Pages 20-26

Realizing the potential of root crops in the 21st century: the modalities for sub-Saharan Africa

F.M Quin

ABSTRACT

The modalities for Africa for realizing the potential of root crops that are produced in the continent require that we build future work on the already available information and experience from different areas where these crops are grown in Africa. It also requires that there be effective technology transfer arrangements, collaborative research that requires that users of the technology participate in its development The development domains should he defined so that we could use the findings from an area similar to those we wish to implement. Target groups more likely to create the desired impact to food production and cash generation should be the focus of our efforts. The partners involved in the systems are many and the need to be holistic and collaborative is important. Seed systems and rapid multiplication techniques should be adopted. Existing knowledge should also affect the production systems and researchers should be both willing to take risk while being innovative. We should also work with farmers on a longer term and on large farm holdings to better understand the system. To build credibility, only few proven technologies should he introduced to farmers after testing so that the rate of failure of introduced technology is greatly reduced.

Pages 27-34

IPM of cassava in Africa in the 21st century (a light-hearted glimpse into my crystal ball)

Peter Neuenschwander

ABSTRACT

In a fictive report from the year 2020, the author looks back on 25 years of Integrated Pest Management (IPM) in cassava, describing potential scenarios concerning IPM on cassava in Africa. While actual work has progressed considerably and has been adapted to new conditions (for example, periurban agriculture), previously used plant protection approaches are still valuable. Many organisms have been recognized as posing no economic threat. The development of new, more nutritious or low-cyanide varieties has, however, led to new pest problems. The increased frequency of El Nino events has favored many old pests, and several new species have been introduced inadvertently from South America. Cassava cultivation has spread, particularly to less productive sites, with a corresponding increase of pest problems. The genetically more uniform background of cassava has allowed epidemics to develop; but, overall, plant protection practices have been improved to cope with the remaining challenges. Under conditions of good plant husbandry genetic improvement of cassava could truly realize its potential, combining drought resistance, more efficient use of nutrients, resistance to a number of diseases and pests, weed-competitive plant types, and varied consumer characteristics. Invaders from South America have been brought under good, though not total, control by the introduction of exotic natural enemies (classical biological control). Against some grasshoppers and termites, specific mycopesticides are routinely applied. Location-specific agronomic practices that enhance pest control are still few and difficult to propagate, despite ample use of farmers- field schools. The old admonition for better collaboration and priority setting in research to achieve the goal of poverty alleviation through improved and sustainable agriculture still holds true.

Pages 35-42

Promotion of cassava in semi-arid zones of sub-Saharan African: Status of Cassava in Northern Nigeria

E.B. Amans, M. Tshiunza, B. Ahmed, A.G.O. Dixon, M. Mahmud, and M. Bokanga

ABSTRACT

Nigeria is a leading producer of cassava (Manihot esculenta Crantz) but production in the Semi-arid zone, which lie between latitudes 10°N and 14°N, is relatively insignificant compared with the humid south. However, the strategic role of the crop in food security, particularly in this drought prone zone is well acknowledged among the people. Therefore, a study survey was undertaken to determine what is the constraints and opportunities existing for the expansion of cassava production and utilization in the semi-arid zone of the country. The Repaid Rural Appraisal (RRA) techniques with structured questionnaires were employed for the study: The study revealed that inadequate knowledge of improved production practices, damages by livestock, insufficient rainfall poor yielding cultivars, pests and diseases were the major constraints to production. Lack of a major postharvest outlet, other than local domestic consumption, is also a bottleneck to expansion. Simple analyses of these constraints and their implication are presented in the paper.

Pages 42-50

Promotion of Cassava Utilization for Improvement of Food Security and Income generation in Tanzania: Viability of processing cassava flour for biscuit production in Dar-es-Salaam

N. Mlingi, K. Mtunda. G.T. Ndunguru, A. Kiriwaggulu and N.M. Mahungu

ABSTRACT

In order to promote and increase utilization of cassava in Tanzania, a baseline study was carried out in Dar es Salaam city and the surrounding suburbs to study the viability of substituting cassava flour with wheat flour for biscuit production. In the study, 20 bakeries and 36 millers were interviewed by multidisciplinary team of researchers in order to obtain primary data on capacities, products baked and milled respectively. Secondary data on the location of the bakeries, millers and on crop production was obtained from health, trade and agricultural offices. It was observed that four bakeries were ready to accept substituting cassava flour with wheat if quality cassava flour is made available to them and technical know how is at hand. Similarly if significant economic benefits are realized from substitution of wheat with cassava flour, this will be another contribution for the adoption. The farmers were interest in processing quality cassava flour to sell/supply to the city if technology is provided to them and the economic benefits exceed that of fresh cassava sale. Available data showed that wheat flour importation could very much be reduced and foreign exchange of about Tshs. 780 million (US $ 1.2 million) annually, based on the current wheat flour needs in Tanzania could he saved by substituting wheat flour with cassava in the bakery industry.

Pages 54-57

Situation du manioc en zone semi-aride du Tchad

Mbayhoudel Koumaro, Mbailao Kemdingao, et Naitormbaide Michel

ABSTRACT

A baseline survey on status of cassava occurs in 40 Chadian villages located between latitude of 10 degree and 14 degree North and at longitude 15 degree West and 20 degree East, during November 1997. Questionnaires of village level survey were administrated to farmers of these selected villages at random, concerning production system in general and cassava production particularly, its utilization and the main constraints. The survey shows the major crops in that area are cereals (sorghum and millet) and oilseeds (groundnut, beneseed). Cassava is 8th out of 30 products. Only 25% of the surveyed villages cultivate cassava m 4% of cultivated area. The main

reasons mentioned are: lack of water supply; lack of know how; lack of planting materials; presence of termites; presence of cattle and poor -sandy soil. Concerning post harvest, 50% of producing villages transform cassava by fermenting only, the remaining eat it row or boiled. To promote cassava production in that area, we should find solutions to these constraints and transfer postharvest technology.

