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(*Manihot esculenta* Crantz)

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INTRODUCTION

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

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

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

Year of publication

Sequential number in the journal (for use of indexes)

0012

Accesion number (for photocopy requests)

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

Authors

Original title

Language of summary

Additional notes

English title

Source

Pages

Language of paper

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

Keywords

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

Abstract

Subject categories

Abstractor and/or translator

HOW TO USE THE INDEXES

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

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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.

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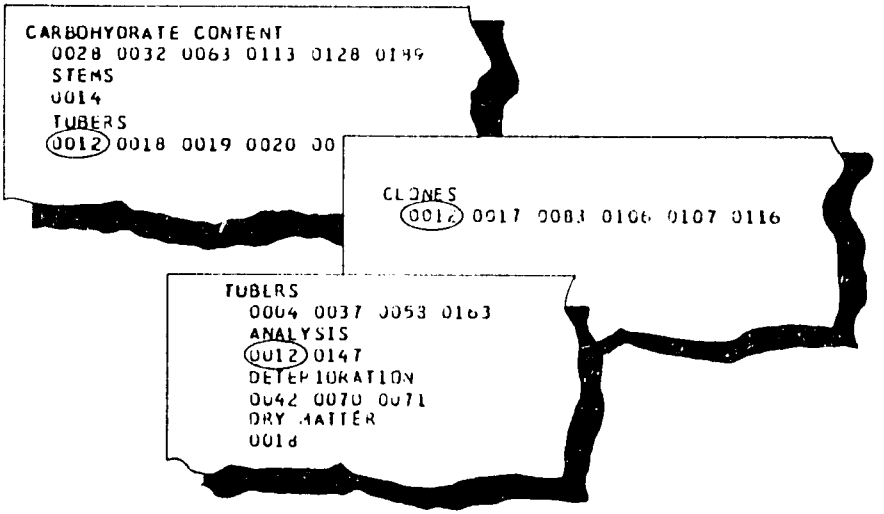
The Subject Index presents an alphabetical list of descriptors used in cassava research, many of which are combined with other descriptors, allowing the identification of more specific topics.



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

A00 BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

0001

11746 SILVA, S. DE O.E. 1979. **Cultivares de mandioca (*Manihot esculenta* Crantz) utilizadas no Brasil e problemas relativos à sua nomenclatura.** *(Cassava varieties cultivated in Brazil and some problems regarding their nomenclature).* *In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.559-568. Port., Sum. Port., Engl., 24 Refs.

Cassava. Cultivars. Identification. Plant geography. Brazil.

Nineteen Brazilian states - Amazonas, Pará, Maranhão, Piauí, Ceará, Paraíba, Rio Grande do Norte, Alagoas, Pernambuco, Sergipe, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro, Goiás, Mato Grosso, São Paulo, Santa Catarina, and Rio Grande do Sul - and the Amapá territory were surveyed to determine the cassava var. most cultivated in these areas. Some morphological and nomenclatural aspects of cassava cv. in Brazil are also discussed. *(Author's summary)* A00

B00 PLANT ANATOMY AND MORPHOLOGY

0002

18125 BAI, K.V.; JOS, J.S. 1981. **Distribution of stomata and trichomes in cassava leaves.** Journal of Root Crops 7(1/2):11-14. Engl., Sum. Engl., 14 Refs., Illus.

Cassava. Stomata. Leaves. Clones. Plant anatomy.

A total of 64 genetic stooks and 11 polyploid clones were studied for stomatal characteristics and the occurrence of trichomes by adopting a simple adhesive peeling technique. There was no difference in the stomatal distribution between broad- and narrow-leaf types and also between indigenous and exotic clones. The stomatal distribution ranged from 278.2-67.8/mm^2. There was a sharp reduction in the no. of stomata/unit area in the polyploids in comparison with their resp. diploids but the same stomatal range was also found among the other diploid clones. A few clones were found to be densely hairy. The occurrence of variation in stomatal distribution and trichomes are being reported for the 1st time in cassava. *(Author's summary)* B00

C00 PLANT PHYSIOLOGY

0003

16133 PATTERSON, R.; WILSON, G.L.; FUKAI, S. 1981. **Assimilate distribution in cassava.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.95-96. Engl.

Cassava. Plant assimilation. Plant physiological processes. Cassava programs. Australia.

The relationship between source strength or the assimilatory capacity of the tops, and the competitive sink strengths of top growth and tuber bulking was studied in cassava cv. M AUS 7 grown under local environmental conditions of the Redland Bay U. Research Station, Queensland, Australia. Treatments applied 140 days after planting included 2 levels of shading, lower leaf removal, top pruning, thinning of neighbouring plants, and apex removal. Responses to the treatments will be examined at 4 and 8 wk. after the initial harvesting and the yields of leaves, stems, and tubers, tuber no., and LAI will also be measured. *(Summary by I.B. Trans. by L.M.F.)* C00

0004

11755 CORREA, H.; PEREIRA, P.; BUENO, L.C. DE; VIEIRA NETO, J.C. 1979. **Efeito do número de hastes no comportamento de quatro variedades de mandioca (*Manihot esculenta* Crantz).** *(Effect of the number of stems on the performance of four cassava varieties). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.569-588. Port., Sum. Port., Engl., 4 Refs., Illus.

Cassava. Cultivars. Stems. Agronomic characters. Tuber productivity. Starch content. Plant height. Dry matter. Field experiments. Brazil.

From Nov. 1977-June 1979 an expt. was conducted in Lavras, MG, Brazil to evaluate the effect of different plant densities and the no. of stems/plant [1, 2, and 3 or more (free growth)] on several agronomic traits of cassava cv. Sonora, Riqueza, Branca de Santa Catarina, and IAC 14-18: stand at harvest, av. no. of stems, stem Ø, no. of tuberized roots/plot, branch and root yield (kg/plot), DM and starch contents. Sonora and Branca de Santa Catarina had the highest root yields, the former outyielding the latter by approx. 4 t/ha - this amount being economically significant. There was an interaction between var. and no. of stems only in the case of the av. no. of stems. Sonora, Branca de Santa Catarina, and IAC 14-18 had the same performance, indicating that it is not necessary to leave more than 2 stems/plant. For cv. Riqueza, the av. no. of stems increased with the no. of initial stems. The av. no. of stems had increasing values in the treatment with 1 stem/plant vs. free growth. Stem Ø decreased with free growth. *(Author's summary)* C00 D03

0005

11756 CARVALHO, J.G. DE; VIEIRA, M. DAS G.G.C.; PINTO, M.V.A.; M.A.F., E.; VIEIRA NETO, J.C.; SILVA, J.B.S. DA; TANAKA, R.T.; CARVALHO, F. DE; HOSTALACIO, S. 1979. **Comparação entre métodos de determinação de área foliar em mandioca (*Manihot esculenta* Crantz).** *(Comparison of methods for determining leaf area in cassava). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.589-598. Port., Sum. Port., Engl., 5 Refs.

Cassava. Leaf area. Analysis.

Several methods used to measure leaf area in cassava were compared. The following methods were tested: xerox method (check), leaf disc method (samples taken from the apex, middle, and base), and a method correlating leaf area with linear measurements (the square of the av. length of the lobes, restricted leaf area, and the square of the length of the central lobe). There were no significant differences among methods, except for the apex and the middle lobe disc method. The method correlating the square of the length of the central lobe (regression equation, Y = 71,1546 + 0.3845X) is considered the most efficient due to its accuracy and its easy application. *(Author's summary)* C00

0006

17581 IKE, I.F. 1982. **Effect of water deficits on transpiration, photosynthesis and leaf conductance in cassava.** Physiologia Plantarum 55(4):411-414. Engl., Sum. Engl., 20 Refs., Illus.

Cassava. Water stress. Plant respiration. Photosynthesis. Leaves. Laboratory experiments.

The effects of water deficits on transpiration, net photosynthesis, and leaf conductance in cassava cv. Llanera were studied. Stem cuttings were grown in silica sand in wooden boxes inside a controlled environment room (day length, 14 h; day:night temp., 29:24°C; RH, 60%). Transpiration, net photosynthesis, and leaf conductance decreased when leaf water potential dropped below -0.30 MPa. Both transpiration and net photosynthesis rates were considerably reduced before the leaves were visibly wilted at -0.95 MPa. Consequently, visual symptoms are unlikely to provide a useful index for characterizing water deficits in cassava. Decreases in net photosynthesis closely followed decreases in transpiration and this suggests that stomatal closure controls both processes. *(Author's summary)* C00

0007

18126 NAIR, P.G.; KUMAR, B.M.; THOMAS, P.K.; RAJENDRAN, N. 1981. **Root cation exchange capacity as an index of yielding ability in cassava and sweet potato.** Journal of Root Crops 7(1/2):5-9. Engl., Sum. Engl., 7 Refs., Illus.

Cassava. Roots. Cation exchange. Timing. Plant physiological processes. Tuber productivity. Starch productivity.

Root CEC of 21 genotypes of cassava and 20 of sweet potato at various stages of growth was estimated and correlated with their tuber and starch yields in field expt. at the Central Tuber Crops Research Institute Farm, Sreekariyam (India). For cassava, a randomized block design with 3 replications was used. The highest correlation for cassava was obtained at the 2nd mo. stage (r = 0.656 for tuber yield and r = 0.642 for starch yield). Regression lines were also fitted for the above said positively associated variables. If an index can be worked out between root CEC and cassava yield, on the basis of their positive association, it can be used as a tool in the evaluation of yield potential in breeding programs. *(Author's summary)* C00 D03

See also 0051 0056

C01 Plant Development

0008

16146 HICKS, L.N.; FUKAI, S. 1981. **Field nutrition studies at Mt. Cotton.** *In* Cassava Research Program. St. Lucia, Australia, University of Queensland. Department of Agriculture. pp.70-78. Engl., 4 Refs., Illus.

Cassava. Field experiments. Growth. Tuber productivity. Biomass production. Nutrient absorption. N. Fertilizers. Plant height. Leaf area. Dry matter. Stems. Tubers. Cassava programs. Australia.

The underground storage yield was compared with total biomass yield; N, P, and K uptake was estimated, and the response to N fertilization was determined in cassava cv. M AUS 7 at Mt. Cotton, Queensland (Australia). N (0, 25, 50, and 200 kg/ha) was applied at planting to a podzolic soil after a fallow period of 5 mo.; P (26 kg/ha) and K (70 kg/ha) were applied a year later. Fresh wt. was determined at harvest and subsamples were taken of leaves, stems, underground swollen stems, and tubers to determine dry wt. Leaf areas of subsamples were measured with a planimeter. The no. of nodes produced/stem axis and the no. of nodes from which leaves were shed were counted and new nodes were marked. Dry wt. loss and the accumulation of carbohydrates by different sections of stems were estimated on the basis of the leaves and stems produced between successive harvests. Chemical analyses were conducted after 9 mo. growth. Underground yield was low in the 1st growing season (800 g/m^2) due to the low distribution of carbohydrate into the storage organs (32%), attributed to the high soil fertility in the exptl. field and to a lesser extent, day length. LAI was often above 3-3.5. Stem wt. increased markedly during the 2nd yr of growth, indicating that stems are the major sink for carbohydrates which competes against the underground storage organs. Although the effect of applied N was generally small, there was a tendency towards vigorous shoot growth at the expense of underground organs. It is recommended to maintain the optimum level of available soil N for max. tuber production. *(Summary by I.B. Trans. by L.M.F.)* C01 C03 D03

0009

17589 CAÑAS, B.M.; ROCA, W.M. 1982. **Cultivo de anteras de la yuca.** *(Anther culture of cassava).* Revista de Investigación (Colombia) 12(1):5-16. Span., Sum. Span., Engl., 21 Refs., Illus.

Cassava. Anthers. Tissue culture. Culture media. Morphogenesis. Colombia.

It was demonstrated that through in vitro anther culture of cassava, containing microspores in the early uninuclear stage, the normal ontogeny of pollen grains can be shifted to a process of androgenesis, which consists of the meiosis of the microspores to form callus from which roots are derived. Estimations of the chromosomic complement of these roots indicated that the no. of the chromosomes was reduced in half. A marked genotypic effect was observed as expected, as well as that of each flower bud within each var., for callus induction but the final response of each anther depends on its interaction with the culture

medium. Studies should be conducted to improve methods that allow the incorporation of haploids into specific cassava breeding strategies. *(Author's summary. Trans. by L.M.F.)* C01

0010

17583 SAN JOSE, J.J.; MAYOBRE, F. 1982. **Quantitative growth relationships of cassava (*Manihot esculenta* Crantz): crop development in a savanna wet season.** Annals of Botany 50(3):309-316. Engl., Sum. Engl., 40 Refs., Illus.

Cassava. Growth. Leaf area. Plant assimilation. N. P. K. Fertilizers. Field experiments. Venezuela.

Growth characteristics of cassava cv. Cubana were determined for a crop cultivated in savanna soil at the Calabozo Biological Station in Venezuela with 5 different levels of fertilizer. A population of 25,000 plants/ha was studied using conventional growth analysis techniques. The storage root does not act as a sink for large amounts of assimilates and differences in growth response were mainly a result of the morphology development and function of leaves in the cassava canopy (source activity). Thus, during tuberization, cv. Cubana produces a progressively higher proportion of new leaves, maintaining throughout the season a relatively high NAR and LAI. *(Author's summary)* C01 D01

0011

17575 STAMP, J.A.; HENSHAW, G.G. 1982. **Somatic embryogenesis in cassava.** Zeitschrift für Pflanzenphysiologie 105:183-187. Engl., Sum. Engl., 7 Refs., Illus.

Cassava. Tissue culture. Culture media. Morphogenesis. Plant physiology.

Cotyledon pieces from mature cassava seeds, cultured on Murashige & Skoog basal medium supplemented with various concn. of 2,4-D and BAP, developed morphogenically-active ridges on their surfaces, which eventually produced both foliose structures and somatic embryos. Embryo initiation was highest in the presence of 4 mg 2,4-D/*l* only. Somatic embryos, only, were initiated on embryonic axes treated in the same manner, but the incidence was lower and the embryogenic response was restricted to the subapical regions of the shoot. The somatic embryos developed further when the cultures were transferred to Murashige & Skoog medium supplemented with 0.1 mg BAP/*l* and 0.01 mg 2,4-D/*l*. Morphologically normal plantlets were produced if the embryos were then isolated on the same medium, while secondary embryogenesis occurred if higher levels of 2,4-D (2 or 4 mg/*l*) were employed. *(Author's summary)* C01

0012

18139 KEATING, B.A.; EVENSON, J.P.; FUKAI, S. 1982. **Environmental effects on growth and development of cassava (*Manihot esculenta* Crantz). 1. Crop development.** Field Crops Research 5(4):271-281. Engl., Sum. Engl., 26 Refs., Illus.

Cassava. Plant development. Temperature. Photoperiod. Planting. Timing. Flowering. Developmental stages. Stems. Canopy. Leaf area. Branching. Tuber development. Australia.

Morphological development of serial plantings of the cassava cv. M Ans 10, made over a year and each grown for 1 yr duration, were studied with sequential harvests in the relatively high lat. (27° 37'S) environment of SE Queensland, Australia, under favorable moisture and nutritional conditions. The extent and timing of storage root initiation was relatively unaffected by the different temp., solar radiation, and photoperiod conditions associated with the different planting dates. Likewise, main stem and lateral branch no. showed little variation either between planting dates or with time in any one planting. The time to 1st flowering and forking was substantially reduced for mid-summer planting dates, an effect being most likely related to the longer photoperiods of these mo. Canopy development was also highly seasonal with LAI ranging from above 10.0 in March and April for early

planted crops to zero in the cooler mo. of August and Sept. for all planting dates. *(Author's summary)* C01 D01

0013

18140 KEATING, B.A.; EVENSON, J.P.; FUKAI, S. 1982. **Environmental effects on growth and development of cassava (*Manihot esculenta* Crantz). 2. Crop growth rate and biomass yield.** Field Crops Research 5(4):283-292. Engl., Sum. Engl., 18 Refs., Illus.

Cassava. Plant development. Dry matter. Planting. Timing. Climatic requirements. Temperature. Biomass. Productivity. Australia.

Frequent harvests of serial plantings of cassava cv. M Aus 10 in SE Queensland, Australia (lat. 27° 37'S) were used to examine the effect of environment on DM growth and biomass yield. Max. CGR calculated from fitted logistic curves ranged from 23.8-2.4 g/m²/day for the various planting dates and occurred in late summer to autumn, becoming progressively smaller and later for plantings made later in the growth season. CGR declined to zero or near zero for all planting dates in late winter. Max. CGR were higher than those reported for cassava at lower lat. but, because of the restricted growing season, annual biomass yields from early planting times were similar and of the order of 30 t/ha/yr. Multiple regression models were developed which could account for 89% of the variation in CGR in terms of mean air temp. or solar radiation and LAI. Temp. and solar radiation were highly correlated at this exptl. site and it was not possible to distinguish their separate effects on CGR. *(Author's summary)* C01 D01 D03

0014

18141 KEATING, B.A.; EVENSON, J.P.; FUKAI, S. 1982. **Environmental effects on growth and development of cassava (*Manihot esculenta* Crantz). 3. Assimilate distribution and storage organ yield.** Field Crops Research 5(4):293-303. Engl., Sum. Engl., 20 Refs., Illus.

Cassava. Climatic requirements. Temperature. Photoperiod. Planting. Timing. Tuber development. Dry matter. Plant assimilation. Statistical analysis. Leaf area. Australia.

Assimilate distribution and storage organ (storage roots + swollen planting piece) yield of serial plantings of the cassava cv. M Aus 10, made throughout a year, and grown for 1 yr duration were studied with sequential harvests in SE Queensland (lat. 27° 37'S), Australia. Seasonal differences in the proportion of total DM assimilation partitioned to storage organs over a given time period (referred to as distribution ratio, DR) were observed with low DR over the mid-summer (Jan. to March) period (0.1-0.3) when CGR was at a max. compared with 0.4-0.5 in Nov.-Dec. and 0.5-1.0 in late autumn to winter (April-July). This period of low DR restricted storage organ yields which were generally lower (6-9 t dry wt./ha/yr) than those reported for adapted germplasm at lower lat. Multiple regression models were developed which accounted for much of the variation in DR in terms of mean air temp. or photoperiod and LAI (R^2 = 0.73). High temp., long photoperiods, and high LAI were associated with reduced DR. Mean air temp. and photoperiod are highly correlated in this environment and their separate effects on DR could not be distinguished. This model of distribution ratio was combined with earlier published models of CGR, and storage organ growth rate predicted. *(Author's summary)* C01 D01

0015

17543 KEATING, B.A. 1980. **Environmental effects on growth and development of cassava (*Manihot esculenta* Crantz.) with special reference to photoperiod and temperature.** Ph.D. Thesis. St. Lucia, Brisbane, University of Queensland. 330p. Engl., Sum. Engl., 290 Refs., Illus.

Cassava. Growth. Plant development. Temperature. Photoperiod. Plant assimilation.

Planting. Harvesting. Timing. Flowering. Branching. Stems. Leaves. Leaf area. Canopy. Tuber development. Dry matter. Statistical analysis. Shoots. Australia.

Patterns of growth and development of the cv. MAUS10 planted at 12 mo. intervals were studied under nonlimiting moisture and nutritional conditions at Redland Bay, Australia (lat. 27° 37'S, longitude 153° 17'E). The choice of this relatively high lat. site made it possible to examine growth and development under a broad range of seasonal conditions. Sequential harvests carried out at 45-day intervals over a 1 yr period for each planting date indicated important effects of environment, particularly temp. and photoperiod, on patterns of assimilate distribution. Controlled environment studies were undertaken to study these effects. Time to 50% of final emergence ranged from 13-15 days for plantings from Nov.-Feb. to 135 days for a May planting. Final emergence % was correspondingly reduced from 98-100% to 2%, resp. These seasonal differences were related to soil temp. and linear heat sums developed for prediction of emergence times and selection of optimum planting dates. Canopy development was also highly seasonal with LAI ranging from above 10.0 for early planted crops in March and April to zero for all planting dates in August and Sept. Controlled environment studies indicated that low temp. and short photoperiods restricted leaf production and expansion and this, combined with shedding of existing leaf, resulted in reduced LAI over the winter mo. Likewise, high temp. and long photoperiods promoted leaf production and expansion and hence the high levels of canopy growth recorded from Jan.-March. Regrowth began in Sept. and Oct. and was accompanied by a drop in the starch levels in storage roots. First forking (branching associated with reproductive development) generally occurred in Dec./Jan. and subsequent controlled environment studies indicated that this was due to the long photoperiods of these mo. Flower buds always accompanied forking but floral development only proceeded in the field from March-June and controlled environment studies showed that this was favored by lower temp. and shorter photoperiods. Max. CGR calculated from fitted logistic curves ranged from 23.8 g/m²/day to 2.4 g/m²/day for the various planting dates and occurred from Feb. to early June, becoming progressively smaller for later planting dates. CGR declined to zero or near zero from July-Sept. and this, being the period of max. starch content in storage roots, represented the optimum harvest time. Max. CGR's were higher than those reported for cassava at lower lat. but, because of the restricted growing season, annual total biomass yields were similar and of the order of 30 t dry wt./ha/yr. Multiple regression models were developed which could account for much of the variation in CGR in terms of mean air temp. or solar radiation and total DM (TDM) or LAI. Temp. and solar radiation are highly correlated in the Redland Bay environment and it was not possible to distinguish their separate effects on CGR. LAI was considered to have more general application than TDM in such models. Important seasonal differences in the proportion of TDM assimilation partitioned to storage organs (referred to as distribution ratio, DR) were observed with low DR over the Jan. March period (0.1-0.3) when CGR was at a max. compared with 0.4-0.5 in Nov. and Dec. and 0.5-1.0 from April-July. This period of low DR restricted storage organ yields which were generally lower (6-9 t dry wt./ha/yr) than those reported for adapted germplasm at lower lat. Multiple regression models were developed which accounted for much of the variation in DR in terms of mean air temp. or photoperiod and LAI. High temp., long photoperiods, and high LAI were associated with reduced DR. Mean air temp. and photoperiod are correlated in this environment and their separate effects on DR could not be distinguished. Models of storage organ growth rate (SOGR) were developed (SOGR = CGR) x DR) based on mean air temp. and LAI. Simple linear heat sums describing TDM and storage organ DM were calculated for comparison with these multiple regression models describing rates of total or storage organ growth. The effects of temp. and photoperiod on assimilate distribution were examined in a series of controlled environment studies. Growth and development of cv. MAUS10 and MAUS7 were studied in day/night temp. of (i) 34/28, 28/22, and 22/16°C and (ii) 28/28, 28/22, and 28/16°C. Higher temp. promoted all aspects of shoot growth, except forking which was inhibited in MAUS10 at 34/28°C and delayed at 28/28°C. A reduction in partitioning of TDM to storage roots accompanied this promotion of shoot growth under high temp. (DR for MAUS10 was 0.14, 0.29, and 0.41 at 34/28, 28/22, and 22/16°C, resp. The timing and extent of storage root initiation were

effectively the same for both MAUS7 and MAUS10 under 10 and 16 h photoperiods but the subsequent balance between shoot and storage root growth strongly favored shoot growth in long days (DR = 0.15 for MAUS7 and 0.37 for MAUS10) and storage root growth in short days (DR = 0.49 for MAUS7 and 0.68 for MAUS10). Distribution to storage roots was quantitatively reduced in MAUS10 with each additional 1 h increment used in an expt. comparing 10, 11, 12, 13, 14, 15, and 16 h photoperiods although the 12-13 h region was a particularly critical part of the response curve. A treatment consisting of a short day (10 h) plus a 1 h nightbreak in the middle of the dark period produced long day type growth. A small interaction between temp. and photoperiod was detected in that the increase in HI under short days (10 h compared with 14 h) was greatest at lower temp. (28/22°C compared with 34/28°C). Differences in cv. response to a range of temp. (35/30, 30/25, 25/20, 20/15°C) and photoperiods (11, 12, 13, and 14 h) were studied in other expt. Possible mechanisms through which temp. and photoperiod may affect assimilate distribution in cassava are discussed, although no firm conclusions could be reached. It was concluded that the major constraints to productivity of cassava in SE Queensland were a restricted growing season and low levels of partitioning of TDM to storage roots over the peak summer growth period. How such constraints might be altered in importance at higher and lower lat., and how they might be overcome are discussed. *(Author's summary)* C01 D01

0016

18127 INDIRA, P.; RAMANUJAM, T. 1981. **Influence of the month of planting on flower initiation in cassava (*Manihot esculenta* Crantz).** Journal of Root Crops 7(1/2):1-4. Engl., Sum. Engl., 3 Refs., Illus.

Cassava. Planting. Timing. Flowering. Climatic requirements. Field experiments. India.

Seasonal influence on flower initiation was studied in a poor flowering cassava var. S-1315 by changing the mo. of planting in a randomized block design with 4 replications under field conditions in Trivandrum, India. Plant growth, time taken for flower bud initiation, and flowering % were recorded for each treatment (mo. of planting). Weather data on sunshine hours, rainfall, temp., and humidity were collected for the entire expt. period (July 1975-June 1976). The time of flower initiation was influenced by rainfall and cumulative sunshine hours received during the initial period of plant growth. Flowering in S-1315 occurred earlier in July, Sept., and Oct. mo. of planting. *(Author's summary)* C01 D02 D01

0017

11757 RIBEIRO, J.V.; CORREA, H.; HOSTALACIO, S. 1979. **Comportamento de quatro cultivares de mandioca (*Manihot esculenta* Crantz) em relação à formação inicial de raízes.** *(Behavior of four cassava cultivars regarding initial root development). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.599-619. Port., Sum. Port., Engl., 17 Refs., Illus.

Cassava. Cultivars. Agronomic characters. Tuber development. Tuber productivity. Plant height. Stems. Leaves. Laboratory experiments. Brazil.

The behavior of 4 cassava cv. (Branca de Santa Catarina, Riqueza, Vassourinha SEL-544, and Sertaneja) was studied regarding the initial development of the root system in a greenhouse expt. at the Escola Superior de Agricultura de Lavras, MG, Brazil, from Nov. 1976-Feb. 1977. A completely randomized exptl. design was arranged in a 6 x 4 factorial scheme with 3 replications. Treatments consisted of 6 harvest periods: 20, 35, 50, 65, 80, and 95 days after planting. A substantial increase in the Ø of cv. Sertaneja at the final harvest did not correspond to a greater production of fresh root wt. In 3 cv. a positive correlation was observed among plant height, stem Ø, no. of roots and leaves, and root wt. *(Author's summary)* C01 D03

18123 LIAN, T.S. 1980. **Growth parameters related to productivity in cassava (*Manihot esculenta* Crantz).** Mag. Sc. Thesis. Serdang, Selangor, Universiti Pertanian Malaysia. 192p. Engl., Sum. Engl., 185 Refs., Illus.

Cassava. Growth. Plant development. Canopy. Stems. Leaves. Timing. Branching. Photosynthesis. Dry matter. Tuber productivity. Tuber development. Harvesting. Plant assimilation. Cultivars. Pruning.

DM production and distribution to major plant organs were studied by periodic harvests over 12 mo. in 6 cassava varieties (MCol 22, MCol 72, MCol 113, MMex 11, MMex 59, CMC 40) with varying branching patterns. Simultaneous studies traced the pattern of branching, leaf size and leaf area development, rates of leaf production and of node wt. increase, and leaf life. Total DM production depends on LAI and leaf photosynthetic rate. Measurements by an infrared gas analyzer on single attached leaves indicated var. differences in apparent photosynthetic rates.The LAI of 3 var. (CMC 40, MMex 11, and MCol 72 with high, intermediate, and low rates, resp.) was altered by leaf and apex clipping. A relationship was found between CGR and LAI, and a possible association between CGR and photosynthetic efficiency. LAI is influenced by canopy characteristics (leaf size, rate of leaf production, and leaf life). Leaf production has 2 components: production rate/apex and rate of apex production which i related to branching. Root bulking has a lower optimal LAI than CGR, implying competition with DM utilization by stems, leaves, and cuttings. The capacity for branching determines LAI but also establishes the potential for top growth and its competitive sink strength. Node wt. increased throughout the crop duration, and branching both augmented the stem mass and accelerated leaf production rate through rapid apex increase. Result. from leaf and apex clipping suggest that new leaves constituted a very substantial sink. The simulation of branching patterns by pruning a highly branched var. showed that while the rate of apex. no. increase was moderate, root yields were high and similar to var. with such characteristic branching patterns. Leaf life is important in maintaining LAI by precluding the need for rapid leaf production to replace abscised leaves. Introduced shade reduced leaf life, while highly branched var. also had shorter leaf lives. Optimal LAI for high root yield, therefore, may possibly be achieved through the selection of favorably branched phenotypes having long leaf life and superior photosynthetic capacity. *(Author's summary)* C01 D03

See also 0064

C03 Chemical Composition, Methodology and Analyses

0019

11581 ROSENTHAL, F.R.T.; NAKAMURA, L.M.K.; GHIOTTI, A.M.T.; ESPINDOLA, L.; NAKAMURA, T. 1979. **Amido de mandioca: influência da maturação.** *(Cassava starch: effect of maturation). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.459-481. Port., Sum. Port., Engl., 2 Refs.

Cassava. Cultivars. Maturation. Timing. Cassava starch. Analysis. Gelatinization. Viscosity. Brazil.

Starches from different cassava var. grown in the state of Pará, Brazil, were compared to determine the effect of maturation on starch properties. Var. were harvested between 9-12 mo. after planting in order to determine the earliest time of maturation at which these var. could be processed to obtain high quality starch. Var. used were Chapéu de Chuva, Sutinga, Pacajá, Maranhense, Saracura, Bubão, Rainha do Sol, Bonita, Javarité, Simeão, Pixinga, Natalina, Manoel Graveto, Imitação, and Vermelhão. In some var. it was observed that the difference of 3 mo. in maturation time significantly affected root productivity and some characteristics of starch. Tables are included on starch analysis, gelatinization temp., % of large starch granules, Brabender viscograph curves, and resistance of starch viscosity under agitation at high velocities. *(Author's summary)* C03 I01

See also 0008 0026 0028 0031 0046 0075 0078

C04 PLANT NUTRITION

0020

18105 JINTAKANON, S.; EDWARDS, D.G.; ASHER, C.J. 1979. **An anomalous, high external phosphorus requirement for young cassava plants in solution culture.** Bangkok, Thailand, Kasetsart University. Department of Soils. 19p. Engl., Sum. Engl., 14 Refs., Illus.

Paper presented at International Symposium on Tropical Root Crops, 5th., Manila, Philippines, 1979.

Cassava. P. Cultivars. Nutritional requirements. Nutrient solution. Growth. Nutrient absorption. Laboratory experiments. Plant physiology.

Twelve cassava cv. and 1 cv. each of soybean, cotton, and maize were grown for 28 days in flowing culture solution with 8 constant P conen. ranging from 0.05-1021 μM. Cassava cv. required solution P conen. fror. 28-78 μM to achieve 95% max. whole plant yield whereas soybean, cotton, and maize required 0.6, 0.6, and 1.0 μM, resp. Young cassava plants exhibited a higher internal P requirement than the other species. However, the major reason for the higher external P requirement of cassava was the low physiological efficiency of its root system in absorbing P. Rates of P absorption associated with 95% of the max. yield were similar in all species; the physiologically inferior root system of cassava required a much higher external P conen. than the other species to achieve these rates. The results are discussed with reference to the reputation that cassava has as a plant well-adapted to low soil fertility situations. *(Author's summary)* C04 D01

D00 CULTIVATION

0021

16604 ARRAUDEAU, M. 1979. **Le manioc en Côte d'Ivoire; comparaison de deux situations culturales.** *(Comparison of two cassava cultivation systems in Ivory Coast).* Paris, Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières. 12p. Fr.

Cassava. Cultivation. Cultivars. Tuber productivity. Composition. Ivory Coast.

Two mechanized cassava cultivation systems were compared in Bouaké and Toumodi in April 1979 regarding environment (climate and soil), crops (var., fertilization, cultural techniques, weeds—especially *Imperata cylindrica*), and the results obtained within an industrial and traditional frame of reference for the development of cassava, 3rd in importance in Ivory Coast. Although the pluviometric regimes of the 2 sites are similar, soils are considerably different. In Toumodi they are deficient in OM, N, Ca, K, P, and Mg; therefore, fertilization, measures to protect soil physical structure, weeding, and studies on var. adaptation are necessary for a rotational cropping scheme. In Toumodi var. Bonua and CB, with av. yields at 20 mo. of 35.2 and 39.2 t/ha, resp., were studied. In Bouaké var. CB reached 86.1 t/ha 20 mo. after planting. Among major diseases are mosaic and cercosporiosis. Neither bacteriosis (*Xanthomonas manihotis*) nor major insect parasites were observed. The importance of the 2 centers as operational bases for crop extension into savanna areas is highlighted. *(Summary by I.B. Trans. by L.M.F.)* D00

0022

18117 EMPRESA BRASILEIRA DE ASSISTENCIA TECNICA E EXTENSAO RURAL. 1980. **Sistema de produção para mandioca: Cerrado-MA.** *(Cassava production system: Cerrado-MA).* São Luis-MA, Brasil. Série Sistemas de Produção. Boletím no. 261. 30p. Port., Illus.

Cassava. Land preparation. Planting. Weeding. Harvesting. Insect control. Inter-cropping. Maize. Rice. Technological package. Brazil.

Two cassava production systems are given for the cerrado region of the state of Maranhão, Brazil. The 1st system is for farmers who cultivate cassava in monoculture, with possibilities of adopting new technology, are land owners or tenants, and CF producers. This system includes aspects such as land selection, soil preparation, planting and fertilization, cultural practices, phytosanitary aspects, harvesting, root processing, and stem conservation for propagation material. The 2nd system is for farmers who cultivate cassava in association with rice and maize, with possibilities of adopting new technology, land owners or tenants with easy access to credit. The technical recommendations for this system are the same as for the former, except those regarding fertilization, root processing, and stem conservation. *(Summary by J.L.S. Trans. by L.M.F.)* D00 K01

0023

18111 LORENZI, J.O.; MONTEIRO, D.A. 1980. **A mandioca (*Manihot esculenta* Crantz) como matéria-prima para produção de etanol no Brasil.** *(Cassava as a raw material for ethanol production in Brazil).* Campinas-SP, Instituto Agronômico. Boletim Técnico no. 67. 80p. Port., Sum. Port., Engl., 33 Refs., Illus.

Cassava. Land preparation. Cuttings. Planting. Timing. Spacing. Minerals and nutrients. Pest control. Weeding. Productivity. Ethanol. Uses. Brazil.

The potential of cassava for the production of food and alcohol in Brazil is discussed. The operations of traditional agricultural production systems are analyzed and their limitations and possible changes as a result of research are discussed. Suggestions are presented for research priorities to improve the production techniques in order to make cassava a more competitive crop in relation to sugar cane and sweet sorghum. *(Summary by Abstracts on Tropical Agriculture)* D00 102

0024

16698 CORREA, H. 1982. **Estudo de diferentes níveis de tecnología na produção de mandioca.** *(Effect of different levels of technology on cassava production). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.148-151. Port.

Cassava. Technological package. Costs. Land preparation. Planting. Fertilizers. Insect control. Harvesting. Mechanization. Weeding. Brazil.

Six levels of technology were assessed to determine their influence on cassava production costs. These start at level I (plowing; harrowing; furrowing; planting, cultural practices, and harvesting by hand) and gradually incorporate higher rates of lime, fertilizers, phytosanitary treatment, mechanized planting and harvesting, and the use of herbicides. The structure of the production costs for each level corresponding to the labor and inputs used in land preparation, planting, cultural practices, harvesting, and transportation are included. The costs of harvesting are highlighted, since they sum up more than 15% of total production costs for each of the levels. *(Summary by I.I.S. Trans. by L.M.F.)* D00 J00

See also 0071 0083 0095 0097 0104

D01 Soil, Water, Climate and Fertilization

0025

11379 SILVA, J.R. DA; LORENZI, J.O.; MONTEIRO, D.A.; NORMANHA, E.S.; PEREIRA, A.S. 1979. **Métodos de aplicação de NPK em mandioca.** *(Methods of applying NPK in cassava). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária Departamento de Informação e Documentação. pp.363-368. Port., Sum. Port., Engl., 5 Refs.

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

The results of 9 fertilizer expt. with NPK in cassava, conducted in Araras, SP, Brazil, are given. A randomized block design was used with 5 treatments. NPK was applied at rates of 40, 80, and 50 kg/ha, resp. to the furrow or top dressed. There were no significant differences between applying PK in the furrow and N as top dressing or NPK as top dressing in lateral furrows in 2-3 mo.-old plants. Fertilizers applied only in the 2nd growth cycle proved to be inefficient. *(Author's summary)* D01 D03

0026

11733 OLIVEIRA, S.L. DE; MACEDO, M.M.C.; PORTO, M.C.M. 1979. **Déficit hídrico e a produção de mandioca.** *(Soil moisture stress and cassava root yield). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.621-626. Port., Sum. Port., Engl., 6 Refs., Illus.

Cassava. Water requirements (plant). Water stress. Timing. Tuber productivity. Starch content. Foliage. Field experiments. Brazil.

A study is currently being carried out at the Unidade Estadual de Pesquisa of the Empresa de Pesquisa Agropecuária da Bahia, Ilhéé, Brazil, to determine the effects of water stress on cassava cv. Aipim Bravo. A completely randomized block design was used with 6 treatments and 4 replications. Treatments were water stress at 2-3, 4-5, 8-9, and 10-11 mo. after planting. Furrow irrigation was used at 7 day intervals. At harvest data on root, stem, and leaf yield, and starch content will be collected. *(Author's summary)* D01 D03 C03

0027

11396 SILVA, J.R. DA; LORENZI, J.O.; MONTEIRO, D.A.; NORMANHA, E.S.; PEREIRA, A.S. 1979. **Experimentos de algumas fontes de fósforo para mandioca.** *(Experiments on some phosphorus sources for cassava). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.369-374. Port., Sum. Port., Engl., 4 Refs.

Cassava. P. Fertilizers. Tuber productivity. Field experiments. Brazil.

Seven expt. were carried out on sandy soils of the municipality of Araras, SP, Brazil, in a randomized block design with 16 treatments and 6 replications to examine the possibility of partially or totally substituting soluble phosphate fertilizers with other more economical sources. The following sources of P and their combinations were used: simple superphosphate, triple superphosphate, bone meal, Araxá phosphate (crystalline), and Olinda phosphorite (amorphous). Despite the low levels of available P in these soils (according to chemical analyses), phosphate fertilizer (120 kg/ha) did not increase root yields. *(Author's summary)* D01 D03

0028

18129 CADAVID L., L.F.; HOWELER, R.H. 1982. **Fertilización de la yuca** *(Manihot esculenta* **Crantz) y su efecto a largo plazo sobre la fertilidad suelo.** *(Fertilization in cassava and its long-term effect on soil fertility).* Suelos Ecuatoriales 12(1):59-75. Span., Sum. Span., 17 Refs.,

Cassava. N. P. K. Soil fertility. Soil analysis. Fertilizers. Tuber productivity. Mineral content. Leaves. Timing. Nutrient absorption. Cultivars. Field experiments. Colombia.

To study the response of cassava to N, P, and K applications and their long-term residual effect, a trial was established on an Inceptisol in Santander de Quilichao, Cauca, Colombia, for 3 yr as of Nov. 1977. Levels of 100-200, 200-400, and 150-300 kg N, P, and K/ha, resp. were applied broadcasted and incorporated with a rotovator before planting the 1st yr. Fertilizers were only applied again in some additional treatments (annual application), incorporated into the furrow, in the next 2 yr. Llanera, CMC 40, and M Col 1684 were used as index cv. at a plant density of 10,000 plants/ha. There was no marked response to N application in the absence of P and K. When P or K were included into the fertilization formulation, a significant increase in yield was observed when 100 kg N were applied the 1st yr. With higher levels of N + P or K yields generally decreased. With 200 kg P/ha without N and K the 1st yr, yields increased significantly (31 t/ha vs. 22 t/ha for the check). During the 2nd and 3rd yr there was no significant response to residual P while there was a positive effect with annual applications of P. Yields of 39 t/ha vs. 31 t/ha of the check were obtained with 150 kg K/ha during the 2nd yr without N and P. The combination 100-200-150 kg N, P, and K/ha seems to be the optimum rate to achieve acceptable yields. P applications notably increased soil P content, especially if it was applied with N or K during the 1st yr, maintaining some residual effect during the following 2 yr. Although P was the most limiting micronutrient during the 1st yr, in successive cassava plantings K was the most limiting micronutrient due to the high elimination of K in every harvest. *(Author's summary. Trans. by L.M.F.)* D01 C03

0029

16692 CORREA, H.; ANDRADE, A.M. DE S. 1982. **Introdução e avaliação de clones e cultivares de mandioca.** *(Introduction and evaluation of cassava cultivars and clones). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.91-114. Port., Illus.

Cassava. Cultivars. Clones. Ca. N. P. K. Zn. Tuber productivity. Starch productivity. Foliage. Timing. Harvesting. Field experiments. Brazil.

Preliminary testing of cassava cv. was conducted along with an agronomic characterization of cv. belonging to the collection of the Empresa de Pesquisa Agropecuária de Minas Gerais-Escola Superior de Agricultura de Lavras (Brazil) and 2 assessments of the response of cassava cv. to the presence and absence of liming and fertilizers. A total of 158 cv. were included in the 1st fertilization trial, using 3000, 60, 50, 20, and 15 kg lime, P, K, N, and Zn/ha, resp. Branch and root production and starch content were the parameters determined. Among the cv. showing the greatest response to liming were Branca de Santa Catarina, Cacau Vermelha, SF 26-55, SF 2473, SF 2800, IAC 352-6, Mico, Sabiá Amarela, Gostosa, and IAC 14-18 (root production at 18 mo.); less response was obtained in cv. Ri-

queza, Mameluca, Desconhecida I, and Vassourinha. In the 2nd trial 3500, 54, 56, and 5 kg lime, P, K, and Zn/ha, resp., were applied and its effect on root and branch production and the no. of roots were determined in 100 cv. In this expt. without liming cv. IAC 352-7, IAC 5-66, IAC 12-52, Mantiqueira, Sonora, and Congonha had the highest root yield and with liming, cv. IAC 352, SRT 59, IAC 12-52, IAC 5-55, and Branca de Santa Catarina. According to the data recorded, some cv. respond to Ca application, others are indifferent, and a 3rd group undergoes depressive effects. *(Summary by I.B. Trans. by L.M.F.)* D01 D03

0030

16690 CORREA, H.; GUEDES, G.A.A.; ANDRADE, A.M. DE S.; ROCHA, B.V. DA 1982. **Adubação mineral da cultura da mandioca (*Manihot esculenta* Crantz) em solo sob cerrado.** *(Mineral fertilization in cassava grown on cerrado soils). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.48-66. Port.

Cassava. Ca. N. P. K. Timing. Tuber productivity. Foliage. Dry matter. Field experiments. Brazil.

Seven expt. were conducted on cerrado soils in Felixlândia and Lavras, Brazil, in order to determine the effect of different application rates of Ca, N, P, and K on cassava productivity, the possible interactions among these factors, and the effect of application dates, and to compare different sources and methods of applying P and K. Under these exptl. conditions, no response to application rates of Ca was observed. In general N, applied entirely at planting and top dressed in split applications, affected production parameters; K did not increase production. P was considered the most limiting nutrient. Phosphate from Patos did not give high yields during the 1st year. *(Summary by I.B. Trans. by L.M.F.)* D01 D03

See also 0010 0012 0013 0014 0015 0016 0020

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

0031

16688 CARVALHO, V.D. DE; CHALFOUN, S.M.; TANAKA, M.A. DE S.; MORAES, A.R. DE; CARDOSO, D.A.M. 1982. **Influência da época de colheita sobre a produtividade e composição química de cultivares de mandioca.** *(Influence of harvesting time on productivity and chemical composition of cassava cultivars). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.25-38. Port., 5 Refs., Illus.

Cassava. Harvesting. Timing. Cultivars. Tuber productivity. Starch content. Composition. Field experiments. Brazil.

The best harvesting dates for the var. grown in Minas Gerais, Brazil, and the cv. with the highest industrial yield were determined under field conditions in Lavras using cv. Sonora, Branca de Santa Catarina, Broto Roxo, Híbrida, Guaxupé, Sabará, IAC 1418, Baiana, and Vassourinha (Sel 514). Harvesting took place at 12, 16, 20, and 24 mo. and MC, starch, ash, protein, total phenolic compound, Ca, P, N, K, B, Mg, and Zn contents of 3 kg of roots of each var. were determined. Results are given in table form. The following harvesting dates were determined on the basis of economic profit and starch content: 12 mo. (Vassourinha), 16 mo. (Híbrida, Guaxupé, IAC 1418, Broto Roxo, Branca de Santa Catarina, and Sonora), 20 mo. (Híbrida and Sabará), and 24 mo. (IAC 1418, Broto Roxo, and Sonora). Cv. Baiana was eliminated since its yields were lower than the national av. *(Summary by I.B. Trans. by L.M.F.)* D02 D03 C03

0032

16696 ALCANTARA, E.N. DE; LIMA, P.C. 1982. **Efeito de doses de herbicidas para a cultura da mandioca (*Manihot esculenta* Crantz).** *(Effect of herbicide application rates in cassava). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.130-135. Port.

Cassava. Field experiments. Herbicides. Brazil.

In 1978 a field trial was conducted in Felixlândia, MG (Brazil) in order to select effective herbicides and herbicide combinations and to determine the phytotoxicity of the rates used on cassava cv. Branca de Santa Catarina. A randomized block design was used with 26 treatments and 4 replications. All herbicides controlled dicotyledons up to 30-60 days, with no differences as to rates. Monocotyledons appeared at 50 days in the treated plots; after 60 days metribuzin (0.3 and 0.5 kg/ha) was not effective. At 90 days a residual effect was observed, controlling broadleaf weeds, except *Sida* sp. The most effective herbicides in controlling this weed were diuron, linuron, and alachlor at all rates, and metribuzin at 0.5 kg/ha. Herbicide application gave a better control of broadleaf weeds than the unweeded check; did not affect sprouting; and all herbicides were effective at min. rates. The highest application rate of linuron (4.5 kg/ha) reduced the no. of plants and consequently, production. *(Summary by I.B. Trans. by L.M.F.)* D02

0033

11491 TESTA, A.; LORENZI, J.O.; MONTEIRO, D.A.; PEREIRA, A.S. 1979. **Colhedora-carregadora de mandioca (*Manihot esculenta* Crantz).** *(Cassava harvester-loader). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.433-437. Port., Sum. Port., Engl., 5 Refs., Illus.

Cassava. Harvesting. Agricultural equipment. Mechanization. Brazil.

A preliminary trial was conducted with a newly designed cassava harvester-loader in fields planted to cv. Branca de Santa Catarina in the state of São Paulo, Brazil. Cuttings were planted 1.10 x 0.60 m at a depth of 10 cm. Observations showed that on sandy soils a tractor with 85 HP bar potential can work at a speed of 3.5 km/h at a depth of 30 cm. The up-rooting mechanism worked satisfactorily but some modifications must be made to reduce the damage caused to the roots and avoid certain parts of the machine being jammed with weeds. After harvesting, the soil was in suitable conditions for a new planting without requiring additional plowing or harrowing. *(Author's summary)* D02

0034

16695 ALCANTARA, E.N. DE; SOUZA, I.F. DE 1982. **Herbicidas na cultura da mandioca (*Manihot esculenta* Crantz).** *(Herbicides in cassava cultivation). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.136-141. Port., Illus.

Cassava. Field experiments. Herbicides. Brazil.

The efficiency of several herbicides was assessed in trials conducted in cassava crops in Lavras (clay soil, 1.49% OM) and in Felixlândia (sandy clay soil, 2.39% OM), MG, Brazil. A randomized block design was used with 11 treatments and 4 replications. Herbicides were applied with an Excelsior spray gun (Teejet 8003 nozzle) at 400 *l*/ha. The no. of plants/specie (monocotyledon and dicotyledon) were counted monthly and phytotoxicity was assessed visually. The most effective products at both localities were: alachlor, diuron, fluometuron, linuron, and the mixtures alachlor + diuron and alachlor + linuron. Trifluralin treatments were phytotoxic in Lavras but not in Felixlândia due to the difference in OM content and cutting planting depth. *(Summary by I.B. Trans. by L.M.F.)* D02

0035

10711 SEIXAS, B.L.S. 1979. **Influência da profundidade de aração na produção de raízes de mandioca (*Manihot esculenta* Crantz).** *(Effect of the depth of plowing on cassava root yield). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.105-112. Port., Sum. Port., Engl., 5 Refs., Illus.

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

In 1970-73, cassava cv. Mamão (9 mo. cycle) and Cigana (13 mo. cycle) were planted in fertilized soil in rows with a 1 x 0.8 m spacing in Cruz das Almas, BA, Brazil. Before 2 harrowings, the soil was ploughed to a depth of 0.10, 0.15, or 0.20 m. Mamão showed no significant root yield difference with ploughing depth but Cigana yielded 18.0, 18.9, and 19.2 t/ha for the 3 depths, resp. *(Summary by Field Crop Abstracts)* D02 D03

0036

18144 MARIGA, I. 1982. **Cassava propagation methods for commercial production.** Zimbabwe Agricultural Journal 79(4):133-137. Engl., Sum. Engl., 7 Refs., Illus.

Cassava. Propagation. Cuttings. Shoots.

The importance of adopting standard procedures in cassava planting is highlighted. This would lead to a more efficient use of propagation material and a uniform crop establishment. The following propagation methods are briefly described and illustrated: standard method (20-25 cm cuttings with a min. of 5 nodes); rapid propagation methods (10 cm shoot tips, shoot rooting from standard size cuttings, and the use of short 2-node, 1-node, or half-node stem cuttings). *(Summary by J.L.S. Trans. by L.M.F.)* D02

0037

17571 CARLIER, P. 1976. **Le manioc.** *(Cassava).* Paris, France, Institut de Recherches Agronomiques Tropicales. 64p. Fr., 10 Refs., Illus.

Cassava. Cultivars. Planting. Timing. Harvesting. Tuber productivity. Dry matter. Starch content. Tubers. Mechanization. Agricultural equipment. Field experiments. Ivory Coast.

A description is given of cassava, its cultivation (ecology and cultural practices), phytosanitary problems, storage, processing, and the research work carried out at the Central Station of the Institut de Recherches Agronomiques Tropicales in Bouake, Ivory Coast. Varietal trials tried to confirm the results previously obtained regarding yields of selected var. introduced from Madagascar (H57, H58, H34, H43, and H45) and var. CB, determine starch and DM contents on different harvesting dates (at 10, 15, and 20 mo.), and determine yield in relation to 2 planting times (April and Aug.). Var CB had a higher yield (4.569 kg roots/plant) at 15 mo. than the other var. at 20 mo., showing its superiority. H57 gave similar results. Regarding planting time, Aug. was best for var. CB while H57 could be planted regardless of planting time. Trials on mechanized harvest assessed different tools operated by mechanical (HUARD HB1 and HUARD BR66S double bottom plow, CAVEL disk plow, and a JUMBO subsoiler) and animal traction (ERBA furrow opener and plow). Best results were obtained with the HUARD BR66S double bottom plow which left only 6.84% of roots underground. *(Summary by J.L.S. Trans. by L.M.F.)* D02 D03 G01

0038

18121 TALATALA, R.L.; BACUSMO, J.L.; VILLANUEVA, M.R. 1980. **Response of cassava to different durations of weed control and weed competition.** Philippine Journal of Weed Science 7:11-16. Engl., Sum. Engl., 5 Refs.

Cassava. Weeding. Timing. Tuber productivity. Field experiments. Philippines.

The effect of different durations of weed control and weed competition on cassava cv. Golden Yellow was determined at 2 different plant spacings (0.75 x 1 m, 0.5 x 1 m) at the Philippine Root Crop Research and Training Center, Baybay, Leyte (Philippines). A split plot design with 4 replications was used. Planting distances represented the main plots and 10 weed control treatments, the subplots. Weed control consisted of maintaining plots weed free or unweeded, resp., for 2, 4, 6, or 8 wk. after planting with a hand weeded and an unweeded check. The dry wt. of weeds was generally higher at the wider than at the closer spacing. However, tuber yield did not differ significantly between the planting distances used. Cassava tolerated weed competition for the 1st 4 wk. from planting without yield reduction. Nevertheless, controlling weeds in cassava for a period of not less than 6 wk. from planting produced optimum tuber yield. Weed regrowth after 6 wk. was suppressed by the shade formed by the cassava canopy and did not considerably reduce tuber yield. Weed control between the 4th-6th wk. may be acceptable if weeding cannot be performed for the 1st 6 wk. *(Author's summary)* D02 D03

0039

18134 OKIGBO, B.N. 1979. **Effects of preplanting cultivations and mulching on the yield and performance of cassava** *(Manihot esculenta). In* Lal, R. ed. Soil tillage and crop production. Ibadan, Nigeria, International Institute of Tropical Agriculture. Proceedings Series no.2. pp.75-92. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Land preparation. Cuttings. Planting. Mulching. Tuber productivity. Plant development. *Xanthomonas manihotis*. Soil requirements. Cultivars. Field experiments. Nigeria.

Two series of expt. were conducted, in 1963-66 to study the effects of 4 preplanting cultivations on cassava yield and in 1970-73 the expt. was modified to include zero cultivation and mulching treatments. Cassava was grown in an Ultisol at the U. of Nigeria, Nsukka. For most of six planting seasons, preplanting cultivations did not significantly affect root yields, plant population, no. of stems/plant, and stem dry wt. Nontilling of the Nkpologu soil had more adverse effects on cassava yield and performance than any of the other preplanting cultivations. The 6 cassava cv. significantly differed in almost all observations made. Soil temp. were significantly affected by preplanting cultivations with higher temp. and wider temp. ranges observed on the mounds and ridges than on the flat. Mulching had more pronounced effects than preplanting cultivations. Mulching often significantly tended to increase plant height, leaf no./plant, and fresh and dry wt. of roots and leaves, while it decreased stem no./plant and soil surface temp. and, to an insignificant extent, storage root no. The most pronounced effect of the mulch was on soil temp. and this was more pronounced on the flat than on ridges and mounds. Mulching decreases bacterial blight incidence, especially on ridges and mounds. Mulching also tended to reduce harvesting time. Harvesting took slightly more time on the flat than on mounds and ridges but this was not significantly different on per plant and small plot basis as it would be for larger plots with higher plant populations. Correlations were established among various measurements taken. There is need to extend these studies to other soil types and crops. *(Author's summary)* D02 D03

0040

18143 RODRIGUEZ, S.; GARCIA, M. 1981. **Estudio de métodos de plantación en yuca (*Manihot esculenta*).** *(Study on planting methods in cassava).* Ciencia y Técnica en la Agricultura: Viandas, Hortalizas y Granos 4(2):25-35. Span., Sum. Span., Engl., 14 Refs.

Cassava. Planting. Cuttings. Tuber productivity. Field experiments. Cuba.

A comparative study on different planting positions of cuttings of commercial cassava clone Señorita (vertical, horizontal, and inclined on the ridge and horizontal on the bottom of the furrow) was carried out during 1979-80 at the Centro de Mejoramiento de Semillas Agámicas (CEMSA), Santo Domingo, Villa Clara (Cuba). A Latin square design was used with 4 replications. Highly significant differences were found among treatments regarding the no. of weeks to field coverage with foliage and commercial root yield. Vertical (90°) and inclined (45°) positions gave an earlier coverage to the field than horizontal planting on the ridge, and this in turn took less time than horizontal planting at the bottom of the furrow. All 3 positions of the cutting on the ridge had higher commercial root yields than planting on the bottom of the furrow, but differences were not significant. The advantages of each one are analyzed and it is recommended to consider as a definite criterion, the results obtained on farms as well as the opinions of producers regarding the advantages and disadvantages of each planting position. *(Author's summary)* D02 D03

0041

11515 ABRAMOVITZ, J.; WEISS, A.E.; GUIMARAES, L.B. DE M.; SILVA, A.J.V. DA; FREITAS, R. DE 1979. **Desenho industrial de implemento para colheita de raízes de mandioca.** *(Industrial design for a cassava root harvester). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.439-446. Port., Sum. Port., Engl., Illus.

Cassava. Harvesting. Agricultural equipment. Development. Brazil.

A brief description of the different stages of design, development, and operation of a model

of a tool used for the extraction of cassava roots is given. The finished model was tested with a Velmet 86 ID tractor at a depth of 250 mm. In plots with 1 m row spacing and using the tool at 85% of its capacity, 400 m^2 were covered per hour; in other words, 4 ha can be harvested in a 10-h work day. Drawings are included. *(Summary by J.L.S. Trans. by L.M.F.)* D02

See also 0016 0105

D03 Energy Productivity and Yields

0042

16601 BARRETO, J.H. DE A.; SILVA, M.F. DA; CAVALCANTI FILHO, M.T. DE M. 1972. **Competição de cultivares de mandioca.** *(Comparison of cassava cultivars). In* Seminário Brasileiro de Sementes, 3o., Recife, 1970. Anais. Recife-PE, Brasil, Superintendência do Desenvolvimento do Nordeste. pp.106-109. Port.

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

The root production of 2 cassava cv., Passarinha and Lagoa, extensively cultivated in NE Brazil, was compared with that of 4 cv. grown in the southern part of the country :Sutinga, Saracura, Vassourinha, and IAC 7-127 from São Paulo. Thirty plots (3.50 x 3.30 m) were used with cuttings with 12-15 buds planted slanted at 1.10 x 0.70 m. Five replications were made. Passarinna had the highest yield (44.6 t/ha), followed by Sutinga (31.8 t/ha); Vassourinha produced the lowest yield (19.5 t/ha). There was a significant variation among treatments at the 1 and 5% level, although there was no variation among blocks due to soil homogeneity. *(Summary by I.B. Trans. by L.M.F.)* D03

0043

17572 SANTIAGO, A.D.; MAGALHAES, P.C. 1981. **Introdução de cultivares de mandioca no Estado de Alagoas.** *(Introduction of cassava cultivars into the state of Alagoas).* Maceió, Alagoas. Empresa de Pesquisa Agropecuária do Estado de Alagoas. Pesquisa em Andamento no. 07. 3p. Port.

Cassava. Cultivars. Selection. Foliage. Tuber productivity. Starch content. Brazil.

In evaluation trials carried out with 70 cassava cv. at the Arapicara Exptl. Station, AL, Brazil, 10 cv. were selected for their productivity, starch content, pest and disease resistance, and certain botanical characteristics (plant growth habit, branching type, petiole color, root surface, and pulp color). Cv. Sipeal 1, Barrinha, and Mamão (canopy yield of 25.53, 22.93, and 21.46 t/ha, resp.) and Sipeal 2, Var 77, and Mamão (25.06, 23.46, and 21.46 t roots/ha, resp.) were among those cv. outstanding in productivity. *(Summary by J.L.S. Trans. by L.M.F.)* D03 G01

See also 0004 0007 0008 0013 0017 0018 0025 0026 0027 0029 0030 0031 0035 0037 0038 0039 0040 0046 0064 0070 0105

D04 Postharvest Studies

0044

11739 FUKUDA, W.M.G.; MENDES, K.A.; SILVA, S. DE O.E. 1979. **Resistência varietal de raízes de mandioca (*Manihot esculenta* Crantz) à deterioração pós-colheita.** *(Varietal resistance of cassava roots to postharvest deterioration). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informaçao e Documentação. pp.547 558. Port., Sum. Port., Engl., 5 Refs., Illus.

Cassava. Tubers. Deterioration. Resistance. Post-harvest technology. Vascular streaking. Storage. Brazil.

Eighty-six cassava cv. were assessed for resistance to postharvest root deterioration. This deterioration is characterized by vascular streaking followed by root rot. Roots were examined 3, 7, and 11 days after harvest, under field conditions and in the shade. For each observation 9 roots were cut transversely, each one being graded according to the stage of development of vascular streaking related to total root length on a 0-4 scale. Seven cv. under field conditions and 44 cv. in the shade were resistant to deterioration 11 days after harvest. *(Author's summary)* D04

0045

17566 DHIAUDDIN, M.N.; BOOTH, R.H. 1979. **Cassava storage and processing research: 1976-1978.** Serdang, Selangor, Malaysian Agricultural Research and Development Institute. 23p. Engl., Sum. Engl., Mal., 14 Refs., Illus.

Cassava. Cassava chips. Storage. Solar drying. Timing. Tubers. Fresh products. Post-harvest technology. Malaysia.

The postharvest life of fresh cassava roots may be extended from a few days to several weeks under local conditions in West Malaysia by packing them in moist materials in boxes at ambient temp. The potential of salt and sodium metabisulphite as chemical preservatives during predrying storage of wet cassava chips and during slow sun drying under adverse weather conditions was studied. Both chemicals successfully maintained good chip color and texture and prevented gross microbial deterioration. Treatment with salt caused an immediate loss of moisture but treated chips finally required a longer drying time to reach a MC of 13% or below. The quality of cassava chips incorporated into broiler diets did not affect feed intake but did appear to influence feed efficiency. The presence of high salt conen. in the diets following its use as a chip preservative resulted in some diarrhea and toxicity. Further research is required to determine the nature of this toxicity and the optimum levels of salt treated cassava chips, both sun-dried and fresh, in diets for poultry and other farm animals. *(Author's summary)* D04 H03 I02

E00 PLANT PATHOLOGY

E02 Bacterioses

0046

11731 PERIM, S.; TAKATSU, A. 1979. **Seleção de variedades de mandioca resistentes à bacteriose para a região dos Cerrados.** *(Selection of cassava varieties resistant to bacteriosis for the Cerrado region). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.513-522. Port., Sum. Port., Engl., 11 Refs.

Cassava. Cultivars. Selection. Resistance. *Xanthomonas manihotis.* **Tuber productivity. Starch content. Foliage. Field experiments. Brazil.**

Fifty-eight cassava var. were evaluated for resistance to bacteriosis (*Xanthomonas manihotis*) and for yield capacity under cerrado conditions at the Centro de Pesquisa Agropecuária dos Cerrados, DF (Brazil). These materials were previously selected from a collection of 242 var. for resistance to bacteriosis by the CIAT fast screening method under greenhouse conditions. Seven var. showed a high level of resistance to *X. manihotis*; 14 mo. after planting their root production was 30 t/ha and starch contents > 30%. These can be considered promising var. for the cerrado area. Many var. severely affected by bacteriosis had yields higher than the av. for cassava grown in the cerrado area, indicating that the lower resistance to bacteriosis of these var. was compensated by higher photosynthetic efficiency of unaffected parts (leaves and stems) and by plant capacity to quickly recover from infection under conditions unfavorable for bacteriosis. Less resistant var. can be cultivated in the cerrado area when farmers use adequate control methods. However, the use of susceptible var. is not recommended since any failure in these methods would result in severe losses. *(Author's summary)* E02 D03 C03

E03 Mycoses

0047

11709 FUKUDA, C.; FUKUDA, W.M.G.; SOUZA, A. DA S. 1979. **Seleção de cultivares e clones de mandioca resistentes à antracnose** (*Colletotrichum gloeosporioides*). [*Selection of cassava clones and cultivars resistant to anthracnose (Colletotrichum gloeosporioides)*]. *In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.503-512. Port., Sum. Port., Engl., 4 Refs.

Cassava. Cultivars. Clones. Selection. Resistance. *Glomerella cingulata*. **Field experiments. Brazil.**

A total of 100 cassava cv., 36 open-pollinated clones, and 56 control pollinated clones were studied to determine sources of resistance to anthracnose (*Colletotrichum gloeosporioides*) under field conditions in Cruz das Almas, BA, Brazil. A randomized block design was used with each plot containing 45 plants/treatment. Planting took place in Nov. 1978 using 20-cm cuttings planted horizontally at 1 x 1 m, 10 cm in depth. Evaluations in Feb. and June (4 and 8 mo. after emergence, resp.) indicated that 7 cv., 3 open-pollinated clones, and 19 clones of controlled pollination were resistant. Moderately resistant, moderately susceptible, and susceptible materials were also found. High rainfall, RH > 80%, and temp. between 20-25°C were found to be ideal conditions for the development of anthracnose and consequently, plant infection. The use of resistant and moderately resistant materials in areas with similar conditions is recommended. *(Author's summary)* E03

0048

11462 SOUZA FILHO, B.F. DE; OLIVEIRA, H. DE F. 1979. **Danos causados por** *Botryodiplodia* **em mandioca** (*Manihot esculenta* Crantz). *(Damage caused by Botryodiplodia in cassava). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.413-417. Port., Sum. Port., Engl., 5 Refs.

Cassava. *Botryodiplodia theobromae*. **Cultivars. Resistance. Plant damage. Field experiments. Brazil.**

Field and lab. expt. were conducted to detect differences in susceptibility of 6 regional cassava cv. (Manjari, Suruí, Xico Vianna, Aipim Cachoeiro, Lastradeira, and Moreninha) to *Botryodiplodia theobromae*, which caused damping-off and dieback of cassava in the northern region of the state of Rio de Janeiro, Brazil, during 1978 and 1979. Damping-off was more marked during the rainy season; dieback symptoms during the dry season. Field observations and lab. trials indicated that the regional cv. Manjari was resistant and presented good agronomic characteristics. *(Author's summary)* E03

See also 0071

E04 Viroses

0049

11468 PEREIRA, A.S.; COSTA, A.S. 1979. **Estudos sobre a disseminação em campo dos vírus do mosaico comum e do mosaico das nervuras da mandioca.** *(Studies on the dissemination of cassava common mosaic and vein mosaic viruses under field conditions). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.419-423. Port., Sum. Port., Engl., 4 Refs.

Cassava. Cassava common mosaic virus. Cassava vein mosaic virus. Virus transmission. Cultivars. Cuttings. Tuber productivity. Harvest index. Field experiments. Brazil.

Ten virus-free cassava cv., Vassourinha, Guaxupé, Ouro-do-Vale, IAC 7-163, IAC 15-27, IAC 18-13, IAC 19-7, IAC 19-66, IAC 23-1, and SRT 806 (Guaxupé type) were planted in alternate rows of 10 plants with 2 other var., Branca do Pomar and Guaíba, infected, resp., with cassava common mosaic and cassava vein mosaic viruses. No field dissemination of the 2 viruses from infected plants to healthy ones was noticed, based on symptoms during plant growth cycle. Tests of cuttings from healthy plants confirmed that no infection had occurred. Although the results are not perfectly comparable, yield data showed that the healthy plants of the 10 cv produced a mean 4.5 times more roots than infected plants and 2.8 times more above-ground parts (stem and leaves). Yield reduction induced by the 2 virus diseases was nearly the same. *(Author's summary)* E04

0050

11458 MENDES, R.A. 1979. **Sintomas de mosaico africano em brotações de manivas-semente de mandioca (*Manihot esculenta* Crantz) em vasos.** *(Cassava African mosaic disease symptoms on new sprouts of cassava cuttings in pots). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais, Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.403-411. Port., Sum. Port., Engl., 10 Refs., Illus.

Cassava. Cassava African mosaic virus. Cuttings. Symptomatology. Selection. Laboratory experiments. Nigeria.

