History. Research. Cultivation. Plant breeding. Processing. Cassava programs. Colombia.

Basic historical, morphological, and economical data on cassava cultivation are given, as well as recent research developments in the obtainment of new var., methods of multiplication, agronomic practices, crop protection, processing, and use as for food and feed purposes. The potential of cassava as an energy foodstuff is stressed. It is grown on poor soils and marginal areas by small farmers in India, Thailand, and Latin America and shows high disease and pest tolerance. National and international programs (e.g., CIAT, Colombia, and IITA, Nigeria) work in collaboration for the production and adoption of high-yielding hybrids and simple, low-cost technologies. CIAT's germplasm bank contains approx. 3000 var. from 15 tropical countries; its breeding program focuses on 6 different edaphoclimatic zones. (Summary by I.B.) D00

0376

21104 DOORMAN, F. 1982. A matter of taste as a matter of fact: the socio-economic context of technological change among cassava cultivators in a northern Colombian village. In Box, L.; Doorman, F., eds. Man and Manihot. Volume 1. Case studies on cassava cultivators. Wageningen, Netherlands. Mededelingen van de Vakgroepen Sociologie van de Landbouwhogeschool, no.3. pp.71-111. Engl., Sum. Engl., 11 Refs., Illus. [Landbouwhogeschool, Hollandseweg 1, 6706 KN Wageningen, Netherlands]

Cassava. Cultivation. Planting. Harvesting. Intercropping. Rotational crops. Socio-economic aspects. Labour. Costs. Marketing. Cassava programs. Research. Colombia.

The social and economic context in which new cassava technology is to be introduced was studied over a period of 4 mo. in the village of Media Luna, on the North Coast of Colombia. The demands this technology must meet to be successful are also surveyed. Main topics of investigation were: occupational structure of the village; farmers' cultivation methods, especially for cassava; use of credit; marketing of crops; land tenancy; use and organization of labor; motives behind production decisions; cooperation among farmers; and farmers' opinions of new CIAT technology. (Author's summary) D00

0377

21405 FUKUBA, H.; DATA, E.S. 1984. Root crop survey in Mindanao. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.31-34. Engl., Illus. [Inst. of Environmental Science for Human Life, Ochanomizu Univ., Otsuka, Bunkyo-ku, Tokyo 112, Japan]

Cassava. Cultivation. Cassava starch. Factories. Maps. Philippines.

A survey on the cultivation and utilization of root crops, especially of cassava, was done around Cagayan de Oro, Mindanao Island, Philippines, in Aug. 1982. In the Claveria exptl. field, about 300 ha are planted to cassava, mainly cv. Java Brown. Cv. Hawaiian 5 was wiped out by CBB (Xanthomonas manihotis). Cassava yields were about 20 t/ha. A cassava plantation of about 125 ha and a cassava starch factory were visited. To keep a reasonable balance between cassava production and starch manufacture (650 bags/day; 50 kg/bag), it would be necessary to increase the capacity of this factory, or to produce cassava chips as raw material for starch manufacturing. (Summary by I.B.) D00

0378

21136 INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES ET DES CULTURES VIVRIERES. 1981. Recherche d'accompagnement sur manioc en Cote-d'Ivoire. (Collaborative research on cassava in Ivory Coast). IRAT Informations no.13:1-2. Fr.

Cassava. Cultivation. Root productivity. Research. Ivory Coast.

A collaborative research program will be initiated in Ivory Coast under the responsibility of the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, to assist in solving production problems of an agro-industrial project covering 2400 ha, of potential significance for regional food self-sufficiency. The program includes: rectifying technical and mechanical aspects of agroindustrial production; var. selection; soil preparation; mineral fertilization; mechanical drying at 30 and at 60 days; cultivation of selected var. CB and Bonoua. Faulty practices for conservation of planting material and poor control of crop weeding accounted for low yields in 1980. Var. CB was found to have a high MC and a strong tendency to lignification with age; 10 other var. will also be tested. Phytosanitary conditions are generally satisfactory, although transportation of plant materials has ceased in view of the presence of Xanthomonas manihotis in surrounding areas. (Summary by I.B.) D00

See also 0354 0485 0501 0504

D01 Soil, Water, Climate and Fertilization

0379

21441 BAKAR, M.Z.A.; NAFIS, A.W.; CHAANG, T.C.; MOHAMAD, A.R. 1982. Distribution, characterization and utilization of problem soils in Malaysia. A country report. Tropical Agriculture Research Series no.15: 41-61. Engl., 34 Refs., Illus. [Malaysian Agricultural Research & Development Inst., Serdang, Selangor, Malaysia]

Cassava. Soil fertility. Soil requirements. Soil analysis. Malaysia.

The distribution, characterization, and utilization of peat, acid sulfate, and sandy beach soils, which constitute the major portion of the problem soils in Malaysia, are discussed. Peat soils occur in the poorly drained inland depressions along the coastal area and, despite their abundance, they have remained comparatively undeveloped. Pineapple is the most extensively cultivated crop on peat in Peninsular Malaysia (20,000 ha) which is ascribed to its adaptability to soil acidity and low fertility. Among possible annual crops are cassava, maize, tomatoes, sweet potatoes, and sorghum; on peat soils in W. Selangor, cassava var. Black Twig yielded 49 t/ha. Acid sulfate soils are commonly found in the coastal region of

Malaysia and in almost all the states of Peninsular Malaysia; they occur in isolated patches in otherwise good soils. These soils have been used for rice production. Fruit trees with acid tolerance and shallow rooted crops can be grown on acid sulfate soils. Sandy beach or Bris soils occur mainly along the east coast of Peninsular Malaysia, and due to the almost total lack of clay, have very poor physical and chemical properties. Coconut, cashew, tobacco, water melon, cabbage, and passion fruit grow satisfactorily on Bris soils. At present, more attention is being paid to the development of saline soils for cultivation. Yields of promising crops are given. (Summary by I.B.) D01

0380

21448 CHAIWANAKUPT, S.; TONGYAI, C. 1982. Improvement and fertilization of acid sulfate soils in Thailand. Tropical Agriculture Research Series no.15:341-350. Engl., 14 Refs., Illus. [Fertilizer Branch, Dept. of Agriculture, Bangkhen, Bangkok, Thailand]

Cassava. Upland farming. Soil requirements. Soil fertility. N. P. K. Fertilizers. Soil impoverishment. Soil analysis. Thailand.

The problems of soil conservation and management with relation to the expansion of cultivated areas and to the productivity of major crops (rice, maize, cassava, sugarcane, soybean, cotton, peanut, mung bean, and kenaf) are analyzed. Many political and socioeconomic difficulties have to be overcome in order to develop stable methods of land use. Development will have to be a gradual transformation of the existing farming system; 70% of the total Thai population consists of subsistence farmers. Upland soil deterioration is discussed as well as the problems associated with upland cultivation. Major problems include underutilization of the land, low cropping intensity, low crop yields due mostly to climate and soil fertility conditions. Methods for increasing crop yields by irrigation (run-off recycling, engineering systems), fertilization (chemical and organic fertilizers), green manures, cover crops (legumes), mulching, and min. tillage are discussed. Any effective remedy must take into consideration better soil and moisture conservation, and fertility improvement through both chemical and organic fertilizers. (Summary by I.B.) D01

0381

21490 GOMES, J. DE C.; CARVALHO, P.C.L. DE; CARVALHO, F.L.C.; RODRIGUES, E.M. 1983. Adubacao organica na recuperacao de solos de baixa fertilidade com cultivo da mandioca. (Use of organic fertilizers in the recovery of low fertility soils planted to cassava). Revista Brasileira de Mandioca 2(2):63-76. Port., Sum. Port., Engl., 18 Refs. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. N. Fertilizers. Manures. P. K. Root productivity. Foliage. Starch productivity. Analysis. Leaves. Mineral content. Brazil.

Four expt. were conducted on a yellow Latosol, sandy clay loam texture, in Cruz das Almas, BA, Brazil, each consisting of a N source corresponding to 40 kg N/ha: (1) manure applied directly to the soil by animals, (2) manure applied to the soil and incorporated, (3) castor bean cake applied to the soil and incorporated, (4) urea applied 60 days after the plant emergence. A randomized block design was used for each expt. with 3 replicates. Within each N source, doses of P (0, 30, 60, and 90 kg/ha) and K (0 and 40 kg/ha), from simple superphosphate and potassium chloride, resp., were studied. Thus each expt. was composed by the following treatments: $N_1P_0K_0$, $N_1P_0K_1$, $N_1P_1K_1$, $N_1P_2K_1$, and $N_1P_3K_1$. Results showed higher efficiency for the

organic sources, and the 1st source promised the highest yield. K had a favorable effect in presence of manure, castor bean cake, and urea; P had a greater effect when applied with the less efficient N sources (urea and castor bean cake). Besides promoting the best yield (38.6 t roots/ha), the 1st source improved the chemical condition of the soil, making further fertilization unnecessary. (Author's summary) DOI

0382

20743 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1981. Management of siliceous Ultisols: K and Mg response of cassava. In _____. Annual report for 1980. Ibadan, Nigeria. pp.31-32. Engl. [IITA, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Soil management. K. Mg. Soil fertility. Root productivity. Nigeria.

In trials on the K and Mg response of cassava cv. TMS 30395 and 30211 carried out on a Ultisol near Onne (Nigeria) in 1978, tuber yields showed a marked response to K application only. (Summary by L.M.) DOI

0383

21433 IRIZARRY, H.; RIVERA, E. 1983. Nutrient and dry matter contents of intensively managed cassava grown on an Ultisol. Journal of Agriculture of the University of Puerto Rico 67(3):213-220. Engl., Sum. Engl., Span., 7 Refs., Illus. [Agricultural Experiment Station, Univ. of Puerto Rico, Río Piedras, Puerto Rico]

Cassava. N. P. K. Mg. Fertilizers. Mineral content. Dry matter. Leaves. Stems. Roots. Timing. Growth. Puerto Rico.

N, P, K, Ca, and Mg contents of cassava cv. Llanera were determined in a clayey Corozal soil (Ultisol) with 3 levels of fertility in Puerto Rico. Half of the fertilizer was applied 1 mo. after planting, and the rest 3 mo. later. Treatments were compared in a design with 4 complete blocks. One plant/plot was harvested at monthly intervals, beginning 3 mo. after planting. The plant was divided into leaves, stems, and roots; fresh and dry wt. were determined, analyzing each part for the different nutrients. The 3 levels of fertility did not affect commercial root production (37.5 MT/ha at 10 mo. after planting). Plants reached a max. content of 204, 12, 222, 86, and 33 kg N, P, K, Ca, and Mg/ha, resp. N and K contents were high, Ca intermediate, and P and Mg low during the whole growth cycle. DM content in stems and roots increased with plant age; however, leaf DM content notably decreased after 6 mo., stabilizing after 8 mo. Nutrient content was always higher in the leaves. Estimations based on the nutrient contents in cassava, nutrient contents available in typical Ultisol soils in Puerto Rico, and the loss of nutrients applied as manures, show that to obtain almost max. yields in cassava it is necessary to apply 272, 32, 249, and 50 kg N, P, K, and MgO, resp., equivalent to approx. 2000 kg of a commercial fertilizer 14-2-13-3/ha. This fertilizer should be applied in 2 equal parts 2 and 6 mo. after planting. Contents of 4.3, 0.12, 1.8, 1.4, and 0.4% N, P, K, Ca, and Mg, resp., in cassava leaves indicated an adequate level of fertilizer. (Author's summary. Trans. by L.M.F.) DOI

0384

21440 McINTOSH, J.L.; ISMAIL, I.G.; EFFENDI, S.; SUDJADI, M. 1982. Cropping systems to preserve fertility of red-yellow podzolic soils in Indonesia. Tropical Agriculture Research Series no.15:297-308. Engl., 10

Refs., Illus. [International Rice Research Inst., Program in Indonesia, P.O. Box 107, Bogor, Indonesia]

Cassava. Soil fertility. Intercropping. Maize. Rice. Cultivation. Soil requirements. Cultivation systems. Soil conservation. Soil analysis. Indonesia.

The importance, physiography, and physical characteristics of red-yellow podzolic soils in Indonesia are discussed. These soils cover about 15% of the country's land area (about 32 million hectares). Climatological data show a tremendous potential for year-round crop production. Traditional land use has involved (1) a sequence of cutting and burning of the forests, production of food crops (3-4 yr), and gradual interplanting of perennial crops; and (2) cutting and burning, and production of food crops until the soil nutrients are lost. The 2nd practice has caused large areas to become infested with Imperata cylindrica. Research on soil and crop management, cropping systems, and cultural practices (land preparation, planting, fertilizing, weeding, pest management, harvest and crop residue management, var. and crop arrangement) is presented. Crops grown on these soils respond dramatically to P and N treatments. Without fertilization and incorporation of residues, production declines. Total calorie production/ha from maize + upland rice intercropped with cassava, followed by peanut and then cowpea in 1 yr exceeds that from 15 t/paddy rice. Data from 6-yr cropping show that yield levels can be maintained and even increased. In transmigration areas with good infrastructure, improved management practices are highly profitable. These soils are fragile and susceptible to erosion and sloughing; continuous covering (cropping, mulching, and terracing) is recommended. Cropping systems with a high proportion of pasture crops are recommended for both hilly and remote areas. (Summary by I.B.) D01

0385

21159 REBOUL, J.L. 1980. Manioc. Compte-rendu de l'essai de fertilisation conduit sur sol ferrallitique de plateau a Taravao, du 15/12/1977 au 28/6/ 1979 (no.193 bis RAPT). [Cassava. Report on fertilization trials carried out on ferrous soils of the Taravao Plateau from 15/12/1977 to 28/6/1979 (no.193 bis RAPT)]. In Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres. Rapport analytique 1979. Paris, Groupement d'Etudes et de Recherches pour le Developpement de l'Agronomie Tropicale, no.1. pp.160-170. Fr., Illus.

Cassava. Fertilizers. N. P. K. Timing. Harvesting. Root productivity. Costs. Tahiti.

An expt. was carried out in Taravao, Tahiti, to determine the most economical fertilizer rate for a local cassava var. and to evaluate its yield. Rates were 0, 150, 300, 600, and 1000 kg KCl/ha, preplanting, and 0, 500, 1000, 2000, and 100 kg urea + 500 kg NPK (12-12-20)/ha, in split applications: presowing and 2 mo. afterwards. The exptl. design consisted of 5 x 5 m plots (25 plants spaced at 1 x 1 m) with 4 replications. Cassava was harvested at 12, 15, or 18 mo. When no fertilizer is used, harvesting should take place at 12 mo. (39 t/ha). For best economic results, fertilizer rates should approximate 120 kg N, 120 kg P, and 376 kg K/ha. Harvest can be done at 12 or at 15 mo. (61 and 75 t roots/ha, resp.). (Summary by I.B.) D01

0386

21434 RIVERA, E.; SILVA, S.; VICENTE-CHANDLER, J. 1983. Distribution of pigeon peas, cassava, coffee and grass roots in an Ultisol. Journal of Agriculture of the University of Puerto Rico 67(3):278-285. Engl., Sum.

Engl., Span., 4 Refs., Illus. [Agricultural Experiment Station, Univ. of Puerto Rico, Río Piedras, Puerto Rico]

Cassava. Rooting. Root system. Soil requirements. Puerto Rico.

The distribution of roots of cassava, pigeon pea, coffee, and 4 grasses growing in Ultisols in Puerto Rico was studied. Cassava plants were spaced at 0.3 m, in rows 2 m apart; 500 kg 10-5-15 were applied per hectare 1 and 4 mo. after planting. Yields of 30,000 kg edible roots/ha were obtained 10 mo. after planting. Cassava was the most shallow rooted of the crops with no roots extending below 105 cm, and few below a 30-cm soil depth. Fleshy edible roots were all found in the upper 30 cm. It also had the lowest density of roots at different depths. with only about 100 cm/l soil in the upper 30 cm of soil. The data presented are important in developing recommendations for irrigating, cultivating, and fertilizing the crops studied and in determining the areas best suited to their production. (Summary by L.M.F.) D01

0387

21485 SOUZA, A.B. DE; BEGAZO, J.C.E.O.; DEFELIPO, B.V.; CARDOSO, A.A. 1983. Fontes e níveis de fertilizantes fosfatados sobre alguns carcteres das raízes da mandioca. (Sources and levels of phosphate fertilizers and their effect on some root characters of cassava). Revista Brasileira de Mandioca 2(2):33-38. Port., Sum. Port., Engl., 19 Refs. [Inst. Agronomico do Paraná, Caixa Postal 129, 84.100 Ponta Grossa-PR, Brasil]

Cassava. P. Minerals. Roots. Plant anatomy. Starch content. Fertilizers. Brazil.

A field expt. was conducted on a red yellow, Cambic podzolic soil in Vicosa, MG, Brazil, to evaluate the effects of sources and levels of P fertilizer on the yield and selected root characters (no., length, diameter, wt., and starch content) of cassava cv. Pao-do-Chile. A randomized block design was used, arranged in a 3 x 4 factorial scheme, with 4 replications. Three sources of P, namely, Araxa phosphate, Patos phosphate, and triple superphosphate, and 4 levels (0, 40, 80, and 120 kg/ha) were used. Plants were harvested 10 mo. after planting. There were no significant differences among the characters studied regardless of P source or level. (Author's summary) D01

See also 0362 0412 0449 0452 0461 0503

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

0388

20742 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1981. Weed control in no-tillage system. In _____. Annual Report for 1980. Ibadan, Nigeria. pp.16-17. Engl., Illus. [IITA, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Weeding. Tillage. Land preparation. Fallowing. Herbicides. Cassava programs. Nigeria.

Weed control in conventional and no tillage cassava was evaluated in an Alfisol in a subhumid climate (International Institute of Tropical Agriculture, Nigeria, 1980). Fallow vegetation (*Panicum maximum*, *Eupatorium odoratum*, *Alchornia laxiflora*, and *Ficus* spp.) was 1st slashed and then

sprayed with 3.0 kg glyphosate a.i./ha. In conventional tillage, the fallow was plowed under and cassava was planted on the flat, spaced at 1 x 1 m, after harrowing. In no tillage, cassava was planted directly into the regrowth. Preemergence herbicides were more effective in conventional than in no tillage cassava. A mixture of metolachlor and fluometuron provided the best weed control. Crop yield was significantly higher in the hand-weeded plot under no tillage, and compared favorably with the preemergence herbicide treatments under conventional tillage. Good cassava yield is possible under no tillage conditions provided that weeds are controlled. (Summary by I.B.) D02

0389

20795 ODIGBOH, E.U.; AHMED, S.F. 1982. A cassava harvester: design analysis and prototype development. Agricultural Mechanization in Asia, Africa and Latin America (Japan) 13(3):40-48. Engl., Sum. Engl., 8 Refs., Illus. [Agricultural Engineering Dept., Univ. of Nigeria, Nsukka, Anambra State, Nigeria]

Cassava. Agricultural equipment. Harvesting. Mechanization. Nigeria.

A prototype cassava harvester with a separately powered rotary knife, mounted in front of the tractor and designed to cut the cassava stems and clear the aboveground vegetation to facilitate the root lifting operations, is discussed. Behind the tractor is mounted the cassava root lifter which is a reciprocating hoe designed to move under the cassava roots to dig and lift them onto a belt which conveys the roots to a collection box at the rear of the machine. The harvested roots are dumped in heaps at intervals along the row for subsequent collection. Single-row harvester field tests on the prototype give a net work rate of more than 0.15 ha/h at a speed of 2.5 km/h which is more than 20 men can achieve by hand. The % of broken, cut, and skinned roots vary somewhat with soil conditions but were less than possible in manual harvesting. (Author's summary) D02

0390

21483 PINHO, J.L.N. DE; TAVORA, F.J.A.F.; MELO, F.I.O.; QUEIROZ, G.M. DE 1983. Conservacao de maniva-semente de mandioca no Ceará. (Storage of cassava stem cuttings in Ceará, Brazil). Revista Brasileira de Mandioca 2(2):1-11. Port., Sum. Port., Engl., 5 Refs. [Empresa de Pesquisa Agropecuária do Ceará, Av. Rui Barbosa, 1246, Aldeota, 60.000 Fortaleza-CE, Brasil]

Cassava. Cuttings. Storage. Plant development. Root productivity. Germination. Dry matter. Brazil.

A field study was conducted in Pacajus, CE, Brazil, to study the effect of 10 different methods and 4 periods of storage (30, 60, 90, and 120 days) on the sprouting and vigor of cassava stem cuttings. A randomized complete block design in split-plot arrangement was used with 4 replications. The methods and periods of storage did not affect the av. no. of shoots/cutting. The % of sprouting was not influenced by the methods and periods of storage up to 90 days. With 120 days of storage there was a small decrease in the % of sprouting. A sharp and pronounced decrease in the vigor of the sprouted cuttings was observed after 30 days of storage; another reduction was also noticed after 90 and 120 days of storage. Storing the stems in bundles both in the normal upright or inverted position, covered with straw, was found to be the best methods tested. Storage enhanced root development compared with the control. (Author's summary) D02

0391

21121 POESPODARSONO, S.; WINARNO, A.; WIJOYO, P. 1976. Survey on Mukibat cassava in East Java. Malang, Indonesia, Universitas Brawijaya. Fakultas Pertanian. 28p. Engl., Illus.

Cassava. Mukibat system. Planting. Land preparation. Grafting. Spacing. Intercropping. Rotational crops. Harvesting. Root productivity. Gaplek. Processing. Roots. Starch content. Labour. Costs. Maps. Java.

The results of a survey on Mukibat cassava, covering 24 districts in 12 regencies in East Java, are given. In each district 4 villages were selected and at least 3 farmers growing Mukibat cassava in each of these villages were questioned giving a total sample of 292 farmers. Overall, the data obtained between the regencies was fairly consistent. Most of the farmers grow both normal and Mukibat cassava in their homeyards and their upland fields. However, it appears from the data that the Mukibat plants perform better than the normal cassava plants. The "average" farmer has 440 Mukibat plants which produce 5-6 t of roots plus 1637 normal cassava plants which produce only 3.3 t of roots. This means that even with their much lower planting density (2500-3500 plants/ha) than that of normal cassava plants (7000-10,000 plants/ha), the Mukibat plants produce 6.5 t more roots/ha. The data also indicate that Mukibat plants give a higher profit margin than normal cassava plants; however, in order to obtain this a higher input is required, which is one of the reasons the Mukibat system is not fully adopted by the farmers. The survey received varied responses from the farmers concerning the many agronomic aspects of the Mukibat planting system, such as land preparation, use of OM and fertilizers, var., planting material and methods of grafting, planting, weedings, moulding, irrigation, intercropping, harvesting, and yield. It also included the farmers' responses to questions on the processing of both normal and Mukibat cassava to make gaplek, and on the differences between normal and Mukibat fresh tubers and leaves. (Summary by J.R.) D02

0392

21158 REBOUL, J.L. 1980. Manioc. Compte-rendu d'un essai de diverses techniques de plantation et de conduite du manioc, realisé a Papara du 27/3/1978 au 20/7/1979 (no.299 RAPT). [Cassava. Report of trials on different cassava planting and management techniques carried out in Papara from 27/3/1978 to 20/7/1979 (no.299 RAPT)]. In Institut de Recherches Agronomiques Tropicale et des Cultures Vivrieres. Rapport analytique 1979. Paris, Groupement d'Etudes et de Recherches pour le Developpement de l'Agronomie Tropicale, no.12. pp.171-182. Fr., Illus.

Cassava. Cuttings. Planting. Root productivity. Harvesting. Timing. Costs. Mechanization. Labour. Polynesia.

In 1978-79 the effects on cassava yields of 2 planting techniques (mechanically on the flat at 1.0 x 0.85 m vs. hand sowing vertically at 1.0 x 1.0 m) were compared in exptl. plots containing 24 cassava plants with 1, 2, or 3 stems in Papara, French Polynesia. Higher yields and economic returns, taking all costs into account, were obtained with vertically hand-sown 2-stemed plants. (Summary by I.B.) D02

0393

21157 REBOUL, J.L. 1978. Mecanisation de la culture du manioc. Compte-rendu de 2 essais de plantation mécanisée du manioc a Tahiti. (Mechanization of cassava cropping. Report of two trials on mechanized cropping of cassava in Tahiti). Paris, Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres. 11p. Fr., Illus.

Cassava. Mechanization. Planting. Cuttings. Agricultural equipment. Tahiti.

Cassava was mechanically sown with a double-row planter-fertilizer mounted on the 3-point hitch of a tractor, with pneumatic wheels and an apron-chain distributor for cuttings, and regulated hilling discs (Gard-Mouzon-Delfosse) in 2 trials conducted at AFAAHITI, Taravao (Tahiti). The feasibility of crop mechanization is conditioned by (1) the use of young cuttings, 2-3 cm in diameter; (2) land clearance of stumps and roots from preceding crop; and (3) tractor speed which should be intermediate (3-4 km/h). Fulfilling these conditions 3000-4000 m^2/h can be sown to cassava with a high level of establishment at 2-3 wk. and good root development at 6 mo. The distributor capacity for fertilizer (500 kg 12-12-20) was too low: 250 kg. (Summary by I.B.) D02

0394

21164 ROCA, W.M.; RODRIGUEZ, J.A.; MAFLA, G.; ROA, J. 1984. Procedures for recovering cassava clones distributed in vitro. Cali, Colombia, Centro Internacional de Agricultura Tropical. 8p. Engl., 9 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Propagation. Clones. Cassava programs. Propagation materials. Colombia.

Guidelines are provided to acquaint the personnel of national programs and other collaborators with the procedures to recover, propagate, and transplant culture materials after their arrival. These include: (1) recovery of the cultures by direct potting of cassava plants after short trips; 1 wk. of 2000 lux illumination, 14-h photoperiod, and 26-28°C temp., after 1-2 wk.-trips; and aseptical excision of available green axillary or terminal bud growth, before proceeding to micropropagation, after trips lasting more than 3 wk.; (2) micropropagation for which procedures, equipment, and illustrations are given, and suppliers are listed; (3) potting, listing the procedures and needed items and including illustrative pictures; (4) explanation of field transplantation procedures and conditions needed for successful results. Brief background information on in vitro methods for the international exchange of cassava clones is presented, as well as complementary references. (Summary by I.B.) D02

0395

20769 WEIR, C.; DEXTER, A. 1974. Cassava. In Jamaica. Ministry of Agriculture and Lands. Investigations 1970-1974. Jamaica. Bulletin no.64. pp.193-196. Engl., 3 Refs.

Cassava. Cultivars. Propagation. Storage. Rooting. Cuttings. Planting. Colombia. Jamaica.

Results are presented of research on cassava propagation methods, storage, and rooting techniques, aimed at improving the situation of the cassava industry in Jamaica. In 1973, 2 introductions from CIAT, Llanera and MCol 22, were propagated in Hope Nursery and Lawrencefield. In Hope Nursery, cuttings with 1-3 buds and 2-bud cuttings split into cylinders were dipped in IBA powder and placed in a mist propagator. Buds germinated after 2 days and rooting was extensive after 12 days. Vaseline was used to seal all cut surfaces, reducing the incidence of rot to almost nil and improving growth performance. However, no success was obtained in the greenhouse. In Lawrencefield, the Colombian introductions were planted in the field together with C 5, No. 69, and No. 30, promising var. from the Bodless Agricultural Station. Expt. undertaken in 1974 showed that tubers packed in moist coir soon after reaping and stored at ambient temp. remained in good

condition for 4 wk.; tubers were also successfully stored for 3 wk. at 13°C after 1 wk. at ambient temp. or above, packed in moist coir. Different rooting techniques were investigated by using cuttings from the entire plant and planting them at an angle in prepared beds, under plastic sheeting or mist propagator. Stakes cut transversely had a higher survival rate (97.2 and 91.2% under plastic sheeting and under mist, resp.). Cuttings with split stems had a high % of loss. Three-node cuttings planted under plastic sheeting are therefore recommended for rapid clonal multiplication. (Summary by I.B.) D02

See also 0384 0397 0449 0508 0511

D03 Energy Productivity and Yields

0396

21475 CORLEY, R.H.V. 1983. Potential productivity of tropical perennial crops. Experimental Agriculture 19(3):217-237. Engl., Sum. Engl., 81 Refs. [Unifield T.C. Ltd., Unit 1, St Martins Way Industrial Estate, Cambridge Road, Bedford, England]

Cassava. Productivity. Root productivity. Dry matter. Growth. Harvest index. Energy productivity. Photosynthesis. Plant respiration. Leaf area. Malaysia.