Pages 58-64

Enhancing root crops production and utilization among Cameroon's rural poor: lessons from Bonavada

J.M. Ngeve

ABSTRACT

In 1997, Cameroon government launched a scheme to help Bonavada community by resettling young school leavers. This study used a 70 point questionnaire in the first quarter of 1997. The study found that root crop and the main food crops in the area together with maize, plantain and leaf vegetables. However cocoyam was the preferred specie. A greater proportion of both native and non-native farmers preferred yams and plantain besides cocoyam for cultivation. The major constraints to these crops as regards production relates to root rot of cocoyam, mosaic of cassava, yam nematode and beetles, dasheen mosaic virus for cocoyam, sweetpotato virus and weevils, as reported by researchers. The perception of farmers for cassava was soil fertility depletion, cost of planting materials and transportation of stakes for yam, lack of improved varieties for all these root and tuber crops. In general, most farmers were willing to accept agricultural innovations wanting credit to fund farm operations. They have in the first year learn minisett technique among young farmers and many farming groups have been formed specializing in sweetpotato, vegetables, yam minisetts, traditional yam production and maize. Overall the villagers are divided in their views

such that technologies requiring high level of know-how are more appropriate for young educated farmers whereas the others prefer simple technologies that match their skills, credit facilities and circumstances. Credit facilities are welcome by males who see this as a source of cash to settle social needs before undertaking farming activities. If properly supervised, the project will help contribute to Cameroon's problems of food self sufficiency.

Pages 65-74

Status of Sweetpotato production, utilization and marketing in Nigeria

O.O. Tewe, O.A. Abu, E.F. Ojeniyi and N.H. Nwokocha

ABSTRACT

A comprehensive literature search and countrywide survey was carried out on sweetpotato between September 1995 and June 1996 Production, marketing and utilization has expanded in the last decade beyond its traditional areas in the Central and riverine areas to all ecological zones in the country. Production figures of 40,000 t by FAO are a gross under estimation compared to local figures of 250,000-570,000 t. Farm yields vary from 3.5 t in northern zone to 7-8 t/ha in the Central and south eastern zones. Experimental fields gave figures between 23.5-71 t/ha. Traditional 'boil and eat' or use as sweetener dominate its usage. Popularizing high yielding varieties and promotion of improved cultural practices coupled with linkage of producers, processors and industrialists are critical to a rapid expansion of sweet potato in root-based industries in Nigeria.

Pages 75-82

The dynamics of the root and tuber cropping systems in the middle belt of Nigeria

Olaniyan, G.O, V.M. Manyong and B. Oyewole

ABSTRACT

An opinion survey of the village extension agents in about 1300 cells of the Nigerian middle belt indicated that yam was the first crop of the cropping system in terms of area cultivated in more than 50% of cells. It was one of the five main crops (yam, sorghum, cassava, rice, and maize) in 100% of survey cells. Cassava was ranked as a first crop in less than 10% of cells. While the expansion of yam was recorded in only about 12% of cells cassava cultivation was found to be expanding in about 43% of cells. The observed changes in crop enterprises are an indicator of both diversification and intensification in agricultural practices. Criteria on the diversification and intensification of agriculture were then used to make a typology of cells and to select sites for detailed studies. The challenge in the middle belt is to sustain yam production in an intensified land use while capitalizing on the dynamics of cassava.

Pages 88-92

Les acquis de la recherche sur le manioc à l'Institut des sciences agronomiques du Burundi: Les technologies transférables

Emmanuel Nizigiyimana

Résumé

Le manioc constitue une des pnncipales denrées alimentaires produites au Burundi. En 1993, la production brute a été de 584 300 tonnes soil 40% de la production totale en tubercules, juste derrière la patate douce (46%). Le manioc occupe la troisième place en production vivrière, juste après les bananes et la patate douce. Le manioc constitue une source d'alimentation pour les æ de la population du Burundi et dans certaines régions naturelles, il constitue un aliment de base. C'est aussi une denrée utilisée en période de soudure permettant amsi d'atténuer les effets de la de disette. De véritables circuits commerciaux sur le manioc se développent à 1'intérieur du pays consituant de fait une source de revenus pour les agriculteurs. Malgré cette importance, la recherché sur le manioc au Burundi n'a démarré qu'en 1978 à 1'Institut des Sciences Agronomiques du Burundi. Plusieurs axes de recherche ont été développés : 1'amélioration variétale, la lutte contre les maladies et ravageurs, les techniques culturales, la technologie alimentaire et Ie transfert en milieu réel. Des résultats de cette recherche sont: six variétés hautement productives ont été proposées à la diffusion (Criolinha Java, Bitamisi, Mpambayabashengeye, Maguruyinkware, Sagarara et TMS 40/60/3), la meilleure période d plantation a été déterminée ; en technologie alimentaire une fanne enrichie en protéines (11%) a été produite ; en défense des cultures des méthodes de lutte biologique ont été initiées pour lacochemlle fanneuse et 1'acanen vert du manioc.

Pages 104-109

Tuber and Root Information System (TRIS): an essential tool for research, planning and development

Okechukwu, R; F.M. Quin; A.G.O. Dixon and R. Asiedu

ABSTRACT

Tuber and Root Information System (TRIS ver. 1.0) is a collection of databases on three International Institute of Tropical Agriculture (IITA) mandate crops namely cassava, yam and sweetpotato in sub-Saharan Africa. TRIS presents real life information in simple maps and easy procedures. Long-term averages of climatic data on rainfall, length of growing period, mean above-ground temperature, temperature range, and soil types obtained from the Crop Ecology/Modeling Unit IITA were considered together to produce various crop suitability maps. TRIS ver. 1.0 contains 42 basic coverage and 50 point databases. Each coverage has user-input features and can be customized (controlled selectively) by switching themes to meet user's need. TRIS is an essential tool for broad scientific research planning, implementation, and evaluation of tuber and root crops in sub-Saharan Africa. A strong advantage of TRIS is its ability to show homologous environments on maps that will help in the distribution of tuber and root research information and technologies. TRIS runs on a geographic information system (GIS) software known as ArcView. Minimum requirements for installation on PCs are 160-MB hard disk space, 16 MB RAM, and 100 MHz. TRIS can be obtained on CDs from Crop Improvement Division of ITTA.