A short-term greenhouse trial was established at the International Institute of Tropical Agriculture, Ibadan, Nigeria, to determine the effect of selecting cassava planting material on the reduction of CAMV attack and the advantage of using CAMV-resistant genotypes. Eighty cuttings of cv. Isunikankiyan (susceptible to CAMV) and 80 from clone 30211 (resistant to CAMV) were used. For each genotype, 40 cuttings from mosaic-infected plants and 40 from healthy plants were planted. A 15% reduction in diseased sprouting was observed in cv. Isunikankiyan when healthy cuttings were used and 27.5% in clone 30211. *(Author's summary)* E04

0051

17600 AYANRU, D.K.G.; SHARMA, V.C. 1982. **Effects of cassava mosaic disease on certain leaf parameters of field-grown cassava clones.** Phytopathology 72 (8):1057-1059. Engl., Sum. Engl., 16 Refs.

Cassava. Cassava African mosaic virus. Clones. Leaves. Chlorophyll. Plant anatomy. Leaf area.

Mature leaves of 14 field-grown 8-mo.-old cassava clones with (diseased) and without (healthy) symptoms of the CAMD were assessed comparatively for concn. of chlorophylls a and b, leaflet surface area, leaflet dry wt., and petiole dry wt. Ratios of chlorophyll a and chlorophyll b were similar in diseased and healthy leaves (1.76-2.23 and 1.90-2.20, resp.). Concn. of chlorophyll a and chlorophyll b were between 1.35-2.38 and 0.67-1.19 mg/g dry wt., resp., in healthy leaves, and 0.84-1.42 and 0.40-0.72 mg/g dry wt., resp., in diseased leaves. Concn. of chlorophyll a and chlorophyll b, as well as leaflet surface area, leaflet dry wt., and petiole dry wt. of diseased leaf samples were reduced significantly ($P < 0.01$) by 32-62, 37-57, 21-48, 25-54, and 27-51%, resp., compared with corresponding data from healthy leaves. It is suggested that the bulk of CAMD-induced heavy yield reductions in cassava can be explained on the basis of the diminished chlorophyll content, leaflet size, and possibly other aspects of photosynthetic carbohydrate production. *(Author's summary)* E04 C00

0052

17599 BOCK, K.R.; GUTHRIE, E.J. 1982. **Control of cassava mosaic disease in Kenya.** Tropical Pest Management 28(3):219-222. Engl., Sum. Engl., 5 Refs.

Cassava. Cassava African mosaic virus. Disease control. Cultivars. Resistance. Kenya.

CAMD is one of the most important factors limiting production in East Africa. The disease can be controlled by the use of healthy planting material. Plots of carefully selected, apparently healthy cassava of several cv. of differing genetic constitution were established and successfully kept free of disease by inspection and roguing. The rate of spread of mosaic disease into mosaic-free plots over a 5-yr period was consistently very low (< 2% and most frequently < 1%) irrespective of cv. type or size of plot (0.02-1.00 ha), which clearly indicates that CAMD can be effectively controlled in Kenya by the use of mosaic-free propagation material. Comparative yield data indicated that yields of local cv. are at least equal to those of improved resistant cv. and suggest that agronomic evaluation of Kenya cv. would be of great value. *(Author's summary)* E04

0053

17594 SEQUEIRA, J.C.; HARRISON, B.D. 1982. **Serological studies on cassava latent virus.** Annals of Applied Biology 101:33-42. Engl., Sum. Engl., 24 Refs., Illus.

Cassava. Cassava latent virus. Serology. Laboratory experiments. Analysis.

Particles of CLV were purified by a method that yielded up to 3 mg/100 g of systemically infected *Nicotiana benthamiana* leaf. Specific antiserum was prepared and used for ELISA, which detected purified virus at 5 ng/ml. As estimated by ELISA, CLV antigen reached a greater concn. in leaves of *N. benthamiana* plants kept at 20-25°C than in those at 15 or 30°C. CLV was also detected in leaf extracts of naturally infected cassava plants kept at 25°C but its concn. was only 1-7% of that in comparable extracts from *N. benthamiana*. Staining sections of *N. benthamiana* leaves with fluorescent antibodies indicated that CLV particle antigen accumulates in the nuclei of many phloem cells and of some cells in other tissues. In tests on mosaic-affected cassava plants of Angolan origin, 3 plants were found in which CLV could not be detected by either ELISA or immunosorbent electron microscopy, or by transmission to indicator plants. This suggests that the mosaic symptoms were caused

by a pathogen other than CLV, but no such agent was detected by electron microscopy of leaf extracts. Three kinds of serological test indicated that CLV is related to BGMV. Evidence was also obtained of a distant relationship to beet curly top virus but none was detected to 4 other geminiviruses. *(Author's summary)* E04

0054

17593 MOHANRAJ, V.; NARAYANASAMY, P. 1981. **Hastening symptom expression for early detection of cassava mosaic virus infection.** Indian Phytopathology 34(3):372-373. Engl., 2 Refs.

Cassava. Cassava mosaic virus. Symptomatology. Laboratory experiments.

A new technique developed to detect cassava mosaic virus infection is described. Single budded cuttings from diseased plants were used, planted in pots with sterilized sand. These pots were placed on a platform kept inside a rectangular iron tank filled to 1/4 of its capacity with water and covered with a polyethylene sheet. The no. of days to germination and for symptom expression were recorded. It was demonstrated that germination was earlier in the presence of high humidity. Disease symptoms were observed 15 days earlier than in the case of cuttings germinated under normal conditions. This method allows the early detection of virus infection in large-scale testing. *(Summary by I.S. Trans. by L.M.F.)* E04

0055

18101 ADEJARE, G.O.; COUTTS, R.H.A. 1982. **The isolation and characterisation of a virus from Nigerian cassava plants affected by the cassava mosaic disease, and attempted transmission of the disease.** Phytopathologische Zeitschrift 103(3): 198-210. Engl., Sum. Engl., Germ., 36 Refs., Illus.

Cassava. Cassava African mosaic virus. Disease transmission. Cassava latent virus. Isolation. Laboratory experiments.

The symptomatology of CAMD in Nigerian cassava is described, but attempts to transmit the disease from infected clones to healthy seed-derived cassava plants by mechanical inoculation of infected leaf sap failed. The disease could only be transmitted by bud-grafting of infected buds onto healthy plant stems. Leaf homogenates prepared from CAMD affected cassava elicited symptoms on several species of *Nicotiana*, notably *N. benthamiana*, which proved to be the most sensitive assay and propagation species. The purported pathogenic agent of CAMD is CLV, which has been isolated and purified from systemically infected *N. benthamiana* leaves 14-28 days after inoculation by differential centrifugation. The host range of CLV is apparently limited to the Euphorbiaceae and Solanaceae. A_{260}/A_{280} ratios of purified virus preparations were 1.6 ± 0.08 at an av. yield of 3 mg virus/100 g of tissue. Electron microscopy of the purified virus revealed the presence of polyhedral particles 18 nm in ϕ usually occurring as paired structures about 19 x 30 nm in unfixed negatively stained preparations. The virus contained infectious single-stranded DNA of mol. wt. ca. 0.77 x 10^6 d and a capsid protein of apparent mol. wt. 26,300 d. It has not been proven that CLV is the causative agent of CAMD in Nigerian cassava, and the pathogenic status of the virus remains unknown. Three African isolates of CLV have now been purified and partially characterized, but whether these isolates are strains of the virus, or isolates of the same strain is not known. Slight differences in host range between the isolates may only reflect differing assay conditions. Sensitive serological and molecular biological techniques must be used in the future to resolve these aspects. *(Author's summary)* E04

0056

13738 DENGLER, H.J. 1980. **Untersuchungen über die Befalls-Verlust-Relation beim Maniokmosaic in Togo.** *(Investigations on the disease intensity/crop loss-relationship of cassava mosaic in Togo).* Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz 87(10/11):607-620. Germ., Sum. Germ., Engl., 19 Refs., Illus.

Cassava. Leaf area. Photosynthesis. Cassava African mosaic virus. Epidemiology. Tüber productivity. Plant damage. Togo.

A procedure to estimate yield losses in cassava was developed. It is based on the estimation of the loss of leaf assimilation area due to virus attack during a vegetation period of 6 mo. Using this method, yield losses between 34-41% were determined for var. Goula and 38-66% for Kataoli. A significant correlation existed in most expt. between the loss of assimilation area and the loss in DM wt. of roots. *(Author's summary)* F04 C00

0057

18124 NAIR, N.G. 1981. **Relationship between cassava mosaic disease spread and whitefly (*Bemisia tabaci* Gen,) population under different insecticide treatments.** Journal of Root Crops 7(1/2):15-19. Engl., Sum. Engl., 12 Refs., Illus.

Cassava. Cassava mosaic virus. *Bemisia*. Insect biology. Insecticides. Field experiments. India.

The effect of insecticides, applied at monthly intervals, on the spread of cassava mosaic disease in India and on the population of whiteflies (*Bemisia tabaci*) was studied in a field trial conducted for 3 seasons. A hybrid cassava var., H-226, was used. Treatments consisted of 2 systemic granules (carbofuran and disulfoton), 2 emulsifiable concentrates (dimethoate and methyl demeton), 2 foliar protectants (carbaryl and fenitrothion), and 1 check (water spray). Population density of whiteflies was recorded just before spray applications at monthly intervals. Total no. of immature stages of the whiteflies from 9 sampling units were taken from each plot. Data on disease spread (plants showing symptoms) were also collected. Results show that whitefly populations varied significantly between years and between mo. within a given year. No significant differences in disease spread was recorded for the different insecticidal treatments. *(Author's summary)* E04 F01

F00 PEST CONTROL AND ENTOMOLOGY

F01 Injurious Insects and their Control

0058

18112 IHEAGWAM, F.U. 1981. **Natural enemies and alternative hostplant of the cassava mealybug, *Phenacoccus manihoti* (Homoptera, Pseudococcidae) in south-eastern Nigeria.** Revue de Zoologie Africaine 95(2):433-438. Engl., Sum. Engl., 19 Refs.

Cassava. *Phenacoccus manihoti*. Biological control. Predators. *Manihot glaziovii*. Nigeria.

A large-scale infestation of cassava by *Phenacoccus manihoti* was 1st observed in SE Nigeria in 1979; within a few mo. it had spread to many cassava-growing areas causing up to about 80-100% damage. The mealybug is usually rare on cassava during the wettest mo. (May-August) of the rainy season, possibly because it is washed off the plants. According to observations made, the ultimate removal of *P. manihoti* is by predacious larvae of the lycaenid *Spalgis lemolea* and *Chrysopa* sp., both of which are reported preying on the mealybug in Nigeria for the 1st time. The coccinellids *Exochomus flavipes* and *Hyperaspis pumila* have also been reported preying on *P. manihoti* in Nigeria. The Cerea rubber tree (*Manihot glaziovii*), grown in Nigeria for rubber and as an ornamental, is reported for the 1st time as a food plant of *P. manihoti*. During the rainy season, a conspicuous population of the mealybug, accompanied by *S. lemolea* and *Chrysopa* sp., occurred on the leaves of the lower branches of *M. glaziovii*, apparently shielded from the direct effect of the rains. This food plant may be a source of the pest and its predators after the rains. *(Summary by Review of Applied Entomology)* F01

0059

18104 HARRIS, K.M. 1981. *Dicrodiplosis manihoti*, **sp. n. (Diptera: Cecidomyiidae), a predator on cassava mealybug, *Phenacoccus manihoti* Matile-Ferrero (Homoptera: Coccoidea: Pseudococcidae) in Africa.** Annales de la Societé Entomologique de France 17(3):337-344. Engl., Sum. Engl., Fr., 6 Refs., Illus.

Cassava. *Phenacoccus manihoti*. Predators. *Dicrodiplosis manihoti*. Entomology. Africa.

Adults and larvae of *Dicrodiplosis manihoti*, sp. n. are described and illustrated on the basis of specimens from the Congo Republic and Senegal. Larvae feed as predators in egg masses of the cassava mealybug, *Phenacoccus manihoti*, on cassava. *D. manihoti*, possibly a sibling species associated with other species of Pseudococcidae, is recorded from Iran, Iraq, and Israel. The geographical distributions and host ranges of all known species of *Dicrodiplosis* are summarized on a world basis. *(Author's summary)* F01

0060

16689 CIOLA, A.I. 1982. **Controle biológico natural de pragas da mandioca.** (*Natural biological control of cassava pests*). *In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.39-41. Port.

Cassava. Injurious insects. Injurious mites. Predators. Biological control. Brazil.

A list of insects and mites found in cassava in the region of Lavras, MG, Brazil, is given. Data are included on their importance, plant part attacked, and natural enemies. Major pests in this region are *Mononychellus tanajoa, Vatiga illudens, Scirtothrips manihoti, Neosilba perezi, N. nigrocoerulea,* and *Erinnyis ello. (Summary by J.L.S. Trans. by L.M.F.)* F01 F03

0061

16223 SOUZA, J.C. DE; REIS, P.R.; ANDRADE, A.M. DE S. 1982. **Levantamento da fauna de artrópodos da mandioca (*Manihot esculenta* Crantz) na região do Alto Jequitinhonha.** *(Survey on the arthropod fauna in cassava in the Alto Jequitinhonha region).* Belo Horizonte-MG, Brasil, Empresa de Pesquisa Agropecuária de Minas Gerais, Pesquisando no. 44. 4p. Port., Illus.

Cassava. *Neosilba perezi. Erinnyis ello. Scirtothrips manihoti. Mononychellus tanajoa.* Insect control. Brazil.

The following insects were found in cassava crops in surveys conducted in the municipality of Itamarandiba, MG, Brazil: *Neosilba perezi, Erinnyis ello, Scirtothrips manihoti,* an unidentified whitefly, and the mite *Mononychellus tanajoa.* The degree of susceptibility of cassava cv. IAC 14-18, Iracema, Mantiqueira, Branca de Santa Catarina, Taquari, IAC 7.127, Sonora, Caapora, IAC 12-829, and Vassourão to the attack of *N. perezi* (the most severe) was determined. Brief recommendations on the chemical and mechanical control of these pests are given. *(Summary by J.L.S. Trans. by L.M.F.)* F01 F03

See also 0057

F03 Injurious Mites and their Control

0062

11413 FARIAS, A.R.N.; SOUZA, A. DA S.; MACEDO, M.M.C. 1979. **Controle químico do ácaro *Mononychellus tanajoa* (Bondar, 1938) em mandioca.** *(Chemical control of the cassava mite Mononychellus tanajoa). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária, Departamento de Informação e Documentação. pp.377-383. Port., Sum. Port., Engl., 5 Refs.

Cassava. *Mononychellus tanajoa.* Mite control. Acaricides. Brazil.

A field trial was carried out at the Escola de Agronomia of the U. Federal da Bahia, Cruz das Almas, Brazil, to determine the efficiency of chemical products in controlling the cassava mite, *Mononychellus tanajoa*, in cassava cv. Cigana Preta. Treatments included omethoate (0.12% a.i.), azinphos-ethyl (0.08% a.i.), chlorobenzilate (0.05% a.i.), phosalone (0.07% a.i.), and the check. On the basis of the data obtained, omethoate was the most efficient in controlling *M. tanajoa*, followed by phosalone and azinphos-ethyl. Although chemical control proves to be efficient, var. resistance continues to be considered as a more effective and durable control. *(Author's summary)* F03

0063

17578 GUTIERREZ, J.; ETIENNE, J. 1981. **Quelques données sur les acariens Tetranychidae attaquant les plantes cultivées au Sénégal.** *(Data on tetranychid mites attacking cultivated plants in Senegal).* Agronomie Tropicale 36(4):391-394. Fr., Sum. Fr., 12 Refs.

Cassava. *Oligonychus gossypii. Eutetranychus monodi.* Injurious mites. Insect biology. Senegal.

As a result of a series of mite collections on crops (cassava, groundnut, maize, rice, sorghum, soybean, *Vigna* sp., cucumber, and papaya) in Casamance, Senegal, 8 species of tetranychids were identified, of which *Oligonychus gossypii* was recorded for 1st time on cassava in Senegal; *Eutetranychus monodi* on groundnut and cassava was already known in that country. Notes are given on the morphology, history, host plants in other countries, and biology, including feeding habits and the nature of the damage caused. *(Extracted from summary by Review of Applied Entomology)* F03

0064

17582 BYRNE, D.H.; GUERRERO, J.M.; BELLOTTI, A.C.; GRACEN, V.E. 1982. **Yield and plant growth responses of *Mononychellus* mite resistant and susceptible cassava cultivars under protected vs. infested conditions.** Crop Science 22(3):486-490. Engl., Sum. Engl., 17 Refs.

Cassava. *Mononychellus caribbeanae. M. tanajoa.* Cultivars. Resistance. Plant damage. Tuber productivity. Plant height. Leaves. Growth. Colombia.

Root yield, propagation material yield, and growth responses to *Mononychellus* mite (Acari: Tetranychidae) populations, and foliage damage ratings of resistant and susceptible cassava cv. (previously determined by foliage damage ratings) were compared in protected and unprotected plots. These parameters were used to confirm the level of resistance, relate foliage damage estimates with economic yield reductions, and study the general effect of mite attacks on cassava. On the av., cassava cv. selected as susceptible had larger reductions in leaf size, leaf life, leaf formation rate, plant height, root yield, yield of propagation material, root wt., root no., and % marketable roots than did the resistant cv. when compared with their respective performance in protected plots. The av. yield loss for susceptible cv. was 73% for roots and 67% for propagation material, the respective losses for the resistant cv. were 15 and 19%. The selection criterion for resistance (foliage damage ratings) was correlated with mite density and associated with the % yield loss caused by the mites, indicating this criterion's potential value in future breeding efforts, although exceptions exist due to the presence of tolerance. *(Author's summary)* F03 C01 D03

0065

11414 FARIAS, A.R.N.; ZEM, A.C.; FLECHTMANN, C.H.W. 1979. **Flutuação populacional do ácaro da mandioca *Mononychellus tanajoa* (Bondar, 1938) em Cruz das Almas-Bahia.** *(Fluctuation of Mononychellus tanajoa population in cassava crops in Cruz das Almas-Bahia). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.385-391. Port., Sum. Port., Engl., 4 Refs., Illus.

Cassava. *Mononychellus tanajoa.* Insect biology. Brazil.

A 1-yr survey (Sept. 1977-Aug. 1978) of the population of the neotropical cassava mite (*Mononychellus tanajoa*) on a 1-ha field in Cruz das Almas, BA, Brazil, showed a high relationship between rainfall and mite reduction. Since the RH showed only a slight variation throughout the yr, suppression of the mite population cannot be attributed to increased RH. It is probably due to the detachment of the active stages of *M. tanajoa* from the leaves by rain. Highest population levels occurred from Oct.-Nov. with peak infestation in Nov., mo. of the lowest precipitation. *(Author's summary)* F03

0066

18114 BYRNE, D.H.; GUERRERO, J.M.; BELLOTTI, A.C.; GRACEN, V.E. 1982. **Behavior and development of *Mononychellus tanajoa* (Acari: Tetranychidae) on resistant and susceptible cultivars of cassava.** Journal of Economic Entomology 75(5):924-927. Engl., Sum. Engl., 14 Refs.

Cassava. *Mononychellus tanajoa.* Insect biology.

The biology of *Mononychellus tanajoa* on resistant and susceptible genotypes of cassava was studied by using the leaf disc procedure. Mite biology was affected distinctly by different resistant sources. Among these effects were the lowering of fecundity, preference, larval and nymphal survival, adult longevity, and the rate of development as compared with the susceptible controls. The M Col 1434 resistant var. had the most severe effects on mite development, survival, and preference. M Bra 12, although showing high levels of resistance in the field, had intermediate effects on mite survival and preference. *(Author's summary)* F03

See also 0060 0061 0071

G00 GENETICS AND PLANT BREEDING

0067

16684 CORREA, H.; RAMALHO, M.P. 1982. **Estimativa dos parâmetros genéticos e fenotípicos para caracteres da mandioca.** *(Evaluation of genetic and phenotypic parameters of cassava characteristics). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.115-116. Port., 3 Refs.

Cassava. Genetics. Inheritance. Productivity.

Thirty-six cassava clones were used to assess genetic and phenotypic parameters of the characteristics root production (x) and branch production (y) and to estimate root and branch production/plant/crop yr in order to conduct inter- and intraphenotypic variance trials. Environmental factors likewise affected both characteristics x and y, genetic variability being greater for x. A high positive correlation exists between both characteristics; if a clone is selected for increases in y, x will also increase. The phenotypic and genetic correlations between x and y are $A_{6\,xy}$ = 0.7647 and rf_{xy} = 0.8010. *(Summary by I.E. Trans. by L.M.F.)* G00

G01 Breeding, Germplasm, Varieties and Clones, Selection

0068

17564 MOH, C.C.; ALAN, J.J. 1973. **Methods for inducing mutations in cassava and the possible uses of the mutants.** *In* Induced Mutations in Vegetatively Propagated Plants, Vienna, 1972. Proceedings of a Panel. Vienna, International Atomic Energy Agency. pp.67-74. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Mutation. Irradiation. Plant breeding.

Since cassava can be propagated sexually as well as vegetatively, seeds, stem cuttings, and pollen can be irradiated as a method for mutation induction. While the efficiency of these methods for inducing mutations in cassava has not been thoroughly evaluated, pollen irradiation appears to have certain advantages. It eliminates the chimera production and allows an early evaluation of the mutated characters. Some mutants from pollen treatments were especially vigorous and many have value in the breeding program. Only 2 locations are known to have used mutation method for cassava breeding: India and Costa Rica. In India, yield improvement is the primary objective; in Costa Rica cv. of early root maturity and free of hydrocyanic glucosides are being sought. *(Author's summary)* G01

0069

17597 NASSAR, N.M.A. 1981. **Registration of Paraiba 10 cassava germplasm.** Cassava Newsletter 9:13-14. Engl., 7 Refs., Illus.

Cassava. Cultivars. Germplasm. Brazil.

Paraiba 10 was developed from the cross *Manihot dichotoma* x *M. esculenta* cv. Catelo. The former is a wild, woody, tree-like species that rarely forms tubers and is native to NE Brazil. F_1 plants selected for early maturity and tuber formation gave marketable tubers in 6 mo. compared with 10 mo. in cv. Catelo. Paraiba 10 grows vigorously, is easily reproduced by cuttings, and reaches about 2 m in height. Early maturity makes Paraiba 10 suitable for the semiarid regions of NE Brazil. *(Summary by Plant Breeding Abstracts)* G01

0070

11737 FUKUDA, W.M.G. 1979. **Produção e seleção preliminar de novos híbridos de mandioca (*Manihot esculenta* Crantz).** *(Production and preliminary selection of new cassava hybrids). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.535-545. Port., Sum. Port., Engl., 9 Refs., Illus.

Cassava. Hybrids. Selection. Tuber productivity. Harvest index. Agronomic characters. Resistance. Field experiments. Brazil.

Cassava hybrids produced by controlled crossings at the Centro Internacional de Agricultura Tropical were evaluated and selected at the Centro Nacional de Pesquisa de Mandioca e Fruticultura in Cruz das Almas, BA, Brazil, during 2 crop cycles. Selection was based on general plant appearance, root wt., and HI. A great phenotypic variability was observed. Some of the selected hybrids yielded 8 kg of roots/plant. A positive correlation was observed between root wt. and HI for both sexually and asexually-propagated hybrids. *(Author's summary)* G01 D03

0071

17508 LENOIR, H.; MATHIEU, G.; BEAULIEU, G. 1981. **Résultats: racines et tubercules.** *(Root and tuber crops). In* _____. Recherche agronomique appliquee region du Nord. Resultats sur la periode 1977 à 1980. Haiti. Programme Agricole de l'Organisme de Développement du Nord. pp.19-28. Fr., Illus.

Cassava. Cultivars. Field experiments. Adaptation. Tuber productivity. Starch content. Sweet cassava. Bitter cassava. *Cercospora henningsii. C. caribaea. C. vicosae. Silba pendula.* **Injurious mites. Resistance. Haiti.**

The results of several trials with bitter and sweet cassava conducted in northern Haiti during 1977-80 are given. Local var. Madame François yielded 18 t/ha in a plant density trial. A plant density of 10,000 plants/ha is recommended for monoculture; lower densities should be used in association. In Grand Pré (silty soils) good yields were obtained, var. CMC 40 (CIAT) being the most promissory. In another trial M Col 1684 (CIAT) gave the highest yield. These results should be verified in var. trials. The presence of diseases and shoot flies (*Silba pendula*) was recorded, introduced var. being more susceptible. In a comparative trial conducted in Acul du Nord (clay soil with 50-100-100 fertilization), CMC 40 gave a yield of 37 t/ha; this var. is currently being released with the name of Madame Jacques. Descriptive data are given. *(Summary by I.B. Trans. by L.M.F.)* G01 D00 E03 F03

See also 0037 0043

H00 NUTRITION

H01 Cassava Foods and Nutritive Value

0072

18115 COLLINS, J.L.; TEMALILWA, C.R. 1981. **Cassava (*Manihot esculenta* Crantz) flour fortification with soy flour.** Journal of Food Science 46(4):1025-1028. Engl., Sum. Engl., 17 Refs., Illus.

Cassava. Cassava flour. Protein enrichment. Soybean flour. Nutritive value. Organoleptic examination.

Soy flour, CP 53.8%,, was mixed, 5-20%, with CF, protein 2.1%. Soy flour increased the chemical score of the essential amino acids (EAA) of cassava but the EAA composition was still well below that of the FAO reference protein. In studies with rats a diet with 10.6% protein from cassava and soy flours (4:1) had a PER of 1.55 compared with the adjusted value for casein 2.5. Rats given diets with 1.7 and 3.6% protein from 100 and 95% CF lost 0.73 and 0.37 g bodywt. daily whereas there was no substantial wt. change in 28 days on a diet with 5.6% protein from a 90% cassava mixture. Addition of soy flour up to 15% improved the appearance and eating quality of cassava dough. *(Summary by Nutrition Abstracts and Reviews)* H01

0073

17568 SHIROSE, I.; AGUIRRE, J.M. DE; FERREIRA, V.L.P. 1978. **Aplicação do delineamento escalonado ("staggered design") no estudo da vida-de-prateleira do produto alimentício farinha de mandioca enriquecido com resíduo do extrato protéico de soja.** *(Application of a staggered experimental design to study the shelf-life of cassava flour enriched with soybean protein extraction residue).* Coletânea do Instituto de Tecnología de Alímentos 9:313-334. Port., Sum. Port., Engl., 9 Refs., Illus.

Cassava. Cassava flour. Storage. Timing. Organoleptic examination. Statistical analysis.

The staggered exptl. design procedure of Gacula (1975) was applied to determine the shelf-life of a 60:40 CF/soybean protein extraction residue blend packaged in polyethylene bags and stored at ambient temp. for ≤ 125 days. Organoleptic quality was evaluated by taste panels on a 7-point scale every 14 days up to 104 days of storage, subsequently every 7 days. A table of results is given. Normal, lognormal, exponential, extreme-value, and Weibull models were evaluated; the Kolmogorov-Smirnov test was used to determine goodness of fit. The results show the Weibull model to be adequate for shelf-life prediction. The product developed a very slight to slight off-flavor after 105 days at ambient temp. *(Summary by Food Science and Technology Abstracts)* H01 I02

H03 Animal Feeding

0074

16280 PEREZ, J.M.; CASTAING, J.; GROSJEAN, F.; CHAUVEL, J.; BOURDON, D.; LEUILLET, M. 1981. **Valeur énergétique de deux types de manioc et utilisation comparée dans les régimes du porc en croissance et du porcelet: synthèse des résultats d'une concertée, I.N.R.A.-I.T.C.F.-I.T.P.** *(Energy value of two types of cassava and comparison of their use in rations for growing pigs and piglets: synthesis of results of a study, I.N.R.A.-I.T.C.F.-I.T.P.).* Journées de la Recherche Porcine en France 13:125-144. Fr., 37 Refs.

Cassava. Cassava meal. Pellets. Digestibility. Feeds and feeding. Fattening. Finishing. Swine. Animal physiology. Animal nutrition. Dietary value. Feed constituents.

Two types of cassava, one from Thailand (T) and one from Malawi (M), were compared regarding digestibility (Institut National de Recherches Agronomiques, INRA, trial A) and different zootechnical parameters (Institut Technique des Céréales et des Fourrages, ITCF-Institut Technique du Porc, ITP) in growing pigs (trials B and C) and in piglets (trial D). Information is included on origin, lot formation, chemical and bacteriological characteristics, and mycotoxin analysis of the raw materials used. In trial A, the incorporation of cassava up to 50% did not decrease feed intake of confined castrated Large White males (30.1 kg wt. at 91 days). Energy value was 3640 Kcal for T and 3930 for M, determined by 2 methods of analysis: regression and difference. In trial B, there was a significant interaction sex x treatment ($P < 0.01$). A level of 30% cassava type T enhanced wt. increase in growing males. In the finishing period the cassava-based diet had a higher intake than the control (maize and soybean cake, 76 and 20%, resp.). Throughout the entire period of fattening (23-103 kg) there were no differences among diets for males, but there was a depressive effect in females fed cassava, wt. increase/day being 93, 94.3, and 96.5% and the index of intake/day, 107.6, 105, and 104.7% (15% cassava type T, 30% cassava type T, and 30% cassava type M, resp.), compared with the check. In trial C, the incorporation of 30% cassava types T or M did not vary the performance of growing animals significantly, although the index of intake ($P < 0.01$) of finishing females was slightly increased. There was a significant interaction sex x treatment ($P < 0.05$). In trial D the incorporation of 10 and 20% cassava did not have significant effects. Eighty percent of the meat carcass was classified as grades I and II used by the EEC. Cassava-based diets should be balanced with N materials. The influence of cassava heterogeneity on its nutritive value is discussed. *(Summary by I.B. Trans. by I.M.F.)* H03

0075

17596 REED, J.D.; McDOWELL, R.E.; SOEST, P.J. VAN; HORVATH, P.J. 1982. **Condensed tannins: a factor limiting the use of cassava forage.** Journal of the Science of Food and Agriculture 33(3):213-220. Engl., Sum. Engl., 33 Refs., Illus.

Cassava. Tannins. Leaves. Stems. Petioles. Protein content. Fibre content. Analysis. Cultivars. Digestibility. Forage. Laboratory experiments.

The chemical compositions of leaf blade samples from 9 cassava var. were examined to determine whether factors other than cyanogenic glycosides influence the nutritional value of cassava forage. The neutral-detergent fibre (NDF) contained condensed tannins (CT) and high levels of CP (mean 24.1%). The amount of CP in the NDF that was insoluble when treated with pepsin or protease was highly correlated with the amount of CT in NDF. The NDF, pepsin-insoluble and protease-insoluble NDF and CT values were lower in 3 greenhouse-grown var. (Llanera, Fowl Fat, and Foestua) than in 6 var. (Pana, Ceiba, 899, 900, 901, and 903) from 2 localities in Puerto Rico, the Isabela and Corozal substations. All var. apparently had values exceeding those of temperate forage species. *(Summary by Nutrition Abstracts and Reviews)* H03 C03

0076

17586 BOTTALICO, A.; LERARIO, P.; FRISULLO, S. 1980. **Presenza di aflatossine, di zearalenone e di ceppi di *Aspergilli* produttori di aflatossine in campioni di farina di manioca.** *(Occurrence of aflatoxins, zearalenone, and aflatoxigenic strains of Aspergillus in samples of cassava meal).* Zootecnia e Nutrizione Animale 6(3): 209-214. Ital., Sum. Ital., Engl., 35 Refs.

Cassava. Cassava meal. Toxicity. *Aspergillus.* Aflatoxins.

Samples of CM imported into Italy for animal feed were examined for aflatoxins, zearalenone, and aflatoxigenic strains of *Aspergillus.* Low concn. of aflatoxin B_1 (0.7 μg/kg) and zearalenone (90 μg/kg) were found in samples from a 13,650 kg stock of CM, imported from Indonesia. In a previous investigation on samples of CM imported from Thailand, one sample was found contaminated by aflatoxin B_1 (9 μg/kg) and by high levels of zearalenone (3 mg/kg); another sample contained aflatoxin B_1 (2 μg/kg) and aflatoxin G_1 (2 μg/kg). In all samples examined strains of *Aspergillus flavus* group were present, a few of which, when cultured, were able to produce large amounts of aflatoxin B_1 (25-200 mg/kg) and aflatoxin B_2 (0.7-10 mg/kg). These 1st findings suggest the need of great caution in using CM for feed, and stress the urgency for adequate control measures for imported products. *(Author's summary)* H03

0077

18138 ARAUJO, E.C. DE; LANGUIDEY, P.H. 1982. **Composição química, consumo voluntário e digestibilidade aparente de fenos da rama da mandioca.** *(Chemical composition, voluntary intake, and apparent digestibility of cassava hay).* Pesquisa Agropecuária Brasileira 17(11):1679-1684. Port., Sum. Port., Engl., 17 Refs.

Cassava. Forage. Sheep. Digestibility. Drying. Composition. Dietary value. Animal nutrition.

An expt. was conducted with 2-yr old castrated wethers weighing 42 kg to evaluate the chemical composition, apparent digestibility, and voluntary intake of cassava hay using the conventional method of feces collection in a completely randomized design with 6 replicates. Hay was made from the upper third part of cassava var. Caravela plants, obtained from a 10-12 mo. old planting. Two processes were used: natural dehydration in sunlit areas and artificial dehydration in industrial furnaces using firewood. Chemical analyses and digestibility coefficients were: CP, 22.21 (57.09) and 23.12 (36.81); crude fiber, 24.89 (30.92) and 27.35 (33.70); ether extract, 7.36 (38.41) and 6.83 (43.87); N-free extract, 36.22 (48.52) and 32.88 (51.94); and DM, 88.34 (42.60) and 87.96 (41.03), giving TDN values of 43.12 and 41.54 for the 1st and 2nd process, resp., on a DM basis. There were significant differences between the digestibility coefficients of CP ($P < 0.01$), the digestible protein ($P < 0.01$), and the digestible fiber ($P < 0.05$). The voluntary intakes of DM, CP, and TDN (g/kg $W^{0.75}$) for the 1st and 2nd process, were 69.95 and 78.33, 15.82 and 18.47, and 30.14 and 32.74, resp. *(Author's summary)* H03

See also 0045 0084 0091

H04 HCN Toxicity and Detoxification

0078

16299 COOKE, R.D.; COURSEY, D.G. 1981. **Cassava: a major cyanide-containing food crop.** *In* Vennesland, B.; Conn, E.E.; Knowles, C.J.; Westley, J.; Wissing, F., eds. Cyanide in biology. London, Academic Press. pp.93-114. Engl., 79 Refs., Illus.

Cassava. Cyanides. Analysis. Cyanogenic glycosides. Enzymes. Biochemistry. Toxicity.

Aspects regarding cassava cyanide toxicity are reviewed and discussed. The nature and extent of cyanide toxicity of cassava are described and the limitations of current assay methods are discussed. Problems involved in sampling, especially the distribution of cyanide within cassava roots and the inter-root variation in cyanide content, are discussed. Breeding schemes to reduce cassava toxicity are briefly described. Finally, the effects of processing (dehydration, soaking, and boiling) on the cyanide content of cassava are explained. *(Summary by EDITEC. Trans. by L.M.F.)* H04 C03

0079

16298 NARTEY, F. 1981. **Cyanogenesis in tropical feeds and foostuffs.** *In* Vennesland, B.; Conn, E.E.; Knowles, C.J.; Westley, J.; Wissing, F., eds. Cyanide in biology. London, Academic Press. pp.115-132. Engl., 45 Refs., Illus.

Cassava. Cassava products. Cyanides. Fermentation. Biochemistry. Cyanogenesis. Toxicity.

The chemical origin of HCN in tropical crops, with special reference to cassava, is reviewed and discussed. Although the synthesis and accumulation of cyanogenic materials in cassava tissue is genetically controlled, factors such as soil, humidity, rainfall, and season have great influence along with intrinsic factors such as valine and isoleucine levels, the activities of synthetic as well as hydrolytic enzymes, transport, storage, and degradation of these materials. Cyanogenesis in cassava varies with plant age and among clones and cv. Considerable variations have been found at different times during the day. All parts of the cassava plant are capable of synthesizing cyanogens. The bacteria involved in the fermentation of cassava roots during gari production and their biochemical relationship with HCN content are discussed; special reference is given to *Pseudomonas* spp. Finally, the diseases caused by cyanogenesis in cassava are discussed, especially endemic goitre, depletion of the sulphane pool of the body, vitamin B_{12} deficiency, cretinism and mental retardation, ataxic neuropathy, and in the worst cases, death. *(Summary by EDITEC. Trans. by L.M.F.)* H04

I00 PROCESSING, PRODUCTS AND USES

I01 Cassava Starch and its Properties

0080
17584 CHIU, C.W.; RUTENBERG, M.W. 1980. **Cold-water dispersible, gelling starch.** United States Patent 4,229,489. 8p. Engl., Sum. Engl.

Cassava. Cassava starch. Patents. Uses. Modified starches.

A cold-water dispersible, modified starch characterized by forming a gel having a Bloom strength of at least 50 g in prepared by reacting a cassava starch with a crosslinking agent to within defined Brabender viscosity limits; converting the crosslinked starch in a sufficient amount to provide the modified starch with gelling properties; and drum drying the cross-linked and converted starch to obtain the modified starch product. The gelling instant starch thus prepared is particularly useful in food systems of the type which gel upon standing, such as pie filling, jellies, and puddings. *(Author's summary)* I01

See also 0019 0084

I02 Uses, Industrialization, Processing and Storage

0081

16295 MILFONT JUNIOR, W.N. 1978. **Balanço energético da produção de álcool de mandioca.** *(Energy balance of cassava alcohol production).* Fortaleza-CA, Universidade Federal do Ceará. 13p. Port., 5 Refs., Illus.

Paper presented at Painel sobre Produção e Utilização de Energia de Biomassa, no Centro Nacional de Pesquisa de Mandioca e Fruticultura-CNPMF/EMBRAPA, Cruz das Almas-BA, 1978.

Cassava. Uses. Alcohol. Industrialization. Brazil.

The Centro de Tecnología Promon (CTP) studied the feasibility of a cassava alcohol distillery with a capacity of 150 m^3/day that uses traditional processing concepts and the technology and equipment available in Brazil. Some variations of a typical distillery are discussed and compared with an autonomous sugar cane alcohol distillery. The importance of energy analysis is highlighted and its limitations explained. The net energy ratio (NER), defined as the ratio between the energy content of outputs and the energy content of inputs, is affected by system limitations, criteria of energy equivalence, efficiency of industrial, agricultural, and transportation activities, and the type of external source. In this case only the energy flux of economical value was considered. A NER value of 8.7 was obtained for a distillery that used firewood and electricity in its system. This value indicated a positive gain in energy investment, comparable to the system using sugar cane. It is necessary to design distilleries with a lower energy use, using fuel sources already in the system (cassava branches), and generating electricity within the system, taking into account the economic balance of the agroindustrial activity. *(Summary by I.B. Trans. by L.M.F.)* I02

0082

16676 MILFONT JUNIOR, W.; PINHO, S.G. DE 1978. **Alcool direto de cana e mandioca: problemas e oportunidades no contexto do PROALCOOL.** *(Alcohol from sugar cane and from cassava: problems and opportunities regarding PROALCOOL.). In* Seminario sobre Energia de Biomassas no Nordeste, 1o., Fortaleza, Ceará, 1978. Anais. Fortaleza, Universidade Federal do Ceará. pp.330-373. Port., 10 Refs., Illus.

Cassava. Uses. Alcohol. Industrialization. Cassava programs. Costs. Prices. Brazil.

The problems as well as the advantages of producing alcohol from sugar cane and from cassava as an independent industrial activity are given. The Brazilian alcohol market is discussed along with technical aspects of the production process and the energy balance of the process or energetic profitability (EP) of both raw materials, and economical and managerial aspects. Autonomous distilleries fulfill PROALCOOL's strategic objectives of economic and social profit. Likewise, they have a multiplying effect on farm activities and represent a challenge to national planning and training. Regarding cassava this is an opportunity to

technically improve agricultural and industrial operations. Aspects related to environment protection and use of renewable resources are emphasized. *(Summary by I.B. Trans. by L.M. F.)* I02 J00

0083

11754 PORTO, M.C.M. 1977. **Aspectos agroeconômicos da cultura da mandioca para produção de álcool.** *(Agroeconomic aspects of cassava cultivation for alcohol production).* Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. 14p. Port., 11 Refs., Illus.

Cassava. Uses. Alcohol. Cultivation. Cassava programs. Brazil.

The background and agroeconomic perspectives of cassava alcohol production in Brazil are given based on the current dependence on imported petroleum and the need to find new internal sources of fuel. The advantages of ethyl alcohol are included along with Brazil's perspectives of engaging in large-scale ethanol production. Basic criteria for the establishment of new distilleries, perspectives of alcohol commercialization, long-term capacity and projects, and raw materials are discussed. The objectives of the Centro Nacional de Pesquisa de Mandioca e Fruticultura regarding research on cassava are indicated; these pretend to attain a rational research on the crop. *(Summary by I.B. Trans. by L.M.F.)* I02 J00

0084

11574 PIZZINATTO, A.; VITTI, P.; LEITÃO, R.F.F. 1979. **Comportamento de cinco cultivares de mandioca (*Manihot esculenta* Crantz) procedentes da região de Macapá na produção de pellets.** *(Pellet production of five cassava cultivars from the Macapá region). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária, Departamento de Informação e Documentação. pp.447-458. Port., Sum. Port., Engl., 8 Refs.

Cassava. Cultivars. Uses. Pellets. Analysis. Water content. Ash content. Starch content. Cassava starch.

Five cassava cv. (Ouro do Vale, Milagrosa, Branca, Olho Verde, Mameluca) from the Macapá region, Brazil, were tested for pellet processing. Data resulting from chemical and physical analyses of pellets and chips (raw material) of the cv. were practically the same, indicating that a close relationship exists between the raw material used and the pellets obtained. The pelletizing process did not affect the starch granule structure since the pellets and chips of the different cv. showed similar viscographic characteristics, nor did pellets from different cv. have significant differences among themselves. However, cv. Mameluca was slightly superior to the others regarding density and resistance to breaking. Pellet fiber content was a limiting factor, 2 cv., Milagrosa and Olho Verde, had fiber contents that do not correspond to the specifications established by the FFC. Regarding other FCC specifications, all cv. presented satisfactory values. *(Author's summary)* I02 I01 H03

0085

16212 SINICIO, R.; ROA, G. 1980. **Secador rural de café, cacau, mandioca e outros produtos agropecuários com uso de energia solar.** *(Farm drier for coffee, cacao, cassava, and other farm products using solar energy).* Viçosa-MG, Centro Nacional de Treinamento em Armazenagem. Série CENTREINAR no. 1. 22p. Port., 7 Refs., Illus.

Cassava. Cassava chips. Solar drying. Small-scale equipment. Costs. Brazil.

A drying bin that uses solar energy is described: this drier is the result of 5 yr of research. Tables and technical details of the system which consists of a bin, a fan, and a solar col-

lector are included. The system of operation with coffee, cacao, and cassava is explained. Washing-peeling, chip cutting, and the drying unit of cassava processing are described. The final product has 12-13% MC. The drier can also be used to simultaneously dry several products. *(Summary by I.B. Trans. by L.M.F.)* 102

0086

11681 OSPINA, J.E.; ROCHA, J.L.V. 1979. **Comparação de três formas de mandioca secadas em barcaça solar.** *(Comparison of three forms of drying cassava in solar bins). In* Congresso Brasileiro de Mandioca. 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.483-497. Port., Sum. Port., Engl., 9 Refs., Illus.

Cassava. Cassava chips. Solar drying. Temperature. Water content. Brazil.

The processing of cassava chips was studied using roots recently harvested cut in 3 different ways: in cubes, round or rectangular slices. These were dried in bins in the sun at 32°C and 43% RH. After 36 h of sun drying, the product contained approx. 10% MC and showed good quality characteristics. Cassava cut in cubes was more efficient. It is recommended that the 1st 10 h after drying the chips should have a MC < 50% to prevent deterioration, and abrupt changes in temp. should be avoided during the process of drying in solar bins. *(Author's summary)* 102

0087

17563 SAWADA, I.M.N. 1979. **Contribuição ao estudo da obtenção de etanol a partir de mandioca por fermentação contínua.** *(Study on ethanol production from cassava by continuous fermentation).* Tese Doutorado. Campinas, Universidade Estadual de Campinas. Faculdade de Engenharia de Alimentos e Agrícola. 130p. Port., Sum. Port., Engl., 86 Refs., Illus.

Cassava. Ethanol. Fermentation. Enzymes. Industrial microbiology.

The production of ethanol by a continuous fermentation process, using CM as raw material, was studied. During the 1st stage, 2 methods of starch saccharification were studied: utilization of commercial enzymes and utilization of enzymes produced by a continuous culture of *Aspergillus usamii* var. *shirousamii.* Expt. on alcohol fermentation were carried out with *Saccharomyces cerevisiae* Hakken-1. The parameters of the enzymatic reaction and the kinetics of microorganism growth, enzyme and ethanol production were obtained with lab.-scale expt. on enzymatic hydrolysis of starch and continuous fermentation. The use of cassava as raw material for ethanol production through a continuous starch hydrolysis, using commercial enzymes or continuous culture of fungus, proved to be technologically feasible. An overall analysis of the process (including economy) showed that the use of commercial enzymes was promising *(Author's summary)* 102

0088

11762 FERREIRA, V.M. 1979. **Alcool etílico a partir de mandioca, produtos e subprodutos: a usina de alcool da PETROBRAS.** *(Ethanol from cassava, products and by-products: the PETROBRAS alcohol factory). In* Congresso Brasileiro de Mandioca. 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.171-180. Port.

Cassava. Cassava starch. Uses. Ethanol. Factories. Development. Economics. Brazil.

Several considerations on the use of cassava starch for the production of ethanol are given along with notes on the establishment of an alcohol factory by PETROBRAS in Curvelo, MG, Brazil, as part of a project developed by the Instituto Nacional de Tecnologia (INT). To establish this factory, the recommendations and results of trials carried out at pilot and

semi-industrial factories were taken into account. Data and information were obtained at the INT, Instituto de Tecnologia de Alimentos (Campinas, SP), Centro de Tecnologia do PROMON, and from the experience acquired at the Destilería de Santa María in Lençois Paulista, SP. The major purpose of the factory would be to investigate technological development, analyzing not only the feasibility and the reliability of the process undertaken by the INT, but also establish the conditions that determine the major parameters that may affect the profitability of the process (yield, indirect and direct costs, in particular- the difficulties in production and handling of great amounts of raw material). *(Summary by EMBRAPA. Trans. by L.M.F.)* 102

0089

18120 WARSA, S.R. 1980. **Properties of wood adhesives extended with sweet potato and cassava flours in kalumpit (*Terminalia microcarpa* Decne) plywood.** Mag. Sc. Thesis. Los Baños, University of the Philippines at Los Baños. 68p. Engl., Sum. Engl., 52 Refs., Illus.

Cassava. Cassava starch. Uses. Industrial starches. Adhesives.

Sweet potato and CF were tried as extenders for urea and phenol formaldehyde adhesives. Properties of the adhesives were compared with those extended with wheat flour, a common extender in synthetic resin adhesives used to reduce its glueline costs. Kalumpit (*Terminalia microcarpa*), a lesser known species, was used as the substrate. A 3 x 5 factorial expt. in completely randomized design with 5 replicates was employed. The factors were type of extender and level of extender. The type of extender had 3 levels: sweet potato, cassava, and wheat flours. The extender had 5 levels namely 10, 20, 30, 40, and 50% of resin solid of neat adhesive. Urea formaldehyde adhesive extended with sweet potato flour developed good gluebond quality. The quality, however, was lower than that extended with either cassava or wheat flour. Extension can be done up to either 30% sweet potato or 20% CF by which a depression of gluebond quality will be relatively small. Phenol formaldehyde adhesive extended with sweet potato flour produced plywood with good bond quality. The value was higher than that extended with CF, and was lower than that extended with wheat flour. The proposed levels of extension are 40% and 30% for sweet potato and cassava flour, resp. Plywood glued with either urea or phenolic resin complied with the gluebond requirements of PHILSA Standard Specification for Plywood for interior and exterior types of bond. Most dry specimens were broken in tension, particularly those glued by phenolic resin, which used longer pressing time. *(Author's summary)* 102

See also 0023 0045 0073 0100 0101

I03 Industrial Microbiology

0090

17590 CARRIZALEZ, V.; RODRIGUEZ, H.; SARDINA, I. 1981. **Determination of the specific growth of molds on semi-solid cultures.** Biotechnology and Bioengineering 23(2):321-333. Engl., Sum. Engl., 23 Refs., Illus.

Cassava. Industrial microbiology. Cassava flour. Fermentation. *Aspergillus.* Moulds. Analysis. Culture media.

The determination of growth constants of *Aspergillus niger* were obtained for semisolid cultures on CF as a sole C source. As a consequence, a technique was developed that consisted of the use of a packed-bed microfermentor with a working vol. of 16 cm^3. The bed consisted of gelatinized and granulated CF containing mineral nutrients and mold spores. The CO_2 produced during the respiration was drawn off with a current of air and then absorbed in a solution of sodium hydroxide. The absorption of CO_2, P, was correlated with the specific growth rate μ by means of the equation $P = Ke^{\mu t}$, where t is time and K is a constant. Ammonium nitrogen was used as a limiting substrate and its concn. was varied from 0.039-2.5% in dry base. The max. growth rate, μ_{max}, and the saturation constant, Ks, were 0.31/h and 0.065 mmol $(NH_4)_2SO_4$/g total dry solids. Substrate inhibition was presented and the constant k_i gave a value of 1.5 mmol $(NH_4)_2SO_4$/g total dry solids. The proposed method is highly recommended for the evaluation of the semisolid fermentation of molds and for strictly aerobic bacteria and yeasts. It can be used especially in the evaluation of the growth of microorganisms on peanut shells, coffee residues, sugar cane bagasse, and other agricultural wastes. *(Author's summary)* 103

0091

18118 OBUEKWE, C.O. 1977. **Chicken manure and cellulose as substrates for thermotolerant fungi selected for protein production from cassava.** Mag. Sc. Thesis. Ontario, University of Guelph. 192p. Engl., Sum. Engl., 214 Refs., Illus.

Cassava. Industrial microbiology. Protein enrichment. Biomass production. Proteins. Cassava starch. Uses. Dung. Cellulose. Analysis. N. Culture media.

Five microfungi (*Aspergillus fumigatus* 1-21A, *Cephalosporium eichhorniae* 152, *Rhizopus chinensis* 180, *Mucor* sp. 193 and the control *Sporotrichum thermophile* M211) were evaluated for SCP production from cassava mash, using chicken manure as the N source. *R. chinensis* 180 proved to be the best-suited organism and was chosen for scale-up of the biomass production in the process developed. A high aeration rate of 3 *l* of air/*l* of culture/min was necessary before ample growth and biomass production by *R. chinensis* 180 was possible. The highest protein yield/g carbohydrate supplied was obtained at a carbohydrate concn. of 2% and at a manure N concn. of 1.6 g/*l* medium. A max. true protein yield of 0.27 g/g carbohydrate supplied and a protein concn. of 15% were obtained. Stabilization of the pH of the culture at 3.5 during biomass production was not possible when manure alone,

or in combination with $(NH_4)_2SO_4$, was used unless external pH control was employed. The low pH, high temp. production process employed was not self-sterilizing and only about 50% mortality was registered in 42 h with the spore-forming bacterium, *Bacillus subtilis*, inserted into the fermenter jar during biomass production by *R. chinensis* 180. However, *Escherichia coli* was completely destroyed within 36 h under these same conditions employed. Feeding of the biomass of *R. chinensis* 180, grown on cassava-manure medium, to male weanling rats was lethal to the animals. However, extensive analyses for mycotoxins and other possible toxic substances did not incriminate any of these as the cause of death. Of the five microfungi used in the project, *C. eichhorniae* 152 and *A. fumigatus* 1-21A were most cellulolytic. The cellulolytic activities of the culture filtrates of *C. eichhorniae* 152 and *A. fumigatus* 1-21A were higher than that of *S. thermophile* M211, a culture known to be highly cellulolytic. Because of the greater cellulolytic activity and culture stability of *A. fumigatus* 1-21A, it was selected for 5 *l* trial runs for SCP production from α-cellulose. A final product (retentate) of 20% true protein content could be obtained with *A. fumigatus* 1-21A grown on NaOH-treated α-cellulose within 48 h of incubation. The decided advantage of the use of *A. fumigatus* 1-21A for SCP production from cellulose was the high rate of growth on this substrate. *(Author's summary)* 103 H03

J00 ECONOMICS AND DEVELOPMENT

0092

17175 FEDERACION NACIONAL DE CAFETEROS DE COLOMBIA. PROGRAMA DE DESARROLLO Y DIVERSIFICACION DE ZONAS CAFETERAS. 1978. Yuca Chirosa. *(Cassava variety Chirosa). In* —— . Productos agrícolas perecederos; bases de análisis, proyecciones para 1978. Bogotá. Series de precios no. 6. pp.38-40. Span., Illus.

Cassava. Prices. Statistical data. Colombia.

Tables and graphics are given that include the market prices of cassava var. Chirosa in Bogotá, Cali, and Medellín (Colombia) for 1977. Annual and monthly wholesale prices (kg) at these 3 markets are included [index basis: 1972 av. (or 1975) = 100] along with seasonal variations (based on price records) in market places in Cali, price of kg of cassava var. Llanera in Bogotá (monthly and annual means). *(Summary by I.B. Trans. by L.M.F.)* J00

0093

15786 OBORDO, R.A. 1980. Technology of cassava production. *In* Seminar Workshop on Rootcrops as Energy Sources, Los Baños, Laguna, 1980. Proceedings. Los Baños, Laguna, Philippine Council for Agriculture and Resources Research. pp.25-32. Engl., 13 Refs.

Cassava. Production. Uses.

The potentials of cassava to produce abundant carbohydrates/ha at min. inputs are revised to partially meet the needs of national policy planners and international agricultural programs administrators. The principal current uses of cassava and its yields on fertile, moderately fertile, and acid infertile soils are included. Technology generation should be based on the kind of product desired and vol. of demand. *(Summary by I.B. Trans. by L.M. F.)* J00

0094

16194 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1981. Cereals, cassava and livestock products: cassava. *In* —— FAO Commodity Review and Outlook 1980-1981. Rome, FAO Economic and Social Development Series no. 20. pp.51-54. Engl., Illus.

Cassava. Cassava products. Production. Statistical data. Marketing.

Data on world cassava production, trade, and prices are given for 1980-81 and forecasts are included for 1981-82. As a result of the larger exports from Thailand and China, exports increased by over 10% and export earnings by 12%, with a world cassava production more than 3% above that of 1979. World output is estimated to rise 3-4% (approx. 125 million t) in 1981 given normal weather in the main producing areas and expected recovery in

Thailand from the drought-reduced production levels. In L.A. the area planted to cassava tends to remain static. The increase in exports will depend on the commercial policies of the EEC, Thailand, and USSR. *(Summary by I.B. Trans. by L.M.F.)* J00

0095

10989 GROYCO, M. 1979. **A cultura da mandioca no Paraná.** *(Cassava cultivation in the state of Paraná). In* Congresso Brasileiro de Mandioca, 1o., Cruz das Almas-BA, 1979. Anais. Bahia, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Departamento de Informação e Documentação. pp.189-208. Port., Sum. Engl., 3 Refs.

Cassava. Production. Cultivation. Brazil.

Areas where cassava is cultivated in the state of Parana, Brazil, production estimates,comparisons with other Brazilian states, alternative land utilization, traditional cultivation methods, and use of machinery to increase yield are discussed. *(Summary by Field Crop Abstracts)* J00 D00

0096

16603 LIMSKUL, K. 1979. **Comparative advantage of the agricultural sector in Thailand: a study of domestic resource cost for rice, maize, cassava, and sugar.** M. Econ. Thesis. Bangkok, Thailand, Thammasat University. Faculty of Economics. 187p. Engl., 28 Refs., Illus.

Cassava. Trade. Costs. Income. Prices. Consumption. Statistical data. Developmental research. Processing. Cultivation. Socio-economic aspects. Thailand.

The comparative advantage of producing rice, maize, cassava, and sugar was determined using the domestic resource cost coefficient (DRC) and the estimation of private and social profitability of each one in Thailand by establishing comparisons among different regions of the same country and among countries. The production of cassava in Thailand for the 3 representative areas selected for the study (Nakhon Ratchasima, Ratchburi, and Chon Buri) were profitable both from the private and the social points of view. Tax structure is not a disincentive to cassava production, although differences exist from one region to another. DRC coefficients (0.67, 0.84, and 0.88 for Nakhon Ratchasima, Ratchburi, and Chon Buri, resp.) indicate that the most efficient area is Nakhon Ratchasima. When crops were compared in 4 zones (Ratchburi, Nakhon Ratchasima, Suphan Buri, and Nakhon Pathom) considering the DRC, rice ranked the highest followed by cassava, sugar, and maize in terms of comparative advantages in production. Three hypotheses were tested: I. The DRC of the 4 crops are different. II. Rice production has comparative advantage in Thailand. III. The diversification scheme in Thailand directs resource allocation in an efficient way. The 1st 2 hypotheses were accepted, based on the results of analysis, but Hypotheses III was rejected. In general, cassava production in Thailand is sensitive to changes in yield, and processing, transportation, marketing, and labor costs according to sensitivity analysis. The analysis of the DRC shows that the central region of Thailand has a comparative advantage in producing rice and the NE region, cassava. In general, the 4 crops are socially profitable if the critical min. world price for each crop is analyzed. Further studies that should be conducted are listed. *(Summary by EDITEC. Trans. by L.M.F.)* J00

0097

16607 TINPRAPHA, C. 1979. **Employment and agricultural products in Thailand: a case study of rice, maize, cassava and sugar cane.** M. Econ. Thesis. Bangkok, Thailand, Thammasat University. Faculty of Economics. 102p. Engl., Sum. Engl., 14 Refs.

Cassava. Cultivation. Costs. Labour. Income. Developmental research. Economics. Statistical data. Thailand.

The intensities of production factors in the cultivation of rice, maize, cassava, and sugar cane were estimated, emphasizing labor inputs at each stage of production in order to examine the predominant factors that may affect the farmer's choice of techniques. The effects of modern technology on employment opportunities and income distribution in response to the system of incentives established by the Thai government are determined. Cost components were divided into 4 factors namely labor, capital, land, and entrepreneur (residual income) which were determined for each crop in different regions (for cassava the regions of Chalburi, Katburi, and Nakornrajsima). Factor shares of labor, capital, and land in cassava production costs for the resp. sites were 0.339, 0.532, and 0.129 at the 1st; 0.424, 0.478, and 0.098 at the 2nd; and 0.340, 0.263, and 0.397 at the 3rd. Factor shares of labor, capital, land, and residual income in farm output were 0.307, 0.482, 0.116, and 0.09; at the 1st; 0.306, 0.345, 0.071, and 0.278 at the 2nd; and 0.190, 0.147, 0.222, and 0.441 at the 3rd, resp. Labor requirements (man-day and Baht) are analyzed for each crop for the stages of preparation, planting, cultural practices, and harvesting. In cassava relative labor inputs are highest during harvesting. On the basis of the domestic resource cost coefficient the comparative advantage of production of the 4 crops is, in descending order, rice, cassava, sugar cane, and maize. *(Summary by EDITEC. Trans. by L.M.F.)* J00 D00

0098

16610 PONGPOJKASI M, J. 1979. **The effectiveness of agricultural incentives in Thailand: a case study of rice, maize, cassava and sugar.** M. Econ. Thesis. Bangkok, Thailand, Thammasat University, Faculty of Economics. 147p. Engl., 55 Refs., Illus.

Cassava. Cassava programs. Prices. Socio-economic aspects. Costs. Trade. Developmental research. Fertilizers. Thailand.

The agricultural incentives used in Thailand in the 1970's are analyzed and the effect of these on the prices of rice, maize, cassava, and sugar are evaluated. Regarding price incentives for cassava, up to the present only export quotas have been imposed without any special export tax. Neither has cassava received governmental intervention regarding price control and support. Other incentives not directly related to prices are analyzed in general, especially, policies on fertilizers, agricultural credit, irrigation systems in the country, road construction, and land tenancy. Private return and social return of production are compared for these crops. Non-price incentives are difficult to quantify, thus, price incentives are used to estimate nominal and effective protection coefficients. Recommendations include the establishment of a fertilizer subsidization policy, the development of a more flexible law governing agricultural credit and subsidized low cost credit means, the restructure of current farmer organizations, modernization of infrastructure (transportation, energy, and water services), and the extension of irrigation facilities by introducing new agricultural technology into the area covered and with the aforementioned incentives. *(Summary by EDITEC. Trans. by L.M.F.)* J00

0099

16611 LOKAPHADHANA, T.; WELSCH, D.E. 1982. **Net social profitability and domestic resource cost of eight agricultural commodities in Thailand.** St. Paul, Minnesota, University of Minnesota. Institute of Agriculture, Forestry and Home Economics. Staff Papers Series P82-11. 62p. Engl., 25 Refs., Illus.

Cassava. Production. Trade. Statistical data. Socio-economic aspects. Costs. Developmental research. Thailand.

The economic efficiency and the real cost of earning foreign exchange through producing and exporting 8 selected agricultural commodities (rice, sugar cane, maize, cassava, kenaf, mung beans, groundnuts, and soybeans) were measured in 19 agroeconomic zones of Thailand using the concepts of social profitability and domestic resource cost. The interaction between economic efficiency and government intervention in the external trade of these commodities was also examined. A presentation of the theoretical considerations on

which the analysis is based is given. Exchange rate policies and government intervention in the external trade of the products are briefly discussed. The export of cassava pellets to the European Economic Community (EEC) has been implicitly subsidized by import taxes since cassava imports are cheaper per unit of energy than other animal feed grains in the EEC market. The Thai government and the EEC are currently trying to find means to reduce the quantity of cassava products supplied to the EEC. Two means suggested include imposing an export quota on cassava products and inducing Thai farmers to shift from cassava to other crops. Based on the analysis made, it was found to be socially profitable to produce cassava roots in 13 out of 14 cassava producing zones in the country. Compared with the other crops, cassava is the most efficient crop in the agroeconomic zones 1, 2, 3, and 5 in the NE, since their domestic resource costs are the lowest; in the north, it is the most efficient in zones 6 and 8, and along with rice in zone 10; and in the central region, cassava production is most efficient in zones 12, 15, and 16. The sensitivity of the domestic resource cost to changes in one variable (land, labor, capital, or yield), maintaining all other variables constant, was measured. The elasticity of the domestic resource cost with respect to yield was negative and highly significant for all crops (av. -1.0195 for cassava) indicating a high degree of sensitivity. The domestic resource costs for all products are more sensitive to changes in labor and land costs than to capital costs (av. 3.190 and 2.157 compared with 18.447, resp. , for cassava). Efforts should be made to try to negotiate with the EEC and maintain this market. It is also recommended that exporters look for new markets. Intervention in prices and markets should be avoided. An efficient tax system less detrimental to production and exports should be adopted. *(Summary by EDITEC. Trans. by L.M.F.)* J00

0100

16672 TITAPIWATANAKUN, B. 1981. **Regional co-operative activities in tapioca products.** United Nations, New York, United Nations Development Programme. Economic and Social Commission for Asia and the Pacific Project Ras/79/010. 38p. Engl., Illus.

Cassava. Cassava products. Trade. Consumption. Marketing. Processing. Cassava programs. Developmental research. Statistical data. Economics. Asia.

The activities that may be pursued under regional cooperative arrangements for products derived from cassava in the region under ESCAP (Economic and Social Commission for Asia and the Pacific) including Malaysia, India, Indonesia, Philippines, Sri Lanka, and Thailand are analyzed in detail. The proposed activities are classified into 3 groups that include objectives, background, and plan of work for each one of these: (A) **Studies and research on important areas:** A1. Market study on nongrain feed for animal feed in the European Economic Community (EEC); A2. Study on transportation and shipping problems faced by cassava products industry; A3. Analysis of the short- and long-term demand and supply prospects; and A4. Study on possible expansion in the end uses of cassava products. (B) **Technical and economical cooperation:** B1. Preparation of proposals for improvement in quality standards and control measures in producing/exporting countries; B2. Collection and dissemination of statistics and other information; and B3. Development of market information service. (C) **Issues requiring continuing efforts and consultations:** C1. Coordination of research and development in the production, processing, and marketing of cassava products and by-products; and C2. Promotion of inter- and intra-regional trade. Success depends on the cooperation of the trade associations among the countries concerned, and especially, the private sector. *(Summary by EDITEC. Trans. by L.M.F.)* J00 102

0101

17515 KOIDE, S.; BROOKS, R.B.; VICHARANGSAN, T. 1982. **Regional study on production of fuel ethanol from agro-products.** United Nations, Economic and Social Commission for Asia and the Pacific. 100p. Engl., Sum. Engl., 103 Refs., Illus.

Cassava. Uses. Ethanol. Developmental research. Costs. Economics. India. Indonesia. Philippines. Sri Lanka. Thailand. Australia.

A regional study was conducted in some countries of the Economic and Social Commission for Asia and the Pacific - ESCAP (Australia, India, Indonesia, the Philippines, Sri Lanka, and Thailand) on the production of fuel ethanol from agro-products in order to provide recommendations for energy policies and programs of each country. The most promising energy crops were identified, the process technology for converting agro-products into liquid energy was assessed, the economic costs and benefits were estimated, and suitable institutional mechanisms for a harmonious development in each country were proposed. The global situation of the countries regarding their energy situation and the development of their resp. ethanol programs are analyzed. Common issues concerning ethanol programs in the region are studied such as crop production for use as food or for energy, available technology, pollution, and rural development. The applications of ethanol as fuel extender (alcohol-gasoline blending, alcohol-diesel fuel blending, and duel-fuel systems) and as straight fuel (for spark-ignition engines and diesel engines) are discussed. Economic aspects of the production of ethanol in the countries are analyzed. In the countries visited molasses has so far been used as the source for commercial ethanol production, with sugar cane and cassava being used as experimental sources and sweet sorghum and sweet potato as potential sources. Sugar cane or cassava could substitute molasses in the future. Processing technology is similar in all countries and with some modifications is considered adequate. Prices of ethanol currently can not compete with those of gasoline at refineries but it can compete with pump prices. The trade balance of a country would benefit from producing ethanol fuel to substitute gasoline but only if there is no market for the agricultural sources used in the country. Methanol can be produced at a lower cost than ethanol. Reviews are included for each country along with specific recommendations for each one. *(Summary by EDITEC. Trans. by L.M.F.)* J00 102

0102

18146 COCK, J.H. 1982. **Cassava: a basic energy source in the tropics.** Science 218(4574):755-762. Engl., Sum. Engl., 52 Refs., Illus.

Cassava. Research. Consumption. Productivity. Plant breeding. Marketing. Uses.