Large yields and DM production rates have been recorded for tropical perennial crops (oil palm, coconut, rubber, cocoa, cassava, sago, and Leucaena), despite the fact that little research has been done on most of them. Considerable increases in productivity should still be possible, since the potential energy fixation rate for such crops is estimated to be about 1.2 TJ/ha/yr. The DM equivalent of this energy varies between species; the oil crops and rubber, in particular, have large energy contents in their resp. economic products. Hot leaf temp. appear to limit productivity in some crops, while unfavorable partitioning of assimilates limits yield at the large LAI necessary to maximize DM production. Respiratory losses are large in these crops and selection for smaller respiration rates could lead to considerable improvements in their net productivity. (Author's summary) D03

0397

21125 EVENSON, J.P.; KEATING, B.A. 1980. Cassava cultivar evaluation in south-east Queensland. In Australian Agronomy Conference Pathways to Productivity, Lawes, Queensland, 1980. Proceedings. Lawes, Queensland Agricultural College. p.232. Engl., 2 Refs.

Cassava. Cultivars. Selection. Harvesting. Timing. Root productivity. Cultivation. Australia.

The completion of 3 cycles of cassava cv. testing in SE Queensland, Australia, has shown that the best local cv. outyield the imported ones after 1, but not necessarily after 2 growth cycles, and that some cv. may not perform best at the current standard cassava spacing (1 x 1 m). Therefore, in order to make the best selections, future cv. testing will require the critical evaluation of both plant density and growth cycle length. (Summary by J.R) D03

0398

21484 FUKUDA, W.M.G.; CALDAS, R.C.; FUKUDA, C. 1983. Comportamento de cultivares e clones de mandioca resistentes a bacteriose. (Performance of cassava cultivars and clones resistant to bacteriose). Revista Brasileira de Mandioca 2(2):23-31. Port., Sum. Port., Engl., 8 Refs. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cultivars. Root productivity. Foliage. Harvest index. Climatic requirements. Brazil.

The performance of 10 cassava cv. and clones (BGM 214, BGM 266, BGM 204, BGM 413, BGM 211, EAB 672, EAB 652, Clone 245-A, Clone 382, and CPM 19-09), all resistant to bacteriose (Xanthomonas campestris pv. manihotis), was evaluated regarding root production, wt. of aerial parts, total plant wt., and HI, in trials carried out during 1980/81/82 at the Felixlandia Exptl. Station in Minas Gerais (Brazil) in collaboration with the Empresa de Pesquisa Agropecuária de Minas Gerais. A randomized block design was used, with 3 replications the 1st yr and 4 replications the last 2 yr. The interaction cv. x yr was statistically significant for all the characters studied. Cv. BGM 266 had the highest root production over the 3 yr, in spite of the environmental changes from year to year. The year did not have a significant effect on the performance (root yield) of cv. BGM 413, BGM 204, and 2 clones, 245-A and CPM 19-09. There was no significant interaction either between clone CPM 19-09 and the year regarding the rest of the characters studied. Over the 3-yr period, HI was the character least affected by environmental changes. (Author's summary) D03

0399

21173 LORENZI, J.O.; MONTEIRO, D.A.; PEREIRA, A.S.; IGUE, T. 1983. Avaliacao de variedades de mandioca no Estado de Sao Paulo. (Evaluation of cassava varieties grown in the state of Sao Paulo). Bragantia 42:79-89. Port., Sum. Port., Engl., 3 Refs. [Secao de Raízes e Tubérculos, Inst. Agronomico, Caixa Postal 28, 13.100 Campinas-SP, Brasil]

Cassava. Cultivars. Roots. Dry matter. Root productivity. Brazil.

Root production and DM content of cassava var. were determined in 15 var. trials carried out at different sites in the state of Sao Paulo, Brazil. The trials were grouped into 4 series with 10, 12, 12, and 9 var., resp. Plants were harvested at 18 and 24 mo. of age. A randomized block design was used with 4 replications. Combined and individual variance analyses were made. Results showed that only IAC 12-829 yielded more than the check var. Branca de Santa Catarina (39.0 and 25.4 t/ha, resp.). (Author's summary) D03

See also 0363 0381 0392 0417 0449 0450 0451 0452 0453 0454 0456 0457 0458 0459 0460 0461 0506 0508 0510

D04 Postharvest Studies

0400

21411 DATA, E.S.; QUEVEDO, M.A.; GLORIA, L.A. 1984. Pruning techniques affecting the root quality of cassava at harvest and subsequent storage. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press.

pp.127-143. Engl., Sum. Engl., 16 Refs., Illus. [Postharvest Technology Section, Philippine Root Crop Research & Training Center, Visayas State College of Agriculture, Baybay, Leyte 7127-A, Philippines]

Cassava. Pruning. Roots. Storage. Timing. Deterioration. Plant respiration. Vascular streaking. HCN content. Sugar content. Starch content. Fibre content. Water content. Dry matter. Cooking. Organoleptic examination. Post-harvest losses. Post-harvest technology. Philippines.

Plants of cassava cv. Golden Yellow were pruned 1, 2, 3, and 4 wk. before harvest with some plants left unpruned to determine the effect of pruning on physiological, biochemical, chemical, and quality changes of cassava roots at harvest and subsequent storage. Except for polyphenol oxidase (PPO) activity, and crude fiber, sugar, and moisture contents, cassava roots harvested from unpruned plants exhibited higher respiration rate, phenylalanine ammonia-lyase (PAL) activity, and starch, HCN, and DM contents than roots from pruned plants at harvest. The ratings for quality attributes in terms of texture, flavor, and general acceptability were lower in roots harvested from unpruned than pruned cassava plants, while the reverse was true in color and appearance. Regardless of days of storage, respiration rate, wt. loss, vascular streaking, decay, PAL activity, and DM content were higher in roots harvested from unpruned plant than from pruned plants. The reverse was true regarding sugar, crude fiber, and moisture contents. Starch and HCN contents were comparable. The ratings for quality attributes were low for cassava roots harvested from unpruned plants and from plants pruned 4 wk. before harvest compared with cassava roots harvested from plants pruned 1, 2, and 3 wk. before harvest. Respiration rate, wt. loss, vascular streaking, decay, PAL and PPO activities, sugar and crude fiber contents of cassava roots increased with storage time. Starch content and ratings for all quality attributes decreased, while HCN content increased earlier and decreased later during storage. (Author's summary) D04

0401

21422 FUKUBA, H.; MENDOZA, E.M.T. 1984. Intestinal absorption of linamarin. The main cyanogenic glucoside in cassava. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.313-317. Engl., Sum. Engl., 6 Refs., Illus. [Inst. of Environmental Science for Human Life, Ochanomizu Univ., Otsuka, Bunkyo-ku, Tokyo 112, Japan]

Cassava. Linamarin. Absorption. Laboratory animals. Amygdalin. Cyanides. Enzymes. Biochemistry. Animal physiology. Human physiology.

The absorption of linamarin by the intestinal tract of albino rats was studied and the specificity of intestinal beta-glucosidase was determined. Rat intestine absorbed 25% more linamarin than amygdalin. The beta-glucosidase present in the mucosal membrane of rat intestine slightly hydrolyzed both linamarin and amygdalin. The composition of the incubation media must be reconsidered to improve absorption efficiency. Another mechanism for the decomposition of these cyanogenic glucosides, their digestion by digestive juices, should be investigated to clarify the relationship, if any, between these 2 physiological phenomena. (Author's summary) D04

0402

21421 GARCIA, V.V.; LAPITAN, O.B.; FLORES, D.M.; URITANI, I. 1984. Changes in coumarin and phenol content and peroxidase activity as affected by drying methods for cassava root slices and their relation to food quality. In Uritani, I.; Reyes, E.D., eds. Tropical root crops:

postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.299-309. Engl., Sum. Engl., 17 Refs., Illus. [Inst. of Food Science & Technology, Univ. of the Philippines at Los Baños, College, Laguna 3720, Philippines]

Cassava. Biochemistry. Cassava chips. Roots. Cassava flour. Enzymes. Coumarin. Phenol. Drying. Sun drying. Storage. Analysis. Organoleptic examination. Puto. Post-harvest technology. Philippines.

The relationship between methods of making CF and the biochemical changes occurring during drying was investigated qualitatively and quantitatively to establish suitable methods for CF making in tropical regions and the evaluation of food quality of CF or chips. UV-light exposure on the developed TLC plate indicated the presence of the stress coumarin derivatives, scopoletin, esculin, and scopolin, in the alcoholic extracts of CF made from slowly dried chips. The quantitative analysis confirmed that the total amount of coumarins in CF varied according to the methods of preparation/drying. Results also indicated that peroxidase activity depended on modifications in the drying methods. It is proposed that analysis for coumarin content or peroxidase activity may be used as a tool intended for the above-mentioned purposes on CF. Phenols also formed in cassava slices during drying, but appeared to be oxidized quickly. Thus, the amount of phenols was not well correlated with the methods of making CF. To investigate the relationship between coumarin and phenol contents and peroxidase activity and the food quality of flours made from dried cassava chips, the nonfermented puto samples from the flours of the chips made from the healthy tissues of the roots that were stored for 0, 10, and 20 days were subjected to sensory evaluation. Secondary metabolite contents and the peroxidase activity in cassava chips were inversely correlated with the quality of the flours. (Author's summary) D04

0403

21414 GLORIA, L.A.; URITANI, I. 1984. Changes in beta-carotene content of Golden Yellow cassava in relation to physiological deterioration. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.163-168. Engl., Sum. Engl., 13 Refs., Illus. [Dept. of Agricultural Chemistry & Food Science, Visayas State College of Agriculture, Baybay, Leyte 7127-A, Philippines]

Cassava. Roots. Analysis. Carotenoids. Cultivars. Deterioration. Post-harvest technology. Philippines.

The changes in beta-carotene content in roots of cassava cv. Golden Yellow are discussed in relation to physiological deterioration. Most of the orange pigment in the roots was found to be beta-carotene. The content of beta-carotene in the tissue ranged between 10-70 micrograms/g dry wt. in the parenchyma tissue, and was less in the outermost part (A-part) than in the intervening part (B-part, where physiological deterioration occurred) which in turn was less than in the innermost part (C-part). The content in the B- and C-parts decreased following the appearance of physiological deterioration and depended on its severity. (Author's summary) D04

0404

21407 HIROSE, S.; DATA, E.S.; QUEVEDO, M.A. 1984. Changes in respiration and ethylene production in cassava roots in relation to postharvest deterioration. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.83-98. Engl., Sum. Engl., 24 Refs., Illus. [Dept. of Land

Development, College of Agriculture & Veterinary Medicine, Nihon Univ., Setagaya-ku, Tokyo 154, Japan]

Cassava. Plant physiology. Roots. Deterioration. Plant respiration. Timing. Cultivars. Storage. Ethylene. Analysis. Post-harvest losses. Post-harvest technology. Philippines.

Expt. were conducted to examine changes in respiration and ethylene production in cassava root pieces or slices and to elucidate the effect of endogenous and exogenous ethylene on physiological deterioration. Respiratory rates of root pieces with artificial injury increase were found to rapidly reach a peak 1 day after harvest and another max. peak 4 or 5 days later. The respiratory rate of the intact roots was lower than that of the injured root pieces. Var. difference in respiratory rate was observed. Cv. Golden Yellow and Kadabao showed higher rates of respiration than cv. Hawaiian-5 (H-5). A slight difference in the degree of deterioration was observed between intact roots and root pieces with different kinds of injury. Moreover, root pieces with a high degree of physiological deterioration showed higher respiratory rates than the intact roots with a low degree of physiological deterioration. Av. wt. losses during 4 days after harvest, under low and high humidity condition were 2.92 and 0.88%, resp. Cv. with both a higher respiratory response and wt. loss seemed to develop slightly greater deterioration than others. A time course study on respiratory rate and the development of physiological deterioration showed that the 1st peak was due to wound respiration and the 2nd to biochemical changes induced by the development of physiological deterioration. Ethylene was produced in root slices in detectable concn. 15-16 h after incubation reaching max. value after 1 day of incubation. Ethylene production in cassava slices was higher than in sweet potato slices. Var. differences in the amount of ethylene production were observed in the following order: cv. Golden Yellow more than cv. CCS-1984 more than cv. H-5 more than cv. CCS-167. Deteriorated root slices with vascular streaking scores of 4.0 produced 4 times as much ethylene as the nondeteriorated slices. A comparison of ethylene production in the 4 parts of cassava root with histologically different characteristics revealed that cv. H-5 produced much more ethylene in the cortex and in the A-part than in other parts, whereas cv. Golden Yellow produced much more ethylene in the A-part but less in the cortex and other parts. To clarify the effect of exogenous ethylene, ethrel (500 ppm) was applied to root pieces. Ethylene production, enhanced by ethrel treatment, seemed to have little effect on the occurrence and development of physiological deterioration. Although exogenous ethylene apparently stimulated physiological deterioration occurrence and development, conclusions as to its effect were not reached. (Author's summary) D04

0405

21408 HIROSE, S.; DATA, E.S.; MATURAN, E. 1984. Relation of respiration and ethylene production to postharvest deterioration in cassava roots from pruned and unpruned plants. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.99-107. Engl., Sum. Engl., 23 Refs., Illus. [Dept. of Land Development, College of Agriculture & Veterinary Medicine, Nihon Univ., Setagaya-ku, Tokyo 154, Japan]

Cassava. Pruning. Plant respiration. Ethylene. Roots. Deterioration. Timing. Cultivars. Plant physiology. Post-harvest technology. Philippines.

Changes in the respiratory rate and ethylene production in roots or tissue blocks from pruned (2 wk. before harvest) and unpruned cassava plants were compared in relation to the occurrence of physiological deterioration. The

effects of endogenous and exogenous ethylene on physiological deterioration were also investigated. Cassava roots used were harvested from the Philippine Root Crop Research and Training Center. Results showed that roots from pruned plants deteriorated more slowly than roots from unpruned plants, and that pruning delayed the occurrence of physiological deterioration. Differences in the respiratory rate between tissue blocks from pruned and unpruned plants were not clear, except that freshly prepared tissue blocks from pruned plants had a lower respiratory rate than tissue blocks from unpruned plants. The 1st increase in respiratory rate of tissue blocks was ascribed to wounding and the 2nd increase after 3 days of storage to biochemical changes induced by physiological deterioration. A slight quantitative difference in ethylene production was observed between tissue blocks from pruned and unpruned plants. The peak of ethylene production in the tissue blocks from unpruned plants appeared 1 day earlier than in the tissue blocks from pruned plants. Endogenous ethylene did not have a direct effect on the occurrence of physiological deterioration. Tissue blocks from cv. Golden Yellow produced 14 times as much ethylene as those from cv. Hawaiian-5, indicating var. difference in ethylene production. The respiratory rate in the ethrel-treated tissue blocks showed little or no difference when compared with that of the unpruned plants. Slight development of physiological deterioration was observed in the ethrel-treated tissue blocks, tending to occur in tissue blocks from both pruned and unpruned plants. (Author's summary) D04

0406

21417 KAWABATA, A.; SAWAYAMA, S.; ROSARIO, R.R. DEL; NOEL, M.G. 1984. Effect of storage and heat treatment on the sugar constituents of tropical root crops. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.243-258. Engl., Sum. Engl., 9 Refs., Illus. [Dept. of Nutrition, Tokyo Univ. of Agriculture, Sakuragaoka, Setagaya-ku, Tokyo 156, Japan]

Cassava. Roots. Storage. Sugar content. Timing. Sucrose. Fructose. Glucose. Linamarin. Inositol. Water content. Leaves. Analysis. Post-harvest technology. Phillippines.

The effect of storage and heat treatments on the sugar constituents of tropical root crops were investigated. Roots of cassava cv. Lakan and Vassourinha and 1 cv. each of sweet potato and yambean (Pachyrrhiuns erosus) were stored under ambient conditions for 18-28 days. Wt. loss was 11.5 and 16.8% for cv. Vassourinha and Lakan, resp. Sugar content was determined by high performance liquid chromatograph. Total sugar content increased during the 1st 2 wk. and the results obtained indicated that metabolic changes occurred during storage. The ratio of fructose and glucose to total sugar content increased while that of sucrose decreased. The ratio of inositol and linamarin content to total sugar content slowly decreased during storage. The linamarin content increased markedly in 7 days and continued to increase for several days, then decreased gradually and almost disappeared before decay. In the case of cv. Vassourinha, root deterioration was exhibited faster than in cv. Lakan. Boiling, roasting, and drying all tended to increase the total sugar content of cassava roots. Linamarin content, however, was significantly affected by the heat treatment. After boiling of whole leaves of cv. Datu (bitter type), there was a change in the linamarin content, but not much. However, on boiling of the finely cut leaves, the linamarin content decreased markedly. The pectic substances were extracted fractionally into 4 fractions from roots; the water-soluble pectin tended to increase, while protopectin showed a slight decrease at the end of storage. The apparent changes occurring in tissue during storage of cassava roots were observed under a scanning electron microscope. (Author's summary) D04

0407

21410 TANAKA, Y.; DATA, E.S.; LAPE, V.C.; VILLEGAS-GODOY, C.D.V.; GORGONIO, M.A.; HIROSE, S. 1984. Effect of pruning treatment on physiological deterioration and related biochemical changes in cassava roots. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: post-harvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.119-125. Engl., Sum. Engl., 13 Refs., Illus. [Radioisotope Center, Nagoya Univ., Chikusa, Nagoya, Aichi 464, Japan]

Cassava. Pruning. Deterioration. Biochemistry. Enzymes. Roots. Analysis. Timing. Coumarin. Phenol. Plant physiology. Post-harvest technology. Philippines.

The changes in some enzyme activities, production of coumarins and phenols, and MC in the A (outermost)-, B (intervening)-, and C (innermost)-parts of 1.5 cm thick tissue blocks and of intact roots coming from pruned and unpruned cassava plants of cv. Golden Yellow were studied. Activities of L-phenylalanine ammonia-lyase, peroxidase, and acid invertase developed during incubation in all root parts although they were lower in pruned plants. Activities of these enzymes in the intact root from the pruned plant were lower than in tissue blocks from the pruned plant and were less than in the intact root from the unpruned plant. A similar pattern was observed in the production of coumarins as in the development of the activities of these enzymes between the tissue blocks or intact roots from the pruned and unpruned plants. The effect of the pruning treatment in retarding physiological deterioration in cassava roots may be partly based on the toughening of the cellular structure of the root tissue of both the outer and inner parts, thus reducing mechanical injury at harvest and during handling. (Author's summary) D04

0408

21412 TANIGUCHI, T.; DATA, E.S.; BURDEN, O.J.; GORGONIO, M.A.; UMERES, E. 1984. Production of antifungal substances in cassava roots in response to physiological and microbial deterioration. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.145-149. Engl., Sum. Engl., 15 Refs., Illus. [Plant Pathology Laboratory, Faculty of Agriculture, Nagoya Univ., Chikusa, Nagoya, Aichi 464, Japan]

Cassava. Roots. Deterioration. Pythium. Botryodiplodia theobromae. Plant tissues. Analysis. Post-harvest technology. Philippines.

The production of antifungal substances was examined both in cassava root tissues showing physiological deterioration and in tissues adjacent to those showing rotting by infection with Pythium sp. (WF) and Botryodiplodia theobromae (BT). The tissues were homogenized separately with ethanol and then filtrated off. The filtrates were concentrated in a vacuum. The concentrates then were again taken up in ethanol, and chromatographed on the thin-layer chromatographic (TLC) plates. The chromatograms were studied under an UV lamp for the presence of fluorescent spots. The extracts from freshly harvested (H) and nonphysiologically deteriorated (-PD) roots did not show clear fluorescent spots but physiologically deteriorated (+PD) and fungus-inoculated (WF and BT) ones did. After that, the spots on the plate were made visible with 1% vanilline in ethanol and a mixture of acetic acid and H_2SO_4. More spots were observed on the chromatograms of deteriorated tissues (+PD, WF, and BT) than those of nondeteriorated ones (H and -PD). Other plates were chromatographed as above, sprayed with the spore suspension of Alternaria alternata, and kept in a moist chamber for 2 days. Spots which showed antifungal activity were observed on TLC plates of physiologically and microbially deteriorated cassava root tissues but not in the case of healthy ones. (Author's summary) D04

0409

21406 TANIGUCHI, T.; HIROSE, S.; DATA, E.S. 1984. Types of postharvest deterioration of cassava roots. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.79-81. Engl., Sum. Engl., 13 Refs. [Plant Pathology Laboratory, Faculty of Agriculture, Nagoya Univ., Chikusa, Nagoya, Aichi 464, Japan]

Cassava. Roots. Deterioration. Vascular streaking. Post-harvest technology. Philippines.

The relationship between the types of symptoms of primary (physiological) and secondary (microbial) deterioration of cassava roots is briefly described and discussed. (Extracted from author's summary) D04

0410

21409 URITANI, I.; DATA, E.S.; VILLEGAS, R.J.; FLORES, P. 1984. Changes in secondary metabolism in cassava roots in relation to physiological deterioration. In _____.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.109-118. Engl., Sum. Engl., 17 Refs., Illus. [Faculty of Home Economics, Nagoya Women's Univ., Shioji-cho, Mizuho, Nagoya, Aichi 467, Japan]

Cassava. Plant physiology. Deterioration. Roots. Enzymes. Biochemistry. Coumarin. Phenols. Analysis. Storage. Timing. Post-harvest technology. Philippines.

The relationship between biochemical changes and physiological deterioration in roots of cassava cv. Golden Yellow is discussed. When cassava roots were stored, coumarins and phenols were produced and the activities of phenylalanine ammonia-lyase and peroxidase were activated in every part of the parenchyma tissue, namely, the outermost tissue (called the A-part), the intervening tissue (called the B-part), and the innermost tissue (called the C-part), in parallel with the occurrence of physiological deterioration in the B-part. In many cases, more secondary metabolites were produced in the B-part than in the A- and C-parts. Parenchyma tissue blocks were divided into the A-, B-, and C-parts and separately incubated, together with undivided parenchyma tissue blocks. In both cases, metabolic changes occurred in the A-, B-, and C-parts, but physiological deterioration was induced only in the B-part. (Author's summary) D04

0411

21401 URITANI, I.; REYES, E.D., eds. 1984. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. 328p. Engl., 242 Refs., Illus. [Faculty of Home Economics, Nagoya Women's Univ., Shioji-cho, Mizuho, Nagoya, Aichi 467, Japan]

Cassava. Roots. Deterioration. Biochemistry. Plant physiology. Microbiology. Processing. Detoxification processes. Post-harvest losses. Post-harvest technology. Philippines.

Results are presented for a cooperative research program carried out during 1981-83 between the Philippines and Japan, to promote rural development in the Philippines and tropical regions of the world. Research work focuses on postharvest physiology and processing. The different studies undertaken on root crops are documented. Surveys on the present status of root crop

production and processing are outlined. Cassava is highlighted considering its future potential; postharvest handling is emphasized. (Summary by I.B.) D04

See also 0366 0367 0370 0478 0494 0495

E00 PLANT PATHOLOGY

0412

21428 COCK, J.H.; BELLOTTI, A.C.; LOZANO, C. 1981. Cassava: integrated crop protection with high yield technology. In International Congress of Plant Protection, 10th., Brighton, England, 1983. Proceedings of a conference; plant protection for human welfare. London, British Crop Protection Council. v.3,pp.1173-1182. Engl., Sum. Engl., 17 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Insect control. Disease control. Biological control. Integrated control. Plant breeding. Intercropping. Cultivars. Resistance. Weeding. Colombia.

The importance of cassava and its potential as a source of energy for the tropics are discussed. It is the 4th most important source of food energy in the area, with a relatively stable yield of ca. 9 t/ha. The implications of new technologies for the development of crop protection systems are presented, with special emphasis on changes from traditional systems of management, which base crop protection on host plant tolerance and partially on the overall production system which limits pest population. A natural balance among pests, their natural enemies, and tolerant var. has evolved in the Americas. In Africa and Asia the no. of pests is lower; however, in Africa newly introduced pests are devastating the crop, in the absence of natural enemies and resistant var. The implications of a narrower gene pool are described. New high-yielding var. will not be physiologically as tolerant of diseases and pests, and of weed competition as traditional ones. These factors tend to increase the probability of severe epidemics. The development of multiple plant resistance, use of good quality planting material, biological control, improved mixed cropping systems, and other low cost management practices can greatly reduce the chances of pest and disease damage. (Summary by I.B.) E00

E02 Bacterioses

0413

20745 BACH, E.E.; ALBA, A.P.C.; RODRIGUES NETO, J. 1982. Detection of strains of Xanthomonas campestris pv. citri (Hasse) Dye by enzyme-linked immunosorbent assay (ELISA). Fitopatologia Brasileira 7(3):407-415. Engl., Sum. Engl., Port., 34 Refs. [Inst. Biologico, Caixa Postal 7119, 01000 Sao Paulo-SP, Brasil]

Cassava. Laboratory experiments. Xanthomonas manihotis. Brazil.

Xanthomonas campestris pv. citri strains A and C were distinguishable from one another by the double antibody sandwich ELISA in cell suspensions, extracts from mild acid hydrolyzed cells of both strains, and in extracts from lesions of citrus leaves infected with strains A and C. Positive reactions occurred between 1 isolate of X. campestris pv. manihotis and the immunoglobulin (Ig) from antiserum for strain A, but no reaction was observed between Ig from antiserum for strain C and this isolate. Possibilities of the application of ELISA in the serodiagnosis of X. campestris pv. citri are discussed. (Author's summary) E02

0414

20762 DANIEL, J.F.; BOHER, B. 1982. Quelques aspects de la survie et de la dissemination de l'agent causal de la bacteriose vasculaire du manioc: Xanthomonas campestris pathovar manihotis. (Aspects of survival and dissemination of the causal agent of cassava bacterial blight: Xanthomonas campestris pv. manihotis). Brazzaville. Office de la Recherche Scientifique et Technique Outre-Mer. 10p. Fr., 5 Refs., Illus. [Office de la Recherche Scientifique et Technique Outre-Mer, Centre de Brazzaville, B.P. 181, Brazzaville, Congo]

Cassava. Xanthomonas manihotis. Disease transmission. Congo.