Pages 110-120

Gender implications for sustainable technology adoption

M.O. Ekop

ABSTRACT

Assessment of the average yields at farmers' level has indicated only limited adoption of improved technologies inspite of years of research efforts. Research Centers are therefore faced with challenges of adoptions of existing prototype technologies in appropriate areas. Central to improving livelihood systems are the capacities of local institutions to respond to challenges within these ecosystems. Moreover, the effectiveness of institutional responses is limited to the roles of both women and men within local communities. The purpose of the gender project is to understand the ways in which gender as a key factor in division of labour, rights and responsibilities affects the management of local systems for sustainable livelihood. This poster explores alternative approaches to technology adoption and resource management, identifies changing forms of community organizations and clarifies the important gender-based variables arising from community level management of technology.

Pages 121-125

Opportunities and constraints in the commercialization of cassava production and processing in Kenya

Anselimo O. Makokha

ABSTRACT
Kenya has been experiencing recurrent food shortages, which are partly due to over reliance on maize, wheat and rice as the main staple and industrial food crops. Though both the colonial and post-colonial government policies promoted the production of these and other recently introduced crops, they cannot grow well in most of the country, 80% of whose land mass lies in the marginal and semi-arid land zone On the other hand there is great potential of alleviating the food deficiency and increasing income among the rural poor in these marginal regions by expanding the production and utilization of cassava This crop, which is at present mainly produced, processed and utilized on a limited subsistence scale, can give better yields in these regions. It was an important traditional food in western, eastern and the coast regions of Kenya crop. Other than past government policies, lack of commercially processed and marketed cassava products have restricted cassava production and utilization. Recent national and regional research work indicates that appropriate machinery and equipment for processing cassava into flour and pellets can be fabricated. But more work still needs to be done in linking variety development to specific cassava products, and in product development, including market studies.

Pages 126-131

Processing and economics of production of lesser known cassava food products in southwestern Nigeria

Elizabeth Tola Ojeniyi

ABSTRACT
Cassava is a staple energy food crop that is processed into various food products in Nigeria. Lesser-known cassava products include; “Ajogun” - local cassava biscuit. “Benju” – local cassava cake, “Abodo” local cassava bread, and “Apran” a cassava based dough in Lagos and Ogun state while “Kpukpuru” is produced in Ondo State. The processing technology involve peeling, grating, dehydration and smoking in some cases and all these processing stages complement the high digestibility of the cassava food products by adults and children. The economics of production shows highest profit margin for “Apran” at N45, 280/tonne and the least for “Kpukpuru” at N1.900/tonne. The products are all consumed by adults while additionally “Kpukpuru” is consumed as a weaning food. There is a need to investigate the nutrition, toxicology and microbiological safety of the various food products.

Pages 132-136

Economics of potato production under irrigated and rainfed conditions in high altitude areas of Nigeria

Asumugha, G.N; Okonkwo, J.C. and Okoli, O.O

ABSTRACT
Potato production in Nigeria is restricted to high altitude areas. Jos Plateau alone accounts for over 75% of total potato produced in Nigeria. It is grown mainly under rainfed condition. This limits the availability to consumers throughout the year. Supplemental irrigation was seen as possible way of raising the productivity of the crop as well as increasing output of growers. This study was designed to as certain the economics of potato production under irrigated conditions compared to the rainfed system by utilizing data obtained in both rainy and dry season trials at the National Root Crops Research Institute Research farm in Kuru, Plateau State of Nigeria in 1994/1995. Compared to the rainfed production system, the irrigated potato farm produced higher quantity of

output at relatively high unit cost of production. However, the per-unit net returns are much higher on the irrigated potato farm. Results of the economic efficiency tests showed that the irrigated potato farm has high level of technical efficiency where land, labour and capital inputs were intensively used, while the unirrigated potato farm was allocatively more efficient.

Pages 147-155

Compétitivité de l'igname au Nord de la Côte d'Ivoire: concepts et méthodologies d'élaboration des budgets de culture

Stessens Johan Doumbia Sekou

Résumé

La production agricole en Afrique de l'Ouest résulte la plupart du temps d-un processus d'adaptation complexe et dynamique des agriculteurs aux ressources limitées à un environnement physique difficile. Une étude de l'impact des améliorations techniques ou politiques sur la production et les exploitations agricoles est une étape logique, pour qui veut bien comprendre le processus de réalisation du progrès en agriculture. Les budgets financiers constituent une composante de base d'une telle étude permettant l'évaluation de la productivité et de la compétitivité des différente cultures. En effet il s'est opéré en Côte d'Ivoire un changement important dans l'environnement économique des exploitations agricoles à la faveur de la dévaluation mtervenue en Janvier 1994. La rentabilité de certaines cultures a été remise en cause tandis quo celle d'autres a été affirmée. A l'occassion de cette communication nous intéresserons aux budgets financiers dont les concepts et les méthodes d'élaboration sont expliqués à travers 1'analyse de 47 exploitations agricoles. Nos résultats indiquent que la culture d'igname reste compétitive par rapport aux autres principales cultures de la région.