Cassava is the 4th most important source of food energy in the tropics. More than 2/3 of the total production of this crop is used as food for humans, with lesser amounts being used for animal feed and industrial purposes. The ingestion of high levels of cassava has been associated with chronic cyanide toxicity in parts of Africa, but this appears to be related to inadequate processing of the root and poor overall nutrition. Although cassava is not a complete food it is important as a cheap source of calories. The crop has a high yield potential under good conditions, and compared with other crops it excels under suboptimal conditions, thus offering the possibility of using marginal land to increase total agricultural production. Breeding programs that bring together germplasm from different regions coupled with improved agronomic practices can markedly increase yields. The future demand for fresh cassava may depend on improved storage methods. The markets for cassava as a substitute for cereal flours in bakery products and as an energy source in animal feed rations are likely to expand. The use of cassava as a source of ethanol for fuel depends on finding an efficient source of energy for distillation or an improved method of separating ethanol from water. *(Author's summary)* J00

0103

16190 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 1980. **Crops: cassava.** *In* ———. FAO production yearbook 1979. Rome. FAO Statistics Series no. 28, v.33, pp.116-117. Engl., Fr., Span.

Cassava. Production. Statistical data.

World statistics are given on cassava production, area harvested, and yield/ha, by country and by regions, for the 1977-79 period. *(Summary by J.L.S. Trans. by L.M.F.)* J00

0104

16247 LARRAYA L., P.J.; LIMONTA, J.A.; ROSENFELD, V. 1981. **Estructuras de los costos de producción de los principales cultivos de la Provincia: mandioca.** *(Structure of the production costs of major crops grown in the province of Misiones, Argentina: cassava). In* Manual para la agricultura en la Provincia de Misiones República Argentina. 2. Economía Agraria. Argentina, Federación de Cooperativas Agrícolas de Misiones. Ministerio de Asuntos Agrarios. pp.125, 127, 129, 131, 133, 135. Span.

Cassava. Cultivation. Costs. Mechanization. Argentina.

Tables are given of the costs involved in cassava cultivation (labor, inputs, machinery) for fresh consumption, using nonmechanized and mechanized technology, and for industrial purposes (mechanized technology) in the province of Misiones, Argentina. *(Summary by I.B. Trans. by L.M.F.)* J00 D00

See also 0024 0082

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0105

16549 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1980. **USAID: Zaire's National Manioc Program (PRONAM); cassava.** *In* —— . Annual Report 1979. Ibadan, Nigeria. pp.76-78. Engl., Illus.

Cassava. Planting. Inter-cropping. Groundnut. Leaf area. Productivity. Agronomic characters. Zaire.

In yield trials conducted in 3 major cassava growing regions in Zaire (Bas-Zaire, Bandundu, and Kivu), clone 300704 consistently showed the highest av. yield (20 t/ha) in the Bas-Zaire region, followed by A 56, 30346, and 301792. The consumer acceptance quality was good and clones resistant to major diseases were identified. In cassava/peanut intercropping, increasing peanut population from 50,000 to 100,000 plants/ha did not affect cassava yield; however, this yield was significantly reduced compared with cassava in monoculture. In another trial cassava plants with a tall growth habit and scarce branching had the highest root yield. *(Summary by I.B. Trans. by L.M.F.)* K01 D02 D03

0106

16693 CORREA, H.; ANDRADE, A.M.S.; ROCHA, B.V. DA 1982. **Métodos culturais. Consorciação e culturas intercalares.** *(Cultural practices. Intercropping). In* Projeto mandioca, relatório 76/79. Belo Horizonte, Empresa de Pesquisa Agropecuária de Minas Gerais. pp.117-126. Port.

Cassava. Inter-cropping. Fertilizers. Tuber productivity. Field experiments. Soybean. Beans. Maize. Rice. Groundnut. Sorghum. Planting. Brazil.

Cassava. cv. Riqueza was intercropped with soybeans, beans, maize, rice, and peanuts in double rows (0.50 x 0.60 x 2.0 m) at the Empresa de Pesquisa Agropecuária de Minas Gerais (Felixlândia), at the Escola Superior de Agricultura de Lavras, and at VERAGRO to modify the planting system in order to use sunlight advantageously (border effect). Bean and soybean planting notably affected cassava; cassava plants were affected by peanut proximity due to its profuse canopy. At VERAGRO liming induced lower productivity in intercropped cassava. When cassava cv. Branca de Santa Catarina was intercropped in quintuple rows, neither beans nor crotalaria affected cassava production. Crops of considerable growth, when planted at an appropriate distance, offered more protection to cassava rows. Climatic, disease (bacteriosis), and labor problems were registered. *(Summary by I.B. Trans. by L.M.F.)* K01

See also 0022

LIST OF ABBREVIATIONS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
Afr.	Afrikaans
a.i.	Active ingredient
alt.	Altitude
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
AMV	Alfalfa mosaic virus
approx.	Approximate(ly)
atm.	Atmosphere
ATP	Adenosine 5'-triphosphate
av.	Average
BAP	6-Benzylaminopurine
BEMV	Broad bean mosaic virus
BCMV	Bean common mosaic virus
BGMV	Bean golden mosaic virus
BGYMV	Bean golden yellow mosaic virus
BOD	Biochemical oxygen demand
BPMV	Bean pod mottle virus
BRMV	Bean rugose mosaic virus
BSMV	Bean southern mosaic virus
BV	Biological value
BYMV	Bean yellow mosaic virus
°C	Degrees Celsius (centigrade)
ca.	About (circa)
CBB	Cassava bacterial blight
CBSD	Cassava brown streak disease
CEC	Cation exchange capacity
CER	CO_2 exchange rate
CF	Cassava flour
CGR	Crop growth rate
CLM	Cassava leaf meal
CLV	Cassava latent virus
CM	Cassava meal
cm	Centimeter
COD	Chemical oxygen demand
concd.	Concentrated
concn.	Concentration
CP	Crude protein
CSL	Calcium stearyl lactylate
CSW	Cassava starch wastes
C.V.	Coefficient of variation
cv.	Cultivar(s)
2,4-D	2,4-dichlorophenoxyacetic acid
DM	Dry matter
DNA	Deoxyribonucleic acid
EC	Emulsifiable concentrate
EDTA	Ethylenediaminetetraacetic acid
EEC	European Economic Community
e.g.	For example
ELISA	Enzyme-linked immunosorbent assays
EMS	Ethyl methane sulfonate
Engl.	English
expt.	Experiment
exptl.	Experimental
°F	Degrees Fahrenheit
Fr.	French
ft-ca	Foot candles (10.76 lux)
FYM	Farmyard manure
g	Gram(s)
G	Giga (10^9)
GA	Gibberellic acid
gal	Gallon(s)
GE	Gross energy
Germ.	German
GERs	Glucose entry rates
GLC	Gas-liquid chromatography
govt.	Government
govtl.	Governmental
h	Hour(s)
ha	Hectare(s)
HCN	Hydrocyanic acid
HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
HI	Harvest index
IAA	Indoleacetic acid
IBA	Indolebutyric acid
Illus.	Illustrated
in.	Inches
i.e.	That is
Ital.	Italian
IU	International unit
J	Joule
Jap.	Japanese
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilogram-calorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate
kR	Kiloroentgen(s)
l	Liter(s) (only in combination with no.)
LAD	Leaf area duration
LAI	Leaf area index
lat.	Latitude
lb	Pound(s)
LD_{50}	Mean lethal dose

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

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(*Manihot esculenta* Crantz)

Vol. IX No. 2 August, 1983

Centro Internacional de Agricultura Tropical

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Abstracts on Cassava
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INTRODUCTION

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

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

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

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0012

Keywords

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

Abstract

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

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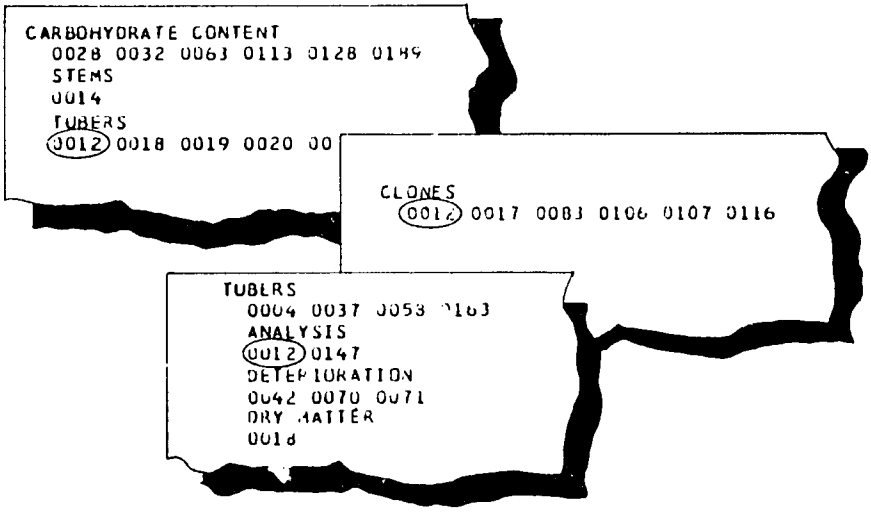

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DOS NUEVOS LIBROS DEL CIAT SOBRE YUCA:

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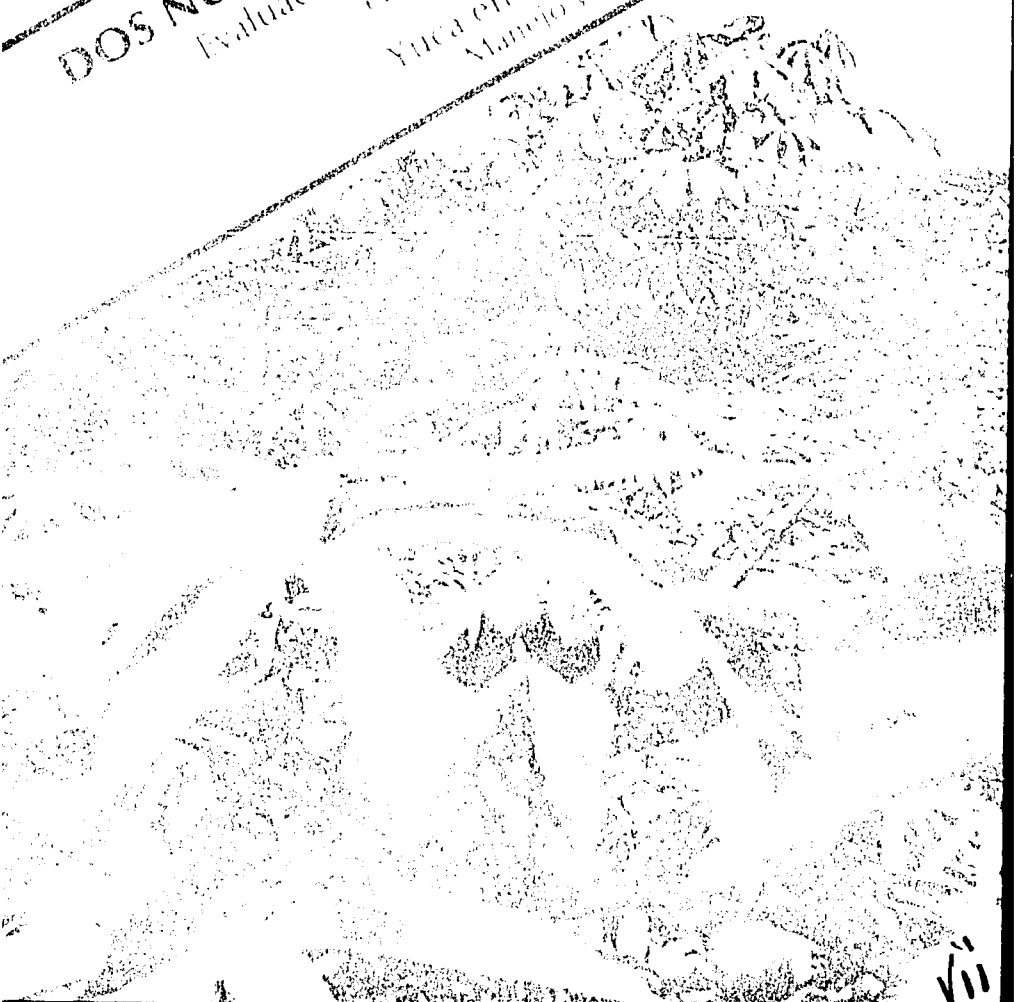
Yuca en cultivos asociados
Manejo y evaluación



EVALUACION DE VARIEDADES PROMISORIAS DE YUCA EN AMERICA LATINA Y EL CARIBE

Memorias de un Taller celebrado en Cali, Colombia, 10-14 Mayo, 1982

Editadas por **Julio César Toro,** Ph.D.

La producción y la productividad del cultivo de la yuca pueden incrementarse sustancialmente si se siembran variedades seleccionadas y se aplica una tecnología mejorada, sencilla y de bajo costo. Tan promisoria alternativa — que esta publicación presenta a los agricultores latinoamericanos— fue discutida y perfeccionada durante una reunión de trabajo en mayo de 1982, por científicos dedicados al estudio de la yuca y por expertos en diversas áreas de ese cultivo, pertenecientes a nueve países de la región.

El libro considera el estado actual del cultivo de la yuca en los principales países productores y evalúa el trabajo realizado por sus respectivos programas nacionales de yuca, especialmente la labor de sus investigadores y de sus técnicos en extensión rural.

El desarrollo del cultivo de esta raíz farinácea —tan importante en la dieta de la población rural y urbana de esta zona del continente— depende de mecanismos eficientes de cooperación internacional y de procedimientos uniformes de evaluación agronómica; necesita resolver sin tardanza los problemas que suscita tanto la certificación de "semilla" asexual de yuca, como el intercambio de materiales promisorios.

La publicación analiza todos esos temas y describe también la estrategia de cooperación del Programa de Yuca del CIAT, acorde no sólo con el grado de progreso alcanzado por cada uno de los países cultivadores, sino con las necesidades reales y con el interés demostrado por éstos.

El editor de la obra, Julio César Toro, agrónomo especializado en yuca en Colombia y Brasil, dirigió durante más de diez años las secciones de Agronomía, Pruebas Regionales y Cooperación Internacional del Programa de Yuca del CIAT. Actualmente es jefe del Programa de Yuca del Instituto Colombiano Agropecuario, ICA.

El Centro Internacional de Investigaciones para el Desarrollo (CIID) Ottawa, Canada, patrocinó la reunión de trabajo y la publicación de esta obra.

CONTENIDO: El cultivo de la yuca en Cuba durante la última década. Desarrollo del Programa de Yuca en la República Dominicana. Investigación sobre adaptación de la yuca en Haití. Avances del Programa de Yuca en México. Programa de Yuca en Paraguay: comienzo y desarrollo. La investigación con yuca en el Sureste y Sur del Brasil. Evaluación y difusión de variedades promisorias de yuca en Perú. Investigación sobre yuca en Ecuador. La investigación sobre el cultivo de la yuca en Colombia. La transferencia de germoplasma y de tecnología mejorada mediante la cooperación internacional. Germoplasma básico y mejorado de yuca disponible en el CIAT y su manejo por los programas nacionales. Distribución internacional de clones de yuca *in vitro*. Conclusiones. Reconocimiento.

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VIII

YUCA EN CULTIVOS ASOCIADOS
MANEJO Y EVALUACION
por **Dietrich Leihner,** Dr.agr.

Este trabajo —condensación de la tesis de doctorado del autor— trata en forma completa y detallada los distintos aspectos involucrados en el cultivo asociado de la yuca —un sistema de producción generalizado en las zonas productoras del mundo, particularmente entre los pequeños cultivadores.

Junto con el tratamiento de los varios componentes de la asociación, se extiende en la tecnología mejorada para la yuca intercalada, constituyéndose así en una valiosa guía para los técnicos y cultivadores interesados en mejorar el cultivo y sus rendimientos.

Finalmente, el libro presenta una metodología para evaluar las diferentes prácticas agronómicas que recomienda, desde el punto de vista de la eficiencia biológica del sistema y de los aspectos económicos.

El autor es doctor en agronomía de la Universidad de Göttingen, República Federal de Alemania, y trabaja en el Programa de Yuca del CIAT a cargo de Prácticas Culturales.

CONTENIDO: Aspectos Generales. Definición de los Sistemas de Cultivo Múltiple. Aspectos Básicos Biológicos y Nutricionales. Sistemas de Asociación con Yuca Practicados en el Mundo. Tecnología Mejorada para Yuca Intercalada. Evaluación de Sistemas Asociados.

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C00 PLANT PHYSIOLOGY

See 0119

C01 Plant Development

0107

18183 BRUIJN, G. H. DE 1982. Performance and dry matter distribution of cassava at different ages and ecological conditions in Ivory Coast. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.323-337. Engl., Sum. Engl., 4 Refs., Illus.

Cassava. Plant physiology. Dry matter. Plant height. Tuber development. Cultivars. Timing. Ecology. Ivory Coast.

The performance of 3 cassava var. was studied at 4 harvesting periods, at 6, 9, 12, and 15 mo. after planting, in 4 locations in Ivory Coast: Adiopodoume, Bouake, Ferkessedougou, and Man. Important differences between locations were found concerning plant height, flowering habit, mosaic virus attack, no. and diameter of storage roots, dry wt. of plant parts and its distribution. Emphasis was given to DM distribution, adopting a model developed by Boerboom (1978). Efficiency of storage root production (ESRP) and initial plant wt. at which storage root production starts (ISS) were determined for the different situations. Var. differences of ESRP and ISS values were maintained in the different locations, but ISS values were much more dependent on location than ESRP values. In fact ISS proved to be an important factor in DM distribution. It is recommended that for var. selection, a combination of ISS and ESRP is preferable to use than HI, which is always biased by ISS. (Author's summary) C01

0108

18174 HOLMES, E. B.; WILSON, L. A. 1982. Effect of nitrogen supply on early growth development and nitrate reductase activity in two cassava cultivars. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.487-506. Engl., Sum. Engl., 38 Refs., Illus.

Cassava. Cultivars. N. Fertilizers. Enzymes. Shoots. Leaves. Petioles. Growth. Leaf area. Timing

Leaf growth, development, and nitrate reductase activity (NRA) of 2 cassava cv. (Maracas Blackstick and Whitestick 2) in relation to N-supply are discussed. Differences in NRA between the cv. and variations in enzyme activity with leaf and plant ontogeny were found. Significant decreases in leaf NRA occurred at the time of tuber initiation and was coincident with reduction in the rate of shoot growth. High N-supply stimulated leaf growth and NRA was shown to be correlated with leaf growth rate and final leaf size. A regulatory role for NRA in assimilate distribution is suggested. (Author's summary) C01

0109

18170 ZOKOU B., I.; RAFFAILLAC, J.P. 1981. Note preliminaire sur la

dynamique racinaire de boutures de manioc fraiches et stockees au cours du premier mois. (Root production during the first month in fresh and stored cassava cuttings). Abidjan, Cote d'Ivoire, Office de la Recherche Scientifique et Technique Outre-Mer. Centre d'Adiopodoume. 9p. Fr., 1 Ref., Illus.

Cassava. Cuttings. Rooting. Timing. Plant development. Storage. Root system. Dry matter. Foliage.

Root production was studied using cuttings of cassava var. CB obtained from fresh stems and stored for 43 days. Apical and basal cuttings were used and planted in pots. Cuttings were examined 10, 20, and 30 days after planting to determine the following parameters: length and no. of stems, no. of leaves/stem, leaf surface, no. of nodes with roots, no. of nodal and basal roots, as well as the production of DM and green material of cuttings, root and canopy. The no. of roots of basal and apical cuttings obtained from stored stems was higher (34.26 and 24.5, resp.) than that of cuttings from fresh stems (30.26 and 19.5, resp.). The same trend was observed in the dry and fresh wt. of roots, 10.75 and 6.90 g from basal and apical cuttings obtained from stored stems and 7.86 and 5.94 g, resp., for cuttings from fresh stems. Basal cuttings were slightly superior to apical cuttings regarding root production (no. and wt.), regardless of their origin. Leaf indices of plants from stored basal cuttings were higher (83.13) than those of other treatments (71.29, 65.98, and 52.95 for fresh basal cuttings, fresh apical cuttings, and stored apical cuttings, resp.). In stored stems previous development was observed (germinated buds and stems with leaves), which could be the cause of fast root development. Storage could be advantageous in regions where planting takes place after the rainy season, followed by dry season. Fast root development favors plant drought resistance. (Summary by S.B. Trans. by L.M.F.) C01

See also 0120 0128 0130 0143 0227

C02 Cyanogenesis

0110

18169 PEREIRA, J.F.; SEIGLER, D.S.; SPLITTSTOESSER, W.E. 1981. Cyanogenesis in sweet and bitter cultivars of cassava. HortScience 16(6):776-777. Engl., Sum. Engl., 13 Refs., Illus.

Cassava. Cyanogenesis. HCN content. Cultivars. Leaves. Roots. Analysis.

Cyanide content of the leaves and roots of 6 Venezuelan cassava cv. (no. 2062, 2078, 2106, 2112, 2191, and 2490) did not necessarily coincide with their organoleptic classifications. Leaves and root periderm contained the largest amount of cyanogenic compounds. The content of cyanide in leaves and root periderm was not associated with the cyanide content of root parenchymal tissue. (Author's summary) C02

C03 Chemical Composition, Methodology and Analyses

0111

18195 GUTIERREZ, L.E.; LORENZI, J.O. 1981. Teores de amido e carboidratos

soluveis em diferentes epocas e tipos de raizes de mandioca (Manihot esculenta Crantz). (Starch and soluble carbohydrate content of different types of cassava tubers at different periods). Revista de Agricultura (Brasil) 56(3):147-153. Port., Sum. Port., Engl., 4 Refs., Illus.

Cassava. Tubers. Starch content. Carbohydrate content. Dry matter. Timing.

Starch and total soluble carbohydrate content of cassava cv. IAC-Mantiqueira tubers, taken from 3 different locations of the stool, was investigated at the Piracicaba Expt. Station of the Instituto Agronomico do Estado, SP (Brazil). The plants were grown from horizontally planted cuttings. Tubers were collected from the middle and from the base positions of the cuttings and from the base of the stems which sprouted from the cuttings. Analyses were carried out at 4 different times at 4-mo. intervals, beginning with plants 9 mo. old. Results showed the lowest starch but the highest soluble carbohydrate content in tubers from the base of the stems. (Author's summary) C03

0112

16697 JUSTE JUNIOR, E. S. C.; CARVALHO, V D. DE; CORREA, H.; CLEMENTE, P. R. 1982. Estudo comparativo entre metodo pratico de campo e metodos laboratoriais na determinacao de amido em mandioca. (Comparative study between field and laboratory methods of determining cassava starch content). In Projeto mandioca, relatorio 76/79. Belo Horizonte, Brasil, Empresa de Pesquisa Agropecuaria de Minas Gerais. pp.142-147. Port., 2 Refs., Illus.

Cassava. Field experiments. Laboratory experiments. Starch content. Timing. Cultivars. Analysis. Brazil.

Optimum harvest time was determined in a completely randomized exptl. design with 5 replicates and 3 treatments based on starch content of studied cv. and sugar and starch contents of the peel and pulp of cassava roots. Treatments were harvest times (11, 14, 17, and 20 mo. after planting), cv. (Mantiqueira, Branca de Santa Catarina, and Riqueza), and methods of determining sugar and starch contents (physical with the hydrostatic balance and chemical by hydrolisis and titration according to Fehling, and colorimetry). Differences in the methods of determining starch content were not significant, variations depending on harvest time and cv. Starch contents of the peel of all cv. were lower than those of the pulp. Considering that the min. level of starch required by alcohol industries is 30%, the following harvest times are recommended for the different cv.: Branca de Santa Catarina, 14-20 mo. (peeled roots) and 11-20 mo. (pulp); Riqueza, 17-20 mo. (peeled roots) and 14-20 mo. (pulp): and Mantiqueira, 14-20 mo. (peeled roots or pulp). When the total sugar content was added to starch content, Branca de Santa Catarina and Riqueza had hexose contents higher than 30% between 11-20 mo. This favors their period of use. (Summary by EDITEC. Trans. by L.M.F.) C03

0113

18411 LORENZI, J. O.; GALLO, J. R.; MALAVOLTA, E. 1981. Acumulacao de materia seca e macronutrientes por dois cultivares de mandioca. (Dry

matter and macronutrient accumulation by two cassava cultivars). Bragantia 40:145-156. Port., Sum. Port., Engl., 20 Refs., Illus.

Cassava. Cultivars. Dry matter. N. P. K. Ca. Mg. S. Soil analysis. Mineral content. Tubers. Leaves. Stems. Timing. Nutrient uptake. Brazil.

Samples collected in a field trial conducted on a dark red Latosol (Typic Euthrorthox) at the Centro Exptl. de Campinas, MG, Brazil, were used to study DM accumulation and macronutrient uptake and export in 2 cassava cv.: Branca de Santa Catarina and IAC-Mantiqueira. Plants received a uniform fertilization of N, P, and K, at 40, 80, and 60 kg/ha, resp., as ammonium sulfate, simple superphosphate, and muriate of potash; N was top dressed 60 days after germination. Samples were taken at 6 occasions during the growing season, at 60-day intervals. Plants were divided into roots, leaves, and stems and each part was analyzed for N, P, K, Ca, Mg, and S. The period of greatest DM accumulation was between 120-180 days after plant germination, with an av. of 105 kg/ha/day. Macronutrient uptake was the same in both cv. with the exception of P; export was different only in the case of K and S; uptake, in kg/ha and kg needed for the production of 1 MT of roots was, resp., 113.3 and 6.21, 11.0 and 0.62, 78.6 and 4.24, 62.0 and 3.37, 18.5 and 1.00, and 8.3 and 0.46, for N, P, K, Ca, Mg, and S, resp. The export, in kg/ha and kg/t of roots was, resp., 39.1 and 2.12, 3.9 and 0.22, 32.5 and 1.71, 12.1 and 0.66, 6.7 and 0.36, and 1.7 and 0.09 for N, P, K, Ca, Mg, and S, resp. (Author's summary) C03

See also 0110 0118 0133 0147 0160 0193

C04 Plant Nutrition

0114

17551 INDIRA, P.; RAMANUJAM, T. 1982. Note on potassium:sodium ratio in cassava grown under salt and moisture stress. Indian Journal of Agricultural Sciences 52(3):198-199. Engl., 4 Refs.

Cassava. Cultivars. Resistance. Drought. Salinity. K. Na. Mineral content. Leaves. Water stress.

An expt. was conducted with 14 cassava cv. to assess their tolerance to salinity and drought based on their K:Na ratio. The 1st part of the expt. took place in pots containing 8 kg of laterite soil, salinized with 1500 ppm NaCl before planting of cassava cuttings. Watering was done carefully to avoid leaching and after 1 mo. leaf samples were analyzed for K and Na using flame-photometer. In the 2nd part of the expt. the same var. were planted in pots and were subjected to moisture stress (40% reduction of moisture) by detaining the irrigation for 5 days continuously after 1 mo. growth. Plants were fertilized with the recommended rates of NPK. Leaf K and Na contents were analyzed. K:Na ratio was higher under moisture stress than under salt stress, maybe due to the higher availability of Na in NaCl-treated plants in this expt. Var. response was marked under both moisture and salt stress. Only var. H 398, S 1315, H 1253, H 226, H 648, and Ce 22 were tolerant. These were planted in fields with a pH of 8.65 and ECe of 3 mmhos/cm. None of the var. showed disorders during their establishment. (Summary by EDITEC. Trans. by L.M.F.) C04

See also 0108 0113

0115

18110 CONCEICAO, A. J. DA 1975. Projeto mandioca; instrucoes para o cultivo da mandioca. (Cassava project; technical recommendations on cassava cultivation). Cruz das Almas-BA, Brasil, Universidade Federal da Bahia. Serie Extensao no.2. 22p. Port., Sum. Engl.

Cassava. Cultivation. Brazil.

Recommended agronomic practices for cassava cultivation in the coastal regions of Cruz das Almas, Brazil, are described. These include var. selection according to their use and crop cycle, soil selection and preparation, selection of cuttings and planting systems and distances, fertilization, irrigation, weeding, description of damage caused to the plants and control of pests (Atta spp., Acromyrmex spp., Erinnyis ello, E. alope, Silba pendula, Coelosternus, and Mononychellus tanajoa) and diseases (Cercosporidium henningsii, Cercospora caribaea, Uromyces manihotis, Colletotrichum manihotis, Phytophtora drechsleri, Xanthomonas manihotis, Sphaceloma manihoticola, and mosaic), pruning, harvesting, root conservation, crop rotation, and the use of cassava as forage. Technical coefficients of the operations involved and agricultural inputs for small-scale and industrial plantings are included. (Summary by EDITEC. Trans. by L.M.F.) D00

0116

18151 EMPRESA BRASILEIRA DE ASSISTENCIA TECNICA E EXTENSAO RURAL. 1980. Sistema de producao para mandioca; Cocais-MA. (Cassava production systems for Cocais, Maranhao). Bacabal-MA, Brasil, Serie Sistemas de Producao. Boletim no. 186. 28p. Port., illus.

Cassava. Land preparation. Planting. Harvesting. Weeding. Insect control. Marketing. Inter-cropping. Technological package. Brazil.

Two cassava production systems are given for the region of Cocais, MA, Brazil, based on the technological levels of the cassava growers identified in the area. The 1st system is for small-scale (av. 3 ha) cassava growers (landlords or tenants) not too receptive to adopting technological innovations and producing CF. Operations forming the system include choice of area, preparation, planting, cultural practices, phytosanitary treatments, harvest, conservation of cuttings, and commercialization. Specific technical recommendations are given for each operation. Current av. yields of 8 t/ha are estimated to increase to 12 t/ha if these recommendations are followed. The 2nd system is for small-scale (av. 5 ha) cassava growers (landlords or tenants) that plant cassava in association with beans and maize, are not too receptive to innovations but have access to farm credit. Technical recommendations are given for each of the operations making up the system, similar to those of the 1st system. The use of recommendations is estimated to increase cassava, bean, and maize yields from 5000, 300, and 400 kg/ha to 8000, 450, and 600 kg/ha, resp. Technical coefficients for each system are included. (Summary by EDITEC. Trans. by L.M.F.) D00

0117

18147 HOWELER, R. H.; CALLE, F., SALAZAR, E. 1982. El cultivo de yuca

para la altillanura plana de los Llanos Orientales de Colombia. (Cassava cultivation in the plateau area of the Colombian Llanos Orientales). Asiava 3:13-14. Span., Illus.

Cassava. Cultivation. Colombia.

Specific recommendations for cassava cultivation and soil conservation in the plateau area of the Colombian llanos Orientales are given. These include choice of area (level), soil preparation, var. (M Ven 77, M Per 245, and HMC 2, and the hybrids CM 507-37, CM 523-7, and CM 430-37), selection of cuttings (bulky, 20 cm long, and fresh), treatment of cuttings (immersion in a solution of fungicides, insecticides, and zinc sulfate), planting system (vertical position with buds facing upwards, 80 x 80 cm apart in Sept. or Oct.), fertilization and liming, pest control (thrips and mites), and harvest (1st months of the year, 12-14 mo. after planting). If these recommendations are followed, yields of 15-20 t/ha can be obtained in this region. (Summary by EDITEC. Trans. by L.M.F.) D00

See also 0204 0220 0225

D01 Soil Water, Climate and Fertilization

0118

18176 CHAN, S. K.; LEE, C. S. 1982. Relationships of tuber yield, starch content and starch yield of cassava with potassium status of fertilizer, soil and leaf. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.461-473. Engl., Sum. Engl., 16 Refs., Illus.

Cassava. K. Leaves. Mineral content. Tubers. Starch content. Starch productivity. Tuber productivity. Soil analysis. Malaysia.

Relationships of soil K and leaf K with cassava yield and starch content were established in a trial conducted on an Oxisol at the Malaysian Agricultural Research and Development Institute, Malaysia. Nine levels of K (0, 40, 60, 80, 120, 160, 200, 240, and 300 kg/ha) were used in a randomized complete block design with 4 replications. Significant correlations were obtained between applied K and water-soluble soil K, and between applied K and leaf K. However, leaf K was a better indicator of starch yield than water-soluble soil K. The optimum leaf K for max. starch yield was 2.11%. The rate of K fertilization to obtain this optimum level might depend on its method of application. In this trial where K was broadcasted 1 mo. before planting, it was predicted to be 180 kg K/ha. (Author's summary) D01

0119

18181 FLACH, M. 1982. Ecological competition among the main moisture rich starchy staples in the tropics and subtropics. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.345-375. Engl., Sum. Engl., 41 Refs., Illus.

Cassava. Ecology. Climatic requirements. Nutritional requirements. Plant physiology. Productivity.

Cassava produces 67%, yam 9.2%, sweet potato 9%, plantain 7.1%, potato 4.7%, aroids 1.6%, and sago palm 1.3% of total food energy in the tropics and subtropics. Potential production/unit, time, and surface is twice that of cereals. Research should be aimed at lengthening the period of quick starch accumulation, in which partitioning of DM over sink and other plant parts appears to be constant with the possible exception of plantain. Needs of plant nutrients differ considerably with cassava and sago palm as the cheapest and sweet potato as the most expensive. A distinction should be made between fresh food crops (yam, plantain, and potato), starch or energy-producing crops (cassava and sago palm), and dual purpose crops (sweet potato and aroids). (Author's summary) D01

0120

18185 KEATING, B. A., EVENSON, J. P.; EDWARDS, D. G. 1982. Effect of pre-harvest fertilization of cassava, (Manihot esculenta Crantz.) prior to cutting for planting material, on subsequent establishment and root yield. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.301-306. Engl., Sum. Engl., 10 Refs., Illus.

Cassava. N. P. K. S. Fertilizers. Timing. Cuttings. Planting. Germination. Tuber productivity. Foliage. Australia.

An expt. was conducted at the U. of Queensland Exptl. Station, Redland Bay, Australia, on a krasnozem soil to evaluate the effect of preharvest fertilization of cassava prior to cutting for planting material, as a means of improving crop establishment. A uniform 24-mo. old stand of cassava cv. M Aus 7 was selected as planting material. N, P, K, and S were topdressed 6 wk. prior to cutting at the rate of 75, 125, 150, and 60 kg/ha, resp. Twenty-five-cm long cuttings were planted horizontally at a depth of 10 cm and at a 1 x 1 m spacing; % emergence was recorded on a weekly basis. Plants were evaluated for their fresh wt. of tops and roots, plant height, stem and tuber no., and starch content. While the prefertilization treatment of cassava had no effect on the final no. of cuttings which emerged, it significantly reduced the time taken to reach 90% of final emergence from 28.3 to 18.4 days. Fresh root yield 233 days after planting was signlficantly increased from 14.7 to 17.5 t/ha. (Summary by J.L.S.) D01

0121

18161 MAGALHAES, P. C.; AZEVEDO, J. N. 1980. Comparacao de cultivares de mandioca em diferentes epocas de colheita e niveis de fertilizacao na regiao Agreste de Alagoas. (Comparison of cassava cultivars harvested at different times and with different levels of fertilization in the Agreste region of Alagoas). Maceio-AL, Brasil, Empresa de Pesquisa Agropecuaria do Estado de Alagoas. Pesquisa em Andamento no. 01. 5p. Port.

Cassava. N. P. K. Fertilizers. Harvesting. Timing. Tuber productivity. Foliage. Starch content. Cultivars. Brazil.

Due to the low yields of cassava in the state of Alagoas, Brazil, an expt. was carried out to determine a production system appropriate for the region. Planting took place in Arapiraca and cv. Cariri Preta, Campinas,

Pacare, Catirina Branca, Perna Gorda, and Isabel de Souza were used. A randomized block design was used with 3 replications. Parameters assessed at 3 harvest times (14, 18, and 22 mo. after planting with and without NPK fertilization at 20, 40, and 100 kg/ha, resp.) were root yield, canopy yield, and root starch content. Highest root yields corresponded to cv. Campinas, Cariri Preta, and Perna Gorda with av. of 30.98, 23.55, and 22.18 t/ha, resp. Regarding canopy yield, Pacare, Campinas, and Catirina Branca were outstanding with av. of 25.20, 21.84, and 19.77 t/ha, resp. Catirina Branca had the highest starch content with an av. of 31.86%. (Summary by J.L.S. Trans. by L.M.F.) D01

0122

18163 MAGALHAES, P.C.; SANTIAGO, A.D. 1981. Efeito do manganes e outros micronutrientes no rendimento da mandioca em solo podzolico Vermelho Amarelo. (Effect of manganese and other micronutrients on cassava yields on red yellow podzolic soil). Maceio-Al, Brasil, Empresa de Pesquisa Agropecuaria do Estado de Alagoas. Pesquisa em Andamento no. 09. 3p. Port.

Cassava. Mineral deficiencies. N. P. K. Zn. B. Cu. Mo. Mn. Fe. Tuber productivity. Starch productivity. Starch content. Brazil.

During the 1979-80 crop yr an expt. with micronutrients was established in Pindorama, Al, Brazil, to determine the cause of yellowing in cassava plants, regionally known as Chapeu de Palha. Cv. Catirina Branca was planted in a red yellow podzolic soil in a randomized block design with 10 treatment and 4 replications. Fertilizer rates (kg/ha) were: N (250), P (178), K (67), Zn (18), Cu (16), B (9), Mo (0.5), Fe (14), and Mn (75, 150, and 225). Data on canopy and root yield, and starch content and production are given. Although there were no statistically significant differences among treatments, treatments with NPK + Zn, Mo, Fe, and Mn (150 kg/ha) and NPK + Cu, B, Mo, Fe, and Mn (150 kg/ha) gave slightly higher results than the other treatments. No yellowing was observed in any of the plots and this initially indicates that these symptoms could be due to soil fertility, in particular micronutrient deficiency (especially Mn). (Summary by J.L.S. Trans. by L.M.F.) D01

0123

18164 MAGALHAES, P. C. 1981. Efeitos de diferentes niveis de P, na presenca e ausencia de N e K em mandioca. (Effect of different levels of P in the presence and absence of N and K in cassava). Maceio-Al, Brasil, Empresa de Pesquisa Agropecuaria do Estado de Alagoas. Pesquisa em Andamento no. 08. 4p. Port.

Cassava. P. N. K. Tuber productivity. Starch content. Foliage. Fertilizers. Brazil.

Studies were carried out at the Arapicara Exptl. Station, Al, Brazil, to determine adequate rates of P for cassava crops. The expt. took place in a Latosol using a randomized block design arranged in a 4 x 2 x 2 factorial with 4 replications. Four levels of P (0, 40, 80, and 120 kg/ha), 2 of N (0 and 60 kg/ha), and 2 of K (0 and 50 kg/ha) were used. Data analyzed at harvest were canopy and root yield, and root starch content. Different levels of P did not show statistical differences among themselves regarding canopy yield. Regarding root yield, the application of 120 kg P/ha gave the highest yield (av. 27.29 t/ha). There were no differences among treatments regarding starch content. N and K application, as well as their

interaction with P, did not have significant differences regarding the parameters studied. (Summary by J.L.S. Trans. by L.M.F.) D01

See also 0113 0124 0126 0127 0128 0152 0224 0227

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

0124

18142 ASHBY, J. A.; DE JONG, G. 1982. Farmer field preparation and tillage practices. Implications for fertilizer technology research. Soil and Tillage Research 2(4):331-346. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Cultivation. Land preparation. Technology evaluation. Fertilizers. Socio-economic aspects. Developmental research. Labour. Costs. Colombia.

The way in which information from diagnostic research on small farmer decision-making about land preparation and tillage practices may be integrated into exptl. research on the design and evaluation of fertilizer technology is demonstrated. Analysis of different land preparation and tillage practices used by farmers in cassava production in Cauca, Colombia, is utilized to develop a model of farmers' decision-making in the choice of tillage techniques. The decision model indicates that manual tillage practices which involve only partial field tillage are a response to relatively fixed constraints, which imply that it may be difficult for farmers facing these constraints to adopt fertilizer technology which requires full field tillage. Variables associated with choice of tillage method are identified and related to implications for exptl. evaluation of fertilizer technology and the distribution of benefits from this research. The findings illustrate that diagnostic research on the agro-socioeconomic constraints faced by small farmers can alert researchers to limiting factors which require recognition in the design and testing of agricultural technology, in order to facilitate rapid and effective adoption by a majority of small farmers. (Author's summary) D02

0125

17569 KATO, M. DO S. A.; KATO, O. R. 1982. Influencia da epoca de plantio e colheita na producao de 4 cultivares de mandioca. (Effect of planting and harvest times on the production of four cassava cultivars). Altamira-PA, Brasil, Empresa Brasileira de Pesquisa Agropecuaria. Unidade de Execucao de Pesquisa de Ambito Estadual de Altamira. Pesquisa em Andamento no. 01. 4p. Port.

Cassava. Planting. Harvesting. Timing. Tuber productivity. Foliage. Brazil.

The effect of different planting (Jan., Feb., March, April, and May) and harvest times (12, 15, and 18 mo.) on the yields of cassava cv. Amarelinha, Inaja, Pretinha, and Sacai was studied in Altamira, PA, Brazil, using a randomized block design with split plots arranged in a 5 x 3 factorial with useful plot areas of 40 m^2. Harvest times were in the main plots and the 4 cv. in the subplots. Twenty-cm cuttings were planted at a depth of 10 cm, spaced at 1 x 1 m. The May planting was excluded from the trial. Root and branch wt. were measured. Jan. and May were the best planting times (av. above 26 and 37 t of roots and branches/ha, resp.). The best harvest time was at 18 (av. of 31 and 42.76 t of roots and branches/ha, resp.) and 15

mo. (av. of 25.4 and 38.15 t of roots and branches/ha, resp.). Pretinha root and branch yield was outstanding (61 and 81.4 t/ha, resp.) with the Jan. planting and harvest at 15 and 18 mo., followed by Inaja (41.9 and 46 t roots/ha and 58.6 and 51.7 t branches/ha with Feb. and March plantings, resp., and harvest at 15 and 18 mo.), Sacai (30.14 t roots/ha with March planting and harvest at 15 mo. and 40.7 and 43.4 t branches/ha with March and April plantings, resp., and harvest at 15 mo.), and Amarelinha which was severely attacked by pests. (Summary by EDITEC. Trans. by L.M.F.) D02

0126

18137 LAL, R.; DINKINS, E.L. 1979. Tillage systems and crop production on an ultisol in Liberia. In _____. ed. Soil tillage and crop production. Ibadan, Nigeria, International Institute of Tropical Agriculture. Proceedings Series no. 2. pp.221-233. Engl., 7 Refs., Illus.

Cassava. Land preparation. Soil requirements. Inter-cropping. Maize. N. P. K. Fertilizers. Tuber productivity. Liberia.

The effects of 2 methods of seedbed preparation, conventional plowing and no-tillage, on maize, rice, and cassava yields were studied during 1973-74 at the College of Agriculture and Forestry, U. of Liberia, near Monrovia. The soil of the exptl. site was shallow with grey-brown loamy sand over a yellow-brown sandy loam. Three cropping sequences were used: upland rice, maize-cassava, and maize-maize. Cassava yields were low, but conventionally tilled and ridged plots produce more cassava tubers than no till-plots (8.6 and 6.5 t/ha with fertilizer vs. 4.7 and 3.2 t/ha without fertilizer, resp.). The soil moisture regime was generally superior with no-till mulch treatments compared with plowed bare plots. Plowed plots, however, had slightly lower bulk density than no-till treatments. Cassava is considered a suitable crop for acidic soils in the high rainfall region. Low cassava yield is attributed to shallow soils and to high concn. of gravel and to concretionary material. If the soil had a deep surface horizon, satisfactory cassava yield could be obtained with the no-till system. (Summary by S.B.) D02

0127

18165 MAGALHAES, P.C.; AZEVEDO, J.N. DE 1980. Comparacao de cultivares de mandioca em diferentes epocas de colheita e niveis de fertilizacao nas regioes litoranea e do Sao Francisco, de Alagoas. (Comparison of cassava cultivars at different harvest times and levels of fertilization in the coastal and San Francisco regions, Alagoas). Maceio-Al, Brasil, Empresa de Pesquisa Agropecuaria do Estado de Alagoas. Comunicado Tecnico no. 01. 9p. Port.

Cassava. Cultivars. Harvesting. Timing. N. P. K. Fertilizers. Tuber productivity. Starch content. Foliage. Brazil.

Comparative expt. were conducted in Alagoas, Brazil, to determine the effect of 3 harvesting times (14, 18, and 22 mo. after planting) and NPK fertilization treatments (60-60-0 and 60-80-60 in Penedo and Pindorama, resp.) on the yields of roots and aerial parts and starch content of cassava cv. Pacare, Catirina Branca, Olho Roxo, Campinas, Carii Preta, and Isabel de Souza in Penedo and Branca de Santa Catarina, Pacare, Olho Roxo, Perna Gorda, Isabel de Souza, and Catirina Branca in Pindorama. In Penedo, outstanding yields of aerial parts were obtained with cv. Pacare (av. 30.76 t/ha with or without fertilization for all harvesting times). However,

harvesting at 22 mo. significantly affected yields. Root yields were highest in cv. Campinas, Olho Roxo, and Isabel de Souza with av. yields of 43.8, 37.4, and 32.58 t/ha, resp. Highest starch contents were found in cv. Catirina Branca, Pacare, and Olho Roxo (31.53, 30.55, and 30.72%, resp.), increasing when no fertilizers were applied and harvest taking place at 14 mo. In Pindorama, Perna Gorda, Catirina Branca, and Branca de Santa Catarina were the highest yielding cv.; however, at this site the response of fertilized plots was greater than that of unfertilized ones. Cv. Olho Roxo and Catirina Branca are recommended for starch and alcohol production and Pacare for forage under conditions at Penedo. Cv. should be harvested at 14 mo. when max. starch content is reached. At this site fertilization did not affect the results. Perna Gorda was the highest yielding cv. at Pindorama (av. yield of aerial parts, 13.34 t/ha; roots, 21.51 t/ha; starch, 27.68%). Harvest time did not affect the parameters at this site but a response to fertilization was observed. The causes of yellowing in cassava at this site should be studied. (Summary by EDITEC. Trans. by L.M.F.) D02

0128

18136 MAURYA, P.R.; LAI, R. 1979. No-tillage system for crop production on an Ultisol in eastern Nigeria. In Lal, R. ed. Soil tillage and crop production. Ibadan, Nigeria, International Institute of Tropical Agriculture. Proceedings Series no.2. pp.207-219. Engl., 8 Refs., Illus.

Cassava. Land preparation. Soil requirements. Plant height. Plant development. Tuber productivity. Soil fertility. Nigeria.

The effects of tillage systems on crop production (maize, cowpea, cassava, pigeon pea) and soil properties of an Ultisol in eastern Nigeria are described. The expt. was conducted on newly-cleared land at the Onne exptl. farm of the International Institute of Tropical Agriculture, near Port Harcourt. The soil was an Oxic Paleudult, coarse-textured with a pH of about 4.5. Tillage treatments were conventional tillage, disc plowed to a depth of approx. 20 cm and harrowed, and no-tillage, with 2.5 l paraquat/ha applied before planting. Tillage methods affected the physical and chemical properties of the surface 0-10 cm layer; however, there were no differences in these properties due to tillage methods for the 10-20 cm layer. Plant height of cassava was always 5-10% greater in the conventionally plowed than in no-tillage plots. The yield of cassava was generally low and did not show any differences due to tillage treatments (7.1 and 8.8 t/ha with no tillage vs. 6.9 and 9.5 t/ha with conventional tillage for 1976 and 1977, resp.). Nevertheless, cassava is better suited for these soils and environments than the grain crops. Tables on the effect of tillage on plant height and tuber yield are presented. (Summary by S.B.) D02

0129

18122 ODIGBOH, E. U.; AHMED, S. F. 1982. An automatic cassava planter. Agricultural Mechanization in Asia, Africa and Latin America 12(4):15-20. Engl., Sum. Engl., 19 Refs., Illus.

Cassava. Planting. Mechanization. Agricultural equipment. Nigeria.

On the basis of the deficiencies found in an earlier design, a new cassava planter was designed, constructed, and tested. While the old planter is trailed, the new one is mounted. The old design has a hopper that poses

problems of manufacture; the hopper of the new planter is simple, yet very effective and easy to load. The new planter is a single-row prototype meant to serve as a building block for multi-row versions. It plants cassava stakes vertically on 25-30 cm high ridges with a within-row spacing of practically 100 cm at an optimum planting speed of 7 km/h. (Author's summary) D02

0130

18128 OGBUEHI, S. N. 1981. A preliminary study on preplant cassava stem storage on tuber yield. Journal of Root Crops 7(1/2):65-66. Engl., 4 Refs.

Cassava. Stems. Storage. Timing. Cuttings. Tuber productivity. Tuber development.

Stems of 1 yr-old plants of cassava cv. Nwugo and 53101 were stored for varying periods (0, 21, 42, and 63 days) in a farmhouse under ambient conditions. Twenty-cm cuttings were planted in a randomized block design with 4 replications. Nine mo. after planting, the crop was harvested and fresh tuber yield, no. of tubers/plant, av. tuber length and wt., and HI were determined. Both cv. responded alike to storage treatments. Variance analysis did not show any differences between storage treatments as to no. of tubers/stand, tuber length, and HI. However, the 0- and 21-day treatments were each significantly superior (P = 0.05) to the other treatments regarding tuber wt. and yield. (Summary by S.B.) D02

0131

18166 PINHO, J. L. N. DE 1980. Metodos de obtencao e preparacao de sementes vegetativas de mandioca para plantio. (Methods of obtaining and preparing vegetative cassava seeds for planting). Fortaleza-CE, Brasil, Empresa de Pesquisa Agropecuaria do Ceara. Comunicado Tecnico no.5. 8p. Port., 6 Refs.

Cassava. Propagation materials. Stems. Cuttings. Selection.

Different aspects that should be taken into account in order to obtain good quality cassava cuttings for planting are discussed. Three ways of obtaining cuttings are examined: pruning cassava crops that are already established, storing cuttings after cassava harvest, and maintaining part of the crop until the next planting time. Quality parameters of the cuttings include stem maturity, cutting length and diameter, healthiness of planting material, and mechanical damage to the cuttings. Preparation of planting material includes the vertical cut of 20-cm long cuttings with a good no. of buds and their treatment with a mixture of insecticides and fungicides. (Summary by EDITEC. Trans. by L.M.F.) D02

See also 0109 0164 0224 0227 0229

D03 Energy Productivity and Yields

0132

17570 KATO, M. DO S.A.; KATO, O.R.; OLIVEIRA, R.P. DE 1982. Competicao de cultivares de mandioca na Transamazonica-Para. (Competition of cassava cultivars in the Transamazonic Region of Para). Altamira-PA,

Brasil, Empresa Brasileira de Pesquisa Agropecuaria. Unidade de Execucao de Pesquisa de Ambito Estadual de Altamira. Comunicado Tecnico no. 05. 4p. Port.

Cassava. Cultivars. Tuber productivity. Foliage. Brazil.

Competitive trials were conducted with 14 promissory regional cassava cv. at exptl. fields in Altamira, Maraba, and Itaituba, PA, Brazil. A randomized block design was used with 14 treatments and 4 replications. Twenty-cm long cuttings were hand planted at a depth of 10 cm and spaced at 1 x 1 m. Harvest took place at 12 mo. and root and branch yields were determined. In Altamira, highest root yields were obtained with cv. Inaja (48.17 t/ha in 1976), Iracema (33.5 and 28.5 t/ha in 1974 and 1976, resp.), Engana Ladrao (19.5 and 33.3 t/ha, resp.), Amazonas (18.7 and 34.17 t/ha, resp.), and Lagoa (30.5 and 16.67 t/ha, resp.) and the highest branch yields with Bubao (78.17 and 72.83 t/ha, resp.), Pretinha (61 and 49 t/ha, resp.), and Engana Ladrao (51.33 and 50.67 t/ha, resp.). In Itaituba highest root yields were obtained with cv. Mameluca (26.17 t/ha), Inaja (25.5 t/ha), and Lagoa (25.17 t/ha) and the highest branch yields with Mameluca (74.33 t/ha), Pretinha (71.83 t/ha), Lagoa (66.67 t/ha), Inaja (62.17 t/ha), Bubao (59.67 t/ha), and IPEAN-12 (59.5 t/ha). In Maraba cv. outstanding in root yields were Juriti (38.16 t/ha), Engana Ladrao (37.5 t/ha), Tataruaia (35.83 t/ha), Mameluca (35.33 t/ha), Lagoa (35.17 t/ha), Pretinha (35 t/ha) Jurara (34.83 t/ha), Jabuti (30.17 t/ha), and Jaibara (29.83 t/ha) and those outstanding in branch yield, Amazonas (46.17 t/ha), Tataruaia (44.17 t/ha), Mameluca (38 t/ha), Pretinha (35.5 t/ha), and Engana Ladrao (35.5 t/ha). (Summary by EDITEC. Trans. by L.M.F.) D03

0133

16687 VIEIRA NETO, J. C.; CORREA, H. 1982. Avaliacao da producao e dos teores de amido, proteina e HCN em quatro cultivares de mandioca (Manihot esculenta Crantz) em diferentes epocas de colheita. (Evaluation of production and starch, protein, and HCN contents in four cassava cultivars at different harvest times). In Projeto mandioca, relatorio 76/79. Belo Horizonte, Brasil, Empresa de Pesquisa Agropecuaria de Minas Gerais. pp.22-24. Port.

Cassava. Cultivars. Tuber productivity. Foliage. Timing. Brazil.

At the Escola Superior de Agricultura de Lavras, MG, Brazil, the starch and protein contents of 4 cassava cv. (Branca de Santa Catarina, Mantiqueira, Riqueza, and Vassourinha), their root and branch production, and optimum harvest time were assessed in a randomized complete block design with 5 replications, main plots with the cv. and split-plots with the harvest time treatments (9, 12, 15, and 18 mo.). Highest branch yield was obtained with var. Riqueza (19.64 t/ha); Branca de Santa Catarina and Riqueza gave the highest av. root yields (22.92 and 21.3 t/ha, resp.). Best harvest time was at 18 mo. Branca de Santa Catarina had the highest starch content and production as well as the highest % of protein in the roots. Cv. Riqueza harvested at 15 mo. gave the highest protein content in the canopy. (Summary by EDITEC. Trans. by L.M.F.) D03

See also 0118 0119 0120 0121 0122 0123 0125 0126 0127 0128 0129 0130 0147 0150 0151 0152 0153 0154 0156 0157 0159 0165 0217 0227 0229

0134

18431 PHILIP, S. 1981. Sequence of occurrence of microflora in stored cassava tubers. Agricultural Research Journal of Kerala 19(1):126-127. Engl., 3 Refs.

Cassava. Tubers. Storage. Mycoses. Bacterioses. Deterioration. India.

The microorganisms causing rot in stored cassava tubers were identified. Rhizopus arrhizus and Mucor hiemalis were the initial colonizers followed by Aspergillus spp. and Fusarium sp. Botryodiplodia theobromae appeared at the last stages of tuber rot. (Summary by Review of Plant Pathology) D04

0135

18188 RICKARD, J. E. 1982. Cytology and cytochemistry of vascular discoloration in cassava roots. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.307-315. Engl., 27 Refs., Illus.

Cassava. Post-harvest technology. Tubers. Deterioration. Biochemistry. Laboratory experiments. Analysis. Plant tissues.

The nature and origin of the occluding material formed in cassava root xylem during the development of vascular discoloration in the absence of any infection were investigated. Roots of cassava cv. Yellow Heart (Jamaica) and Ankrah (Ghana) were washed in water, cut laterally into sections of 50 mm long and rewashed. Primary deterioration was induced by dehydration or by placing the sections on perforated plastic shelves in aerated, distilled water to a depth of 10 mm. Unfixed, frozen sections 10-20um were prepared and histochemical tests conducted on both discolored and unpigmented material, and on wound surfaces 2 days after cutting. Specimens were prepared for scanning electron microscope studies and ultra-thin sections for transmission electron microscope. The formation of vascular occlusions in xylem occurs as a gel-like material lining the vessel walls and forming connecting strands or as large granular masses filling the vessel lumen. These occlusions appears to be a physiological process which occurs as a response to wounding. Histochemical tests showed that the pigmented material was composed of lipid, lignin, and carbohydrate. Cassava xylem is also occluded by tyloses, but there is no indication that tylose formation is essential to vascular discoloration. (Summary by S.B.) D04

0136

18193 SIVAN, P. 1979. Post-harvest durability of fresh roots of cassava varieties in Fiji and storage of roots in moist sawdust. Fiji Agricultural Journal 41(2):95-102. Engl., Sum. Engl., 10 Refs., Illus.

Cassava. Cultivars. Tubers. Storage. Deterioration. Timing. Resistance. Fiji.

Twenty-three cassava var. were harvested and 50 undamaged (without visual signs of damage) roots of each var. were selected and stored on an open shelf in a shed. Five roots of each var. were taken at random, dissected

and rated for deterioration (based on the extent of discoloration) on days 1, 2, 3, 4, 5, 6, 7, 10, and 14. Max. temp. range was 25.6-28.4°C, min. temp. 16.7-23.4°C and RH 62-93%. One var. was found to be resistant to primary deterioration while another was slightly resistant but all others were susceptible. Var. Navolau and Vulatolu (susceptible) and Beqa (very susceptible) were stored in moist sawdust in boxes and var. Vulatolu in sacks. About 90% of roots of the susceptible var. were in acceptable condition after 8 wk. storage in boxes. Storage of Beqa by this method gave 80% acceptable roots at 4 wk. but thereafter it deteriorated rapidly. When stored in sacks, 84% of the roots of a susceptible var. were acceptable after 3 wk. but thereafter, the roots deteriorated rapidly. (Summary by Food Science and Technology Abstracts) D04

0137

18131 WHEATLEY, C.; LOZANO, C.; GOMEZ, G. 1982. Deterioracion postcosecha y almacenamiento de raices de yuca. (Postharvest deterioration and cassava root storage). In Centro Internacional de Agricultura Tropical. Programa de Yuca. Yuca: investigacion, produccion y utilizacion. Cali, Colombia. pp.493-512. Span., 27 Refs., Illus.

Cassava. Post-harvest technology. Deterioration. Tubers. Analysis. Cultivars. Resistance. Pruning. Storage. Colombia.

Different aspects related to deterioration, treatments to extend cassava root durability, and root storage practices are briefly reviewed. The initiation and subsequent level of deterioration of cassava roots is closely related to the presence of mechanical damage which is normally caused at harvest. A subjective method that allows the % of deterioration to be assessed is described. The results obtained show that var. MCol 22 is more susceptible than MCol 113. Changes in the color of cassava are due to occlusion of the xylem vessel fascicles and to the production of fluorescent compounds in the parenchyma among which scopoletin was identified. The % of deterioration in roots of var. MCol 22 varied from less than 20% up to 90%, indicating that this var. could be susceptible or resistant depending on the conditions at harvest and that it is difficult to determine the absolute degree of susceptibility of a var. Evaluations of postharvest deterioration in 5 localities in Colombia, under different edaphoclimatic conditions, showed that there is a wide range of deterioration among the var. at CIAT-Palmira and in Popayan, while in the northern coast of Colombia the level of deterioration was considerably lower. All of the var. were resistant in Carimagua. Var. MCol 1807 and MCol 22 were also found to be the var. most susceptible to deterioration before canopy pruning and the most resistant after pruning. (Summary by S.B. Trans. by L.M.F.) D04

E00 PLANT PATHOLOGY

E02 Bacterioses

0138

18198 FUKUDA, C. 1982. Bacteriose da mandioca (Xanthomonas campestris pv. manihotis): resistencia varietal e alguns possiveis fatores pre-infeccionais de resistencia do hospedeiro. [Cassava bacterial blight (Xanthomonas campestris pv. manihotis): varietal resistance and some possible preinfection factors of host resistance]. Tese Mag.Sc. Vicosa-MG, Brasil, Universidade Federal de Vicosa. 58p. Port., Sum. Port., Engl., 49 Refs.

Cassava. Cultivars. Resistance. Xanthomonas manihotis. Stomata. HCN content. Leaves. Petioles. Stems. Brazil.

The resistance of 270 cassava var. to CBB (Xanthomonas campestris pv. manihotis) was assessed in field trials conducted in Felixlandia, MG, Brazil. Twenty-six of these var. (5 resistant, 10 moderately resistant, and 11 susceptible) were reevaluated under greenhouse conditions. Once the results obtained in the field were verified, intents were made to identify possible preinfection mechanisms of pathogen resistance such as the no. of stomas/leaf area unit, size of stomatal opening, and HCN and total phenol contents in the leaves, petioles, and stems of these 26 var. Regarding the no. of stomas/leaf area unit there was a significant difference among var., but there was no correlation between this no. and resistance. On the other hand, the size of the stomatal opening varied statistically in function of the var. and was related to resistance once these var. had openings smaller than the susceptible var. HCN and total phenol contents showed that some var. statistically differ from others regarding these contents in leaves as well as in the petioles and the stems. No correlation was found between var. resistance and the HCN and phenol contents. (Author's summary. Trans. by L.M.F.) E02

0139

18172 LOZANO, J.C.; LABERRY, R. 1982. Screening for resistance to cassava bacterial blight. Plant Disease 66(4):316-318. Engl., Sum. Engl., 12 Refs., Illus.

Cassava. Xanthomonas manihotis. Cultivars. Resistance. Selection. Field experiments. Colombia.

Resistance to Xanthomonas campestris pv. manihotis in cassava was identified during 4 cycles of field evaluation in an area where CBB is endemic, Carimagua ecosystem (Colombia). Some genotypes that were rated resistant based on foliar symptoms produced under controlled conditions (80-90% RH, day/night temp. 30/18°C, and a 12-h photoperiod at 6 klux) were eliminated because of infection after 2, 3, or 4 cycles of continuous cultivation. (Author's summary) E02

0140

18184 PACUMBABA, R. P. 1982. Tong method: an effective screening technique for young cassava seedlings for detecting resistance against cassava bacterial blight disease in Zaire. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.317-322. Engl., Sum. Engl., 2 Refs., Illus.

Cassava. Xanthomonas manihotis. Inoculation. Resistance. Selection. Zaire.

The artificial inoculation of Xanthomonas manihotis by the tong method is recommended for detecting resistance in 3-8 wk. old cassava seedlings, against CBB, but is not suitable for cassava plants 3 mo. old or older. The technique used either CBB gum exudates or cut pieces of angular, water-soaked leaf spots immersed in water for 12-24 h or water solution of pure culture of X. manihotis as inoculum. Tiny, angular leaf spots developed on inoculated cassava leaves after 24-48 h. (Author's summary) E02

See also 0115 0150 0152 0153 0156 0160

E03 Mycoses

0141

18408 MATOS, A. P. DE 1976 Esporulacao de Cercospora henningsii Allesch. em funcao de fatores fisicos e nutricionais. (Sporulation of Cercospora henningsii depending on physical and nutritional factors). Tese Mag.Sc. Vicosa-MG, Brasil, Universidade Federal de Vicosa. 39p. Port., Sum. Port., 41 Refs.

Cassava. Cercospora henningsii. Isolation. Culture media. Laboratory experiments. Brazil.

The influence of the interaction temp. and culture media, light regime, time of incubation, H concn., addition of thiamine, and radiation with UV light (254 nm) on the sporulation of Cercosporidium henningsii was studied. Temp. of 16, 20, 24, and 28°C were studied in interaction with sweet potato dextrose agar, modified Richard's medium, cassava leaf extract agar (CLEA), and carrot leaf extract agar. Other studies with CLEA were conducted at 24°C. Except for trials on days of incubation which lasted 8 days, the time of incubation of the trials was 7 days. Research was conducted alternating light and dark periods, except for the trial on light regime which was conducted under constant light, continuous darkness, and alternating light and dark periods. Max. sporulation of the pathogen occurred at a pH between 5.0-7.0. The addition of 6, 30, and 150 international units of thiamine/l of culture medium in the form of hydrochloride stimulated the production of fungal conidia. Exposure to 254 nm UV light during 30, 60, and 120 s also increased conidial production of C. henningsii. Highly sporulating variants of the fungus were also identified in monosporous culture. (Author's summary. Trans. by L.M.F.) E03

0142

18401 ZEIGLER, R. S. 1982. The superelongation disease of cassava: pathogen taxonomy, gibberellin production, and some characteristics of host resistance. Ph.D. Thesis. Ithaca, N.Y., Cornell University. 133p. Engl., Sum. Engl., 70 Refs., Illus.

Cassava. Sphaceloma manihoticola. Pathogenicity. Inoculation. Cultivars. Symptomatology. Resistance. Pest damage.

The previously unreported sexual stage of Sphaceloma manihoticola, causal agent of the superelongation disease of cassava, is described as an Elsinoe species. Cross-inoculation studies, symptomatology, colony characteristics, and morphological comparisons among isolates, type specimens, and published descriptions are used to support proposed synonymy of the Elsinoe from cassava with E. jatrophae and E. brasiliensis under the name Elsinoe brasiliensis. Sphaceloma manihoticola is retained, and S. krugii is combined with S. poinsettiae under the latter name. Host specificity of some isolates was found to be plastic. In vitro production of gibberellin A_4 by the pathogen is demonstrated through combined gas chromatography-mass spectrometry of purified culture extracts. Regardless of field susceptibility, stem tissue of all cv. tested developed resistance to the pathogen after about 8 days. Disruption of stem cuticle significantly

increased the level of disease as measured by no. of lesions, % susceptible tissue diseased, and no. of diseased internodes. Conidia and hyphae of monoconidial isolates were monokaryotic. Reisolations from different lesion types yielded morphologically identical colonies which showed no difference in virulence on the cv. from which the reisolations were made. Inoculations of selected cv. of diverse origin and morphology with isolates of diverse origin in all combinations yielded variable but significant cv. x isolate interactions suggestive of pathogenic specialization. It is hypothesized that specific host-isolate incompatibility is only part of a complex of resistance mechanisms in field-resistant cv. Field-resistant and field-susceptible cv. were treated with different gibberellin A_4 concn. and inoculated with the pathogen. No difference in response to the hormone was detected between resistant and susceptible cv. when evaluated for change in length and susceptibility. All cv. showed an increase in internode length at 10^3 ug/ul hormone concn., and all showed increased level of disease over control when inoculation followed hormone application. Hormone production appears to confer an advantage to the pathogen by inducing growth and increasing the amount of susceptible juvenile tissue. (Author's summary) E03

See also 0115 0134 0152 0153

E04 Viroses

0143

18168 FAUQUET, C.; THOUVENEL, J.C. 1981. Mosaique du manioc. (Cassava mosaic). Toumodi. Experimentation O.R.S.T.O.M. Resultats du 01-07-80 au 01-07-81. Abidjan, Cote d'ivoire, Office de la Recherche Scientifique et Technique Outre-Mer. 11p. Fr., 2 Refs., Illus.

Cassava. Cassava African mosaic virus. Cuttings. Planting. Germination. Cultivars. Resistance. Timing. Ivory Coast.

The results of research carried out by the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) in Toumodi, Ivory Coast, from July 1980-July 1981, to determine the % of natural infection by mosaic of healthy plants of cassava var. CB, 86, 87, H34, H57, H58, Ta 49, and Bonoua Rouge are given. Germination % of these var. varied from 88-89%. Var. 87 was the most susceptible; therefore it had to be completely eliminated. Var. H34 was the most resistant (28.1%). The other var. had the following infection %: H58 (35.4), CB (41.3), Ta 49 (42.0), H57 (43.8), Bonoua Rouge (56.0), and 86 (94.0). Planting time affected the % of infection of var. CB and Bonoua Rouge passing from 41.3% in July to 1.7% in Sept. for the 1st var. and 56 to 5.8% for the 2nd var. On the other hand, the % of infection increased in var. H34 from 28.1 to 42%. No influence of rainfall on cassava infestation was observed. (Summary by S.B. Trans. by L.M.F.) E04

0144

18179 TERRY, E. R. 1982. Resistance to African cassava mosaic and productivity of improved cassava cultivars. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.415-429. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Cultivars. Resistance. Cassava African mosaic virus. Tuber productivity. Dry matter. Timing. Nigeria.