Several mechanisms that favor the survival and dissemination of Xanthomonas campestris pv. manihotis under the ecological conditions of Congo (Central Africa) are described: survival of epiphytic populations on leaves of cassava or on adventitious plants; conservation in the host tissues, in the grains, in plant debris, and in some insects as Zonocerus variegatus and Pseudotheraptus devastans. Conservation of bacteria in host tissues together with the host's capacity to pass through an infectious cycle are the most effective survival mechanisms from one crop cycle to the next. (Summary by I.B.) E02

0415

21144 MARCANO, M.; TRUJILLO, G. 1981. Papel de malezas y otras plantas cultivadas en relación a la perpetuación de Xanthomonas campestri pv. manihotis (Berthet & ondar 1915) Dye 1978 causante del añublo bacteriano en la yuca (Manihot esculenta Crantz). (Role of weeds and other plants in the perpetuation of Xanthomonas campestris pv. manihotis, causal agent of cassava bacterial blight). Maracay, Universidad Central de Venezuela, Facultad de Agronomía. 1p. Span. [Univ. Central de Venezuela, Maracay, Venezuela]

Cassava. Xanthomonas manihotis. Weeds. Venezuela.

The perpetuation of rifocin-resistant isolates of Xanthomonas campestris pv. manihotis (10^9 cells/ml, by foliar spraying) on different plant species was investigated. Periodic sampling was done (4 marked leaves/observation). Labeled plates were kept under lab. conditions (27°C; 70% RH) until development (more than 48 h). The pathogen survived up to 54 days under favorable ambient conditions (high RH, rains and clouds) on the following species: Paspalum paniculatum, Panicum fasciculatum, Sorghum halepense, Amaranthus sp., Acalypha alopecuroide, Emilia sonchipholia, Euphorbia heterophyla, Desmodium tortuosum, and Ageratum conzyoides. Survival was difficult under adverse ambient conditions (3 days). (Summary by I.B.) E02

0416

5744 OKPALA, E.U. 1974. Cultural and biological control of bacterial blight of cassava caused by Xanthomonas manihotis (Burkholder). In _____.; Glaser, H.J., eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st., Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station. pp.33-38. Engl., 8 Refs.

Cassava. Xanthomonas manihotis. Disease control. Biological control. Cultural control. Nigeria.

Factors favoring CBB (Xanthomonas manihotis) and possible methods of cultural/biological control are reviewed. Possible sources of entry/infection are: infected cuttings or knives, natural openings such as stomata and

lenticels, aphids, leaf hoppers, mites and insects (through wounds or as vectors), root infection, wind during rainy spells, animals and men, long growing seasons, exposure of cut ends of planting stakes above the soil surface, planting at beginning of rains (abundance of inoculum in the air). Suggested control measures are: use of healthy cuttings (methyl bromide potassium dichromate, formaldehyde, or thymol dippings are recommended, as well as streptomycin sulphate); use of resistant cv.; destruction of insects (regular spraying of Dimicron, lindane, Vetox 85, and other insecticides); roguing and burning of infected stands; tar-coating of upper ends of stakes; and planting in Aug.-Sep.-Oct. A discussion related to the systemic nature of the fungus and to the definition of the disease as wilt or blight is included. (Summary by I.B.) E02

0417

21429 OTIM-NAPE, G.W. 1981. The effects of bacterial blight on germination, tuber yield and quality of cassava. In International Congress of Plant Protection, 10th., Brighton, England, 1983. Proceedings of a conference; plant protection for human welfare. London, British Crop Protection Council. v.3,p.1205. Engl., 3 Refs. [Sere Agricultural Research Station, P.O. Soroti, Uganda]

Cassava. Xanthomonas manihotis. Root productivity. Germination. Uganda.

In field expt. conducted in 1980-81 different levels of CBB severity were generated by planting mixes of CBB-free and CBB-infected stem cuttings, in order to determine the effects of the disease on germination, tuber yield, and quality of cassava. Combination of CBB-infected to CBB-free stem cuttings were: 0:100, 25:75, 50:50, 75:25, and 100:0%. CBB-infected stems were obtained from 15-mo. old plants with 4 or 5 CBB severity in a previous CBB screening trial, and CBB-free stems from plants rooted by the shoot tip method. Germination of cuttings decreased from 97.9 to 81.6% with increasing levels of the disease; disease incidence, severity, leafspots/ plant, and leaf blights/plant increased from 55.0 to 73.4, 1.3 to 2.7, 1.1 to 26.7, and 3.2 to 23.5%, resp. Fresh tuber yield and no. of marketable tubers decreased from 40.1 to 26.6 t/ha and from 418.6 to 298.3 marketable tubers, resp., while the no. of unmarketable tubers increased from 100.0 to 209.4. (Summary by I.B.) E02

0418

20758 WEBER, G.F. 1973. Cassava (Manihot esculenta Crantz). In _____. Bacterial and fungal diseases of plants in the tropics. Gainesville, Florida, University of Florida Press. pp.105-111. Engl., 9 Refs.

Cassava. Xanthomonas cassavae. Xanthomonas manihotis. Erwinia cassavae. Rosellinia. Fomes lignosus. Phyllosticta manihotae. Diplodia theobromae. Gloeosporium manihotis. Glomerella cingulata. Septogloeum manihotis. Cercospora caribaea. Cercospora henningsii. Helminthosporium heveae. Verticillium dahliae.

The symptoms, etiology, and causal agents of several cassava diseases are given that presented: leaf spots (Xanthomonas cassavae, Erwinia cassavae, Phyllosticta manihotae, Septogloeum manihotis, Cercospora caribaea, Cercosporidium henningsii, and Helminthosporium heveae); wilt (X. manihotis, Verticillium dahliae); root rot (Rosellinia bunodes, Fomes lignosus); cankers (Diplodia theobromae); withertip (Gloeosporium manihotis); dieback (Colletotrichum gloeosporioides f. manihotis) and other 19 fungi associated with cassava. (Summary by I.B.) E02

See also 0449

E03 Mycoses

0419

20761 BOHER, B.; DANIEL, J.F. 1982. L'anthracnose du manioc en Republique Populaire du Congo. (Anthracnose of cassava in the People's Republic of Congo). Brazzaville. Office de la Recherche Scientifique et Technique Outre-Mer. 9p. Fr., 7 Refs., Illus. [Office de la Recherche Scientifique et Technique Outre-Mer, Centre de Brazzaville, B.P. 181, Brazzaville, Congo]

Cassava. Glomerella manihotis. Inoculation. Plant damage. Congo.

Data are presented on symptomatology of anthracnose in cassava in the People's Republic of Congo. Wilting of tips, young stems, apices, and leaves of cassava plants is widespread in savanna zones, of high importance for cassava growing, and less so in the forest areas. In the plains region, the pathogens Colletotrichum gloeosporioides f. manihotis and Xanthomonas campestris pv. manihotis were detected through isolation in nutritive medium, and by indirect immunofluorescence (X. campestris). The 2 parasites were found in 32 out of 34 cassava var. tested, and a Nigerian strain, C.q., was found in only 2 var. Inoculations of X. campestris by leaf infiltration (108 bacteria/ml) caused stem and leaf wilt. Inoculation of C. gloeosporioides only induced the formation of small cankers. In the lab., a deep stem wound was necessary to obtain symptom expression when an aggresive strain of Colletotrichum was used. Pseudotheraptus devastans played an important role in canker formation; this insect is widespread and active throughout the year. The Congolese cv. evaluated are divided into: (1) those that do not allow fungal penetration, the fungus surviving in melanized appresoria; (2) those that permit penetration but mycelium remains intraepidermal; and (3) those in which penetration is followed by rapid colonization of the foliar mesophyll, with fructification in 72 h. (Summary by I.B.) E03

See also 0408 0418 0453 0454 0459

E04 Viroses

0420

21432 BOCK, K.R.; WOODS, R.D. 1983. Etiology of African cassava mosaic disease. Plant Disease 67(9):994-995. Engl., Sum. Engl., 7 Refs. [Kenya Agricultural Research Inst., Crop Virology Research Project, Nairobi, Kenya]

Cassava. Cassava African mosaic virus. Etiology. Kenya.

Isolates of both the type and coast strains of CLV were inoculated mechanically to the mosaic-sensitive cassava cv. N Mex 55, in which they induced symptoms typical of CAMD. CLV was recovered from these infected plants by standard sap-transmission inoculations to Nicotiana benthamiana and gemini particles were subsequently detected in leaf-dip preparations of them, indicating that this virus is in fact the causal agent of mosaic disease. Transmission rates were low (4/20 and 10/50 for CLV-C and CLV-T, resp.) when partially purified virus preparations from infected N. benthamiana were used as inocula but were comparatively high (11/26) when partially purified preparations of CLV-C from mosaic-affected cassava were used. It is apparent that the name cassava latent virus is no longer valid and that the pathogen should be referred to as cassava mosaic virus. (Author's summary) E04

0421

21464 BOCK, K.R. 1982. Kenya: avoiding cassava mosaic disease. Span (Inglaterra) 25(1):11-13. Engl., Sum. Engl., Fr., Span., Germ., 8 Refs., Illus. [Kenya Agriculture Research Inst., Crop Virology Research Project, P.O. Box 30148, Nairobi, Kenya]

Cassava. Cassava African mosaic virus. Resistance. Plant breeding. Epidemiology. Symptomatology. Kenya.

The CAMD, widespread in Kenya, affects over 80% of cassava plants in some districts, and on small farms, it is possible that practically all of the plants will be affected. Yields are reduced by 70% and tolerance has not been found among the tested var. The mosaic disease is transmitted in the field by the whitefly Bemisia tabaci and by vegetative propagation of diseased plant cuttings. In Kenya healthy plants of hybrids and local var. have been selected and disease-free plots have been established. Results of studies on the rate of spread of CAMD in healthy cassava plots have showed that the rate of reinfection is less than 2% over a 12-mo. growth period, regardless of plot size, its location, and annual or geographical climatic variations. All of the var. used in the expt. contained a level of resistance high enough to withstand the local infection pressure. The use of diseased planting material is the main cause of CAMD dissemination. Mosaic-free material from var. resistant to inoculation should be planted. Breeding for a higher degree of tolerance is not appropriate for the epidemiology of the disease in Kenya, although it can be useful under different climatic regimes in which the possibilities of infection are constantly high. (Author's summary. Trans. by L.M.F.) E04

0422

21145 ZERPA V., M.E. 1981. Estudio de una enfermedad viral en el cultivo de yuca. (Study of a viral disease of cassava). Maracay, Universidad Central de Venezuela, Facultad de Agronomía. 42p. Span., 32 Refs. [Univ. Central de Venezuela, Dept. de Fitopatología, Maracay, Venezuela]

Cassava. Viroses. Etiology. Venezuela.

A viral disease attacking commercial cassava crops in Monagas, Venezuela, was studied using (1) mechanical inoculation and (2) grafting. The inoculum was prepared with distilled water, phosphate buffer at pH 7.2, carborundum, and young leaves from infected samples at La Toscana, Costo Abajo, Orocual, Cachipo, and El Tropical. Infected cuttings were also rooted in a liquid medium with a mycoplasma-detecting antibiotic. Yields of diseased plants were determined; healthy plants showed better statistical performance for root wt. and no. Heat treatments with vapor or microwaves had no effects on disease control. It was concluded that: (1) the disease is not caused by a mycoplasma, (2) disease transmission was possible only by grafting, and (3) the virus was not identified but symptoms relate to typical leaf vein mosaic virus symptomatology. A literature review on major viral diseases is included. (Summary by I.B.) E04

See also 0453 0454

E06 Nematodes

See 0491

F00 PEST CONTROL AND ENTOMOLOGY

F01 Injurious Insects and their Control

0423

21115 ARIAS, B.; REYES, J.A. 1983. Cría masal de Erinnyis ello (L) (Lepidoptera:Sphingidae) gusano cachón de la yuca. [Mass rearing of the cassava hornworm, Erinnyis ello (Lepidoptera:Sphingidae)]. In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.343-351. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Erinnyis ello. Insect control. Entomology. Integrated control. Colombia.

As mass rearing is a prerequisite for a continuous, timely, and adequate supply of material for biological studies of insect pests, a methodology for mass rearing of Erinnyis ello is presented, adaptable to specific problems and needs. Materials, facilities, procedures, and special cares in colony management are listed. Illustrations are also provided on the design of breeding, mating, and ovipositions cages; a tray for transportation of pupae; and on sexual differentiation of E. ello. (Summary by I.B.) F01

0424

21469 BASTOS, J.A.M. 1981. Ataque do mandarová da mandioca, Erinnyis ello (Linné, 1758) em plantio de manicoba do Ceará, Manihot glaziovii Muell. Arg. [Attack of the cassava hornworm, Erinnyis ello, in Ceara rubber tree crops (Manihot glaziovii)]. Fitossanidade 5(1):55-56. Port., Sum. Engl., 1 Ref., Illus. [Conselho Nacional de Desenvolvimento Científico e Tecnológico, Caixa Postal 2071 JA, 60.000 Fortaleza-CE, Brasil]

Cassava. Manihot glaziovii. Erinnyis ello. Entomology. Brazil.

The cassava hornworm (Erinnyis ello) was reported to have caused severe damage in Ceara rubber tree crops in the municipality of Maranguape, CE, Brazil, during 1983. (Author's summary) F01

0425

21467 BASTOS, J.A.M.; ALVES, V.P.O. 1981. Levantamento populacional do trips vermelho da manicoba, Retithrips syriacus (Mayet, 1980) em manicoba. (Population survey of Retithrips syriacus in Ceara rubber trees). Fitossanidade 5(1):1-6. Port., Sum. Engl., Port., 2 Refs., Illus. [Conselho Nacional de Desenvolvimento Científico e Tecnológico, Caixa Postal 2071 JA, 60.000 Fortaleza-CE, Brasil]

Manihot glaziovii. Thrips. Injurious insects. Entomology. Brazil.

In 1981 and 1982, Retithrips syriacus insects were collected from 10 Ceara rubber trees (Manihot glaziovii) in Maranguape, CE, Brazil, and transferred to the lab. for counting. Data showed a linear growth trend for R. syriacus during both years, except during the host plant dormancy period. (Author's summary) F01

0426

21468 BASTOS, J.A.M. 1981. Ponteiro seco em manicoba do Ceará, Manihot glaziovii Muell. Arg. (Dried branches of the Ceara rubber tree, Manihot glaziovii). Fitossanidade 5(1):47-49. Port., Sum. Engl., 4 Refs., Illus.

[Conselho Nacional de Desenvolvimento Científico e Tecnológico, Caixa Postal 2071 JA, 60.000 Fortaleza-CE, Brasil]

Manihot glaziovii. Hypotenemus obscurus. Entomology. Brazil.

Results of trials carried out with monocrotophos and omethoate to control the attacks of Hypotenemus obscurus in crops of Manihot glaziovii are briefly discussed. (Summary by L.M.F.) F01

0427

21112 BELLOTTI, A.C. 1983. Control integrado de las plagas de la yuca. (Integrated pest control in cassava). In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.249-264. Span., 17 Refs. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Insect control. Mite control. Integrated control. Mononychellus tanajoa. Phenacoccus manihoti. Aonidomytilus albus. Tetranychus urticae. Oligonychus peruvianus. Aleurotrachelus socialis. Vatiga manihotae. Vatiga illudens. Silba pendula. Chilomina clarkei. Anastrepha manihoti. Anastrepha pickeli. Eudiplosis brasiliensis. Thrips. Colombia.

In order to improve cassava yields, measures to achieve integrated pest control (biological control + host plant resistance + cultural practices) and to keep pest population levels under the economic injury threshold are recommended. Minor losses in cassava yields due to insects and mites include: death of young plants (up to 20%), reduced no. of active shoots, small losses in root no., and small reductions in leaf area. Major losses are due to: reduced leaf longevity and photosynthetic rate, severe stem damage, and death of young plants (less than 30%). Tables are included on var. resistance to pests in cassava (no. of lines evaluated, levels and mechanisms of resistance) and on natural enemies of mites and insect pests (information on predators, parasites, and pathogens). Some cultural practices generally recommended are related to selection of cuttings, land clearance (crop residues), sowing time, intercropping, crop rotation, weed control, var. multiplicity, and use of insecticides. Suggestions on the integrated control of Erinnyis ello and the complex of cassava pests in specific ecosystems are included. (Summary by I.B.) F01

0428

21114 BELLOTTI, A.C.; REYES, J.A.; VARELA, A.M. 1983. Observaciones de los piojos harinosos de la yuca en las Américas; su biología, ecología y enemigos naturales. (Observations on mealybugs in the Americas: their biology, ecology, and natural enemies). In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.313-339. Span., 28 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Phenacoccus manihoti. Phenacoccus herreni. Phenacoccus. Entomology. Ecology. Predators and parasites. Biological control. Integrated control. Colombia.

Different aspects of the biology, ecology, and natural enemies of mealybugs, especially Phenacoccus herreni and P. manihoti, are described. The results of greenhouse observations of P. herreni on M-Col 113 cassava seedlings are reported. Sexual dimorphism is apparent in the 2nd instar. The oval-shaped, cream-colored female goes through 4 instars (7.7, 5.1, 5.6, and 24.8 days, resp., the last being the adult stage). The male goes through 4 nymphal stages: 7.5; 6.0; 2.8 (prepupal stage); and 3.1 days

(pupal stage), resp. No parthenogenesis was observed. The av. egg laying period lasted 18.4 days (773 eggs). Field expt. have shown that the wind is the main disseminating factor for mealybugs; other factors are infected cuttings and crop residues, and long storage periods. Losses due to mealybugs are reported; root reductions caused by P. herreni in Brazil may reach 80%, and force cassava farmers in Pernambuco to change to a new crop. Approx. 25 parasites of P. gossipyii, P. herreni, and P. manihoti (23 belonging to Encyrtidae) have been recorded in the Americas in addition to 43 predators. Expt. on the frequency and effectiveness of natural enemies and the problem of hyperparasitism are reported. (Summary by I.B.) F01

0429

21108 BORRERO, H.M.; BELLOTTI, A.C. 1983. Estudio biológico de el chinche de encaje Vatiga manihotae (Hemiptera:Tingidae) y de uno de sus enemigos naturales Zelus nugax Stal (Hemiptera:Reduviidae). [Biological study of the lace bug Vatiga manihotae (Hemiptera:Tingidae) and one of its natural enemies, Zelus nugax (Hemiptera:Reduviidae)]. In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.163-167. Span., 8 Refs. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Vatiga manihotae. Insect biology. Predators and parasites. Entomology. Integrated control. Colombia.

The biological cycle of both Vatiga manihotae and its predator Zelus nugax, and the predatory capacity of the latter were studied under screenhouse (23°C; 72% RH) and lab. (22°C; 67% RH) conditions. The biological cycle of V. manihotae covered 68.8 and 72.3 days for males and females, resp.; incubation, 12.6 days; nymphal period, 17.3 days; and adult longevity, 38.9 and 42.3 days for males and females, resp. The biological cycle of Z. nugax covered 107.7 days for males, and 120.4 days for females; incubation, 14.6 days; nymphal period, 56.8 days; adult longevity, 36.3 and 49.0 days for males and females, resp. Z. nugax preyed on an av. of 496 Vatiga individuals, showing preference for adult insects. Highest predation % were recorded for the 4th and 5th instars (21.97 and 55.21%, resp.). Z. nugax reared on a diet based solely on Vatiga did not reach normal development (one out of every 60 individuals reached the 4th instar). Erinnyis ello and Galleria mellonella could be a more balanced source of nutrients; 3 nymphs reared on E. ello completed their cycles, and 8 reached the adult stage when reared on G. mellonella. (Summary by I.B.) F01

0430

21487 FARIAS, A.R.N.; BELLOTTI, A.C. 1983. Parasitismo de ovos de Erinnyis ello e Erinnyis alope em condicoes de campo. (Parasitism of Erinnyis ello and E. alope eggs under field conditions). Revista Brasileira de Mandioca 2(2):45-49. Port., Sum. Port., Engl., 8 Refs. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Erinnyis ello. Erinnyis alope. Predators and parasites. Biological control. Brazil.

In order to determine the degree of parasitism of Erinnyis ello and E. alope eggs by Trichogramma and Telenomus under field conditions, 113 samples were collected, without determined dates, from Sept. 1978-March 1980, in Cruz das Almas, BA, Brazil, throughout the whole cassava cycle. Eggs were taken to the lab. and placed individually in vials for observation of parasitism. It was observed that from 3170 collected eggs, 3031 (96%) were of E. ello and 139 (4%) of E. alope. From the E. ello eggs,

2120 (70%) larvae hatched and 713 (24%) were not fertile, being or not parasitized. From the E. alope, 110 (79%) larvae hatched. Of the total no. of E. ello eggs, 198 (6%) were parasitized by Trichogramma spp. and Telenomus sp., being 62 (31%) parasitized by Trichogramma and 136 (69%) by Telenomus. From the total no. of E. alope eggs collected, only 2 (1%) were parasitized by Telenomus. It was observed, also, that an av. 18.7 adults of Trichogramma emerged from each egg, with a min. of 5 and max. of 44, and for Telenomus, an av. 4.6 adults emerged from each egg, with min. of 1 and max. of 8. (Author's summary) F01

0431

20778 GELOSI, A. 1982. Punteruolo del riso (Sitophilus oryzae Linneus). [Rice weevil (Sitophilus oryzae)]. Informatore Fitopatologico 32(12):31-34. Ital., Illus.

Cassava. Injurious insects. Sitophilus oryzae. Storage. Insect control.

Notes are given on the morphology, biology, and control of Sitophilus oryzae and on the damage that it causes on rice and various cereal grains, pulses, cassava, and pasta in storage. It has 6-7 generations in Italy, which overlap, each lasting 40 days, in hot summer weather; the adults and occasionally the larvae overwinter within the rice grains. The most common parasite is Lariophagus distinguendus, and Anisopteromalus calandrae (Aplastomorpha calandrae) and Choetospila elegans are also present. Control consists of thorough cleaning of cereal storehouses and of containers and vehicles used for transportation, and treatment with the contact insecticides malathion, pirimiphosmethyl, dichlorvos, or pyrethrins, or with the fumigants, phosphine, methyl bromide, carbon disulfide, or a mixture of carbon tetrachloride with dichloroethane or dibromoethane. (Summary by Review of Applied Entomology) F01

0432

21124 INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT. 1983. Africa-wide project for biological control of cassava pests. Rome, Italy. 75p. Engl., Illus. [IFAD, 107, Via del Serafico, 00142 Rome, Italy]

Cassava. Cassava programs. Biological control. Phenacoccus manihoti. Mononychellus tanajoa. Predators and parasites. Costs. Economics. Africa.

The 5-yr Africa-wide project for biological control of cassava pests, initiated by the International Fund for Agricultural Development, aims to achieve biological control of 2 dangerous insect pests, the cassava mealybug (Phenacoccus manihoti) and the green spider mite (Mononychellus tanajoa), which are causing about $1.8 billion worth of damage annually and threatening the livelihood of many African people. Biological control is considered to be the most rapid and effective action to prevent the destruction of cassava production in tropical Africa before the end of the century. The project is designed in 2 parts: research and development, and a control campaign. Research and development include the intensification of the search for natural enemies of the 2 pests in South America, their place of origin, as well as further studies on both insect taxonomy and on cassava production as part of a mass-rearing system for natural enemies. It is responsible for the release of natural enemies using ground release methods, and a pilot operation for aerial release in Nigeria. The designs and contract documents for the construction of a mass-rearing insectary and for equipment for insect packaging and aerial release are also covered. The control campaign, which runs parallel with research and development in terms of time, firstly comprises of preliminary activities which include the construction of the insectary and support facilities and the

augmentation of the electrical generating capacity of the International Institute of Tropical Agriculture (IITA) to serve the mass-rearing enterprise, and secondly of aerial releases of natural enemies on a large scale whenever requested by national governments. Although the organization and management of this project is based at IITA, where the initial successful research has recently been undertaken, the project includes collaboration with many institutions throughout the world. (Summary by J.R.) F01

0433

21445 LAL, S.S. 1981. An ecological study of the whitefly, Bemisia tabaci (Genn.) population on cassava Manihot esculenta Crantz. Pestology 5(1):11-17. Engl., Sum. Engl., 11 Refs. [Indian Agricultural Research Inst., Regional Station, Kanpur-24, U.P., India]

Cassava. Entomology. Bemisia. Ecology. Cultivars. HCN content. Leaves. N. P. K. Insect population. Manihot glaziovii. Fertilizers. Predators and parasites. India.

Ecological aspects of Bemisia tabaci, an important insect pest and vector of the cassava mosaic disease, were studied over a 2-yr period, 1976-78. Studies on population dynamics revealed that June, July, Aug., and Oct. were the months of max. population abundance. Correlation with weather factors showed that RH, coupled with rainfall, played a major role and influenced whitefly population. Max. temp. under Trivandrum (India) conditions did not show much fluctuation, ranging from 29.4 to 32.9°C only, whereas optimum max. temp. required was reported to be from 21 to 35°C. From 6.81 to 29.50% parasitization of whitefly population by Prospaltella flava, a chalcid parasite, was observed. Host-parasite relationship showed that parasite activity seems to play a decisive role in regulating the whitefly population besides abiotic factors. Investigation on Manihot glaziovii, an important host plant being used as a scion on cassava stock for higher tuber yield, harbored higher population of whiteflies in the early growth stage but fewer no. in the latter stage in comparison with M. esculenta. Ninety-eight var. representing hybrids; selections, and germplasm collections were evaluated for var. performance. Var. were classified into highly susceptible, moderately susceptible, less susceptible, and moderately resistant with 29, 35, 33, and 1 var. in each group, resp. Estimation of HCN content leaves of var. showing varying population of B. tabaci did not indicate any definite relationship with HCN content and var. susceptibility to the whitefly incidence. Investigations on the influence of age of leaf demonstrated that younger leaves had more population density than older ones. The influence of mineral fertilizers on B. tabaci populations was studied. Results showed that application of higher rate of NPK resulted in higher no. of whiteflies. Among different combinations of NPK with P as constant, the combination of N and K in the ratio of 1:1 resulted in fewer no. of whiteflies in comparison with other ratios. (Author's summary) F01

0434

20787 LIU, Z.C.; SUN, Y.R.; WANG, K.R.; WU, J.Q.; CHEN, D.J.; ZHEN, J.C.; LIANG, Y.F.; TAN, L.C. 1982. [Studies and demonstrations of large-scale rearing of Philosamia cyntia ricina on an artificial diet]. Guangdong Nongye Kexue no.3:35-36. Chin. [Inst. of Plant Protection, Guangdong Academy of Agricultural Science, Guangzhou, Guangdong, China]

Cassava. Leaves. Uses. Silkworm. Entomology. China.

In Guangdong, China, in 1981, larvae of Samia cynthia ricini (Philosamia cynthia ricini) were reared on an artificial diet based on dried cassava

tubers and leaves, soybean, wheat bran, yeast, and citric acid. The av. % survival, adult emergence and cocoon shell production, and the no. of eggs laid/female were only slightly lower than when the larvae were reared on fresh cassava leaves. It was found by experimentation that the amino acid content of the dried cassava leaves had a significant effect on larval development and that if the content was more than 30% lower than that in fresh leaves, cocoon spinning was delayed and survival and oviposition decreased. (Summary by Review of Applied Entomology) F01

0435

21169 LOPES, E.B. 1982. Ocorrencia da cochonilha dos brotos da mandioca (Phenacoccus herreni) no Estado da Paraíba. (Presence of the mealybug Phenacoccus herreni in the state of Paraiba). Lagoa Seca-PB, Brasil, Empresa Estadual de Pesquisa Agropecuária da Paraíba. Comunicado Técnico no.1. 2p. Port. [Empresa Estadual de Pesquisa Agropecuária da Paraíba, 58.117 Lagoa Seca-PB, Brasil]

Cassava. Phenacoccus herreni. Productivity. Entomology. Brazil.