Pages 156-167

Farmers' perceptions of, and actions on, resource management constraints, in the yam based systems of western Nigeria

Manyong, V.M, R. Asiedu and G.O. Olaniyan

ABSTRACT

Farmers' perceptions of, and actions on, resource management constraints were investigated from a participatory rural appraisal survey with about 600 yam growers in a major yam-growing area of Nigeria The results indicated that, contrary to many conventional views, women (35% of survey farmers) are widely involved m yam production. Women were found to be more efficient in yam production than men. Women achieved a higher benefit: cost ratio (women 3.43, men 2.94). Fewer women than men were marginal yam growers i.e. with a benefit: cost ratio below 1 (women 13.5%, men 21.4%). The major constraints in yam production for both sexes were pests and diseases m the field and in storage such as scale insects (*Aspidiella hartii* (Cockerell), (Hom: *Diaspididae*), yam tuber beetles (*Heteroligus* spp), nematodes (*Scutellonema brad*ys (Steiner et Lettew), Adrassy and *Pratylenchu*s spp. Filipyer), and viruses. Other field constraints such as weeds, declining soil fertility, labour cost, and lack of staking materials were of less importance. This is probably because land is still abundant in the area and the high returns from the crop (average benefit: cost ratio was 2.98) overshadow the high intensity of labour. Overall, the study shows that a large majority of farmers had no solution to most of the perceived problems. The existing technologies were considered ineffective, unavailable, or expensive. The paper concludes that gender and control of pests and diseases should he an integral part in the process for the development of sustainable yam production systems in West Africa.

Pages 167-173

Comparative analysis of costs and returns in dry and wet season planted yams in Benue State Nigeria

B.O. Ugwu, T.O Ezulike, G.C. Orkwor and E.C. Nwauzor

ABSTRACT

In forest and savanna zones of Nigeria, yams may be planted in dry or wet season. Differences in time of planting may influence the amount and availability of labour, disease/pest incidence, and yield of yam. All this could affect returns on investment in yam production. The problem is to ascertain when best to plant yams to maximise gross returns. In forest and savanna zones of Nigeria, yams may be planted in dry or wet season. Differences in time of planting may influence the amount and availability of labour, disease/pest incidence, and yield of yam. All this could affect returns on investment in yam production. The problem is to ascertain when best to plant yams to maximise gross returns. Five cultivars of yam were planted in heaps in January 1994, for the dry season planting, and in April of the same year, for the wet season planting. The experimental design was a randomised complete block design in four replications, and the experiment was repeated in 1995. A cost and returns enterprise budget shows that, for both *Dioscorea rotundata* and *Dioscorea alata*, time of planting did not affect total variable costs. However, yield, total revenue and gross margin were significantly higher for the dry, than wet season planted D. rotundata, but the reverse was the case with respect to D. *alata.*

Pages 174-195

African cassava trends and prospects for the 21st century

Felix I. Nweke

ABSTRACT

Cassava production achieved positive, though marginal, growth in the past 37 years. It provided some measure of security in food supply by increasing when the productivity of other staples declined in countries which suffered major crises such as drought or civil wars. But the positive growth rate was achieved only in a few countries where farmers had access to labor-saving processing technologies. The high growth rates attained in the Sahel during the drought periods were not sustained; in those areas grains were preferred to cassava in the food system. With few exceptions and apart from countries where the crop played major food security roles, cassava production was positively correlated with national income only in countries which process cassava into convenient food products which are attractive to urban consumers and therefore has relatively high income elasticities of demand. The post-harvest technologies were generated in the private sector and they have been available for relatively long periods though not used in many countries. The increase in per capita production was achieved through increase in yield because area harvested per capita declined during the period. The period of increase in yield coincided with the period of wide adoption of high yielding varieties in Nigeria, a very recent development. African cassava is used predominantly for human consumption although there is a downward trend in the food share of the African cassava. But Africa's share of world food cassava has an upward trend because the relative food shares of other regions' productions are declining faster than the relative food share of African production. The feed share of the African cassava production has an increasing trend, which is strong enough to produce an upward trend in Africa's share of world feed cassava. The increase in the feed share of Africa's cassava was derived from just one country. Similarly, industrial use share of African cassava production showed an upward trend which was strong enough to cause an increasing trend in Africa's share of world industrial use cassava even though known recent developments in uses of cassava in industries have not entered the records. Cassava was exported at one time or another by most African producing countries and even though the export share in production declined to near zero at a certain time it appears to be recovering. Africa's ability to compete in the export market is constrained by high domestic demand for food, high production and processing costs and low product quality. The downward trend in food share of African cassava production and the upward trends in feed and industrial use shares reflect positive impact of the recent public sector post-harvest research and development and increasing commercialization of production. There was an upward trend in waste share of African cassava and an upward trend in African share of world waste cassava. These suggest that Africa is lagging

other regions in post-harvest management technology adoption. In the 21st century cassava will continue to provide food security in periods of crises; to sustain production gains made during such period's research and development must address the specific needs of areas prone to drought. This will include breeding of varieties suitable for the ecological and system conditions as well as adapting and extending available labor-saving processing technologies and convenient food products which will help cassava compete with preferred grains. Public sector research and development made positive impact in their short time of existence; if they continue to build on their accomplishments and on the accomplishments of the private sector post-harvest research and development, many positive things will happen in cassava production and utilization in Africa For example, waste share of African cassava will decline, cassava will serve the food, feed and other industries, and Africa's share of world export cassava will increase. Cassava will be widely transformed into a commercial crop in the 21st century.

Pages 195-197

Socio-economic determinants of ginger (*Zingiber officinale*) surplus traded in Nigeria

G.N. Asumugha, J.E. Njoku and F.I. Nweke

ABSTRACT

Ginger (*Zingiber officinale*) a root crop, is an important cash crop in Nigeria which contribute to foreign exchange earnings. Ginger is used as spice in confectionery and bakery industries, in culinary as well as soft drink concentrates, and in perfume and pharmaceutical industries. In this study, the socio-economic determinants of the ginger surplus traded in Nigeria are analyzed using the method of ordinary least squares (OLS) regression. Cross-sectional data were obtained in a survey across the ginger growing and marketing areas of Nigeria. The study covered the period 1996-1997. The empirical results of the regression analysis suggests that the ginger surplus traded is fairly well accounted for by age of trader, marital status, household size, social organization membership, trading experience, source of capital and transportation mode as indicated by the high

t-values obtained for the coefficients. This was at 1-10 percent levels of probability. The coefficient of determination (R^2) was 0.83 showing that 83 percent of the total variations in the surplus ginger traded were explained by the included explanatory variables. It is recommended that in maintaining surplus ginger produced and traded in Nigeria, attention should be paid to this group of variables. Also reasonable producer prices for ginger should be ensured.