Improved cassava cv. TMS 30211 and TMS 30395 (with varying levels of resistance to CAMD) were evaluated for their productivity (root fresh wt., root size and no., top fresh wt., and DM content) under varying levels of CAMD incidence and stress and compared with the local susceptible cv. Isunikakiyan. Yield reductions due to clonal CAMD-infection (plants established from CAMD-infected cuttings) differed significantly among the 3 test cv., with the highest reductions in the susceptible unimproved cv. Yield reductions due to vector CAMD-infection were consistently lower than those in plants established from CAMD-infected cuttings. The lowest rate of increase of CAMD incidence and severity on plants established from CAMD-free cuttings was recorded for resistant cv. TMS 30395. Data indicate that one component of resistance to CAMD is the resistance to vector inoculation of the agent into the cassava plant. The implication of this finding and its importance in maximizing cassava productivity under CAMD stress are discussed. (Author's summary) E04

See also 0115 0153 0156

E06 Nematodes

See 0156

F00 PEST CONTROL AND ENTOMOLOGY

F01 Injurious Insects and their Control

0145

18424 APEJI, S.A. 1980. Euproctus fasciata Walker (Lep., Lymantriidae) feeding on cassava in northern Nigeria. Entomologist's Monthly Magazine 116(1388/1391):92. Engl.

Cassava. Entomology. Euproctis fasciata. Nigeria.

On June 7, 1979 about 120 newly hatched caterpillars were found clustered on the lower surface of a cassava leaf in an observation plot at Samaru, northern Nigeria. The remains of egg shells were still being eaten by their recent occupants. Caterpillars were removed for rearing on cassava leaves, on which they thrived, pupating from July 12 They had urticating hairs which broke off easily. Adults began to emerge on July 27, mostly after dusk. Adult moths were determined as Euproctis fasciata by comparison with examples from Samaru determined by the late C.L. Collenette. The species has previously been recorded at Samaru from larvae found feeding on groundnut leaves and, on one occasion, on leaves of an attempted establishment of apricot trees. (Complete text) F01

0146

18455 DUNSTAN, W.R.; MAGAZINE, I.A. 1981. Tanzania - the larger grain borer on stored products. FAO Plant Protection Bulletin 29(3/4):80-81. Engl.

Cassava. Cassava products. Processed products. Storage. Injurious insects. Prostephanus truncatus. Tanzania.

Prostephanus truncatus was found causing severe damage to stored maize, dried cassava, and occasionally the timber supports of stores in the Tabora region of Tanzania in April-May 1981. The bostrichid was subsequently also found in the Shinyanga region and in Mwanza. (Summary by Review of Applied Entomology) F01

See also 0115 0149 0152 0156

F03 Injurious Mites and their Control

See 0115 0152

G00 GENETICS AND PLANT BREEDING

G01 Breeding, Germplasm, Varieties and Clones, Selection

0147

18470 ANZULES, V.; CARCELEN L., R. 1983. Investigacion sobre yuca en Ecuador. (Cassava research in Ecuador). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.83-91. Span., Sum. Span., 8 Refs.

Cassava. Cultivars. Selection. Tuber productivity. Dry matter. Starch content. Cassava programs. Ecuador.

Cassava is one of the traditional crops exploited in the low Ecuadorian tropics. It is mainly planted by small farmers who do not uae the inputs recommended by modern agricultural technology. The private and public economic sectors, on the other hand, have not shown interest in the crop. Approx. 25,000 ha have been planted to cassava in Ecuador and av. yields of 9 t/ha are obtained. As of 1976, the Instituto Nacional de Investigaciones Agropecuarias (INIAP) began research work on cassava by introducing promissory material and establishing regional trials throughout the country. Five regional trials have been conducted and 18 var. and 20 hybrids have been introduced from CIAT. The province of Loja is the area in which research results have been best applied in on-farm trials; technology has been directly released to farmers in field days and demonstrations. At request of the farmers, promissory var. CMC-40, ICA HMC-7, and M Col 22 have been released in the area of Loja and in eastern Ecuador, ICA HMC-2 and M Col 1684, outstanding for their yields and agronomic characteristics. (Author's summary. Trans. by L.M.F.) G01

0148

18467 CACERES, L. A. 1983. Programa de yuca en Paraguay: comienzo y

desarrollo. (The cassava program in Paraguay: its initiation and development). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.51-59. Span., Sum. Span., 3 Refs.

Cassava. Production. Cultivation. Cultivars. Selection. Plant breeding. Germplasm. Cassava programs. Paraguay.

In Paraguay cassava is traditionally cultivated by small and intermediate farmers, the majority of the country's population, who consume cassava directly as a dietary supplement. It is also processed at home to obtain starch to be used in preparing different edible foodstuffs and for industrial purposes. Generally, near 190,000 ha are planted per year, cassava occupying 4th place (12%) among temporary crops. Only 43 of the great amount of var. existing in the country have been collected. With the help of the FAO, through the International Board for Plant Genetic Resources (IBPGR), a greater no. of var. is being collected. Several trials on agronomic practices as well as regional trials with the 10 most commonly cultivated var. (Concepcion, Jovy, Pomberi, San Rafael, Toledo, Yeruti-i, Tacuara, Canario, Cano, Yeruti Guazu) are being conducted, one of the trials at Caacupe and the other at Chore. Crosses are planned to be made between national var., introduced var., national and introduced var., multiple crossing, and screening of material from segregating populations. (Author's summary. Trans. by L.M.F.) G01

0149

18189 CENTRO AGRONOMICO TROPICAL DE INVESTIGACION Y ENSENANZA. UNIDAD DE RECURSOS GENETICOS. 1981. Catalogo de la coleccion de yuca (Manihot esculenta Crantz) del CATIE. (Catalog of the cassava collection at CATIE). Turrialba, Costa Rica. Serie Tecnica. Boletin Tecnico no.2. 40p. Span., Illus.

Cassava. Germplasm. Clones. Identification. Silba pendula. Resistance. Costa Rica.

Data on the environment and the planting conditions under which the cassava clones that form part of the germplasm bank at the Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE) in Turrialba, Costa Rica, were evaluated are given. The descriptors used to characterize the germplasm are listed and defined. Results of the systematic description of 153 cassava clones include data on clone identification (no. of introduction, name, country and locality of origin, and yr of introduction), characteristics of the root, stem, and leaf, and degree of resistance to Silba pendula. Information on the codes used to describe colors, the clones that are probably duplicated, and distribution frequencies is given in annexes. (Summary by J.L.S. Trans. by L.M.F.) G01

0150

18468 CORREA, H.; TERNES, M. 1983. La investigacion con yuca en el sureste y sur del Brasil. (Research on cassava in southeastern and southern Brazil). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.61-71. Span., Sum. Span., 4 Refs.

Cassava. Cassava programs. Research. Cultivars. Selection. Starch productivity. Tuber productivity. Foliage. Resistance. Bacterioses. Brazil.

The Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF), located in Cruz das Almas, BA, Brazil, has a national cassava collection consisting of 850 materials, of which approx. 250 have been evaluated in several regions of the country. The changing socioeconomic conditions of rural areas affects cassava cultivation. Agronomic practices vary from one region to another, mainly regarding soil preparation, selection of cuttings, plant population, fertilization, weed control, and mechanization. Bacteriosis (Xanthomonas campestris pv. manihotis) is considered the most severe disease and a factor limiting cassava production both in the SE (Minas Gerais) and southern part (Santa Catarina) of the country. Var. IAC 12-829, IAC 7-127, Mico, Manjari, Sonora, Paiza, IAC 105-66 (Caapora), Engana Ladrao, IAC 24-2 (Mantiqueira, CMC-40), IAC 352-6, Pirassununga, and CM 425-5 were released for the SE and var. Mico, Mandim Branca, and Aipim Gigante for the southern area. All of these var. are resistant to bacteriosis and yield more than 20 t/ha. Av. yields in Brazil are 14 t/ha, being lower in the SE than in the south. There are 26 cassava production systems, published as technical bulletins, to advise farmers on var. and cultural practices to increase production. (Author's summary. Trans. by L.M.F.) G01

0151

18167 D'OLIVEIRA, L .O. B. 1971. Experimento de competicao de variedades de mandioca; executado no periodo de 25-09-69 a 25-01-71. (Trial on competition of cassava varieties, conducted between 25-09-69 and 25-01-71). Petrolina-PE, Brasil, Superintendencia do Vale do Sao Francisco. Estacao Experimental do Bebedouro. 14p. Port.

Cassava. Cultivars. Selection. Tuber productivity. Composition. Foliage. Brazil.

At the Bebedouro Exptl. Station, Brazil, cassava var. Cigana, Aipim Casca Roxa, Sutinga Branca, Vassoura Branca, Sutinga, Mamao, Salangorzinha, and Platina were planted in order to determine which var. is best for human and animal nutrition in terms of its root and foliage production. No statistical differences were observed among var. regarding foliage yield at 4 cuttings, ranging from 44,052 kg/ha for Aipim Casca Roxa to 68,467 kg/ha for Platina. However, statistical analysis of the yields showed that with a min. significant difference of 5176 kg/ha, highest yielding var. were in descending order: Mamao (51,153 kg/ha) and Salangorzinha (46,538 kg/ha); Sutinga (45,288 kg/ha) and Sutinga Branca (40,964 kg/ha); Vassoura Branca (38,669 kg/ha), Cigana (37,948 kg/ha), and Aipim Casca Roxa (37,692 kg/ha); and Platina (31,089 kg/ha). Var. Mamao was statistically superior in root yield. (Summary by EDITEC. Trans. by L.M.F.) G01

0152

17544 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO NACIONAL DE PESQUISA DE MANDIOCA E FRUTICULTURA. 1980. Projeto mandioca. (Cassava program). In _____. Relatorio tecnico anual do Centro Nacional de Pesquisa de Mandioca e Fruticultura-1979. Brasilia. pp.92-132. Port. Illus.

Cassava. Cassava programs. Germplasm. Cultivars. Clones. Selection. Adaptation. Tuber productivity. Foliage. Starch content. Starch productivity. Spacing. Cuttings. Planting. Storage. Timing. Land

preparation. Entomology. Mononychellus tanajoa. Erinnyis ello. Predators. Vatiga illudens. Silba pendula. Xanthomonas manihotis. Glomerella cingulata. Uromyces. Resistance. Brazil.

Major results obtained in 1979 by the cassava program of the Centro Nacional de Pesquisa de Mandioca e Fruticultura of the Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA), Brazil, are given in detail. Advances in the following areas are covered: genetic breeding (cv. selection, F_1 hybrid selection, hybridization, adaptation of cv., use of wild Manihot species in genetic improvement, and assessment of active germplasm bank); crop management and cultural practices (planting in double rows, conservation of branches for planting material, and effect of cutting length and diameter on yield); soil management and conservation (depth of tillage and min. tillage cultivation system); fertilization and mineral nutrition (application rates and times of N, rates and methods of applying P, sources and rates of P, and application rates, methods and times of K); entomology (economic damage caused by the mite Mononychellus tanajoa, identification of mite predators (Typhlodromalus limonicus and Typhlodromalus sp.), use of the dipteron Euphorocera sp. to control Erinnyis ello larvae, use of Trichogramma sp. to control E. ello eggs, determination of cassava pests and their fluctuations in population, yield losses due to the attack of Vatiga illudens, and effect of the attack of Silba pendula on yields); plant pathology (control of Xanthomonas manihotis through genetic breeding and selection of cv. resistant to Colletotrichum gloeosporioides); water stress and cassava production. (Summary by EDITEC. Trans. by L.M.F.) G01

0153

18180 EZUMAH, H. C. 1982. Cassava selections for the Republic of Zaire. In Belen, E.H., Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.385-397. Engl., Sum. Engl., Illus.

Cassava. Clones. Selection. Tuber productivity. Resistance. Cassava African mosaic virus. Xanthomonas manihotis. Mycoses. Leaf area. Plant development. Leaves. Starch content. Dry matter. Zaire.

Cassava production in Zaire is threatened by 3 major diseases [CAMD, CBB (Xanthomonas manihoti), and anthracnose (Colletotrichum spp.)] and 2 serious pests [(mealybugs (Phenacoccus spp.) and green mites (Mononychellus tanajoa)], resulting in part, to reduced yield since 1972. Progress made in selecting high yielding resistant clones as well as factors to consider in selecting for high root and leaf yield are presented. Depending upon sites, yield increases from improved cv. ranged from 50% to over 300%. The performance of selected clones on farmers' fields (fresh root yield, DM and starch content) and the stability of their resistance to diseases are examined as well as plant vigor in relation to major diseases and as a selection criterion for yield, and pattern of leaf development of 7 cv. Studies and cultural practices to strike a balance between high leaf yield and high root yield are recommended. (Summary by J.L.S.) G01

0154

18464 GUZMAN A., L. 1983. Desarrollo del programa de yuca en la Republica Dominicana. (Development of the cassava program in the Dominican Republic). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982.

Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83 pp.13-28. Span., Sum. Span., 3 Refs.

Cassava. Production. Consumption. Germplasm. Cultivars. Tuber productivity. Selection. Identification. Socio-economic aspects. Uses. Cassava programs. Dominican Republic.

The importance of cassava cultivation in the Dominican Republic, as a staple foodstuff that is consumed and commercialized in the form of casave or cassava cookie, is analyzed. Growing sweet cassava represents a good source of foreign exchange in the exporting of fresh roots to Latin markets in the USA. In the Dominican Republic 20,000-25,000 ha are planted to cassava with av. yields of 10 t/ha. More than 30 cassava var., that differ regarding productivity, growth cycle, root shape and color, are grown in commercial plantings. More than 20 bitter var. exist among which are Zenon, Bilin, Jibara Blanca, and Machetazo and 8 sweet var. among them Facundo, Agua de Coco, La Blanca, and Agua Dulce, in particular. Introduced var. are important in order to respond to the increase in demand generated by industrialization processes. Regional trials carried out during the last 5 years have confirmed the higher potential production of introduced var. Among introduced var., CMC-40 has been outstanding (up to 50 t/ha) and could be highly demanded by agroindustries. Since the Dominican Republic imports all of the wheat for breadmaking, 80% of the maize, and all of the barley that is consumed, serious thoughts have been given to the role cassava could play in this type of market. A well-defined strategy should be adopted on the mechanisms used in the release of outstanding var. to farmers; likewise, a pilot project of cassava drying for poultry and swine nutrition should be established. The implementation of a cassava seed certification program is of utmost importance. (Author's summary. Trans. by L.M.F.) G01

0155

18473 HERSHEY, C. D. 1983. Germoplasma basico y mejorado de yuca disponible en el CIAT y su manejo por los programas nacionales de yuca. (Basic and improved cassava germplasm available at CIAT and its management by national cassava programs). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.113-124, 150-184. Span., Sum. Span., 2 Refs.

Cassava. Germplasm. Plant breeding. Seeds. Cuttings. Selection. Cassava programs. Colombia.

The different forms of germplasm available at CIAT and the handling and facilities required for each one are described. Germplasm can be classified according to its type of propagation (vegetative or by sexual seed) and its stage of development measured by its genetic manipulation and selection. The advantages and disadvantages of the alternatives of germplasm introduction are discussed. The 4 forms of germplasm are: (1) Basic material in form of in vitro meristem tissue culture, sent to advanced programs with trained personnel capable of making and assessing crosses. (2) Hybrids from crosses extensively evaluated under different edaphoclimatic conditions in Colombia, selected for each country according to its needs. This material is also sent as in vitro culture, and preferably to programs that can not make specific crosses. (3) Directed or controlled crosses, material sent as sexual seed mainly to advanced programs that can handle segregating populations. (4) Open-pollinated crosses sent in the form of sexual seed to advanced programs. Unlike

directed crosses, these have a common parent widely tested under the environmental conditions for which the cross is requested in a given country. (Extracted from author's summary. Trans. by L.M.F.) G01

0156

18162 INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1981. Root and tuber improvement program; cassava. In _____. Annual report 1980. Ibadan, Nigeria. pp.51-64. Engl., Illus.

Cassava. Cassava programs. Plant breeding. Cultivars. Selection. Tuber productivity. Foliage. Dry matter. HCN content. Resistance. Mononychellus tanajoa. Phenacoccus manihoti. Biological control. Predators. Entomology. Cassava African mosaic virus. Vectors. Disease transmission. Xanthomonas manihotis. Nematodes. Clones. Germplasm. Gari. Nigeria.

Significant results of research activities carried out by the Root and Tuber Improvement Program of the International Institute of Tropical Agriculture (IITA) in 1980 are given. Activities included are genetic improvement (var. performance, performance of promising clones, low cyanide clones, clones resistant to Mononychellus tanajoa and heritability of this resistance, factors affecting the garification rate, and distribution of improved var. in Nigeria), entomology (screening for resistance to M. tanajoa and Phenacoccus manihoti and biological control of P. manihoti with the coccinellid Hyperaspis sp.), pathology (frequencies of transmission of CAMD by Bemisia tabaci and epiphytic populations of Colletotrichum manihotis on cassava), nematology (screening for resistance to Meloidogyne incognita and M. javanica), and tissue culture and virus indexing (distribution of cassava for international testing). The activities in genetic improvement and quality evaluation of Zaire's National Manioc Program (PRONAM) and the Cameroon National Root Crops Improvement Program (CNRCIP) are described. (Summary by EDITEC. Trans. by L.M.F.) G01

0157

18465 LENOIR, H. 1983. Investigacion sobre adaptacion de la yuca en Haiti. (Research on the adaptation of cassava in Haiti). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.29-35. Span., Sum. Span., 1 Ref.

Cassava. Cultivars. Adaptation. Tuber productivity. Cassava programs. Haiti.

Cassava cultivation in Haiti is described. It is generally planted on small farms in association with maize, bean, sorghum, cowpea, groundnut, and plantain. As food, it is consumed in the form of home-made casave cakes. Production technology and cultural practices are adequate in Haiti, except for the selection of planting material (cuttings less than 20 cm long are used). The national av. yield, however, is 4 t/ha due mainly to the lack of high-yielding var. This deficiency has been partly corrected by the introduction of 21 promissory materials from CIAT. These were multiplied by the rapid propagation technique and were later evaluated at the Acul du Nord exptl. station and in on-farm trials. Sweet var. CMC-40 and bitter var. MCol 1684 were selected for their root yield and no. of casave cakes produced/ha planted. Var. CMC-40 has already been released as Madame Jacques and MCol 1684, which is already in the multiplication stage, will

soon be released. Hybrids CM 321-188, CM 323-375, and CM 342-55 are also being multiplied. (Author's summary. Trans. by L.M.F.) G01

0158

18471 LOZADA, E.; LUNA R., J.M. 1983. La investigacion sobre el cultivo de la yuca en Colombia. (Research on cassava in Colombia). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.93-100. Span., Sum. Span., 2 Refs.

Cassava. Cultivars. Selection. Hybrids. Cultivation. Cassava programs. Colombia.

In Colombia cassava cultivation is still not sufficiently technified due to the dispersion of exploitations and to their reduced size. Only a small % of farmers apply the technology recommended by the Instituto Colombiano Agropecuario (ICA); those farmers living in the central part of the country receive more benefits. Cassava cultivation has spread to regions below 2000 m.a.s.l.; however, the departments with the greatest area planted to cassava are Santander del Sur, Magdalena, Sucre, Bolivar, Meta, Cauca, and Quindio. Area planted ranges between 170,000-200,000 ha, with a current av. yield of 11 t/ha (in 1973, 8 t/ha). This increase, registered by the Oficina de Planeacion del Sector Agricola (OPSA), responds possibly to the impulse given to the crop by the Federacion Nacional de Cafeteros and the ICA in the central region of the country, as well as the attractive price paid for cassava during the last 8 yr. Var. that have been released to farmers are CMC-9 (Valle del Cauca, Meta), CMC-40 and CMC-76 (Atlantic coast, Tolima), CMC-57 (Atlantic coast, Antioquia), CMC-59 (Antioquia, Caldas), Valluna (Valle del Cauca, Quindio, Risaralda, Caldas), CMC-92 (Cauca), Chiroza (Valle del Cauca, Quindio), hybrids ICA HMC-1 and ICA HMC-2 (Valle, Quindio, the area of Patia, Magdalena Medio), ICA HMC-53 (Uraba), M Col 1684 (Atlantic coast, Piedemonte Llanero, Magdalena Medio), M Mex 59 (Piedemonte Llanero), and M Col 22 (Atlantic coast). (Author's summary. Trans. by L.M.F.) G01

0159

18466 MENDEZ R., A. 1983. Avances del programa de yuca en Mexico. (Highlights of the cassava program in Mexico). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.37-49. Span., Sum. Span., 5 Refs.

Cassava. Cassava programs. Germplasm. Cultivars. Hybrids. Selection. Tuber productivity. Cultivation. Uses. Resistance. Mexico.

Since 1967 research work on cassava in Mexico has been conducted in an isolated manner, basically focussed on the observation and evaluation of cassava var. regarding their value as garden produce. Before beginning the cassava program as such, in 1977, approx. 2000 ha were planted to cassava in Mexico. Currently, this area has duplicated due to the efforts of the cassava program and the rural development services of the Banco Rural. Mexico has a germplasm collection that includes 256 materials, 110 Mexican and 146 introductions. During the assessment of selected materials in on-farm regional trials in the Huimanguillo area, 4 var. (MMex 59, Guaxupe, MPan 51, and the hybrid SG-596-C-59-12) were outstanding; 2 of these have

been released: MMex 59 as Costena and MPan 51 as Sabanera. (Author's summary. Trans. by L.M.F.) G01

0160

16254 MORAES, O. DE; TERNES, M.; MONDARDO, E.; MIURA, L.; MOREL, D.A.; SCHMITT, A.T. 1981. Mandioca. (Cassava). In Empresa Catarinense de Pesquisa Agropecuaria, Florianopolis, SC. 1981. Recomendacao de cultivares para o Estado de Santa Catarina 1981-1982. Florianopolis. Boletim Tecnico no.6. pp.41-44. Port., 3 Refs., Illus.

Cassava. Cultivars. HCN content. Starch content. Tuber productivity. Resistance. Xanthomonas manihotis. Brazil.

A list of cassava cv. recommended for production in Santa Catarina, Brazil, is given along with some of their agronomic and production characteristics. Var. Mico, Mandim Branca, and Aipim Gigante are included with their classification as to HCN content, tuber yield, starch content, pulp and peel color, plant height, and resistance to CBB (Xanthomonas manihotis). (Summary by EDITEC. Trans. by L.M.F.) G01

0161

18410 PEREIRA, A.S.; LORENZI, J.O.; MONTEIRO, D.A.; VEIGA, A. DE A. 1981. Estudo de uma progenie de autofecundacao de mandioca Guaxupe. (Study on progeny of self-pollinated cassava Guaxupe). Bragantia 40:217-219. Port., Sum. Engl., 2 Refs., Illus.

Cassava. Cultivars. Selfing. Plant anatomy. Tuber productivity. Harvest index. Brazil.

The progeny of self-pollinated cassava Guaxupe was studied to determine the % of plants with similar phenotypes and the influence of self-pollination on vigor and root production in trials carried out in Campinas, SP, Brazil. Harvesting took place at 16 mo. and the following parameters were observed: root and branch production, node formation, branching habit, shape of leaf lobes, and color of petioles, branches, terminal buds, suberin membranes, and root pulp. Data obtained indicate that Guaxupe is homozygous for some physical characteristics of the canopy and roots since 92.1% of the progeny plants were similar to the cv.; 52 and 30% of them had higher root yield and HI, resp., than the check cv. (Author's summary) G01

0162

18177 RAJENDRAN, P.G.; HRISHI, N. 1982. Variation in dry matter content of tuber in seedling population of three crosses of cassava. In Belen, E.H.; Villanueva, M. eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.457-460. Engl., Sum. Engl., 3 Refs., Illus.

Cassava. Tubers. Dry matter. Crossbreeding.

Three crosses of cassava involving 4 parents, 3 exotic (Ce 22, Ce 110, Ce 177) and one indigenous (Ci 776), with different DM content in tubers were studied. Patterns of variation in the F_1 population are reported. Parents Ce 22 and Ce 177 had high DM content while Ce 110 had medium and Ci 776 low DM contents. When these were crossed in 3 combinations (Ce 22 x Ce 177, Ce

22 x Ce 110, Ce 22 x Ci 776), a higher frequency of seedlings containing more DM than the parents was observed when both parent tubers had high DM content. DM contents varied from 19.2-66.4%. (Author's summary) G01

0163

18474 ROCA, W. M.; RODRIGUEZ, J. 1983. Distribucion internacional de clones de yuca in vitro. (In vitro international distribution of cassava clones). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.125-133. Span., Sum. Span., 11 Refs.

Cassava. Tissue culture. Apical meristems. Propagation. Clones. Germplasm. Colombia.

In vitro shoot-tip meristem culture and its modifications constitute the most useful propagation technique in cassava. Meristem culture maintains vegetative material isolated from possible contaminants (practically disease-free). Since this culture method occupies little space and has a high potential rate of propagation, it can be used in the international exchange of cassava clones. The process of transferring in vitro cassava clones is described: culture establishment, packing and shipment, and handling at the receiving end. (Extracted from author's summary. Trans. by L.M.F.) G01

0164

18463 RODRIGUEZ N., A. 1983. El cultivo de la yuca en Cuba durante la ultima decada. (Cassava cultivation in Cuba during the last decade). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.1-12, 143-146. Span., Sum. Span., 4 Refs.

Cassava. Cultivars. Selection. Propagation materials. Cassava programs. Cuba.

The Cassava Program in Cuba, based on the research projects carried out by the Centro de Mejoramiento de Semillas Agamicas (CEMSA) and complemented by 3 other exptl. stations that cover the areas of most interest to cassava cultivation, is described and the results obtained during the last 10 yr are given. The program consists of the following sections: germplasm and plant breeding, plant protection, agronomy, mechanization, herbicides, soils and plant nutrition, biological control, meristem culture, and production of cuttings. Currently 65% of the total area (37,218 ha) is planted with selected var., representing an increase of 15,000 ha in the last 4 yr. The av. yield, in most of the state farms, increased in these same 4 yr from 7 to more than 20 t/ha. A new technology, that is currently known in Cuba as the Colombian system, was introduced from CIAT along with the method of accelerated multiplication and germplasm. Selected scientific personnel has likewise been trained. A total of 280 of the 305 materials belonging to the Cuban cassava collection are native. On the basis of selection and evaluation of promissory materials, 4 var. have been released during regional trials: Senorita, Pinera, CMC-40, and CEMSA 5-28. The process of releasing selected material to the farmers and the certification of cassava seed are also described. (Author's summary. Trans. by L.M.F.) G01

0165

18469 SOLORZANO H., A. 1983. Evaluacion y difusion de variedades promisorias de yuca en Peru. (Evaluation and dissemination of promissory cassava varieties in Peru). In Toro, J.C., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.73-81. Span., Sum. Span., 5 Refs.

Cassava. Cultivars. Germplasm. Tuber productivity. Hybrids. Selection. Cassava programs. Peru.

In the Peruvian jungle region 80% of the 37,000 ha that form the total area planted to cassava in the country are cultivated. In this area, cassava is used in human and animal nutrition and for small-scale starch extraction. The national av. yield is 11 t/ha, which is below the potential yields obtained in research conducted at El Porvenir (Tarapoto) and Tulumayo (Tingo Maria) exptl. stations, where yields higher than 20 t/ha have been consistently reached in farmer's fields. There are 20 selected var. released to farmers during the last 10 yr, var that are outstanding for their high yields in the different cassava growing regions of the country. Among these, var. Blanca de Chongo-yape, Cogollo Morado, Pico de Oro, Serranita, Blanca Mochera, and Talonera with av. yields of 45, 39, 37, 35, 19, and 17 t/ha, resp., are recommended for the northern coast; var. Lucero 1M (a hybrid from free pollination), Sandy, and Negra Mochera with av. yields of 36.4, 33.6, and 23.5 t/ha, resp., for the central coastal region; and var. Negra Mochera with 20.8 t/ha for the southern coast. (Author's summary. Trans. by L.M.F.) G01

0166

18472 TORO, J.C.; COCK, J.H. 1983. La transferencia de germoplasma y de tecnologia mejorada mediante la cooperacion internacional. (Transfer of germplasm and improved technology through international cooperation). In _____., ed. Evaluacion de variedades promisorias de yuca en America Latina y El Caribe, Cali, Colombia, 1982. Memorias de un Taller. Cali, Centro Internacional de Agricultura Tropical. Serie CIAT 03SC(1)83. pp.101-112. Span., Sum. Span., 6 Refs.

Cassava. Germplasm. Technology. Cassava programs. Cultivars. Hybrids. Tuber productivity. Latin America. Colombia.

The most efficient methods used to transfer technology from the Cassava Program at CIAT to national institutions and from these to farmers, the real users of this technology, are described. Some results are given of the expansion of cassava cultivation in different countries of Latin America and the Caribbean. Notable progress has been made in both research and application of new technology of cassava production. (Extracted from author's summary. Trans. by L.M.F.) G01

See also 0139 0140 0142 0144

H00 NUTRITION

0167

18415 LEHMANN, G.; MOLLER, S. 1981. Moglichkeiten zur Verbesserung der

Welternahrungslage unter Berucksichtigung von Maniok, Soja, Milcheiweiss und Blut plasma. (Feasibility of improving world nutritional status considering cassava, soybean, milk protein, and blood plasma). Fette-Seifen-Anstrichmittel 83(12):453-461. Germ., Sum. Germ., Engl., 21 Refs., Illus.

Cassava. Human nutrition. Developmental research. Consumption. Nutritive value. Composite flours. Bakery products. Uses. Cassava flour.

Developing countries will not obtain self-sufficiency with conventional food based on cereals (annual increase of consumption, 3.7% vs. annual increase of production, 2.6%) in spite of intense agricultural support given by industrial countries. Cassava with its high starch and flour yield and soybean with its high protein content can represent the main support of nutrition in the coming decades if modern food technology is applied. Bread and extrusion products from cassava starch and flour together with soybean flour and lupine flour or from mixtures with wheat flour will make up a reliable component of human nutrition in the next years. (Author's summary) H00

0168

18433 OMAWALE; RODRIGUES, A.M. 1980. Nutrition considerations in a cassava production program for Guyana. Ecology of Food and Nutrition 10(2):87-95. Engl., Sum. Engl., 16 Refs.

Cassava. Cassava programs. Human nutrition. Socio-economic aspects. Developmental research. Diets. Costs. Food energy. Proteins. Guyana.

To increase food self-sufficiency, the Guyana government has proposed a policy of progressive reduction of wheat imports accompanied by expanded production of cassava. To evaluate this strategy which might increase the prevalence of malnutrition because of cassava's low protein content, a study of areas targeted for increased cassava production was conducted. Surveys were administered to 129 households, including 163 young children randomly selected from 4 major cassava growing areas in NW Guyana. The 1st 3 areas - classified as the Market Area - were heavily dependent on market purchases. The other area - classified as the Semi-subsistence Area - was comprised mainly of small farmers who produced most of their own food. Information was collected on land ownership, family size, food expenditures, and dietary intake. The latter included 7-day recall and analysis of the protein and energy content of one day's meals consumed by a subsample of 12 children. Prices of food items commonly purchased were obtained from local markets in order to calculate the av. costs of an adequate family diet. In both areas, per capita food expenditures were consistently higher among large, as opposed to small, farm households, with the disparity greater in the Semi-subsistence Area. Frequency of cassava consumption (largely self produced) in the Semi-subsistence area was inversely related to consumption of purchased items such as wheat, flour, milk, rice, legumes, meat, and eggs. These items were eaten more frequently by large farm households. No such consumption differences were found between households of different sizes in the Market Area. In the Semi-subsistence Area, less than 5% of households spent enough to ensure adequate intake of energy and protein; the corresponding figure for the Market Area was 13%. Overall, a higher total intake of protein and energy was found in the Market Area and among larger farm households in each area. Evidence presented concerning children under age 3 yr indicated low levels of undernutrition. Seventy-two percent of Semi-subsistence Area children and 63% of children from the Market Area were normal or above Gomez standards for wt.-for-age. Surprisingly, the prevalence of malnutrition did

not differ according to household size. These findings are believed to reflect the practice of prolonged breastfeeding, especially among small farm households in Semi-subsistence regions. Analysis of the diets of the subsample of 12 children also showed that, except for one child, protein and energy consumption were adequate. It is concluded that if the cassava program leads to greater production and income for small farmers, it should result in increased energy intakes for these households and, in many cases, greater purchases of milk, legumes, and meat which would supplement the cassava porridge that is a major component of weaning diets. Care must be exercised in the Semi-subsistence Area to ensure that the program makes more food available and that it does not reduce the real incomes of the urban poor. Food price stabilization policies should be implemented along with continued nutrition surveillance during the program's operation. Seven tables are provided. (Summary by Nutrition Planning) H00

H01 Cassava Foods and Nutritive Value

0169

18427 MADUAGWU, E.N.; FAFUNSO, M. 1980. Particle size distribution of hydrocyanic acid in gari, a cassava-based product. Toxicology Letters 7(2):171-174. Engl., Sum. Engl., 12 Refs., Illus.

Cassava. Gari. HCN content. Sugar content. Carbohydrate content. Analysis. Nigeria.

The distribution of free HCN in the various particle sizes of gari was studied to determine the possible relationships between HCN content and particle size, and with sugar and starch content. Eight random samples of commercial gari were each sieved into 4 different particle sizes (approx. 2000, 1000, 500, and 250 um). Free HCN, sugar, and starch contents were determined using equal wt. (2 g for HCN and 100 mg for sugar/starch) of each particle size of a given test sample. A reciprocal relationship was observed between the cyanide content of gari and particle size. HCN content was positively correlated (r = 0.62) with sugar content but the correlation with starch content was poor (r = 0.33). From both the nutritional and toxicological standpoints, it would appear that larger particle size in gari is beneficial. (Author's summary) H01

0170

18107 RAJA, K.C.M.; ABRAHAM, E.; MATHEW, A.G. 1982. Effect of defatting on amylose contents, viscosity characteristics and organoleptic quality of cassava (Manihot esculenta Crantz). Journal of Food Technology 17:761-765. Engl., 8 Refs.

Cassava. Cassava flour. Fat content. Analysis. Viscosity. Gelatinization. Organoleptic examination.

Six cassava var. (M-4, H-97, H-2304, H-165, H-226, H-1687) were studied for their total, water soluble, and insoluble amylose content in plain (non-defatted) and in defatted CF. Organoleptic qualities in terms of stickiness were also determined. Viscosity characteristics (peak, hot paste, and cold paste viscosities; break down and set back) and gelatinization temp. of var. M-4, the most popular var. grown in Kerala, India, were also studied. The flour produced from freshly harvested tubers was defatted by: (1) extracting with n-hexane in a Soxhlet for 16 h and (2) extracting with a solvent system consisting of chloroform-methanol (2:1) in

a ratio of 1:5 (w/v) at room temp. in a blender. The amount of fat extracted from the samples ranged from 0.40-0.57% for the 1st method and from 0.9-1.2% for the 2nd one. Defatting the flour with chloroform-methanol enhanced the amylose content. The true amylose content of cassava var. varied from 20.3-21.9%, and from 18.4-19.9% for the n-hexane defatted flour and from 20.3-21.9% for the chloroform-methanol defatted flour. Defatting with chloroform-methanol also increased the hot water soluble amylose content, except for var. H-1687. The hot water soluble amylose content varied from 12.4-15.4% in plain non-defatted flour and from 12.4-17.8% in defatted flour. Defatting of the var. M-4 flour lowered the gelatinization temp. from 73.5°C for plain flour to 69°C for n-hexane defatted flour and 66°C for chloroform-methanol defatted flour. Also, defatted CF samples showed lower peak and hot paste viscosities after defatting, especially with chloroform-methanol. During the organoleptic study, no direct correlation was observed between insoluble amylose content and stickiness. (Summary by S.B.) H01

0171

18419 SUZUKI, K.; KANKE, Y.; GOTO, S. 1981. Effect of starches on protein and mineral utilization. Nutrition Reports International 23(4):645-652. Engl., Sum. Engl., 10 Refs., Illus.

Cassava. Cassava starch. Uses. Dietary value. Laboratory animals. Animal physiology. Analysis. Proteins. Minerals and nutrients.

For 2 periods of 7 days 36 male albino Wistar rats were given diets with 10% casein or soybean and 80% maize, rice, or cassava starch. Wt. gain and wt. gain/N intake were less with cassava than with the other starches in the 2nd period on a diet containing soybeans. The type of starch sometimes affected the retention of minerals. Rats fed the cassava starch with soybean protein diet showed a positive Cu balance and higher hemoglobin value. (Summary by Nutrition Abstracts and Reviews) H01

See also 0191 0195 0196 0212

H02 Nutritive Disorders in Humans

0172

18160 COLINET, E.; ERMANS A.M.; DELANGE, F. 1982. Experimental study of mechanisms responsib'e for mental retardation resulting from cassava ingestion. In Delange, F.; Iteke, F.B.; Ermans, A.M. eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.74-83. Engl., Sum. Fr., 65 Refs., Illus.

Cassava. Endemic goitre. Cretinism. Etiology. Human physiology. HCN. Toxicity. Thiocyanates. Analysis. Diets. Iodine. Deficiencies. Biochemistry. Endocrine disorders. Laboratory animals.

The role of cassava consumption by the mother during pregnancy and lactation on the development of irreversible cerebral lesions in the newborn and during the 1st wk. of life was evaluated. The respective roles of HCN itself and of the resultant hypothyroidism in the development of

these lesions were assessed experimentally in rats. Different lots of pregnant and lactating rats were submitted to I-deficient diets, supplemented with HCN or SCN, with or without added I. Young rats were sacrificed at birth and at the end of the lactation period (16 days); the nucleic acid, protein, and lipid contents of the cerebral hemispheres and cerebellum were measured to detect eventual alterations of cell no., density, and size. Levels of serum SCN and T_4 were also determined. The administration to female rats of an I-deficient diet supplemented with HCN induced marked thyroid hyperplasia and decreased serum T_4 levels in both mothers and offspring, indicating thyroid insufficiency. These effects are more important than those due to I deficiency alone and are corrected with a normal supply of I. HCN overload, supplemented or not with I, is accompanied by a serum SCN increase. These observations indicate that HCN-induced hypothyroidism involves its previous conversion into SCN. Cerebral development of the young hypothyroid rats is strongly altered following the administration of HCN to the mothers, subjected to I deficiency. The most stricking anomalies were observed in the cerebellum at day 16 when a strong decrease of the protein, RNA, and cholesterol contents slow down cellular growth. These anomalies were not observed when the same HCN overload is administered in the presence of a normal I supply. Whatever the diet fed to the different exptl. groups and the degree of hypothyroidism it induces, brain RNA, used as an index of the process of cellular growth, remains remarkably constant as long as the serum T_4 content is above the critical threshold of 1 ug/dl. Below this level, however, RNA content drops sharply. Nevertheless, the intake of very high SCN quantities is also susceptible to reduce the brain RNA, even when a concomitant administracion of I prevents the development of hypothyroidism. The effect of HCN on the cerebral development of young rats in the presence of I deficiency seems to be essentially the result of a thyroid insufficiency resulting after being converted to SCN. However, it is not excluded that at higher doses, SCN could have by itself, a toxic effect. These observations underline the risk of irreversible alterations of the central nervous system of young children associated with cassava ingestion by pregnant women, especially in the presence of I deficiency. (Author's summary. Trans. by S.B.) H02

0173

18155 DELANGE, F.; THILLY, C.; BOURDOUX, P.; HENNART, P.; COURTOIS, P.; ERMANS, A.M. 1982. Influence of dietary goitrogens during pregnancy in humans on thyroid function of the newborn. In _____., Iteke, F.B.; Ermans, A.M., eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.40-50. Engl., Sum. Fr., 66 Refs., Illus.

Cassava. Endocrine disorders. Iodine. Thiocyanates. Endemic goitre. Biochemistry. Deficiencies. Analysis. Human physiology. Human nutrition. Zaire.

Since the role played by cassava in the induction of thyroid failure in the newborn in the Ubangi area is not clear, a study was designed to evaluate the influence of the balance between the dietary supplies of I and SCN in pregnant women on the thyroid function of the newborn, assess the role played by SCN of maternal origin on this function, and compare the relationship between the maternal and newborn thyroid functions in normal conditions and in severe endemic goitre. Concn. of serum TSH, T_4, T_3, and SCN were determined in cord blood samples of 674 newborns in Brussels (Belgium); Kinshasa, Bas-Zaire, Kivu, and Ubangi (Zaire) and in 637 mothers at delivery. Urinary concn. of I and SCN and the urinary I/SCN ratios were also determined in the mothers. The Clinique Ngaliema in Kinshasa was used

as control. There was a progressive increase in the concn. of serum and urinary SCN and a decrease in the urinary I/SCN ratios in women at delivery in passing from Kinshasa through Bas-Zaire and Kivu to Ubangi. As for the adult population, a significant increase of serum TSH was only observed in Ubangi in women during pregnancy (15.8 uU/ml vs. 3.4 uU/ml, P < 0.001). On the contrary, cord TSH was higher in Bas-Zaire (9.8 uU/ml) and Kivu (10.1 uU/ml) than in the (7.8 uU/ml, P < 0.01). In Ubangi, TSH levels were 9 times higher (69.8 uU/ml, P < 0.001). In this last region, 11.2% of the newborns had a biochemical profile of sporadic congenital hypothyroidism characterized by the association of cord TSH value higher than 100 uU/ml with a T_4 value lower than 3 ug/dl. It was clearly demonstrated that SCN passes freely through the placenta in humans. The role of the maternal SCN overload in the impairment of thyroid function of the newborn in Zaire was shown by the fact that in Ubangi, where the urinary I concn. of the mothers is identical to that observed in Kivu, a more important SCN overload goes together with extreme alterations of the newborn thyroid function. Similarly, in Kivu, where the I supply of pregnant women is the same as in Brussels, but where the SCN supply is higher, the TSH ratios in the cord are significantly increased but those of T_4 decreased. In physiological conditions such as those in Kinshasa, there are no correlations between the T_4, T_3, and TSH levels measured in the mother at delivery and the newborn. However, these correlations have been observed in rural zones of Zaire, especially in Ubangi. They probably provide evidence of the action of the same environmental dietary factors on both the mother and the newborn. In conclusion, the pregnant women and, especially, newborns are more sensitive to the antithyroid action of cassava than the av. population living in the same environmental conditions. The target fraction of this population is constituted by the newborn. Consequently, systematic screening for congenital hypothyroidism constitutes the most sensitive index for detecting the risk of the thyroid function alteration and mental retardation resulting from cassava consumption in I-deficient areas. (Author's summary. Trans. by S.B.) H02

0174

18153 HENNART, P.; BOURDOUX, P.; LAGASSE, R.; THILLY, C.; PUTZEYS, G.; COURTOIS, P.; VIS, H.L.; YUNGA, Y.; SEGHERS, P.; DELANGE, F. 1982. Epidemiology of goitre and malnutrition and dietary supplies of iodine, thiocyanate, and proteins in Bas Zaire, Kivu, and Ubangi. In Delange, F.; Iteke, F.B.; Ermans, A. M., eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.25-33. Engl., Sum. Fr., 26 Refs., Illus.

Cassava. Endemic goitre. Malnutrition. Cretinism. Epidemiology. Iodine. Proteins. Thiocyanates. Biochemistry. Human physiology. Cassava products. Human nutrition. Zaire.

In order to define the nutritional conditions required in humans for cassava to induce endemic goitre and cretinism, comparative epidemiological, clinical, nutritional, and biochemical studies were carried out in Zaire in the regions of Kinshasa (control), Bas-Zaire, Kivu, and Ubangi. Brussels (Belgium) was used as control. The prevalences of goitre were 3.0, 1.5, 12.5, and 76.8% in Brussels, Bas-Zaire, Kivu, and Ubangi, resp. The figure reported for Kivu is 7 times higher than the one reported for the same region approx. 10 yr ago. This growth is due to an increasing intake of cassava. The study of clinical signs of malnutrition, wt. and height curves, and serum albumin concn. as a function of age shows that malnutrition is moderate in Bas-Zaire, extremely severe in Kivu, and only occasional in Ubangi. Dietary supply of I, estimated by urinary concn.

of I, is 5.3 ug/dl in Brussels (51.2 ug/day), a relatively low value compared with the international norms (100 ug/day). Compared with the results obtained in Brussels, I intake is hardly lower in Bas-Zaire (4.0 ug/dl), but is strongly decreased in Kivu (2.7 ug/dl) and in Ubangi (2.3 u/dl). Dietary supply of SCN, estimated from the urinary concn. of SCN, is 0.60, 1.43, 1.10, and 1.83 mg/dl in Brussels, Bas-Zaire, Kivu, and Ubangi, resp. These values are significantly higher and are due to an important consumption of cassava in these 3 regions where 91-96% of the people questioned had consumed cassava during the previous 24 h. The form in which cassava is consumed is very different in the 3 regions: cassava is soaked in Bas-Zaire, not so in Kivu, and Ubangi. As a result of the resp. modifications observed for the urinary concn. of I and SCN, the urinary ratio I/SCN used as an indicator of the dietary balance in I and SCN decreases progressively from 8.8 in Brussels to 3.8 in Bas-Zaire, 2.6 in Kivu, and 1.9 in Ubangi. In the presence of a cassava-based diet and of a low I supply, the development of endemic goitre is critically dependent on the dietary balance between I and SCN. There is no endemic goitre as long as the urinary ratio I/SCN is higher than the critical threshold of 3-4, but the goitre becomes hyperendemic and complicated by cretinism when it is lower than 2. The presence of malnutrition in a population does not affect the process of endogeneous conversion of HCN in SCN at an individual level. The massive introduction of cassava in the presence of I deficiency may result in the development of endemic goitre in previously unaffected populations. (Author's summary. Trans. by S.B.) H02

0175

18154 LAGASSE, R.; BOURDOUX, P.; COURTOIS, P.; HENNART, P.; PUTZEYS, G.; THILLY, C.; MAFUTA, M.; YUNGA, Y.; EPMANS, A.M.; DELANGE, F. 1982. Influence of the dietary balance of iodine/thiocyanate and protein on thyroid function in adults and young infants. In Delange, F.; Iteke, F.B.; Ermans, A.M., eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.34-39. Engl., Sum. Fr., 40 Refs., Illus.

Cassava. Iodine. Thiocyanates. Proteins. Diets. Biochemistry. Analysis. Human physiology. Malnutrition. Deficiencies. Human nutrition. Endocrine disorders. Zaire.

The influence of dietary environmental factors on thyroid function of the adult was studied in Bas-Zaire, Kivu, and Ubangi (Zaire) and in each of these 3 regions, the thyroid function of the infants aged 1-3 yr old was compared with that of adults. Normal Belgian patients were used as controls. Parallel to a progressive decrease of the urinary I/SCN ratios in Brussels (8.8), Bas-Zaire (3.7), Kivu (3.0), and Ubangi (1.6), a progressive and significant decrease of adult levels was observed in Bas-Zaire, Kivu, and Ubangi compared with the Belgian controls. Serum TSH levels increased only in the Ubangi region. Levels of serum T_3 were normal in Bas-Zaire, lower in Kivu, and higher in Ubangi. In spite of urinary concn. of I, identical and lower in Bas-Zaire and in Kivu, resp., than in Brussels, the thyroidal uptake of radioiodine was lower in the 1st region, not significantly different in the 2nd, but markedly higher in Ubangi. The differences observed between the infants of the 3 regions investigated in Zaire and the Belgian controls of the same age were quite similar to those observed in adults. In addition, infants in Ubangi have notably higher TSH levels than adults of the same region in spite of the fact that they are submitted to the same level of I deficiency and have higher T_4 ratios. A decrease of the balance between dietary supplies of I and SCN was followed by a progressive decrease of T_4 in the serum in adults and infants of 1-3 yr old. Significant hypersecretion of TSH was observed only when the

urinary I/SCN was less than 2. This level is lower than the one corresponding to the development of endemic goitre. These observations indicate that infants are more susceptible than adults to the antithyroid action of combined I deficiency and SCN overload resulting from cassava consumption. It is not excluded that the existent malnutrition in Bas-Zaire and Kivu is partly responsible for the decrease of T_4 levels and for the intakes lower than those expected on basis of the I intake in those 2 regions. The SCN overload could also explain this last observation. (Author's summary. Trans. by S.B.) H02

0176

18157 VANDERPAS, J.; VANDERPAS-RIVERA, M.; BOURDOUX, P.; DRAMAIX, M.; LAGASSE, R.; SEGHERS, P.; DELANGE, F.; ERMANS, A.M.; THILLY, C. 1982. Breast feeding, thiocyanate metabolism, and thyroid function in young infants in severe endemic goitre. In Delange, F.; Iteke, F.B.; Ermans, A.M., eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.59-64. Engl., Sum. Fr., 26 Refs., Illus.

Cassava. Thiocyanates. Metabolism. Endocrine disorders. Biochemistry. Endemic goitre. Human nutrition. Human physiology. Zaire.

A previous survey demonstrated that in the case of endemic goitre in Ubangi (Zaire), practically 10% of the newborns presented a biochemical profile of thyroid deficiency and that the SCN of maternal origin played a determining role in the iniciation of hypothyroidism. The question arises as to what extent the nutritional conditions present immediately after birth and during the 1st yr of growth affect the thyroid function of the young infants. Particular attention was paid to the supplements to the maternal milk administrated to breast fed infants since these infants had previously presented high serum SCN concn. although the SCN level in breast milk in Ubangi was not higher than in Brussels, Belgium. The study included 311 patients aged 0.2-83 mo. and consisted in evaluating the evolution of the prevalence of goitre, urinary SCN and I concn., and serum SCN, TSH, T_4, and T_3 levels as a function of age. It also assessed the relative importance of breast feeding and dietary supplements administrated to the infants during the 1st 5 yr. From birth to 84 mo. I deficiency is very important and does not vary as a function of age (urinary I, 1.7-2.2 ug/dl). Serum SCN, high at birth (0.75 mg/dl), decreases linearly during the first 6 mo. to about 50% of its initial value. But from the age of 12 mo. until the age of 36 mo. concn. increase to levels observed in adults. The prevalence of goitre also increased with age and paralleled the increase of serum SCN. The simultaneous increase of these 2 variables corresponds to the progressive introduction of supplements to breast feeding that consist essentially of juice of unsoaked cassava. These supplements are introduced after the age of 6 wk. and were observed in 50% of the 4 mo.-old children; 50% of the children were weaned at 27 mo. and 100% at 60 mo. Serum TSH concn. measured on the group of children studied were usually higher, and those of T_4 lower than those of Belgian controls of the same age. Starting from the age of 60 mo. or at the moment when all the infants are weaned, an additional increase of TSH is observed. Serum T_4 concn. were directly correlated to urinary I and indirectly to urinary SCN. The overload of SCN in young infants in Ubangi results from the early introduction of a cassava-based diet as supplement to maternal milk. This overload plays a determining role in the development of goitre and thyroid failure observed during the critical period of brain development. Thus, breast feeding seems to act as a protective measure against the development of endemic cretinism in Ubangi, mainly due to the delay in the introduction of cassava supplements to diets for young infants. (Author's summary. Trans. by S.B.) H02

0177

18159 VIS, H.L.; VUYE, A.; HENNART, P. 1982. Serum levels of free amino acids in mothers at delivery, newborns, and adult males. In Delange, F.; Iteke, F.B.; Ermans, A.M. eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.70-73. Engl., Sum. Fr., 11 Refs., Illus.

Cassava. Malnutrition. Biochemistry. Human physiology. Amino acids. Proteins. Analysis. HCN. Metabolism. Thiocyanates. Zaire.

Whether the malnutrition prevailing in Kivu and Bas-Zaire could constitute a limiting factor in the endogenous conversion of HCN into SCN, which requires sulfur amino acids such as met. was studied. In each of the study areas in Zaire (Bas-Zaire, Kivu, and Ubangi, and Kinshasa as control) and in Brussels (Belgium) the serum levels of free amino acids were determined in 4 different groups of patients: males aged 25-30 and 30-35 yr, pregnant women at delivery, and newborns (cord blood). In the 4 groups of patients the levels of serum met. were practically identical in the different regions. In the adult males of Kivu, but not in the mothers or in the newborns, the levels of valine, leucine, and isoleucine were lower than in the controls and the free amino acid pattern was characteristic of severe malnutrition. On the other hand, in the 4 groups of patients assessed in Ubangi levels of serum free amino acids, in particular valine and leucine, were nearly consistently higher than in the controls. It is strongly suggested that in Kivu and Bas-Zaire, in spite of protein calorie malnutrition, sulfur amino acid intake is enough to allow the endogenous conversion of HCN into SCN. In Kivu, the pattern of free amino acids along with the decrease in levels of serum albumin show the severity of malnutrition in that region. The peculiar amino acid pattern in Ubangi could not be explained; possibly resulting from a cassava rich diet and the presence of endemic hypothyroidism in that region. (Author's summary. Trans. by S.B.) H02

See also 0191

H03 Animal Feeding

0178

18145 BALOGUN, O.O.; FETUGA, B.L.A. 1981. Methionine requirements of weanling European pigs given cassava flour/soya bean meal diets. Animal Production 33(3):305-312. Engl., Sum. Engl., 21 Refs.

Cassava. Swine. Methionine. Supplements. Animal nutrition. Cassava flour. Feeds and feeding. Animal physiology. Dietary value. Nigeria.

Forty-eight Large White x Landrace weanling pigs weighing initially 9.69 kg were used to evaluate the dietary met. requirements of weanling European pigs reared under a humid, lowland, tropical environment as typified by Ibadan, Nigeria. Response criteria used were growth rate, efficiency of food conversion, carcass quality, and the wt. of some organs and individual muscles. The pigs (3 male castrates and 3 females/treatment) were given a CF-SBM diet containing 202 g CP/kg DM and supplemented with increments of multiples of 0.8 g DL-met./kg diet. Total dietary met. levels ranged from 2.3-7.9 g/kg diet DM. All diets contained 14.75 MJ digestible energy/kg DM. The expt. lasted 42 days, at the end of which the pigs were slaughtered at an av. live wt. of 17 kg. Growth rate and feed efficiency were significantly improved when the basal diet was supplemented with DL-met.

($P < 0.001$). No significant treatment differences in organ wt. were found. Met. requirements was significantly influenced by sex and age of the pigs, with castrates having lower requirements than females. Pooled estimated met. requirements for optimum growth rate and efficiency of food conversion were 4.0 and 4.3 g/kg diet DM, resp. Max. proportion of lean was recorded on the diet containing 3.1 g total met./kg DM. (Author's summary) H03

0179

18149 CONCI, V.A. 1980. A raiz de mandioca na alimentacao de suinos. (Cassava roots in swine nutrition). Lavoura Pecuaria 3(12):38-42. Port., 2 Refs., Illus.

Cassava. Uses. Swine. Animal nutrition. Silage.

The advantages of cassava production in Brazil and the use of cassava swine nutrition in the form of silage and chips are discussed. The proce of elaborating cassava silage is described and the nutritional composition of silage and chips given. The use of either product to substitute maize in rations for in-pig sows and finishing pigs did not affect animal performance regarding DM, crude protein, and digestible energy intake, time to reach slaughter wt., av. daily wt. gain, feed conversion and efficiency of protein utilization, or characteristics of the carcass measured by the area of the loin, fat back thickness, meat/fat ratio, ham yield, total meat, fat, and carcass bone yields. (Summary by EDITEC. Trans. by L.M.F.) H03

0180

18405 FFOULKES, D.; PRESTON, T.R. 1978. Forraje de yuca o batata como fuente combinada de proteina y forraje en dietas de melaza: efecto de la suplementacion con harina de soya. (Cassava and sweet potato forages as a combined source of protein and forage in molasses diets: effect of supplementation with soybean meal). Produccion Animal Tropical 3(3):188-194. Span., Sum. Span., 6 Refs., Illus.

Cassava. Forage. Sweet potatoes. Feeds and feeding. Cattle. Supplements. Proteins. Dietary value Animal physiology. Animal nutrition.

Sixteen Zebu bulls with an initial wt. of 216 kg were used to compare cassava forage (4% live wt.) and sweet potato forage (5% live wt.), with or without supplementation of 400 g soybean meal/day, in a 2 x 2 factorial design with 2 replications. A basic molasses diet with 2.5% urea was given ad libitum. The rate of live wt. gain with sweet potato forage was significantly increased by the addition of soybean meal (from 570 to 784 g/day); with cassava forage there was similar trend but the difference was nonsignificant (from 853 to 94 g/day). The effect of the forages and the soybean supplement is related to the effects on free consumption, which in turn is closely related to live wt. gain ($r^2 = 0.75$ for wt. gain and DM intake and $r^2 = 0.69$ for wt. gain and protein intake). There was a significant interaction between the effects of the different forages and the level of soybean meal on feed conversion. In the absence of soybean meal, cassava forage was superior to that of sweet potato; but in the presence of soybean meal (when protein content was not a limiting factor), the opposite effect was observed. The importance of the results of this expt. is related to the general development of cattle feeding systems based on the use of high levels of molasses/urea. The perspectives of reaching superior levels of animal performance without using protein supplements,

which have been scarce and expensive during the last years, are found feasible. (Author's summary. Trans. by L.M.F.) H03

0181

18288 GODOY, R.; ELLIOTT, R. 1981. Efecto de cinco forrajes tropicales sobre algunos parametros de la funcion ruminal y flujo de nutrientes al duodeno de bovinos alimentados a base de melaza/urea. (Effect of five tropical forages on several parameters of rumen function and flow of nutrients to the duodenum in bovines fed diets based on molasses/urea). Produccion Animal Tropical 6(2):177-184. Span., Sum. Span., 28 Refs.

Cassava. Forage. Cattle. Animal physiology. Digestibility. Feeds and feeding. Feed constituents. Animal nutrition.

Five steers with cannulas in the rumen and duodenum were fed molasses-urea ad libitum, 300 g fish meal/day, and different forages according to a 5 x 5 Latin square design. Forages used were sweet potato, cassava, Leucaena leucocephala, plantain, and sugar cane leaves, supplied at 0.5% dry basis of animal live wt. A negative correlation (r^2 = 0.72) was found between protein content and % of cell walls of the forages under study. The rate of DM degradation in the rumen, expressed as the half-life, is positively correlated (r^2 = 0.71) with the acid detergent fibre fraction of forages. The different sources of forage did not affect DM intake, rumen liquid vol., rechange rate of rumen liquid, concn. of ammoniac, or rumen pH. The flow of DM to the duodenum was positively correlated with the half-life and content of lignin in forages (r = 0.78 and 0.62, resp.). The flow of N to the duodenum was significantly higher when Leucaena was the forage source (2.58 g N/100 g OM consumed). When forage supply in diets based on molasses-urea is very restricted, it is important to select forages with high protein contents and a rumen fibre fraction with a slow degradation rate. (Author's summary. Trans. by L.M.F.) H03

0182

18133 GOMEZ G., G.; SANTOS N., J.; VALDIVIESO G., M. 1982. Utilizacion de raices y productos de yuca en alimentacion animal. (Use of cassava roots and products in animal nutrition). In Centro Internacional de Agricultura Tropical. Programa de Yuca. Yuca: investigacion, produccion y utilizacion. Cali, Colombia. pp.539-566. Span., 40 Refs., Illus.

Cassava. Leaves. Tubers. Nutritive value. Poultry. Swine. Cattle. Animal nutrition. Feeds and feeding. Supplements. Cassava meal. Forage. Colombia.

Information on the nutritional quality of cassava roots and leaves (chemical composition, root HCN content) and the use of these products in nutrition programs for domesticated animals, especially poultry and pigs, is reviewed. In feeding trials no differences were found regarding the production of broiler chicks fed rations containing similar levels of CM from either bitter or sweet var. Broiler chicks consumed greater quantities of rations with 20 and 30% CM compared with rations containing 10%. Recent results with CM-based rations for in-pig and nursing sows and for growing pigs indicate that under normal conditions it is not necessary to add met. in higher amounts than those needed to meet normal requirements. Piglets preferred and consumed greater amounts of rations containing 40% CM than rations containing 20% CM. The feasibility of efficiently using CM and sugar cane molasses as basic ingredients to totally substitute ceral grains was proven; however, the amount of soybean cake required as protein supplement is greater. Cassava forage production represents the highest

potential of utilization of cassava in ruminant nutrition. Yields more than 30 t can be obtained throughout the yr by increasing the no. of plants/ha to 111,000 with a spacing of 30 cm x 30 cm and 4 cuttings/yr of the whole plant canopy. Tables are included on the chemical composition of cassava products and the results of poultry and swine feeding programs. (Summary by S.B. Trans. by L.M.F.) H03

0183

17573 GUERRA, P. 1981. Utilizacion del forraje de yuca como fuente de proteina y fibra. 2. Forraje de yuca como alimento para el ganado bovino. (Use of cassava forage as source of protein and fiber. 2. Cassava forage as feed for bovine cattle). Carta Informativa Pecuaria (Panama) 10:7-11. Span., 10 Refs.

Cassava. Forage. Uses. Animal nutrition. Cattle.

The results obtained by several investigators on the use of cassava forage as feed for bovine cattle are compiled. Cassava forage has a limited value as a source of protein when it is used to supplement urea in sugar cane-based diets. On the other hand, it is possible to feed bovines in molasses/urea-based diets, supplemented with only cassava forage. (Summary by S.B. Trans. by L.M.F.) H03

0184

18430 LONGE, O.G.; OLUYEMI, J.A. 1983. Feed value of heated and unheated cassava starch for chicks. Zentralblatt fuer Veterinaermedizin. Reihe A 27(9/10):819-823. Engl., Sum. Engl., Germ., Span., 15 Refs.

Cassava. Cassava starch. Chicks. Animal nutrition. Dietary value. Feeds and feeding. Animal physiology. Supplements.

Cassava starch promoted poorer growth of chicks than did Guinea corn or maize starch when substituted in a diet containing glucose at 21.45 and 45.90%. Feed efficiency was equally affected. Nutrient retention was comparable, but fat retention was much lower. ME values of cassava-based diets were, however, higher than with the other diets. Heat treatment, which resulted in starch gelatinization, was beneficial and promoted chick growth comparable with raw Guinea corn or maize starch. (Author's summary) H03

0185

18173 MONTILLA, J.J.; VARGAS, R.; CARABANO, J.M.; MONTALDO, A. 1982. Cassava root and foliage within a program for poultry and swine feeding in the tropics. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.399-414. Engl., 45 Refs., Illus.

Cassava. Tubers. Foliage. Poultry. Swine. Feeds and feeding. Costs. Animal nutrition.

A scheme is formulated for vegetable production (rice, maize, sorghum, cassava, sweet potato, Cannavalia ensiformis, sugar cane) in the tropics to support poultry and swine production capable of achieving by 1985, an

annual per capita consumption of poultry and pig products similar to the current world av. of 5.7 kg of poultry meat, 5.9 kg of eggs, and 10.7 kg of pork. Achieving this aim implies that in 1985 the annual per capita consumption of these products in developing countries will reach 14.7 million MT of poultry meat, 14.9 million MT of eggs, and 26.1 million MT of pork. The amount of poultry and pig feeds required to achieve this production are therefore increased by 257.6 million MT. Assuming that 30% sugar cane 1st molasses (77.2 million MT), 25% cassava root flour (64.4 million MT), 10% cassava foliage flour (25.7 million MT) and 8% jack bean (C.ensiformis) flour (20.6 million MT) can be generally incorporated into feeds for poultry and pigs, totalling 73% of the ingredients of the feeds, the cultivation of 27.9 million ha (8.05 million ha of cassava to be harvested) will be necessary. The remaining 27% will be made up by cereal, slaughter house by-products, fish meal, oilseed flours, industrial by-products, minerals, vitamins, and processed wastes. This program would permit a substancial improvement in the protein consumption of the people of developing countries. The execution of this program would require copious investments to carry out a more technified agriculture and for processing the vegetable products to be utilized. Full collaboration of developed countries and the combined effort between all the developing countries are also necessary. (Summary by S.B.) H03

0186

18106 ONG, H.K.; HUTAGALUNG, R.I. 1981. A note on the digestibilities of pig diets containing fermented cassava-manure. Malaysian Agricultural Journal 53(1):52-57. Engl., Sum. Engl., 28 Refs.

Cassava. Cassava chips. Fermented products. Swine. Digestibility. Feeds and feeding. Animal nutrition.

Growing pigs were used for digestibility and N metabolism studies on the use of fermented cassava-manure (FCM) produced by inoculating Rhizopus spp. to substrates comprised of cassava chips and dehydrated poultry manure (DPM). FCM was used in exptl. diets at 0, 30, and 60%. The diets were isonitrogenous but contained crude fibre (CF) at 1.8, 4.0, and 5.4% and ash at 7.5, 11.6, and 15.7%, resp. Apparent digestibilities for DM and GE decreased with increase in FCM level in the diet, being 84.2, 70.6, and 63.3% for DM and 86.9, 79.6, and 71.7% for GE at 0, 30, and 60% FCM level, resp. Apparent N digestibility was 93.2, 86.1, and 83.2% for diets with 0, 30, and 60% FCM, resp., the latter 2 being significantly different from control diet but not significantly different from each other. Poor digestibility of FCM-incorporated diets was attributed to inefficient microbiological utilization during fermentation, uric acid content, and higher CF and ash due to presence of DPM. (Author's summary) H03

0187

18196 TELLEZ B., G.; CAICEDO G., J. 1983. Adicion de aceite vegetal o sebo animal en dietas conteniendo harina de yuca de una variedad amarga para pollos de engorde. (Addition of vegetable oil or tallow to broiler diets containing cassava meal from a bitter variety). Tesis Zootecnista. Palmira, Universidad Nacional de Colombia. Facultad de Ciencias Agropecuarias. 83p. Span., Sum. Span., Engl., 45 Refs., Illus.

Cassava. Chicks. Cassava meal. Feeds and feeding. Feed constituents. Dietary value. Costs. Income. Animal physiology. Animal nutrition. Colombia.