The mealybug Phenacoccus herreni is reported attacking several microregions in the state of Paraiba (Brazil), where the pest is completely acclimatized and losses in CM production are as high as 40-60%. Pest symptoms are described. The most severe attacks were reported for cv. Amazoninha and Pé-de-Pombo in the municipality of Aracagi and for Amazoninha, Nao Tem, and Bujona in Guarabira. Cv. Verdinha (10-15% pest attack) and Olho Frio were the least susceptible. Direct application of ethyl parathion (0.1% a.i.) on infested parts is recommended. Triona B, a mineral oil, may also be applied at 1.5 l/ha when the 1st symptoms appear. (Summary by I.B.) F01

0436

21116 MARTIN, C.A.; ARIAS, B. 1983. Método de recolección, transporte y establecimiento de Polistes erythrocephalus (L tr.). (Method for the collection, transport, and establishment of Polistes erythrocephalus). In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.353-358. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Erinnyis ello. Biological control. Integrated control. Predators and parasites. Polistes. Entomology. Colombia.

A method is given for establishing Polistes erythrocephalus colonies near cassava crops to control Erinnyis ello. Materials needed are listed. An appropriate work outfit is required for the collection of nests (5:30 pm on). Nests and wasps are introduced into inflated plastic bags which are then sealed. The nest is carefully forced out of the bag by softly pressing the peduncle with the hand; at the same time CO_2 is injected into the bag to still the wasps and put them into glass jars. The nests and jars are labeled and transported to huts, the latter being transported in iced thermos bottles made of Icopor. Procedures for the transportation and establishment of Polistes are described, and designs of different types of huts are given. (Summary by I.B.) F01

0437

21150 NSIAMA SHE, H.D.; ODEBIYI, J.A.; HERREN, H.R. 1984. The biology of Hyperaspis jucunda (Col.:Coccinellidae) an exotic predator of the cassava mealybug Phenacoccus manihoti (Hom.:Pseudococcidae) in southern Nigeria. Entomophaga 29(1):87-93. Engl., Sum. Engl., Fr., 7 Refs., Illus. [Dept. of Agricultural Biology, Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Phenacoccus manihoti. Entomology. Predators and parasites. Nigeria.

The biology of Hyperaspis jucunda, an imported predator of Phenacoccus manihoti in Nigeria, was studied in growth chambers at 27°C and 75% RH; incubation period averaged 5.1 days. The 1st, 2nd, 3rd, and 4th larval instar averaged 2.5, 2.8, 3.4, and 5.0 days, resp. Larval development was completed in about 13.8 days while pupae took 7.1 days. Total developmental time averaged 26.4 days. Mean longevity was 100 and 101 days for males and females, resp. The premating period was 19-24 h while the preoviposition period averaged 6.3 days. The generation cycle (egg to egg) averaged 32.8 days. The oviposition period was about 93 days during which females laid an av. of 456 eggs. The long life span and oviposition period of H. jucunda may constitute desirable characteristics in predator-prey interaction. (Author's summary) F01

0438

21111 REYES, J.A.; BELLOTTI, A.C. 1983. Insectos asociados con nidos de Polistes spp. en cinco regiones de Colombia. (Insects related to nests of Polistes spp. in five regions of Colombia). In _____., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.241-246. Span., 10 Refs. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Entomology. Predators and parasites. Polistes. Erinnyis ello. Integrated control. Colombia.

Natural enemies of Polistes erythrocephalus were identified in different regions of Colombia (Valle del Cauca, Cauca, Caldas, and Quindio) and of P. canadensis in Magdalena in order to develop future strategies tending to reduce their harmful effects on these important predators of the cassava hornworm, Erinnyis ello. Nineteen insects were identified: 10 Hymenoptera, 3 Coleoptera, 2 Lepidoptera, 2 Diptera, 1 Psocoptera, and 1 Strepsiptera. These are presented in table form and include site where found, species, and relation with Polisces spp. Oxysarcodexia sp. is the most frecuently found parasite of Polistes larvae and pupae (17% of the collected nests); 4 parasites of Oxysarcodexia were also found. (Summary by I.B.) F01

0439

21117 REYES, J.A.; ARIAS, B. 1983. Manejo y métodos de liberación de Trichogramma en yuca. (Management of Trichogramma and methods for their release in cassava). In _____., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.359-362. Span., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Erinnyis ello. Predators and parasites. Biological control. Trichogramma. Integrated control. Colombia.

Factors affecting the release of Trichogramma for the biological control of Erinnyis ello are discussed: quality of Trichogramma lab. materials which includes cleanliness, a min. of 85% parasitism/in., more females than males, and parasitism and hatching dates; timing of release and distribution in the field. The paper bag and plastic jug methods are explained and illustrations are included. (Summary by I.B.) F01

0440

21106 REYES, J.A., comp. 1983. Yuca: control integrado de plagas. (Cassava: integrated pest control). Cali, Colombia, Centro Internacional de

Agricultura Tropical. 362p. Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Injurious insects. Injurious mites. Insect control. Mite control. Integrated control. Resistance. Entomology. Cassava programs. Colombia.

Due to the increasing extension of areas planted to cassava in tropical countries, the maintenance of biological equilibrium through adequate integrated control techniques becomes imperative as well as the collection of data on var. resistance, biological control, and cultural practices. Basic information for integrated pest control is given. Arthropods attacking cassava are described regarding yield losses, biology, morphology, and ecology. Criteria for the establishment of a control program on var. resistance are discussed and techniques for germplasm evaluation and new developments on var. resistance to mites and insects are described. Biological control is discussed in detail: beneficial agents and their use, population studies, identification and management of hyperparasites. A conceptual framework is provided and recommendations are given for the control of economically important pests. Mass rearing techniques and methods for the collection, handling, and establishment of beneficial agents are included. (Summary by I.B.) FOI

0441

21489 SCHMITT, A.T. 1983. Ocorrencia de inimigos naturais de Erinnyis ello (L.) no Estado de Santa Catarina. (Occurrence of natural enemies of Erinnyis ello in the state of Santa Catarina, Brazil). Revista Brasileira de Mandioca 2(2):59-62. Port., Sum. Port., Engl., 15 Refs. [Empresa de Pesquisa Agropecuária de Santa Catarina, Estacao Experimental de Itajaí, Caixa Postal 277, 88.300 Itajaí-SC, Brasil]

Cassava. Erinnyis ello. Predators and parasites. Biological control. Brazil.

An expt. was carried out during 1982 to determine the occurrence of natural enemies of Erinnyis ello in 3 different regions of the state of Santa Catarina, Brazil: Alto Vale do Itajaí, Baixo Vale do Itajaí, and Litoral Sul. Eggs and larvae were collected from cassava fields in these regions and grown in the lab. Besides a no. of virus-infected larvae, the following natural enemies were identified: Euphorocera sp., Criptophion sp., Belvosia sp., Trichogramma sp., and Telenomus sp. Polistes sp., Calosoma sp. Podisus sp., Chrysopa sp., and Apanteles sp. were only observed in the field. (Author's summary) FOI

0442

20777 UMEH, E.D.N.N. 1983. Towards a biological control of cassava mealybug: Phenacoccus manihoti Mat.-Ferr. (Homoptera, Pseudococcidae). Revue de Zoologie Africaine 97(1):60-64. Engl., Sum. Engl., 2 Refs., Illus. [Dept. of Science Technology, Inst. of Management & Technology, Enugu, Nigeria]

Cassava. Phenacoccus manihoti. Insect control. Biological control. Predators and parasites. Nigeria.

In a survey of the natural enemies of Phenacoccus manihoti on cassava in SE Nigeria in Dec. 1980, the predacious coccinellid Hyperaspis marmottani was found to be particularly abundant. On an exptl. farm, the coccinellid annihilated the mealybug population in 7 mo. In the lab., larvae and adults of H. marmottani killed their prey by mechanically injuring them and by

predation. The coccinellid was secretive, hiding under egg masses and in cracks and curled up leaves. The coccinellid was attacked by an unknown parasite. (Summary by Review of Applied Entomology) F01

0443

20785 WEEMS JUNIOR, H.V. 1982. Anastrepha striata Schiner (Diptera: Tephritidae). Gainesville, Florida Department of Agriculture and Consumer Services. Entomology Circular no.245. 2p. Engl., 4 Refs., Illus. [Division of Plant Industry, P.O. Box 1269, Gainesville, FL 32602, USA]

Cassava. Entomology. Anastrepha striata.

Notes are given on the distribution in the Americas, food plants, morphology, and detection of Anastrepha striata, which is very common and destructive to some tropical fruits in private gardens in Florida (USA) but is not considered to be of primary economic importance. It prefers guava, other food plants including mango and the seed pods of cassava. Adults may be collected by means of baited traps and sticky boards. (Summary by Review of Applied Entomology) F01

See also 0412 0448 0449 0459 0489

F03 Injurious Mites and their Control

0444

21113 BELLOTTI, A.C.; REYES, J.A.; GUERRERO, J.M.; FERNANDEZ O., F. 1983. Acaros presentes en el cultivo de la yuca y su control. (Mites in cassava crops and their control). In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.283-304. Span., 21 Refs. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Mononychellus tanajoa. Mononychellus caribbeanae. Tetranychus cinnabarinus. Oligonychus peruvianus. Mite control. Biological control. Predators and parasites. Entomology. Integrated control. Colombia.

General aspects of the biology and habits of phytophagous mites, of both primary and secondary importance, attacking cassava crops are presented as well as their characteristic damages to the crops and their economic importance. Some management and control methods are recommended: var. resistance, and biological, cultural, and chemical control measures. Brief reference is made to biotic and abiotic factors affecting mite populations. Approx. 40 mite species have been identified, some of which cause economic losses in different cassava growing areas around the world. Sixteen mite species have been reported attacking cassava in Colombia, the most important ones being Mononychellus tanajoa, M. caribbeanae, Tetranychus cinnabarinus, and Oligonychus peruvianus. Taxonomic data are given for important species. Main differences between Mononychellus, Tetranychus, and Oligonychus are presented in table form. (Summary by I.B.) F03

0445

21182 BYRNE, D.H.; BELLOTTI, A.C.; GUERRERO, J.M. 1983. The cassava mites. Tropical Pest Management 29(4):378-394. Engl., Sum. Engl., 158 Refs. [Dept. of Horticultural Sciences, Texas A & M Univ., College Station, Texas 77843, USA]

Cassava. Injurious mites. Acarology. Mite control. Biological control. Predators and parasites. Resistance. Selection.

Cassava is attacked by about 50 species of mites. Of these, the most important are Mononychellus tanajoa, M. progresivus, M. caribbeanae, Tetranychus urticae, and T. cinnabarinus. These arthropods cause 3 patterns of damage and have been shown to cause a decrease in root and stake yield of up to 87 and 82%, resp. It is expected that as cassava is further commercialized there will be a greater tendency towards monocropping in large fields and towards the more frequent use of broad spectrum pesticides. As a result, mites as well as other pests will probably increase in importance. Future research should be directed towards a mite management system which combines the use of resistant var., cultural practices, biological control, and occasional use of selective acaricides. Research up to this point on the biological control of cassava mites has been done with the Mononychellus mites. This work primarily reports on the identification and life cycle studies of the important predators. Although the potential losses due to mites have been shown to be high, the mite population level which is damaging to cassava yield is not known. This economic damage level should be estimated with respect to mite populations and/or foliar damage. When the mite population rises above this level it will be necessary to correct the situation by mass release of predators or selective killing of the mites. Good resistance exists. Resistance to the Mononychellus mite is due to several separate mechanisms which when combined promise to result in a stable resistance. Although less work has been done on resistance to Tetranychus and other cassava mites, preliminary data and literature from other crops suggest that the development of resistant cassava var. is a viable strategy. Given the ease of use and safety of this control method it should be encouraged. Suggestions for future work on all aspects of control are discussed. (Author's summary) F03

0446

21110 GUERRERO, J.M.; BELLOTTI, A.C.; REYES, J.A. 1983. Control de los ácaros en yuca mediante la utilización de sus enemigos naturales. (Mite control in cassava by using natural enemies). In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.221-226. Span., 18 Refs. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Also in ASIAVA no.8:17-18. 1984.

Cassava. Mononychellus tanajoa. Tetranychus urticae. Predators and parasites. Biological control. Mite control. Integrated control. Colombia.

Information is given on natural enemies of the cassava mites Mononychellus tanajoa and Tetranychus urticae, which drastically reduce yields of susceptible var. A total of 41 beneficial agents have been reported attacking phytophagous mites worldwide. Some pathogens attacking mites are: Entomophthora sp., which attacks up to 100% of the female adults of Eutetranychus banksi in addition to T. urticae and T. cinnabarinus; Pseudomona aeruginosa attacking T. urticae; and Hirsutella thompsonii, which attacks Phyllocoptruta oleivora. Predaceous mites are: Phytoseiulus persimilis, which controls T. urticae; Typhlodromalus limonicus and Neoseiulus anomymus which eat the eggs and active stages of M. tanajoa. Phytoseiidae mites are more efficient predators than beneficial insects when mite populations are low. They can consume 25-50% of mite progeny. Oligota minuta, an important predaceous insect, preys on all stages of M. tanajoa; adults eat a total of 97-142 eggs and mites over 7-16 days. Stethorus shows preference for Tetranychus spp. Resistant var. are essential for delaying the presence of mites and for regulating mite populations through biological control. (Summary by I.B.) F03

0447

20775 PUTTASWAMY; CHANNABASAVANNA, G.P. 1982. Influence of host plants on the reproductive biology of Tetranychus neocaledonicus (Acari: Tetranychidae). Indian Journal of Acarology 6(1-2):72-76. Engl., Sum. Engl., 3 Refs. [Dept. of Entomology, Agricultural College, Hebbal, Bangalore-560024, India]

Cassava. Acarology. Tetranychus neocaledonicus. India.

The effect of selected crops (mulberry, castor bean, cassava, and Amaranthus viridis) on the development, fecundity, and longevity of Tetranychus neocaledonicus was studied in the lab., at a temp. ranging from 23 to 26°C and 74-81% RH. The mites reached maturity on all the hosts tested. The duration of the developmental time from egg to adult was significantly longer on cassava (12.11 days) than on castor bean, A. viridis, and mulberry (10.48, 10.20, and 10.14 days, resp.). Mites fed castor bean and mulberry laid 209.83 and 185.33 eggs, resp., compared with A. viridis and cassava with 147.42 and 87 eggs/female. Mites fed cassava had a shorter life cycle (16.62 days) compared with those fed A. viridis (27.69 days), castor bean (26.32 days), and mulberry (23.55 days). (Author's summary) F03

See also 0412 0427 0432 0440 0448 0449 0454

G00 GENETICS AND PLANT BREEDING

G01 Breeding, Germplasm, Varieties and Clones, Selection

0448

21109 BELLOTTI, A.C.; KAWANO, K. 1983. Mejoramiento para resistencia varietal en el cultivo de la yuca. (Breeding for varietal resistance in cassava). In Reyes, J.A., comp. Yuca: control integrado de plagas. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.171-194. Span., Sum. Span., 23 Refs., Illus. [CIAT, Apartado Aéreo 6713, Cali, Colombia]

Cassava. Plant breeding. Germplasm. Resistance. Cultivars. Mononychellus tanajoa. Tetranychus urticae. Oligonychus peruvianus. Aleurotrachelus. Aonidomitylus albus. Phenacoccus manihoti. Coeolosternus. Carpolonchaea chalybea. Silba pendula. Entomology. Integrated control. Colombia.

Background genetic data for Manihot esculenta and criteria for developing a program for the obtainment of resistance are considered. Breeding for resistance to insects and mites has a high potential value and should also be considered as an economically viable alternative since pesticides and other control measures are often too expensive for this little valued crop. Screening focuses on pests attacking cassava during its growth cycle (8-12 mo.) for long periods of time, namely, mites, thrips, lace bugs, mealybugs, and whiteflies which cause substantial yield reductions. Breeding systems are described. The conventional pedigree method is successful when resistance characters are controlled by dominant genes; the procedure becomes more complicated when resistance characters are controlled by recessive genes, demanding double crossing between high-yielding resistant hybrids or var. When working with additive genes, the source of resistance should be identified 1st and then the progeny with increased resistance is screened out. Once a superior type has been found, it can be indefinitely multiplied. High levels of resistance to thrips and moderate levels of resistance to mites and whiteflies have been found. Techniques for germplasm

evaluation and screening procedures for insect and mite resistance are described. The following points are important under field, lab., or screen-house conditions: (1) a large and varied germplasm collection, (2) screening under high pest populations, and (3) a reliable and exact damage scale. (Summary by I.B.) G01

0449

21455 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO NACIONAL DE PESQUISA DE MANDIOCA E FRUTICULTURA. 1984. Programa Nacional de Pesquisa de Mandioca. (National Research Program on Cassava). In _____. Relatório técnico anual do Centro Nacional de Pesquisa de Mandioca e Fruticultura 1983. Cruz das Almas-BA, Brasil. pp.119-155. Port., Sum. Port., Engl., 26 Refs.

Cassava. Cassava programs. Germplasm. Foliage. Leaves. Stems. Productivity. Root productivity. Starch content. Agronomic characters. Cultivars. Adaptation. Selection. Erinnyis ello. Biological control. Insect control. Predators and parasites. Phenacoccus. Phenacoccus herreni. Injurious mites. Bacterioses. Resistance. Mycorrhizae. Inoculation. N. P. Fertilizers. HCN content. Timing. Soil fertility. Root system. Plant, development. Land preparation. Rotational crops. Intercropping. Soybeans. Brazil.

The National Research Program for Cassava in Brazil included, in 1983, 113 projects conducted in 22 states. This program has generated important information about the behavior of cv. in diverse regions of the country, adequate planting and harvesting times, efficiency of intercropping systems, rational fertilization formulas, and occurrence and control of insects and diseases. The Centro Nacional de Pesquisa de Mandioca e Fruticultura coordinated the technical activities of the Cassava Program and also conducted in 1983, 20 projects under the supervision of a multi-disciplinary team of 15 researchers. The main results obtained have shown that cassava is largely dependent on the association with mycorrhizas for its normal development. Through preliminary evaluations some cv. with high levels of tolerance to the green mite, Mononychellus tanajoa, were identified and still others have shown good yield potential in Cruz das Almas-BA, Felixlandia-MG, and Sinop-MT. Reduced tillage, attained by lack of plowing in alternate cycles or soil preparation only in the planting rows, reduced the cost of soil preparation up to 75%. The efficiency of Bacillus thuringiensis in the control of the hornworm (Erinnyis ello) was confirmed and preliminary results have shown the efficiency of cattle manure as a N source for cassava fertilization. (Author's summary) G01

0450

21425 FUKUDA, W.M.G.; SILVA, S. DE O.E.; CALDAS, R.C. 1983. Avaliacao e selecao de cultivares de mandioca em Cruz das Almas, Bahia. (Evaluation and selection of cassava cultivars in Cruz das Almas, Bahia). Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Boletim de Pesquisa no.4. 21p. Port., Sum. Engl., Port., 10 Refs. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Cultivars. Selection. Root productivity. Starch content. Dry matter. Harvest index. Foliage. Germplasm. Brazil.

Cassava cv. from the germplasm collection at the Centro Nacional de Pesquisa de Mandioca e Fruticultura were evaluated and selected in Cruz das Almas, BA, Brazil, on the basis of fresh root production, starch and DM contents in roots, and HI. A wide variability was observed in relation to

the studied characters. Cv. with high root production potential (approx. 39 t/ha) were identified. During the observation period (3 crop cycles) some cv., which were superior to local cv. BGM 116 or Cigana Preta with regard to root yield (130% relative profit), were selected indicating the possibility of obtaining a rapid increase in production just through selection. Root yield was positively correlated with HI, root DM, and no. of roots/plant, while the HI was negatively correlated with plant height and aerial part wt. (Author's summary) G01

0451

21133 INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES ET DES CULTURES VIVRIERES. 1981. Collection clones de manioc. Observations 1980. (Cassava clone collection: observations made in 1980). In _____. Rapport des activités en 1980. Guyane. Fiche d'essai no.18. 7p. Fr. [IRAT, 110, rue de l'Université, 75.007, Paris, France]

Cassava. Cultivars. Selection. Sweet cassava. Bitter cassava. Flowering. Root productivity. Leaves. Stems. Starch content. Dry matter. Starch productivity. Timing. French Guiana.

Sixty-three sweet and bitter cassava var. from Brazil, Surinam, Madagascar, and Guyana, forming part of the Guiana Collection of the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, were observed regarding days to flowering; leaf, stem, and root yields; N content, and DM and starch %. Trials were conducted on slopes with ferrous soil previously sown to maize, at Cabassou. The exptl. design consisted of one 16-ft. row/var. The whole cycle lasted 12 mo. NPK was applied as well as herbicides and insecticides. Highest yielding var. were: Pretinha, MU 15, MU 16, Importé 54, MU 13, and MU 17 for starch production; MU 22, MU 24, MU 20 for leaf production; and MU 22, MU 20, Pretinha, MU 16 Courge sauvage, and Galibi for ensilage of the whole plant. (Summary by I.B.) G01

0452

21132 INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES ET DES CULTURES VIVRIERES. 1981. Essai varietal manioc. (Cassava varietal trial). In _____. Rapport des activités en 1980. Guyane. Fiche d'essai no.23. 6p. Fr., 3 Refs. [IRAT, 110, rue de l'Université, 75.007, Paris, France]

Cassava. Cultivars. Sweet cassava. Bitter cassava. Root productivity. Root development. Starch content. Roots. Dry matter. Harvest index. Foliage. Starch productivity. Drainage. Selection. French Guiana.

In order to find a high-yielding clone, resistant to hydromorphic conditions and with appropriate characteristics for mechanical harvesting, a trial was established at the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres at Godebert, St. Laurent (French Guiana) on a ferrous slow-draining soil, after a 16-mo. fallow, following a cassava crop. A randomized block design was used with 9 treatments and 4 replications in an 11-mo. cycle. Best results were for clones from St. Georges de l'Oyapok (3500 mm/yr): MU 20 and MU 24 had higher starch % (significant at 5%) with 28 and 27%, resp.; 24 and 57 showed high leaf and stem yields; and 24 and 20, high whole-plant yields. Clones recommended for free-draining soil are sweet var. MU 10 and bitter var. MU 20 and for blocked soil, sweet var. Mu 15, 16, and 17 and bitter var. 20 and 24. Best HI was for 15 and 17. Root shape was satisfactory and root length (less than 30 cm) reduced harvest losses. (Summary by I.B.) G01

0453

20763 INSTITUT DES SCIENCES AGRONOMIQUES DU BURUNDI. 1983. Manioc. (Cassava). In _____. Rapport Annuel 1983. Bujumbura, Burundi. pp.112-136. Fr. [ISABU, B.P. 795, Bujumbura, Burundi]

Cassava. Cassava programs. Cultivars. Sweet cassava. Selection. Germplasm. Resistance. Cassava African mosaic virus. Injurious mites. Branching Flowering. Root productivity. Root development. Cercospora henningsii. Cercospora caribaea. Ecology. Burundi.

Prescreening trials of more than 104 cassava clones, final var. trials, and prerelease activities carried out in Burundi (1982-83) to identify sweet cassava var. that are high-yielding, showing acceptable organoleptic and technical characteristics, disease tolerance and good adaptability to major ecological zones, are reported. The area planted to cassava in Burundi surpasses by 50-60% that of other crops, but yields of only 11-16 t/ha are reached. In prescreening trials with 21 local var. and 35 from the International Institute of Tropical Agriculture, local var. showed better regrowth, high branching (2.50 m), higher vigor, higher susceptibility to mosaic (particularly at Imbo), similar susceptibility to mites (frequently observed at Mosso), and higher susceptibility to Cercospora sp., in comparison with introduced var. Highest yields were obtained at Imbo with TMS 40160/3 DB, Zayimeti, and Sagarara (65.0, 51.79, and 49.92 t/ha, resp.), and at Mosso with TMS 41589/2, Nakarasi, and TMS 30741 (85.1, 81.0, and 68.6 t/ha, resp.). In final trials, a positive correlation was verified between plant vigor and Cercospora sp., and the degree of conservation. The no. of roots (x 1000/ha) was highly related to yield. Cercospora sp. incidence was higher at Mosso than at Imbo. Local clones showed high stability in both regions. Genealogical selection is outlined. (Summary by I.B.) G01

0454

20740 INSTITUT DES SCIENCES AGRONOMIQUES DU RWANDA. 1983. Manioc (Manihot esculenta (Grantz). (Cassava). In _____. Compte rendu des travaux du Département Production Végétale en 1982. Rubona, Rwanda. pp.59-71. Fr.

Cassava. Cassava programs. Cultivars. Selection. Root productivity. Sweet cassava. Bitter cassava. Plant development. Root development. Cassava African mosaic virus. Cercospora caribaea. Cercospora henningsii. Mononychellus tanajoa. Bemisia. Resistance. Rwanda.

Results are given of trials carried out on seedbed germination of cassava (24.54%), disease incidence, and screening of mosaic-resistant plants. Eight out of 324 clones evaluated showed mosaic symptoms. Sixty-four clones were selected for tuber characteristics and disease tolerance; 20 will be delivered for advanced testing. In var. selection trials, 2nd-harvest yields at 15 mo. almost doubled those of the 1st harvest at 10 mo. Late maturity was verified for local var. Var. P.Y.T. Bulk 1977/31 doubled its own yields in only 5 mo. Advanced yield trials in 1981 included the 7 best local var.: Eala 07 (control var. in 1982 trials), Ikiela, Mulundi, Ntolili Seed 16, Ganga na Butu Seed 6, Creolinha, Maguruyinkware, and 42 others. For sweet and bitter var. av. yields were higher at Rubona (38,992 and 57,250 kg/ha, resp.) than at Karama (12,231 and 30,747 kg/ha, resp.). Tillage apparently had a negative effect on cassava development and yield. (Summary by I.B.) G01

0455

21442 LUNDBORG, G. 1983. From the genetic resources of today, the food of tomorrow. Rivista de Agricoltura Subtropicale e Tropicale 77(1):83-92. Engl., Sum. Engl., Ital., 12 Refs., Illus. [Univ. of Uppsala, Dept. of Economic History, P.O. Box 256, 75105, Uppsala, Sweden]

Cassava. Cassava programs. Genetics. Germplasm. Maps. Nigeria.

The collection and storage of germplasm of the genetic resources unit at the International Institute of Tropical Agriculture, Ibadan, Nigeria, from its start in 1975 are discussed and attention is drawn to the fast diminishing genetic diversity of some essential native food crops grown in tropical Africa for thousands of years such as cowpea, yam, and African rice (Oryza glaberrima), or of some introduced later but now integral part of its agriculture such as cassava, maize, and Asian rice (O. sativa). Today over 20,000 accessions are maintained by this unit in base collections (long-term storage up to 50 yr or more, sealed in aluminium tins in cold-storage rooms at -20°C and 60% RH) and active collections (short-term storage at 5°C and 40% RH, keeping seed viable for at least 10 yr). Samples are distributed free of cost to breeders and germplasm institutions all over the world, upon request. (Author's summary) G01

0456

21142 QUINTERO, F. 1980. Ensayos regionales de variedades de yuca. 2. Comportamiento de siete variedades de yuca en San Carlos, Cojedes 1978-1979. (Regional trials with cassava varieties. 2. Performance of seven cassava varieties at San Carlos, Cojedes, 1978-1979). Maracay, Universidad Central de Venezuela. 6p. Span.

Cassava. Cultivars. Root productivity. Dry matter. Timing. Venezuela.