Pages 198-208

Nutrient balance model for design of sustainable yam cropping systems

R.J. Carsky, N. Wolo, V.M. Manyong and G. Tian

ABSTRACT

A simple balance sheet was used to identify nutrient limitations in yam production and to predict changes in soil nutrient stocks as a result of adoption of soil improvement systems for yam, using *Gliricidia sepium* agroforestry (cut-and carry and *in situ*) systems as examples. Fixed nutrient inputs taken from the literature include weathering, atmospheric deposition, non-symbiotic. Biological N-fixation (BNF) and those present in the yam seed while fixed exports are leaching and runoff/erosion. Variable inputs are nutrients in *G. sepium* mulch and crop residue return. Variable exports consist of nutrients in the yam tubers and uptake by trees when grown in the same field with yam. Literature review has provided estimates of yam tuber nutrient concentrations, expected amounts of *G. sepium* mulch and its nutrient content. Sensitivity analysis using the model suggests that nutrient contents of yam and *G. sepium* mulch are important terms in the equation and therefore should be locally measured. The model predicts N depletion in an *in situ* system except for yam yield of 10 Mg/ha or less and *G. sepium* mulch application of 4.5 Mg/ha or more. Higher yields of yam tubers (15 to 20 Mg/ha) are attainable without soil depletion in a cut-and-carry system with 3 to 4.5 Mg/ha of mulch. Without K fertilizer, the model predicts potassium mining under all scenarios of an *in situ* system and even m a *G. sepium* cut-and-carry system

unless 3 to 4.5 Mg/ha of mulch is applied. The results suggest that for long-term sustainability, K must he applied either directly to the yam crop or to the associated *G. sepium* when the two are grown in association.

Pages 209-212

Time of introduction and variety effects of cassava in intercropped upland rice/cassava in southeastern Nigeria

J.E.G. Ikeorgu and Chris Onwubuemeli

ABSTRACT

The effects of introducing TMS 30572 and TMS 4(2)1425 cassava varieties at 0 and 28 days after planting (DAP) upland rice were evaluated on-farm in Enugu and Nsukka ADP zones of Enugu State between 1996 and 1997. The sparse canopy cassava, TMS 4(2)1425 was more compatible with upland rice than the dense canopy cassava. Delaying cassava introduction by 28 days gave higher rice grain yields than simultaneous planting of both crops on the same day, though at the expense of cassava tuber yields. Farmers are advised to delay cassava introduction to rice by 28 days and use sparse cassava genotypes so as to maximize rice yields.

Pages 212-216

Evolution de la fertilite d'un sol degrade sous differents systemes de cultures en rotation

Adissa Mouïssou Toukourou

Résumé

Pour remédier au processus de dégradation des terres cultivées dû à 1'utilisation des techniques culturales inappropriées entraînant une mauvaise gestion des terroirs, une étude de restauration et du maintien de la fertilité est menée à Avrankou dans le département de 1'Ouémé. Dans cette étude trois systèmes de culture avec et sans engrais ont été évalués dans Ie cadre d'une rotation culturale. Il s'agit de S1 (maïs/arachide), S2 (maïs + mucuna), S3 (maïs + manioc). Une fumure annuelle de 100 kg d'engrais coton à1'hectare + 25 kg de chlorure de potassium à l'hectare a été appliquée aux parcelles fumées. La rotation culturale a démarré la seconde année.Les systémes
Sl, S2, S3 sont devenus des sous-systèmes dans chaque système principal de base de la première année. Au cours de la troisième année le système S3 (maïs + manioc) a été dominant pour tous les sous-systèmes de la deuxième année. L'analyse des échantillons de sol prélevés dans les horizons (0-15) cm et (15-30) cm avant la première année d' installation et la quatrième année de la conduite de 1'essai a montré une diminution de la teneur en azote par rapport à la première année où le site était en friche. Cette mobilité de l'azote pourrait être expliquée par deux phénomènes soil l'azote a été utilisé par la culture ou soil l'azote pourrait être lessivé ou volatilisé. De façon global il y a eu une amélioration du taux de la teneur en azote, en matière organique et en potassium du sol qui sont respectivement de 1'ordre de 0,004, 0,724 et 0,205. L'insertion des légumineuses (Mucuna utilis et Arachis hypogea) dans les systèmes de cultures en rotation a aussi amélioré Ie rendement des cultures dans les rotations culturales telles que maïs-mucuna/maïs-mamoc/maïs-manioc; maïs-mucuna/maïs-mucuna/maïs-manioc. La tendance est à la baisse dans les systèmes de culture à monoculture maïs-manioc/maïs-manioc/maïs-manioc.

Pages 217-223

Response of a yam-maize-pepper intercrop to spatial arrangements

J.A. Manu-Aduening and K. Boa-Amponsem

ABSTRACT

Spatial arrangement of plants is critical in determining the growth and yield of intercrops. The productivity of three spatial arrangements of yam-maize-pepper intercrop was studied. The intercrop row arrangements were, 1 row of yam: 1 maize/pepper relay, 2 rows of yam: 2 rows of maize/pepper relay and 1 row of yam-pepper: 1 row of maize, yields of the intercropped components were lower than their sole crops. However, the intercrops were more productive than the sole crops as shown in the Land Equivalent Ratios (LER) which ranged from 1.86 to 2.31 and Crop Performance ratio (CPR) from 1.44 to 1.69. The competitive ratios for the crops showed that yam was more competitive followed by maize and pepper but the influence of the dominated crops (maize and pepper) on the intercrop performance was not significant since the population of yam in all treatments was kept constant. A consequence of the intercrop competition was that maize and pepper components showed differences in plant height and the extent of leaf conductance was also higher than the sole crops. This study showed 1 row of yam/pepper. 1 row of maize, planted the same time, was superior to the other two spatial arrangements where pepper came in as a relay crop.