Two expt. were carried out at the exptl. farm of the U. Nacional, Palmira, Colombia, to evaluate the effect of increasing by 5% the ME of the diets containing CM by adding either vegetable oil in the 1st expt. or tallow in the 2nd, on broiler performance and economic results. CM was prepared by sundrying the whole-root chips of a high-cyanide containing cv. (bitter), CMC-84, on a concrete floor. In both expt., one-day old mixed sex Hubbard broiler chicks were randomly assigned to each of 6 treatment groups with 4 replicates/treatment. Each pen constituted an exptl. unit with 36 and 37 chickens for the 1st and 2nd expt., resp. In the 1st expt. a randomized complete block design was used, whereas the 2nd was designed as a complete 3 x 2 factorial arrangement. The exptl. variables consisted of levels of 0, 20, and 30% CM in broiler diets and 2 levels of ME (standard and plus an increment of 5% ME), obtained with either vegetable oil or tallow. A commercial (expt. 1) and sorghum-based (expt. 1 and 2) diets were used as controls; except for the commercial diet, all other exptl. diets were balanced by least-cost feed formulation using linear programming. Live wt. gain, feed intake, and feed conversion (feed/gain) were recorded biweekly and data of the starter (0-4 wk.), finishing (4-8 wk.), and complete (0-8 wk.) periods were analyzed statistically by variance analysis. The results of the starter period in the 1st expt. showed that diets containing 20 and 30% CM, without any increment of ME, had the best broiler performance, shown by higher live wt. and better feed conversion than the control diets. This demonstrated that 0-4 wk. old broilers could efficiently utilize these levels of CM. However, in the 2nd expt. diets containing 30% CM had a lower performance than diets with 20% CM. The results of the complete exptl. period (0-8 wk.) of both trials indicated that the inclusion of 20% CM yielded higher live wt. at 7 (expt. 2) or 8 (expt. 1 and 2) wk. than the other diets, whereas the 30% CM diet showed results similar to those of the control diets. The main effect of the addition of vegetable oil or tallow was the improvement of feed conversion, especially during the starter period. Results were more consistent with vegetable oil, which was also easier to mix with the other ingredients. Economic evaluation of the exptl. results showed that diets containing 20% CM yielded the best returns compared with the commercial and sorghum-based diets. Diets containing 30% CM produced economic returns similar to those of the commercial diet, but showed the lowest returns in expt. 2. Despite the improvement in feed efficiency, the addition of vegetable oil or tallow showed economic results similar to those of the corresponding diets supplying the standard amount of ME. The results of this study demonstrated that, under these exptl. conditions, the inclusion of 20% CM, at a price equivalent to 80% of the current price of sorghum, gave the best broiler performance as well as the highest economic returns; the additional 5% ME using vegetable oil or tallow was not economically justified. (Author's summary) H03

0188

18441 TEWE, O.O 1975. Implications of the cyanogenic glucoside fraction of cassava in the growth and reproductive performance of rats and pigs. Ph.D. Thesis. Ibadan, University of Ibadan. 517p. Engl., Sum. Engl., 226 Refs., Illus.

Cassava. Toxicity. Animal nutrition. Swine. Laboratory animals. Biochemistry. Cyanogenic glycosides. Animal physiology. HCN content. Metabolism. Cyanides. Thiocyanates. Digestibility. Cooking. Proteins. Iodine. Deficiencies. Analysis. Processed products. Fresh products.

A series of chemical and biological evaluations of the cyanogenic glucoside fraction of cassava as it affects the performance, metabolism, and pathology of rats and pigs is reported. The influence of protein and I deficiency on these parameters was also investigated. Quantitative

estimations of the HCN content of Nigerian and Colombian cassava var. confirmed that the HCN content of the fresh peel, pulp, and whole cassava root was consistently higher in bitter var. than in sweet strains. It was also demonstrated that the HCN content of the peel was much higher than that of the whole tuber in all var. Sun-drying and oven-drying resulted in considerable HCN loss especially in the whole root and pulp. Addition of a crude linamarase extract to fresh and dried cassava test samples demonstrated that the common analytical techniques underestimate the HCN yield of cassava roots in most cases. Feeding trials with gestating rats demonstrated that little if any of the HCN detoxification product, SCN, was transferred to the fetus through the placenta when fresh and dried cassava (173 and 92 ppm HCN, resp.) or diets containing 1000 ppm cyanide added as KCN were fed. Subsequent life-cycle rat studies confirmed that although these diets affected meternal growth and metabolism, fetal development (as indicated by birth wt. and litter size) was protected from the noxious influences of cyanide and its biotransformation product, SCN. Both the fresh and dried cassava diets and dietary KCN (500 ppm cyanide) caused striking metabolic changes in female rats and their offspring during lactation and post-weaning growth. However, while the cassava diets markedly influenced lactation and post-weaning growth performance, the effect of KCN was less marked and restricted largely to the latter phase. This difference appears largely due to cyanide loss from the HCN-added diets or a possible difference in the cyanide molecule of cassava and synthetic cyanide (KCN), that of cassava being organic. A long term (7 mo.) feeding trial demonstrated that fresh and dried cassava diets with up to 402.3 ppm HCN did not cause pathological changes in the thyroid of female rats and their offspring. Gestation trials with pigs fed fresh sweet cassava diets containing 0, 250, and 500 ppm added cyanide (as KCN) demonstrated that the highest cyanide level (500 ppm) produced high levels of SCN that caused pathological changes in the thyroid gland of gestating gilts and passed through the placenta barrier into the fetuses. This level of added cyanide did not, however, cause any detectable effect on reproductive performance. Subsequent lactation studies demonstrated that no marked carry-over effect of cyanide fed during gestation could be observed in lactation performance. Striking metabolic changes were, however, observed in the composition of the serum, colostrum, and milk of the lactating sows. Growth and metabolic studies in rats and pigs fed 750 and 500 ppm cyanide (as KCN), resp., demonstrated that when the diets are otherwise balanced, dietary cyanide causes only a slight reduction in growth performance of there species. Dietary protein deficiency considerably reduced performance while I deficiency had no marked effect. While these 3 dietary variables caused marked metabolic changes in both species, histopathological examination of tissues from the pigs demonstrated that protein deficiency caused pathological lesions in bones and thyroid gland. I deficiency caused hyperplasia of the thyroid follicles, but dietary cyanide did not cause any marked pathological lesion except for a nonsignificant increase in thyroid wt. These data strongly suggest that protein and I deficiency are major etiological factors in the pathogenesis of most endocrinological and neurological maladies observed in the cassava-consuming human population of the humid tropics. (Author's summary) H03

0189

18421 TEWE, O. O. 1982. Protein supplementation of cassava diets for growing pigs: effect on performance, nutrient utilization and cyanide metabolism. Nutrition Reports International 25(3):451-462. Engl., Sum. Engl., 13 Refs.

Cassava. Swine. Proteins. Supplements. Cassava meal. Feeds and feeding. Feed constituents. Digestibility. Cyanides. Thiocyanates. Metabolism. Animal physiology. Animal nutrition. Biochemistry.

Twenty-eight Large White pigs (21 barrows and 7 gilts) allocated on the basis of sex and initial wt. to 7 treatment groups with mean initial wt. of 8.7 kg were individually and semi-restrictedly fed for 56 days on one of 7 diets. Diet 1 had 18% protein and was based on maize and groundnut oilmeal. Diet 2-4 were based on cassava and groundnut oilmeal and had 16, 18, and 20% protein, resp. In diets 5-7, palm kernel meal which replaced part of the groundnut meal constituted 25% of the total protein in the rations which also contained 16, 18, and 20% protein, resp. Performance, nutrient digestibility, and cyanide metabolism were evaluated. Live wt. gain and feed intake were significantly reduced by cassava while inclusion of palm kernel meal in the rations with 18 and 20% protein improved the feed:gain ratio to the level of the control ration. Palm kernel meal in rations 6 and 7 also improved digestibility of crude fibre in diets with 18 and 20% protein. Serum and urinary SCN were significantly ($P < 0.05$) increased on the cassava-based rations. SCN concn. did not relate to the performance characteristics. (Author's summary) H03

0190

18420 TEWE, O.O. 1981. Supplementation of cassava/urea based rations with elemental sulphur for sheep and goats: effect on growth, ruminal, serum and urinary thiocyanate concentrations. Nutrition Reports International 24(6):1263-1269. Engl., Sum. Engl., 16 Refs.

Cassava. Feeds and feeding. Supplements. Cassava meal. Sheep. Goats. Thiocyanates. Animal physiology. Animal nutrition.

Sixteen West African Dwarf (W.A.D.) goats and 8 fistulated W.A.D. sheep were used in growth and metabolism trials. They were randomly assigned to 4 cassava meal/urea based rations containing 0, 0.25, 0.50, and 0.75% elemental S. Growth was significantly improved with up to 0.5% dietary S level. Ruminal NH_3 and blood urea levels were also significantly ($P < 0.05$) reduced with 0.50 and 0.75% S in the diet. Urinary SCN concn. was similar on all rations while serum SCN increased with inclusion of S in the rations. Ruminal SCN decreased in the presence of dietary S. A cyanide containing diet based solely on a nonprotein N source requires elemental S for cyanide detoxification and good growth rate. (Author's summary) H03

See also 0115 0171

H04 HCN Toxicity and Detoxification

0191

18156 BOURDOUX, P.; SEGHERS, P.; MAFUTA, M.; VANDERPAS, J.; VANDERPAS-RIVERA, M.; DELANGE, F.; ERMANS, A.M. 1982. Cassava products: HCN content and detoxification processes. In Delange, F.; Iteke, F.B.; Ermans, A.M., eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.51-58. Engl., Sum. Fr., 12 Refs., Illus.

Cassava. Leaves. Tubers. Foofoo. Chickwangue. Detoxification processes. Solar drying. Fermentation. Steeping. HCN content. Cassava leaves (vegetable). Cassava tubers (vegetable). Zaire.

In the populations of Bas-Zaire, Kivu, and Ubangi (Zaire), there is a SCN overload resulting from chronic consumption of cassava. The importance of this overload and the modes of preparation of cassava are very different in these 3 regions. A comparative study was carried out to evaluate the HCN content of fresh cassava and of cassava-based foods, analyze under lab. conditions the effectiveness of various processing methods in the detoxification of cassava, and attempt to decrease the SCN overload in the inhabitants of Ubangi by modifying their nutritional habits. HCN content in fresh tubers (produced by linamarin hydrolisis) collected in the 3 regions ranged from 2-309 mg HCN/kg in Ubangi (180 samples), 12-205 mg HCN/kg in Kivu (28 samples), and 5-142 mg HCN/kg in Bas-Zaire (25 samples). There was no evident correlation between HCN content and morphological criteria used to discriminate between sweet and bitter var. The % of tubers considered toxic (more than 100 mg HCN/kg) was low (4%) in Bas-Zaire but higher and almost identical (21 and 24%) in Kivu and Ubangi, resp. On the other hand, analysis of the HCN content of cassava products consumed by the populations of the 3 areas revealed very low HCN levels in Bas-Zaire (foofoo and chickwangue less than 1.0 and 1.3 mg HCN/kg, resp.), intermediate in Kivu (bugali, 6.3 mg HCN/kg), and relatively high ones in Ubangi (fuku and mpondu, 17.3 and 8.2 mg HCN/kg, resp.). The study of detoxification processes used by inhabitants of these 3 regions showed that the variation in HCN levels are closely linked to different methods of food preparation. Sun-drying, a widely used detoxification method in Ubangi, produces tuber dehydration with only a partial release (approx. 80%) of the HCN initially present in cassava. The combination of sun-drying and fermentation, used in Kivu, produces foods with lower HCN content than that observed in Ubangi. Soaking cassava once or twice is universally used in Bas-Zaire, and constitutes the most efficient detoxification procedure; the HCN content of the food consumed in that area being, by far, the lowest. A lab. trial on bitter cassava tubers collected in Ubangi confirms that the utilization of more adequate detoxification techniques (soaking) results in foodstuff with negligible HCN levels. In Ubangi, an attempt to reduce the SCN overload by modifying the diet of an apparently motivated family failed. This confirms how extremely difficult it is to introduce such modifications in rural populations. The differences among the 3 rural regions investigated in Zaire regarding the HCN content of cassava products result partly from the differences in the HCN content of fresh cassava but more specifically from the differences in the detoxification procedures used. Soaking appears to be the most efficient method. An increase in cassava consumption and/or a decrease of the efficiency of the detoxification process is likely to induce disruption of the thyroid function in the areas that are now unaffected. (Author's summary. Trans. by S.B.) H04

0192

18108 IKEDIOBI, C. O.; ONYIKE, E. 1982. Linamarase activity and detoxification of cassava (Manihot esculenta) during fermentation for gari production. Agricultural and Biological Chemistry 46(6):1667-1669. Eng., 10 Refs., Illus.

Cassava. Gari. Fermentation. Linamarase. Detoxification.

The detoxifying role of exogenously added linamarase was evaluated by fermenting 5 equal samples of grated parenchymatous tissue of cassava roots at room temp. for 5 days. The 1st sample received 192.6 units of linamarase (1 unit of linamarase activity = the amount of enzyme which produced 1 μmol

of p-nitrophenolate/min) on the 1st day only. The 2nd, 3rd, and 4th samples received the same level of enzyme activity on each of the 1st 2, 3, and 4 days, resp. The 5th sample received no linamarase and was used as control. Samples were then pressed and roasted to yield gari (9% moisture). Linamarase activity and total HCN content decreased steadily until day 3 of fermentation and thereafter levelled off, this occurring simultaneously with a decrease in pH from 6.0 (optimum of linamarase) to 4.0. This shows that detoxification is associated with the enzyme rather than acid hydrolysis. The fact that fermented cassava was detoxified by 87.5% with exogenous linamarase additions compared with 50% detoxification without enzyme addition is a further indicative. The addition of exogenous linamarase detoxified cassava more rapidly after 24 h of fermentation than after 5 days of fermentation without enzyme addition. Very little detoxification was achieved by adding more enzyme to the mash beyond the 1st 24 h due to the favorable pH. Research on the use of linamarase to shorten the fermentation period of cassava during gari production is in progress. (Summary by EDITEC. Trans. by L.M.F.) H04

0193

18428 MADUAGWU, E.N.; UMOH, I.B. 1982. Detoxification of cassava leaves by simple traditional methods. Toxicology Letters 10(2/3):245-248. Engl., Sum. Engl., 11 Refs.

Cassava. Leaves. Detoxification processes. HCN content.

Cassava leaves, which usually contain large quantities of cyanogenic glycosides, were processed into a Zairian traditional vegetable sauce Mpondu by simple methods which included blanching (10 min), mashing, and boiling for 20-80 min. These methods enhanced the detoxification of the leaves, with blanching alone resulting in the loss of 57% of the free (non-glycosidic) cyanide content and 60% of the bound (glycosidic) cyanide. Losses of cyanide during these processes would be accounted for in volatile HCN, its derivatives, and in the boiling water. (Author's summary) H04

See also 0188 0190

100 PROCESSING, PRODUCTS AND USES

101 Cassava Starch and Its Properties

0194

18192 LORENZ, K.; KULP, K. 1982. Cereal- and root starch modification by heat-moisture treatment. 2. Functional properties and baking potential. Starch 34(3):76-81. Engl., Sum. Engl., Germ., 8 Refs., Illus.

Cassava. Cassava starch. Modified starches. Uses. Bakery products. Breads. Analysis.

Functional baking properties of heat-moisture treated starches (barley, triticale, red millet, arrowroot, cassava) are given. The bread and cake baking potential of cereal starches was adversely affected by the treatment. Although the quality of breads and cakes failed to match that of untreated wheat starch, the treatment improved tuber starches, suggesting that the molecular order of starches is an important factor in starch

baking quality. Thickening properties tested with pie fillings demonstrated adverse effects of the treatment on this starch property. Untreated cassava starch did not produce bread or cake of satisfactory quality. The 18% moisture treatment improved the baking quality of cassava starch appreciably. Storage of cassava starch at 10°C produced higher consistencies of fillings than room temp. storage. (Author's summary) 101

0195

18194 RAFFI, J. J.; AGNEL, J.P.L.; THIERY, C. J.; FREJAVILLE, C. M.; SAINT-LEBE, L.R. 1981. Study of gamma-irradiated starches derived from different foodstuffs: a way for extrapolating wholesomeness data. Journal of Agricultural and Food Chemistry 29(6):1227-1232. Engl., Sum. Engl., 21 Refs., Illus.

Cassava. Cassava starch. Analysis.

Radiolysis products from starches from different food plants were studied chemically and by electron spin resonance (ESR). Tabulated data show contents of malonaldehyde, formaldehyde and acetaldehyde, total acidity and formic acid, and H_2O_2 in 8 starches irradiated with ^{60}Co at various levels in the range 5-30 kGy. Quantities/g of these compounds radioinduced in different starches always had the same order of magnitude, and the ratio of the max.:min. amount was always less than 5 for any 1 compound or class of compounds. In the case of total radioinduced acidity there was a simple linear relationship between acidity formed and content of water-soluble dextrins in the sample. H_2O_2 was formed only if the irradiation was performed under O_2. All the starches gave similar radiodepolymerization behavior. ESR spectra immediately after irradiation were different for different starches, and changed with 2nd order kinetics over a period of hours, then spectra decayed with 1st order kinetics to a spectrum common to all the starches. Differences in initial spectra and rates are ascribed to differences in starch structure and crystallinity, rather than differences in free radicals between the starches. Starches investigated were maize (normal, waxy, and amylomaize), cassava, rice, breadmaking wheat, and haricot bean. (Summary by Food Science and Technology Abstracts) 101

See also 0184

I02 Uses, Industrialization, Processing and Storage

0196

18102 ABRAHAM T., E.; RAJA, K.C.M.; MANOHARAN, E.P.; MATHEW, A.G. 1983. Effect of heat-moisture treatment on textural characteristics of cassava flour. Cereal Chemistry 60(1):7-8. Engl., Sum. Engl., 6 Refs. Illus.

Cassava. Cassava flour. Analysis. Organoleptic examination. Cooking. Viscosity. Gelatinization.

Modification studies were performed using CF from cv. Malayan-4 to determine its use as substitute of wheat and rice flour. After conditioning, plain and parboiled flours were subjected to open-pan roasting and pressure steaming. Viscosity and textural characteristics of the samples were then compared. Texture improved significantly only in the parboiled flour, which was open-pan roasted after the moisture level was

adjusted to 28 ± 2%. A comparative study of plain and parboiled dry cassava cubes showed that compressive strength increased 10 times more in the parboiled cubes than in the plain cubes. (Author's summary) I02

0197

18182 BALAGOPAL, C.; VIJAYAGOPAL, K.; HKISHI, N. 1982. Biconversion of cassava - a potential source of energy in India. In Belen, E.H.; Villanueva, M.; eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.339-344. Engl., Sum. Engl., 17 Refs., Illus.

Cassava. Cassava starch. Hydrolisis. Fermentation. Alcohol. India.

An attempt was made to utilize various saccharifying agents (acid, malt, and a commercial enzyme) for the hydrolisis and fermentation of cassava starch for power alcohol production. Hydrochloric acid proved to be more effective, giving smooth saccharification and higher yield of alcohol (44.70 ml/100 g cassava starch with 0.10 N HCl). (Summary by J.L.S.) I02

0198

18132 BEST, R.; GOMEZ, G. 1982. Procesamiento de las raices de yuca para alimentacion animal. (Processing of cassava roots for animal feed). In Centro Internacional de Agricultura Tropical. Programa de Yuca. Yuca: investigacion, produccion y utilizacion. Cali, Colombia. pp.513-538. Span., 17 Refs., Illus.

Cassava. Cassava chips. Drying. Solar drying. Colombia.

Different aspects regarding the terminology used in cassava drying, the process and factors affecting it, and methods (artificial continuous drying, through-circulation batch drying, natural drying on concrete and on trays) are described. The perspectives of increasing the use of cassava roots in animal feeds are good, especially in Latin American countries which import cereal grains to meet the demand of animal feed processing plants. Production associations or cooperatives could be formed; these would be responsible of disseminating the most adequate drying process for animal nutrition. Based on the results obtained on the northern coast of Colombia, demonstrative pilot plants should be set up in order to determine the feasibility of the process and to obtain data on the real working costs. A 500 m^2 factory could be used by an association of 20 producers and would process 240 t during the 4 mo. of the dry season. Investment required to install this factory is Col $434,900 and possible utility, Col $1175/t dry cassava. Figures on the drying processes and cassava chippers are included along with tables on the influence of climatical conditions on the drying process and the investments required to install a 500 m^2 cassava drying factory. (Summary by S.B. Trans. by L.M.F.) I02

0199

18119 BLACK, R. P.; PEYAYOPANAKUL, W.; PIYAPONGSE, S. 1979. Thailand: cassava pelletizing technology. Denver, Colorado, Denver Research Institute. Series Industrial Research Institutes: their role in the application of appropriate technology and development, no.1. 20p. Engl., 1 Ref., Illus.

Cassava. Cassava products. Pellets. Trade. Industrialization. Legal aspects. Thailand.

Indigenous technology for producing cassava pellets is examined as well as the related steps from the growing of cassava through their marketing abroad. Issues are addressed related to the vitality of the cassava pelletizing industry, such as environmental problems and protectionist tendencies in foreign markets. The advantages of hard and soft pellets are discussed relative to price premiums needed to make hard pellets economically viable. Cases are illustrated by means of interviews with a Thai manufacturer of cassava processing equipment, a Thai owner of a pelletizing mill, a manager of a European pelletizing factory, with members of a European industrial mission to Thailand, and with a cassava pelletizing technology leader from the Thailand Institute of Scientific and Technological Research. (Summary by S.B.) I02

0200

18452 BUNYAKIAT, K.; TASAKORN, P. 1980. [Solid fuels briquetting]. Bangkok, Kasetsart University. 14p. Thai., Sum. Thai., Engl.

Paper presented at Conference on Energy, Bangkok, Thailand, 1980.

Cassava. Uses. Adhesives.

The investigation on the solid fuels briquetting under 57-1070 kg/cm^2 pressure in 2.54 cm-diameter briquettes of 3 industrial or agricultural wastes, rice husk, and bagasse, with or without the aid of wax or cassava glue as binders, showed that bagasse and sawdust can be compressed into briquettes while rice husk requires addition of wax or cassava glue. The briquetted samples were stored in plastic bags for 2 mo. and then checked for their storage change and physical properties. The rice husk-bagasse briquettes had lowest % crumbs (1.53%) and sawdust briquettes had lowest ash content (6.19%). All but one type of fuel briquettes boiled water more rapidly than wood charcoal but gave smoky flames at the early stage of combustion. (Author's summary) I02

0201

17585 CHENG, H. 1980. Texturized starch products. United States Patent 4,192,900. 7p. Engl., Sum. Engl.

Cassava. Cassava starch. Patents.

By adding water, extruding, cutting, and drying, uniform starch particles were prepared from one or more starches selected from cassava, maize, waxy maize, potato, sago, arrowroot, and cereal; and one or more gelling hydrocolloids selected from sodium alginate, sodium pectate, hydroxypropylcellulose, methylcellulose, methylhydroxypropylcellulose, methylethylcellulose, carrageenan, furcellaran, agar, gelatin, a mixture of xanthan gum and locust bean gum, and curdlan. These were useful in preparing retorted or aseptically packaged, tapioca-style pudding and other improved, edible texturized starch products. (Author's summary) I02

0202

18449 DAMRONGLERD, S.; NILUBON, N.; TASAKORN, P. 1980. [Alcohol

production from agriculture products for use as fuel substitute]. Bangkok, Kasetsart University. 10p. Thai., Sum. Thai., Engl., 17 Refs.

Paper presented at Conference on Energy, Bangkok, Thailand, 1980.

Cassava. Uses. Alcohol. Waste utilization. Thailand.

In Thailand, the research on alcohol-gasoline blending used as fuel substitute has progressed but the process to produce alcohol from low-cost substrates or agricultural wastes has not developed well. The potential of alcohol production from agricultural products and wastes is very high since Thailand is a country rich in resources; maize, rice, cassava, and cellulose can be converted to alcohol by fermentation, enzyme hydrolysis, or both techniques consecutively, depending on the raw materials. Many agricultural and industrial wastes such as pineapple waste, bagasse, rice-straw, and cornstalk can be converted into alcohol. Therefore, the technology of alcohol production from agroindustrial wastes should be developed in Thailand. A group of researchers, that had already done research on fermentation, was formed recently. (Extracted from author's summary) I02

0203

18402 LEON, M.; MOSCOSO, W.; NUNEZ G., C. 1982. Utilizacion de harinas compuestas en la elaboracion de productos de panaderia. (Use of composite flours in bread-making). La Herradura, Santiago de los Caballeros, Republica Dominicana, Instituto Superior de Agricultura. Centro de Investigaciones Economicas y Alimenticias. 91p. Span., Sum. Span., 68 Refs., Illus.

Cassava. Cassava flour. Composite flours. Uses. Bakery products. Breads. Analysis. Organoleptic examination. Costs. Economics. Dominican Republic.

The technical and economical possibilities of partially substituting wheat flours with locally produced flours in the Dominican Republic were assessed; areas suitable for the production of raw material and the necessary equipment were identified. Recommendations are given on future research programs. The methodology used consisted in personal interviews with officials of the public sector, farm producers, and functionaries of private enterprises. Visits were made to processing plants and production areas and a comprehensive literature review was made. Communication was kept with researchers and equipment manufacturers and seminars on this subject were attended. The technical feasibility of partially substituting wheat flour with sorghum, rice chaff, and cassava flours was evaluated on the basis of the elaboration of sandwich, "sobao", and "de agua" bread. Sensory panels of 30 members were then made. The preference of the panelists for breads containing 0, 5, 10, 15, and 20% substitution of wheat flour with rice, sorghum, and cassava flours was determined. The variables flavor, color, and texture of the breads were evaluated using an hedonic scale of 1 to 9 (1 = extremely disliked and 9 = extremely liked). Bread vol. was also determined. It was concluded that the substitution of wheat flour with combinations of cassava, rice, and sorghum flours up to a level of 10% would not result in significant changes in bread quality and in consumer acceptance. It is recommended that the government start a program aimed at reaching the max. substitution possible of wheat flour with sorghum and/or cassava flours of local production. The amount of rice chaff available on the market is relatively scarce, therefore a national program on substitution of wheat flour should not be based on the use of this raw material. Given the agronomic and economic conditions of the Dominican Republic, as well as the technical knowledge existing in the country and in

the international community, it is recommended that the local production of sorghum and/or cassava flours be based on the economic feasibility of producing these raw materials at prices below that of imported wheat flour. The economic analyses conducted indicate return rates between 22-28% in sorghum and cassava production and processing projects. It is recommended that the flour mixture be made by millers and that a wheat flour substitution program should include a section of adequate training in the area of bakery products. (Author's summary. Trans. by L.M.F.) I02

0204

18150 MONTALDO, A.; MONTILLA, J.J.; GUILLEN, R.D.; GONZALEZ J., E. 1979. La yuca y su agroindustria (Anteproyecto de Programa de Desarrollo sometido a consideracion del Ministerio de Agricultura y Cria). (Cassava and cassava agroindustry (Preliminary Design of the Development Program submitted to consideration of the Ministry of Agriculture, Venezuela). Maracay, Universidad Central de Venezuela. 24p. Span., 8 Refs., Illus.

Cassava. Cassava programs. Industrialization. Factories. Cultivation. Mechanization. Venezuela.

The Preliminary Design of the Cassava Agroindustrial Development Program in Venezuela is given. Recommendations on the availability of cassava propagation material, integrated crop mechanization, industrial processing, and organization of production are included. Production parameters are given of the mills producing cassava root meal for animal nutrition (Central El Pinal, Complejo Agroindustrial Cantaura C.A., Complejo Agroindustrial Pariaguan C.A., Complejo Yuquero Upata, C.A., and Proasa, C.A.), mills producing CF for breadmaking (Central Yuquero Aroa), and mills producing starches, industrial starches, modified starches, glucose, and by-products (Agroindustrial Monagas - Agroinmoca C.A., Central Yuquero El Pao C.A., and Agroinsa C.A.). Estimates of cassava production for 1985 are given and the establishment of new cassava processing plants in Venezuela is recommended. (Summary by EDITEC. Trans. by L.M.F.) I02

0205

18148 PINTO S., R. 1980. Elaboracion y usos del almidon de yuca. (Elaboration and uses of cassava starch). Bogota, Colombia, Instituto Colombiano Agropecuario. Programa de Procesos Agropecuarios. Boletin Tecnico no. 66. 67p. Span., 54 Refs., Illus.

Cassava. Cassava starch. Factories. Water requirements (processing). Washing. Peeling. Rasping. Screening. Silting. Drying. Solar drying. Fermentation. Uses. Colombia.

General information is given on different aspects related to cassava starch, hopefully attracting the attention of agricultural technicians and improving the small starch factories existing in Colombia. A new concept on planning cassava starch industries in the country should be formed. Aspects discussed were: (1) general information on cassava and its composition; (2) conditions required for starch extraction; (3) description of the different stages of the process (washing, peeling, rasping, screening, sedimentation, sulfuring, drying, final treatment of the product, and fermentation); (4) implements and gadgets for washing, rasping, screening, sedimentation, and drying; (5) uses and comercialization of starch. Finally annexes on the methods for determining starch content and the values that can be used in the different estimations of starch sedimentation are included. (Summary by J.L.S. Trans. by L.M.F.) I02

0206

18418 PRODUCTION OF refined maltose from tapioca starch. 1980. Taiwan Sugar 27(5):166-166. Engl., Illus.

Cassava. Cassava starch. Uses.

The steps involved in conversion of cassava starch into maltose are examined briefly: raw material preparation (cassava starch is less than 13% moisture, less than 0.25% ash, and 3.7-4.6 pH, with more than 99% capable of passing through a 100-mesh sieve), liquefaction, saccharification, decolorization, removal of dissolved solids, and concn. The resultant solution is more than 60% maltose, less than 20% dextrin, less than 1% starch, less than 20 ppm dissolved solids, less than 25% moisture, and pH 5-6. (Summary by Food Science and Technology Abstracts) I02

0207

17580 RODRIGUEZ U., F.; WEISMAN DE BENITO, L.; FERNANDEZ, M.V. 1980. El desarrollo rural y la tecnologia apropiada en el caso colombiano. 2. Desarrollo de tecnologia apropiada para el procesamiento de la yuca. Apendice B: Aplicacion al caso de un producto tradicional: la yuca. (Rural development and appropriate technology for the case of Colombia. 2. Development of appropriate technology for cassava processing. Annex B: Application to a traditional product: cassava). Bogota, Universidad de los Andes. Centro de Estudios e Investigacion. 322p. Span., 13 Refs., Illus.

Cassava. Cassava starch. Factories. Technological package. Washing. Peeling. Rasping. Silting. Screening. Fermentation. Packaging. Costs. Statistical data. Marketing. Prices. Small-scale processing. Small-scale equipment. Colombia.

On the basis of a comprehensive review of existing literature and field visits, the alternatives to developing appropriate technology for cassava processing in the 1980's in Colombia are analyzed, highlighting flour and starch production. These alternatives are analyzed from the economical and social points of views for the different regions of the country. Alternatives were analyzed for the following regions: Mesa de Limones and Nilo, Tolima; Santander de Quilichao and Mondomo, Cauca; and Acacias, Meta, in the Llanos Orientales. Proposals to introduce pedal-operated raspers and sifters and to innovate with cassava chip production are analyzed. In Nilo, processors tend to disappear due to agricultural and cattle-raising competition in the region. In Mesa de Limones, the situation is the opposite; suggestions included the introduction of innovations in the mechanization of the prewashing and drying process to improve starch quality. In Acacias, roots represent 90% of the final cost due to the low local production. The most advanced technology exists in Santander de Quilichao; recommendations include innovating the prewashing process with a helicoid brush washer and using ovens for the drying process. In Colombia, cassava chips (animal nutrition) have a market and it possible to adapt technology to its production. (Summary by EDITEC. Trans. by L.M.F.) I02

0208

17574 VINCK, D. 1982. La transformation du manioc en gari.

(Transformation of cassava into gari). These Ing. Chim. Ind. Agric. Gembloux, Belgique, Faculte des Sciences Agronomiques de l'Etat. 220p. Fr., 88 Refs., Illus.

Cassava. Gari. Small-scale processing. Small-scale equipment. Industrial machinery. Processing. Costs. Productivity. Dietary value. Socio-economic aspects. Labour. Industrialization. Fermentation. Nigeria.

The processes to transform cassava into gari and the technologies used at cottage, industrial, and intermediate levels are analyzed. A comparative study of the energy, economical, and social aspects of 2 gari factories, one with intermediate technology and the other with advanced industrial technology, showed that the 1st has great advantages over the 2nd in developing countries. Several technological innovations, such as a modified solar oven for garification, a sun drier and evaporator, are proposed. Microbiological research showed the dominance of streptococcus and in particular Streptococcus faecium in the fermentation of cassava into gari. In garification trials it was determined that to produce good quality gari, the pulp should maintain wet and be cooked at a low temp. for 15 min. (Summary by S.B. Trans. by L.M.F.) I02

0209

18426 SREEKANTIAH, K.R.; SATYANARAYANA R., B.A. 1980. Production of ethyl alcohol from tubers. Journal of Food Science and Technology 17(4):194-195. Engl., Sum. Engl., 6 Refs., Illus.

Cassava. Cassava starch. Uses. Ethanol. Enzymes. Analysis. Cooking. Fermentation. Industrial microbiology. India.

Acid-liquefied potato, cassava, and sweet potato starches were saccharified by utilizing moldy bran of Rhizopus niveus, as the source of amyloglucosidase, prior to alcoholic fermentation by Saccharomyces cerevisiae var. ellipsoideus. Alternatively the fungus was allowed to grow on the starchy substrate and alcoholic fermentation was also carried out simultaneously. This mixed culture technique gave corresponding fermentation efficiencies of 68, 81, and 75 for potato, cassava, and sweet potato. (Author's summary) I02

0210

18417 UEDA, S.; KOBA, Y. 1980 Alcoholic fermentation of raw starch without cooking by using black-koji amylase. Journal of Fermentation Technology 58(3):237-242. Engl., Sum. Engl., 15 Refs., Illus.

Cassava. Cassava starch. Uses. Ethanol. Fermentation. Enzymes. Analysis. Industrial microbiology.

The advantages of alcoholic fermentation of raw starches (corn starch and cassava starch) without precooking and those of vacuum distillation of ethanol from the broth were assessed. In the case of cassava, 9.5-10% ethanol/total vol. of broth was produced by compressed bakers yeast every day during 4 days, after which ethanol yield decreased rapidly. By using prepared yeast cells without dialyzing the broth or adding the mycellium about 9% ethanol was produced every day during 10 days. Raw cassava starch can be easily saccharified, but production of ethanol is about 10% lower as compared with corn starch. Black-koji amylase proved to be very useful for the production of ethanol from raw corn starch and cassava starch without previous cooking. Further, after ethanol is removed by vacuum distillation

and raw starch is added to the spent liquor, continuous alcoholic fermentation of the broth is possible. (Summary by J.L.S.) I02

See also 0146 0156 0167 0169 0170 0192 0194 0215 0221

I03 Industrial Microbiology

0211

18403 AZI, F.A. 1976. Development of process kinetics in the manufacture of microbial protein and scale-up of an unconventional microbial reactor. Ph.D. Thesis. Guelph, Ontario, University of Guelph. 179p. Engl., Sum. Engl., 51 Refs., Illus.

Cassava. Industrial microbiology. Protein enrichment. Fermentation. Statistical analysis. Simulation model. Developmental research.

A process for production of SCP from substrates such as cassava slurry by employing a microbial reactor was developed. Attention was focused on 2 main areas: the development of a model which describes microbial reaction kinetics in a self-aspirating microbial batch and continuous flow reactor and the formulation of equations which describe reactor parameters and which would permit the scale-up of a bench-size reactor to commercial size. The reactor is an unconventional fermentor capable of "pulling in" air from the atmosphere. The reactor was subjected to rigorous theoretical and exptl. analyses with a yeast and a mold capable of utilizing the substrates, whey and cassava, resp. These analyses yielded a no. of algebraic and differential equations which described the system model adequately. With those equations, technical data for design and operation of the self-aspirating reactor were established. A computer program was written in a continuous simulation modelling language (CSMP) to solve the system model. The integration operation was performed with a variable step-size, 4th-order Runge-Kutta method. The simulation results were found to be in close agreement with the exptl. results. The mathematical model was used to predict the reactor performance at various rotor speeds and process temp. The model was also employed to establish a range of process variables at which the reactor should be operated in order to obtain good yields of biomass. The expt. and the simulation results were used to scale-up the reactor from 2 l to 4500 l with a working capacity of 3000 l. Exptl. results obtained with the 4500 l-reactor agreed with those of the smaller reactor sizes. (Author's summary) I03

0212

18425 OKEZIE, B.O.; KOSIKOWSKI, F.V. 1981. Extractability and functionality of protein from yeast cells grown on cassava hydrolysate. Food Chemistry 6(1):7-18. Engl., Sum. Engl., 44 Refs., Illus.

Cassava. Uses. Yeast production. Proteins. Analysis.

An extraction of protein from 2 strains of yeast, Candida tropicalis and C. utilis, grown by batch method on cassava hydrolysate was carried out by a combination of mechanical and mild chemical treatment yielding approx. 71 and 68% protein for C. tropicalis and C. utilis, resp. The process resulted in approx. 75-80% reduction in the nucleic acid level of the freeze dried

whole yeast cells of both organisms. The protein concentrates showed a good amino acid profile comparable with egg protein with met. and tryptophan as the limiting amino acids. The functional characteristics of the 2 yeast proteins were studied and compared with soy protein concentrate. They showed functional properties possessing very good wettability, emulsion capacity and whippability but poor emulsion stability. (Author's summary) I03

0213

18191 VANNESTE, C. 1982. Enrichissement proteinique du manioc par fermentation fongique. (Protein enrichment of cassava by fungal fermentation). Revue des Fermentations et des Industries Alimentaires 37(1):19-24. Fr., Sum. Fr., Dutch., 24 Refs.

Cassava. Protein enrichment. Industrial microbiology. Fermentation. Protein content. Amino acids. Analysis.

The different methods of liquid and semisolid state fermentation, fermentation in rotating vessels, and static with filamentous fungi (Aspergillus niger HM210, A. oryzae MUCL 18821, Rhizopus stolonifer HM27, and Trichoderma viride) were compared to determine their efficiency in protein enrichment of cassava and their possible use in small-scale technology. Best results were obtained with semisolid state fermentation in 50-l containers due to the simplicity of the method, the appearance of the final product, and protein content (12.8-17.5%). Amino acid content of the product was also determined. (Author's summary. Trans. by L.M.F.) I03

0214

18413 SILVA, M.A.A.A. DA; SILVA, G.A. DA; CAMARGO, R. DE 1982. Biomassa produzida de folhas de mandioca por fungos. (Biomass production from cassava leaves by fungi). Pesquisa Agropecuaria Brasileira 17(12):1783-1787. Port., Sum. Port., Engl., 32 Refs.

Cassava. Leaves. Biomass production. Industrial microbiology. Fermentation. Uses. Brazil.

Cassava leaves were tested as N source for biomass production by the fungi Aspergillus niger IZ-9, A. wentii IZ-1625, and Fusarium sp., at pH 1-9, using cassava roots as C source. Results were promising. The best ones were obtained by A. niger IZ-9 at pH values 3.0, 7.0, 8.0, and 9.0; by A. wentii IZ-1625 at pH 3.0; and by Fusarium sp., at pH 3.0-9.0. However, studies are still necessary to improve the process. (Author's summary) I03

See also 0209 0210

J00 ECONOMICS AND DEVELOPMENT

0215

18109 BAKER, J.C. 1981. Structure and outlook: tapioca processing industry in Thailand. Planter (Malaysia) 57(666):500-505. Engl., Illus.

Cassava. Cassava flour. Cassava chips. Pellets. Prices. Trade. Economics. Thailand.

Cassava products in Thailand (chips, pellets, and flour) are described; their vol. of production and distribution in the structured domestic and foreign market, and transportation systems are indicated. Industrial problems including quality, admixture in export products, pollution from dust in pellets, and governmental policies of both Thailand and the EEC are discussed. Future marketing of cassava products in Thailand is also discussed. (Summary by EDITEC. Trans. by L.M.F.) J00

0216

17576 CHIDAMBARAM, T.M.; UTHAMALINGAM, G. 1981. A survey on marketing of tapioca and its products in Tamil Nadu. Coimbatore, Tamil Nadu Agricultural University. Centre for Agricultural and Rural Development Studies. 27p. Engl.

Cassava. Production. Costs. Statistical data. Cultivation. Marketing. Tubers. Prices. Economics. Tapiocas. India.

The marketing costs of cassava and its products in Tamil Nadu, a region in India noted for its production and processing of cassava, were studied. The market structure, its performance, and problems faced by the producer, in particular small farmers, were evaluated. The survey was based on previous existent literature and on interviews conducted in a randomly selected group of 60 producers of 6 villages in Salem district, 5 processors, and 10 middlemen. Analysis of production and marketing costs of cassava and its product tapioca show that cassava cultivation is an economically viable enterprise, although its productivity can be increased reducing the cost/unit produced and increasing the profits. Since the cassava market is determined by processors and wholesale middlemen and very few of them buy from a large no. of farmers, the market is imperfectly competitive and disadvantageous to farmers. The organization of cassava producers into cooperatives is recommended as an alternative. Cassava production in the region is below the demand of processing units and although they receive product from other regions, increasing the area under cassava cultivation in the region would reduce processing costs. Farmers only receive 47.72% of the price paid by the consumer and the remaining 52.28% are shared by the middlemen (16.86%), the processors (9.69%), and the retailers (10.86%). High yielding cassava var. with a high starch content should be developed and the current recovery % of starch and tapioca (20-25%) should be improved by mechanizing several of the processing stages. (Summary by EDITEC. Trans. by L.M.F.) J00

0217

18423 CHOUDHURY, S.N. 1979. Effect of leaf harvest on tapioca and economics of eri rearing on it. Journal of the Assam Science Society 22A:58-61. Engl., Sum. Engl.

Cassava. Leaves. Uses. Defoliation. Tuber productivity. Economics. India.

The eri silkworm Samia cynthia ricini (Philosamia ricini) can be reared on the leaves of cassava. In view of the scope for increasing the income from cassava cultivation by rearing the silkworm on the leaves, the economic returns were investigated in Assam, India, in 1976-77. The green leaves were plucked either once or twice to provide food for the larvae. The total leaf yield from double-plucked plants was 68.90 q/ha, which was

significantly greater than that from single-plucked plants (49.61 q/ha). However, the tuber yields were 8 and 10.23 t/ha, resp. Taking into account the additional income from the silkworm rearing, the total income was 4380 Rs/ha (US$1 = Rs 7.90, Dec. 1979) with single-plucking and 4105 Rs/ha with double-plucking. (Summary by Review of Applied Entomology) J00

0218

18186 COCK, J. H.; LYNAM, J.K. 1982. Cassava: future potential and development needs. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.281-300. Engl., Sum. Engl., 51 Refs.

Cassava. Cassava programs. Developmental research. Technology. Uses. Animal nutrition. Human nutrition. Productivity. Economics. Cultivation. Colombia.

Cassava has the potential of generating low cost calories under relatively marginal production conditions and with minimal increases in inputs. Minimal cost but high yielding production technology is recognized as the key to realizing production potential of cassava. Important areas of research emphasis (var. improvement, pest management, agronomic practices, multiple cropping, and transfer of technology requirements) and how national and international agencies shoulder responsibility for research are presented. Potential and development needs of cassava utilization are discussed regarding status quo, human food, animal feed, and alcohol. (Author's summary) J00

0219

18187 LAMBERT, M. 1982. The role of root crops, their prospects and the development needs in the Pacific (a summary). In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.115-120. Engl., Sum. Engl., 6 Refs.

Cassava. Research. Development. Oceania.

The importance of several root crops (including cassava) grown in the South Pacific, agronomic practices employed, and constraints on production are briefly discussed. The incorporation of CF with wheat flour for baking products, and cooked taro and cassava sold frozen in plastic bags has been studied. A UNDP/FAO root crop development project has been proposed towards the development of root crop production in the area. (Extracted from author's summary) J00

0220

18178 LYNAM, J.K. 1982. On-farm evaluation of improved cassava technology. In Belen, E.H.; Villanueva, M., eds. International Symposium on Tropical Root and Tuber Crops, 5th., Los Banos, Laguna, Philippines, 1979. Proceedings. Los Banos, Laguna, Philippine Council for Agriculture and Resources Research. pp.431-455. Engl., Sum. Engl., Illus.

Cassava. Research. Cultivation. Marketing. Socio-economic aspects. Cassava programs. Productivity. Technology evaluation. Colombia.

Results from on-farm trials of CIAT-developed cassava technology carried out on a sample of small-scale farms on the Caribbean coast of Colombia are analyzed. The farming system is discussed, including resource flow, cassava's role within the cropping pattern, agroclimatic conditions, cultural practices, and incomes. Improved cassava technology is compared with existing technology, with discussion on how the improved technology performs under on-farm conditions and how it fits into the existing farming system. Input-output data was used to construct a linear programming of the farm system. Coefficients from the agronomic trials were introduced to assess the potential impact of new cassava technology. This includes an analysis of potential impact on incomes, potential constraints on adoption, and the potential market impact. (Author's summary) J00

0221

18103 NEWCOMBE, K.J.; HOLMES, E.B. 1982. Implementation of alternative fuels in developing countries: alcohol fuels in Papua New Guinea. Papua New Guinea, Energy Planning Unit. Department of Minerals and Energy. Report no. 7. 18p. Engl., 21 Refs.

Cassava. Uses. Alcohol. Development. Economics. Papua New Guinea.

The strategy of the Papua New Guinea's Alcohol Fuels Programme is summarized. Factors impeding the successful implementation of the Baiyer River Alcohol Project, established to produce 2 million litres of fuel ethanol/yr from cassava roots, are highlighted along with the problems faced. Economic, technical, legal, political, and financial parameters involved in the project are analyzed. It was concluded that very few developing countries can sustain the effort necessary to implement an alcohol fuels program without considerable technical and financial assistance from other countries. (Summary by EDITEC. Trans. by L.M.F.) J00

0222

18197 NORMANHA, E.S. 1982. Derivados da mandioca: terminologia e conceitos. (Cassava derivatives: terminology and concepts). Campinas-SP, Brasil, Fundacao Cargill. 54p. Port., Sum. Port., Engl., 9 Refs.

Cassava. Cassava products. Terminology.

References are made to common vocabulary found in both Brazilian and foreign literature, regarding major cassava derivatives used in human and animal nutrition, and for industrial purposes. Each name is defined and related to its corresponding product according to the current meaning given by authors, manufacturers, and consumers. The etymological origin of several names is given. Brief comments are also made on current methods to obtain some of the derivatives, including names, products, and uses. (Author's summary) J00

0223

18116 PINO C., J. 1979. Mercadeo de yuca en Antioquia. (Marketing of cassava in Antioquia). Medellin, Universidad Nacional de Colombia. Facultad de Agronomia. 65p. Span., Sum. Span., Illus.

Cassava. Marketing. Trade. Prices. Statistical data. Colombia.

All the written information that exists on cassava marketing in the department of Antioquia, Colombia, was collected and analyzed. This was complemented with interviews to farmers, middlemen, and retailers. Estimates on the commercialized vol., selling price of the producer, wholesaler, and recailer, and margins of commercialization are given. Information from the different written sources did not agree. The production of commercialized cassava in Antioquia decreased markedly (14.3% yearly av.) as of 1974. Between 1970-78, retailers had 75% of the margins of commercialization; the farmer received 35% of the price paid by the consumer. (Summary by EDITEC. Trans. by L.M.F.) J00

0224

17565 SITOMPUL, S.M.; GURITNO, B.; DARSONO, S.P.; SOETONO. 1982. Research on Mukibat cassava and its potential impact to farmers, education and research development. Malang, Indonesia, Brawijaya University. Faculty of Agriculture. Cassava Research Project. 29p. Engl., 3 Refs., Illus.

Cassava. Mukibat system. Cassava programs. Research. Planting. Spacing. N. P. K. HCN content. Tuber productivity. Timing. Fertilizers. Harvesting. Socio-economic aspects. Indonesia.

The results of the Cassava Research Project initiated in Indonesia in 1982 and its potential impact on small-scale farming, the educational system at the Faculty of Agriculture, Brawijaya U., and research development in Indonesia are reviewed. Results of research on Mukibat cassava regarding agronomic aspects (planting material preparation, stock and scion material selection, planting method, planting density and spacing, fertilization, time of harvest, and cyanogenic glucosides) are discussed. This cropping system is superior in yields to the conventional system. Mukibat cassava is intended primarily for smallholders. Expt. carried out showed that the disadvantages of the system, related to labor input, can be minimized. A set of crop and soil management practices has been developed for small-holders, allowing high, good quality yields to be obtained. Based on this IDRC (Canada) collaborative project, a new research project on root crops in Indonesia was proposed and accepted. Further attention should be paid to mixed cropping in order to improved protein and vitamin balance in nutrition, considering cassava as the main crop. A detailed summary on the research results of the Cassava Program during 1974-1980 is included. (Summary by EDITEC. Trans. by L.M.F.) J00

0225

17567 TUNKU MAHMUD bin TUNKU YAHYA. 1979. Agro-economic study of tapioca smallholders in Manong, Perak. Serang, Selangor, Malaysian Agricultural Research and Development Institute. Agricultural Economic Bulletin no. 1. 19p. Engl., Illus.

Cassava. Production. Costs. Land preparation. Planting. Weeding. Fertilizers. Pest control. Labour. Harvesting. Income. Productivity. Maps. Prices. Socio-economic aspects. Malaysia.

An agroeconomic study of cassava production was conducted, based on a sample of 24 cassava smallholders in Manong, Perak (a state that accounts for 80% of the total production in Malaysia), in order to (1) identify the existing cultural practices and the levels of available technology and management, (2) investigate production costs and returns, and (3) identify the constraints to profit making. The social composition of the sampled smallholders were described according to age and household size, and age

distribution. Traditional cultural practices in cassava cultivation are described namely land preparation, planting, weeding (hand and chemical), fertilization, pest and disease control, harvesting and transportation. The variables that determine production costs are analyzed and tabulated. In Malaysia it is difficult to predict possible returns since the uncertainty of yield and prices exists. Moreover, the market situation is further aggravated with the easier inflow of cheaper cassava from neighboring countries. Since labor constitutes 70% of total production costs, a possible solution to this problem lies in ways to reduce labor costs. (Summary by EDITEC. Trans. by L.M.F.) J00

See also 0124 0148 0154 0166 0168 0185 0187 0199 0203 0207 0208

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0226

18462 BALACHANDRAN N., G.K.; SASIDHAR, V.K.; SANTHAKUMARI, G. 1978. Production potential and economics on seven rice based crop rotations. Agricultural Research Journal of Kerala 17(1):113-115. Engl., Sum. Mal., 4 Refs.

Cassava. Rotational crops. Rice. Tuber productivity. Economics. India.

In multiple cropping trials with rice grown in the 1st 2 seasons and groundnut, rice, cowpea, green gram (Vigna radiata), cassava, sesame, or horsegram (Macrotyloma uniflorum) in the 3rd season (3 crops/yr), total production was highest in the rice/rice/cassava sequence (180 q/ha), but net profit was highest in the rice/rice/groundnut sequence. (Summary by Field Crop Abstracts) K01

0227

18422 GUNASENA, H.P.M.; SILVA, N.T.M.H. DE; MARTIN, M.P.L.D. 1980. Effect of spacing and nitrogen on growth and yield of manioc, Manihot esculenta Crantz grown as an intercrop under coconut. Journal of the National Science Council of Sri Lanka 8(1):1-10. Engl., Sum. Engl., 6 Refs.

Cassava. Inter-cropping. Coconut. Spacing. N. Fertilizers. Tuber productivity. Dry matter. Leaf area. Growth. Tuber development. Sri Lanka.

In field trials at the Coconut Research Institute of Sri Lanka at Lunuwila in 1973-74 cassava was grown at 4 spacings from 0.61-1.52 m under coconuts and given 44.8, 67.2, or 89.6 kg N/ha. There was no significant effect of N fertilizer on tuber yield, although max. tuber wt. was reached later with higher N levels. Tuber fresh wt. yields increased with decreasing spacing from 13.41 to 36.89 t/ha at 9 mo. after planting. Total DM yields were also greatest with close spacing but were max. at 6-8 mo. after planting. Tuber DM yield was max. at 7-8 mo. with 0.61- and 0.91-m spacings (11.93-14.49 t/ha). Total and tuber DM yields were linearly correlated with LAD. (Summary by Field Crop Abstracts) K01

0228

18130 LEIHNER, D.E.; THUNG, M.; COCK, J.H.; LYNAM, J.K. 1982. Produccion de yuca en cultivos multiples. (Cassava production in multiple cropping). In Centro Internacional de Agricultura Tropical. Programa de Yuca. Yuca: investigacion, produccion y utilizacion. Cali, Colombia. pp.261-315. Span., 66 Refs., Illus.

Cassava. Inter-cropping. Beans. Maize. Cowpea. Legume crops. Minerals and nutrients. Fertilizers. Planting. Timing. Spacing. Injurious insects. Diseases and pathogens. Weeding. Costs. Colombia.

A detailed review on cassava production in intercropping systems is given, based on the following aspects: selection of plant types for intercropping; relative planting time, planting density and pattern (spatial arrangement); mineral nutrition and fertilization, competition for nutrients; pest, disease, and weed management, biological potential to reduce weeds, chemical and integrated weed control; evaluation of intercropping systems; economic evaluation. The advantages of intercropping systems are discussed; tables are included on cassava yields obtained in different trials. (Summary by S.B. Trans. by L.M.F.) K01

0229

18135 WILSON, G.F.; LAL, R. 1979. Preliminary investigation of population densities, spatial arrangement and intercropping with cassava on maize under no-tillage. In Lal, R., ed. Soil tillage and crop production. Ibadan, Nigeria, International Institute of Tropical Agriculture. Proceedings Series no. 2. pp.125-131. Engl., 12 Refs.

Cassava. Cultivation systems. Inter-cropping. Maize. Spacing. Tuber productivity. Nigeria.

A trial was conducted to determine the effects on maize yield of maize population densities associated with intercropping, and cassava as an intercrop under no-tillage at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, where land was newly cleared from secondary forest of about 15 years regrowth. The spacings tested in intercrop were 100 x 30, 150 x 20, 150 x 100 cm for maize and 100 x 100, 150 x 100, and 150 x 100 cm for cassava, resp. Spatial arrangement had significant effect as interrow spacing of 100 cm with 100 cm along the row and was superior to interrow spacing of 150 cm and 100 cm along rows for cassava when intercropped with maize (1.2 t/ha vs. 0.6 t/ha, resp.). Within the 33,300 maize plants/ha range, introduction of cassava resulted in significant yield reduction (4.3 kg/ha in intercropping and 5.2 kg/ha in monoculture). Cassava yield was also affected by crop combination (1.2 t/ha in intercropping vs. 5 t/ha in monoculture) and planting sequence. The effect of no-tillage on cassava yield is yet to be evaluated experimentally, but generalizations will not be possible as performance will depend largely on specific soil type (deeper lighter soil or shallow soils). (Summary by S.B.) K01

See also 0115 0116

LIST OF ABBREVIATIONS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
Afr.	Afrikaans
a.i.	Active ingredient
alt.	Altitude
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
AMV	Alfalfa mosaic virus
approx.	Approximate(ly)
atm.	Atmosphere
ATP	Adenosine 5'-triphosphate
av.	Average
BAP	6-Benzylaminopurine
BBMV	Broad bean mosaic virus
BCMV	Bean common mosaic virus
BGMV	Bean golden mosaic virus
BGYMV	Bean golden yellow mosaic virus
BOD	Biochemical oxygen demand
BPMV	Bean pod mottle virus
BRMV	Bean rugose mosaic virus
BSMV	Bean southern mosaic virus
BV	Biological value
BYMV	Bean yellow mosaic virus
°C	Degrees Celsius (centigrade)
ca.	About (circa)
CBB	Cassava bacterial blight
CBSD	Cassava brown streak disease
CEC	Cation exchange capacity
CER	CO_2 exchange rate
CF	Cassava flour
CGR	Crop growth rate
CLM	Cassava leaf meal
CLV	Cassava latent virus
CM	Cassava meal
cm	Centimeter
COD	Chemical oxygen demand
concd.	Concentrated
concn.	Concentration
CP	Crude protein
CSL	Calcium stearyl lactylate
CSW	Cassava starch wastes
C.V.	Coefficient of variation
cv.	Cultivar(s)
2,4-D	2,4-dichlorophenoxyacetic acid
DM	Dry matter
DNA	Deoxyribonucleic acid
EC	Emulsifiable concentrate
EDTA	Ethylenediaminetetraacetic acid
EEC	European Economic Community
e.g.	For example
ELISA	Enzyme-linked immunosorbent assays
EMS	Ethyl methane sulfonate
Engl.	English
expt.	Experiment
exptl.	Experimental
°F	Degrees Fahrenheit
Fr.	French
ft-ca	Foot candles (10.76 lux)
FYM	Farmyard manure
g	Gram(s)
G	Giga (10^9)
GA	Gibberellic acid
gal	Gallon(s)
GE	Gross energy
Germ.	German
GERs	Glucose entry rates
GLC	Gas-liquid chromatography
govt.	Government
govtl.	Governmental
h	Hour(s)
ha	Hectare(s)
HCN	Hydrocyanic acid
HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
HI	Harvest index
IAA	Indoleacetic acid
IBA	Indolebutyric acid
Illus.	Illustrated
in.	Inches
i.e.	That is
Ital.	Italian
IU	International unit
J	Joule
Jap.	Japanese
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilogram-calorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate
kR	Kiloroentgen(s)
l	Liter(s) (only in combination with no.)
LAD	Leaf area duration
LAI	Leaf area index
lat.	Latitude
lb	Pound(s)
LD_{50}	Mean lethal dose

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

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Abstracts on Cassava
(*Manihot esculenta* Crantz)

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INTRODUCTION

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

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

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.

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

Keywords

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

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

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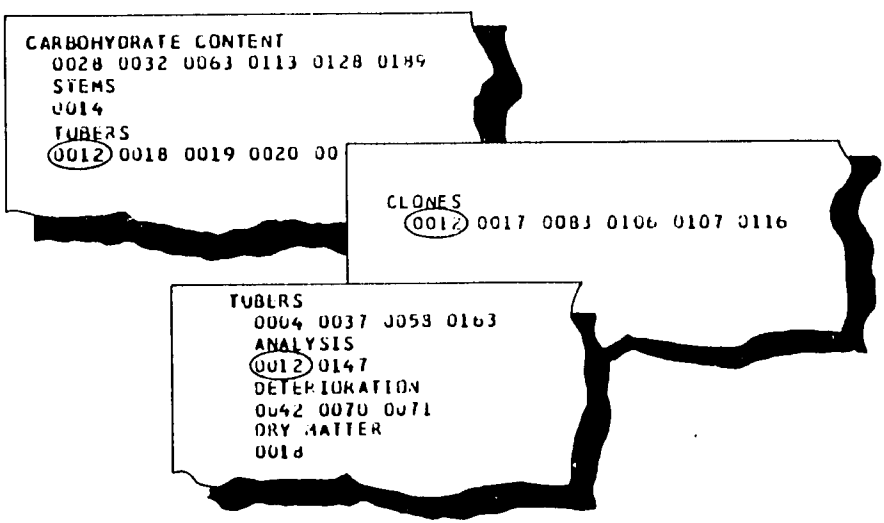

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6. UNESCO coupons, available at UNESCO offices all over the world

A00 BOTANY, TAXONOMY AND GEOGRAPHICAL DISTRIBUTION

0230

18949 NASSAR, N.M.A. 1979. Uma especie de Manihot adaptada a seca. (A Manihot species adapted to drought conditions). In Encontro Nordestino sobre Agricultura de Sequeiro, Patos-PE, Brasil, 1979. Anais. Campina Grande, Universidade Federal da Paraiba. Centro de Ciencias Agrarias. pp.56-61. Port., 9 Refs.

Manihot. Plant geography. Brazil.

A brief description is given of Manihot caerulescens, a promissory species that could be considered as an important source of drought resistance. The species was collected in Araripina, PE, and in Posse, GO, Brazil, and the study on its natural habitat, tuber formation, plant growth, and protein content is given. (Summary by J.L.S. Trans. by L.M.F.) A00

0231

18952 VASCONCELOS SOBRINHO, J. 1939. Consideracoes geraes sobre o genero Manihot. (General considerations on the genus Manihot). Boletim da Secretaria de Agricultura, Industria e Comercio do Estado de Pernambuco 4(1):54-58. Port., Illus.

Cassava. Manihot. Taxonomy.

General considerations on the systematic botany of the sections of the genus Manihot are given in an intent to determine the place that cultivated species occupy among other Manihot species. Cultivated species of the genus Manihot are described as well as sweet and bitter cassava var. (Summary by EMBRAPA. Trans. by L.M.F.) A00

See also 0391

B00 PLANT ANATOMY AND MORPHOLOGY

See 0391

C00 PLANT PHYSIOLOGY

0232

19240 KARTHA, K.K.; LEUNG, N.L.; MROGINSKI, L.A. 1982. In vitro growth responses and plant regeneration from cryopreserved meristems of cassava (Manihot esculenta Crantz). Zeitschrift für Pflanzenphysiologie 107(2): 133-140. Engl., Sum. Engl., 15 Refs., Illus.

Cassava. Laboratory experiments. Meristems. Storage. Temperature. Morphogenesis. Tissue culture.

A droplet-freezing method has been developed for the cryopreservation of cassava meristems. Meristems treated with a 15% dimethylsulfoxide + 3% sucrose solution for 15 min were frozen over an 18 micron aluminum foil in 2-3 microliter droplets of the cryoprotectants in plastic petri dishes at a cooling rate of 0.5°C/min to various sub-zero temp. (-20, -25, -30, and -40°C) and stored in liquid N (-196°C). The meristems retrieved from liquid N storage, upon thawing and return to in vitro culture on plant regeneration medium, exhibited various morphogenetic responses such as differentiation of callus and leaves and whole plantlets, which were successfully grown in pots. (Author's summary) COO

0233

19255 PALTA, J.A. 1982. Gas exchange of four cassava cultivars in relation to light intensity. Experimental Agriculture 18(4):375-382. Engl., Sum. Engl., 13 Refs., Illus.

Cassava. Light. Cultivars. Photosynthesis. Transpiration. Plant physiological processes. Colombia.

Gas exchange measurements were carried out on 4 cassava cv. (M. COL22, M. MEX59, M. COL638, and M. VEN218) under a range of light intensities, to investigate possible differences in photosynthesis and transpiration. Over the range of photon flux density 100-1500 microEinsteins/m^2/s leaves showed a light saturation response typical of C-3 plants with little increase in photosynthetic rate above 1000-1500 microEinsteins/m^2/s. At light saturation there were significant differences in photosynthetic rates between cv., with the highest 10% greater than the lowest. Part of the response could be attributed to increased stomatal aperture, and a greater part to a direct effect of light intensity on the photosynthetic apparatus. Transpiration increased with light intensity levels, but no significant differences were observed between cv. (Author's summary) COO

0234

18995 RAMANUJAM, T. 1982. Leaf area in relation to petiole length in cassava. Turrialba 32(2):212-213. Engl., Sum. Span., Engl., 3 Refs., Illus.

Cassava. Plant physiology. Leaf area. Petioles. Plant anatomy.

The relationship between petiole length and leaf area in cassava was studied in order to develop a simple method for measuring leaf area, especially for larger populations of cassava since the linear measurement methods developed for this crop are time-consuming. A positive correlation was found, therefore it is suggested that petiole length can be taken as an index to measure leaf area for large no. of genetic stocks. (Author's summary) COO

See also 0263 0277 0290 0379

0235

19261 DAHNIYA, M.T.; OPUTA, C.O.; HAHN, S.K. 1982. Investigating source-sink relations in cassava by reciprocal grafts. Experimental Agriculture 18(4):399-402. Engl., Sum. Engl., 5 Refs.

Cassava. Cultivars. Grafting. Plant physiological processes. Dry matter. Tuber development. Tuber productivity. Nigeria.

The relationship between source potentials and sink capacities of 4 cassava var. (Arubielupupa, Isunikankiyan, TMS 30211, and 58308) with different characteristics was investigated by means of reciprocal grafts (16 possible combinations). There were marked differences in the sink capacities (av. stock effects) and source potentials (av. scion effects) of the var. TMS 30211 had the highest mean stock and scion effects, indicating that the var. had the highest source potential and sink capacity, both equally efficient in producing high storage root yield. Local Nigerian unimproved var. Isunikankiyan and Arubielupupa demonstrated poor source potentials and sink capacities, while var. 58308 showed av. values in both. Whenever a particular var. was the stock, the graft in which TMS 30211 was the scion produced the highest total plant DM followed by 58308 as scion. (Author's summary) C01

0236

19000 LAL, R.; MAURYA, P.R. 1982. Root growth of some tropical crops in uniform columns. Plant and Soil 68(2):193-206. Engl., Sum. Engl., 22 Refs., Illus.

Cassava. Roots. Growth. Root system. Plant development. Timing. Plant physiology.

Root system of maize, cowpea, maize and cowpea intercropped, cassava, yam, and sweet potato were investigated in boxes 240 x 115 x 20 cm. One broad side of these boxes was made of a removable transparent plexiglass sheet. The soil was packed in the boxes at a dry bulk density of 128 g/cm^3. Cassava roots penetrated 225 cm in 3 mo. Total root mass at 3, 6, and 12 mo. was 28.3, 57.25, and 196.73 g/plant. Results are discussed in terms of agronomic implications towards spacing, optimum plant population, and tillage practices. (Summary by J.L.S.) C01

0237

18914 MAYOBRE, F.; SAN JOSE, J.J.; ORIHUELA, B.E.; ACOSTA, J. 1982. Características morfológicas, anatómicas y fisiológicas, que influyen sobre el crecimiento de una comunidad de Manihot esculenta Crantz, var. Cubana. (Morphological, anatomical, and physiological characteristics that influence the growth of a plant community of Manihot esculenta var. Cubana). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:197-206. Span., Sum. Span., 31 Refs., Illus.

Cassava. Plant anatomy. Plant physiology. Growth. Plant physiological processes. Analysis.

The process of OM production in cassava var. Cubana was studied using the growth analysis technique. Primary data used to estimate the growth

characteristics of the var. were obtained from previous research. Results indicate that the high OM production is mainly related to the physiological activity of the crop canopy. The RGR of root dry wt. does not depend on the level of fertilization. Therefore its efficiency under competition does not increase nutrient availability, but should be related to the genetic characteristics of the var. (Author's summary. Trans. by L.M.F.) C01

See also 0244 0258 0264 0265 0373 0374 0391

C03 Chemical Composition, Methodology and Analyses

0238

18461 BATTISTI, C.R. DE; COELHO, D.T.; TELES, F.F.F.; OLIVEIRA, L.M. DE; SILVEIRA, A.J. DA 1981. Determinacao do teor de carboidratos ácidos digeríveis em cultivares de mandiocas (Manihot esculenta Crantz) e sacarificacao do amido por extrusao. (Determination of levels of acid digestible carbohydrates in cassava cultivars and starch saccharification by extrusion). Revista Ceres 28(157):318-322. Port., Sum. Engl., 13 Refs.

Cassava. Cultivars. Carbohydrate content. Analysis. Brazil.

The levels of acid digestible carbohydrate for 10 cassava cv. (Preta de Quilombo, Engana Ladrao, SFG-2-204, Mico, Branca de Santa Catarina, Pirassununga, Guaxupé, Manteiga, Vassourinha, and Sabará Entre Rios), grown in Vicosa, MG, Brazil, were determined. Cv. Preta de Quilombo showed the highest level of acid digestible carbohydrate (33.05%). This cv. was extruded and after the level of acid digestible carbohydrate was determined, it was found that only 15% of the starch was hydrolyzed. (Author's summary) C03

0239

17111 COOKE, R.D.; DE LA CRUZ, E.M. 1982. An evaluation of enzymic and autolytic assays for cyanide in cassava (Manihot esculenta, Crantz). Journal of the Science of Food and Agriculture 33(10):1001-1009. Engl., Sum. Engl., 24 Refs., illus.

Cassava. Plant tissues. Cyanides. Composition. Analysis. Laboratory experiments. Cortex. Leaves. Tubers.