Yields, total root DM, and production efficiency of 7 cassava var. (UCV-2078, UCV-2191, UCV-2194, UCV-2062, UCV-2106, UCV-2112, and UCV-2221) harvested at 9 and 12 mo. were assessed at San Carlos, Cojedes (Venezuela) in 1978-79. A randomized block design with 4 replications was used: 4 lines/var. with 1 m interrow and 0.80 m intrarow. Highest fresh root yields and total DM were for UCV-2221 (38.01 and 35.04 t/ha, at 9 and 12 mo., resp.) and UCV-2194. UCV-2194 and UCV-2062 showed better yield and DM stability over both harvest dates. Production efficiency was higher for the 1st harvest, although yields of UCV-2078 and UCV-2194 tended to increase with the later harvest. (Summary by I.B.) G01

0457

21141 QUINTERO, F. 1980. Pruebas regionales de variedades de yuca. 1. Comportamiento de siete variedades de yuca en el Campo de Agronomía, Maracay 1977-78. (Regional trials with cassava varieties. 1. Performance of seven cassava varieties at the Campo de Agronomía, Maracay, 1977-78). Maracay, Universidad Central de Venezuela. 5p. Span.

Cassava. Cultivars. Root productivity. Dry matter. Timing. Venezuela.

Seven outstanding cassava var. from the germplasm bank at the Samán Mocho Exptl. Station, UCV-2078, UCV-2191, UCV-2194, UCV-2062, UCV-2106, UCV-2112, and UCV-2221, were evaluated for fresh root yield, total root DM, and production efficiency at 9- and 12-mo. harvests, at the Campo de Agronomía, Maracay, Venezuela. A randomized block design with 4 replications was used: 4 lines for a total of 80 plants/plot (1 x 0.80 m). UCV-2221 gave higher yields over both harvest dates; however, DM % were lower than those of the other var. UCV-2112 showed higher yield stability and DM %. Generally, production efficiency of the 9-mo. harvest doubled that of the 12-mo. harvest. (Summary by I.B.) G01

0458

21172 REBOUL, J.L. 1981. Manioc. Compte-rendu d'observations de collections variétales (No. 330 RAPT). [Cassava. Report of observations on

varietal collections (No. 330 RAPT)]. In Institut e Recherches Agronomiques Tropicales et des Cultures Vivrieres. Rapport analytique 1980. Paris, Groupement d'Etudes et de Recherches pour le Developpement de l'Agronomie Tropicale no.140. pp.156-162. Fr. [Inst. de Recherches Agronomiques Tropicales et des Cultures Vivrieres, 110, rue de l'Univ., 75.007, Paris, France]

Cassava. Cultivars. Selection. Adaptation. Root productivity. Roots. Plant anatomy. Tahiti.

The response of local var. (sweet white var., Amarara Uouo, Amarara Rehu, Rea rea, and Rehu) and introduced var. (CIAT: MCol 22, CM 308-197, MVEN 156, MVEN 218, MMEX 59, and CMC 40) was assessed on an alluvial soil of the Papara plains; introduced var. were also evaluated on a ferrous, highly acid soil of the Taravao. Exptl. plots (20 plants/plot) consisted of a single line with 1 m between plants and no replications. After basic soil preparation practices (tillage, 300 kg KCl/ha, and planting of cuttings), 500 kg 12-12-20 were applied. Highest yields were for MMEX 59 (97.35 t/ha), the local sweet var. (83.85 t/ha), MVEN 156 (48.0 t/ha), and Amarara Uouo (44.60 t/ha) at Papara. MMEX 59 also outyielded the other var. at Taravao with 70.0 t/ha. (Summary by I.B.) G01

0459

21439 RODRIGUEZ, J.O.; PORTILLO, H. 1980. Evaluación de variedades de yuca (Manihot esculento C.). (Evaluation of cassava varieties). Proceedings of the American Society for Horticultural Science 24:135-140. Span., Sum. Engl., Span., 7 Refs.

Cassava. Cultivars. Root productivity. Timing. Selection. Resistance. Silba pendula. Erinnyis ello. Cercospora henningsii. Cercospora caribaea. Honduras.

In 1976 cassava var. introduced and those already existing in the NE region of Honduras were evaluated for the 1st time to determine high- producing var. for local commercialization, with acceptable flavor, cooking consistency, and resistant to lodging. Promising materials identified were included in trials carried out at the Raul Rene Valle Exptl. Station at Catacamas, Olancho, during 1977-80. Var. ITU, Criolla de San Andres, Valenca, Señora está en la Mesa, H-54, and Criolla de Zamorano had a consistent productivity. Var. Ceiba Guarizama also showed a high productivity, rapidly closing its canopy and thus preventing weed development. Var. ITU, Criolla de San Andres, and Valenca are resistant to Silba pendula and tolerant to Erinnyis ello whereas Señora está en la Mesa and Criolla de Zamorano are susceptible. Señora está en la Mesa and Valenca are susceptible to Cercosporidium henningsii and Cercospora caribaea and Criolla de San Andres and Criolla de Zamorano are tolerant. (Author's summary. Trans. by L.M.F.) G01

0460

20768 WEBSTER, D.C. 1963. Cassava. In Jamaica. Ministry of Agriculture and Lands. Investigations 1962-1963. Jamaica. Bulletin no.62. pp.36-37. Engl.

Cassava. Cultivars. Root productivity. Starch content. Starch productivity. Timing. Jamaica.

Eight cv. introduced from Cuba in 1955 and 49 cv. of the Roger's Classification were compared at Bodless Agricultural Station (Jamaica) in Nov. 1961. After the plants were 6-mo.-old, monthly harvesting of plots (6

plants each) took place and a 3-lb sample of tubers from each cv. was analyzed for starch. Cv. No. 50, 69, C5, and C8 seemed to be the most promising. Yields varied greatly from 1 mo. to the next; starch % also varied with no appreciable change in cv. No. 50 (78-81.2%) and C8 (71.1-73.7%), a gradual increase in No. 69 up to the 12th mo. with a gradual decrease and leveling off thereafter at 70%, and inconsistency in cv. No. 54 and C5. (Summary by I.B.) G01

0461

20770 WEIR, C. 1975. Cassava. In Jamaica. Ministry of Agriculture and Lands. Investigations 1975. Jamaica. Bulletin no.65. pp.115-117. Engl.

Cassava. Cultivars. Root productivity. N. P. K. Fertilizers. Selection. Jamaica.

Results are presented of a comparative trial between local var. No. 30 and No. 69 and Colombian var. Llanera and M Col 22 planted in May 1974 in Lawrencefield, Jamaica. Plants were spaced at 3 x 4' (4000 plants/ac) with final monthly observations made in July. Llanera and M Col 22 yielded 4.9 and 5.3 kg/plant, resp. Two new Colombian var., Mex 55 and M Col 113, were introduced and planted; harvesting will be done 12 mo. after planting. The response of Llanera to 5 levels of NPK (0, 4, 8, and 12 lb/plot, placed; 8 lb/plot, surface broadcasted) was determined in a completely randomized expt. with 4 replications. Differences were not estatistically significant and a 2nd expt. was initiated with the same var. (high or low rate of fertilizer, broadcasted or placed). In herbicide trials, effective control was achieved with chlorbromuron, fluometuron, fluorodifen, benthiocarb, and methazole. (Summary by I.B.) G01

See also 0394 0397 0412 0508

H00 NUTRITION

H01 Cassava Foods and Nutritive Value

0462

20774 ADAMSON, I.; EASTWOOD, M.; GORDON B., W. 1983. Comparison of the effect of yam, cassava and alfalfa on cholesterol metabolism in the rat. Nutrition Reports International 27(3):551-560. Engl., Sum. Engl., 21 Refs. [Dept. of Biochemistry, Univ. of Benin, Benin City, Nigeria]

Cassava. Dietary value. Fibre content. Laboratory animals. Human nutrition. Nigeria.

Yam-, cassava-, and alfalfa-based stock diets were fed to rats with added 0.5% cholesterol. The effect on cholesterol metabolism was recorded by measurements of serum cholesterol, liver lipids, fecal neutral sterols, and bile acids. Feeding the alfalfa diet supplemented with cholesterol resulted in the least increase in serum cholesterol but was associated with the highest liver cholesterol and fecal excretion of cholesterol metabolites. Feeding the cassava-based diet resulted in the highest serum high density lipoprotein cholesterol levels. Feeding the yam diet resulted in the highest serum cholesterol and lowest liver cholesterol and fecal excretion of cholesterol metabolites. The yam-fed animals excreted more primary bile acids and neutral sterols than did animals fed the other diets. Cassava was effective, although less than alfalfa, in modifying the hypercholesterolemia of added cholesterol. (Author's summary) H01

0463

20783 GRAHAMN, H.D.; ARCHBOLD, C.A. 1982. Enrichment of cassava products with soybean, peanut and whey protein. Content and acceptance. Caribbean Journal of Science (Puerto Rico) 19(1-4):115-124. Engl., Sum. Engl., 23 Refs. [Chemistry Dept., Univ. of Puerto Rico, Mayaguez, Puerto Rico 00708]

Cassava. Cassava flour. Protein enrichment. Bakery products. Recipes. Food products. Protein content. HCN content. Organoleptic examination. Puerto Rico.

Cassava-based products (bread, cookies, bammy or casave, patties, fritters, dumplings, and grits), which are quite popular in the Caribbean area, were prepared from CF, to which soybean flour, peanut grits, or cheese whey was added. These enriched products were analyzed for their protein content and were tasted and scored by a panel consisting mainly of natives from high cassava-consuming areas. As compared with products made from CF alone, the protein-enriched products showed increases in protein content ranging from 5 to 27% and were all highly acceptable to the members of the taste panel. (Author's summary) H01

0464

21450 HOSHIAI, K. 1982. [Development of cassava as a biomass resource]. Food Industry [Shokuhin Kogyo] 25(14):73-86. Jap., 22 Refs., Illus.

Cassava. Industrial microbiology. Protein enrichment. Nutritive value. Processing. Detoxification.

The food potential of cassava is discussed in detail, considering its detoxification and processing, food usage by country, nutritional value of cassava, use of whole-crop cassava and leaves for protein production, trade in cassava product, and use of cassava-based substrate for the production of fungal protein. (Summary by Food Science and Technology Abstracts) H01

0465

21118 MUSENGE, H.M. 1980. Evaluation of single cell protein from cassava starch. Zambia Journal of Science and Technology 5:1-7. Engl., Sum. Engl., 22 Refs.

Cassava. Cassava starch. Industrial microbiology. Protein enrichment. Analysis. Yeast production. Amino acids. Productivity.

Candida utilis NRRLY-900 was cultivated on enzymatically hydrolyzed cassava starch. Yields on substrate consumed were comparable in batch and continuous culture, carried out at 30°C in a fermenter, aerated at 0.6 vvm, stirred at 900 rpm and pH maintained at 4.5 automatically; productivity in the latter was 6-fold that of the former. Chemical analysis showed that cassava yeast had an amino acid profile similar to the published values of other SCP products. The amino acids of cassava-yeast were also assessed regarding the requirements of growing rat and pig. The S-containing amino acids (met. and cystine) were limiting. (Author's summary) H01

0466

21174 PEREIRA, A.S.; LORENZI, J.O.; VALLE, T.L. 1983. Avaliacao do tempo de cozimento e padrao de massa cozida em mandiocas de mesa. (Evaluation of cooking time and standard of cooked mass of sweet cassava varieties). Campinas-SP, Brasil, Instituto Agronomico. [illegible] Port., Sum. Port.,

Engl., 2 Refs., Illus. [Secao de Raízes e Tubérculos, Inst. Agronomico, Caixa Postal 28, 13.100 Campinas-SP, Brasil]

Cassava. Sweet cassava. Roots. Pulp. Cultivars. Cooking. Timing. Organoleptic examination. Selection. Brazil.

A simple methodology used by the Root and Tuber Section of the Instituto Agronomico (Brazil) to evaluate the culinary characteristics of sweet cassava var. regarding cooking time and standards for cooked mass is given. Field methodology (plant and root samplings), lab. implements (cooking utensils and vessels), and the know-how to determine the cooking time and cooked mass quality are described. Cooking time was assessed using a scale with 4 classes: 0-10 min, very good; 11-20 min, good; 21-30 min, regular; and over 30 min, bad. A scale with 7 classes that considered 3 major factors (texture, plasticity, and stickiness) is suggested for assessing cooked mass. (Extracted from author's summary) H01

0467

21166 PEREIRA, A.S.; LORENZI, J.O.; KLATILOVA, E.; PERIM, S.; COSTA, I.R.S.; PENNA, S.; VALLE, T.L.; FRANCA, J. DE P.M. 1983. A mandioca na cozinha brasileira. (Cassava in Brazilian cuisine). Campinas-SP, Brasil, Instituto Agronomico. Boletim no.213. 266p. Port., Sum. Port., Engl., 266 Refs. [Inst. Agronomico, Caixa Postal 28, 13.100 Campinas-SP, Brasil]

Cassava. Uses. Human nutrition. Recipes. Food products. Cassava products. Brazil.

This recipe book contains the dishes most commonly prepared in Brazil with cassava and cassava by-products. Some considerations are also given on plant origin and importance, toxicity, var., nutritive value, and culinary aspects such as ingredients, cooking time, cooked mass standard, root deterioration and conservation. The obtention of the cassava by-products involved in this collection of recipes is briefly described. (Extracted from author's summary) H01

0468

20784 PREMAKUMARI, K.; KURUP, P.A. 1982. Lipid metabolism in rats fed rice and tapioca. Indian Journal of Medical Research 76:488-493. Engl., Sum. Engl., 14 Refs. [Dept. of Biochemistry, Univ. of Kerala, Trivandrum, India]

Cassava. Laboratory animals. Dietary value. Biochemistry. Animal physiology. Human physiology. Human nutrition. India.

The effect of feeding cassava and rice on some of the enzymes of lipid metabolism and the fecal excretion of sterols and bile acids was studied using rats as exptl. animals. Diets composed of cassava or rice, casein, groundnut oil, salt, and vitamins were supplied for 3 mo. In rats fed cassava, an increase in serum high density lipoprotein cholesterol and a decrease in low density lipoprotein + very low density lipoprotein cholesterol were seen as compared with those fed rice. Activity of some hepatic lipogenic enzymes increased, while activity of lipoprotein lipase and triglyceride lipase in the extrahepatic tissues decreased. Fecal excretion of neutral sterols and bile acids was significantly more in rats fed cassava. (Author's summary) H01

0469

21435 STEVENSON, M.H.; GRAHAM, W.D. 1983. The chemical composition and true metabolisable energy content of cassava root meal imported into Northern Ireland. Journal of the Science of Food and Agriculture 34(10): 1105-1107. Engl., Sum. Engl., 15 Refs. [Agricultural & Food Chemistry Dept., Queen's Univ. of Belfast, Newforge Lane, Belfast BT9 5PX, Northern Ireland]

Cassava. Cassava meal. Dry matter. Ash content. Protein content. Starch content. Mineral content. Fat content. Uses. Poultry. Dietary value. Animal nutrition. Northern Ireland.

The chemical composition and true content of 10 samples of cassava root meal imported into Northern Ireland (7 native and 3 pelleted) were measured. There were no major significant differences in the chemical composition of the native and pelleted cassava. Traces of HCN were found in all the samples and the 4 mycotoxins for which examinations were carried out were absent. The true ME content of the meal was 13.46 MJ/kg as fed, i.e. 15.13 MJ/kg DM. (Author's summary) H01

0470

21140 SUZUKI, K.; KANKE, Y.; GOTO, S.; KONDO, N. 1983. The effect of root crops on nitrogen, calcium, phosphorus and magnesium utilization. Nutrition Reports International 27(1):213-220. Engl., Sum. Engl., 11 Refs. [Tokyo Univ. of Agriculture, Setagaya Tokyo, Japan]

Cassava. Cassava chips. Cassava flour. Dietary value. N. Ca. P. Mg. Laboratory animals. Mineral content. Analysis.

The effect of different types of tubers (cassava chips, CF, taro root chips, sweet potato chips) on the utilization of protein, mainly casein and soy protein isolate, and some minerals such as Ca, P, and Mg was studied in trials using male albino rats (48) of Wistar strain with initial body wt. averaging 45 g. The groups fed taro root and sweet potato showed higher wt. gain and fecal wt. as compared with groups fed cassava. However, the groups fed taro had significantly higher cecum wt., both with and without contents. Groups fed cassava showed higher N utilization. Utilization of C, P, and Mg was lowest in taro-fed rats of both the casein and soy protein isolate. (Author's summary) H01

See also 0353 0357 0400 0411 0481 0490 0492 0494 0495 0496 0499

H03 Animal Feeding

0471

21447 HUYGHEBAERT, G.; GROOTE, G. DE 1983. Vervanging van granen in legrantsoenen met variërende voedingsdensiteit, verstrekt onder meel- en korrelvorm. (Cereal substitutes in layer rations with varying nutrient concentrations, fed as mash or as pellets). Landbouwtijdschrift 36(1):149-164. Dutch., Sum. Dutch., Engl., 23 Refs. [Rikjsstation voor Kleinveeteelt Burgem, Van Gansberghelaan, 92 B-9220 Merelbeke, Belgium].

Cassava. Feed constituents. Poultry. Substitutes. Dietary value. Animal nutrition. Eggs.

The feed value of cereal substitutes was investigated in a multifactorial expt. (2 x 2 x 2 x 2): laying strains (White Leghorn and a medium wt. strain), nutrient levels (2750-2400 kcal ME/kg), energy sources (cereal substitutes: cassava, wheat middlings, fat, and alfalfa meal). Each treatment was fed to 4 pens of 24 layers, kept in laying batteries (20-72 wk. of age). Compared with the medium wt. strain, the White Leghorn hens produced nearly the same egg mass, being composed of a higher laying % snd a lower egg wt. Consequently, the better feed efficiency of White Leghorn hens is mostly due to the lower daily feed intake. From the substitution of cereals by nongrain items resulted a lower feed intake (4.7%), being more pronounced for mash diets, and also a more favorable feed efficiency (4%). A decrease in nutrient level caused a significantly lower daily egg mass and feed efficiency; however, egg wt. and feed intake were not influenced by varying nutrient level. Compared with mash feed, pelleted feed significantly increased feed intake (+ 18%), significantly decreased feed efficiency, and increased body wt. and mortality. In spite of the higher ME intake, egg wt. was not influenced. The gross profit/hen increased proportionally with the % of alternative new materials. Ad libitum feeding of pelleted diets resulted in lower gross profits, which was almost entirely due to the high overconsumption. (Author's summary) H03

0472

20794 KENDALL, P.T.; HOLME, D.W. 1982. Studies on the digestibility of soya bean products, cereals, cereal and plant by-products in diets of dogs. Journal of the Science of Food and Agriculture 33(9):813-822. Engl., Sum. Engl., 12 Refs. [Animal Studies Centre, Pedigree Petfoods, Waltham on the Wolds, Leicestershire LE14 4RT, England]

Cassava. Feed constituents. Dietary value. Digestibility. Dogs. Animal nutrition.

The apparent digestibility of 21 plant materials was evaluated in dog diets using adult beagles. In most cases the digestibility by difference method was used. Apparent CP (N x 6.25) digestibility coefficients for textured soybean protein, extracted SBM, full-fat soybean flours, and micronized whole soybeans ranged from 0.71 to 0.87. Digestible energy (DE) contents ranged from 1.43 to 20.8 MJ/kg DM. Samples of wholeground wheat, barley meal, and flaked maize were well digested by dogs, as were samples of refined flour, vital gluten, feeding oat meal and wheat germ meal; apparent energy digestibility coefficients ranged from 0.72 to 0.96. Wheat feed and 2 distillers' by-products had lower energy digestibility coefficients (0.39-0.59). Other materials with low apparent digestibility in dog diets (probably because of high fiber levels) were walnut meal, almond meal, dried molassed sugar beet pulp, and locust bean meal. Gross energy and DM digestibility coefficients of below 0.52 were obtained. Data are also presented on the digestibility of samples of rapeseed meal, cassava, and dried potato. When comparison was possible, DE values measured for dogs agreed closely with those for pigs for most materials. (Author's summary) H03

0473

20754 LATIMIER, P.; BLONDEL, R.; LE PAN, J. 1980. Bilan de deux essais de substitution de l'orge par du manioc dans l'alimentation du porc charcutier. (Results of two swine feeding trials substituting cassava for barley). Journees de la Recherche Porcine 12:265-272. Fr., 8 Refs.

Cassava. Swine. Feeds and feeding. Feed constituents. Diets. Dietary value. Animal physiology. Animal nutrition. Substitutes. France.

Cassava was substituted for barley in 2 feeding trials with Large White pigs, at Crecom Exptl. Station, Saint Nicolás du Pelem (France). In the 1st trial groups of 6 animals each were given 1 of 3 rations in an exptl. block design with 5 replications, for a total of 90 animals. Rations were 36:0, 18:1, and 0:30% barley:cassava. In the 2nd trial, a total of 108 animals were assigned to 1 of 3 rations: 46% barley (control), 30 and 40% cassava. All rations were balanced and included 39 or 29% maize and 21-27% soybeans. Cassava quality was poor with abundant fungi. No significant difference in av. daily wt. gain or intake was found between treatments; carcass characteristics were similar. It is concluded that cassava can be substituted for barley at a 30-40% level, provided a proper lysine balance is maintained. (Summary by I.B.) H03

0474

21451 McALLAN, A.B.; SMITH, R.H. 1983. Estimation of flows of organic matter and nitrogen components in postruminal digesta and effects of levels of dietary intake and physical form of protein supplement on such estimates. British Journal of Nutrition 49(1):119-127. Engl., Sum. Engl., 26 Refs., Illus. [National Inst. for Research in Dairying, Shinfield, Reading RG2 9AT, Berkshire, England]

Cassava. Feeds and feeding. Cattle. Animal physiology. Diets. Uses. Animal nutrition. Supplements.

Steers fitted with simple rumen, abomasal, and sometimes duodenal cannulas were given isonitrogenous and isoenergetic diets consisting of pellets containing equal amounts of rolled barley and chopped straw together with cassava alone (B), or with some cassava replaced by coarse SBM (M) or finely ground soybean flour (F). Diet B had an estimated rumen degradable N (RDN): ME value of approx. 0.8 g/MJ. The corresponding value for each of the supplemented diets was 1.3-1.4. Diets were given at 2 levels of intake designed resp. to provide ME intakes to support wt. gains of 0.5 kg/day (L) and 1.0 kg/day (H). Chromic oxide and polyethylene glycol were given as indigestible markers. Values were calculated for flows (g/24 h) at the abomasum of OM, nonammonia-N (NAN) and microbial (bacterial)-N (MN). Estimates of MN were based on RNA and alpha-epsilon-diaminopimelic acid (DAP) measurements. The steers had low rumen protozoal counts throughout the whole expt. with fewer than 8000 ciliate protozoa/ml of rumen fluid. Proportions of OM apparently digested between the mouth and abomasum were significantly lower for H than for L intakes but showed no other significant differences. Mean estimated efficiency of microbial protein synthesis was approx. 17 g N/kg OM apparently digested in the rumen for the LB diet, but was significantly greater at approx. 26 g N/kg OM apparently digested for the HB diet. The protein-supplemented diets gave values of 31-32 which were significantly greater than the value for the LB but not the HB diet. Amounts of feed nitrogenous constituents surviving between the mouth and the abomasum were estimated from NAN minus MN corrected for endogenous N. Values for the proportions of feed N degraded, derived from these estimates, were 0.71, 0.66, 0.72, 0.69, 0.67, and 0.70 for diets LB, HB, LM, HM, LF, and HF, resp. There were no significant differences due to level of feeding, supplementary protein, or the physical form of that protein. Estimates of MN flows at the abomasum based on RNA determinations in fresh samples did not differ significantly from estimates based on DAP determinations. However, storage of aqueous suspensions of mixed rumen bacteria by deep-freezing or freeze-drying resulted in significant losses of RNA. No such losses were observed for abomasal digesta. This meant that if samples were stored by these means before analysis, the use of RNA as a microbial marker was vitiated. In some expt. digesta samples were taken from the doudenum as well as the abomasum. Estimates of total N flows did not differ significantly between these sites. (Author's summary) H03

0475

20781 PASCUAL, F.P.; COLOSO, R.M.; TAMSE, C.T. 1983. Survival and some histological changes in Penaeus monodon Fabricius juveniles fed various carbohydrates. Aquaculture 31(2-4):169-180. Engl., Sum. Engl., 21 Refs., Illus. [Aquaculture Dept., Southeast Asian Fisheries Development Center, P.O. Box 256, Iloilo City, Philippines]

Cassava. Cassava starch. Uses. Feeds and feeding. Fish. Dietary value. Animal physiology. Animal nutrition. Philippines.

Juveniles of Penaeus monodon (initial mean wt. 1.76 g) were reared on semipurified diets containing 10 or 40% maltose, sucrose, dextrin, molasses, cassava starch, corn starch, or sago palm starch for 6 wk. Highest survival (56%) was obtained in juveniles fed with a diet containing 10% sucrose. Within 10 days of rearing, complete mortality was observed in prawns fed with higher levels of maltose and molasses. After 6 wk. among the starches, sago palm starch provided for the best survival at 10% level, cassava starch showing 0% survival. There was no relationship between time to death and size of the prawn (r = -0.10). Significant differences were observed between the type, as well as the level, of carbohydrate in the diet on the survival of juvenile prawn. Histopathological changes in the hepatopancreas, gills, and exoskeleton of juveniles fed with the various carbohydrates were also studied. (Author's summary) H03

0476

20779 UMOH, I.B.; AYALOGU, E.O. 1983. Effects of different levels of palm oil and sulphur in cassava-based diets. Food Chemistry 10(2):83-95. Engl., Sum. Engl., 28 Refs. [Biochemistry Dept., Univ. of Ibadan, Ibadan, Nigeria]

Cassava. Dietary value. Diets. Digestibility. Feed constituents. Minerals. Proteins. Supplements. Animal physiology. Animal nutrition. Palm oil. S. Nigeria.

The effects of different levels of palm oil and S on the nutritive value of a cassava leaf protein diet was investigated using rats. With 40% cassava and no palm oil, the PER and NPU were very low (0.3 and 23.8, resp.), but the true digestibility was the same as that of the casein control (95.0%). With 5% palm oil there was no improvement in PER, but both the NPU and BV were increased appreciably (38.1 and 40.3, resp.). The best result was obtained with 10% palm oil, with which the PER was more than doubled (0.7), and there were similar increases in both the NPU and BV (46.6 and 48.9, resp.). Cassava at the 40% level was supplemented with various sources of S (met., $Na_2S_2O_3$, elemental S, Na_2SO_4, and $FeSO_4$). With met., the PER, compared with the control (0.7), was more than trebled (2.2), and the NPU and BV were also significantly increased (72.6 and 83.3, resp.). Elemental S gave a PER of 1.8 while $Na_2S_2O_3$ and $FeSO_4$ gave 1.9. The lowest PER was obtained from $Na_2S_2O_3$ (1.1). The importance of palm oil and S donors in cassava-based diets is discussed. (Author's summary) H03

See also 0469 0497 0500 0505

H04 HCN Toxicity and Detoxification

0477

21454 ERMANS, A.M. 1981. Intervention de goitrigenes d'origine végétale dans l'étiologie du goitre endémique. (Goitrogens of vegetable origin as

possible etiological factors in endemic goitre). Annales d'Endocrinologie 42(4-5):435-438. Fr., Sum. Fr., Engl., 2 Refs. [Université Libre de Bruxelles, Service des Radioisotopes de l'Hopital Saint-Pierre, 322, rue Haute, Bruxelles, Belgium]

Cassava. Endemic goitre. Etiology.