Pages 224-229

Evaluation of new fertilizer formulations for seed yam production using minisett technique in yam/cassava/maize/melon intercrop in a highly degraded tropical rain forest soil of southeastern Nigeria

Olojede A.O, A.C. Ohiri and G.O Chukwu

ABSTRACT

Six new (fertilizer formulations were evaluated at four rates (0,400, 800 and 1200 kg ha^{1}) for seed yam production using the minisett technique. The field trial was conducted in 1994 at University of Uyo, Main Campus, Uyo - Akwa Ibom State while the repeat trial was sited at the experimental farms of the National Root Crops Research Institute, Umudike in 1995. The aim of the trial was to provide a complete production package for yam minisett technique through appropriate fertilizer formulation and rate for seed yam production in nutrient deficient soils of the Southeast agro-ecology. A combined analysis of the two year data showed that fertilizer formulations had significant ($P < 0.05$) effects on yam tuber yield, total calorie yield and net returns while fertilizer rates significantly influenced all parameters considered for the two years. For seed yam production under this cropping situation, fertilizer of higher K ratios performed better. There was no apparent yield advantage of calcium blended fertilizer types over non-calcium ones. Zinc blended formulation (20:10:10+ 2S + Zn) gave a better yield of yam tubers and net returns followed by the popular NPK 15:15:15 and 27:13-13. A rate of 800 kg ha^{-1} irrespective of fertilizer formulation was found adequate and economical having 49% profit margins over the control.

Pages 230-236

Yams in the Tanzanian food and farming systems: implications for research and development

R. Kapinga, N. Wanyera, R. Asiedu, B. Chirimi and S. Kaare

ABSTRACT

Yams have been known to grow in Tanzania for many generations. At farm level the role of yams goes beyond the subsistence farming systems and household food security to serve as income generating commodity. In 1996, the International Institute of Tropical Agriculture (IITA) in collaboration with the National Root and Tubers Research Program conducted a baseline study on yam production prospects in 31 villages from three major growing zones. Results showed that farmers have good experience in yam cultivation practices. Five different species are grown. There is a great genetic diversity including wild and domesticated species which provides opportunities for selection to suit various ecologies, production systems and modes of utilization. Major constraints to production include pests e.g.yam beetles, diseases, lack of improved varieties and good quality planting material as well as high cost of staking material. The outputs of this study called for opportunities for further development of the crop. In January 1998, the national program initiates yam research through the IITA collaborative project: Community-based Promotion of Food Security Crops in Selected African Countries. This project involves five national programs and IITA. It is sponsored by USAID office for Foreign Disaster Assistance. To-date yam (D. *alata* and D.*cayenensis*) planting materials collected from farmers are under multiplication at Ukiriguru and Maruku Research stations in the Lake zone for distribution to farmers. Seventy-two farmers have been trained in miniset rapid multiplication techniques. Thirty varieties of improved white yam have been introduced from IITA for future evaluation with farmers on adaptability and acceptability.

Pages 237-240

Integrated weed management of *Panicum maximum* in minisett cocoyam/maize intercrop in southeastern Nigeria

T. Enyinnia

ABSTRACT
An integrated weed management trial on Panicum maximum in minisett cocoyam/maize intercrop, comprised pre-emergence application of aclonifen plus metolachlor (Challenge-M) with egusi (*Citrullus vulgaris*), atrazine plus metolachlor (Primeztra) with egusi, hoe weeding with egusi and "no weeding" with egusi treatments. *P. maximum* was slashed from each treatment 9 weeks after planting (WAP) cocoyam and maize. Weed control rating at 60 days after planting (dap) was higher in the treatments containing herbicides. At 9 WAP the herbicides significantly reduced the dry weight of *P. maximum* over both the hoe weeding and "no weeding" treatments. Removal of *P. maximum* resulted in higher maize and minisett cocoyam yield but not that of Egusi for each treatment. Thus *P. maximum* may be kept under control through integrating suitable herbicides e.g. Primetre or challenge-M herbicides, growing of egusi and slashing.

Pages 241-245

Cassava based farming systems in the semiarid zone: need for a change in agronomic practices

I.j. Ekanayake and U.C. Okarter

ABSTRACT
Cassava (*Manihot esculenta* Crantz) is one of the main staple crops grown in the semiarid zone of sub-Saharan Africa. It is reported to be a favoured alternate crop in the drought-, famine-, and war-prone areas of this region due to its desirable morphological, physiological, genetic and agronomic features. Production levels in fanners' fields however do not meet its potential biomass yields (storage roots and foliage) as reported by the researchers. Therefore, we attempted to search for possible ways of alleviating the factors responsible for this yield gap. Data gathered from various field trials conducted on-station and on-farm and surveys carried out over a 6-year period in the Northern Guinea Savanna zone and Sudan Savanna zone in Nigeria are used to synthesize appropriate agronomic practices for cassava. Recommendations are given for the improvement of productivity of cassava using two components strategy, the combined use of improved and drought-adapted clones and good quality planting materials.