The total cyanide contents of cassava parenchymal tissue (peeled roots), cortex (peel), and leaves were evaluated by autolytic and enzymic assays. Autolysis of parenchymal tissue was studied under different conditions of pH, time and temp. and addition of exogenous enzyme and antibiotic. Optimal conditions were determined to be 24 h at 37°C in acetate buffer (0.1 M; pH 5.5) with 0.1 mg/ml chloramphenicol. Total cyanide contents similar (about 90%) to those obtained by enzymic assay could be achieved only by the use of small sample sizes: less than 1 g of parenchymal tissue, less than 0.3 g of cortex, and less than 0.1 g of leaf tissue. This caused sampling problems because of the presence of cyanide gradients in cassava tissues, which could only be resolved by tissue homogenization prior to analysis. A study using the enzymic assay of cyanide stability in such homogenates, at different pH values and temp., has indicated that subsampling must be done

within 15 min so as to prevent appreciable losses in the measured cyanide contents. The rate of loss of total cyanide was found to depend not only on the proportion of total cyanide which is non-glucosidic (free), but also on the proportion of the non-glucosidic cyanide present as cyanohydrins. The implications with regard to residual cyanide contents on cassava processing and the advantages of the enzymic assay over autolytic methods are discussed. (Author's summary) C03

0240

19237 FABOYA, O.O.P. 1981. The fatty acid composition of some tubers grown in Nigeria. Food Chemistry 7(2):151-154. Engl., Sum. Engl., 4 Refs.

Cassava. Tubers. Fat content. Analysis. Nigeria.

The fat content of some tubers, water yam (Dioscorea alata), white yam (D. rotunda), yellow yam (D. esculenta), sweet potatoes, cassava, cocoyam (Xanthosoma sagittifolium), and carrot, grown in Nigeria was determined and the distribution of fatty acids measured by GLC. The fat content was low (equal to or less than 1.2%) in all species, cassava presenting the highest; however, the peel contained more fat than the pulp. Oleic acid (35-68%) and palmitic acid (21-39%) were the main fatty acids. Arachidic acid was present is small amounts (less than 3%) in all samples. Other fatty acids were present only in minor amounts, except for higher levels in the peel. (Author's summary) C03

0241

17109 JUSTE JUNIOR, E.S.G.; CARVALHO, V.D. DE; VILELA, E.R.; CLEMENTE, P.R.; CORREA, H.; MORAES, A.R. DE 1983. Comparacao entre o método físico da balanca hidrostática e métodos químicos na determinacao do amido em raízes de mandioca. (Comparison between the physical method of hydrostatic balance and chemical methods of determining starch content in cassava roots). Pesquisa Agropecuária Brasileira 18(1):55-57. Port., Sum. Port., Engl., 8 Refs.

Cassava. Cultivars. Starch content. Timing. Analysis. Laboratory experiments. Brazil.

Root starch content of cassava cv. Mantiqueira, Riqueza, and Branca de Santa Catarina, harvested 9, 12, 15, and 18 mo. after planting, was determined by the physical method of hydrostatic balance and 2 chemical methods using acid hydrolisis extraction: titrimetrically (Fehling solution) and by colorimetry (Somogyi-Nelson method). There were significant correlations between these 2 methods; however, the correlations between hydrostatic balance and Fehling and Somogyi-Nelson starch data were not significant. The physical method of hydrostatic balance can not replace chemical methods of starch determination in cassava roots. (Author's summary) C03

0242

18485 RAO, R.P.; AZEEMODDIN, G.; RAMAYYA, D.A.; RAO, S.D.T.; DEVI, K.S.; PANTULU, A.J.; LAKSHMINARAYANA, G.; PILLAIYAR, P.; BALASUBRAMANIAN, A.; KRISHNAMOORTHY, K. 1980. Characteristics and composition of Indian cassava seed and oil. Journal of Food Science and Technology 17(6): 266-267. Engl., Sum. Engl., 3 Refs.

Cassava. Seeds. Composition. Analysis. India.

Seeds, kernels (50% of seed), and husks of cassava contained oil, 26.1, 49.0, and 3.0; crude protein, 18.5, 29.2, and 7.6; crude fibre, 31.3, 2.2, and 60.0; and ash, 7.2, 4.0, and 10.6%, resp. The main fatty acids were palmitic 11.4, oleic 25.1, and linoleic 51.4% of the total. (Summary by Nutrition Abstracts and Reviews) C03

See also 0253 0254 0256 0307 0315 0321 0323 0329 0342 0358 0373 0374 0391

C04 Plant Nutrition

0243

18200 CARVALHO, P.C.L. DE; EZETA, F.N.; GOMES, J. DE C. 1982. Toxidez de alumínio em mandioca (Manihot esculenta Crantz). (Aluminum toxicity in cassava). Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em Andamento no. 04. 3p. Port., 8 Refs.

Cassava. Nutritional requirements. Al. Cultivars. Roots. Plant development. Mineral content. P. Ca. Cassava programs. Brazil.

Advances in research at the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, BA, Brazil, on cassava var. with a high degree of adaptability to acid, infertile soils are briefly reported. The level of tolerance of high-yielding cassava var. to critical levels of Al was determined in terms of root development and leaf P and Ca concn. Var. Cigana Preta was used in Steinberg's solution and $AlCl_3.6H_2O$ was used as source of Al at 0, 2, 4, 8, 16, and 32 ppm. Root development and P and Ca contents were adversely affected as Al concn. increased. (Summary by J.L.S. Trans. by L.M.F.) C04

0244

18456 EZETA, F.N.; CARVALHO, P.C.L. DE 1982. Influencia da endomicorriza na absorcao de P e K e no crescimento da mandioca. (Influence of endomycorrhiza on P and K uptake and growth of cassava). Revista Brasileira de Ciencia do Solo 6(1):25-28. Port., Sum. Port., Engl., 9 Refs.

Cassava. Mycorrhiza. Inoculation. Leaves. Roots. Plant development. Mineral content. P. K. Nutrient absorption. Brazil.

The dependence of cassava on vesicular-arbuscular (VA) mycorrhiza formed with endogone fungi was studied under greenhouse conditions. Native spores of Acaulospora sp. were inoculated on the roots of cassava cuttings which were planted in sterilized soil. Endomycorrhiza was essential to cassava growth. Uninoculated plants did not develop, showing low tissue concn. of P. K concn., however, was higher in the leaves of uninoculated plants in sterilized soil. Sterilization decreased root infection but increased the no. of spores of the inoculated VA species in the soil at the end of the expt. In spite of their high rates of root infection, the plants in the unsterile soil grew less than those inoculated and grown in sterilized soil. (Author's summary) C04

0245

18171 GODO, G. 1981. Nouvelle approche agronomique dans la culture du manioc. (New agronomic focus of cassava growing). Abidjan, Cote d'Ivoire, Office de la Recherche Scientifique et Technique Outre-Mer. Centre D'Adiopodoumé. 7p. Fr., 9 Refs.

Cassava. Nutritional requirements. Plant physiology.

In order to improve the understanding of fertilization problems in cassava, determine the optimum combination of cultural practices, and increase crop yields, it is necessary to study plant physiological processes and the production of DM. This study should cover aspects regarding development of the root system (rooting, tuber development, growth) and the canopy; crop fertilization and soil evolution; field and on-farm trials; and a soil survey. (Summary by S.B. Trans. by L.M.F.) C04

0246

18955 HOWELER, R.H.; CADAVID, L.F.; BURCKHARDT, E. 1982. Response of cassava to VA mycorrhizal inoculation and phosphorus application in greenhouse and field experiments. Plant and Soil 69:327-339. Engl., Sum. Engl., 18 Refs., Illus.

Cassava. Mycorrhiza. Inoculation. P. Mineral content. Nutrient absorption. Soil analysis. Tuber productivity. Foliage. Field experiments. Laboratory experiments. Colombia.

Cassava was grown in the greenhouse and in the field (Quilichao, Colombia) at different levels of P applied, with or without inoculation with vesicular arbuscular (VA) mycorrhiza in sterilized or unsterilized soil. When grown in a sterilized soil to which 8 levels of P had been applied the noninoculated plants required the application of 3200 kg P/ha to reach near-max. yield of plant DM at 3 mo. Inoculated plants, however, showed only a minor response to applied P. Mycorrhizal inoculation in the P check increased top growth over 80 fold and total P uptake over 100 fold. Relating DM produced to the available P conc. in the soil (Bray II), a critical level of 15 ppm P was obtained for mycorrhizal and 190 ppm P for non-mycorrhizal plants. This indicates that the determination of critical levels of P in the soil is highly dependent on the degree of mycorrhizal infection of the root system. In a 2nd greenhouse trial with 2 sterilized and unsterilized soils it was found that in both sterilized soils, inoculation was most effective at intermediate levels of applied P resulting in a 15-30 fold increase in DM at 100 kg P/ha. In the unsterilized soil inoculation had no significant effect in the Quilichao soil, but increased DM over 3 fold in the Carimagua soil, indicating that the latter had a native mycorrhizal population less effective than the former. When cassava was grown in the field in plots with 11 levels of P applied, uninoculated plants grown in sterilized soil remained extremely P deficient for 4-5 mo. after which they recuperated through mycorrhizal infection from unsterilized borders or subsoil. Still, after 11 mo. inoculation had increased root yields by 40%. In the unsterilized soil inoculation had no significant effect as the introduced strain was equally as effective as the native mycorrhizal population. These trials indicate that cassava is extremely dependent on an effective mycorrhizal association for normal growth in low-P soils, but that in most natural soils this association is rapidly established and inoculation of cassava in the field can only be effective in soils with a low quantity and quality of native mycorrhiza. In that case, plants should be inoculated with highly effective strains. (Author's summary) C04

0247

19260 OKEKE, J.E.; KANG, B.T.; OBIGBESAN, G.O. 1982. Effects of fertilizer and plant age on distribution of nutrients in Nigerian cassava (Manihot esculenta). Experimental Agriculture 18(4):403-411. Engl., Sum. Engl., 17 Refs., Illus.

Cassava. Nutritional requirements. N. P. K. Nutrient absorption. Cultivars. Leaves. Stems. Analysis. Fertilizers. Mineral content. Dry matter. Timing. Tuber productivity. Nigeria.

The effects of soil fertilization and plant age on the nutrient composition of various parts of 5 Nigerian cassava var. were studied both in the glasshouse and in the field to identify suitable index plant tissues, sensitive growth stages, and optimum nutrient concn., to develop better fertilizer practices for the crop. The 3rd mo. from planting was the most sensitive stage for diagnostic sampling, when N status was best reflected in leaf blades and K in petioles. N and P were most concentrated in leaf blades and least in root tubers. The largest root tuber yields after 12 mo. were associated with leaf blade analyses of 5% N, 0.4% P, and 2% K at 3 mo. after planting. (Author's summary) C04

See also 0254 0257 0373 0374 0391

D00 CULTIVATION

0248

19271 BELEHU, T. 1982. Ethiopia. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.109-110. Engl., Sum. Engl.

Cassava. Cultivation. Ethiopia.

Several million people in Ethiopia depend on root and tuber crops as a staple food; therefore, a national effort has been directed toward developing acceptable cv. and appropriate cultural practices so that improved yields and better quality products can be obtained. The root and tuber crops given priority in this program are potato, sweet potato, enset (Enset ventricosa), yam, taro, anchote (Coccinia abyssinica), and cassava. (Author's summary) D00

0249

19275 BRUIJN, G.H. DE; GUTHRIE, E.J. 1982. Kenya. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.95-98, 122-128. Engl., Sum. Engl., 15 Refs.

Cassava. Cultivation. Cultivars. Cultivation systems. Cassava African mosaic virus. Xanthomonas manihotis. Xanthomonas cassavae. Mononychellus tanajoa. Kenya.

Information on var., cropping systems used, time of planting and harvesting, pests and diseases, and utilization of cassava in Kenya is given. Cassava is grown on about 7.0×10^4 ha in Kenya and is mainly used for human consumption, although interest in its use in animal feed and

industry is growing. In some areas it is a staple food, in others a famine reserve. Main production areas are in the west of the country and at the coast. Because of the rapid increase in population, the area of production is likely to expand, mainly in semiarid areas. The main constraint is CAMD, which causes serious yield reductions. The disease can be controlled in most cases by the use of healthy stakes and subsequent roguing of infected plants. Other constraints are bacterial blight (Xanthomonas manihoti and X. cassavae) and cassava green mite (Mononychellus tanajoa), both of which entered the country in recent years. These constraints should be the focus of any program to improve production. Efforts should be devoted to varietal development through selection, agronomic investigations, and sanitary measures for disease control. (Author's summary) D00

0250

18406 HOLGUIN M., F.; MENDEZ R., A.; SANCHEZ E., D.; URIAS L., M.A.; AQUINO V., B.; CANALES C., J.A.; GONZALEZ L., V. 1982. La producción de yuca y su potencial en el trópico húmedo de México. (Cassava production and its potential in the humid tropics of Mexico). Huimanguillo, Tabasco, México, Secretaría de Agricultura y Recursos Hidráulicos. Folleto para Productores no. 1. 42p. Span., Illus.

Cassava. Cultivation. Injurious insects. Diseases and pathogens. Propagation. Cultivation systems. Uses. Mexico.

On the basis of the results obtained by the cassava research program with headquarters at the Huimanguillo Agricultural Expt. Field in the state of Tabasco, Mexico, a new technology for cassava cultivation in Mexico is given. Aspects described were land preparation, recommended var., crop establishment (selection and disinfection of cuttings, planting time and methods, planting distances), fertilization, control of weeds, pests (Frankliniella cephalica, Caliothrips masculinus, Erinnyis ello, Phenacoccus gossypii, Silba pendula), diseases (Xanthomonas manihotis, Sphaceloma manihoticola, Cercosporidium henningsii, and witches' broom), and rapid propagation of planting material. The most common production systems in Mexico are described: cassava/bean, cassava/maize, and cassava/coconut intercropping. Harvest, processing, and utilization of cassava are described and finally the yields obtained with traditional and improved technology are compared. (Summary by EDITEC. Trans. by L.M.F.) D00

0251

18985 HOLMES, E.B. 1982. Food crops: cassava. In _____. Lowlands food crop research and development in the Department of Minerals and Energy. Konedobu, Papua New Guinea, Energy Planning Unit, Policy and Planning Division. Department of Minerals and Energy. Report no. 15/82. pp.7-12. Engl.

Cassava. Cassava programs. Cultivation. Papua New Guinea.

A research program on cassava in Papua New Guinea was initiated by the Department of Minerals and Energy with resources of both government and commercial organizations. The program, established at different sites, includes trials on cv. selection and evaluation, planting time vs. harvesting time, spacing, weed control, tuber starch evaluation methods. Starch should be included as a plant for study in the UNDP/FAO root crop project due to its importance in the development of Papua New Guinea. (Summary by I.B. Trans. by L.M.F.) D00

0252

19273 SAUTI, R.F.N. 1982. Malawi. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.104-106, 122-128. Engl., Sum. Engl., 5 Refs.

Cassava. Cultivation. Cassava African mosaic virus. Cultivation systems. Cultivars. Tuber productivity. Marketing. Cassava programs. Malawi.

Cassava and sweet potato are the two commonly grown root crops in Malawi. Cassava (predominantly bitter cv.) is mainly grown as a staple crop along the lakeshore area, while sweet types are common along the Shire highlands as a famine reserve, mostly eaten as a snack. Production problems are discussed: the absence of high-yielding var., the damage from diseases and pests, the lack of adequate techniques for storage, the shortage of extension services, and poor techniques in management. Cassava research activities in Malawi are reported. (Summary by L.M.F.) D00

See also 0379 0385

D01 Soil, Water, Climate and Fertilization

0253

18948 ABRUÑA-RODRIGUEZ, F.; VICENTE-CHANDLER, J.; RIVERA, E.; RODRIGUEZ, J. 1982. Effect of soil acidity factors on yields and foliar composition of tropical root crops. Soil Science Society of America Journal 46(5): 1004-1007. Engl., Sum. Engl., 11 Refs., Illus.

Cassava. Soil fertility. pH. Soil requirements. Leaves. N. P. K. Ca. Mg. Mn. Mineral content. Analysis. Productivity. Puerto Rico.

Expt. on 2 Ultisols and an Oxisol showed that 3 tropical root crops differed markedly in sensitivity to soil acidity factors. Yams were very sensitive to soil acidity with yields on a Ultisol decreasing from 70% of max. when Al saturation of the effective CEC of the soil was 10, to 25% of max. when Al saturation was 40%. On the other hand, cassava was tolerant to high levels of soil acidity, yielding about 85% of max. with 60% Al saturation. Cocoyams (Xanthosoma sp.) were intermediate between yams and cassava in their tolerance to soil acidity yielding about 60% of max. with 50% Al saturation of the soil. Foliar composition of cassava was not affected by soil acidity levels and that of yams and cocoyams was also unaffected except for Ca content which decreased with decreasing soil pH and increasing Al saturation. Response of these tropical root crops to soil acidity components was far more striking on Ultisols than on the Oxisol. For yams, soils should be limed to about pH 5.5 with essentially no exchangeable Al^{3+} present whereas high cocoyam yields can be obtained at about pH 4.8 with 20% exchangeable Al^{3+} and high cassava yields at pH as low as 4.5 with 60% exchangeable Al^{3+}. (Author's summary) D01

0254

18988 ALMENDRAS, A.S.; DE LA CRUZ, R.E.; MANGUIAT, I.J. 1982. Effect of soil type, fertilization and mycorrhizal inoculation on NPK uptake of cassava. Annals of Tropical Research 4(2):118-126. Engl., Sum. Engl., 11 Refs.

Cassava. Soil requirements. Mycorrhiza. N. P. K. Mineral content. Nutrient absorption. Analysis. Shoots. Timing. Philippines.

The response of cassava cv. Lakan to NPK fertilization and mycorrhizal inoculation was evaluated through a pot expt. using unsterilized soil (Lipa clay loam and Luisiana clay). Application of 45-60-60 and 90-60-60 in Lipa clay loam and Luisiana clay, resp., resulted in significantly higher P uptake than with 0-60-60 treatment in both soil types. Both soil type and inoculation failed to have any significant effect on shoot dry wt. of cassava. However, fertilization and its interaction with soil type significantly affected shoot DM production. Regardless of soil type and inoculation, highest av. shoot N content was obtained from plants applied 0-60-60 and 90-0-60. These values were significantly higher when compared with plants treated with 45-60-60 and 90-60-30. A significant interaction between soil type and different fertilizer levels on N content was also observed. A significant combined effect of soil type and fertilizer treatment on P content was also observed. Highly significant effects of soil type and fertilizer treatments were observed only on K uptake but not on K content of shoots, regardless of inoculation treatments. (Summary by L.M.F.) D01

0255

18906 CEPEDA V., R.A.; ACOSTA S., C.E. 1983. Fertilización de la yuca (Manihot esculenta C.) en suelos del Centro Regional de Investigación El Carmen de Bolívar. (Cassava fertilization in soils at the Centro Regional de Investigación El Carmen in Bolívar). Revista ICA 18(1):9-17. Span., Sum. Span., Engl., 11 Refs., illus.

Cassava. Field experiments. N. P. K. Mg. Productivity. Soil analysis. Colombia.

Five expt. were conducted between 1974-76 on a vertisol soil at the Centro Regional de Investigación El Carmen, Bolivar (Colombia) to study the effect of different levels and application methods of N, P, K, and Mg on the yields of cassava var. CMC-40. Rates of N, P, and K varied between 0-120, 0-180, and 0-120 kg/ha, resp. for a total of 15 treatments and those of Mg, between 0-120 kg/ha. Results of yield trials showed significant differences in 1975 regarding the treatment consisting of 60-90-60 kg NPK in comparison with other treatments. In 1974 and 1976 there were no significant differences among treatments due to limited, irregular rainfall during plant growth cycle. The application of Mg sulfate along with 60-90-60 and 0-180-120 NPK did not show statistically significant differences in yield although the effect of Mg on cassava yield was greater when N was applied than when it was not. Full-circle or half-circle application of fertilizers increased production compared with the method of spot-applying fertilizers. (Author's summary. Trans. by L.M.F.) D01

0256

18999 GLIESSMAN, S.R. 1982. Nitrogen distribution in several traditional agro-ecosystems in the humid tropical lowlands of south-eastern Mexico. Plant and Soil 67(1):105-117. Engl., Sum. Engl., Span., 11 Refs.

Cassava. Soil analysis. N. Roots. Stems. Leaves. Analysis. Ecology. Mexico.

N distribution was examined in 5 local agroecosystems typical of the lowlands of tropical SE Mexico: monoculture maize, maize/bean polyculture, cassava, taro, and upland rice. Total biomass and N content were determined

monthly for standing live, standing dead, and litter biomass of both crop and noncrop components of each system. The crop component was further divided into roots, crown, stem, leaves, fruits, and flowers. Soil N determinations were also made monthly. Results demonstrated that N maintenance in the system is highly dependent on the proportion of the net biomass produced which is returned to the system. Leguminous and weed components may reduce net N losses from these systems. (Author's summary) D01

0257

19244 GOMES, J. DE C. 1979. Adubacao da cultura da mandioca. (Cassava fertilization). Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 31p. Port., 32 Refs., Illus.

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

Cassava. Nutritional requirements. Nutrient absorption. N. P. K. Minerals. Fertilizers. Tuber productivity.

A literature review is presented on the use of fertilizers in cassava. The following aspects are highlighted: (a) plant requirements; (b) effects of fertilization; (c) symptoms of deficiency including macro- and micronutrients. Based on the results obtained with the use of mineral fertilizers, it was determined that (a) cassava responds well to organic manures; (b) although P is required in lower amounts, it is still limiting to production (between 80-120 kg P should be applied per hectare); (c) the plant extracts great amounts of N and K from the soil; in the presence of N and K, there is a better response to P; (d) no response to liming, S, and micronutrients was recorded. (Summary by EMBRAPA. Trans. by L.M.F.) D01

0258

18913 MAYOBRE, F.; SAN JOSE, J.J.; ORTHUELA, B.E.; ACOSTA, J. 1982. Influencia del nivel de fertilización y riego sobre el crecimiento de Manihot esculenta Crantz var. Cubana. (Influence of the level of fertilization and irrigation on the growth of Manihot esculenta var. Cubana). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:171-196. Span., Sum. Span., 16 Refs., Illus.

Cassava. N. P. K. Irrigation. Growth. Timing. Leaves. Petioles. Stems. Cuttings. Tubers. Climatic requirements. Venezuela.

The dynamics of the process of OM production in cassava var. Cubana, planted in the Llanos Altos Centrales of Venezuela, is analyzed. Exptl. units consisted of ten 20 x 20 m plots, divided into 2 groups each treated with 0, 1, 2, 3, and 4 t NPK 12:12:17/2 per hectare. One of the groups was spray irrigated during the dry season. Planting took place on 30-6-78, and density was 25,000 plants/ha. Data of harvests conducted approx. every 15 days were recorded during 3 climatic seasons. Results indicate that the OM production of var. Cubana was considerably higher (41.8 t/ha fresh wt. at 4.5 mo., for the treatment with 4 t fertilizer/ha) than that harvested for other crops planted and fertilized in the area. Crop growth, after this 1st period, occurred in growth cycles, reflecting plant lodging due mainly to the decomposition of mature roots and plant wt. A large no. of scions fell to the ground, lost their leaves and new scions were formed at the expense

of the energy stored in stems and roots. (Author's summary. Trans. by L.M.F.) D01

0259

19276 PFEIFFER, H.J.; LYONGA, S.N. 1982. Cameroon. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.89-94. Engl., Sum. Engl., Illus.

Cassava. Cultivation. Soil requirements. Rainfall data. Soil fertility. Drainage. Production. Cameroon.

The cropping systems found in the different zones in Cameroon are described and they are related to the ecological and sociological conditions of the regions. A large var. of soils and ecological zones characterize the country, and the potential for root crop production ranges from poor to excellent. (Author's summary) D01

0260

19243 PORTO, M.C.M. 1979. Os fatores climáticos e a mandioca. (Climatic factors and cassava). Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 12p. Port., 15 Refs.

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

Cassava. Climatic requirements. Temperature. Photoperiod. Brazil.

A literature review is given of the climatic factors that affect cassava production: temp., water, photoperiod, and light. The climatic zonation of cassava cultivation in Brazil is also outlined. (Summary by J.L.S. Trans. by L.M.F.) D01

0261

18493 SADASIVAM, K.V. 1982. Studies on the metabolic activity of rhizosphere soil of tapioca (Manihot utilissima Pohl.). Zentralblatt für Mikrobiologie 137(1):14-19. Engl., Sum. Engl., Germ., 11 Refs., Illus.

Cassava. Roots. Tubers. Soil analysis. India.

An attempt was made to measure the metabolic activity of the rizosphere of cassava, both in tuberous and nontuberous roots and control soil, and to compare the effect of root extract on soil metabolism through manometric studies. Respirometric studies showed that rhizosphere soils were metabolically more active than the control soil; there was no significant difference between the root and tuber rhizosphere. Comparing the effect of plain and autoclaved tuber extracts on the metabolic activity of soil, it was found that with autoclaved extract the rate of O_2 uptake was higher and the overall attack on the substrate more rapid. Similarly, comparing the effect of tuber extract and pure KCN solution, it was noted that pure KCN solution was toxic and inhibited O_2 uptake even in low concn., whereas with the tuber extract, although the concn. of KCN was quite high, no such effect was found. (Author's summary) D01

See also 0243 0246 0247 0313 0318 0373 0374 0379
0387 0390 0391

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

0262

19233 ALMEIDA, P.A. DE; MATTOS, P.L.P. DE ·1979. Métodos de colheita para mandioca. (Cassava harvesting methods). Cruz das Almas-BA, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 6p. Port., 5 Refs.

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

Cassava. Planting. Harvesting. Tuber productivity. Brazil.

Brief comments on manual, semimechanical, and mechanical cassava harvesting are given. Manual harvesting is recommended when cassava is planted in hills or in furrows; cassava planted in furrows can also be harvested semimechanically. Planting on ridges is most viable for mechanical harvesting. The extent of the area planted to cassava, planting distance, var. used, and soil preparation and type are factors that should be taken into account when adopting a harvesting method. (Summary by EMBRAPA. Trans. by L.M.F.) D02

0263

18404 DELA CRUZ, A.Q. 1979. The production of four field crops in a Chromolaena odorata (L.) R.M. King and H. Robinson infested field. Mag. Sc. Thesis. Los Baños, Laguna, University of the Philippines at Los Baños. 129p. Engl., Sum. Engl., 57 Refs., Illus.

Cassava. Field experiments. Weeding. Plant development. Tuber productivity. Plant height. Cultivation. Weeds. Philippines.

Two studies were conducted during the dry season of 1978-79 on an Aborlan sandy loam soil at the Palawan Agricultural Research Center, Palawan National Agricultural College, Aborlan, Palawan to: (a) determine the effect of several preplant treatments in a Chromolaena odorata-infested field on the growth and yield of cassava, maize, mungbean, and sweet potato; (b) identify a suitable preplant treatment operation for a chromolaena-infested field; (c) determine the shift of weed species on a chromolaena-infested field; and (d) analyze the economics of production of cassava, maize, mungbean, and sweet potato which were affected by the selected preplant treatments in a chromolaena-infested field. No differences among treatments were observed regarding the dry wt. of cassava. The use of C. odorata as mulch in cassava plants after emergence produced the tallest plants and had the heaviest dry stubble. Cassava response to P seemed to be less pronounced than the other crops; however, this could be due to the vegetative stage of cassava plants. The CEC, OM (%), and exchangeable Ca and Mg values did not differ among crops within the preplant treatment. The leaves of C. odorata contained the highest % values of N, P, and K. C. odorata grew notably in association with cassava. The most common and predominating weed species regardless of crops grown were C. odorata, Ageratum conyzoides, Lindernia crustacea, Cyperus iria,

and Fimbristylis dichotoma. C. odorata and A. conyzoides were found to be persistent in varying no. of population. Shift in weed species and weed composition were affected by the preplant treatments. Merremia tridentata and Peperomia pellucida were eliminated in all crops. Weed composition changed with the appearance of many annual broadleaves, grasses, and sedges such as L. crustacea, Phyllantus amarus, Ludwigia octovalvis, Scoparia dulcis, Vernonia cinerea, Starchytarpeta jamaicencis, Eleusine indica, Paspalum notatum, and C. iria. Plants grown under complete removal of C. odorata, the use of C. odorata as mulch, and the addition of C. odorata in cassava, maize, mungbean, and sweet potato gave the highest cost of production. Cassava and sweet potato produced a profitable gain in chromolaena-infested field. The crops also required the lowest amount of inputs to produce a kg of tuber yield. (Author's summary) D02

0264

18490 LOPEZ Z., M.; VAZQUEZ B., E. 1982. Influencia de la densidad de población en el rendimiento y crecimiento de las raíces tuberosas de yuca, Manihot esculenta Crantz. (Influence of population density on the growth and yield of cassava roots). Centro Agrícola 9(1):59-67. Span., Sum. Span., Engl., 8 Refs., Illus.

Cassava. Field experiments. Planting. Spacing. Growth. Dry matter. Foliage. Tubers. Plant assimilation. Tuber productivity. Leaf area. Venezuela.

The influence of population density (37,037, 18,500, 12,300, and 9220 plants/ha) on the growth and yield of roots of cassava var. Señorita was studied at the Alvaro Barba Exptl. Station of the U. Central (Cuba). Different var. may vary considerably in their response to planting distance. Var. with vertical leaf position, like Señorita, give higher yields in comparison with var. with horizontal leaves. Foliage and root DM were determined at 2, 3, 5, 6, 8, and 10 mo. Leaf area was estimated on the basis of the ratio leaf area:leaf DM. A population density of 18,500 plants/ha in this var. resulted in adequate foliage development that at the same time allowed an effective NAR in order to attain high root yields. (Author's summary. Trans. by L.M.F.) D02

0265

18491 LOPEZ Z., M.; VAZQUEZ B., E. 1982. Influencia de la profundidad de plantación en el crecimiento y rendimiento de las raíces tuberosas de yuca Manihot esculenta Crantz. (Effect of planting depth on the growth and yield of cassava roots). Centro Agrícola 9(1):31-39. Span., Sum. Span., Engl., 7 Refs., Illus.

Cassava. Planting. Tuber development. Leaf area. Dry matter. Foliage. Tubers. Plant assimilation. Tuber productivity. Field experiments. Venezuela.

The effect of planting depth (5, 10, 15, and 20 cm) on the growth and development of cassava roots was studied in a brown soil with carbonate at the Alvaro Barba Exptl. Station, U. Central (Cuba). Planting depths of 5-20 cm did not affect leaf development nor planting cycle; however, its influence on root development was considerable. With a 5 cm depth higher root production was obtained, while depths of 20 cm produced physiological disorders in the development of new stems, inducing elongation and weakening the stem from the growing point up to the ground surface, thus impeding circulation in this part of the stem. Growth parameters, dynamics

of the foliage and root DM, and NAR values were also determined. (Author's summary. Trans. by L.M.F.) D02

0266

18980 VALAREZO M., C.; SAMANIEGO, V.H. 1983. Ensayo de tecnología mejorada a nivel de finca en yuca; experimentos: 1. Influencia de la población de yuca sobre el rendimiento. 2. Efecto de la posición de la estaca en la plantación sobre la producción de yuca. (On-farm cassava trials on improved technology; experiments: 1. Influence of cassava population on yield. 2. Effect of cutting position at planting on cassava yield). Proyecto Zamora-Nangaritza. Loja, Ecuador, Subcomisión Ecuatoriana Predesur. Gerencia de Desarrollo Agropecuario. Publicación no. 7. 23p. Span., Sum. Span., Engl., 9 Refs., Illus.

Cassava. Technology evaluation. Planting. Spacing. Cuttings. Root system. Tuber productivity. Costs. Ecuador.

Cassava, one of the most important staple food crops in the valleys of the Zamora and Nangaritza Rivers, Ecuador, is cultivated in an area ranging from 800 to 1200 ha, with av. yields of 7 t/ha. The Research and Extension Subproject of the Zamora-Nangaritza Integrated Rural Development Project has carried out 2 expt. in cassava. The 1st expt. studied the effect of cassava population on yield on recent and old alluvial soils, with 4 different treatments (D1, 10,000; D2, 8000; D3, 6000; and D4, 5000 plants of local var. Embayecana/ha) and 4 replications, arranged in a randomized block design. All the plots received 66, 26, and 16 kg NPK/ha, resp. Cultural practices applied were those currently used in the area. The highest no. of marketable roots was obtained with the treatment D1. However, the lower populations yielded relatively more than 50% marketable roots. The highest mean yield, 33 t/ha, was obtained with treatment D1. Treatments D4, D3, and D2 were statistically similar, their mean yields being 22, 24, and 28 t/ha, resp. The 2nd expt. studied the effect of the cutting position at planting on cassava yield, easiness for harvesting, and size and shape of roots. The trial was carried out on well-drained, recent alluvial soils with 3 treatments or positions (vertical, horizontal, and oblique-45°) and 4 replications, arranged in a randomized block design. All of the plots received 66, 20, and 16 kg NPK/ha, resp. Cultural practices applied were those currently used in the area. There were no statistically significant differences regarding root no. Yields of marketable roots were significant at the 0.05 level. The highest production, 35 t/ha, was obtained with the horizontal position while the vertical and oblique positions yielded 32 and 27 t/ha, resp. Harvesting roots planted vertically was more difficult. (Author's summary) D02

0267

18925 VELASQUEZ, E. 1982. Evaluación de seis herbicidas en yuca (Manihot esculenta Crantz) en suelos de sabana del sur de Anzoátegui. (Evaluation of six herbicides in cassava in savanna soils of southern Anzoátegui). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:305-318. Span., Sum. Span., Engl., 8 Refs.

Cassava. Weeds. Herbicides. Field experiments. Tuber productivity. Germination. Cuttings. Timing. Venezuela.

An expt. was carried out to evaluate the effect of 6 herbicides on weeds present in cassava grown in savanna soils of the state of Anzoátegui,

Venezuela. Prometryn, ametryn, fluometuron, diuron, and simazine were applied at 2 and 3 kg/ha preemergence, and trifluralin at 3 and 4 l/ha, incorporated into the soil before sowing. Results show that the use of fluometuron, trifluralin, ametryn, and diuron was positive and feasible in cassava, without damaging the canopy and sprouting. These products exerted a good weed control, especially of gramineae, thus favoring root production. Simazine was toxic for cassava, severely affecting plant foliage, young branches, budding, and root production. Trifluralin was found to have a long residual effect on gramineae. (Author's summary) D02

See also 0235 0318 0373 0374 0379 0387 0388 0389 0391

D03 Energy Productivity and Yields

0268

175/7 REYES, R.D. 1978. Ensayos preliminares en el rendimiento de clones de yuca nacional y extranjera. (Preliminary yield trials of local and introduced cassava clones). In Universidad de Panamá. Facultad de Agronomía. Progresos de labores de investigaciones agropecuarias 1976-1977. Panamá City, Panamá. pp.179-187. Span.

Cassava. Field experiments. Clones. Cultivars. Tuber productivity. Panama.

A comparative yield trial was conducted at the Centro de Investigación y Enseñanza Agropecuaria in Tocumen, Panama, with 3 local clones (7, 14, and 21) and 4 var. introduced from Colombia (CMC # 84, CMC # 39, CMC # 76, CMC # 15). Introduced var. yielded less (25.70-32.65 t/ha) than the local clones (29.18-37.72 t/ha) and their cooking characteristics were inferior. (Summary by L.M.F.) D03

See also 0255 0263 0264 0265 0266 0267 0276 0305 0313 0315 0318 0319 0320 0321 0322 0325 0372 0373 0374 0380 0384 0391

D04 Postharvest Studies

0269

18412 RICKARD, J.E. 1981. Biochemical changes involved in the postharvest deterioration of cassava roots. Tropical Science 23(3):235-237. Engl., 12 Refs.

Cassava. Tubers. Deterioration. Biochemistry. Post-harvest technology. Analysis.

The results of expt. regarding the biochemical changes occurring during the nonpathological postharvest deterioration of cassava roots are summarized. Cassava roots injured by a transverse cut and stored under high humidity (80-90%) conditions formed a blue-green and brown pigmented layer chemically associated with the presence of phenols and lignin-like material. The cytochemical study of the colored deposits showed

carbohydrates, lipids, and lignin-like material in association with free phenols (leucoanthocyanidins and catechins). Biochemical analyses indicated changes in the phenolic constituents of the roots following injury, but increased fluorescence was mainly due to the production of scopoletin and scopolin. These changes were followed by the formation of a periderm in the roots with lignified cell walls. Under low humidity (45-55%) conditions a colored periderm was not formed, instead a thick white layer developed. Increases in scopoletin, leucoanthocyanidins, and catechins did not remain localized but spread down the root preceding the development of vascular and storage parenchyma discoloration. This was accompanied by localized increases in the activity of polyphenol oxidase and peroxidase. Some of the lignin-like cytochemical responses observed in the colored material were due to condensed tannins derived from leucoanthocyanidins and catechins. These expt. indicate that postharvest deterioration commences as a nonspecific response to wounding. (Summary by EDITEC. Trans. by L.M.F.) D04

See also 0374 0391

E00 PLANT PATHOLOGY

E02 Bacterioses

0270

19285 BUTARE, I.; BANYANGABOSE, F. 1982. Effects of soil fertility on cassava bacterial blight in Rwanda. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.53-55. Engl., Sum. Engl.

Cassava. Soil fertility. Xanthomonas manihotis. Rwanda.

The ecological factors that influence the seriousness of bacterial blight caused by Xanthomonas cassavae in Rwanda are discussed. Field observations have indicated that the disease is most serious where the soil is poor, gravelly, and sandy; therefore, expt. were conducted to determine the effect of soil fertility on bacterial blight. Results showed that bacterial blight was most prevalent in sandy clay or clayey sand soils, with a low level of fertility and deficient in P and K. Increased fertility through the addition of nutrients did not prevent infection but hindered disease development. (Author's summary) E02

0271

18484 CHERIAN, M.T.; MATHEW, J. 1981. Influence of age of plants on cassava bacterial blight incidence and development. Agricultural Research Journal of Kerala 19(1):116-117. Engl., Sum. Mal., 5 Refs.

Cassava. Timing. Plant development. Xanthomonas manihotis. Pathogenicity. India.

Field inoculation showed that 1-mo.-old plants of cassava var. H-165 had a higher rate of infection by Xanthomonas campestris pv. manihotis than plants aged 2, 3, 5, 7, and 9 mo. The infection rate was similar at 4-9 mo. but less than in plants 1-3 mo. old. There was a negative correlation between the age of plants and disease incidence (r = -0.6249) and

development (r = -0.7147). Max. disease incidence and development therefore occurred in early growth stages (1-3 mo.). (Summary by Review of Plant Pathology) E02

0272

18904 IKOTUN, T. 1982. The survival of Xanthomonas manihotis (Arthaud-Berther) Starr in the soil. Fitopatologia Brasileira 7:29-36. Engl., Sum. Engl., Port., 24 Refs., Illus.

Cassava. Xanthomonas manihotis. Soil analysis. Colombia.

Survival of Xanthomonas manihotis was poor in all 3 Colombian soils that were tested (CIAT, pH 6.8; Jamundi, pH 4.2; Popayan, pH 4.5), but was better in near-neutral than in acid soils. Both water-saturation and desiccation greatly decreased the longevity of X. manihotis in soil. Below 1.0×10^3 bacterial cells/g (fresh wt.) of soil, cassava leaves were infected from soil splashes in the field or by leaf spraying in the greenhouse. Regular hoeing of surface soil to expose soil and bacteria to the sun and cause dessication will probably decrease X. manihotis populations and disease incidence greatly. Removal and burning of infected plants in the field and the use of healthy bacteria-free cuttings as planting material are recommended for preventing the spread of X. manihotis to new plantations and from one season to another. (Author's summary) E02

0273

18991 MARCANO R., M.; TRUJILLO P., G. 1982. Bacteriosis de la yuca; identificados algunos aspectos epidemiológicos del patógeno que pueden utilizarse para disminuir los daños ocasionados por la enfermedad. (Identification of some epidemiological aspects of the pathogen of cassava bacterial blight that can be used to reduce damage caused by the disease). Fonaiap Divulga (Venezuela) 1(6):12-13. Span., Illus.

Cassava. Xanthomonas manihotis. Disease control. Cultivars. Resistance. Venezuela.

In epidemiological surveys of CBB (Xanthomonas campestris pv. manihotis), Amaranthus sp., Panicum fasciculatum, Sida sp., Sorghum halepense, and several species belonging to the Euphorbiaceae family were identified as alternate hosts of the pathogen. Rainfall and rainfall distribution constitute the most important climatic factor affecting disease incidence and severity. Infected material should be destroyed and healthy planting material and resistant or tolerant var. such as Brasilera, M VEN Clon 7, and Chapapotera Negra should be used. (Summary by J.L.S. Trans. by L.M.F.) E02

0274

18959 NAIR, R.R.; PAILY, P.V.; MENON, M.R. 1981. Symptomatology and etiology of bacterial blight of cassava (Manihot esculenta Crantz). Agricultural Research Journal of Kerala 19(1):59-62. Engl., Sum. Engl., Mal., 15 Refs., Illus.

Cassava. Xanthomonas manihotis. Symptomatology. Etiology. India.

The symptomatology and etiology of CBB, reported in Trivandrum, Kerala (India) in 1975 and since then in other regions of Kerala and in

Kanyakumari District, Tamil Nadu, are discussed. Symptoms were leaf blighting, defoliation, dieback, necrosis of the stems, root rot, and wilting. The causative bacterium was isolated and its pathogenicity established by artificial inoculation. Based on the morphological, physiological, and biochemical characteristics of the bacterium and the symptoms produced by it, the pathogen causing CBB was identified as Xanthomonas manihotis. (Author's summary) E02

0275

19284 ONYANGO, D.M.; MUKUNYA, D.M. 1982. Distribution and importance of Xanthomonas manihotis and X. cassavae in East Africa. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.56-58, 122-128. Engl., Sum. Engl., 1 Ref.

Cassava. Xanthomonas manihotis. X. cassavae. Kenya. Malawi. Tanzania. Rwanda. Uganda.

The diseases caused by Xanthomonas manihotis and X. cassavae are currently referred to as CBB. Although the symptoms of the diseases do overlap, some distinctive features can be observed, and the bacteria can be identified on the basis of the symptoms of the diseases they cause. Both species have been reported in East Africa, probably introduced from West Africa via Central Africa. However, surveys (1976-77 and 1978-79) in cassava-growing areas of Kenya have indicated that X. manihotis is probably more important than X. cassavae in the region. (Author's summary) E02

0276

18992 PINO, J.A. 1980. Estudio del efecto del añublo bacterial (Xanthomonas manihotis) sobre los rendimientos en yuca (Manihot esculenta). [Effect of bacterial blight (Xanthomonas manihotis) on cassava yields]. Ciencia y Técnica en la Agricultura: Viandas, Hortalizas y Granos 3(2):95-100. Span., Sum. Span., Engl., 8 Refs.

Cassava. Xanthomonas manihotis. Cultivars. Tuber productivity. Cuba.

The effects of bacterial blight (Xanthomonas manihotis) on the yields of cassava clones Señorita and Pinera were assessed during the 11 mo. of its growth cycle at the Centro de Mejoramiento de Semillas Agámicas Fructuoso Rodriguez in Villa Clara, Cuba, during 1976-77. Both clones were more susceptible to the disease during the initial growth stages. Yields decreased between 20-50%. Planting should take place between Nov.-Jan. so that the 1st mo. of growth do not coincide with the rainy season. (Author's summary) E02

0277

18113 MABANZA, J. 1980. Essai d'isolement de clones de manioc (Manihot esculenta Grantz) en vue d'isoler ulterieurement des clones resistants a la bacteriose. (Attempt at isolating cassava clones with a view to the eventual isolation of clones resistant to bacteriosis). Montpellier, Université des Sciences et Techniques du Languedoc. 61p. Fr., 42 Refs., Illus.

Cassava. Clones. Selection. Resistance. Xanthomonas manihotis. Plant tissues. Tissue culture. Morphogenesis.

The feasibility of obtaining whole cassava plants from cuttings of diverse origin was studied as a 1st step to isolating plants resistant to bacteriosis through tissue culture in order to obtain disease-free material. Cassava var. MM 78, Malela 1, MA 255, and CB were studied. A Murashige and Skoog culture medium was used. The development of cuttings from var. Malela 1 and MM 78 took less time (15 days) than that of cuttings from MA 255 (15-20 days). Better callus growth was observed in culture media with concn. of 0.5 and 0.1 mg BAP and NAA/l, resp. Whole plants were not obtained from the callus of internodes, petioles, and limbs. On the contrary, several whole plants were obtained from only one, stimulating the development of axillary buds without eliminating the terminal bud. Callus growth initiated in the culture medium with concn. of 0.5, 1.0, and 0.1 mg BAP, NAA, and GA/l, resp. Leaf development occurred in a medium with 0.1 and 0.2 mg BAP and NAA/l, resp. Roots formed in a medium with 0.05 mg NAA/l. To transfer seedlings to the greenhouse, a sterile vermiculite medium with Murashige and Skoog mineral solutions was used. (Summary by S.B. Trans. by L.M.F.) E02

0278

19238 MANICOM, B.Q.; BECKER, M.M.; DESCHODT, C. 1981. First report of cassava bacterial blight in South Africa. Phytophylactica 13(4):195-196. Engl., Sum. Engl., Afr., Fr., 4 Refs.

Cassava. Xanthomonas manihotis. South Africa.

Bacteria isolated from diseased cassava plants in cassava growing areas of Natal and the Transvaal gave symptoms typical of CBB on inoculation. Physiological and biochemical tests confirmed the identity of the pathogen as Xanthomonas campestris pv. manihotis. (Author's summary) E02

0279

18909 RONDON, A.; APONTE, A.; GUEVARA, Y. 1982. Enfermedades de importancia económica de la yuca (Manihot esculenta Crantz) en Venezuela. (Cassava diseases of economic importance in Venezuela). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:131-134. Span., Sum. Span., 3 Refs.

Cassava. Sphaceloma manihoticola. Erwinia carotovora. Venezuela.

The Plant Pathology Section of the Centro Nacional de Investigaciones Agropecuarias (Venezuela) is conducting a study on major cassava diseases. The fungus Sphaceloma manihoticola and bacteria of the genus Erwinia spp., one of them identified as E. carotovora, were observed. The dissemination of these pathogens was initially determined and their pathogenicity was verified through lab. and field trials. Currently promissory cv. resistant to superelongation are being selected and trials are conducted with several chemical products in an intent to obtain products like captafol, which eradicates pathogens from cassava cuttings. (Author's summary. Trans. by L.M.F.) E02

0280

19227 SERPA R., C.A.; ESPINOSA B., P.R. 1976. Tratamiento de estacas con agua caliente para el control de la bacteriosis CBB (Cassava blight bacterium) en dos variedades de yuca (Manihot esculenta). (Treatment of cuttings with hot water to control cassava bacterial blight in two

cassava varieties). Tesis Ing. Agron. Santa Marta, Colombia, Universidad Tecnológica del Magdalena. 52p. Span., Sum. Span., Engl., 17 Refs., Illus.

Cassava. Xanthomonas manihotis. Pathogenicity. Inoculation. Cuttings. Disease control. Hot water treatments. Timing. Symptomatology. Colombia.

The effect of the utilization of 2 heat treatments and 4 exposure times on cassava cuttings infected with CBB (Xanthomonas manihotis) was studied in a trial conducted by the U. Tecnológica del Magdalena (Colombia) in collaboration with the Caribia Exptl. Farm of the Instituto Colombiano Agropecuario in 1975. The pathogen was isolated from leaves of diseased plants and the pathogenicity test was applied. Cuttings were then taken from diseased and healthy plants of cassava var. 10-70 and H-34. The isolated bacteria were inoculated on cuttings from healthy plants by rubbing with a cotton swab moistened in the bacterial suspension. Before planting the cuttings were submerged in hot water (52 and 56°C) at 4 times of exposure (2, 5, 10, and 20 min). Leaves were assessed immediately after crop germination and were rated according to a scale established that goes from 0 to 4 degrees of infectivity. Days after germination samples were taken of the stem and placed in petri dishes containing nutritive agar-TZC. Here the pathogen grew, showing the inefficiency of these treatments. RH and rainfall played an important role in the development of the disease. (Author's summary. Trans. by L.M.F.) E02

0281

18918 TRUJILLO, G.E.; SUBERO, L.J.; LUCIANI, J. 1982. Evaluación preliminar de algunos clones de yuca (Manihot esculenta Crantz), del banco de germoplasma de la UCV, al añublo bacterial por Xanthomonas manihotis. (Preliminary evaluation of some cassava clones from the germplasm bank of the Universidad Central de Venezuela regarding bacterial blight caused by Xanthomonas manihotis). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:231-239. Span., Sum. Span., 9 Refs., Illus.

Cassava. Clones. Resistance. Xanthomonas manihotis. Venezuela.

The performance of 29 cassava clones from the germplasm bank of the Universidad Central de Venezuela at Maracay under the attack of bacterial blight (Xanthomonas manihotis) was assessed under lab. conditions at the Faculty of Agronomy. Inoculation consisted of spraying plants with a concn. of 10^8 bacterial cells/ml and then placing these plants in wet chambers for 48 h. Data were recorded 14 days after inoculation and evaluation continued for 3 wk. All the tested clones were affected by bacteriosis to a greater or lesser extent. Clones UCV-2332, 2459, 2484, and 2338 were the most resistant, showing few angular leaf spots. Clones UCV-2271, 2347, 2385, 2364, 2483, and 2558 had angular leaf spots and extensive blight of the lower leaves. Clones UCV-2292, 2627, 2621, 2221, 2320, 2350, 2534, 2592, 2595, 2607, 2608, and 2609 were severely affected by the bacterium, showing leaf blight and a high degree of defoliation as well as spots on the stem; clones UCV-2106, 2112, 2321, 2389, 2486, 2386, 2323, and 2318 showed blight and defoliation of almost all the leaves and dieback. (Author's summary. Trans. by L.M.F.) E02

0282

18917 TRUJILLO, G.E.; TRUJILLO, L.V. 1982. Xanthomonas manihotis resistente a rifocina, una herramienta para el estudio del añublo bacterial. (Rifamycin-resistant Xanthomonas manihotis, a tool for the

study of bacterial blight). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31: 219-229. Span., Sum. Span., 16 Refs., Illus.

Cassava. Xanthomonas manihotis. Isolation. Antibiotics. Laboratory experiments. Venezuela.

Several isolates of Xanthomonas manihotis (Xm), resistant to the antibiotic rifamycin, were selected for their similarity with type isolates and their utility as possible tools in the study of CBB. A rifamycin-resistant isolate (R_{22}), from Xm_1, and another R_{23}, from Xm_{12}, were found to be similar to type isolates in numerous bacteriological trials, growing at the same rate in culture media and on cassava leaves. They also had the same virulence as their resp. original isolates. The indicator rifamycin in PDA allowed the selective isolation of R_{22} and R_{23} from cassava leaves and stems previously inoculated with the bacteria. The rifamycin medium inhibited all other contaminating bacteria present on the leaves and stems. Normally 60 mg rifamycin were used for each liter of medium. Although R_{22} and R_{23} grew well up to a concn. of 350 kg rifamycin/l of culture medium, 35 mg of cycloheximide were added per liter in order to reduce the growth of fungi and yeasts. The indicator rifamycin was stable when bacteria grew on the leaves and stems, and in culture media in the lab. Reversion to sensitivity to the antibiotic was not observed. (Author's summary. Trans. by L.M.F.) E02

See also 0249 0314 0325 0373 0374 0387 0391

E03 Mycoses

0283

18905 ALMEIDA, O.C. DE; OLIVEIRA, G.H.N. DE; RIBEIRO, R. DE L.D. 1982. Nova doenca da mandioca causada por Cylindrocladium clavatum. (A new disease of cassava caused by Cylindrocladium clavatum). Fitopatologia Brasileira 7(1):145-147. Port., Sum. Port., Engl., 5 Refs., Illus.

Cassava. Cylindrocladium clavatum. Symptomatology. Brazil.

A new fungal disease of cassava was reported in Santa Cruz, RJ, Brazil. Disease symptoms were tissue rot in the collar region, next to the cuttings which turned black. This was followed by root necrosis, yellowing and dropping of the leaves, wilt, and death. In the rotten stem areas a white fungal mass formed by conidia, conidiophores, and vesicles produced by the pathogen, identified as Cylindrocladium clavatum, was commonly observed. (Author's summary) E03

0284

19234 BATISTA, U.G.; FERREIRA, F.A.; SILVEIRA, A.J. DA 1982. Incidencia severa da ferrugem (Uromyces manihotis Henn) em tres cultivares de mandioca (Manihot esculenta Crantz) em Vicosa-MG. [Severe incidence of rust (Uromyces manihotis) on three cassava cultivars in Vicosa-MG]. Fitopatologia Brasileira 7(1):125-128. Port., Sum. Port., Engl., 3 Refs., Illus.

Cassava. Uromyces manihotis. Cultivars. Resistance. Brazil.

Of 24 cassava cv. planted in exptl. plots at the U. Federal de Vicosa, MG, Brazil, severe attack of rust (Uromyces manihotis) was only observed in cv. Preta de Quilombo, Baiana, and germplasm no. 42 at the end of the rainy season. (Author's summary) E03

0285

18989 MAKAMBILA, C.; BAKALA-KOUMOUNO, L. 1982. Inoculation artificielle des tiges de manioc avec Colletotrichum manihotis Henn. (Artificial inoculation of cassava stems with Colletotrichum manihotis). Agronomie Tropicale 37(2):172-175. Fr., Sum. Fr., 5 Refs., Illus.

Cassava. Stems. Inoculation. Glomerella manihotis. Congo.

Colletotrichum manihotis is the pathogen of cassava anthracnose, a disease widespread in cassava growing areas in Africa. A method of artificial inoculation was developed to study the behavior of new improved cassava genotypes to some C. manihotis isolates. The currently used methods to infect some host plants with other species of Colletotrichum genus and which consist in putting or spreading out a conidium suspension on the plant did not prove to be efficient in infecting cassava stems with C. manihotis. The new method of artificial inoculation of cassava stems developed consists in putting a conidium suspension or an agar-agar pellet 4 mm in diameter containing some mycelium and conidia on a part of the stem where cells had been previously injured. Moreover, a very high humidity rate is required for the inoculation to be successful. (Author's summary) E03

0286

18903 PONTE, J.J. DA; FRANCO, A.; SILVEIRA, L.M.; FONTELES, R. DE C.; BASTOS, J.A.M. 1982. Podridao seca da manicoba, Manihot glaziovii Muell. (Dry root and stem rot in Manihot glaziovii). Arg. Fitopatologia Brasileira 7:51-54. Port., Sum. Port., Engl., 4 Refs., Illus.

Cassava. Manihot glaziovii. Diplodia manihoti. Disease control. Brazil.

A new disease of Manihot glaziovii was reported in the state of Ceará, Brazil. Pathogenicity tests carried out under lab. conditions by inoculating seed cuttings indicated that the fungus Diplodia manihoti was the causal agent of the disease. Disease symptoms are described and some control measures suggested. Among these are disinfecting the storage sites with 6% copper sulfate, selecting healthy cuttings for seed, treating these cuttings with benomyl and captafol, and storing cuttings in cool and well ventilated sites. M. glaziovii is a native plant of Ceará and its economic importance derives from rubber production. (Author's summary. Trans. by L.M.F.) E03

0287

18443 PUNITHALINGAM, E. 1982. Diaporthe manihotis. CMI Descriptions of Pathogenic Fungi and Bacteria no.734. 2p. Engl., 1 Ref., Illus.

Cassava. Diaporthe manihotis. Symptomatology. Disease transmission.

Diaporthe manihotis Punithalingam (conidial state: Phomopsis manihotis) is described. Illustrations are also included. The pathogen has been recorded on cassava in Ethiopia, Nigeria, India, Colombia, Central America, and the West Indies. In early stages of infection the visible symptoms are pale green, watersoaked, small round spots on young cassava leaves and petioles. Severe attack leads to defoliation and infection spreading to the stem. The pathogen is probably dispersed by watersplashed conidia. (Summary by J.L.S.) E03

0288

18435 ROY, A.K.; SAIKIA, B.K. 1978. Leaf blight of tapioca caused by Periconia manihoticola. Current Science 47(24):970. Engl., 3 Refs.

Cassava. Periconia manihoticola. Cultivars. Resistance. India.

Cassava leaf blight caused by Periconia manihoticola is reported for the 1st time in the Old World in Jorhat, India, in plots planted to cassava cv. H-97, H-2304(5), H-3641(2), H-1687(1), H-4, H-312, Rani, H-43, and H-226. Disease symptomatology is described. Cv. H-97 was highly susceptible and H-43 and H-226 less susceptible. (Summary by L.M.F.) E03

0289

17108 ZEIGLER, R.S.; LOZANO, J.C. 1983. The relationship of some Elsinoe and Sphaceloma species pathogenic on cassava and other Euphorbiaceae in Central and South America. Phytopathology 73(2): 293-300. Engl., Sum. Engl., 23 Refs., Illus.

Cassava. Sphaceloma manihoticola. Elsinoe. Pathogenicity. Inoculation. Symptomatology.

Isolates of Sphaceloma and Elsinoe spp. were collected from Euphorbia brasiliensis, Eu. heterophylla, Eu. pulcherrima, Jatropha aconitifolia var. papaya, Manihot carthaginensis, and M. esculenta in Mexico, Costa Rica, the Dominican Republic, and Colombia. M. carthaginensis and J. aconitifolia var. papaya had not been reported previously as Sphaceloma hosts, and cassava had not been previously reported as a host of Elsinoe spp. A connection between the Elsinoe from cassava with Sphaceloma manihoticola is established. Cross inoculations demonstrated that some isolates were pathogenic on several euphorbiaceous species. Pathogenicity on cassava of an isolate of Elsinoe brasiliensis from Eu. brasiliensis was enhanced by reisolation from cassava. Cultural characteristics on PDA were not sufficiently different to aid in separating the species. Conidial dimensions on the same medium were not significantly different among isolates from Eu. brasiliensis, M. esculenta, M. carthaginensis, and J. aconitifolia var. papaya. No significant differences were found between isolates from Eu. pulcherrima and Eu. heterophylla, but each was different from the other 4. Sphaceloma krugii and S. poinsettiae both produced large, pigmented, spindle-shaped spores in addition to the more typical small, hyaline Sphaceloma conidia. In light of these studies, a combination of several species is proposed. S. poinsettiae and S. krugii are combined under S. poinsettiae. E. jatrophae, E. brasiliensis, and the Elsinoe found on cassava are combined under the name Elsinoe brasiliensis. (Author's summary) E03

See also 0279 0379 0387 0391

0290

19267 ALAGIANAGALINGAM, M.N.; RAMAKRISHNAN, K. 1978. Effect of cassava mosaic on photosynthetic pigments and photosynthesis. Auara 7/8:120-123. Engl., Sum. Engl., 11 Refs.

Cassava. Cassava African mosaic virus. Photosynthesis. Plant pigments. Plant physiology. India.

The influence of CAMD on photosynthetic pigments, with particular reference to chlorophyll, on the activity of chlorophyllase, and on the photosynthetic rate was studied using cassava var. T. 108 plants under field conditions. CAMV-infected cassava leaves recorded lower carotene and chlorophyll content than healthy ones. Diseased plants also showed a lower photosynthetic rate. (Summary by L.M.F.) E04

0291

18494 FAUQUET, C.; FARGETTE, D.; THOUVENEL, J. C.; MONSARRAT, A. 1982. Etude de la mosaique africaine du manioc. (Cassava African mosaic disease). Abidjan, Cote d'Ivoire, Office de la Recherche Scientifique et Technique Outre-Mer. 28p. Fr., Sum. Fr., Engl., 21 Refs., Illus.

Cassava. Cassava African mosaic virus. Epidemiology. Bemisia. Vectors. Disease transmission. Disease control. Cassava programs. Ivory Coast.

The CAMD, one of the biological factors that most limits cassava production in Africa, is described. Its causal agent is a geminivirus transmitted either by cuttings or by whiteflies (Bemisia tabaci). To control disease development, the mechanisms interacting during the epidemiological process should be examined. The 1st 3 yr of this study were mostly dedicated to the obtainment of disease-free cuttings and to elaborate reliable serological assays. During the next 3 yr. the economical impact of the disease will be assessed and natural sources of the virus determined, contamination kinetics and population dynamics of vectors also being studied. Factors affecting these kinetics will also be identified. Finally var. and multilocal trials should be conducted to enable an epidemiological model to be determined, regardless of cropping conditions. (Author's summary) E04

0292

19283 GUTHRIE, E.J. 1982. Cassava mosaic disease. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.50, 122-128. Engl., Sum. Engl., 1 Ref.

Cassava. Cassava African mosaic virus. Cassava latent virus. Kenya.

A geminivirus has been isolated from cassava infected with CAMD on the Kenyan coast; it is related but distinct from an earlier isolate from western Kenya and requires different procedures for isolation. This newly isolated virus is probably a causal agent of CAMD in eastern Kenya, although it may not be the sole cause. (Author's summary) E04

See also 0252 0314 0325 0387 0391

E06 Nematodes

0293

17112 CAVENESS, F.E. 1982. Root-knot nematodes as parasites of cassava. IITA Research Briefs 3(2):2-3. Engl., Illus.

Cassava. Nematodes. Pest damage. Plant development. Nigeria.

The problem of root knot nematodes in cassava was evaluated at the International Institute of Tropical Agriculture (Nigeria). Seed was screened for genetic resistance or susceptibility to root knot nematodes, finding that all families tested were susceptible to one or more species of the root knot nematode. In greenhouse trials, light nematode infestations increased plant height up to 10% but heavier infestations reduced plant height as much as 52% and also decreased the wt. of root systems. In field trials plants suffered reductions in plant height, stem and storage root wt. in soils with high nematode populations. (Summary by L.M.F.) E06

F00 PEST CONTROL AND ENTOMOLOGY

F01 Injurious Insects and their Control

0294

17110 ATU, U.G.; OKEKE, J.E. 1982. Cassava mealybug and green spider mite: can we eradicate or live with the pests. NRCRI Newsletter 19:2-3. Engl., Illus.

Cassava. Phenacoccus. Mononychellus tanajoa. Cultivars. Resistance. Insect control. Mite control. Nigeria.

Surveys showed that the cassava mealybug (Phenacoccus spp.) and the green spider mite (Mononychellus tanajoa) have established in 17 of the 19 states of Nigeria. Integrated control measures have been developed and these include, among others, the use of var. resistant or tolerant to the green spider mite (TMS-300017, 61342, 60741, and 40764) and to the mealybug (TMS-6177, 42025, 60142, 61324, 4(2)1425, U/42232, and U/41044). Chemical treatment of planting material, roguing of diseased plants, and release of predators are also recommended. (Summary by J.L.S.) F01

0295

18497 BELLOTTI, A.C.; REYES, J.A.; VARELA, A.M.; CASTILLO, J. 1983. El piojo harinoso (Phenacoccus sp.) de la yuca; una de las plagas agrícolas más importantes en el mundo. [The cassava mealybug (Phenacoccus sp.); one of the major agricultural pests in the world]. Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie Seminarios Internos SE-5-83. 24p. Span., Sum. Span., 28 Refs.

Cassava. Phenacoccus. Entomology. Biological control. Colombia.

Cassava mealybugs constitute one of the major production problems of cassava in Africa and the Americas. The species already identified that attack cassava in the Americas include Phenacoccus manihoti, P. herreni, P. gossypii, and P. grenadensis. Since its introduction into Africa, P. manihoti has caused considerable yield losses in some regions, especially

Zaire. In the Americas, severe outbreaks of P. herreni have been reported in several areas of Brazil, Colombia, and the Guianas. These 2 species are similar taxonomically and in plant damage symptoms but differ biologically. The initial and most severe attack of both species occurs on the growing point of the cassava plant shoots. Plant reaction consists of a rosetting effect on the apical leaves which results in a cabbage-like appearance of the shoot. High mealybug populations, together with the stress caused by drought, cause defoliation, deformation of the shoots, shortening of internodes, and distortion of stems. The bionomics of both species differ in that P. herreni is bisexual and P. manihoti reproduces parthenogenetically. Biological studies on P. herreni show that the female passes through 3 instars before the adult stage. The complete life cycle from egg to adult lasts 49.5 days. Males pass through 4 instars before the adult stage, in which the adult male is winged. The whole cycle lasts 29.5 days. The cassava mealybug has numerous natural enemies. Biological control combined with resistance offers a healthy and economical control of the pest. Tables are included on the life cycle of P. herreni and P. gossypii on plants of cassava var. M Col 113 under lab. conditions, size and size increase of P. herreni on cassava under greenhouse conditions, hyperparasites of Phenacoccus spp. in L.A., populations of natural enemies of the cassava mealybug in the field, and natural enemies of P. gossypii and P. herreni in L.A. and the Caribbean. (Author's summary. Trans. by L.M.F.) F01

0296

18947 BRADER, L. 1982. Recent trends of insect control in the tropics. Entomologia Experimentalis et Applicata 31(1):111-120. Engl., Sum. Engl., Fr., 25 Refs.

Cassava. Entomology. Insect control.

Efforts to increase agricultural production in the tropics must be oriented in the 1st place towards the small farmers' food crops. However, by tradition virtually all research efforts have been oriented to the so-called cash crops, and consequently current knowledge on pest control in food crops in the tropics is very limited. Moreover, entomologists are trained on the basis of intensive agricultural production systems. From a selected no. of examples it is evident that insects can cause significant losses in major food crops such as rice, maize, cassava, sorghum, millet, pulses, and vegetables. However, the history of insect control in cotton growing, for example, shows that in tropical ecosystems insect population can be maintained at comparatively low levels when properly managed. Insect control in the tropics will lead to the further development and application of integrated pest control, and this will be the surest way to achieve real improvement in the plant health situation. (Author's summary) F01

0297

19266 BRUNER, S.C.; SCARAMUZZA, L.C.; OTERO, A.R. 1975. Manihot. (Cassava). In _____. Catálogo de los insectos que atacan a las plantas económicas de Cuba. La Habana, Cuba, Academia de Ciencias de Cuba. pp.201-204. Span., Illus.

Cassava. Injurious insects. Injurious mites. Cuba.

Insect pests of cassava recorded in Cuba are: Anartia jatrophae guantanamo, Atta insularis, Cryptocephalus marginicollis, Erinnyis alope, E. ello, Frankliniella cubensis, Lagochirus dezayasi, Lepidosaphes alba, Leptostylus

biustus, Lonchaea chalybea, Pachnaeus litus, Tetranychus bimaculatus, and Vatiga illudens. (Summary by J.L.S.) F01

0298

18437 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO DE PESQUISA AGROPECUARIA DOS CERRADOS. 1982. Variedades de mandioca resistentes ao percevejo de renda. (Cassava varieties resistant to lace bugs). In _____. Relatório técnico anual do Centro de Pesquisa Agropecuária dos Cerrados 1980-1981. Planaltina-DF, Brasil. v.6, p.94. Port.

Cassava. Vatiga illudens. Cultivars. Resistance. Brazil.