Ingestion of unsoaked cassava is followed by an increase of the SCN production in men and in rats. Even a moderate increase of serum SCN concn. induces, in chronic conditions, a clear-cut goitrogenic effect characterized by the aggravation of the effects of a preexisting I deficiency. The mechanism of the antithyroid action of SCN at low concn. lies in an acceleration of the exit rate of thyroidal I; this effect cannot be identified by the usual clinical investigation with I^{131}. (Author's summary) H04

See also 0366 0401

I00 PROCESSING, PRODUCTS AND USES

I01 Cassava Starch and its Properties

0478

21418 KAWABATA, A.; SAWAYAMA, S.; NAGASHIMA, N.; ROSARIO, R.R. DEL 1984. Physico-chemical properties of starches from cassava, arrowroot and sago. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.259-271. Engl., Sum. Engl., 10 Refs., Illus. [Dept. of Nutrition, Tokyo Univ. of Agriculture, Sakuragaoka, Setagaya-ku, Tokyo 156, Japan]

Cassava. Cassava starch. Analysis. Water content. Ash content. Mineral content. Viscosity. Gelatinization. Post-harvest technology. Sago. Maranta. Philippines.

Physico-chemical properties of starches of cassava, arrowroot, and sago, which were prepared with various washing solutions, were examined using potato starch as the reference control. Amylose content in cassava starch was 17.9-18.9%. Cassava starch samples prepared using tap water and 0.5 M $CaCl_2$ solution contained higher Ca, arrowroot starch contained high K, and sago starch contained high Na. However, when demineralized water was used for the preparation of cassava starch, Ca content was low, and thus it was found that the amount of cation in the washing solution influenced the cation content of the prepared starch samples. The distribution of granular size showed that the peak was located in around 10.1-20 microns in the cassava starch. The X-ray diffraction pattern of the cassava starch was regarded as the C-type close to the A-type. Swelling power of cassava starches prepared with various washing solutions was larger in the following order: demineralized water more than tap water more than 0.5 M $CaCl_2$ solution. Ca was found to have suppression effect on the swelling power of the starch. The gelatinization temp. as determined by the amylograph and photopastegraph of the tropical starch samples was slightly higher than that of the potato starch. Rate of retrogradation of the cassava starch was the smallest. The wt.-av. mol. wt. of amylose isolated from the starch was determined as a solution of dimethylsulfoxide (DMSO) by light scattering method. It was found that only the mol. wt. of sago amylose was extremely small and those of cassava, arrowroot, and potato amylose were 32-39 x 10^4. The radius of gyration was also smallest in the sago amylose, 200 angstroms, and those of other amylose samples were in a range of 320-390 angstroms. (Author's summary) I01

0479

21453 KUMAKURA, M.; KAETSU, I. 1983. Pretreatment of starch raw materials and their enzymatic hydrolysis by immobilized glucoamylase. Enzyme and Microbial Technology 5(3):199-203. Engl., Sum. Engl., 11 Refs., Illus. [Takasaki Radiation Chemistry Research Establishment, Japan Atomic Energy Research Inst., Takasaki, Gunma, Japan]

Cassava. Cassava starch. Enzymes. Biochemistry. Analysis. Hydrolysis.

The pretreatment of starchy raw materials such as sweet potato, potato, and cassava has been carried out using various types of crusher, juice mixer homogenizer, and high-speed planetary mill. The effect of pretreatment of the materials on their enzymatic hydrolysis was studied. High-speed planetary mill treatment was the most effective and comparable with heat treatment (pasting). Various crushing times were used to examine the effect of crushing by mill treatment on the enzymatic hydrolysis. In the enzymatic hydrolysis of cassava, the use of both cellulase and glucoamylase enhanced the D-glucose yield. This result suggest that the enzymatic hydrolysis by glucoamylase proceeds smoothly by the elimination of cellulose, and the cellulose is bound with tissue containing the starch. The immobilization of glucoamylase was studied by radiation polymerization of hydrophilic monomers at low temp., and it was found that enzymatic activity of the immobilized glucoamylase particles varied with monomer concn. and particle size. Starchy raw materials pretreated with the mill can be efficiently hydrolyzed by immobilized glucoamylase. (Author's summary) I01

0480

21123 NEGRAO, O.L.; FONTANA, J.D.; ZANCAN, G.T. 1981. Production of glucoamylase by Dactilium dendroides. Revista de Microbiología (Brasil) 12(4):170-175. Engl., Sum. Engl., Port., 25 Refs., Illus. [Dept. de Bioquímica, Univ. Federal do Paraná, Caixa Postal 939, 80.000 Curitiba-PR, Brasil]

Cassava. Cassava starch. Biochemistry. Enzymes. Analysis. Hydrolysis. Brazil.

The mold Dactylium dendroides accumulated into the culture medium a glucoamylase depending on the C source (glycerol, D-glucose, D-cellobiase, D-melibiose, D-maltose, soluble starch) used for growth. Yields were highest with starch, whereas no enzyme or only traces of it were obtained when the C source was glycerol or glucose. Optimum pH and temp. for this enzyme were determined. Hydrolysis limit for glycogen, amylose, and amylopectin were 84, 100, and 100%, resp. D. dendroides glucoamylase hydrolyzed soluble starch from cassava and potato more efficiently than soluble starch from maize. (Author's summary) I01

0481

21200 ROSENTHAL, F.R.T.; NAKAMURA, L.M.K.; GHIOTTI, A.M.T.; NAKAMURA, T. 1979. Amidos de mandioca; algumas variedades do Estado de Sao Paulo. (Cassava starches; some varieties of the state of Sao Paulo, Brazil). Informativo do Instituto Nacional de Tecnología 12(21):9-26. Port., Sum. Port., Engl., 6 Refs., Illus.

Cassava. Cassava starch. Analysis. Cultivars. Water content. Ash content. Fat content. Protein content. pH. Gelatinization. Particle size. Viscosity. Selection. Brazil.

Starches extracted from yellow-pulped Brazilian cassava var. IAC-48-243 and IAC-1073 and from white-pulped var. SRT-1099, IAC-1416-67 (Yara), and

IAC-51-287 were studied. It was found that colored-pulped var. may contain white-colored starches which satisfy more demanding specifications. No marked differences were found among the viscosity characteristics of the cooked pastes. According to the specifications of the Conselho Nacional de Comercio Exterior for the export of cassava starch, only IAC-48-243 produced A-type starch. Only starches of var. SRT-1099 and IAC-51-287 satisfy all the items of the specifications of viscosity of the General Food Co. (Author's summary. Trans. by L.M.F.) I01

See also 0411

I02 Uses, Industrialization, Processing and Storage

0482

20788 BERMUDEZ, R.; MEJIA, F.A.; VELEZ M., A.L. 1983. Alcohol carburante a partir de yuca. (Fuel alcohol from cassava). Cali, Colombia, Pontificia Universidad Javeriana. Facultad de Ingenieria Industrial. 57p. Span., 6 Refs., Illus.

Cassava. Cultivation. Ethanol. Industrialization. Uses. Processing. Industrial machinery. Factories. Development research. Colombia.

The possibilities of using cassava in agroindustrial systems in Colombia are explored and the establishment of an industrial cassava-based fuel alcohol plant in northern Valle del Cauca was studied. Basic agricultural and economic concepts of cassava cultivation, the industrial processes, as well as the legal aspects for a correctly designed system are explained. These include: areas recommended for cassava growing, edaphoclimatic conditions (Atlantic Coast and Llanos Orientales), technological aspects, programs for ethyl alcohol production, agreement between public and private sectors, incentives, raw materials and potentially useful crops, different types of engines, required equipment, the process of alcohol production and advantages of such a system for the country. (Summary by I.B.) I02

0483

7453 BEST, R. 1976. Secamiento de la yuca. (Cassava drying). In Curso sobre producción de yuca. Cali, Colombia, Centro Internacional de Agricultura Tropical. pp.260-273. Span., Illus.

Cassava. Roots. Solar drying. Small-scale equipment. Storage. Composition. Costs. Legal aspects. Colombia.

Long-term storage of cassava depends upon the reduction of its MC when fresh (60-70%) to less than 14%. For this purpose the cassava is dried either naturally in the sun or artificially in hot-air driers. The latter system has the advantage that it can be easily controlled in order to obtain a product of uniform quality. The parameters of the drying process to be taken into account are the MC of cassava, chip size, temp., RH, and wind velocity. The quality of the dried cassava increases if the roots are washed before peeling them; the moisture is then extracted by mechanical comprension. The methods of drying on cement and on trays are described; an economic comparison is made in table form of the 2 methods and the range of specifications (moisture, starch content, total ash, and crude fiber) that are required in Asia and Africa is indicated. Photographs are also included of chippers, rakes, and shovels used to spread and collect the cassava, and a tray drier. (Summary by S.S. de S.) I02

0484

21461 CHANDRA, V. 1982. Alcohol cropping. Biological Memoirs 7(2):148-161. Engl., Sum. Engl., 18 Refs. [National Botanical Research Inst., Lucknow, 226001, India]

Cassava. Uses. Ethanol. Productivity. Energy productivity.

Results of agronomic expt. with sugar beet, cassava, sweet sorghum, Napier grass (Pennisetum purpureum), and sugarcane on sodic soils, conducted to determine their feasibility for augmenting alcohol production in India, are given. High-yielding cassava var. H-226, H-97, H-167, H-2304, H-1687, and M-4 were planted at Banthra and data showed that all var. established on sodic soils but differed considerably as to av. height (1.27-4.08 m), av. stem diameter at base (1.75-3.06 mm), and yield (5.432-17.732 t/ha). It was concluded that sodic soils can be satisfactory producers of all these energy crops. (Author's summary) I02

0485

21183 EMPRESA DE PESQUISA AGROPECUARIA DE MINAS GERAIS. 1979. O PROALCOOL em Minas Gerais; a pesquisa agropecuária com a cultura da mandioca. (Alcohol Production Program in Minas Gerais: agricultural research on cassava). Belo Horizonte-MG, Brasil. 26p. Port., Illus.

Cassava. Cassava programs. Alcohol. Cultivation. Economics. Savannas. Cassava products. Uses. Waste utilization. Agricultural equipment. Costs. Brazil.

Research activities of PROALCOOL are discussed in relation to: factors that affect cassava cultivation in Minas Gerais, Brazil: pest and disease control (production of healthy planting material; chemical, cultural, and biological control; var. resistance); development of standards on soil amendment and fertilization; production systems; regional adaptation trials and publication of results; economy (production costs and benefits; agroindustrial production systems; energetic balance); mechanization (definitions, equipment, evaluation, and requirements); cycling of industrial by-products; technical assistance and training. The present and future of cassava projects of the Empresa de Pesquisa Agropecuária de Minas Gerais for the area around the Curvelo Pilot Factory are discussed as well as PROALCOOL resources, projects, and programs. (Summary by I.B.) I02

0486

21402 GARCIA, V.V.; FUKUBA, H. 1984. Root crop survey in Luzon. Survey on root crops and factory visits in Luzon. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.3-8. Engl., Illus. [Inst. of Food Science & Technology, Univ. of the Philippines at Los Baños, College, Laguna 3720, Philippines]

Cassava. Processing. Research. Factories. Maps. Philippines.

Records of a survey carried out in 1981 in Luzon, Philippines, of root crop growing areas and factories manufacturing puto, arrowroot starch and cookies, sotanghon, sago pearls, and monosodium glutamate are briefly mentioned. Cassava production has decreased lately in Pangasinan because of low market prices, long growing periods compared with rice and other staples, and rapid postharvest deterioration. Low production of cassava starch is due to the unstable root supply. Samples were collected at every stage of the puto making process and the microorganisms involved in fermentation were studied. Cassava starch has been used instead of sago

starch as raw material of sago pearls, used as ingredient in a popular sweet syrup refreshment. At the monosodium glutamate factory, molasses is used instead of cassava starch as the supply of the 1st is stable. Nutritional aspects of root crop production were discussed at the Food and Nutrition Research Institute. Root crop cultivation is being studied at the Mountain State Agricultural College and the Northern Philippine Root Crop Research and Training Center. (Summary by I.B.) I02

0487

20780 JOSHI, K.L.; MISRA, S.D. 1982. Silk percentage and effective rate of rearing of erisilkmoth, Philosamia ricini Hutt. (Lep:Saturniidae) reared on two host plants and their combinations. Entomon 7(1):107-110. Engl., Sum. Engl., 6 Refs., Illus. [Dept. of Zoology, Jodhpur Univ., Jodhpur-342001, Rajasthan, India]

Cassava. Uses. Silkworm. India.

The silk ratio (SR) and effective rate of rearing (ERR) of eri silkworm, Philosamia ricini, were studied by rearing the worms on 4 combinations of 2 host plants, castor bean and cassava: TT (I-V instar larvae reared on cassava leaves), TC (I-III instar larvae reared on cassava leaves and IV-V on castor bean), CT (I-III instar larvae reared on castor bean leaves while IV-V on cassava leaves), and CC (I-V instar larvae reared on castor bean leaves alone) at 26 ± 2°C temp. and 90 ± 5% RH (up to IV instar) and 60 ± 5% to the rest of the stages. The SR is max. in dietary regimen CC and min. in dietary regimen TT while in TC it is higher than in dietary regimen CT. The ERR is almost similar in dietary regimen TT and CT while it is slightly lower in dietary regimen CC than in TC. (Author's summary) I02

0488

21446 KHOVANSKAYA, S.S.; DREMINA, N.V.; ORLOVA, M.M. 1982. [Use of cassava in the manufacture of jelly concentrates]. Konservnaya i Ovoshchesushil' naya Promyshlennost' no.6:17-20. Russ., Illus.

Cassava. Cassava starch. Uses. Food products. Confectioneries.

Cassava starch was tested for manufacture of concentrates for jellies and puddings. At the same temp. cassava starch grains swelled more than maize starch grains, but considerably less than potato starch grains (1.2-2.3 x); peak swelling for cassava starch occurred at 80°C. Viscosity of gelled starch was 2.5 x lower from cassava than from potatoes, but 3 x higher than from maize. Study of sensory and physicochemical properties of dried jellies containing cassava starch, carried out at 20 and 40°C, and 70 and 80% RH, showed a decline in MC but a marked rise in acidity (as malic acid). The content of reducing sugars rose, with a parallel drop in sucrose, this drop being more pronounced under the more adverse conditions. Variations of consistency indicated a tendency towards retrogradation with the cassava, but lower than that of maize starch-based jellies. Use of cassava starch was considered to improve quality and reduce costs. (Summary by Food Science and Technology Abstracts) I02

0489

21452 LIU, Z.C.; WANG, K.Y.; WU, C.T.; SUN, Y.Y.; WANG, C.Y.; CHEN, T.C.; TSUENG, C.C.; LIAN, Y.F.; TAM, L.S. 1983. [Rearing the factitious host of trichogrammatid wasp-(Eri-silkworm) on artificial diets]. Acta Entomologica Sinica 26(2):165-171. Chin., Sum. Chin., Engl., 3 Refs., Illus. [Inst. of Plant Protection, Guangdong Academy of Agricultural Sciences, China]

Cassava. Uses. Silkworm. China.

Three artificial diets were used for rearing the eri silkworm, Philosamia cynthia ricini, during expt. carried out during 1978-81, consisting of raw materials of low cost agricultural products. The success of rearing was related to 6 strains of the eri silkworm found suitable to be reared on artificial diets. Cassava leaves, the basic material of the diets, were dried and preserved at room temp. for 9 mo. A method was designed for rearing the silkworm, and 25 generations and more than 150,000 eri silkworms were reared during the exptl. phase. The % of larvae that survived up to the pupal stage reached 70.1-97.7% and the general performance of the silkworms was quite similar to those feeding on fresh cassava leaves. Trichogrammatid wasps that emerged from eggs of the eri silkworms met the requirements of biological control of lepidopterous pests in sugarcane fields, shown in expt. releasing these trichogrammatid wasps over the 2-yr period. (Author's summary) 102

0490

21443 MEIMBAN, E.J.; BAUTISTA III, J.G.; SORIANO, M.R. 1982. Studies on the fortification of biscuits with cassava leaf protein concentrate (LPC). Philippine Journal of Nutrition 35(2):82-86. Engl., Sum. Engl., 13 Refs.

Cassava. Leaves. Proteins. Uses. Protein enrichment. Biscuits. Philippines.

The effect of fortification with cassava LPC on the acceptability and nutritional quality of chocolate-flavored biscuits was studied. Statistical analysis indicated that up to 2% LPC fortification was acceptable. The width and thickness of the biscuits were significantly affected as the level of fortification increased. The protein content of the biscuits increased with the level of fortification; however, the increase was not significant. The amino acid profile of the 2% LPC-fortified biscuits was improved based on the FAO/WHO recommended pattern. (Author's summary) 102

0491

20119 PONTE, J.J. DA; FRANCO, A. 1981. Manipueira, um nematicida nao convencional de comprovada potencialidade. (Cassareep, a nonconventional nematicide of confirmed potentiality). In Reuniao de Nematología, 5o., Piracicaba-SP, Brasil, 1981. Trabalhos apresentados. Piracicaba, Sociedade Brasileira de Nematología. Publicacao no.5. pp.25-33. Port., Sum. Port., Engl., 5 Refs. [Centro de Ciencias Agrárias, Univ. Federal do Ceará, Fortaleza-CE, Brasil]

Cassava. Cassareep. Uses. Nematodes. Pest control. Brazil.

Cassareep, a by-product of the cassava industry, was tested in soils previously infested with the root knot nematodes Meloidogyne incognita and M. javanica. Tomato plants cv. Santa Cruz, cultivated in soils treated at rates of 0, 500, 1000, and 1500 ml cassareep/pot, showed severe, slight, and no infestation for the last 2 higher doses, resp. Data indicated a high nematicide action of cassareep, a possible substitute for conventional organosynthetic nematicides. (Author's summary) 102

0492

21474 RODRIGUEZ-SOSA, E.J.; CRUZ-CAY, J.R.; CALONI, I.B. DE 1983. Amylography of plantain, cassava, and tanier flours. Journal of Agriculture of the University of Puerto Rico 67(3):303-310. Engl., Sum. Engl., Span., 12 Refs. [Food Technology Laboratory, Agricultural Experiment Station, Univ. of Puerto Rico, Río Piedras, Puerto Rico]

Cassava. Cassava flour. Analysis. Viscosity. Puerto Rico.

The pasting properties of plantain, cassava, and tanier (Xanthosoma spp.) flours and of various mixtures prepared thereof were studied with the Brabender amylograph-viscograph. The flour mixtures were prepared with the following %: 50-25-25, 60-20-20, 75-15-10, and 75-10-15, each flour as the main one in at least 1 mixture. The slurries used in the amylography of the individual flours were prepared by using 27.5, 35, and 40 g of flour, and those of the flour mixtures with 35 g of the mixtures. These were mixed with 450 ml distilled water. Starches of individual flours as well as the mixtures of flours were not fragile and were relatively stable. Different from flours where cassava and tanier were used as the main flour, when plantain was used as the main one, pasting measurements increased with the increase in plantain flour %. The reaggregation tendency and pasting measurements were higher in flours when plantain was used as the main flour. (Author's summary) I02

0493

13628 STUMPF, U.E. 1980. El alcohol y el aceite vegetal como combustibles para motores. (Alcohol and vegetable oil as motor fuel). In Brekelbaum, T.; Toro, J.C.; Izquierdo, V., eds. Simposio Colombiano sobre Alcohol Carburante, 1o., Cali, Colombia, 1980. Memorias. Cali, Centro Internacional de Agricultura Tropical. pp.155-165. Span., Sum. Span., Illus.

Cassava. Uses. Ethanol. Brazil.

The perspectives of using ethyl alcohol, a product of bioconversion, in Brazil, were analyzed: (1) self-sufficiency in liquid fuel for automotive use, (2) solution to the problem of atmospheric contamination, (3) economy and source of foreign currency. Based on this analysis, the government created the National Alcohol Program, through which more than 200 distilleries have been approved. Brazil is considered a privileged country since it has the 3 conditions essential for ethanol production: great territorial extension, soil appropriate for agriculture, and a tropical climate. The principal technical properties of ethanol are discussed: (1) high increase in the no. of molecules in combustion, (2) combustion with a poor mix, (3) high antidetonant power, (4) high latent vaporization heat, (5) constant boiling temp., and (6) high density. Its special characteristics related to motor operation are: volatility, lubrication, and antidetonant power. The application of alcohol in motors can be done in 3 ways: mixed with gasoline; in a parallel manner, or in other words with gasoline and with oil for ACPM motors; in converted gasoline motors and in special motors for alcohol. The advantages and disadvantages of each are given. (Author's summary. Trans. by L.M.F.) I02

0494

21419 UCHIMURA, T.; GARCIA, V.V.; FLORES, D.M. 1984. Microbiological studies on fermented rice cake, "puto" and the application to puto making using cassava flour. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.273-283. Engl., Sum. Engl., 5 Refs., Illus. [Laboratory of Applied Microbiology, Dept. of Agricultural Chemistry, Tokyo Univ. of Agriculture, Sakuragaoka, Setagaya-ku, Tokyo 156, Japan]

Cassava. Cassava flour. Uses. Puto. Food products. Microbiology. Composite flours. Analysis. Organoleptic examination. Post-harvest technology. Philippines.

The microorganisms involved in the fermentation process during puto making were isolated. The lactic acid bacteria which take part in the process have been identified to be Streptococcus faecium, S. lactis, and Lactobacillus plantarum. A lactic acid bacteria (isolate no. 54) that is sble to ferment starch was also isolated. Strain 54 may preferentially participate in puto making. This strain should be further examined to verify whether it is a new type of Streptococcus. Preliminary studies have shown that the cassava-substituted puto at 50% level was preferred over the pure rice puto. Using this level of substitution, different kinds of starters were tested. Puto made from rice-CF mixture (1:1) with strain no. 54 and commercial yeast as starter was the most acceptable. Preliminary results indicated that puto making requires not only bacteria or yeast alone but a combined action of both microorganisms to make a good quality puto. Further studies are still being undertaken to develop an acceptable formulation using CF and the appropriate starter for fermentation to obtain a product with the desirable flavor and texture. (Author's summary) I02

0495

21420 YOSHII, H.; HIGASHI, K.; UCHIMURA, T.; GARCIA, V.V. 1984. Utilization of cassava flour for puto making. In Uritani, I.; Reyes, E.D., eds. Tropical root crops: postharvest physiology and processing. Tokyo, Japan Scientific Societies Press. pp.285-298. Engl., Sum. Engl., 3 Refs., Illus. [Dept. of Brewing & Fermentation, Tokyo Univ. of Agriculture, Sakuragaoka, Setagaya-ku, Tokyo 156, Japan]

Cassava. Cassava flour. Uses. Puto. Composite flours. Fermentation. Composition. Organoleptic examination. Analysis. Post-harvest technology. Philippines.

For the utilization of CF for puto, the composition of ingredients, kind of starters, and methods of fermentation were studied. The detailed structures of the ingredients, dough, and puto products were also studied with a scanning electron microscope. Puto made wholly from CF was most inferior in quality, but 50% substitution of CF for rice flour or wheat flour resulted in marked improvement of the quality of puto. In the puto products made from rice or cassava flour, the starch granules had been gelatinized and mixed with the cellular texture resulting in the formation of a matrix network in which CO_2 gas was retained. In the case of wheat flour, starch granules gelatinized and were joined together with the continuous sheet of gluten which held CO_2 gas and air. From the evaluation of the expansion rate, hardness, detailed structures and preferences tests, the use of the combination of lactic acid bacteria and yeast was suitable as the puto starter. Micrographs are included. (Author's summary) I02

See also 0353 0354 0355 0365 0369 0377 0402 0411 0431 0434 0463 0467 0475 0499 0501 0502

I03 Industrial Microbiology

0496

21122 FERNANDES, V.M.V.; NICOLI, J.R. 1981. Production of protein from the thermotolerant fungus Phanerochaete chrysosporium, using the brown juice from a protein extract of cassava leaves as substrate. Revista de Microbiología (Brasil) 12(4):121-124. Engl., Sum. Engl., Port., 19 Refs., Illus. [Dept. de Bioquímica e Imunologia, Univ. Federal de Minas Gerais, Caixa Postal 2486, 30.000 Belo Horizonte-MG, Brasil]

Cassava. Industrial microbiology. Protein enrichment. Proteins. Leaves. Waste utilization. Biochemistry. Composition. Brazil.

The possibility of obtaining SCP from a residue of cassava leaf protein extract was investigated. The thermotolerant fungus Phanerochaete chrysosporium ATCC 28326 was cultured in brown juice obtained from a protein extract of cassava leaves, either pure or fortified with salts, at 45°C. The max. biomass production, after 40 h of incubation, was essentially the same in both conditions. The yield was low, apparently due to the lack of an important substrate. Salt fortification increased the biomass protein content and also affected the amino acid profile of the proteins. (Author's summary) I03

0497

21491 SALES, A.M.; MENEZES, T.J.B. DE; LAJOLO, F.M.; IADEROZA, M. 1983. Fermentacao semi-sólida de raspa e folhas de mandioca. (Semisolid fermentation of cassava chips and leaves). Revista Brasileira de Mandioca 2(2):77-86. Port., Sum. Port., Engl., 16 Refs. [Inst. de Tecnologia de Alimentos, Caixa Postal 139, 13.100 Campinas-SP, Brasil]

Cassava. Industrial microbiology. Fermentation. Leaves. Cassava chips. Protein enrichment. Amino acids. Protein content. HCN content. Animal nutrition. Brazil.

The production of fungal biomass using substrata of cassava chips and leaves was studied, comparing semisolid fermentation to submerged fermentation, to produce a high protein product for animal feeding. Of the 7 fungal strains selected, 1 strain of Aspergillus niger and another of Rhizopus sp. produced biomass concn. above 18.50 g/l, protein contents of 34%, and conversion factors of 0.56-0.61, when fermented under submerged culture. Mycelia of Rhizopus sp. showed high levels of lysine, threonine, and aromatic amino acids. Although deficient in the S-containing amino acids, it showed a PER of 1.82 and a relative protein value in relation to that of casein of 81%. By semisolid fermentation, using cassava chips as substrate, the protein of the biomass obtained with Rhizopus sp. was 9.64% on a dry wt. basis. The addition of dehydrated cassava leaves to the substrate in the proportion of 16%, resulted in a 4.74% increase in the protein content of the fermented biomass to 13.74%, corresponding to an increase by 2.9 when compared with the quantity present before fermentation. The HCN content was, however, reduced by half, from 8.64 to 4.3 mg/%. (Author's summary) I03

See also 0464 0465

J00 ECONOMICS AND DEVELOPMENT

0498

21188 ALVAREZ, M.N.; HAHN, S.K. 1983. Exploiting the potentials of cassava and sweet potatoes to meet Rwanda's food needs. In Chang, J., ed. Agricultural research in Rwanda: assessment and perspectives. Kigali, Rwanda, 1983. Report of a seminar. Hague, Netherlands, International Service for National Agricultural Research. pp.149-151. Engl. [IITA, P.M.B. 5320, Ibadan, Nigeria]

Cassava. Cassava programs. Research. Rwanda.

Benefits and constraints of cassava and sweet potato production in Rwanda are outlined. Yield increases of both crops are due to increased acreage.