Pages 249-255

Place du manioc dans les systèmes de production des zones semi-arides de l'Afrique centrale et occidentale

Tshiunza M. et A.G.O. Dixon

Résumé
L'objectit de cette étude était d'établir 1'importance actuelle de la culture du manioc dans la zone semi-ande de l'Afrique centrale et occidentale et de proposer quelques grandes lignes d' intervention en vue de la vulgarisation de cette culture dans la région. Pour ce faire, une enquête-village a été organisée d'octobre à décembre 1997 dans 200 villages du Burkina Faso, du Ghana, du Niger, du Nigéria et du Tchad. Il ressort des résultats de 1'enquête qu'environ 40 % des villages visités cultivent le manioc. Cependant le manioc y est une culture d'une moindre importance. Il se positionne généralement entre la 5^{e} et la 10^{e} places parmi les cultures les plus importantes et il est

cultivé par environ 42% des paysans. Dans la plupart des villages, la superficie allouée à sa culture (ou plus exactement Ie nombre de pieds de manioc) est en nette progression depuis les dix demieres années alors que le rendement en tubercules de manioc frais est en diminution, excepté au Nigéria. Ces résultats suggèrent au moins deux grandes lignes d'intervention en vue d'une vulgarisation éventuelle du manioc dans la région étudiée. Une première ligne d'intervention consisterait à mettre en place une stratégic d' « expansion spatiale » de la culture du manioc qui consisterait à introduire, dans la mesure du possible, le manioc là où il n'est pas encore cultivé. La deuxième ligne d'intervention devrait mettre en place une politique d' « intensification de la culture du manioc ». Cette stratégie devrait d'abord s'adresser aux villages où le manioc est actuellement cultivé. Elle se consacrerait prioritairement à 1'identification et la résolution des principales contraintes à la culture du manioc rencontrées par les paysans.

Pages 256-260

The potential of cocoyam production in Ghana

Regina Sagoe, K.A. Marfo & A.A. Dankyl

ABSTRACT

Ghana has a vast potential of increasing its cocoyam production, although its present productivity is as low as 5.6mt/ha as compared to world yields of 12-20 t/ha. A survey was conducted to investigate the production constraints underlying this low productivity in areas that used to boom with cocoyam production. It was observed that improved technologies and varieties that are high yielding and disease tolerant were absent. An economic analysis of the production of the crop using data collected in the survey showed very attractive net returns, even when the cost of labour was varied by as much as five times the existing value. So, in a perfectly competitive system, cocoyam production could be said to be economically efficient. If an integrated approach is made through an improvement program, cocoyam could become a major food crop in Ghana.

Pages 260-265

Influence of shoot number per stand on growth and yield stability in cassava (*Manihot esculenta*)

O.N. Eke-Okoro, O.U. Okereke & J.E. Okeke

ABSTRACT

The effect of shoot number per stand on growth rate, yield and stability of yield in three cassava cultivars (TMS 30572, TMS 91934 and NR 8083) were studied at the National Root Crops Research Institute, Umudike, Nigeria for two years. Differences in shoot number per stand were reflected in crop growth rate and stand yields. Increasing shoot number beyond a maximum of two shoots per stand decreased crop growth rate, fresh root yield and instigated variability in cassava yield in both profusely and sparsely branching types. Two shoots per stand would therefore be regarded as the optimum shoot number for ensuring best performance and stable yields in cassava production. Cassava cultivar TMS 30572 sustained the highest crop growth rate, fresh root yield and stable yield among the three cultivars.

Pages 266-271

Growth and root yield of cassava as influenced by time of intercropping with rice

A. Jalloh & M.T. Dahniya

ABSTRACT

An improved cassava variety 80/40 was intercropped with rice on the same date, 4 and then 8 weeks after planting cassava. A sole plot of cassava was established as a control. This experiment was conducted during the 1993/94 cropping season on the upland of the experimental farm of the Institute of Agricultural Research in Sierra Leone. The objective of the experiment was to determine the effect of time of intercropping cassava with rice on the growth and root yield of cassava. Cassava intercropped with rice on the same date was shaded by the rice throughout their period of association. Delaying the introduction of rice into cassava by at least 4 weeks allowed the cassava to receive 100 percent of global light. Plant growth rate, harvest index and tuberous root yield of cassava were significantly affected by intercropping cassava with rice on the same date. Intercropping rice with 4 week old cassava produced the highest land equivalent ratio and area x time equivalent ratio. The results suggest that for improved growth of cassava intercropped with rice, the cassava should be planted 4 weeks before intercropping with rice.

Pages 272-279

Climatic and growth stage influence on tuberous root yield and cyanogenic potential, leaf water

potential and leaf area duration of divergent cassava (*Manihot esculenta* Crantz) clones

C.M. Githunguri, J.A Chweya, I.J. Ekanayake & A.G.O. Dixon

ABSTRACT

Cassava roots provide a cheap source of dietary energy. Variations in yield, root cyanogenic potential (RCNP), leaf water potential (LWP), and leaf area duration (LAD) occur due to various factors. This makes selection of clones with wide ecological adaptation and high yield difficult. The influence of crop age and agroecozones (AEZ) on above parameters of cassava were studied in Nigeria. The tested AEZs were Sudan savanna (Minjibir), southern Guinea savanna (Mokwa) and forest-savanna transition (Ibadan). Results suggest that root development was restricted by low moisture stress. The highest yield was obtained at 8 months after planting at Mokwa. RCNP increased with age and changed with location. The lowest and highest RCNP and LWP were recorded in wet (Ibadan) and drier (Minjibir) regions and during drought and rains, respectively. The sites had a similar LAD. Close relationships were obtained for root yield and LAD, RCNP, LWP and between RCNP and LAD.

Pages 280-284

Seasonality and climatic period effects on crop evapotranspiration of sweetpotato

Godwin O. Chukwu

ABSTRACT

Poor knowledge of water requirements of sweet potato (*Ipomoea batatas* [L.] Lam) limits irrigation water management to produce the crop throughout the year. Crop evapotranspiration and irrigation water requirement of sweet potato were therefore assessed theoretically at Umudike (05° 29'N; 07° 33'E), southeastern Nigeria, using Blaney-Criddle equation. Seasonality comprised dry season (December, January, February and March) and wet season (May, June, July and August). Climatic period comprised 10 years (1984-1993) and 63-year average. There were no significant differences in crop evapotranspiration between seasons, climatic periods and their interactions. Mean seasonal crop evapotranspiration were 557.1 and 538.2 mm for the dry and wet seasons respectively. Mean seasonal irrigation water requirements were 454.9 mm in the dry season and zero in the wet season to enhance judicious use of water resources to produce sweet potato throughout the year in southeastern Nigeria.