Cassava cv. presenting the highest degree of resistance to Vatiga illudens are Cacau Vermelho, Branca de Santa Catarina, Guaxupé, Pirassununga, and Sertaneja. The most susceptible cv. are Mandioca Osso and Iracema. Information is included on the degree of damage caused by the insect, no. of nymphs and adults on the leaves for each cv. (Summary by J.L.S. Trans. by L.M.F.) F01

0299

19506 GARCIA G., C.A.; BELLOTTI, A.C. 1980. Estudio preliminar de la biología y morfología de Cyrtomenus bergi Froeschner, nueva plaga de la yuca. (Preliminary study on the biology and morphology of a new cassava pest, Cyrtomenus bergi). Revista Colombiana de Entomología 6(3-4): 55-61. Span., Sum. Engl., Span., 5 Refs., Illus.

Cassava. Cyrtomenus bergi. Entomology. Colombia.

The occurrence of a new pest Cyrtomenus bergi (Hemiptera:Cydnidae), commonly named the subterranean chinch bug or the small pox bug, in crops of cassava var. Chiroza Gallinaza in the municipality of Caicedonia (Valle, Colombia) and in var. Barranqueña and Valluna in Santander de Quilichao (Cauca), is reported. This pest attacks cassava roots and affects root quality. Given its incidence and potential as a pest, the biological aspects of the pests were studied under lab. conditions (av. temp., 23°C; RH, 65%) at CIAT to later apply adequate control measures. Insect stages are described in detail. Adult chinch bugs have an oval body, are 7.1 mm long, dark brown to black in color, with spined tibiae and the 1st pair of legs fitted for burrowing. The av. duration of the egg is 13.6 days, nymphs pass through 5 instars totalling 111.2 days, and adult longevity is more than 250 days. Damage caused by the nymphs and adult C. bergi is associated with the action of soil fungal pathogens, considerably deteriorating roots and thus reducing their commercial value. (Summary by L.M.F.) F01

0300

19280 LEMA, K.M.; HERREN, H.R. 1982. Biological control of cassava mealybug and cassava green mite: front-line release strategy. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.68-69, 122-128. Engl., Sum. Engl., 19 Refs.

Cassava. Phenacoccus manihoti. Mononychellus tanajoa. Biological control. Predators. Africa.

The biological control of the cassava mealybug (Phenacoccus manihoti) and the cassava green mite (Mononychellus tanajoa) is discussed. Although it is one of the most promising solutions, at present, however, there are not effective natural enemies in Africa. They must be identified in, and imported from, South America where the 2 pests are indigenous. The International Institute of Tropical Agriculture has undertaken this work, and some progress has already been made. One species of predator imported during the 1st phase of the efforts is being successfully mass-produced and will soon be released against the mealybug. The release may be done at the front as well as inside infested areas. (Author's summary) F01

0301

19282 LEUSCHNER, K. 1982. Pest control for cassava and sweet potato. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.60-64, 122-128. Engl., Sum. Engl., 14 Refs., Illus

Cassava. Mononychellus tanajoa. Phenacoccus manihoti. Zonocerus variegatus. Insect control. Mite control. Africa.

The prevailing socioeconomic conditions of the smallholder farmer in Africa militate against the widespread use of insecticides not only because of the costs of the chemicals but because of the long-term side effects from their misuse. Thus, other means of pest control must be sought. Agricultural researchers must concentrate on building in host-plant resistance, identifying and introducing natural enemies of the offending pests, and developing agronomic practices that discourage the buildup and spread of the pests. Progress along these lines for 2 important staple root crops, cassava and sweet potatoes, in Africa has been considerable over the last 10 yr; the focus and accomplishments of work to date are reviewed. (Author's summary) F01

0302

18460 McCAFFERY, A.R. 1982. A difference in the acceptability of excised and growing cassava leaves to Zonocerus variegatus. Entomologia Experimentalis et Applicata 32(2):111-115. Engl., Sum. Engl., 24 Refs.

Cassava. Zonocerus variegatus. Entomology. Nigeria.

Individual adult female Zonocerus variegatus grasshoppers grew slowly, did not develop oocytes, and had a high mortality when confined in nylon bags attached round growing cassava leaves. In contrast, similar females fed on excised leaves grew quickly and developed large no. of oocytes. The major effect of leaf excision was to allow the insect to ingest much greater quantities. The general importance of this result in studies on feeding and food acceptability is emphasized. (Author's summary) F01

0303

19279 SINGH, T.P. 1982. The mealybug problem and its control. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.70-72, 122-128. Engl., Sum. Engl., 16 Refs.

Cassava. Phenacoccus manihoti. Insect control. Biological control. Insecticides. Zaire.

Control of the cassava mealybug (Phenacoccus manihoti) in Zaire is being investigated through both short-term (cultural and chemical) and long-term (biological and resistance-breeding) measures. Studies on cultural control revealed that early planting and mulching of the cassava crop reduced the damage from the pest and that chemical treatment of planting material was desirable, although chemical control did not seem feasible in areas, such as Zaire, where the cassava leaves are eaten as a vegetable. Parasites and predators found in Zaire have been of little help in controlling the mealybug; therefore, biological control agents will have to come from outside the country. Resistance to mealybug has been identified both in wild and in cultivated cassava types. Some problems, however, have been encountered in the use of this resistance. (Author's summary) F01

0304

18922 VARELA, A.M.; BELLOTTI, A.C. 1981. Algunos aspectos biológicos y observaciones de un nuevo piojo harinoso de la yuca Phenacoccus herreni (Homoptera: Pseudococcidae) en Colombia. [Some biological aspects and observations of a new cassava mealybug Phenacoccus herreni (Homoptera:Pseudococcidae) in Colombia]. Revista Colombiana de Entomología 7(1-2):21-26. Engl., Sum. Engl., Span., 10 Refs., Illus.

Cassava. Phenacoccus herreni. Entomology. Colombia.

In 1978, a new species of mealybug, later described as Phenacoccus herreni, was found in Colombia. Plant damage symptoms of P. herreni are very similar to those of P. manihoti; the initial attack and most severe damage is to the growing point of the cassava plant. However, the biology of the 2 species differs in that P. herreni is bisexual, while P. manihoti reproduces parthenogenetically. Female P. herreni shows that the female pass through 3 instars before reaching the adult stage; the complete cycle of egg through adult is 49.5 days. The male passes through 4 instars before the winged, adult stage; the total cycle is 29.5 days. The ovipositional period of the female is 18.4 days during which an av. of 773.6 eggs are oviposited in the ovisac. The female increases in size through the adult stage while the male increases in size through the 2nd instar, during which it forms a cocoon and gradually transforms into an adult. (Author's summary) F01

0305

18923 VARGAS H., O.; BELLOTTI, A.C. 1981. Pérdidas en rendimiento causadas por moscas blancas en el cultivo de la yuca. (Yield losses in cassava caused by whiteflies). Revista Colombiana de Entomología 7(1-2):13-20. Span., Sum. Engl., Span., 4 Refs., Illus.

Cassava. Entomology. Aleyrodidae. Pest damage. Cultivars. Resistance. Insect control. Insecticides. Starch productivity. Tuber productivity. Colombia.

Whitefly (Aleurotrachelus socialis, Bemisia tuberculata, Trialeurodes variabilis) populations cause 2 types of damage in cassava: direct (leaf yellowing and curling) and indirect (a sooty mold which grows on the sugary excretions of the insect). In the Espinal area (Tolima, Colombia) where whitefly populations are high throughout the year, several var. have been tested for resistance and economic damage. In field trials treated plants presented lower degrees of infestation and higher yields compared with untreated ones. Yield losses due to whiteflies depended on the var. used. Var. H 305-122, CMC 57, M VEN 218, CMC 40, and M MEX 59 had 79.6, 76.7,

68.0, 52.0, and 33.6% yield loss, resp. Yield reduction depended on the duration of the attack, presenting a significant negative correlation (r = -0.90). Applying selective insecticides such as dimethoate every 3 mo. increased root yield. Although chemical control has been effective in preventing or reducing the damage caused by whiteflies, the most efficient method of control would be to develop whitefly-resistant materials. (Author's summary) F01

See also 0312 0373 0374 0387 0391

F03 Injurious Mites and their Control

0306

18499 AKINLOSOTU, T. A. 1982. Seasonal trend of green spider mite, Mononychellus tanajoa population on cassava, Manihot esculenta and its relationship with weather factors at Moor Plantation. Insect Science and its Application 3(4):251-254. Engl., Sum. Engl., 10 Refs.

Cassava. Mononychellus tanajoa. Insect biology. Nigeria.

The population of green spider mite Mononychellus tanajoa was monitored on cassava for 52 wk. (mid Oct. 1979 to mid Oct. 1980) at Moor Plantation, Ibadan, Nigeria. Mite population was found to be high in the dry season (80.1 ± 57.7/leaf) and low in the wet season (15.2 ± 13.5). There was a linear relationship between mite population and the weather factors investigated. The relationship was positive in the cases of temp. and radiation, and negative in those of rainfall and humidity. The high mite population in the dry season was attributed to the high temp. (27.9 ± 1.26°C) and radiation (39.1 ± 7.86), conditions that favored development of the different stages in the life cycle of the mite. The low population in the wet season was attributed to the adverse effects of high rainfall (56.31 ± 33.14 mm) and humidity (87.29 ± 2.36%) on the mites. Seasonal fluctuations in mite population were attributed to the physiological condition of the host plant. (Author's summary) F03

0307

18901 AYANRU, D.K.G.; SHARMA, V.C. 1983. Chlorophyll depletion in leaves of field-grown cassava clones infested by cassava green spider mites, Mononychellus tanajoa (Bondar) (Acarina: Tetranychidae). Tropical Agriculture 60(2):85-88. Engl., Sum. Engl., 17 Refs.

Cassava. Leaves. Chlorophyll. Mononychellus tanajoa. Clones. Nigeria.

Leaves of 13 field-grown cassava clones infested by cassava green spider mites (CGM), Mononychellus tanajoa, were rated for density of pubescence and % chlorotic leaf area, and analyzed for chlorophyll a and b concn. in trials conducted at Ugbowo, Benin City, Nigeria. CGM-induced leaf chlorosis and chlorophyll reductions were not influenced by the degree of pubescence. Early and late symptom-developing clones, as well as clones with significant (P = 0.01) and nonsignificant reductions in leaf chlorophyll contents, were recognized. The causes of the varied responses among the clones are discussed, and the suitability of selecting for high pubescence in cassava is questioned. (Author's summary) F03

0308

17370 BERNARDO, E.N.; ESGUERRA, N.M. 1981. Reaction of some cassava accessions to red spider mite (Tetranychus kanzawai Kishida) infestation. Annals of Tropical Research 3(4):229-240. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Injurious mites. Tetranychus kanzawai. Resistance. Selection. Philippines.

A satisfactory technique for evaluating cassava accessions/var. for resistance to the red spider mite (Tetranychus kanzawai), a serious pest throughout the Philippines, in the field or screenhouse was developed. Of the 295 entries tested, 50 showed varying levels of tolerance to the pest when tested in the field. At a much higher mite population in the screenhouse, however, practically all the accessions showed lower levels of tolerance although leaves of the more tolerant accessions 17, 29, 33, 48, and 49 were still green when the susceptible checks began to defoliate. Differences in tolerance levels were most evident 3 wk. after artificially infesting each plant with 20 reproducing adult mites. Significant antibiotic effects of the resistant hosts on the pest were not detected. (Author's summary) F03

0309

18916 DORESTE, E. 1982. El complejo de ácaros tetraníquidos como plaga importante en el cultivo de la yuca. (The Tetranychid mite complex as an important pest in cassava). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:213-218. Span., Sum. Span., Engl., 9 Refs.

Cassava. Injurious mites. Cultivars. Resistance. Venezuela.

Damage of Tetranychid mites on cassava leaves and buds is described. Detrimental effects on yield are reported to be above 50%. A list of species of the family Tetranychidae registered in cassava with their distribution is given. Some data on the life cycle of the mite Mononychellus tanajoa are summarized, and results obtained until the present date in the search for resistant var. are given. (Author's summary) F03

0310

19281 NYIIRA, Z.M. 1982. Cassava green mite: its distribution and possible control. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.65-67, 122-128. Engl., Sum. Engl., 1 Ref.

Cassava. Mononychellus tanajoa. Mite control. Biological control. Uganda.

The distribution and possible control of the cassava green mite (Mononychellus tanajoa), not known in Africa prior to 1971, are discussed. It is now distributed in East, Central, and West Africa. Investigations to date have covered its identification, biology, ecology, and control. Recently, it has been claimed that M. tanajoa is a synonym for Eotetranychus caribbeanae, which attacks cassava in the Caribbean and L.A. and is known to exist in various African countries. Findings so far indicate the following: (a) the green mite reproduces rapidly; (b) physical factors affect population and reproduction of the mite; (c) the pest is

airborne and its dispersal across borders is not possible to control; (d) biological control should be part of an integrated approach; (e) some cassava cv. are tolerant or resistant to mite damage; (f) early-maturing var. are subjected to fewer attacks; (g) plants subjected to stress (from lack of nutrients or water or from weed competition) during the 1st 2-3 mo. of development suffer particularly heavy damage from mite infestation. The pest apparently has a 5-yr, long-term population cycle as opposed to an intraannual population trend. Another finding is that an Entomophthora fungus attacks and kills green mites, but its application in biological control programs is limited because it kills predatory mites and is only effective during the rainy season when the mite population is already greatly reduced. (Author's summary) F03

0311

18994 NYIIRA, Z.M. 1980?. Phytophagous mites of tropical root and tuber crops. Kampala, Uganda, Kawanda Research Station. 14p. Engl., 26 Refs.

Cassava. Injurious mites.

The following mite species associated with cassava are reported: Allonychus reisei, Eutranychus banksi, E. enodes, E. orientalis, Eotetranychus planki, Mononychellus bondari, M. caribbeanae, M. chemosetosus, M. mcgregori, M. planby, M. tanajoa, Oligonychus coffea, O. biharensis, O. gossypii, O. peruvianus, Tetranychus amicus, T. cinnabarinus, T. curcubitae, T. kanzawi, T. lombardina, T. marianae, T. neocaledonicus, T. sayedi, T. telarius. T. trancatus, T. tumidus, T. urticae, T. yustii. Information is also included on their world distribution, host relationship, types, and synonyms. (Summary by J.L.S.) F03

0312

17140 VINE, P.N.; OBIGBESAN, G.O. 1982. Soil moisture, time of planting, and spraying in relation to green spider mite, mealybug and variegated grasshopper damage in cassava. In Okoli, O.O.; Enyinnia, T.; Igbokwe, M.C.; Odurukwe, S.O.; Okeke, J.E.; Okereke, H.E., eds. International Workshop on Control of Cassava Mealybug and Green Spider Mite, Umudike, Nigeria, 1981. Proceedings. Nigeria, National Root Crops Research Institute. pp.94-102. Engl., Sum. Engl., 9 Refs..

Cassava. Soil moisture. Planting. Timing. Insecticides. Cultivars. Resistance. Mononychellus tanajoa. Zonocerus variegatus. Phenacoccus. Nigeria.

Outbreaks of severe damage from cassava green spider mite (Mononychellus tanajoa) occurred during the wet and dry seasons in Trinidad (Nigeria) in 1976. Damage by M. tanajoa was virtually eliminated in Trinidad and Ibadan by spraying with 0.05% solution of dimethoate every 10 days. At Ibadan this rate also completely controlled the variegated grasshopper (Zonocerus variegatus). Even in absence of pests, yield increase in dry season in Trinidad and Ibadan depended on availability of soil water. Leaving a crop in dry ground, with concomitant pest damage, may only be justified if harvesting is left until the end of the following rainy season. Four cassava var. (TMS 30572, TMS 30211, TMS 30395, TMS 3001) planted in the wet season at Ibadan and not sprayed, lost most of their leaves in the dry season due to moisture stress, M. tanajoa, the cassava mealybug (Phenacoccus manihoti), and Z. variegatus. The relationship between soil properties, plant vigor, and pest tolerance is discussed. A new cropping schedule was examined at Ibadan: planting at the beginning of the 1980/81

dry season, chemically suppressing pests on the emerging crop until the rains came, and harvesting before the onset of the 1981/82 dry season. (Author's summary) F03

See also 0249 0294 0297 0300 0301 0314 0373 0374 0391

G00 GENETICS AND PLANT BREEDING

G01 Breeding, Germplasm, Varieties and Clones, Selection

0313

19229 BARRIGA, R. H. M. P. 1980. Caracterizacao de cultivares de mandioca (Manihot esculenta, Crantz) com relacao a producao e estabilidade. (Characterization of cassava cultivars regarding yield and yield stability). Tese Mag.Sc. Piracicaba-SP, Brasil, Escola Superior de Agricultura Luiz de Queiroz, da Universidade de Sao Paulo. 128p. Port., Sum. Port., Engl., 106 Refs., Illus.

Cassava. Cultivars. Tuber productivity. Foliage. Genetics. Statistical analysis. Climatic requirements. Brazil.

A group of cassava cv. was characterized regarding root and branch production and their stability over a range of environmental conditions. Additionally, interclonal competition trials were assessed, emphasizing exptl. precision and its relationship with the available genetic variance. The effect of the genotype x environment interaction on total variability was also examined. Field trials with several cv. from the Amazon region and from other regions in Brazil were conducted at Belém (1971/72, 1972/73, and 1976/77), Tracuateua (1973/74, 1974/75, and 1975/76), and Macapá (1973/74, 1974/75, and 1975/76), PA, Brazil. Cv. were tested using a randomized block design with 4 replications. Plants were spaced 1 x 1 m with 2 m between plots and blocks. Useful plot area included 15 plants. No fertilizer was used. Variance analysis of original root and branch production data (t/ha) from each trial tried to relate the mean square of the cv. to the range of variation between means and the exptl. variation coefficient to the genetic variance estimate and the genotypic determination coefficient. A joint variance analysis, emphasizing the effect of the interactions cv. x site, cv. x year, and cv. x site x year, on cv. performance, was carried out. Only 2 sites, Macapá and Tracuateua, were considered. Effects due to cv. and to sites were considered as fixed while the effects due to year were considered aleatory. The method developed by Eberhart and Russell (1966) was used to analyze yield stability. Environmental conditions were favorable for cv. selection. The exptl. variation coefficient alone, as usually utilized, should not be the only measure of precision used. The available genetic variance should also be estimated for each expt. as well as its relationship with environmental variance as well as the genotypic determination coefficient. Broad variability was found regarding root and branch production, useful in further selection studies. Branch production was less affected by environmental changes than root production. Belém had the highest root and branch yields, indicating that this site could be an appropriate site for selecting more productive and resistant cv. The year had considerable influence on cv. performance regarding root production. This influence was mainly due to the variation in rainfall that occurred during the initial growth period. Site x year interaction was highly significant for both characters. Production stability analysis showed that

the most stable cv. tended to give low yields, indicating that the selection of cassava cv. has been directed towards more specific environments. For both characters analyzed, cv. Pretinha had the most stable behavior under favorable conditions. Cv. Amazonas and Ipean-12 (the most stable root and branch production, resp.) showed adaptability to less favorable environments. A high correlation was observed between production and stability, reinforcing the hypothesis that stability is a genetically controlled property. (Author's summary) G01

0314

19288 BECK, B.D.A. 1982. Historical perspectives of cassava breeeding in Africa. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.13-18, 122-128. Engl., Sum. Engl., 43 Refs.

Cassava. Plant breeding. Resistance. Cassava African mosaic virus. Xanthomonas manihotis. Mononychellus tanajoa. Cyanides. Clones. Africa.

The early records of the introduction of cassava to East and West Africa are reviewed, and the 3 major cassava breeding programs that involved the use of interspecific hybridization to obtain resistance to CAMD are outlined. Earlier work to produce the interspecies hybrid clone 58308 is described; this clone has shown stable resistance to CAMD for 22 yr under continuous, high-inoculation pressure. Research at the International Institute of Tropical Agriculture (IITA) has shown that this resistance is recessive, is polygenic, and is inherited in a largely additive manner. It has also shown that 58308 provides polygenic resistance to CBB and that this resistance is also recessive and is inherited additively. The resistances to CAMD and CBB are strongly linked, and this link may occur in the chromosome complement derived from the Manihot glaziovii parent. Clone 58308 has also been the principal parent in the production of lines with low cyanide in the roots. Resistance to both diseases and the presence of low cyanide have been incorporated into a large no. of high-yielding populations at IITA, through a half-sib selection procedure with relatively large families. The future development and the distribution of new disease-resistant, low-cyanide cv. for the smallholder and for large-scale producers as an industrial feedstock are discussed. (Author's summary) G01

0315

18481 CARVALHO, P.C.L. DE; EZETA, F.N. 1982. Estudo de precocidade em mandioca. (Early maturity in cassava). Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Pesquisa em Andamento no. 2. 3p. Port., 4 Refs.

Cassava. Cassava programs. Cultivars. Timing. Tuber productivity. Tubers. Starch content. Leaves. Protein content. Brazil.

The Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, BA, Brazil, is conducting a series of expt. to study the process of starch accumulation in roots of 20 cassava cv. and the variations in foliage protein content. Results of the 1st sampling are given; cv. MMEX-59 had the highest root (9.42 t/ha) and starch (29.99%) yields. Cv. Suruí was outstanding regarding its foliage protein content (18.75%). (Summary by J.L.S. Trans. by L.M.F.) G01

0316

18961 FUKUDA, W.M.G.; SILVA, S. DE O.E. 1979. Escolha de variedades de mandioca (Manihot esculenta Crantz). (Screening cassava varieties). Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 9p. Port., 11 Refs.

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

Cassava. Cultivars. Selection. Brazil.

Aspects are included on the characteristics that should be taken into account when screening cassava var. according to utilization—human consumption, forage production (leaves and roots), and industrialization (flour, starch, chips, alcohol). Other characters that are important to reach higher yield indices are growth cycle, starch and HCN contents, easiness to harvest, presence of peduncle, root size and no., phelloderm color and pulp color, growth habit, HI, initial vigor, and pest and disease resistance. (Summary by EMBRAPA. Trans. by L.M.F.) GOi

0317

19287 HAHN, S.K. 1982. Research priorities, techniques, and accomplishments in cassava breeding at IITA. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.19-22, 122-128. Engl., Sum. Engl., 5 Refs., Illus.

Cassava. Cassava programs. Research. Plant breeding. Selection. Nigeria.

Since major biological constraints to cassava production in Africa are diseases, especially CAMD and CBB, and insect pests, such as the mealybug (Phenacoccus sp.) and the green mite (Mononychellus tanajoa), the primary objectives of cassava breeding at the International Institute of Tropical Agriculture (IITA) have been to alleviate these constraints. Cassava breeding techniques used such as pollination, seed collection, seed germination, and screening for important agronomic characteristics are discussed, and the procedures and yield trials are described. The most promising IITA cv. with good performance in a wide range of environments within Nigeria are TMS 30572 and TMS 30555. The most CAMD- and CBB-resistant cv. is TMS 30001, which is also low in cyanide. Sources of resistance to cassava green mite have been identified, and a mealybug-resistant Manihot species has been found. The improved populations and families of true seeds with sources of disease and insect resistance, high yield potentials, compact roots, and low cyanide levels are available for selection. (Author's summary) GOi

0318

17379 INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES ET DES CULTURES VIVRIERES. 1981. Tubercules et racines: le manioc. (Root and tuber crops: cassava). In _____. Rapport Annuel 1981. Paris. pp.157-160. Fr.

Cassava. Cassava programs. N. P. K. Ca. Mg. Nutrient absorption. Fertilizers. Hybrids. Cultivars. Tuber productivity. Soil requirements. Adaptation. Planting. Upper Volta. Ivory Coast. French Guiana. Polynesia.

Exptl. research carried out on cassava in Upper Volta, Ivory Coast, French Guiana, and Polynesia is reported. Data on the response of cassava grown in Ivory Coast to fertilization (N, P, K, Mg) are included, in particular those regarding the amount of these nutrients used by different parts of the cassava plant. Plant breeding in Bouaké included the evaluation of 27 local cv. and comparative trials of 37 hybrids with var. CB. Data obtained from trials carried out with var. CB, Bonoua Blanc, H 45, H 57, H 58, Kataoli, H 43, TA 24, and TA 49 in the regions of Man, Bouaké, Ferke, Fitabro, and Moyenne are given. Highest yields corresponded to var. CB, Bonoua Blanc, TA 24, and TA 49. In French Guiana the performance of clones MU 10, MU 16, MU 15, MU 17, and MU 54 was studied in sandy soil. In Polynesia different planting methods were studied and var. yield trials were carried out in which var. M MEX-59 and M VEN-156 were outstanding. (Summary by J.L.S. Trans. by L.M.F.) G01

0319

18984 INSTITUT DES SCIENCES AGRONOMIQUES DU RWANDA. 1982. Tubercules et racines: manioc (Manihot esculenta Grantz). (Root and tuber crops: cassava). In _____. Compte rendu des travaux du Departement des Productions Vegetales en 1981. Rubona, Rwanda. pp.46-52. Fr.

Cassava. Clones. Selection. Tuber productivity. Timing. Sweet cassava. Bitter cassava. Cultivars. Rwanda.

Data on trials carried out in Karama and Rubona (Rwanda) are given: (1) a seed nursery, in which 324 clones were selected for disease resistance and root characteristics; (2) clonal screening trial for sensitivity to acariasis and Cercospora spp., selecting 64 clones; (3) collection of 55 local clones; (4) clonal screening in staggered harvest in which outstanding var. were Creolinha (63,000 kg/ha at 24 mo.), Ganga na Butu Seed 6 (56,666 kg/ha at 24 mo.), Eala 07 (42,636 kg/ha at 18 mo.), and the early-maturing sweet var. Ikiela and Maguruyinkware (41,808 and 31,042 kg/ha, resp., at 12 mo.); (5) clonal screening trials with 4 Eala 07 clones as control in which local var. Kibombwe (31,263 kg/ha) and IITA var. 30572 (30,010 kg/ha) were outstanding and a great genetic variability was observed regarding drought- and green mite-resistance; (6) comparative var. trials with sweet and bitter cassava. Higher yields were obtained in Rubona (26,411 and 30,365 kg/ha for sweet and bitter cassava, resp.) in comparison with yields obtained in Karama (7711 and 22,828 kg/ha, resp.). This could be due to the greater amount of rainfall in Rubona. Sweet var. Mulundi (44,556 kg/ha) and bitter var. Ganga na Butu Seed 6, Eala 07, and Creolinha were considered outstanding. Data are included on collaborative activities, multiplication, and release of clones. (Summary by I.B. Trans. by L.M.F.) G01

0320

18414 IYAMUREMYE, F. 1983. Manioc et patate douce. (Cassava and sweet potato). In _____. Synthese des acquis scientifiques et techniques de la recherche agricole au Rwanda. Butare, Institut des Sciences Agronomiques du Rwanda. pp.52-58. Fr.

Cassava. Cassava programs. Cultivars. Selection. Adaptation. Tuber productivity. Rwanda.

Research carried out by the Institut des Sciences Agronomiques du Rwanda during 1930-82 is briefly reviewed. In var. selection trials for yield conducted in 1978 var. Creolinha and Ganga na Batu Seed 6 were outstanding

for their higher root yield at 24 mo. (63 and 56.6 t/ha, resp.). Var. Ikiela was outstanding for its early maturity and high yield (41.8 t/ha) at 12 mo. In regional yield trials during 1980-82 better results were obtained in Karama (32.7 t/ha) than in Rubona (10 t/ha). Brief information is included on fertilization trials, pathology, HCN content, and var. released at both sites. (Summary by J.L.S. Trans. by L.M.F.) G01

0321

18945 LENOIR, H.; MATHIEU, G. 1982. Résultats: racines et tubercules. (Results: root and tuber crops). In _____. Recherche agronomique apliquée region du Nord. Résultats sur la période 1980 a 1981. Haiti, Programme Agricole de l'Organisme de Développement du Nord. pp.21-29, 81-88. Fr., Illus.

Cassava. Cultivars. Adaptation. Tuber productivity. Starch content. Sweet cassava. Bitter cassava. Dry matter. Tuber development. Haiti.

Results of several trials conducted at the Osmond and Acul du Nord research stations in NE Haiti during 1980-81 are given. In Osmond performance trials were conducted during 1979-80 on 30 m^2-plots, plants spaced at 1 x 1 m. Bitter cassava var. Toro Ganisé and Madame Francois (from the NE and N, resp.) were outstanding with 66.6 and 57% of marketable tubers. At the same station these 2 var. were again outstanding the following year along with var. Carne Blanca (from the Dominican Republic) and Gros Elias (from the NE). These 4 var. were compared with Mcol 1684 and CMC 40, the 2 main var. introduced from CIAT (Colombia) and widely commercialized in several countries. In 1980-81 a var. trial was conducted in Acul du Nord to compare var. Madame Francois and CM 342-55 with the 2 introduced Colombian var. The performance of the introduced var. was superior (21,370 and 16,560 kg/ha for Mcol 1684 and CMC 40, resp.; 11,800 and 10,280 kg/ha for Madame Francois and CM 342-55, resp.). In 1981 results of a study on productivity showed that the following bitter var. were outstanding: Ti Fou Negre with 13.2 t/ha, CM 342-55 with 15.9 t/ha, and Ti Fronte with 15.5 t/ha. Toro Ganisé had a high CF yield (10.8 t/ha) and Clementine (sweet) yielded 15.6 t roots/ha. Mcol 1684 and CMC 40 are described. (Summary by I.B. Trans. by L.M.F.) G01

0322

18446 PEREIRA, A.V.; FURTADO, M.J. 1982. Avaliacao de cultivares de mandioca de ciclo curto para o Espírito Santo. (Assessment of cassava cultivars with a short growth cycle for Espírito Santo). Cariacica-ES, Brasil, Empresa Capixaba de Pesquisa Agropecuária. Comunicado Técnico no.08. 3p. Port.

Cassava. Cultivars. Selection. Tuber productivity. Brazil.

The performance of cassava var. with a short growth cycle (12 mo.) was determined and those apt for the northern region of the state of Espírito Santo, Brazil, were selected. Trials were carried out during 1979-80 and 1980-81 on a Red Yellow Latosol. A randomized block design was used with 4 replications, the exptl. plot consisting of 21 useful plants, spaced 1 m between rows and 0.6 m between plants. Cv. Pao do Chile Sul, Riqueza IPEACO-1, Sao Pedro Mirim Pampas, Cacauzinha, Juliao Roxo, Santa Cruz, Prato Cheio com Folha Miuda, Rio Branco, Arizoninha Branca, and Rosa were used. Preliminary root production data indicated that the means reached in 1979-80 were higher mainly due to the better environmental conditions during this period. A list of recommended cv. for the municipalities of

Linhares, Boa Esperanca, Conceicao de Barra, Sao Mateus, and Pinheiro is included. (Summary by J.L.S. Trans. by L.M.F.) G01

0323

18902 RAMIREZ, O.D.; GREEN, J.J.; BEAUCHAMP DE CALONI, I. 1983. Evaluation and acceptability of cassava cultivars. Journal of Agriculture of the University of Puerto Rico 67(1):16-21. Engl., Sum. Engl., Span., 12 Refs.

Cassava. Cultivars. Tuber productivity. Tubers. HCN content. Protein content. Organoleptic examination. Puerto Rico.

Ten cassava cv. (IAC-12-829, Jamaica 18, Trinidad 14-56, Ceiba, Llanera, IAC-Mantequeira, SRT-59B-Sta. Catarina, Seda, Cubana, and Jamaica 4C) were planted at the Corozal Substation, located in the east central region of Puerto Rico, in order to assess their yield and overall acceptability by tasting panel. Highest yielding cv. were IAC-12-829, IAC-Mantequeira, Jamaica 18, and SRT-59B-Sta. Catarina with 41.98, 39.24, 35.17, and 31.43 t/ha, resp. Regarding overall acceptability by the tasting panel, all the cv. were considered acceptable except SRT-59B-Sta. Catarina. Cv. Jamaica 4C, IAC-Mantequeira, Trinidad 14-56, and Seda had the highest ratings of overall acceptability. HCN content among cv. was below the toxicity level (50-100 mg/kg). On the basis of yield, % of marketable roots, and overall acceptability, IAC-12-829, IAC-Mantequeira, Jamaica 18, and Trinidad 14-56 were the most promissory cv. in this preliminary evaluation. (Author's summary. Trans. by L.M.F.) G01

0324

18982 SILVA, S. DE O.E.; ALVES, F.J.; CUNHA, G.A.P. DA; SAMPAIO, J.M.M.; CUNHA SOBRINHO, A.P. DA; LUNA, J.V.U. 1982. Banco ativo de germoplasma de mandioca. (Active cassava germplasm bank). In _____. Preservacao e utilizacao de recursos genéticos vegetais de batata-doce, citros, frutas tropicais e mandioca. Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. Documentos no. 4. pp.29-34, 38-39. Port.

Cassava. Germplasm. Brazil.

The institutions that have the major germplasm collections of Manihot esculenta in the world and in Brazil are listed. Likewise, the botanical characteristics used in cv. evaluation and the institutions covered by the Active Germplasm Bank of the Centro Nacional de Pesquisa de Mandioca e Fruticultura are given. (Summary by J.L.S. Trans. by L.M.F.) G01

0325

19286 TERRY, E.R.; HAHN, S.K. 1982. Increasing and stabilizing cassava and sweet-potato productivity by disease resistance and crop hygiene. In Root crops in Eastern Africa, Kigali, Rwanda. 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.47-52, 122-128. Engl., Sum. Engl., 53 Refs.

Cassava. Cassava African mosaic virus. Cassava brown streak virus. Cassava bacterial blight. Plant breeding. Resistance. Disease control. Productivity. Africa.

The major viral and bacterial diseases affecting cassava and sweet potato are described, with special reference to Africa. Data on crop yield reductions caused by the diseases are also reviewed. Evidence of host plant resistance to CAMD and CBB and to the sweet potato virus disease is presented and reviewed. The possibilities for integrated disease control by the use of the available levels of disease resistance, together with sound crop hygiene, to increase and stabilize the yields of both crops are set forth. (Author's summary) G01

See also 0230 0373 0374 0379 0381 0383 0384 0391

G02 Cytogenetics

0326

18987 ARMECIN, C.F.; CARPENA, A.L. 1982. Determination of the nature of tetraploidy in cassava through meiotic analysis. Annals of Tropical Research 4(2):77-84. Engl., Sum. Engl., 9 Refs., Illus.

Cassava. Cytogenetics. Polyploidy. Chromosomes.

A cytological investigation was carried out to determine whether Manihot esculenta is an autotetraploid or an allotetraploid. Male inflorescences were collected in 30-min intervals at different stages of development of cassava var. Niña Girl Bonita, Forastera, Sip 24-2, Matalin Collection, and MCol 1684. The iron acetocarmine squash technique was used for studying meiotic stages. Although the prevalence of normal bivalent pairing at diakinesis and metaphase I and the higher % of cells having regular meiosis suggest that cassava is an allotetraploid and not an autotetraploid, on the basis of the results obtained cassava seems to be a segmental rather than a true allotetraploid as indicated by the presence of multivalents and univalents in 29% of the total meiotic cells observed. This implies partial homology between the chromosomes of the species resulting in segmental pairing of homologous chromosomes. Therefore, cultivated cassava is a segmental allotetraploid with a basic chromosome no. of x = 9 and a chromosome no. of 2n = 4x = 36. (Author's summary) G02

H00 NUTRITION

H01 Cassava Foods and Nutritive Value

0327

18958 ABRAHAM, T.E.; RAJA, K.C.M.; SREEMULANATHAN, H.; MATHEW, A.G. 1979. Improvement of texture of cassava flour by chemical treatment. Journal of Root Crops 5(1-2):11-18. Engl., Sum. Engl., 27 Refs.

Cassava. Cassava flour. Analysis. Organoleptic examination. Cooking. India.

The possibility of removing the inherent stickiness of CF by chemical treatment was studied. Treatment of raw as well as parboiled CF of var. Malayan 4 with bifunctional chemical reagents like sodium trimetaphosphate, and epichlorhydrin in alkaline pH and phosphorus oxychloride in acid pH was

found to reduce the pastiness of the steamed products. Best results were obtained in the case of 1.0-1.5% of sodium trimetaphosphate at pH 10.0-10.4. (Author's summary) H01

0328

17378 BELLAMY, M. 1981. Le tapioca: un produit nouveau. (Tapioca, a new product). Alimentation (France) 91:71-72,74-75. Fr., Illus.

Cassava. Tapiocas. Dietary value. Uses. Factories. France.

The new qualities of using tapioca as a combined food in the food industry, especially in France and Germany, are highlighted. The French society Tipiak produces 5000 t of a variety of products per year. Qualities are: purity; absence of gluten, which makes it appropriate for diets for gluten intolerance and allergies, and for diets for children and elder people, weak buffer capacity that does not increase gastric secretions; low Na content, recommended for arterial hypertension; excellent mixing qualities with milk and weak fixation point that does not modify peptin and trypsin proteolysis; totally neutral flavor that makes it appropriate for extruded products, tidbits, candies, creams, sauces, soufflés, cookies, and salted foods; different granulations (Tipiak has 4); high degree of viscosity; good plasticity together with corn starch, or corn grits or wheat semola bran; delays staleness in some products and prolongs conservation in others. (Summary by I.B. Trans. by L.M.F.) H01

0329

18450 RAJA, K.C.M.; ABRAHAM, E.; NATHAN, H.S.; MATHEW, A.G. 1979. Chemistry and technology of cassava. Indian Food Packer 33(3):31-43. Engl., 68 Refs.

Cassava. Composition. Tubers. Storage. Uses. Nutritive value. Cassava products. Processing. India.

Aspects of cassava covered include: cultivation, chemical composition, storage, utilization, cassava starch, tapioca, and other products. (Summary by Food Science and Technology Abstracts) H01

See also 0323 0391

H02 Nutritive Disorders in Humans

0330

19257 AYANGADE, S.O.; OYELOLA, O.O.; OKE, O.L. 1982. A preliminary study of amniotic and serum thiosulphate levels in cassava-eating women. Nutrition Reports International 26(1):73-76. Engl., Sum. Engl., 8 Refs., Illus.

Cassava. Human physiology. Human nutrition. Gari. Toxicology. Thiocyanates. Analysis. Endemic goitre. Cretinism. Nigeria.

The amniotic fluids and blood samples of 40 pregnant women were analyzed for SCN. The concn. in the amniotic fluids varied from 0.66 to 3.88 Mmol/l

while those of the blood samples varied from 0.70 to 2.80 Mmol/l. The concn. of SCN followed the same pattern in the blood and amniotic fluid, with a correlation coefficient r = 0.484 (P = 0.01). The concn. of SCN in both fluids varied according to the standard of living of the subjects. The highest concn. occurred in the lower income groups who eat a lot of gari (cassava pudding), which is the staple diet that contains the cyanogenic glycoside linamarin. The detoxification product, SCN, seems to penetrate the placental barrier. The implication of this in the etiology of goiter and cretinism was discussed. (Author's summary) HO2

0331

19205 BENMILOUD, M.; BACHTARZI, H.; CHAOUKI, M.L. 1983. Public health and nutritional aspects of endemic goitre and cretinism in Africa. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, Ontario, International Development Research Centre. IDRC-207e. pp.49-54. Engl., 31 Refs., Illus.

Cassava. Endemic goitre. Cretinism. Maps. Iodine. Human health. Human nutrition. Africa.

The incidence of goitre in Africa is reviewed and its coexistence with endemic cretinism is analyzed. The clinical characteristics of these 2 diseases and their etiological factors are discussed; among these, I deficiency is the most important. This deficiency may be related to geological factors. Other determinants of endemic goitre are the role of fluoride, the goitrogenic action of Ca, polluted drinking water, genetic factors that could arise in the family (endogamy), nutritional factors (protein caloric malnutrition), existence of a goitrogenic agent in food such as cassava, turnips, cabbage, millet, onion, garlic, olive oil, and other vegetable oils. Preventive measures taken in several African countries are described. Although the governments of several countries have undertaken measures toward I supplementation, an active prophylaxis is needed to eradicate totally, or at least reduce considerably, these endemias. (Summary by I.B. Trans. by L.M.F.) HO2

0332

18152 BOURDOUX, P.; PUTZEYS, G.; LAGASSE, R.; STEIRTEGHEM, A. VAN 1982. Biochemical and statistical methods. In Delange, F.; Iteke, F.B.; Ermans, A.M., eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.20-24. Engl., 26 Refs.

Cassava. Iodine. Thiocyanates. HCN. Biochemistry. Statistical analysis. Endemic goitre.

A detailed description is given of the biochemical and statistical methods used to compare and relate the results from epidemiological studies and biochemical investigations of thyroid function, SCN metabolism, and dietary supplies of I, HCN, and proteins in groups of patients with goitrogenic problems due to nutritional factors present in cassava. (Summary by EDITEC. Trans. by L.M.F.) HO2

0333

18158 COURTOIS, P.; BOURDOUX, P.; LAGASSE, R.; ERMANS, A.M.; DELANGE, F. 1982. Role of the balance between the dietary supplies of iodine and

thiocyanate in the etiology of endemic goitre in the Ubangi area. In Delange, F.; Iteke, F.B.; Ermans, A.M., eds. Nutritional factors involved in the goitrogenic action of cassava. Ottawa, Canada, International Development Research Centre. pp.65-69. Engl., Sum. Fr., 23 Refs., Illus.

Cassava. Endemic goitre. Etiology. Epidemiology. Cretinism. Iodine. Human physiology. Human nutrition. Thiocyanates. Zaire.

The epidemiological situation observed among communities located along 2 roads at the southern limit of the Ubangi endemic goitre area (Zaire) helped determine the role played by SCN and I deficiency in the etiology of endemic goitre in the region. In the 49 villages on the 2 road axes (each 100 km long), the prevalence of goitre in the population (23,578 inhabitants) increased progressively from 20 to 80%. Endemic cretinism increased when the prevalence of goitre reached the critical threshold of 50% of the population. Metabolic studies were conducted on 257 adults with normal thyroid function living on the 2 roads. Av. concn. of TSH and T_4 were within normal limits where the prevalences of goitre were lower than 60%. Above this value, TSH increased sharply ($P < 0.01$) and T_4 decreased ($P < 0.01$). Along the West-East road, the concn. of urinary I was very low (1.7-2.5 micrograms/dl) and remained practically unchanged. On the other hand, urinary SCN increased from 0.7 to 3.2 mg/dl ($P < 0.001$) after the increased consumption of unsoaked roots. Along the South-North road, the concn. of urinary SCN were constant and almost 1.5 mg/dl while urinary I decreased progressively. Therefore, along both roads the urinary I:SCN ratios were 3.1 and 3.0 in villages with a low prevalence of goitre, and 0.70 and 0.75 in hyperendemic villages. The prevalence of endemic goitre and cretinism in this region depends more on the balance between I and SCN in the diet than on I supply. (Author's summary. Trans. by L.M.F.) H02

0334

19202 DELANGE, F.; BOURDOUX, P.; COLINET, E.; COURTOIS, P.; HENNART, P.; LAGASSE, R.; MAFUTA, M.; SEGHERS, P.; THILLY, C.; VANDERPAS, J.; YUNGA, Y.; ERMANS, A.M. 1983. Nutritional factors involved in the goitrogenic action of cassava. In _____.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, Ontario, International Development Research Centre. IDRC-207e. pp.17-26. Engl., Sum. Engl., 2 Refs., Illus.

Cassava. Endemic goitre. Epidemiology. Biochemistry. Iodine. Thiocyanates. Cretinism. HCN. Toxicity. Human physiology. Human nutrition. Detoxification processes. Zaire.

Epidemiological, clinical, nutritional, and biochemical studies were conducted to evaluate the nutritional conditions required to induce the goitrogenic action of cassava in 3 rural areas in Zaire. The respective roles played by thyroid failure and the toxic effect of HCN on the central nervous system were evaluated. Field studies demonstrated the following points: (1) chronic consumption of large quantities of cassava does not necessarily result in the development of endemic goitre. (2) The development of goitre is critically related to the balance between dietary supplies of I and SCN. This balance can be altered by a subnormal I supply + a high SCN supply or by a severe I deficiency + periodic utilization of poorly detoxified cassava. Factors determining the I/SCN ratio are level of I intake, HCN content of cassava, efficiency of detoxification processes (soaking being the most efficient), and the frequency and quantity of

consumption of these foods. (3) Protein calorie malnutrition does not greatly impair the endogenous conversion of HCN into SCN. (4) Adaptation of thyroid function to less severe goitrogenic conditions can take place without a marked increase in TSH stimulation in adults but not in infants. Newborns and pregnant women are the vulnerable target groups of the population for the toxic action of cassava. (5) Breast-feeding plays a protective role by delaying the feeding of cassava-based foods to young infants. (6) Evaluation of the goitrogenic environment in a given area should be based on the degree of I deficiency and SCN overload; the risk of mental deficiency can be determined by systematic screening for congenital hypothyroidism in the newborn. (Summary by I.B. Trans. by L.M.F.) H02

0335

19201 ERMANS, A.M.; BOURDOUX, P.; STINTHAERT, J.; LAGASSE, R.; LUVIVILA, K.; MAFUTA, M.; THILLY, C.H.; DELANGE, F. 1983. Role of cassava in the etiology of endemic goitre and cretinism. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, Ontario, International Development Research Centre. IDRC-207e. pp.9-16. Engl., 9 Refs., Illus.

Cassava. Endemic goitre. Cretinism. Etiology. Thiocyanates. Absorption. Epidemiology. Human physiology. Human nutrition. Iodine. Africa.

An attempt to provide answers to the following medical and physiopathological problems is made: (1) the lack of parallelism between the degree of I deficiency and the severity of goitrous endemias; (2) the possible relationships between myxedematous cretinism in Central Africa and the goitrogenic environment and, if so, by what specific mechanism; (3) the development of a new method of I prophylaxis that could be readily adapted to local conditions. Research was performed on a multidisciplinary basis in the field, in endemic areas, or in Brussels (Belgium). The different phases of research are described. The role of cassava in the pathogenesis of endemic goitre is analyzed as well as the nature of the antithyroid action of cassava. Results of the clinical and exptl. studies show that cassava ingestion, together with I deficiency, are key factors in the etiology of endemic goitre and cretinism in Central Africa. The main difficulty encountered was to distinguish between the goitrogenic effects of SCN and those of I deficiency. The importance of nutritional education regarding cassava detoxification methods is emphasized and it is essential to establish more precisely the SCN/I ratio. (Summary by I.B. Trans. by L.M.F.) H02

0336

19203 GAITAN, E. 1983. Role of other naturally occurring goitrogens in the etiology of endemic goitre. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, Ontario, International Development Research Centre. IDRC-207e. pp.27-34. Engl., 46 Refs.

Cassava. Endemic goitre. Etiology. Human physiology. Human nutrition.

The evidence implicating environmental goitrogens as etiological factors of endemic goitre are reviewed. These have been detected as thiocyanates and isothiocyanates in vegetables of the Cruciferae family, as cyanogenic glucosides in cassava, maize, bamboo shoots, sweet potatoes, and lima bean, and as aliphatic disulfides in onions and garlic. Several endemias have

been attributed to milk from regions of endemic goitre, the nut of Araucaria araucana, polluted drinking water; the excess of I also causes goitre and hypothyroidism. Some naturally occurring goitrogens in water were analyzed as well as their relationship to disease incidence in different regions. Their chemical characterization, physical state, and geocycle are discussed. There is evidence of organic antithyroid compounds derived from sedimentary rocks that contaminate water supplies. Microorganisms (i.e., Escherichia coli) also contaminate water supplies, being involved in the pathogenesis of endemic goitre. Nutritional status was also analyzed. The best indicators of the disease were the presence of sedimentary rock and the concn. of Klebsiella pneumoniae in the water source. (Summary by I.B. Trans. by L.M.F.) HO2

0337

19211 GEEVARGHESE, P.J. 1983. Cassava diet, tropical calcifying pancreatitis, and pancreatic diabetes. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.77-78. Engl., 12 Refs.

Cassava. Human nutrition. Human health. Clinical manifestations.

Evidence is presented that cassava-based diets are related to the development of tropical calcifying pancreatitis (TCP) and pancreatic diabetes (PD). The 2 diseases are associated with protein deficiencies as shown by surveys in Kerala, India, where intake of carbohydrate was high (478 ± 100 g/day). The source of carbohydrate was found to be cassava. Epidemiological data supporting cassava as a cause of TCP showed that this disease is prevalent in Nigeria, Uganda, India, Indonesia, and Brazil, where cassava is eaten and the incidence of endemic goitre related to cassava toxicity is also common. It is emphasized, however, that cassava-based diets alone may not cause TCP or PD. Other genetic factors, such as pancreatic ductal anomalies, are also present in these diseases. (Summary by I.L.S.) HO2

0338

19204 KOCHUPILLAI, N.; RAMALINGASWAMI, V. 1983. Public health and nutritional aspects of endemic goitre and cretinism in Asia. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, Ontario, International Development Research Centre. IDRC-207e. pp.43-48. Engl., 9 Refs., Illus.

Cassava. Endemic goitre. Cretinism. Human health. Human nutrition. Iodine. India. Maps. Asia.

The problem of endemic goitre and cretinism in Asia, in particular India, is reviewed regarding prevalence, etiology, and health consequences. The contributory role played by dietary or environmental goitrogens such as cassava consumption, relationship with season flooding and poverty-related factors (including unconventional sources of food) is examined. Environmental I deficiency plays an important role in goitrogenesis in all countries studied. There is no evidence to show that cassava consumption plays any role in goitre prevalence in Asia. Several ill-defined contributory factors seem to operate to generate the extreme variability in the prevalence of these diseases. Detailed studies are necessary to clarify these factors.

There is an urgent need to implement I prophylaxis since recent observations indicate that in severely goitrous areas as much as 2-5% of newborns have thyroid insufficiency. (Summary by I.B. Trans. by L.M.F.) H02

0339

19208 KWANG, T.Y. 1983. Endemic goitre in the state of Sarawak, Malaysia. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.64-68. Engl., 18 Refs., Illus.

Cassava. Endemic goitre. Cretinism. Epidemiology. Etiology. Maps. Human nutrition. Human physiology. Malaysia.

Based on epidemiological surveys of endemic goitre and cretinism, 12 of Sarawak's 25 districts (Malaysia) were identified as goitrous. Current estimates indicate that there are at least 20,000 cases of endemic goitre in this state, representing 1.5% of its total population. As part of the program for the control of endemic goitre, the production of iodized salt was initiated and legislation was passed in Jan. 1982 making the import of iodized table salt compulsory. In addition to this program 2 other methods were tested over a period of 1-2 yr. The 1st involved the use of iodized salt injections and the 2nd utilized an iodinator fitted into the gravity-fed village water supply. The latter produced significant results in 9 mo.; the prevalence of goitre was reduced from 61 to 30%. Evidence is provided for the role of cassava in the etiology of endemic goitre. Data from food consumption studies in 2 inland communities indicated an av. intake of 400 g of cassava leaves and 900 g of roots/household; no elaborate preparation of cassava was carried out, except where cassava is consumed as a rice substitute. Research needs are briefly outlined. (Summary by J.L.S.) H02

0340

19209 MATA, L.; ULATE, E.; JIMENEZ, S.; DIAZ, C. 1983. Cassava consumption, endemic goitre, and malnutrition in Costa Rica. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.69-72. Engl., 15 Refs.

Cassava. Human nutrition. Endemic goitre. Malnutrition. Costa Rica.

Results of cassava consumption surveys carried out in Costa Rica in 1978 and 1980 are presented. These include information on mean consumption, consumption by children 1-6 yr old, and daily consumption among lactating women and neonates. Malnutrition and goitre present no serious problem; its decrease is attributed to an overall improvement in the quality of life and to the government-supported salt iodation program. As goitre is still observed in certain families, studies should be undertaken to determine the role of cassava in such cases. (Summary by J.L.S.) H02

0341

19206 VAREA T., J.R. 1983. Nutritional and public health considerations relating to endemic goitre and cretinism in South America. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and

public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, International Development Research Centre. IDRC-207e. pp.55-61. Engl., 53 Refs., Illus.

Cassava. Endemic goitre. Cretinism. Epidemiology. Biochemistry. Human physiology. Human health. Iodine. South America.

In 65% of Latin American countries, endemic goitre is a public health problem. The major etiological factor is I deficiency. Data are presented on the prevalence of goitre in South America prior to and following prophylaxis by iodized salt, endemic cretinism, and parameters of thyroid function in endemic goitre. Since I deficiency in the diet, along with protein calorie malnutrition, induces progressive physiological delays in children in developing countries, the adoption of nutritional measures is suggested. To increase the rate of nutritional improvement, it is necessary to (1) establish better iodized salt programs, (2) create iodized oil programs in marginal zones, (3) detect and treat congenital hypothyroidism in endemic zones, and (4) study and treat the psychomotor and mental disorders associated with goitre. (Summary by J.L.S.) H02

See also 0351

H03 Animal Feeding

0342

19231 AGUDU, E.W.; THOMAS, O.P. 1982. Available carbohydrate in cassava meal determined by chick bioassay. Poultry Science 61(6):1131-1136. Engl., Sum. Engl., 17 Refs.

Cassava. Cassava meal. Carbohydrate content. Feed constituents. Chicks. Animal physiology. Animal nutrition. Dietary value.

The availability of carbohydrate contained in peeled (PCASS) and nonpeeled (NPCASS) cassava, and soybean oilmeals (SBOM) was estimated in 3 feeding trials on chicks each lasting for 2 wk. The chicks were fed for 7 days on a carbohydrate-free, basal diet containing soybean oil as the sole source of nonprotein energy. From 8 until 21 days old, chicks of uniform wt. were given small quantities of the test ingredients at 2 levels. Wt. gain of chicks at the end of each expt. was used to estimate the amount of available carbohydrate from a standard glucose curve, plotted using wt. gains and dietary glucose contents expressed as $\log_{10}$ (1 + g glucose/g isolated soybean fatty acids). In all the studies there was a significant linear regression of chick wt. gain on glucose values. Available carbohydrate for NPCASS, PCASS, and SBOM was 83.8, 92.4, and 32.3%, resp. There was a slight increase in wt. gain and improvement in feed efficiency with increased CM. Values for N-free extracts, obtained by chemical analysis, correlated significantly (r = 0.996) with those from chicks. NPCASS contained more acid detergent fibre than did PCASS, and that explained the lower carbohydrate availability from NPCASS. (Author's summary) H03

0343

17113 CARVALHO, J.P.; MONTEIRO, E. DE S.; SOARES, L.M. 1969. Feijao macacar, farelo de algodao sem gossipol e raspa de mandioca na producao

de ovos. (Cowpea, cottonseed meal without gossypol, and cassava chip meal in egg production). Recife, Brasil, Instituto de Pesquisas Agronomicas. Comunicado no.2. 10p. Port., Sum. Port., Illus.

Cassava. Cassava meal. Feed constituents. Poultry. Dietary value. Economics. Animal nutrition. Brazil.

A total of 440 White Leghorn chickens, distributed in 4 cages of 2 chicken houses 110 days after the initiation of egg laying, were used to determine the effect of the total substitution of: wheat flour (T_2) with a mixture of equal protein value, made of toasted cowpea meals, cassava chip and corn meals; soybean and cottonseed meals (T_3) with toasted cowpea flour, cottonseed meal without gossypol, and fish meal; wheat, soybean, and cottonseed meals (T_4) with the mentioned protein mixtures, used together to supply the same protein value as the substituted feedstuffs. The results of 224 days of research showed that T_2 increased egg laying 99% compared with the basic ration which consisted of wheat, soybean, and cottonseed meals and other ingredients and improved feed conversion; the ration required to obtain a dozen eggs was 15.3% less. In addition to maize, the results were practically confirmed in T_4. T_3 also gave positive results since egg production and feed conversion were practically the same. (Summary by EMBRAPA. Trans. by L.M.F.) H03

0344

18486 KIRILLOVA, N. 1981. [Cassava in diets for fattening of pigs]. Svinovodstvo (USSR) 5:21. Russ.

Cassava. Swine. Fattening. Feed constituents. Dietary value. Animal physiology. Animal nutrition.

Young pigs were fattened on a mixture of barley and wheat without or with cassava 20, 40, or 60% by wt. Cassava at 20 or 40% of diet did not cause any significant change in gastric digestion compared with the basal diet given alone. At 60% it caused a delay in stomach emptying during the 1st few hours after eating and changed the ratio of hydrochloric acid to other organic acids by raising the concn. of lactic acid and VFA. (Summary by Nutrition Abstracts and Reviews) H03

0345

18500 RAVINDRAN, V.; KORNEGAY, E.T.; POTTER, L.M.; WEBB JUNIOR, K.E.; PARSONS, C.M. 1983. True metabolizable energy values of cassava tuber and leaf meals for poultry. Tropical Agriculture 60(2):82-84. Engl., Sum. Engl., 13 Refs.

Cassava. Cassava meal. Leaves. Poultry. Digestibility. Metabolism. Dietary value. Proteins.

True ME values of cassava tuber meal and CLM were determined using 18 adult Single Comb White Leghorn roosters. After 24 h of fasting, 6 roosters were force-fed 25 g of each of these feedstuffs. Six roosters were fasted for another 48 h and served as negative controls. Excreta were collected for 2 consecutive 24 h periods. Length of collection period had no effect on the true ME value of cassava tuber meal, indicating that a 24 h collection period was adequate. A collection period of equal to or greater than 48 h, however, was required for roosters force-fed CLM. The mean true ME values

(dry basis) of cassava tuber meal and CLM were determined to be 15.73 ± 0.25 and 8.33 ± 1.17 MJ/kg, resp. (Author's summary) H03

0346

19228 SANTOS, J.; GOMEZ, G. 1983. Fungal protein produced on cassava for growing rats and pigs. Journal of Animal Science 56(2):264-270. Engl., Sum. Engl., 27 Refs., Illus.

Cassava. Cassava meal. Protein enrichment. Swine. Feed constituents. Methionine. Supplements. Industrial microbiology. Dietary value. Amino acids. Animal physiology. Animal nutrition. Laboratory animals. Colombia.

A nutritional assessment was conducted of a fungal (Aspergillus fumigatus I-21A) SCP that was fed to rats and pigs. The sun-dried biomass resulted from fermentation of either fresh roots or CM substrates and had the following % composition: CP (N x 6.25), 34.3; ether extract, 3.1; crude fiber, 20.0; ash, 4.3; N-free extract, 27.9; Ca, 0.20; and P, 0.79. The gross energy was 4260 cal/g. An initial biological evaluation based on PER and NPR methods was conducted using 70 growing rats. Growth responses in rats fed the dried product were similar to those produced by the casein control, provided the biomass was supplemented with DL-met. During the growing-finishing period (15.8-95.0 kg), pigs were given one of the following exptl. diets: (1) control, sorghum + SBM; (2) CM + SBM + 0.3% DL-met.; (3) CM + SCP; and (4) CM + SCP + 0.3% DL-met. Diets were calculated to supply 16 and 13% CP for the growing (15.8-50 kg) and finishing (50-95 kg) periods, resp. The pigs fed the diet based on SCP without any met. took longer (P 0.05) to reach market wt. and had poorer (P 0.05) feed conversion than pigs fed the other diets. Supplementation with DL-met. improved (P 0.05) the nutritive quality of the fungal protein and the results were comparable with those obtained with diets based on SBM. The use of SCP as a total substitute for SBM did not affect the normal physical condition of the animals. (Author's summary) H03

0347

18459 SONAIYA, E.B.; OMOLE, T.A. 1983. Cassava meal and cassava peel meal in diets for growing pigs. Animal Feed Science and Technology 8(3): 211-220. Engl., Sum. Engl., 24 Refs.

Cassava. Cassava meal. Cortex. Uses. Swine. Feed constituents. Dry matter. Digestibility. Animal physiology Animal nutrition. Nigeria.

Expt. were conducted to study the inclusion of 0, 30, 45, and 60% sun-dried, ground cassava tubers (CM) in growing rations, and of 15 and 30% CM + 15 and 20% sun-dried, ground cassava peel (CPM) in finishing rations of Large White and local pigs. Growing pigs receiving rations containing CM or CPM grew slightly but nonsignificantly faster and were slightly more efficient in feed conversion than pigs on the control diet. Generally, Large White pigs appeared to utilize CM better than local pigs while local pigs utilized CPM better than Large White pigs. Carcasses of control pigs had significantly higher dressing values than those of pigs on the substituted rations. CM, being more digestible than CPM, increased the digestibility of CM-CPM mixtures. (Author's summary) H03

0348

18996 SONAIYA, E.B.; OMOLE, T.A. 1982. Cassava meal and cassava peel meal for growing and finishing pigs. Turrialba 32(2):187-194. Engl., Sum. Engl., Span., 18 Refs., Illus.

Cassava. Cassava meal. Cortex. Swine. Finishing. Feed constituents. Dietary value. Animal physiology. Animal nutrition. Nigeria.

The inclusion of 0, 15, 30, 45, and 60% sun-dried, ground cassava tubers (CM) in growing rations and of 15 and 30% CM + 15 and 20% sun-dried, ground cassava peel (CPM) in finishing rations of Large White and local pigs was studied in a 2 x 2 factorial expt. Growing pigs receiving substituted rations grew slightly but nonsignificantly faster and were slightly more efficient in feed conversion than pigs on the control diet. Finishing pigs on CM + CPM diets had slightly depressed but nonsignificant growth rate and feed efficiencies. A combination of 15% CM + 20% CPM was consistently but nonsignificantly superior to other substituted rations. Generally, Large White pigs appeared to utilize CM better than local pigs while local pigs utilized CPM better than Large White pigs. Carcasses of control pigs had significantly higher dressing values than those of pigs on the substituted rations. CM, being more digestible than CPM, had a promoting effect on the digestibility of CM-CPM mixtures. (Author's summary) H03

0349

19256 TEWE, O.O.; PESSU, E. 1982. Performance and nutrient utilization in growing pigs fed cassava peel rations containing different cyanide levels. Nutrition Reports International 26(1):51-58. Engl., Sum. Engl., 13 Refs.

Cassava. Cortex. Uses. Waste utilization. Swine. Feed constituents. Composition. Digestibility. Cyanides. Animal physiology. Animal nutrition. Costs. Nigeria.

Forty-two pigs were allotted to 3 treatment groups: T_1, a maize control ration; T_2, cassava peel rations; and T_3, a cassava peel + dietary KCN ration. Diets T_1 to T_3 contained 0, 96, and 400 ppm cyanide, resp. Feed intake and growth rate were nonsignificantly ($P > 0.05$) reduced on T_2. Feed efficiency and PER on the cassava peel-based rations compared favorably with the control. Performance traits were negatively correlated ($P > 0.05$) with dietary cyanide level. Nutrient digestibility was similar on all treatment groups except for ether extract digestibility which was significantly ($P < 0.05$) higher on T_2 and T_3. ME and N retention/day were not affected by dietary treatments. Cost of feed/unit livewt. gain was similar on all rations. (Author's summary) H03

0350

17114 ZAPATA, O.; RUBIO, J. 1978. Uso de la hoja de yuca fresca y cogollo de caña en la alimentación de vacunos. (Use of fresh cassava leaves and sugar cane shoots in bovine feeding). In Jiménez C., A., ed. Utilización de Subproductos Agrícolas en la Alimentación de Ganado. Cali, Colombia, 1978. Memorias. Cali, Fondo Ganadero del Valle del Cauca. pp.53-61. Span.

Cassava. Leaves. Uses. Supplements. Forage. Feeds and feeding. Cattle. Feed constituents. Animal nutrition. Colombia.

The Dairy Cattle Program of the Instituto Colombiano Agropecuario conducted several bovine feeding trials with cassava leaves and sugar cane shoots with certain nutritional correctives in order to improve the utilization of

cassava as forage and determine the necessary protein supplement. There was no statistical difference among treatments in preliminary trials using cassava leaves + an energy supplement; however, the protein supplement with cassava leaves was more economical than the traditional cakes given. Animal growth was acceptable but inferior to the bovine growth standards, obtainable with concentrates. Three common forages (maize silage, cassava leaves, and Pennisetum purpureum) were given in a comparative trial. From an economic point of view, the use of cassava leaves as a source of protein at a rate of 8 kg/animal/day was corroborated. Another trial compared the use of cassava leaves with that of alfalfa; the total wt. gain/animal with alfalfa was 57 kg compared with 67 kg with cassava. The use of cassava roots as energy supplement left a small margin of profit. This point is discussed. (Summary by EDITEC. Trans. by L.M.F.) H03

See also 0359 0376 0391

H04 HCN Toxicity and Detoxification

0351

19220 BOURDOUX, P.; SEGHERS, P.; MAFUTA, M.; VANDERPAS, J.; VANDERPAS-RIVERA, M.; DELANGE, F.; ERMANS, A.M. 1983. Traditional cassava detoxification processes and nutrition education in Zaire. In Delange, F.; Ahluwalia, R., eds. Cassava toxicity and thyroid: research and public health issues, Ottawa, Canada, 1982. Proceedings of a workshop. Ottawa, Ontario, International Development Research Centre. IDRC-207e. pp.134-137. Engl., Sum. Engl., 5 Refs.

Cassava. Cassava products. Detoxification processes. Human nutrition. HCN content. Zaire.

The effect of traditional cassava detoxification processes in Zaire on the increase in serum and urinary SCN concn. was examined. The HCN content of tubers and of cassava products increases from Bas Zaire to Kivu to Ubangi. This accounts for the differences in SCN levels observed in the 3 populations. Soaking, practiced in Bas Zaire, is regarded as the most efficient detoxification process. Soaking for 1-5 days reduces HCN content 45% for day 1 up to 97% for day 5. It is important that the detoxification processes be carried out carefully. In Ubangi, well-detoxified foodstuffs can be prepared with only slight modification of traditional processing procedures. Modifying the food habits of rural populations in Africa is difficult. Evidence indicates that a lower efficiency of cassava detoxification or an increase in the dietary supply of cassava would result in a SCN overload and concomitant thyroid problems in areas with moderate or low I intake. (Summary by I.B. Trans. by L.M.F.) H04

0352

18416 SINGH, J.D. 1981. The teratogenic effects of dietary cassava on the pregnant albino rat: a preliminary report. Teratology 24(3):289-291. Engl., Sum. Engl., 8 Refs.

Cassava. Laboratory animals. Toxicology. Animal physiology. Clinical manifestations.

Reports are on record showing correlation between cassava intake and occurrence of various types of neuropathies. About 0.1-2 mg of cyanide/100 gm is released from cassava by action of hydrolase. It has been suspected by several local clinicians in SE Nigeria as a cause of congenital anomalies if consumed in excess during pregnancy. However, it remains a controversial problem and precise scientific data is lacking. This study was conducted on albino rats by giving them milled cassava powder as 50% and 80% of their diet during the 1st 15 days of pregnancy. Fetuses collected on day 20 from the group receiving cassava as 80% of the diet showed a low incidence of limb defects, open eye, microcephaly, and growth retardation in the rat. Interpretation of this data for the human should be made with caution. (Author's summary) H04

See also 0391

I00 PROCESSING, PRODUCTS AND USES

I02 Uses, Industrialization, Processing and Storage

0353

18448 BICUDO NETO, L. DE C.; GASPARINO FILHO, J.; SALES, A.M. 1977. Estrutura de custos para a producao de leveduras alimentícias. (Cost structure for the production of food yeast). Campinas-SP, Brasil, Instituto de Tecnologia de Alimentos. Estudos Economicos. Alimentos Procesados no.5. 39p. Port., Sum. Port., Engl., 10 Refs.