Av. yields are far short of their potentials. Some of the benefits of these 2 crops are: dependable yields under relatively low rainfall conditions; efficient use of local topography; low economic risk; suitability for small land holdings; adaptability to a wide var. of agroclimatic and cultural conditions; storage in the soil for several months; and a high potential for industrial utilization. Pests and diseases cause yield losses to cassava (30-80% and 20-95%, resp.). Other constraints are the low yields of local clones, poor cultural practices, and difficulty of transportation and marketing. The development of improved var. will have a major impact on yields, efficiency of land utilization, farm profitability, labor, health, and production. (Summary by I.B.) J00

0499

21466 AMADI, B.C. 1983. The impact of the invention of a mechanical gari processing machine on cultural aspects of gari consumption and cassava farming in Nigeria. Oxford Agrarian Studies no.12:94-99. Engl. [Dept. of Agricultural Economics, Nigeria Univ., Lagos, Nigeria]

Cassava. Gari. Marketing. Prices. Mechanization. Industrialization. Industrial machinery. Socio-economic aspects. Human nutrition. Nigeria.

A local invention has made gari processing less laborious and its consumption safer. Although gari remains a poor man's staple, its use among higher social groups in Nigeria is growing and the consumption of yams as a status symbol is on the way out. Short of fundamental improvements in techniques of yam production, its market could dwindle as it is more expensive to grow than cassava. (Summary by Field Crop Abstracts) J00

0500

21180 EEC TIGHTENS quotas on Thai cassava imports. International Agricultural Development 1982:12-13. October 1982. Engl., Illus.

Cassava. Cassava products. Trade. Thailand. Europe.

Problems faced by Thailand as a result of EEC enforced curtailment of cassava exports to European markets are reviewed. Cassava and US maize gluten feed compete with each other as replacements for cereals in animal feeds, at the same time that the high prices of European grains stimulate overproduction and exports to US markets. In this context, cassava imports are the cause rather than the effect of the problems faced by cereal farmers. Thailand's quota has been fixed at 10.5 million tons over 1983-84 and at 9.5 million tons over 1985-86, giving it 2 yr of grace. The unreliability of EEC cassava markets makes it urgent to diversify Thailand's agricultural production: possibly rubber in the East of the country and kenaf, cotton, castor bean, groundnut, cashew nut, and ethanol in the NE. Unfortunately, costs are likely to be expensive, since they entail further research, costly production schemes, and extensive irrigation. (Summary by I.B.) J00

0501

21105 JANSSEN, W.; DE JONG, G.; DOORMAN, F. 1982. Sour starch and sweet profits: social organization and economics of cassava and cassava starch production and marketing in the Cauca valley, Colombia. In Box, L.; Doorman, F., eds. Man and Manihot. Volume I. Case studies on cassava cultivators. Wageningen, Netherlands. Mededelingen van de Vakgroepen Sociologie van de Landbouwhogeschool, no.3. pp.112-154. Engl., Sum. Engl., 19 Refs., Illus.

Cassava. Cultivars. Cultivation. Land preparation. Planting. Harvesting. Labour. Costs. Marketing. Cassava starch. Small-scale processing. Prices. Socio-economic aspecta. Maps. Colombia.

Social and economic aspects of cassava production, processing, and marketing in the northern Cauca region of Colombia were studied. Research was focuased on factors influencing production and marketing decisiona of cassava farmers and cassava starch producers within the framework of a no. of production and marketing constraints existing in the region. Soil fertility forms the main constraint on the farming aystem, limiting the cropa that can be grown profitably to caasava and coffee. Lack of cash for investments in coffee cultivation and soil fertility problems force small farmers into cassava cultivation. Larger farmers produce both coffee and cassava. The cassava produced goes almost exclusively into the small-acale starch industry. The market for the sour starch produced is the bakery of towns and cities. The markets for cassava and starch are open and competitive, resulting in a favorable market position for both cassava and starch producers. (Author's summary) J00

0502

20748 JONES, S.F. 1983. The world market for starch and starch products with particular reference to cassava (tapioca) starch. London, Tropical Development and Research Institute. Report no.G173. 98p. Engl., Sum. Engl., Fr., Span., 43 Refs., Illus. [Tropical Development & Research Inst., 56/62 Gray's Inn Road, London WC1X 8LU, England]

Caasava. Cassava starch. Marketing. Trade. Tapiocas. Industrial atarches. Food products. Legal aspects. Modified starches. Production. Statistical data. USA. Japan. Thailand. Taiwan. Europe. United Kingdom.

The world starch market is examined from the point of view of starch exporters in developing countries, concentrating on unmodified starch, although other derivatives are also mentioned. Starch is mainly produced commercially from cereals and root crops. Total world annual production is about 16 million tons of which maize starch accounts for about 77%, but only about 4% of this is exported. World trade in unmodified starches was about 450,000 t (US$135 million f.o.b. Thailand's cassava atarch exports averaged 228,000 t/yr in 1976-81 (out of a total 250,000 t/yr, US$40-$50 million). Major importers are Japan, Taiwan, USA, and the EEC. Future prospects for developing country exporters lie mainly with neighboring and nearby countries. Price competitiveness will be the key to export success, and production costs must be minimized. New producers are recommended to concentrate on their domestic markets, followed by neighboring countries, and then the international market. Thailand sets the quality standard. Some potential exists for trade in modified starches and sweeteners. (Summary by World Agricultural Economics and Rural Sociology Abstracts) J00

0503

21152 JUNTA DEL ACUERDO DE CARTAGENA, ed. 1982. Yuca: calendario de siembra y cosecha, superficie cosechada y producción según país. (Cassava: sowing and harvest schedules, area harvested, and production by countries). In _____. Sistema subregional de información estadística. Estadística Agropecuaria Andina 1970-1980. Lima, Perú. pp.89-92. Span., Illus. [Paseo de la República 3895, Casilla de Correo 3237, Lima, Peru]

Cassava. Planting. Harvesting. Timing. Production. Prices. Statistical data. Bolivia. Colombia. Ecuador. Peru. Venezuela.

The schedules for cassava sowing and harvesting for 5 Andean countries (Bolivia, Colombia, Ecuador, Peru, and Venezuela) are given as well as the areas under cultivation (thousands of hectares) and production data (thousands of MT) during 1970-79 in tables and figures. (Summary by I.B.) J00

0504

21160 SINWAMBANA, M.S.C. 1980. The potential of cassava in Zambia. Mansa, Zambia, Department of Agriculture. Luapula Regional Research Station. 9p. Engl., Sum. Engl., 3 Refs.

Paper presented at Pexco Meeting, Luapula Regional Research Station, Mansa, 1980.

Cassava. Research. Cultivation. Zambia.

The potential of cassava in Zambian agricultural industry, mainly for animal feed and ethanol production, is highlighted. Areas for future cultivation should be identified. Constraints to cassava production in this country are mentioned: low yields, time to maturity (2-3 yr), and high incidence of mosaic. A brief description of research activities of the National Collection Nursery to be carried out over the period 1980-85 is included. (Summary by L.M.F.) J00

0505

20790 SURAPHOL, A. 1981. Thailand's role in the European feed industry. Bruxelles, Belgium, Federation Europeenne des Fabricants d'Aliments Composes pour Animaux. 3p. Engl.

Paper presented at European Congress of the Animal Feed Industry, 12th., München, Germany, 1981.

Cassava. Feeds and feeding. Trade. Thailand. Europe.

Thailand's role in the European feed industry is reviewed. Thailand's cassava exports have decreased due to a serious price decline resulting from an export restriction agreement, at a time when unlimited quantities of feed materials from developed countries are imported tax-free into the EEC. Cassava is charged a 6% import levy. In 1978, the low price of cassava roots (US 1 cent/kg) caused total exports to drop from 6,275,157 to 4,003, 457 t. The fate of farmers, who simply leave the roots underground in the hope for better prices, especially in the barren areas of the NE where there are no other crops or occupations to turn to, is considered. (Summary by I.B.) J00

0506

21153 VENEZUELA. MINISTERIO DE AGRICULTURA Y CRIA. 1982. Yuca. (Cassava). In _____. Memoria y Cuenta 1981. Caracas. pp.II-119,II-125,II-130,III-19-III-22,III-80. Span., Illus.

Cassava. Production. Statistical data. Root productivity. Prices. Research. Venezuela.

A 0.86% production increase and a 4.76% increase in the area under cultivation were recorded for cassava in Venezuela in 1981. Yields averaged 6.745, 7.824, and 7.533 kg/ha in 1977, 1980, and 1981, resp. Rains did not significantly affect crops and only 4.10% of the cultivated surface area was lost. Because of the importance of cassava as a cereal substitute and its

role in generating employment, measures supporting this crop are being implemented. (Summary by I.B.) J00

0507

21162 VENEZUELA. MINISTERIO DE AGRICULTURA Y CRIA. FONDO NACIONAL DE INVESTIGACIONES AGROPECUARIAS. 1981. Rubro: yuca. (Cassava). In _____. Avance del Plan Operativo 1981. Venezuela. pp.73-77. Span.

Cassava. Cassava programs. Research. Venezuela.

The problems of cassava cultivation in Venezuela as well as the objectives of several subprograms on this crop at the national, regional (Central-West, Andean, and East) and/or local levels are listed. Problems include a production deficit, lack of technological implementation, low yields, reduced area planted to cassava, pests and diseases. Program objectives include the identification of alternatives for increasing production areas, higher productivity, a germplasm bank, improved var. with high starch content and adapted to mechanical sowing and harvesting, soil analysis, crop mechanization, seed production, and studies on root deterioration. (Summary by I.B.) J00

0508

20767 WEIR, C. 1979. Recent development in root crop research in Jamaica. In Hillside Farming in Jamaica Training Seminar, Jamaica, 1978. Kingston, Ministry of Agriculture. pp.137-148. Engl.

Cassava. Cultivars. Germination. Flowering. Root productivity. HCN content. Toxicity. Storage. Propagation. Production. Research. Jamaica.

The Jamaican Ministry of Agriculture, in collaboration with the U. of the West Indies and the International Development Research Centre, has undertaken projects that cover the agroeconomic evaluation of cassava production in Jamaica and the introduction and testing of 2 cassava cv. from Costa Rica, 68 and Japonesa, and 8 from CIAT, M Col 22, Llanera, SMI-L50, M Col 638, M Col 1468 (CMC 40), M Col 1684, M Mex 59, and M Ven 218. These cv. were compared with the local cv. 30, 69, C5, and C8. Evaluation criteria were: vegetative characteristics, yield and tuber characteristics, and HCN contents. M Col 22, M Mex 59, and M Col 1468 gave the highest yields among introduced var.; cv. 30 and 69 showed high HCN contents, whereas M Col 22, M Mex 59, Llanera, and M Ven 218 showed low HCN contents. Factors affecting toxicity are mentioned as well as insects and fungal diseases. Regarding postharvest storage, tubers were found to keep well (80% survival for 2 mo. or more) if packed in boxes lined with polyethylene, and covered with damp sawdust or coir dust (45-55% moisture). For good propagation of planting material, the age of the stem (plants 8-18 mo. old), no. of nodes/cutting (5-8), and cutting thickness (no less than half the diameter of the stem base). Rapid multiplication techniques (mist and humidity chambers) are mentioned, as well as large-scale cassava production. (Summary by I.B.) J00

0509

20771 WHOLEY, D. 1983. Root crops: their role in Asian development. Far Eastern Agriculture 1983:38-39. January 1983. Engl., Illus.

Cassava. Cultivation. Research. Asia.

The evolution of indigenous root and tuber crops, as well as the impact of introduced American crops (sweet potato and cassava) in SE Asia are considered. Cassava has become an important field and plantation crop during the past century; drought tolerant, it will produce a crop on exhausted soils, and also respond to fertilizers. Cassava's place in the development of Thailand, Indonesia, and Malaysia is discussed. The lack of serious diseases and pests in Thailand has enabled the production of cassava without rotation (which is not recommended), and the development of large-scale plantation-type enterprises specializing in the production of cassava pellets for exportation to the EEC livestock feed compounders. In Indonesia, cassava starch is produced for domestic use. The past, present, and future of cassava as an industrial crop are discussed. (Summary by I.B.) J00

See also 0354 0355 0371 0372 0376 0392 0485 0510

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0510

21488 ALMEIDA, P.A. DE; BEGAZO, J.C.E.O. 1983. Consorcio de mandioca (Manihot esculenta Crantz) com cuatro culturas de ciclos diferentes. (Intercropping cassava with four crops of different growth cycles). Revista Brasileira de Mandioca 2(2):51-57. Port., Sum. Port., Engl., 9 Refs. [Centro Nacional de Pesquisa de Mandioca e Fruticultura, Caixa Postal 007, 44.380 Cruz das Almas-BA, Brasil]

Cassava. Intercropping. Groundnut. Sweet potatoes. Bean. Maize. Root productivity. Foliage. Starch content. Roots. Costs. Income. Brazil.

In Vicosa, MG, Brazil, the cassava crop was intercropped in 5 production systems with peanuts, potato, bean, and maize in a randomized complete block design with 9 treatments and 4 replications. Cassava was harvested 10 mo. after planting and the other crops at the end of each growth cycle. Cassava was considered the main crop and yields of roots and aerial parts and starch were evaluated. For the other crops only final commercial yields were considered. Except for cassava/maize intercropping in which cassava root yield was substantially reduced, treatments did not significantly influence most of the variables analyzed. Cassava/potato intercropping, although more expensive, showed the highest LER value, higher net income, and consequently higher monetary value. On the other hand, cassava/maize intercropping was unefficient, showing a LER below 100%, lower net income, and negative monetary value. (Author's summary) K01

0511

21179 ROSALES, F.E. 1982. Experimental designs for cassava and peanut production systems. Kingston, Jamaica, Instituto Interamericano de Ciencias Agrícolas. Publicación Miscelánea no.356. 36p. Engl., Illus.

Cassava. Cassava programs. Field experiments. Experiment design. Intercropping. Pruning. Timing. Maize. Groundnut. Cowpea. Sorghum. Planting. Spacing. Jamaica.

Eight exptl. designs are presented for cassava and peanut production systems in Jamaica, where low productivity and income, low production, and

large dependency on imported foods affect agriculture. Background information is given on an agreement signed between Inter-American Institute for Cooperation on Agriculture and the Ministry of Agriculture of Jamaica in 1981, with a proposed life of 2 yr, and which is expected to promote and increase cassava and peanut production through improved production. The specific objectives, strategies, and on-going research are described, and the variables, exptl. design, planting material, spacing, area, and plot size of each expt. are outlined. Exptl. designs that include cassava are: cassava (local var. 69)/maize multiple cropping, cassava (var. 69)/peanut multiple cropping with 6 different cassava spacings, cassava (var. 69) multiple cropping without pruning, cassava (var. 69)-peanut-pigeon pea multiple cropping with pruning, and cassava (var. C-5, an early introduction from Colombia)/peanut multiple cropping with 5 different cassava spacings. (Summary by I.B.) K01

See also 0384 0388 0449

ABBREVIATIONS AND ACRONYMS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
Afr.	Afrikaans
a.i.	Active ingredient
alt.	Altitude
AMV	Alfalfa mosaic virus
approx.	Approximate(ly)
atm.	Atmosphere
ATP	Adenosine 5'-triphosphate
av.	Average
BAP	6-Benzylaminopurine
BBMV	Broad bean mosaic virus
BCMV	Bean common mosaic virus
BGMV	Bean golden mosaic virus
BGYMV	Bean golden yellow mosaic virus
BOD	Biochemical oxigen demand
BPMV	Bean pod mottle virus
BRMV	Bean rugose mosaic virus
BSMV	Bean southern mosaic virus
BV	Biological value
BYMV	Bean yellow mosaic virus
°C	Degrees Celsius (centigrade)
ca.	About (circa)
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
CBB	Cassava bacterial blight
CBSD	Cassava brown streak disease
CEC	Cation exchange capacity
CER	CO_2 exchange rate
CF	Cassava flour
CGR	Crop growth rate
CLM	Cassava leaf meal
CLV	Cassava latent virus
CM	Cassava meal
cm	Centimeter(s)
COD	Chemical oxigen demand
concd.	Concentrated
concn.	Concentration
CP	Crude protein
CSL	Calcium stearyl lactylate
CSW	Cassava starch wastes
C.V.	Coefficient of variation
cv.	Cultivar(s)
2,4-D	2,4-dichlorophenoxyacetic acid
DM	Dry matter
DNA	Deoxyribonucleic acid
EC	Emulsifiable concentrate
EDTA	Ethylenediaminetetraacetic acid
EEC	European Economic Community
e.g.	For example
ELISA	Enzyme-linked immunosorbent assays
EMS	Ethyl methane sulfonate
Engl.	English
expt.	Experiment(s)
exptl.	Experimental
°F	Degrees Fahrenheit
Fr.	French
ft-ca	Foot candles (10.76 lux)
FYM	Farmyard manure
g	Gram(s)
G	Giga (10^9)
GA	Gibberellic acid
gal	Gallon(s)
GE	Gross energy
Germ.	German
GERs	Glucose entry rates
GLC	Gas-liquid chromatography
govt.	Government
govtl.	Governmental
h	Hour(s)
ha	Hectare(s)
HCN	Hydrocyanic acid
HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
HI	Harvest index
IAA	Indolyl acetic acid
IBA	Indolebutyric acid
Illus.	Illustrated
in.	Inches
Ital.	Italian
IU	International unit
J	Joule
Jap.	Japanese
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilocalorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate
kR	Kiloroentgen(s)
l	Liter(s)
LAD	Leaf area duration
LAI	Leaf area index
lat.	Latitude
lb	Pound(s)
LD_{50}	Mean lethal dose
LER	Land efficiency ratio
LPC	Leaf protein concentrate
lx	Lux
M	Mega
M	Molar
m	Meter(s)
Mal.	Malay
max.	Maximum

MC	Moisture content
ME	Metabolizable energy
meq	Milliequivalent(s)
met.	Methionine
mg	Milligram(s)
mho	Reciprocal ohm
min.	Minimum
min	Minute(s)
ml	Milliliter(s)
mm	Millimeter(s)
mo.	Month
mol.wt.	Molecular weight
m.p.	Melting point
NAA	Alpha-naphthalene acetic acid
NAD	Nicotinamide adenine dinucleotide
NADH	Nicotinamide adenine dinucleotide, reduced from
NAR	Net assimilation rate
NCE	Net CO_2 exchange
NE	Northeast
NER	Net energy ratio
nm	Nanometer(s) (10^{-9} m)
no.	Number(s)
NPFs	Negative production factors
NPR	Net protein ratio
NPU	Net protein utilization
NW	Northwest
OM	Organic matter
oz	Ounce(s)
P	Probability
Pa.	Pascal(s)
PAN	Peroxyacetic nitrate
PCNB	Pentachloronitrobenzene
PDA	Potato dextrose agar
PER	Protein efficiency ratio
pH	Hydrogen ion concentration
pphm	Parts per hundred million
PPI	Pre-planting incorporation
ppm	Parts per million
PSA	Potato sucrose agar
pv.	Pathovar.
Ref(s).	Reference(s)
resp.	Respective(ly)
Rf	Retardation factor-chromatography
RGR	Relative growth rate
RH	Relative humidity
RNA	Ribonucleic acid
Rom.	Romanian
Russ.	Russian
s	Second
SBM	Soybean meal
SCN	Thiocyanate
SCP	Single cell protein
SDS	Sodium dodecyl sulfate
Sk.	Slovak
sp.	Species
Span.	Spanish
spp.	Species
SSL	Sodium stearyl-2-lactylate
Sum.	Summary
t	Ton(s)
TDN	Total digestible nutrients
temp.	Temperature
TIA	Trypsin inhibitor activity
TIBA	2,3,5-Triiodobenzoic acid compound with N-methylmethanamine
TLC	Thin-layer chromatography
TMV	Tobbaco mosaic virus
TSH	Thyroid-stimulating hormone
UDPG	Uridine diphosphate glucose
UMS	Unmodified cassava starch
UV	Ultraviolet
var.	Variety(ies), varietal
VFA	Volatile fatty acids
vol.	Volume
VPD	Vapor pressure deficit
vpm	Volume per million
W	West
wk.	Week
WP	Wettable powder
wt.	Weight
YFEL	Youngest fully expanded leaves
yr	Year(s)
/	Per
%	percent(age)
>	More than, greater than
<	Less than
≤	Equal to or less than
≥	Equal to or greater than
±	Plus or minus

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0220 0225 0229 0236 0237 0283 0284
0285 0287 0288 0289 0292 0397 0398
0399 0449 0450 0451 0452 0453 0454
0456 0457 0458 0459 0460 0461 0506
TOXICITY
0128 0508

CULTIVATION SYSTEMS
0194
FALLOWING
0388
INTER-CROPPING
0069 0080 0173 0180 0191 0192 0193
0216 0231 0251 0334 0346 0347 0348
0349 0350 0351 0352 0372 0373 0384
0391 0412 0449 0511
ROTATIONAL CROPS
0391 0449

CULTURE MEDIA
0159 0198
TISSUE CULTURE
0197 0201

CUTTINGS
0015 0075 0076 0165 0215 0247 0393
GERMINATION
0093 0390
TIMING
0005 0191 0202 0220
PROPAGATION
0033 0054 0093 0395
ROOTING
0005 0033 0395
SPACING
0093 0236
STORAGE
0005 0191 0223 0226 0390 0395
TUBER PRODUCTIVITY
0005 0024 0033 0035 0091 0093 0191
0202 0220 0225 0236 0349 0390 0392

CYANIDES
0008 0010 0041 0138 0367 0368
DETOXIFICATION
0095
TOXICITY
0112

CYANOGENESIS
0007

CYANOGENIC GLYCOSIDES
0127 0369 0401 0406

CYTOGENETICS
0098 0201 0290

CYTOLOGY
0055

DETERIORATION
0047
TUBERS
0040 0042 0043 0044 0091 0099 0226
0367 0400 0403 0404 0405 0407 0408
0409 0410 0411

DETOXIFICATION
0095 0097 0126 0145 0305 0366 0464

DEVELOPMENTAL STAGES
BRANCHING
0031 0035 0453
FLOWERING
0097 0201 0202 0451 0453 0508
GERMINATION
0005 0090 0093 0191 0202 0220 0356
0390 0417 0508
ROOTING
0005 0033 0097 0386 0395
TUBER DEVELOPMENT
0005 0031 0072 0097 0202 0349 0364
0452 0453 0454

DIETS
0105 0474
DIETARY VALUE
0473 0476
NUTRITIVE VALUE
0353

DIGESTIBILITY
0111 0117 0122 0304 0308 0311 0472
0476
CASSAVA MEAL
0305

DIPLODIA
0418
RESISTANCE
0047

DISEASE CONTROL
0001 0003 0164 0240 0412
BACTERIOSES
0050 0095 0416
MYCOPLASMOSES
0050
MYCOSES
0050 0247
VIROSES
0050 0054 0056 0095

DISEASE TRANSMISSION
0047 0245 0414

DOMESTIC ANIMALS
0109 0110 0111 0113 0115 0116 0117
0118 0119 0121 0122 0123 0124 0138
0293 0298 0301 0303 0304 0305 0306
0308 0309 0310 0312 0338 0469 0471
0472 0473 0474

DOMINICAN REPUBLIC
0158 0282

DRAINAGE
0452

DRIED TUBERS
0008 0101 0112 0135 0138 0140 0144
0156 0181 0305 0306 0312 0391 0402

0470 0497
MARKETING
0180 0334 0344

DRYING
0238 0316 0483
CASSAVA CHIPS
0112 0138 0156 0402
CASSAVA FLOUR
0106 0142 0402

ECOLOGY
0049 0065 0080 0092 0428
CULTIVARS
0047 0173 0433 0453

ECUADOR
0168 0503

EGGS
0471

ELSINOE BRASILIENSIS
0052 0252

ENDEMIC GOITRE
CLINICAL MANIFESTATIONS
0108 0183 0477
ETIOLOGY
0477

ENERGY PRODUCTIVITY
0019 0141 0185 0396 0484

ENTOMOLOGY
0062 0068 0070 0071 0080 0081 0083
0084 0258 0263 0269 0270 0271 0272
0273 0423 0424 0425 0426 0428 0429
0433 0434 0435 0436 0437 0438 0440
0443 0444 0447 0448

EPIDEMIOLOGY
0251 0421

ERINNYIS ALOPE
0430

ERINNYIS ELLO
0028 0062 0173 0423 0424 0430 0436
0438 0439 0441
INSECT CONTROL
0081
BIOLOGICAL CONTROL
0449
RESISTANCE
0093 0449 0459

ERWINIA CAROTOVORA
0241

ERWINIA CASSAVAE
0418

ERYSIPHE MANIHOTIS
0250

ETHANOL
0137 0147 0150 0154 0482 0484 0493

ETHNOBOTANY
0353 0354 0355 0357

EUDIPLOSIS BRASILIENSIS
INSECT CONTROL
0427

EUTETRANYCHUS ORIENTALIS
0089
RESISTANCE
0445

EXPERIMENT DESIGN
0374 0511

FACTORIES
0147 0321 0323 0482 0486
CASSAVA CHIPS
0135
CASSAVA FLOUR
0140 0328
CASSAVA STARCH
0146 0320 0324 0328 0377
PELLETS
0135 0140

FALLOWING
0388

FATTENING
SWINE
0124 0312

FEED CONSTITUENTS
0119 0302 0310 0471 0472 0473 0476
FISH MEAL
0303

FEEDS AND FEEDING
0111 0113 0114 0115 0116 0117 0118
0119 0123 0124 0135 0140 0156 0174
0175 0180 0185 0298 0299 0300 0301
0302 0303 0304 0305 0309 0310 0311
0332 0334 0338 0339 0343 0344 0471
0472 0473 0474 0475 0476 0505
FERMENTATION
0137 0143 0145 0150 0158 0315 0323
0365 0369 0495
PROTEIN ENRICHMENT
0159 0326 0497

FERMENTED PRODUCTS
0021 0134 0137 0141 0143 0146 0147
0148 0149 0150 0152 0153 0154 0155
0188 0190 0315 0321 0323 0331 0465
0482 0484 0485 0493

FERRISIA VIRGATA
0064

FLOWERING
0097 0201 0202 0451 0453 0508

FLOWERS
0196

FOLIAGE
0015 0026 0032 0039 0051 0123 0218
0228 0237 0287 0289 0298 0299 0300
0349 0381 0398 0449 0450 0452 0510

FOMES LIGNOSUS
0.18

FOOD ENERGY
0019 0102 0125 0295 0296 0328

FOOD PRODUCTS
0097 0103 0126 0145 0157 0181 0285
0291 0292 0317 0319 0463 0464 0467
0488 0490 0494 0495 0502

FOO-FOO
COMPOSITION
0097 0292
PROCESSING
0292

FORAGE
0302 0306

FRENCH GUIANA
0451 0452

FROG'S SKIN DISEASE
0001 0047 0050 0056 0240 0241

FRUCTOSE
0406

FRUITS
0196

FUSARIUM
0241
DISEASE CONTROL
0050

GABON
0285

GAPLEK
0391
PRODUCTION
0101 0334
TRADE
0180 0334
USES
0101 0334

GARI
0181
COMPOSITION
0097 0285 0291 0292
DETOXIFICATION
0097 0145
FERMENTATION
0145
HCN CONTENT
0097 0292
INDUSTRIAL MACHINERY
0499
MECHANIZATION
0499
PROCESSING
0157 0292 0317
PROTEINS
0103