Cassava. Protein enrichment. Yeast production. Costs. Labour. Cassava meal. Industrialization. Biomass production. Brazil.

The cost structure for the production of yeast from substrates of molasses and cassava, using 6 independent production lines, is analyzed. Basically, these lines show similar characteristics, and therefore are divided into 3 groups: (1) using cassava as raw material, (2) using molasses as raw material, and (3) using both molasses and cassava. Final products of the production lines included in groups 1 and 2 were dry yeast and/or yeast protein concentrate. Final product of group 3 was CF enriched with yeast protein. Production costs of the following products were determined: dry yeast from molasses, dry yeast from cassava, dry yeast for human consumption from molasses, yeast protein concentrate from molasses, yeast protein concentrate from cassava, and finally CF enriched with yeast protein. Results showed that when the cost of yeast was considered regarding its protein content, its cost is intermediate between those of the vegetable and animal proteins. In all cases fuel was the item that most contributed to total cost. Flow charts of all processes are included. (Author's summary) I02

0354

18409 FLORES, A.S.; SANTOS, A.R. DOS; SILVA, J.R. DA; LIMA, J.A.D. DE; SILVA, J.F. DA; CERQUEIRA, J.H.A. DE; LORDELO, J.C.C.; DINIZ, P.J.C.; LIMA, S.A.A. DE; SOUZA, S.P. DE; DANTAS, T.B. 1982. Casas de farinha. (Cassava flour mills). Brasilia-DF, Empresa Brasileira de Assistencia Tecnica e Extensao Rural. 34p. Port., 12 Refs., Illus.

Cassava. Cassava flour. Factories. Small-scale equipment. Small-scale processing. Peeling. Pressing. Drying. Rasping. Brazil.

The production process of CF in flour mills is described in detail. These cassava flour mills are defined as microagroindustries characterized by being localized in rural areas; intensive family labor and small amounts of capital are used and part of the flour produced is spent for self-consumption of the factory workers. Cassava roots grown on the owner's or neighboring farms are processed, and the mill is built (including equipment and machinery) locally in a rudimentary manner. Aspects that should be taken into account when choosing the site, in the construction of the mills, the receiving and preparation of roots, rasping and types of raspers, pressing and types of pressers, grinding and screening, heat drying, screening, storage, organizing and locating machinery and equipment, and cleaning are given. (Summary by EDITEC. Trans. by L.M.F.) 102

0355

18957 HARUENKIT, R. 1981. The use of waste water from tapioca starch industry as a growth medium for nitrogen fixing bacteria. Mag. Sc. Thesis. Bangkok, Mahidol University. 98p. Engl., Sum. Engl., 86 Refs., Illus.

Cassava. Cassava starch. Factories. Waste utilization. Culture media. Nitrogen-fixing bacteria. Thailand.

Instead of discharging cassava waste water and causing water pollution, it was used as growth media for Beijerinckia spp. and Rhizobium japonicum UB-8T in expt. that substituted the C source in conventional media with OM originally present in the cassava waste water. Results showed that Beijerinckia spp. and Rhizobium japonicum UB-8T could grow in modified media prepared from cassava waste water. Beijerinckia spp. showed abundant growth in the modified media (cassava waste water + ingredients of N-free medium, except glucose). Beijerinckia spp. fixed 0.72 mg N/l when cultured in N-free medium but none in the modified media. Cell yield obtained from culturing Beijerinckia spp. in the modified media was 10^8 cells/ml which was higher than that of the control (N-free medium). The cost of the modified media was 91.29% lower than that of the control. Rhizobium japonicum UB-8T was also able to grow in medium prepared from diluted cassava waste water (waste water:tap water = 1:1) and ingredients of medium -79 (except manitol and $CaCO_3$). The growth of Rhizobium japonicum UB-8T in the modified medium was inferior to that in the medium -79. Yield, expressed as the optical density value, was 65.26% lower than that of the control. The cost of the modified medium was also 62.23% lower than that of medium -79. The problem caused by the waste water from cassava starch industries may also be abated through the production of liquid bacterial fertilizer and inoculant. (Author's summary) 102

0356

18953 HOLMES, E.B.; NEWCOMBE, K.J. 1983. Fuel ethanol from cassava: the Baiyer River experience. Konedobu, Papua New Guinea, Energy Planning Unit, Department of Minerals and Energy. 11p. Engl., Sum. Engl., 7 Refs.

Cassava. Cassava programs. Ethanol. Cultivation. Industrialization. Costs. Economics. Papua New Guinea.

The objectives, strategy, and progress of the Papua New Guinea program for evaluation and production of ethanol from biomass as a transport fuel are outlined. The Baiyer River Alcohol Company was established to develop the 1st pilot demonstration industry in the Highlands of Papua New Guinea. This industry was to produce 2.5 million l of fuel ethanol/year from cassava. The agricultural strategy, early development, and projected capital costs are discussed in detail. This project has now been cancelled following considerable development work. The major problems encountered by this project are outlined as an example of the difficulties of agroindustrial development in developing countries. (Author's summary) I02

0357

19239 JOHN, V.; MADHAVA, M.R.; ROHATGI, P.K. 1982. Solar cooking of cassava. Energy 7(3):313-317. Engl., Sum. Engl., 9 Refs., Illus.

Cassava. Cooking. Human nutrition. India.

Cassava is an important source of carbohydrates in Kerala (India) and nearly 2 million t of it are used annually for human consumption. The result of expt. performed on the cooking of cassava using a bamboo basket concentrator-type of solar cooker are reported. It is estimated that if only 50% of the energy requirements for cooking of cassava are met with solar power an annual saving of more than 400,000 t of firewood can be achieved in Kerala. (Author's summary) I02

0358

18951 LEBEDEFF, S.; AGUIAR, O.B. 1940. Pesquisa e determinacao de ácido cianídrico nos produtos derivados da mandioca. (Research on and determination of hydrocyanic acid in cassava by-products). Boletim da Secretaria de Agricultura, Industria e Comercio do Estado de Pernambuco 6(2):180-188. Port., Illus.

Cassava. Cassava flour. HCN content. Analysis. Bakery products.

The presence of HCN in amounts above 10 mg can cause difficulties in the fermentation of CF dough in breadmaking. It could also affect to a certain extent human beings and animals if the amount of HCN exceeds the threshold limit considered safe for living organisms (1 mg). Cyanogenic glucoside content of CF was determined by the picrosodium method, the qualitative essay based on the formulation of Prussian blue, and the method of qualitative determination. According to the methods used, hydrolisis followed by the addition of bisulfate is the most recommendable. (Summary by EMBRAPA. Trans. by L.M.F.) I02

0359

18407 OSPINA P , B.; GOMEZ G., G.; BEST, R. 1983. El secado de la yuca para la alimentación animal. (Cassava drying for animal feed). Proyecto cooperativo DRI-ACDI-CIAT. Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie CIAT 05SC(1)83. 12p. Span., Illus.

Cassava. Solar drying. Cassava chips. Small-scale equipment. Small-scale processing. Costs. Colombia.

The process of cassava drying using a natural, low cost system applicable on the on-farm level is described in detail. This system allows cassava to

be stored for long periods to be used in preparing balanced feed rations in substitution of sorghum and other cereals. The process is simple and can be carried out by farmers, thus enabling more efficient land and labor use. The described process includes: weighing, chipping, spreading chips on concrete floors for sun drying, turning the chips over, collection, storage, and commercialization. Aspects on the organization and management of a cassava drying plant are included as well as the costs, forms of financing, and production. (Summary by EDITEC. Trans. by L.M.F.) 102

0360

18986 POWER, A.P.; HOLMES, E.B.; WASORI, J. 1982. Cassava. In _____. Sago palm and cassava starch production in Malaysia: a study tour report. Konedobu, Papua New Guinea, Energy Planning Unit, Policy and Planning Division. Department of Minerals and Energy. EPU Report no. 14/82. pp.17-23. Engl., Illus.

Cassava. Processing. Cassava starch. Labour. Malaysia.

Observations reported during a study tour to a cassava starch extracting factory in Ipoh, Perak (Malaysia) are given. This factory uses simple and modern techniques and equipment. The production of tubers delivered to the factory is described as well as the different operations involved. A schematic diagram of the factory and a detailed starch and product flow sheet are included. Labor requirements and starch losses (10%) are discussed and recommendations to improve plant efficiency are given. (Summary by I.B. Trans. by L.M.F.) 102

0361

18498 ROSSI, S.J.; FIOREZE, R.; OLIVEIRA, A.M.C. DE; MALZAC, L.F. 1982. Propriedades térmicas de castanha de caju e raspas de mandioca. (Thermal properties of cashew nuts and cassava chips). Revista Brasileira de Armazenamento 7(1):51-56. Port., Sum. Port., Engl., 5 Refs., Illus.

Cassava. Cassava chips. Storage. Statistical analysis. Temperature. Brazil.

A method previously employed to estimate the apparent thermal values of conductivity and diffusion in cereals was used in this study of cashew nuts and cassava cut into 1.5 and 3.0 cm-long rectangular bars. The method basically consists of placing the product inside a cylinder with dimensions considered to be theoretically infinite, from the point of view of heat transfer, and whose geometric axis is an electric resistance that generates heat under stationary conditions. The exptl. results of the temp. in the combination air-product, as a function of time and the radius of the cylinder, the equations of heat transfer involved in the process, and the use of a nonlinear regression computer program permitted the simultaneous evaluation of the apparent thermal conductivity and diffusion of the products placed inside the cylinder. The values of thermal conductivity and diffusion of 1.5 cm-long rectangular bars of cassava were lower than those of 3.0 cm-long bars. (Author's summary) 102

0362

19242 SATYANARAYANA, K.G.; MOHAN, S.; MATHEW, A.G.; MOHANDAS, P.N.; SREEMULANATHAN, H.; ROHATGI, P.K. 1982. Plantation products industry as a resource for materials. Journal of Scientific and Industrial Research

(India) 41(2):83-87. Engl., Sum. Engl., 13 Refs.

Cassava. Waste utilization. India.

The wastes and by-products from plantation products could be a major resource for materials in India, especially in Kerala. The main plantation products of Kerala (cashew, arecanut, rubber, and cassava) are examined. Regarding cassava, the main waste for material application is the stem, which is also used for replanting. A method for making pressed boards from cassava stems by hot pressing with a binder is presently undergoing trials in Nigeria. The use of the stem as an insulating and cushioning material is also feasible. The possibility of producing paper pulp also needs to be investigated. Major research and development imperatives for better utilization of plantation products are listed. (Summary by L.M.F.) I02

0363

17587 SCHMIDT, H.H.; ENGELBART, W. 1978. Economical and technical aspects of ethanol production from maniok. In International Symposium on Alcohol Fuel Technology: Methanol and Ethanol, Wolfsburg, Germany, 1977. Proceedings. Washington, D.C., U.S. Department of Energy. pp.5-2(1)-5-2(4). Engl., Sum. Engl., 12 Refs.

Cassava. Ethanol.

The use of solar energy for the production of alcohol fuels by agricultural and biotechnological conversion processes, is in the 1st place a question of economy. Using fresh cassava and the common technology of today, only a small net yield of energy can be attained. The aspects of an ethanol plant, to be built in Mato Grasso, Brazil, are discussed. Continuous process techniques are proposed and some alternative solutions for economizing waste treatment are given. (Author's summary) I02

0364

18440 VALERA, G. DE 1960. Industrialización de la yuca. (Cassava industrialization). Tesis Ing. Quim. Palmira, Universidad Nacional de Colombia. 317p. Span., 59 Refs., Illus.

Cassava. Cassava flour. Cassava starch. Composite flours. Processing. Factories. Industrialization. Marketing. Consumption. Costs. Economics. Colombia.

A technical and economical analysis of cassava industrialization and of different cassava by-products in Colombia is given. General aspects on crop history, botanical classification, cultivation, and the 1942 Bill on Cassava Agricultural Economy in Colombia are included. The process of manufacturing CF and breadmaking (composite cassava and wheat flours) are described, indicating the legislation existing in other countries, Cuba and Brazil, on these aspects. The biochemical origin of starch, its properties and uses, industrial obtainment, and starch derivatives are described in detail. The feasibility of cassava industrialization in Colombia is discussed on the basis of the general background indicated, as well as the market, consumption and forms of consumption. Required production is

analyzed and conditions that should be taken into account when choosing the site of the plant are given. A detailed technical description of the industrialization process is given including a flow chart, process control, selection of equipment and machinery, a general layout of the plant and a diagram of material circulation, the balance of materials used (CF, cassava starch), energy requirements, a chemical study of the process, general investment budget, estimated profitability, and calculus of a drying unit. (Summary by EDITEC. Trans. by L.M.F.) I02

0365

18438 VENEZUELA. MINISTERIO DE AGRICULTURA Y CRIA. 1980. Aspectos agroindustriales de la yuca. (Agroindustrial aspects of cassava). Maracay, Instituto Interamericano de Ciencias Agrícolas. 15p. Span.

Paper presented at Seminario Nacional de la Yuca, Maracay, 1980.

Cassava. Cassava programs. Industrialization. Factories. Venezuela.

Results are given of studies being carried out by the Ministry of Agriculture and Husbandry in collaboration with the Instituto Interamericano de Ciencias Agrícolas and other institutions on the conomic feasibility of cassava production and utilization in Venezuela to elaborate animal feed. The agroindustrial demand for cassava in Venezuela, problems related to processing, and the situation of cassava mills are analyzed. (Summary by EDITEC. Trans. by L.M.F.) I02

0366

18439 VENEZUELA. MINISTERIO DE AGRICULTURA Y CRIA. 1981. Estudio técnico-económico del proceso de transformación de yuca. (Technical-economic study of tbe process of transforming cassava). Caracas, Instituto Interamericano de Cooperación para la Agricultura Fondo Simón Bolívar. 46p. Span., Illus.

Cassava. Processing. Factories. Industrialization. Cassava meal. Cassava flour. Pellets. Costs. Cassava programs. Maps. Venezuela.

A technical-economic study of the process of transforming cassava in Venezuela was conducted. A general review of the current situation of cassava root processing plants in Venezuela is given. The current status of each of the existing processing plants is summarized regarding investment, established capacity, products manufactured, location, and current situation. Results of a study on technical processes, based on the visits conducted to the different plants, and one on the costs of transforming cassava roots into flour, pellets, and chips for a model plant are also given. The costs of transforming fresh cassava into flour using the best technical alternatives recommended were determined. Variable costs represent 85% of the total. It is not feasible to substitute sorghum with cassava-based products. It was concluded that cassava production for processing and utilization in animal feed factories is not feasible at the present time. Therefore, it is recommended to use bitter cassava for the manufacture of cassava starch or alcohol. (Summary by EDITEC. Trans. by L.M.F.) I02

0367

18941 VILLA, L.G.; CHAPARRO, J.M.; REA, G.; BRAUNBECK, O. 1982. Secado con aire natural y por convección de chips de yuca. (Natural and convectional drying of cassava chips). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:679-702. Span., Sum. Span., 9 Refs., Illus.

Cassava. Cassava chips. Solar drying. Venezuela.

The results of improved methods of using solar energy to dry cassava chips, including exptl. and simulated studies of natural drying and using solar-heated air, carried out in both Colombia and Brazil, are given. A system of natural convection that can be used in regions lacking electricity is described. This system consists of a man-operated chipper, and a vertical dryer of natural convection. For more developed and higher producing areas, an artificial convection system is described. It consists of 3 elements: (1) a washer-peeler; (2) a chipper; and (3) a dryer. At the same time, an empirical equation to estimate natural drying of cassava chips is given. This equation can be used to compare different systems and also to determine the bulk density of the max. layer in a specific system under given environmental conditions. Thompson's drying model (1968) was adapted to forecast drying by artificial convection of layers of cassava chips. This model can be used to estimate the size of the fan the and solar collector under specific conditions. Detailed diagrams are included on the machines used. (Author's summary. Trans. by L.M.F.) I02

0368

18478 VITTI, P.; LEITAO, R.F.F.; PIZZINATTO, A.; CAMPOS, S.D. DA S. 1978. Variedades de mandioca para o preparo de pellets. (Cassava varieties for pelletization). Boletim do Instituto de Tecnologia de Alimentos 58: 47-61. Port., Sum. Port., Engl., 9 Refs.

Cassava. Cultivars. Cassava chips. Pellets. Processing. Water content. Starch content. Cassava starch. Analysis. Viscosity. Gelatinization. Brazil.

Eight cassava var. were assessed regarding their characteristics in pelletization: IAC-59, IAC-829, IAC-12-58, IAC-452-12, IAC-14-18, IAC-528, IAC-1012, and Branca de Santa Catarina (check). On the basis of its physical characteristics, var. IAC-1012 was selected and used for processing pellets. Two types of pellets were obtained. Pellets were assessed in terms of viscosity, density, and resistance to breaking. A better quality pellet was obtained from cassava chips with an initial MC between 20-25%. (Author's summary) I02

See also 0327 0328 0329 0369 0386 0391

I03 Industrial Microbiology

See 0346 0391

0369

19232 ADAM, M. 1980. Manioc, rente fonciere et situation des femmes dans les environs de Brazzaville (République Populaire du Congo). [Cassava, land rent and the situation of women in the neighborhood of Brazzaville (Congo People's Republic)]. Cahiers d'Etudes Africaines 20(1-2):5-48. Fr., 20 Refs., Illus.

Cassava. Production. Marketing. Socio-economic aspects. Prices. Cultivation. Costs. Chickwangue. Foofoo. Labour. Developmental research. Maps. Congo.

The conditions under which cassava is produced and marketed in the Congo are examined, taking as a case study the village of Moutampa, about 50 km from Brazzaville in the SW of the country. Agricultural practices and the division of labor are studied, particularly with respect to cassava, which is the most important source of income. Particular emphasis is placed on the relations of production, problems of access to land, and the sexual division of labor. It is argued that exploitation of women has increased, and that the transition to more commercial agriculture has stimulated more migration and social differentiation. The future of cassava production may be influenced by trends such as increasing consumption of bread. (Summary by World Agricultural Economics and Rural Sociology Abstracts) J00

0370

18908 BELLO, C. 1982. Política económica para la yuca. Ponencia del Ministerio de Agricultura y Cría. (Economic policies regarding cassava. Report of Venezuela's Ministry of Agriculture and Animal Husbandry). In Seminario Nacional de Yuca, Maracay, Venezuela, 1980. Revista de la Facultad de Agronomía. Alcance no. 31:651-659. Span.

Cassava. Cassava programs. Venezuela.

The economic policies and principles on which these policies are based regarding cassava cultivation in Venezuela are analyzed in a report by the Ministry of Agriculture and Animal Husbandry. This analysis is based on both the world and the internal economic situations. Perspectives for cassava industrialization in Venezuela are discussed. (Summary by EDITEC. Trans. by L.M.F.) J00

0371

19278 CARPENTER, A.J. 1982. Economics of research and development of root and tuber crops in Zanzibar, Tanzania. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.75-77. Engl., Sum. Engl.

Cassava. Economics. Research. Development. Costs. Tanzania.

A total investment of about $100,000, from the International Development Research Centre, the International Institute of Tropical Agriculture, the Canadian U. Service Overseas (CUSO), FAO, and the Ministry of Agriculture, Zanzibar, resulted in the development, to the 1st stage of rapid multiplication, of several pest- and disease-resistant cassava var. The best of these var. could produce an extra 2 t of cassava on each 0.4-ha farm. It is

concluded that research and development in root crop improvement is highly attractive in economic terms, provided that market and family demand is maintained. (Extracted from author's summary) J00

0372

19270 CIMPAYE, D. 1982. Burundi. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.111-113. Engl., Sum. Engl.

Cassava. Cassava programs. Production. Tuber productivity. Research. Burundi.

Cassava and sweet potatoes are the most important root crops grown in Burundi; cush-cush (Colocasia sp.) and yams are also grown. Current production levels and the constraints to production are outlined, the main constraints being land availability, trained personnel, soil fertility, and diseases and pests. Plans are under way to establish a research program on the crops. (Author's summary) J00

0373

18482 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO NACIONAL DE PESQUISA DE MANDIOCA E FRUTICULTURA. 1981. Programa nacional de pesquisa de mandioca. (National research program in cassava). In _____. Relatório Técnico Anual do Centro Nacional de Pesquisa de Mandioca e Fruticultura 1981. Cruz das Almas-BA, Brasil. pp.125-187. Port., Sum. Engl., 32 Refs.

Cassava. Cassava programs. Plant breeding. Germplasm. Cultivars. Selection. Tuber productivity. Energy productivity. Resistance. Xanthomonas manihotis. Mononychellus tanajoa. Vatiga illudens. Mycorrhiza. P. N. K. Al. Soil fertility. Nutritional requirements. Nutrient uptake. Analysis. Mineral content. Leaves. Petioles. Fertilizers. Planting. Spacing. Harvesting. Tuber development. Inter-cropping. Beans. Sweet potatoes. Groundnut. Rotational crops. Drought. Brazil.

The Brazilian national research program in cassava is coordinated by the Centro Nacional de Pesquisa de Mandioca e Fruticultura in Cruz das Almas, BA. Research is conducted in cooperation with the units of the Empresa Brasileira de Pesquisa Agropecuária as part of an integrated agricultural research system. During 1981, efforts were made to increase productivity and total production, preserving the natural resources. The active germplasm collection was also assessed. Priority was given to research in cropping systems, trying to obtain improved plant arrangement in the field, allowing cassava to be intercropped with short cycle crops. In the area of pest control, emphasis was given to integrated systems. Facilities were developed to initiate an intensive program of biological control of insects, such as lace bugs (Vatiga illudens) and mites (Mononychellus tanajoa). The selection of plant material resistant to CBB (Xanthomonas manihotis) has continued in exptl. fields in Felixlandia, MG, where the disease frequently occurs. N fixation through rotation with legumes and improved utilization of P through mycorrhizal symbiosis are 2 new areas of research that have received considerable attention and are giving promising results. (Author's summary) J00

0374

18454 EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA. CENTRO NACIONAL DE PESQUISA DE MANDIOCA E FRUTICULTURA. 1978. Projeto mandioca. (Cassava program). In _____. Relatório Técnico Anual do Centro Nacional de Pesquisa de Mandioca e Fruticultura 1978. Cruz das Almas-BA, Brasil. pp.27-100. Port., Illus.

Cassava. Cassava programs. Germplasm. Cultivars. Clones. Hybrids. Selection. Adaptation. Tuber productivity. Canopy. Plant height. Foliage. Resistance. Deterioration. Dry matter. Nutrient uptake. N. P. K. Ca. Mg. S. Timing. Mineral content. Propagation. Cuttings. Spacing. Costs. Tuber development. Weeding. Herbicides. Stems. Leaves. Petioles. Tubers. Nutritional requirements. Mononychellus tanajoa. Predators. Biological control. Erinnyis ello. Xanthomonas manihotis. Brazil.

Results of research carried out by the Cassava Program of the Centro Nacional de Pesquisa de Mandioca e Fruticultura (Brazil) during 1978 are given in the areas of: genetic breeding (germplasm bank and its evaluation; selection of cv., clones, and lines; hybridization, adaptation trials; var. resistance to postharvest deterioration); physiology (accumulation of DM and the chemical composition of cassava cv., study of initial growth stages of the plant, plant-population density interactions, effect of size of cutting on no. of branches and some agronomic characteristics of the plant); management and cultural practices (planting distances, planting systems based on methods of harvesting); weed control (herbicide competition, selectivity of some herbicides, determination of critical periods of weed competition); mineral nutrition and fertilization (nutritional status of the propagation materials; critical nutrient levels in cassava; levels and times of N application; levels and methods of P application; levels, methods and time of K application; effects of N, P, K, S, micronutrients, and lime on production); pests and their control (population fluctuation of Mononychellus tanajoa; use of the Euphorocera sp. in the control of Erinnyis ello; pathogenicity tests of Bacillus thuringiensis against E. ello larvae); diseases and their control (evaluation of cv. and hybrid resistance to Xanthomonas manihotis, variability of X. manihotis); and production systems. (Summary by EDITEC. Trans. by L.M.F.) J00

0375

18921 FUNDACAO GETULIO VARGAS. INSTITUTO BRASILEIRO DE ECONOMIA. CENTRO DE ESTUDOS AGRICOLAS. 1983. Mandioca: estimativa da disponibilidade interna para consumo humano nos anos de 1975 a 1980. (Estimated domestic availability of cassava for human consumption for 1975-80). In _____. Balanco e disponibilidade interna de generos alimentícios de origem vegetal 1975 a 1980. Rio de Janeiro-RJ, Brasil. p.40. Port.

Cassava. Consumption. Trade. Marketing. Human nutrition. Animal nutrition. Statistical data. Brazil.

Estimates of domestic availability of cassava for human consumption, given in table form for 1975-80, include data related to production, imports, exports, nonhuman consumption (animal nutrition and losses). Annual availability of cassava for human consumption for the mentioned period was 10.38, 10.16, 10.36, 10.16, 9.93, and 9.37 million tons, resp. (Summary by J.L.S. Trans. by L.M.F.) J00

0376

18483 GATEL, P. 1979. La concurrence des produits de substitution des céréales. (Product competition in grain substitution). Agriculture d'Enterprise 7/8:45-53. Fr., Illus.

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

The impact of imports, mainly those of cassava and also those of other products that could potentially substitute grains (PSG), on European economy is analyzed. Cassava has an advantageous tariff policy in the EEC, port facilities, and the cassava/soybean mixture competes successfully with grains in the compound feed industry. This competition has reduced grain market development in Europe, especially that of winter barley; surplus crops have to be directed toward exportation with serious repercussions and cattle production costs and the prices of processed products are distorted in countries with hard currency that are tempted to import cassava, and in countries with soft currency that are restricted to the importation of grains. The threat of a growing dependence of Europe on unpredictable world markets of protein foodstuffs is highlighted. This dependence is due to the greater consumption of cassava which increases the need of soybean imports (also under a preferential policy) and which, on the long term, reduces the grain market. Regarding consumers, these receive only a small benefit (+ 1%). The urgent need for policy-making is emphasized. The possibility of a bilateral agreement between Belgium and Thailand to modify tariff policies is currently under study. A system facilitating statistical data on a permanent basis should be established and one offering equal conditions to PSG and grains should be consolidated. (Summary by I.B. Trans. by L.M.F.) J00

0377

19268 GODFREY-SAM-AGGREY, W. 1982. Swaziland. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.119-128. Engl., Sum. Engl., 3 Refs.

Cassava. Research. Swaziland.

General background information encompassing the agroecological zones and agriculture of Swaziland is presented. The root and tuber crops grown in Swaziland are potato, sweet potato, cassava, and taro (locally called Madumba). The total areas under each crop and their locations are cited. Potato is the most important, followed by sweet potato, whereas cassava and taro are of less importance in terms of area and use. Research on these crops and future research directions are reviewed. There is potential for increased yields of potato and sweet potato and for the increased use of cassava for animal feed and for the industrial production of alcohol for fuel. In the case of Madumba, the collection, characterization, and description of available local material should be attempted so that the spectrum of available germplasm in the country can be monitored. It is imperative for research interests to be developed in both cassava and taro because of their potential. (Author's summary) J00

0378

18479 MALAYSIAN AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE. 1978. Field crops research: cassava. In _____. Annual Report 1978. Serdang, Selangor. pp.37-40. Engl.

Cassava. Cassava programs. Plant breeding. Nutritional requirements. Minerals and nutrients. Cultivation systems. Propagation. Cuttings. Plant physiology. Cercospora henningsii. Cercospora caribaea. Xanthomonas manihotis. Fomes lignosus. Weeding. Malaysia.

The results obtained by the Malaysian Agricultural Research and Development Institute in 1978 in cassava are summarized. Results of plant breeding and var. evaluation, agronomy (studies on NPK requirements in continuous cropping and cultural practices), physiology, and crop protection (incidence levels of Cercosporidium henningsii, Xanthomonas manihotis, Fomes lignosus, and Cercospora caribaea, and studies on weed control) are given. (Summary by EDITEC. Trans. by L.M.F.) J00

0379

18480 MALAYSIAN AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE. 1980. Root/tuber crops. In _____. Annual Report 1980. Serdang, Selangor. pp.19-21. Engl.

Cassava. Germplasm. Cultivars. Adaptation. Productivity. Plant physiology. Cercospora henningsii. Resistance. Cassava programs. Malaysia.

Results obtained by the Malaysian Agricultural Research and Development Institute in 1980 in root and tuber crops are summarized. Three selections (M Mex 1-22, M Mex 1-[illegible], and M Mex 1-20) introduced from CIAT, Colombia, produced starch yields exceeding that of Black Twig by 95, 64, and 63%, resp. Among the clones from the 2nd set of introductions, 18 produced higher root yields than Black Twig, of which 5 showed potential of yielding more starch/ha than Black Twig. Results of cassava adaptability trials over several locations are given. Evidence from a trial at Serdang with cv. Black Twig indicated that cassava planted on sandy soil can give higher yields if planted at a greater density than the usual 10,000 cuttings/ha. Root yield was affected by pruning the plant to a single shoot or stem/cutting. Var. C5 produced the highest yield (39 t/ha) under weeded conditions in trials with 6 var. (C5, Black Twig, Brazil, Bangkok 2, Trinidad, and El Salvadore); under unweeded conditions, Brazil produced the highest yield (25 t/ha). In a weed control trial at Serdang, the preemergence application of a mixture of alachlor and fluometuron (1 kg each/ha) gave a 68% increase in root yield compared with untreated plots. When chemical treatment was followed by hand weeding 2 mo. after planting, the increase in yield over the control was 124%. The study on the relationship between available soil K and cassava yield showed that the content of water-soluble K in the soil accounted for 85% of the variation in cassava starch yield. No important relationship was found between available P and cassava yield. Results of studies on IAI are also included. Var. C3 showed the lowest degree of infection by Cercosporidium henningsii in a comparative study of disease infection by this pathogen carried out with 30 var. Var. Medan, Black Twig, and 85 were more susceptible than at least 18 other less important var. (Summary by EDITEC. Trans. by L.M.F.) J00

0380

19236 MENDES, R.A. 1977. Cassava production in Brazil. Cruz das Almas-BA, Brasil, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Mandioca e Fruticultura. 15p. Engl., Sum. Engl., 20 Refs., Illus.

Cassava. Production. Maps. Cassava programs. Productivity. Brazil.

The importance of cassava in Brazil is highlighted and compared with that of other crops (maize, rice, yam, and sweet potato) regarding area planted, production, and yield in Brazil, India, Indonesia, Nigeria, Thailand, and Zaire. Brazilian cassava production is the highest worldwide; most is for human consumption and to a lesser extent, for export. Santa Catarina is the state that produces the highest amount of flour and starch for foreign trade, contributing with 5.1% of the national production. Cassava occupies the 6th place in planted area in Brazil, with a productivity of 11.9 t/ha. Approx. half of the national production comes from the NE where cassava is the most important source of energy in low-income groups. Cassava production in Brazil was 25.8 million tons in 1975. The objectives of the Centro Nacional de Pesquisa de Mandioca e Fruticultura, Cruz das Almas, BA, are listed. (Summary by J.L.S. Trans. by L.M.F.) J00

0381

19277 MULINDANGABO, J. 1982. Agronomic research on cassava cultivation in Rwanda. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.78-80. Engl., Sum. Engl.

Cassava. Cassava programs. Cultivars. Selection. Rwanda.

Past research on cassava and future prospects of cassava production in Rwanda are reviewed. The Institut des Sciences Agronomiques du Rwanda (ISAR), in cooperation with the International Institute of Tropical Agriculture (IITA) is attempting to reduce cassava production constraints. ISAR has adopted a 6-yr selection procedure, based on IITA standards, for its long-term research program and, on the short term, is involved in assessing the local var. in its collection so that it can provide assistance to farmers. (Author's summary) J00

0382

19274 NYIIRA, Z.M. 1982. Uganda. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.99-103,122-128. Engl., Sum. Engl., 2 Refs.

Cassava. Research. Uganda.

The importance of root and tuber crops in Uganda's agriculture is discussed. Of these, cassava and sweet potatoes are particularly popular among farmers because of their flexibility in mixed cropping, because they keep well in the ground until needed, and, in the case of cassava, because little labor is involved. Cassava is currently attacked by 3 major diseases and pests: CAMD, CBB, and the cassava green mite (Mononychellus tanajoa). Yams and cocoyams are also grown in the country, and, although no major research has been conducted on these crops, evaluation programs have been established. Future programs on root and tuber crops are aimed at popularizing current research results among the rural communities, multiplying cassava and sweet potato planting materials for distribution to farmers, intensifying screening and adaptation trials, and testing the performance of new var. for adaptation to drier and semiarid areas. (Author's summary) J00

0383

19272 ROWE, A.G. 1982. Zimbabwe. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.107-108. Engl., Sum. Engl.

Cassava. Cassava programs. Cultivars. Adaptation. Zimbabwe.

The minor role played by the root crops cassava, sweet potato, yam, and cocoyam in the diet of the population of Zimbabwe due to the relative abundance of, and preference for, cereals such as maize and wheat is discussed. Cassava, however, very probably will expand into a major crop because of its potential as a source of energy and cash for the peasant farmer and its suitability to the lighter soils covering much of Zimbabwe. To date, research work has been limited to collecting and bulking local material and introducing 4 Australian var. (MAus. 1, 7, 10, 19). Several trials, however, are currently being conducted including growth analyses, var. trials, date-of-planting trials, and storage of seed material. Some CAMD has been observed but no other diseases; the only pests to date are cutworms. (Author's summary) J00

0384

19269 SINGH, T.P.; LUTALADIO, N.B. 1982. Zaire. In Root crops in Eastern Africa, Kigali, Rwanda, 1980. Proceedings of a workshop. Ottawa, Canada, International Development Research Centre. IDRC-177e. pp.114-118, 122-128. Engl., Sum. Engl., 10 Refs., Illus.

Cassava. Cassava programs. Production. Tuber productivity. Plant breeding. Cultivars. Selection. Germplasm. Zaire.

Cassava is the most important root crop grown in Zaire, and both the roots and leaves are consumed. Root yields from local var. are low because of their low genetic potential and susceptibility to major pests and diseases. Research for the improvement of cassava in Zaire was initiated in 1976, and breeding efforts have resulted in the identification and development of high-yielding var. with field resistance to major diseases under different soil conditions. A source of resistance to mealybug (Phenacoccus spp.) has been identified in both wild and cultivated cassava, and resistance to cassava green mite (Mononychellus tanajoa) is available. Cassava germplasm screening for leaf HCN content has been started. Agronomic studies have resulted in recommendations to improve cassava production and income at the farm level. A strategy to diffuse improved cassava var. and cultural practices for adoption by farmers in the absence of an effective national extension service has been suggested. (Author's summary) J00

0385

17579 SPIJKERS, P.A.N.M., BOX, L. 1981. Cultivators and their crops. In Essays in rural sociology in honour of R.A.J. van. Lier. Wageningen, Agricultural University. pp.263-304. Engl., Sum. Engl., 70 Refs.

Cassava. Bitter cassava. Cultivation. History. Socio-economic aspects. America.

Based on field work in Colombia on rice cultivation, and on cassava cultivation among Amerindians, a greater role for social scientist in the design and execution of cultivation-innovation programs is advocated. By linking village-level data to research program information, the need for a better understanding of peasant farmer cultivation among crop scientists is

showed. The historical relations between technology and social organization of particular crop production systems are analyzed. The notion of genetic management of crops is introduced and the need to distinguish the different stages in crop cultivation on the basis of anthropological and archeological data is demonstrated. The model is extended into the agricultural research process itself and the value of a sociology of crop cultivation in the generation of technologies which are relevant to the problems of peasant farmers is questioned. (Summary by Abstracts on Tropical Agriculture) J00

0386

18451 UGWU, B.O. 1975. Cassava products industry in Nigeria: problems and possibilities. Nigerian Trade Journal 22(3):29-31, 34-35, 38. Engl., 5 Refs., Illus.

Cassava. Cassava products. Consumption. Uses. Industrialization. Nigeria.

Several problems and possibilities of the cassava products industry in Nigeria are analyzed considering the world market situation, the domestic demand for cassava products (as a staple food, as livestock feed, and as industrial raw material), and the supply of cassava roots and their possible sources. In order to establish a cassava products industry in Nigeria, the following steps are recommended: (1) research programs on root crops in Nigeria should be aimed at improving var. to produce higher yields of good quality roots and at reducing production costs; (2) the government should encourage the establishment of a cassava processing industry in the country; and (3) the Federal Institute of Industrial Research (FIIR) should intensify its research activities in cassava-based products that can be produced locally but are currently being imported. (Summary by EDITEC. Trans. by L.M.F.) J00

See also 0252 0353 0356 0360 0364 0365 0366 0387 0391

K00 OTHER ASSOCIATED COMMODITIES

K01 Rotational Schemes and Intercropping

0387

18475 LEIHNER, D. 1983. Yuca en cultivos asociados: manejo y evaluación. (Management and evaluation of intercropping systems with cassava). Cali, Colombia, Centro Internacional de Agricultura Tropical. Serie CIAT 90SC-1(83). 80p. Span., 69 Refs., Illus.

Also in English.

Cassava. Inter-cropping. Maize. Beans. Groundnut. Cowpea. Planting. Timing. Spacing. Nutritional requirements. N. P. K. Ca. Mg. S. Insect control. Disease control. Weeds. Weeding. Herbicides. Economics. Colombia.

The management of cassava intercropping and its evaluation are described. Multiple cropping systems are defined: consecutive cropping and intercropping (mixed intercropping, row intercropping, strip intercropping,

and relay intercropping). Basic biological and nutritional aspects of multiple cropping are analyzed and cassava intercropping systems practiced throughout the world (Latin America, Africa, and Asia) are described. Improved technology for cassava intercropping is discussed regarding the selection of plant types for association (cassava, grain legumes, and other crops); relative planting time; planting density (cassava, grain legumes, and maize); spatial arrangement of the crops (cassava, grain legumes); mineral nutrition and fertilization (nutritional requirements of cassava and intercrops, selection of crops for intercropping, response to fertilization in monoculture and in association, competition for nutrients in intercropping systems, and methods of fertilizer application); pest, disease, and weed management. Intercropping systems are evaluated on the basis of their biological efficiency (relative planting time, planting density, response to fertilization, and competition between crops) and their economical evaluation (comparison between systems and determination of profitability in intercropping systems). (Summary by EDITEC. Trans. by L.M.F.) KOI

0388

18477 MORALES, L. 1978. Estudios de distancias de siembra y control de malezas en la asociación maíz por ñame intercalado con yuca. (Planting distance and weed control trials in maize/yam/cassava intercropping). In Instituto Colombiano Agropecuario. Programa Nacional de Fisiología Vegetal. Informe de Progreso 1977. Bogotá, Colombia. pp.122-126. Span., 1 Ref.

Cassava. Inter-cropping. Maize. Yams. Planting. Spacing. Weeds. Weeding. Herbicides. Colombia.

Herbicide selectivity in controlling weeds in a maize/yam/cassava intercropping system was assessed at the Turipana Exptl. Center of the Instituto Colombiano Agropecuario. Distances used in a square planting arrangement were 1.2, 1.0, and 0.8 m, maize hybrid ICA H-210 being hill-plot planted at 3 seeds/site. Fifteen days after maize germination, one yam seed was sown per site. Cassava var. Blanca Mona was planted in the center of the plot 1 mo. after maize planting. A split plot exptl. design was used, the main plot corresponding to planting distances and the split plots to the weed control system. Herbicides were more efficient than weeding treatments. Herbicides atrazine + terbutryn and atrazine + alachlor best controlled weeds (mainly broadleaf) at all planting distances. However, at the 0.8 m planting distance there was more competition among intercrops than at other distances. None of the herbicides studied caused damage to the crops and weed control was excellent up to 45 days, after which weeds such as Cyperus rotundus and Rhychocia minima invaded the plots making a weeding with machete necessary. (Summary by EDITEC. Trans. by L.M.F.) KOI

0389

18476 MORALES, L. 1977. Estudio de la distancia de siembra y el control de malezas en la asociación maíz-yuca-ñame. (Planting distance and weed control trials in maize/cassava/yam intercropping). In Instituto Colombiano Agropecuario. Programa Nacional de Fisiología Vegetal. Informe de Progreso 1976. Bogotá, Colombia. pp.123-132. Span., 3 Refs., Illus.

Cassava. Intercropping. Maize. Yams. Planting. Spacing. Weeds. Weeding. Herbicides. Colombia.

In trials at the Turipana Exptl. Center of the Instituto Colombiano Agropecuario the optimum planting distance in a maize/yam/cassava intercropping system was assessed, the no. of weedings and different chemical treatments to obtain adequate weed control were compared, and the best maize var. to be used as prop plants and the growth of the 3 crop species in association were determined. Distances used in a square planting arrangement for maize were 1.0 and 0.8 m. Maize hybrids ICA H-154 and ICA H-210 were hill-plot planted at 4 seeds/site. One yam plant was sown per site 15 days after maize germination. Cassava var. Blanca Mona was planted 2 mo. after maize planting. Herbicide (atrazine + terbutryn and atrazine + alachlor) and weeding treatments were made in different combinations and times. A split plot exptl. design was used with the main plot corresponding to the planting distances and the split plots to the weed control systems. Each hybrid corresponded to an expt. Herbicides gave a better weed control than weeding treatments, giving a better control of broadleaf weeds at the different planting distances. At 0.8 m, the crop exerted a greater pressure of competition on weeds. None of the herbicides studied caused damage to the crop and their control was excellent up to 60 days after application. After 90 days additional weeding was necessary. Highest cassava yields were obtained at a distance of 0.8 m, and in particular with herbicide treatment. (Summary by FDITEC. Trans. by L.M.F.) K01

0390

18457 WILSON, G.F.; LAL, R.; OKIGBO, B.N. 1982. Effects of cover crops on soil structure and on yield of subsequent arable crops grown under strip tillage on an eroded Alfisol. Soil and Tillage Research 2(3): 233-250. Engl., Sum. Engl., 13 Refs., Illus.

Cassava. Fallowing. Soil requirements. Tuber productivity. Nigeria.

Effects of weed fallow and of 3 grasses and 5 leguminous cover crops were investigated on soil structure of an eroded Alfisol. Crop growth and yields of subsequently grown arable crops were assessed under strip-tillage through the mechanically or chemically suppressed sods. Cover crops and fallowing improved soil OM content, total N, water retention and transmission properties, and decreased bulk density only in the top 0-10 cm depth. The improvements rendered were, however, slight. Grasses were difficult to suppress with paraquat or mechanical mowing, which resulted in low or negligible yield of maize, cowpea, and cassava. Leguminous covers were easily suppressed with paraquat application, and resulted in good yield of maize and cowpea. Mechanical mowing was as successful as herbicide application for suppressing Stylosanthes guianensis and resulted in satisfactory yield of maize and cowpea. Yield of cassava tubers was extremely low due to shallow surface soil, compacted subsoil horizons, and competition from weeds and regrown cover crops. Results are discussed in terms of the amelioration of eroded and degraded soil. (Author's summary) K01

See also 0249 0252 0373 0391

Z00 GENERAL

0391

18956 SILVESTRE, P.; ARRAUDEAU, M. 1983. Le manioc. (Cassava). Paris, G.-P. Maisonneuve & Larose. Techniques Agricoles et Productions Tropicales no. 32. 262p. Fr., 445 Refs., Illus.

Cassava. History. Taxonomy. Climatic requirements. Plant breeding. Cytogenetics. Inheritance. Plant development. Plant physiology. Nutritional requirements. Minerals and nutrients. Fertilizers. HCN. Toxicity. Toxicology. Viroses. Bacterioses. Mycoses. Injurious insects. Injurious mites. Nematodes. Cultivation systems. Uses. Animal nutrition. Human nutrition. Cassava products. Industrialization. Industrial microbiology. Trade. Economics.

A synthesis of information on cassava is given. The following aspects are discussed: origin and history; botany; ecology; genetic breeding (cytology, floral biology, inheritance, and varietal improvement); growth and development; HCN toxicity; diseases and pests, including nematodes; cultural techniques and traditional and improved production systems; utilization in human and animal nutrition; industrialization; and economy. (Summary by J.L.S. Trans. by L.M.F.) ZOO

LIST OF ABBREVIATIONS

A	Angstrom(s)
ABA	Abscisic acid
ac	Acre(s)
Afr.	Afrikaans
a.i.	Active ingredient
alt.	Altitude
CAMD	Cassava African mosaic disease
CAMV	Cassava African mosaic virus
AMV	Alfalfa mosaic virus
approx.	Approximate(ly)
atm.	Atmosphere
ATP	Adenosine 5'-triphosphate
av.	Average
BAP	6-Benzylaminopurine
BBMV	Broad bean mosaic virus
BCMV	Bean common mosaic virus
BGMV	Bean golden mosaic virus
BGYMV	Bean golden yellow mosaic virus
BOD	Biochemical 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)
CBB	Cassava bacterial blight
CBSD	Cassava brown streak disease
CEC	Cation exchange capacity
CER	CO_2 exchange rate
CF	Cassava flour
CGR	Crop growth rate
CLM	Cassava leaf meal
CLV	Cassava latent virus
CM	Cassava meal
cm	Centimeter(s)
COD	Chemical oxigen demand
concd.	Concentrated
concn.	Concentration
CP	Crude protein
CSL	Calcium stearyl lactylate
CSW	Cassava starch wastes
C.V.	Coefficient of variation
cv.	Cultivar(s)
2,4-D	2,4-dichlorophenoxyacetic acid
DM	Dry matter
DNA	Deoxyribonucleic acid
EC	Emulsifiable concentrate
EDTA	Ethylenediaminetetraacetic acid
EEC	European Economic Community
e.g.	For example
ELISA	Enzyme-linked immunosorbent assays
EMS	Ethyl methane sulfonate
Engl.	English
expt.	Experiment(s)
exptl.	Experimental
°F	Degrees Fahrenheit
Fr.	French
ft-ca	Foot candles (10.76 lux)
FYM	Farmyard manure
g	Gram(s)
G	Giga (10^9)
GA	Gibberellic acid
gal	Gallon(s)
GE	Gross energy
Germ.	German
GERs	Glucose entry rates
GLC	Gas-liquid chromatography
govt.	Government
govtl.	Governmental
h	Hour(s)
ha	Hectare(s)
HCN	Hydrocyanic acid
HDP	Hydroxypropyl distarch phosphate (modified cassava starch)
HI	Harvest index
IAA	Indoleacetic acid
IBA	Indolebutyric acid
Illus.	Illustrated
in.	Inches
i.e.	That is
Ital.	Italian
IU	International unit
J	Joule
Jap.	Japanese
kat	Katal(amount of enzymatic activity that converts 1 mole of substrate/s)
kcal	Kilocalorie(s)
kg	Kilogram(s)
Kj	Kilojoule
km	Kilometer(s)
KNap	Potassium naphthenate
kR	Kiloroentgen(s)
l	Liter(s) (only in combination with no.)
LAD	Leaf area duration
LAI	Leaf area index
lat.	Latitude
lb	Pound(s)
LD_{50}	Mean lethal dose
LER	Land efficiency ratio
LPC	Leaf protein concentrate
lx	Lux
M	Mega
M	Molar
m	Meter(s)

Mal.	Malay
max.	Maximum
MC	Moisture content
ME	Metabolizable energy
meq	Milliequivalent(s)
met.	Methionine
mg	Milligram(s)
mho	Reciprocal ohm
min.	Minimum
min	Minute(s)
ml	Milliliter(s)
mm	Millimeter(s)
mo.	Month
mol.wt.	Molecular weight
m.p.	Melting point
NAA	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	Pexoxyacetic nitrate
PCNB	Pentachloronitrobenzene
PDA	Potato dextrose agar
PER	Protein efficiency ratio
pH	Hydrogen ion concentration
pphm	Parts per hundred million
PPI	Pre-planting incorporation
ppm	Parts per million
PSA	Potato sucrose agar
pv.	Pathovar.
Ref(s).	Reference(s)
resp.	Respective(ly)
Rf	Retardation factor-chromatography
RGRs	Relative growth rate
RH	Relative humidity
RNA	Ribonucleic acid
Rom.	Romanian
Russ.	Russian
S	Svedberg unit of sedimentation coeff. (10^{-3} S)
s	Second
$S_{20,w}$	Sedimentation coefficient corrected to water at 20°C
SBM	Soybean meal
SCN	Thiocyanate
SCP	Single cell protein
SDS	Sodium dodecyl sulfate
Sk.	Slovak
sp.	Specie
Span.	Spanish
spp.	Species
SSL	Sodium stearyl-2-lactylate
Sum.	Summary
t	Ton(s)
TDN	Total digestible nutrients
temp.	Temperature
TIA	Trypsin inhibitor activity
TIBA	2,3,5-Triiodobenzoic acid compound with N-methylmethanamine
TLC	Thin-layer chromatography
TMV	Tobbaco mosaic virus
TSH	Thyroid-stimulating hormone
UDPG	Uridine diphosphate glucose
UMS	Unmodified cassava starch
UV	Ultraviolet
var.	Variety(ies), varietal
VFA	Volatile fatty a ids
vol.	Volume
VPD	Vapor pressure deficit
vpm	Volume per million
W	West
wk.	Week
WP	Wettable powder
wt.	Weight
YFEL	Youngest fully expanded leaves
yr	Year(s)
α	alpha
β	beta
γ	gamma
δ	delta
ϵ	epsilon
λ	lambda
π	pi
ψ	psi
/	Per
μ	Micro
%	percent(age)
>	More than, greater than
<	Less than
$\leq$	Equal to or less than
$\geq$	Equal to or greater than
$\pm$	Plus or minus
ϕ	Diameter
$\ll$	Much less than
$\gg$	Much greater than

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INCOME
0096 0097 0187 0225

INDIA
0016 0057 0101 0134 0197 0209 0217
0226 0242 0242 0242 0242 0242 0242
0242 0242 0242 0261 0271 0274 0288
0290 0327 0329 0338 0357 0362
MARKETING
0216
PRODUCTION
0216

INDONESIA
0101
SOCIO-ECONOMIC ASPECTS
0224

INDUSTRIAL MACHINERY
0208

INDUSTRIAL STARCHES
0089 0 90

INHERITANCE
0067 0191

INJURIOUS INSECTS
0060 0145 0146 0228 0250 0294 0295
0297 0298 0299 0304 0305 0391
BEMISIA
0057 0291
CRINNYIS ELLO
0051 0152 0374
PHENACOCCUS MANIHOTI
0058 0059 0156 0300 0301 0303
SILGA PENDULA
0149 0152
ZONOCERUS VARIEGATUS
0301 0302 0312

INJURIOUS MITES
0060 0063 0071 0297 0308 0309 0311
0391
MONONYCHELLUS TANAJOA
0061 0062 0064 0065 0066 0152 0156
0249 0294 0300 0301 0306 0307 0310
0312 0314 0371 0374

INOCULATION
0244 0246 0289
DISEASES AND PATHOGENS
0140 0142 0240 0295

INSECT BIOLOGY
0057 0061 0065 0066 0306

INSECTICIDES
0057 0303 0305 0312

INTER-CROPPING
0116 0227
BEANS
0106 0228 0373 0387
COWPEA
0228 0387
GROUNDNUT
0105 0106 0373 0387
LEGUME CROPS
0228
MAIZE
0022 0106 0125 0228 0229 0387 0388
0389
RICE
0022 0105
SORGHUM
0106
SOYBEANS
0106

SWEET-POTATOES
0373
YAMS
0383 0389

IODINE
0172 0173 0174 0175 0188 0331 0332
0333 0334 0335 0338 0341

IRON
0122

IRRADIATION
0388 0389

IRRIGATION
0258

ISOLATION
DISEASES AND PATHOGENS
0055 0141 0282

IVORY COAST
0021 0037 0107 0143 0291 0318

KENYA
0052 0249 0275 0292

LABORATORY ANIMALS
0171 0172 0188 0346 0352

LABOUR
0097 0124 0369
HARVESTING
0275
LAND PREPARATION
0353
PLANTING
0225
PROCESSING
0208 0360

LAND PREPARATION
0022 0023 0116 0124 0225
MECHANIZATION
0024
TUBER PRODUCTIVITY
0039 0126 0128 0152

LATIN AMERICA
GERMPLASM
0166

LEAF AREA
0005 0008 0010 0012 0014 0015 0051
0056 0105 0108 0153 0227 0234 0264
0265

LEAVES
0002 0006 0008 0015 0017 0018 0051
0064 0105 0108 0153 0214 0217 0258
0307 0345
ANALYSIS
0005 0075 0110 0239 0247 0253 0253
0256 0373
ANIMAL NUTRITION
0102 0359
HCN CONTENT
0110 0138 0191 0193
MINERAL CONTENT
0028 0113 0114 0118 0244 0247 0253
0253 0373 0374
NUTRITIVE VALUE
0182
PROTEIN CONTENT
0075 0315

LEGAL ASPECTS
0199

LIGHT
0233

LINAMARASE
0192

MAGNESIUM
0113 0253 0253 0255 0387
TUBER PRODUCTIVITY
0318 0374

MALAYSIA
0045 0118 0339 0360 0378
GERMPLASM
0379
PRODUCTION
0275
SOCIO-ECONOMIC ASPECTS
0225

MALNUTRITION
0174 0175 0177 0340

MANGANESE
0122 0251 0253

MANIHOT GLAZIOVII
0058 0286

MARKETING
0094 0100 0102 0116 0220 0223 0252
0375
CASSAVA FLOUR
0364
CASSAVA MEAL
0369
CASSAVA STARCH
0207 0364
TAPIOCAS
0216
TUBERS
0216

MATURATION
0019

MECHANIZATION
0104 0209
HARVESTING
0024 0033 0037
LAND PREPARATION
0024 0031
PLANTING
0024 0037 0129

METHIONINE
0178 0346

MEXICO
0250 0256
GERMPLASM
0159

MINERAL DEFICIENCIES
0122

MINERALS
0010 0020 0023 0025 0027 0028 0029
0033 0114 0118 0120 0121 0122 0123
0125 0127 0171 0224 0228 0243 0246
0247 0253 0253 0254 0255 0257 0258
0318 0373 0374 0378 0387 0391

MITE CONTROL
0294 0300 0301 0310
ACARICIDES
0062

MODIFIED STARCHES
0300 0194

MOLYBDENUM
0122

MONONYCHELLUS TANAJOA
0062 0065 0066 0249 0306 0307 0310
INSECT CONTROL
0061 0294 0300 0301
PLANT DAMAGE
0064
RESISTANCE
0064 0152 0156 0224 0312 0314 0373
0374

MORPHOGENESIS
0009 0011
PLANT TISSUES
0232 0277

MOULDS
0090

MUKIBAT SYSTEM
0224

MULCHING
0039

MUTATION
0068

MYCORRHIZA
0244 0246 0254 0373

MYCOSES
0134 0141 0279 0283 0285 0287 0289
0378 0391
DISEASE CONTROL
0296
RESISTANCE
0047 0049 0071 0147 0152 0153 0284
0288 0379

NEMATODES
0156 0293 0391

NIGERIA
0037 0050 0058 0105 0128 0129 0144
0145 0169 0178 0229 0235 0240 0247
0293 0294 0302 0306 0307 0312 0317
0339 0347 0348 0349 0396 0399
GERMPLASM
0156
SOCIO-ECONOMIC ASPECTS
0268

NITROGEN
0008 0010 0025 0029 0029 0030 0091
0103 0113 0120 0121 0122 0123 0126
0127 0224 0227 0247 0253 0253 0254
0255 0256 0257 0258 0318 0373 0374
0397

NUTRIENT SOLUTION
0020

NUTRITIONAL REQUIREMENT
0006 0020 0106 0119 0227 0243 0245
0247 0257 0373 0374 0378 0387 0391

ORGANOLEPTIC EXAMINATION
0323
CASSAVA FLOUR
0072 0073 0170 0196 0203 0327
COMPOSITE FLOURS
0203

PACKAGING
0207

PANAMA
0268

PAPUA NEW GUINEA
0221 0251 0356

PATENTS
0080 0201

PEELING
0205 0207 0354

PELLETS
0074 0084 0199 0215
PROCESSING
0366 0368

PERU
GERMPLASM
0165

PEST CONTROL
0022 0023 0024 0052 0061 0062 0116
0225 0273 0290 0296 0294 0296 0300
0301 0305 0310 0325 0337

PEST DAMAGE
0142 0293 0305

PETIOLES
0073 0105 0136 0234 0258 0373 0374

PH
0253 0253

PHENACOCCUS
0294 0295 0303 0304 0312

PHENACOCCUS MANIHOTI
0058 0359
INSECT CONTROL
0300 0301
INSECTICIDES
0333
RESISTANCE
0156

PHILIPPINES
0101 0254 0263 0308

PHOSPHORUS
0010 0020 0025 0027 0028 0029 0030

0113 0120 0121 0122 0123 0126 0127
0224 0243 0244 0246 0247 0253 0253
0254 0255 0257 0258 0318 0373 0374
0387

PHOTOPERIOD
0012 0014 0015 0260

PHOTOSYNTHESIS
0006 0018 0056 0233 0290

PLANT ASSIMILATION
0003 0010 0014 0015 0018 0264 0265

PLANT DAMAGE
0048 0056 0064

PLANT GEOGRAPHY
0001 0239

PLANT HEIGHT
0004 0009 0017 0064 0107 0128 0263
0374

PLANT PHYSIOLOGICAL PROCESSES
0003 0006 0007 0009 0010 0014 0015
0018 0020 0028 0056 0113 0233 0235
0237 0237 0237 0244 0246 0257 0264
0265 0290

PLANT RESPIRATION
0006

PLANT TISSUES
0135 0237
MORPHOGENESIS
0232 0277
TISSUE CULTURE
0232 0277

PLANTING
0012 0013 0014 0015 0016 0022 0105
0116 0141 0312
AGRICULTURAL EQUIPMENT
0037 0129
COSTS
0024 0225 0228 0266
LABOUR
0225
MECHANIZATION
0024 0037 0129
SPACING
0023 0035 0152 0224 0227 0228 0229
0264 0266 0373 0387 0388 0389
TUBER PRODUCTIVITY
0035 0037 0039 0040 0106 0120 0125
0152 0224 0227 0229 0262 0264 0265
0266 0318 0373

PLOUGHING
0035

POLYNESIA
0318

POLYPLOIDY
0326

POULTRY
0182 0184 0185 0187 0342 0343 0345

PRESSING
0354

PRICES
0002 0092 0096 0098 0207 0215 0216
0223 0225 0369 0376

PROCESSING
0085 0095 0100 0135 0329 0360 0364
0366
DRYING
0045 0077 0090 0191 0205 0354 0359
0367
FERMENTATION
0087 0090 0191 0205 0207 0208 0209
0210 0214
GELATINIZATION
0013 0369
PEELING
0205 0207 0354
PRESSING
0354
RASPING
0205 0207 0354
SCREENING
0205 0207
SILTING
0205 0207
STEEPING
0191
WASHING
0205 0207

PROPAGATION
0016 0163 0235 0250 0250 0250 0250
0374 0374

PROPAGATION MATERIALS
0023 0036 0039 0040 0049 0050 0104
0120 0130 0131 0143 0152 0155 0164
0266 0267 0280 0374

PROTEIN CONTENT
0213 0346
LEAVES
0075 0116
STEMS
0075
TUBERS
0323

PROTEIN ENRICHMENT
0072 0091
AMINO ACIDS
0213 0346
ECONOMICS
0353
FERMENTATION
0211 0213

PROTEINS
0174
AMINO ACIDS
0177
ANALYSIS
0091 0171 0175 0177 0188 0212
DIETARY VALUE
0166 0171 0180 0189 0199 0345
DIGESTIBILITY
0184 0189 0345

PRUNING
0016
DETERIORATION
0137

PUERTO RICO
0253 0253 0323

RAINFALL DATA
0259

RASPING
0205 0207 0354

RESISTANCE
0044 0070 0114 0136 0137 0159
DISEASES AND PATHOGENS
0046 0047 0048 0052 0071 0138 0139
0140 0142 0143 0144 0150 0152 0153
0156 0160 0273 0277 0281 0284 0288
0314 0325 0374 0379
INJURIOUS INSECTS
0149 0152 0156 0294 0298 0305 0312
0374
INJURIOUS MITES
0064 0071 0152 0156 0294 0306 0309
0312 0314 0373 0374

RHODESIA
0383

ROOT SYSTEMS
0109 0236 0266

ROOTING
0109

ROOTS
0007 0256 0261
GROWTH
0236
HCN CONTENT
0110
PLANT ANATOMY
0236
PLANT PHYSIOLOGY
0236 0243 0244

ROTATIONAL CROPS
BEANS
0373
GROUNDNUT
0373
RICE
0236

RWANDA
0270 0275 0319 0320 0381

SELFING
0161

SENEGAL
0063

SHEEP
0077 0190

SHOOTS
0015 0036 0108 0254

SILAGE
0179

SILBA PENDULA
RESISTANCE
0071 0149 0152

SILTING
0205 0207

SMALL SCALE EQUIPMENT
0033 0207 0208 0354 0359

SMALL SCALE PROCESSING
0207 0208 0354 0359

SOCIO ECONOMIC ASPECTS
0096 0098 0099 0124 0154 0168 0208
0220 0224 0225 0369 0385

SODIUM
0114

SOIL ANALYSIS
0028 0113 0118 0246 0255 0256 0261
0272

SOIL FERTILITY
0028 0128 0253 0253 0259 0270 0373

SOIL MOISTURE
0312

SOIL REQUIREMENTS
0039 0126 0128 0253 0253 0254 0259
0318 0390

SOLAR DRYING
0045 0085 0096 0191 0198 0205 0359
0367

SOYBEANS
0106

SOUTH AFRICA
0278 0386

SPHACELOMA MANIHOTICOLA
0279
INOCULATION
0142 0289
RESISTANCE
0142
SYMPTOMATOLOGY
0142 0289

SRI LANKA
0101 0227

STARCH CONTENT
0004 0026 0031 0037 0043 0046 0071
0084 0111 0112 0118 0121 0122 0123
0127 0147 0152 0153 0160 0241 0241
0315 0321 0368

STARCH PRODUCTIVITY
0110 0122
CULTIVARS
0029 0150 0152 0305
HARVESTING
0029
TIMING
0007 0029 0152

STATISTICAL ANALYSIS
0014 0015 0073 0211 0313 0332 0361

STATISTICAL DATA
0092 0094 0096 0097 0099 0100 0103
0207 0216 0223 0375

STEEPING
0191

STEMS
0113 0130 0131 0285
ANALYSIS
0075 0247 0256
FORAGE
0075
HCN CONTENT
0138
PLANT DEVELOPMENT
0004 0008 0012 0015 0017 0018 0258
0374

STOMATA
0002 0138

STORAGE
0044 0045 0073 0109 0110 0134 0136
0137 0146 0152 0232 0329 0361

SULPHUR
0113 0120 0374 0387

SUPPLEMENTS
0179 0180 0182 0184 0189 0190 0346
0350

SWEET CASSAVA
STARCH CONTENT
0071 0121
TUBER PRODUCTIVITY
0071 0119 0321

SWEET POTATOES
0190 0373

SWINE
0178 0179 0186 0188 0189 0346 0347
0349
FATTENING
0074 0344
FINISHING
0074 0345
LEAVES
0182
PELLETS
0074
TUBERS
0182 0185

SYMPTOMATOLOGY
0289
DISEASES AND PATHOGENS
0050 0054 0142 0274 0280 0283 0287

TANZANIA
0146 0275 0371

TAPIOCAS
0215
DIETARY VALUE
0320
USES
0320

TAXONOMY
0231 0231 0391

TECHNOLOGY
0165 0218
TECHNOLOGY EVALUATION
0124 0220

TEMPERATURE
0012 0013 0014 0015 0046 0232 0260
0361

THAILAND
0097 0101 0202 0355
PRODUCTION
0097
SOCIO-ECONOMIC ASPECTS
0096 0098 0099
TRADE
0096 0098 0099 0199 0215

THIOCYANATES
0172 0173 0174 0175 0176 0177 0188
0189 0190 0330 0332 0333 0334 0335

TISSUE CULTURE
0009 0011 0163 0232 0277

TOGO
0056

TOXICITY
0076 0078 0079 0172 0188 0334 0391

TOXICOLOGY
0172 0174 0176 0330 0331 0332 0333
0334 0335 0336 0337 0338 0339 0340
0341 0352 0391

TRADE
0096 0098 0099 0100 0223 0375 0376
0391
CASSAVA CHIPS
0215
CASSAVA FLOUR
0215
PELLETS
0197 0215

TUBER DEVELOPMENT
0012 0014 0015 0017 0018 0107 0130
0277 0235 0265 0321 0373 0374

TUBER PRODUCTIVITY
0004 0007 0008 0017 0018 0021 0025
0026 0027 0028 0029 0030 0031 0035
0037 0038 0039 0040 0042 0043 0046
0049 0056 0064 0070 0071 0106 0118
0120 0121 0122 0123 0125 0126 0127
0128 0130 0132 0133 0144 0147 0150
0151 0152 0153 0154 0156 0157 0159
0160 0161 0165 0166 0217 0224 0226
0227 0229 0235 0246 0247 0252 0257
0262 0263 0264 0265 0256 0267 0268
0276 0305 0313 0315 0318 0319 0320
0321 0122 0323 0372 0373 0374 0384
0390

TUBERS
0185 0216 0258 0261
ANALYSIS
0135 0137 0239 0240 0269
BIOCHEMISTRY
0135 0269
DETERIORATION
0044 0134 0135 0136 0137 0269 0374
DRY MATTER
0008 0037 0111 0113 0162 0264 0265
0374

DRYING
0045 0191
FAT CONTENT
0240
HCN CONTENT
0191 0323
NUTRITIVE VALUE
0182 0329
STARCH CONTENT
0037 0111 0116
STORAGE
0044 0045 0134 0136 0137 0329

UGANDA
0275 0110 0382

UROMYCES MANIHOTIS
RESISTANCE
0284

VASCULAR STREAKING
0044

VENEZUELA
0010 0204 0258 0264 0265 0267 0273
0279 0281 0282 0363 0365 0366 0367
0370

VISCOSITY
0170 0196
CASSAVA STARCH
0019 0368

WASTE UTILIZATION
0202 0349 0355 0362 0362 0362 0362
0362

WATER CONTENT
CASSAVA CHIPS
0086 0368
CASSAVA STARCH
0084 0358

WATER REQUIREMENTS(PLANT)
0026

WATER REQUIREMENTS(PROCESSING)
0205

WEEDING
0022 0023 0024 0032 0034 0038 0038
0116 0225 0228 0263 0267 0374 0378
0387 0389 0389

WEEDS
0263 0267 0387 0388 0389

XANTHOMONAS CASSAVAE
0279 0275

XANTHOMONAS MANIHOTIS
0039 0249 0270 0271 0272 0275 0276
0278 0282 0378
DISEASE CONTROL
0273 0280
DISEASE TRANSMISSION
0156
ETIOLOGY
0274
INOCULATION
0140 0260
RESISTANCE
0046 0139 0139 0140 0152 0153 0156
0160 0273 0277 0281 0314 0373 0374
SYMPTOMATOLOGY
0274 0280

YAMS
0388 0389

ZAIRE
0140 0153 0173 0174 0175 0176 0176
0177 0191 0303 0333 0334 0351 0351
GERMPLASM
0384
PRODUCTION
0384

ZINC
0029 0122

ZONOCERUS VARIEGATUS
0302
INSECT CONTROL
0301
RESISTANCE
0312

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