GELATINIZATION
0129 0131 0132 0478 0481

GENETICS
0092 0099 0285 0286 0455

GERMINATION
0417 0508
CUTTINGS
0005 0093 0191 0202 0220 0390
SEED
0090 0356
TIMING
0005 0191 0202 0220

GERMPLASM
0001 0090 0093 0094 0096 0100 0173
0197 0282 0283 0448 0449 0450 0453
0455

GHANA
0109

GLOEOSPORIUM MANIHOTIS
0418

GLOMERELLA
0050 0241 0283

GLOMERELLA CINGULATA
0418
RESISTANCE
0047

GLOMERELLA MANIHOTIS
INOCULATION
0419

GLUCOSE
0406

GOATS
0121 0298 0304

GRAFTING
0391

GROWTH
0002 0014 0025 0197 0383 0396

GUATEMALA
0293
MARKETING
0176
PRODUCTION
0176
SOCIO-ECONOMIC ASPECTS
0176

HAITI
0168

HARVEST INDEX
0090 0196 0220 0229 0235 0236 0287
0348 0349 0396 0398 0450 0452

HARVESTING
0019 0022 0028 0032 0165 0176 0185
0214 0215 0216 0353 0376 0391 0501
AGRICULTURAL EQUIPMENT
0036 0389
TIMING
0034 0035 0169 0226 0229 0385 0392
0397 0503

HCN CONTENT
0007 0126 0128 0369 0508
CASSAVA CHIPS
0497
CASSAVA FLOUR
0463

CASSAVA MEAL
0097 0113 0292
CORTEX
0118 0365
LEAVES
0009 0051 0090 0095 0102 0204 0283
0366 0433 0449 0497
STEMS
0009 0283 0449
TUBERS
0090 0091 0205 0283 0365 0366 0367
0368 0370 0400

HEPATIC DISORDERS
0297

HERBICIDES
0015 0093 0221 0225 0230 0232 0233
0388

HONDURAS
0459
MARKETING
0165
PRODUCTION
0165

HUMAN NUTRITION
0101 0102 0104 0105 0106 0160 0166
0181 0283 0293 0294 0295 0334 0353
0357 0462 0467 0468 0499

HUMAN PHYSIOLOGY
0401 0468

HYBRIDS
0012
PRODUCTIVITY
0033 0168 0169
SELECTION
0033
TUBER PRODUCTIVITY
0033

HYDROLYSIS
0137 0323
CASSAVA STARCH
0143 0479 0480

INCOME
0160 0164 0169 0185 0192 0193 0219
0234 0328 0342 0350 0351 0510

INDIA
0042 0051 0089 0132 0146 0163 0198
0203 0204 0318 0351 0361 0433 0447
0468 0487
GERMPLASM
0197
MARKETING
0334
PRODUCTION
0334
TRADE
0334

INDONESIA
0037 0117 0160 0163 0363 0384 0391
MARKETING
0180 0334 0343 0345
PRODUCTION
0101 0334
SOCIO-ECONOMIC ASPECTS
0294
TRADE
0180 0334 0338 0343 0345

INDUSTRIAL MACHINERY
0320 0324 0482 0499

INDUSTRIAL STARCHES
0136 0324 0502

INJURIOUS INSECTS
0023 0068 0080 0096 0196 0248 0267
0425 0426 0429 0431 0435 0440 0443
ANASTREPHA MANIHOTI
0259 0427
ALEUROTRACHELUS SOCIALIS
0062 0283 0427
ANASTREPHA MANIHOTI
0259 0427
ANASTREPHA PICKELI
0259 0427
ADNIDOMYTILUS ALBUS
0260 0268 0427 0448
ATTA
0028
BEMISIA
0268 0433
CARPOLONCHAEA CHALYBEA
0028 0259 0448
ERINNYIS ALOPE
0430
ERINNYIS ELLO
0028 0062 0081 0093 0173 0423 0424
0430 0436 0438 0439 0441 0449 0459
EUDIPLOSIS BRASILIENSIS
0427
PHENACOCCUS MANIHOTI
0060 0061 0063 0064 0065 0066 0067
0069 0070 0071 0072 0073 0074 0075
0076 0077 0078 0079 0082 0083 0084
0085 0095 0097 0216 0258 0261 0262
0263 0264 0265 0266 0269 0270 0271
0272 0273 0274 0275 0276 0277 0278
0279 0281 0285 0427 0428 0432 0437
0442 0448
SILBA PENDULA
0062 0427 0448 0459
ZONOCERUS VARIEGATUS
0268

INJURIOUS MITES
0023 0028 0086 0090 0096 0196 0260
0283 0440 0447 0449 0453
OLYGONYCHUS PERUVIANUS
0062 0427 0444 0445 0448
MONONYCHELLUS TANAJOA
0060 0062 0065 0066 0067 0069 0074
0077 0078 0082 0087 0088 0093 0095
0097 0216 0264 0266 0275 0277 0278
0279 0281 0285 0427 0432 0444 0445
0446 0448 0454
TETRANYCHUS CINNABARINUS
0089 0280 0444 0445
TETRANYCHUS URTICAE
0062 0230 0427 0445 0446 0448

INOCULATION
DISEASES AND PATHOGENS
0248 0419 0449

INSECT BIOLOGY
0070 0080 0083 0429

INSECTICIDES
0061 0066 0073 0085 0088 0274 0277

INTER-CROPING
0069 0180 0193 0216 0334 0347 0372
0373 0376 0391 0412
BEANS
0080 0191 0192 0251 0346 0351 0510
COWPEA
0173 0348 0349 0511
GROUNDNUT
0231 0348 0349 0510 0511
LEGUME CROPS
0510 0511
MAIZE
0080 0173 0192 0251 0350 0352 0384
0510 0511
RICE
0192 0384
SORGHUM
0511
SOYBEANS
0449
SWEET-POTATOES
0251 0510

IRON
0207 0208

IRRADIATION
0103 0170

IRRIGATION
0002 0025 0060 0185

ISOLATION
DISEASES AND PATHOGENS
0048 0242 0246

IVORY COAST
0058 0378

KENYA
0420 0421

LABORATORY ANIMALS
0127 0401 0462 0468 0470

LABOUR
0328 0342 0350
HARVESTING
0028 0169 0185 0353 0376 0391 0392
0501
LAND PREPARATION
0169
PLANTING
0028 0169 0185 0376 0391 0392 0501
PROCESSING
0353 0355 0391 0501

LAND PREPARATION
0019 0164 0165 0215 0388 0501
MECHANIZATION
0032
TUBER PRODUCTIVITY
0032 0072 0173 0391 0449

LAND USE
0348 0349

LATIN AMERICA
0049 0182
SOCIO-ECONOMIC ASPECTS
0186

LEAF AREA
0006 0029 0031 0349 0362 0363 0396

LEAVES
0004 0093 0094 0196 0200 0243 0318
0358 0360 0434 0451 0490 0496
AMIND ACIDS
0009 0102 0296 0305 0497
ANALYSIS
0002 0006 0204 0207 0208 0209 0244
0361 0363 0366 0381 0406
ANIMAL NUTRITION
0109 0138 0283 0304 0305 0306 0307
0309 0497
HCN CONTENT
0009 0051 0090 0095 0102 0204 0283
0366 0433 0449 0497
MINERAL CONTENT
0016 0102 0173 0207 0208 0209 0210
0296 0349 0381 0383
MINERAL DEFICIENCIES
0210
NUTRITIVE VALUE
0102
PROTEIN CONTENT
0009 0095 0102 0204 0296 0305 0497
VITAMIN CONTENT
0102

LEGAL ASPECTS
0067 0338 0343 0483 0502

LIBERIA
0285

LIGHT
0097 0191 0363

LINAMARASE
0041 0145 0367

LINAMARIN
0127 0369 0401 0406

LODGING
0287

MAGNESIUM
0030 0207 0208 0383 0470
TUBER PRODUCTIVITY
0382

MALAYSIA
0163 0168 0304 0368 0379 0396
MARKETING
0334
PRODUCTION
0334
TRADE
0334

MANGANESE
0207 0208 0210 0218

MANIHOT DICHOTOMA
0290

MANIHOT GLAZIOVII
0282 0424 0425 0426 0433

MANURES
0381

MARANTA
0478

MARKETING
0164 0165 0169 0176 0215 0332 0336
0337 0339 0343 0345 0354 0376 0500
0505
CASSAVA CHIPS
0334 0344
CASSAVA FLOUR
0162 0328 0355
CASSAVA MEAL
0335
CASSAVA STARCH
0162 0180 0328 0334 0344 0501 0502
GARI
0499
PELLETS
0334 0344
TAPIOCAS
0334 0502
TUBERS
0483

MECHANIZATION
0037 0499
HARVESTING
0028 0032 0036 0185 0389 0392
PLANTING
0028 0036 0185 0392 0393

METHIONINE
0124 0127 0310

MEXICO
0080 0205 0310
GERMPLASM
0094

MICROSPOROGENESIS
0098

MINERAL DEFICIENCIES
0210

MINERALS
0014 0015 0017 0018 0024 0026 0027
0029 0030 0093 0097 0164 0165 0173
0207 0208 0209 0210 0215 0218 0219
0299 0349 0350 0380 0381 0382 0383
0385 0387 0433 0449 0461 0470 0476

MITE CONTROL
0060 0065 0066 0074 0077 0082 0085
0087 0089 0095 0277 0278 0279 0281
0427 0440 0444 0445 0446

MODIFIED STARCHES
0131 0502

MOLYBDENUM
0218

MONONYCHELLUS CARIBEANAE
0028 0444
RESISTANCE
0445

MONONYCHELLUS TANAJOA
0062 0085 0087 0088 0216 0275 0432
0444 0446
INSECT CONTROL
0060 0065 0067 0069 0074 0077 0082
0236 0278 0279 0281 0427
BIOLOGICAL CONTROL
0095
INSECTICIDES
0066 0277
RESISTANCE
0066 0069 0077 0078 0093 0097 0264
0285 0445 0448 0454

MOULDS
0158

MUKIBAT SYSTEM
0031 0391

MULCHING
0025 0072

MYCOPLASMOSES
0050

MYCORRHIZA
0014 0015 0017 0018 0024 0173 0449

MYCOSES
0020 0028 0051 0096 0173 0241 0249
0250 0251 0252 0283 0408 0418 0419
DISEASE CONTROL
0050 0247
RESISTANCE
0047 0049 0052 0090 0091 0093 0196
0248 0288 0453 0454 0459

NEMATODES
0057 0058 0059 0095 0097 0256 0257
0491

NEPAL
0108

NICARAGUA
SOCIO-ECONOMIC ASPECTS
0105

NIGERIA
0003 0025 0027 0057 0060 0061 0063
0064 0065 0066 0067 0069 0070 0071
0074 0076 0077 0078 0079 0082 0083
0084 0085 0087 0088 0095 0097 0103
0115 0118 0119 0124 0125 0126 0128
0145 0199 0202 0209 0221 0244 0248
0253 0261 0263 0264 0265 0269 0276
0277 0278 0281 0285 0290 0292 0317
0352 0369 0382 0388 0389 0416 0437
0442 0462 0476
GERMPLASM
0455
MARKETING
0499
PRODUCTION
0371
SOCIO-ECONOMIC ASPECTS
0275 0499

NITROGEN
0002 0014 0024 0027 0029 0030 0097
0173 0193 0207 0208 0209 0215 0219
0308 0380 0381 0383 0385 0433 0449
0461 0470

NORTHERN IRELAND
0469

NUTRIENT SOLUTION
0016

NUTRITIONAL REQUIREMENTS
0018 0208 0210 0381 0385 0387 0461
0465

OIDIUM
0249
DISEASE CONTROL
0050

OIDIUM MANIHOTIS
0250 0251 0288

OLIGONYCHUS BIHARENSIS
0089
RESISTANCE
0445

OLIGONYCHUS PERUVIANUS
0062 0444
INSECT CONTROL
0427
RESISTANCE
0445 0448

ORGANOLEPTIC EXAMINATION
0034 0205 0400 0466
CASSAVA FLOUR
0133 0402 0463 0494 0495
COMPOSITE FLOURS
0133 0494 0495

PACKAGING
0165 0239

PAPUA NEW GUINEA
0179

PARTICLE SIZE
CASSAVA STARCH
0481

PEDICELS
0194

PEELING
0106

PELLETS
0135 0305 0310 0334 0344
PROCESSING
0140

PERU
0303
PRODUCTION
0503

PEST CONTROL
0001 0003 0050 0054 0060 0061 0064
0065 0066 0067 0069 0073 0074 0075
0076 0077 0081 0082 0085 0087 0088
0095 0164 0165 0185 0240 0247 0269
0274 0276 0277 0278 0279 0281 0412
0416 0423 0427 0431 0440 0442 0444
0445 0446 0491

PEST DAMAGE
0062 0279

PETIOLES
0196 0207 0209 0243

pH
0024
CASSAVA STARCH
0481

PHENACOCCUS
0283 0428 0435 0437 0449

PHENACOCCUS HERRENI
0062 0283 0428 0435 0449

PHENACOCCUS MANIHOTI
0063 0070 0071 0072 0079 0083 0084
0085 0216 0258 0261 0262 0265 0270
0271 0272 0273 0275 0428 0432 0437
INSECT CONTROL
0060 0064 0065 0067 0069 0074 0075
0076 0077 0082 0266 0269 0276 0278
0279 0281 0427 0442
BIOLOGICAL CONTROL
0095
INSECTICIDES
0061 0066 0073 0274 0277
RESISTANCE
0066 0069 0077 0078 0097 0263 0264
0274 0285 0448

PHENOLS
0243 0402 0407

PHILIPPINES
0014 0031 0040 0041 0043 0044 0086
0098 0114 0129 0142 0163 0190 0193
0219 0235 0236 0239 0297 0315 0325
0366 0367 0370 0377 0400 0402 0403
0404 0405 0406 0407 0408 0409 0410
0411 0475 0478 0486 0490 0494 0495
MARKETING
0164 0215 0334
PRODUCTION
0234 0334 0372 0373
SOCIO-ECONOMIC ASPECTS
0164 0372
TRADE
0334

PHOMA
0250 0283
DISEASE CONTROL
0050
RESISTANCE
0090

PHOSPHORUS
0014 0015 0017 0018 0024 0027 0029
0030 0097 0173 0193 0207 0208 0209
0215 0218 0219 0349 0380 0381 0383
0385 0387 0433 0449 0461 0470

PHOTOPERIOD
0002 0097 0202

PHOTOSYNTHESIS
0002 0004 0200 0358 0359 0360 0362
0363 0396

PHYLLOSTICTA
0418

PHYSIOLOGY
0364 0383 0390 0405 0449 0454

PHYTOPHTHORA DRECHSLERI
DISEASE CONTROL
0247

PIGLETS
0005 0022 0029 0036 0043 0044 0048
0050 0056 0069 0074 0080 0093 0128
0135 0138 0163 0165 0179 0182 0187
0190 0205 0209 0246 0256 0259 0280
0286 0288 0317 0349 0364 0376 0396
0410 0432 0458

PLANT ASSIMILATION
0362

PLANT DAMAGE
0248 0419

PLANT FERTILITY
0098 0290

PLANT HEIGHT
0025 0026 0031 0193 0195 0219 0221
0222 0228 0236 0237 0349

PLANT PHYSIOLOGICAL PROCESSES
0002 0004 0014 0017 0024 0044 0193
0200 0207 0209 0349 0358 0359 0360
0362 0363 0396 0400 0404 0405

PLANT RESPIRATION
0004 0362 0396 0400 0404 0405

PLANT TISSUES
0014 0016 0041 0043 0044 0198 0207
0208 0244 0367 0408
TISSUE CULTURE
0056 0197 0201

PLANTING
0172 0395 0503
AGRICULTURAL EQUIPMENT
0036 0393
COSTS
0028 0165 0185 0215 0376 0391 0392
0501
LABOUR
0028 0169 0185 0376 0391 0392 0501
MECHANIZATION
0028 0036 0185 0392 0393
SPACING
0164 0193 0227 0229 0236 0346 0391
0511
TUBER PRODUCTIVITY
0033 0072 0193 0228 0229 0231 0236
0391 0392

POLISTES
0436 0438

POLYNESIA
0385 0392 0393 0458

PORTUGAL
0332

POST-HARVEST LOSSES
0400 0404 0411

POULTRY
0113 0115 0138 0298 0310 0469 0471

PRICES
0160 0162 0169 0175 0177 0180 0334
0338 0339 0340 0499 0501 0503 0506

PROCESSING
0008 0042 0102 0126 0140 0147 0156
0157 0176 0180 0226 0292 0317 0322
0324 0333 0353 0354 0355 0366 0375
0391 0411 0464 0482 0486 0501
DRYING
0112 0138 0142 0156 0238 0316 0402
0483
FERMENTATION
0137 0143 0315 0323 0365 0369 0497
GELATINIZATION
0129 0481

PROPAGATION
0031 0033 0054 0090 0093 0198 0391
0394 0395 0508

PROPAGATION MATERIALS
0005 0015 0024 0033 0035 0054 0067
0075 0076 0091 0093 0165 0191 0202
0215 0220 0226 0228 0236 0247 0349
0356 0390 0392 0393 0394

PROTEIN CONTENT
0125 0299 0463 0469 0481
LEAVES
0009 0095 0102 0204 0296 0305 0497
STEMS
0009 0305
TUBERS
0012 0159 0305

PROTEIN ENRICHMENT
0133 0293 0463 0464 0490 0496
AMINO ACIDS
0159 0465 0497
FERMENTATION
0159 0326 0497

PROTEINS
0303 0490 0496
ANALYSIS
0103 0204
DIETARY VALUE
0117 0119 0308 0476
DIGESTIBILITY
0117 0308 0476

PRUNING
0035 0234 0511
DETERIORATION
0047 0400 0405 0407

PUERTO RICO
0383 0386 0463 0492

PULP
0369 0466

QUARANTINE MEASURES
0067

RAINFALL DATA
0229

RASPING
0106

RECIPES
0463 0467

RESISTANCE
0016 0099 0256 0412
DISEASES AND PATHOGENS
0039 0045 0047 0049 0052 0090 0091
0093 0097 0196 0243 0248 0284 0285
0288 0289 0421 0449 0453 0454 0459
INJURIOUS INSECTS
0066 0069 0077 0078 0093 0097 0196
0248 0263 0264 0274 0285 0440 0448
0449 0459
INJURIOUS MITES
0066 0069 0077 0078 0086 0090 0093
0097 0196 0264 0285 0440 0445 0448
0449 0453 0454

ROOT SYSTEM
0005 0196 0202 0386 0449

ROOTING
0005 0033 0097 0386 0395

ROSELLINIA
0418
DISEASE CONTROL
0050

ROTATIONAL CROPS
0376 0391 0449

RWANDA
0245 0285 0454 0498

SAVANNAS
0362 0485

SCLEROTIUM ROLFSII
0241

SEED
0282
COMPOSITION
0090
GERMINATION
0090 0356

SENEGAL
0258

SHEEP
0121 0122 0298 0304 0306

SHOOTS
0014 0202 0220 0364

SIERRA LEONE
0285

SILAGE
0118 0298 0299 0300

SILBA PENDULA
0062
INSECT CONTROL
0427
RESISTANCE
0448 0459

SILKWORM
0434 0487 0489

SMALL SCALE EQUIPMENT
0483

SMALL SCALE PROCESSING
0106 0157 0501

SOCIO ECONOMIC ASPECTS
0105 0106 0153 0157 0162 0164 0169
0176 0181 0186 0275 0294 0295 0333
0353 0354 0355 0372 0376 0499 0501

SOIL ANALYSIS
0207 0210 0215 0219 0379 0380 0384

SOIL EROSION
0215

SOIL FERTILITY
0024 0074 0173 0379 0380 0382 0384
0449

SOIL IMPOVERISHMENT
0380

SOIL REQUIREMENTS
0014 0024 0028 0074 0096 0210 0219
0283 0379 0380 0382 0384 0386 0449
0452

SOLAR DRYING
0138 0156 0316 0402 0483

SOYBEANS
0449

SPHACELOMA MANIHOTICOLA
0050 0173 0241 0252 0283
RESISTANCE
0047 0049 0052 0090 0091 0093
SYMPTOMATOLOGY
0091

SRI LANKA
0163 0296

STARCH CONTENT
0005 0010 0016 0024 0035 0093 0138
0191 0195 0203 0205 0206 0219 0220
0222 0228 0231 0237 0284 0323 0364
0387 0391 0400 0449 0450 0451 0452
0460 0469 0510

STARCH PRODUCTIVITY
0026 0348
CULTIVARS
0039 0173 0228 0451 0452 0460
FERTILIZERS
0173 0218 0381
SOIL FERTILITY
0173
TIMING
0451 0460

STATISTICAL ANALYSIS
0092 0137 0160 0339 0340 0348 0374

STATISTICAL DATA
0020 0101 0149 0152 0161 0162 0166
0170 0172 0176 0183 0184 0328 0331
0333 0334 0336 0337 0338 0342 0343
0344 0502 0503 0506

STEMS
0093 0094 0196 0228 0236 0243 0325
0451
ANALYSIS
0207 0209
CASSAVA MEAL
0305
HCN CONTENT
0009 0283 0449
PLANT DEVELOPMENT
0016 0349 0383 0449
PRODUCTION
0234

STOMATA
0358 0359 0360 0363

STORAGE
0005 0042 0044 0068 0191 0197 0223
0226 0267 0282 0390 0395 0400 0402
0404 0406 0410 0431 0483 0508

SUCROSE
0406

SULPHUR
0024 0207 0218 0476

SUDAN
0365

SUPPLEMENTS
0119 0124 0293 0310 0474 0476 0483

SURINAM
0238
MARKETING
0354 0355
SOCIO-ECONOMIC ASPECTS
0354 0355

SWEET CASSAVA
0355 0466
STARCH CONTENT
0451 0452
TUBER PRODUCTIVITY
0289 0342 0451 0452 0453 0454

SWEET POTATOES
0170 0251 0510

SWINE
0116 0118 0123 0293 0301 0308 0338
0473
FATTENING
0124 0312
FINISHING
0111 0124 0312
LEAVES
0109 0133 0309
PELLETS
0310
TUBERS
0138 0298

SYMPTOMATOLOGY
DISEASES AND PATHOGENS
0046 0054 0091 0254 0421

TAHITI
0385 0393 0458

TAIWAN
0053 0163 0489
MARKETING
0502
PRODUCTION
0502
TRADE
0502

TANZANIA
0068 0211 0267

TAPIOCA PEARLS
0334

TAPIOCAS
CONSUMPTION
0334
LEGAL ASPECTS
0502
TRADE
0334 0502
USES
0334 0502

TECHNOLOGY
0271 0339
TECHNOLOGICAL PACKAGE
0213
TECHNOLOGY EVALUATION
0135 0138 0157 0162 0164 0186

TEMPERATURE
0056 0238 0363

TETRANYCHUS BELLOTTI
0445

TETRANYCHUS CINNABARINUS
0089 0280 0444
RESISTANCE
0445

TETRANYCHUS NEOCALEDONICUS
0089 0447
RESISTANCE
0445

TETRANYCHUS URTICAE
0062 0280 0446
INSECT CONTROL
0427
RESISTANCE
0445 0448

THAILAND
0163 0168 0340 0380
MARKETING
0334 0343 0345 0500 0502 0505
PRODUCTION
0334 0502
TRADE
0334 0338 0343 0345 0500 0502 0505

THRIPS
0283 0425
INSECT CONTROL
0427

TISSUE CULTURE
0001 0003 0056 0097 0197 0199 0201
0290

TONGA
0123

TOXICITY
0112 0128 0305 0508

TOXICOLOGY
0107 0108 0127 0183 0297 0477

TRADE
0174 0175 0184 0332 0336 0338 0343
0345 0500 0505
CASSAVA CHIPS
0334 0344
CASSAVA FLOUR
0162 0328
CASSAVA MEAL
0335
CASSAVA STARCH
0162 0180 0328 0334 0344 0502
PELLETS
0334 0344
TAPIOCAS
0334 0502
TUBERS
0483

TUBER DEVELOPMENT
0005 0031 0072 0097 0202 0349 0364
0452 0453 0454

TUBER PRODUCTIVITY
0005 0024 0025 0026 0027 0029 0032
0033 0034 0035 0038 0039 0062 0072
0079 0090 0091 0093 0097 0173 0179
0191 0193 0202 0209 0218 0219 0220
0221 0222 0224 0228 0229 0231 0234
0235 0236 0237 0283 0284 0285 0287
0288 0289 0292 0328 0337 0342 0348
0349 0352 0378 0381 0382 0385 0390
0391 0392 0396 0397 0398 0399 0417
0449 0450 0451 0452 0453 0454 0456
0457 0458 0459 0460 0461 0506 0508
0510

TUBERS
0012 0094 0196 0236 0289 0458 0466
ANALYSIS
0041 0043 0159 0203 0207 0208 0291
0366 0368 0370 0402 0403 0404 0406
0407 0408 0410
BIOCHEMISTRY
0016 0040 0041 0042 0043 0044 0367
0402 0407 0410 0411
DETERIORATION
0040 0042 0043 0044 0091 0099 0226
0367 0400 0403 0404 0405 0407 0408
0409 0410 0411
DIETARY VALUE
0034 0305
DRY MATTER
0010 0011 0090 0091 0093 0138 0203
0205 0207 0208 0220 0228 0283 0305
0349 0364 0383 0399 0400 0452
DRYING
0138 0402 0483
FAT CONTENT
0010 0305
HCN CONTENT
0090 0091 0205 0283 0365 0366 0367
0368 0370 0400
PACKAGING
0314
SILAGE
0298
STARCH CONTENT
0010 0016 0093 0138 0195 0203 0205
0219 0220 0228 0231 0284 0364 0387
0391 0400 0452 0510
STORAGE
0042 0044 0226 0400 0402 0404 0406
0410 0483
SUGAR CONTENT
0010 0138 0400 0406
TRADE
0483

UGANDA
0268 0417
PRODUCTION
0020

UPLAND FARMING
0037 0380

UROMYCES
0050 0249

VASCULAR STREAKING
0042 0099 0239 0314 0400 0409

VATIGA ILLUDENS
0062 0427

VATIGA MANIHOTAE
0062 0083 0283 0427 0429

VENEZUELA
0004 0009 0019 0028 0032 0036 0135
0136 0140 0177 0189 0206 0214 0257
0327 0362 0415 0422 0456 0457 0507
GERMPLASM
0100
MARKETING
0162
PRODUCTION
0162 0185 0503 0506
SOCIO-ECONOMIC ASPECTS
0162
TRADE
0162

VISCOSITY
0492
CASSAVA STARCH
0129 0131 0132 0478 0481

VITAMIN CONTENT
0102

WASTE UTILIZATION
0117 0122 0125 0133 0139 0146 0312
0323 0485 0496

WASTES
0122 0312 0323

WATER CONTENT
CASSAVA FLOUR
0206
CASSAVA STARCH
0206 0478 0481
LEAVES
0015 0102 0406
STEMS
0016
TUBERS
0016 0400 0406

WATER REQUIREMENTS(PLANT)
0004 0025

WEEDING
0093 0095 0164 0165 0169 0185 0191
0221 0225 0230 0233 0235 0388 0412

WEEDS
0191 0222 0225 0415

XANTHOMONAS CASSAVAE
0048 0241 0244 0246 0418
DISEASE CONTROL
0050
DISEASE TRANSMISSION
0245

XANTHOMONAS MANIHOTIS
0028 0048 0063 0173 0241 0242 0244
0246 0283 0413 0415 0417 0418
DISEASE CONTROL
0050 0095 0416
DISEASE TRANSMISSION
0047 0245 0414
ETIOLOGY
0046 0248
INOCULATION
0248
RESISTANCE
0039 0045 0047 0049 0090 0091 0093
0097 0243 0248 0284 0285 0289
SYMPTOMATOLOGY
0046 0091

YAMS
0103 0170

ZAIRE
0072 0075 0274 0285

ZAMBIA
0216 0217 0279 0504

ZINC
0024 0207 0208 0218 0310

ZONOCERUS VARIEGATUS
0268

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