Pages 284-290

Productivity and storage root quality of sweetpotato (*Ipomoea batatas* [L.] Lam) as influenced b the number of nodes per planted cutting

M.J. Tucker and M.T. Dahniya

ABSTRACT

Scarcity of improved sweetpotato vine cuttings at the beginning of the rains is a major constraint to increased production of the early crop in Sierra Leone. With the limited vines available, farmers resort to planting small plots or using short cuttings with few nodes to plant larger areas. The response of two widely grown sweetpotato cultivars, Njala White and 82/123R, to varying numbers of nodes per planted cutting ranging from 4-18 cm with 1-5 nodes compared with the

normal vine length (NVL) of 25-30 cm with 8 or more nodes (control) was evaluated in two growing seasons at the Institute of Agricultural Research research farm at Njala from June to October. Except for mean marketable root weight, cuttings of both cultivars with 1 and 2 nodes were consistently inferior in terms of stand establishment, storage root numbers and yields compared with cuttings with 3 or more nodes. By final harvesting at 18 weeks after planting, marketable root numbers and yields of 3, 4 and 5-node cuttings were not significantly different from the control. Mean fresh marketable root yield averaged over both years for 1-node cuttings and the control ranged from 4.55 - 16.66 t ha^{-1} and from 6.33- 16.87 t ha^{-1} for Njala White and 82/123R, respectively. Significant increases in root yield resulted with increase in nodal units per cutting from 2 to 3 nodes. Investment in vine cuttings was highest for the control. Highest net benefits were derived from 4 and 5-node cuttings for both cultivars indicating the potential of increasing total production and returns by using 4 and 5-node cuttings of swetpotato to plant larger areas with the early crop which usually yields higher and commands a higher price.

Pages 290-297

Field performance and reaction to weevils of improved and local sweetpotato genotypes in Cameroon

J.M. Ngeve

ABSTRACT

Three sites differing in soil type, temperature, vegetation and weevil pressure, were used to evaluate the field performance of 18 sweet potato clones and two local cultivars and their reaction to weevils (*Cylas* spp.), in Cameroon. The wet season crop produced higher yields than the dry season crop. Clones 048 and 1112 produced the highest storage root yields (about 17 t/ha) across sites during the rainy season but only 12 t/ha in the dry season. Marketable yields were also higher (10 t/ha) in the wet season crop than in the dry season crop (6 t/ha). The highest yields were obtained in Nyombe in both wet and dry seasons; yields were halved in each of the other sites.

Stability methods differed in identifying stable clones, and differed in ranking clones depending on the trait measured. However, both Eberhart-Russell and Shukla stability methods rated clones 048, Tib 1, 1602, 1639, 002 and Njombe as stable for root yields. Clones suffered more weevil damage in the dry season than in the wet season. Root yields and related characters where highly correlated with weevil damage. There relationship between weevil tolerance and cultivar adaptability was not consistent. This study shows that the main sweet potato crop should be grown during the first cropping season when there is abundant moisture for slip sprouting and establishment and when there is little soil cracking to facilitate weevil infestation. The study suggests that since root yields are adversely affected by weevil damage, weevil control measures should be seriously considered in commercial sweet potato production. Lastly, it suggests that since fewer clones were found to carry high levels of tolerance to weevils, further research is necessary in breeding for resistance to weevils.

Pages 297-299

Producing seed yams (Dioscorea rotundata) from sprouts

B.A. Aighewi, R. Asiedu and M.O. Akoroda

ABSTRACT

Obtaining seed yams in sufficient quantity and quality is a persistent problem in production of white yam (*Dioscorea rotundata* Poir.), especially for beginning yam farmers and researchers. Conventionally, the tuber is the only means of propagation for white yam and it is very expensive. Yam sprouts which are normally cut off from tubers in storage and discarded were evaluated as an alternative means for producing seed yams. The critical period for plant survival was 4-6 weeks after planting (WAP) In 1994, 3.2% of sprouts from local variety Pepa established and survived until harvest, compared to 32.3% from local variety Abi. In 1995, 56.7% of sprouts from Pepa established and survived till harvest. Mean tuber weight for Pepa was 1808.0 ± 255.1 g and 522.8 ± 30.3 g in 1994 and 1995, respectively, while that for Abi was 277.4 ± 20.7 g in 1994. In 1994, 71.4% of Pepa plants produced tubers weighing 1 kg or more.

Pages 300-303

Seed yams (*Dioscorea rotundata* Poir) production, storage and quality in some yam zones of Nigeria

B.A. Aighewi, M.O. Akoroda and R. Asiedu

ABSTRACT

The unavailability of good quality seed yams (*Dioscorea rotundata* Poir.) is frequently cited to be responsible for the slow rate of growth or decline in yam production. Current production, storage practices, and quality of seed yams in 35 villages of Oyo North, Asaba, Lokoja and Lafia areas of Nigeria were studied by survey. Over 57.9% of farmers used only seed yams from their farms. All farmers practiced double harvesting together with other traditional methods of production. Between 50.0 - 65.0% of farmers in Asaba treated seed yams before planting to protect against beetle attack, while at other locations less than 35% did any form of treatment. Storage in situ or planting shortly after harvest is widely practiced in Oyo North, Lokoja and Lafia areas. The yam beetle and scale insects caused much damage to seed yams at Asaba and Lokoja, respectively. About 47.4 - 90.0% of farmers had a combination of pests and rots on their seed tubers.

Pages 304-307

Influence of tuber sett-weights on flowering in *Dioscorea rotundata* Poir

V.A. Chikaleke, R.Asiedu and C.A. Fatokun

ABSTRACT

To formulate an efficient hybridization system for the improvement of *Dioscorea rotundata* (white guinea yam) the influence of tuber sett-weight on flowering was investigated. The results showed tuber sett-weights can be manipulated as a means of synchronizing anthesis in male plants and receptivity in female plants apart from multiple and staggered planting dates previously in use. Although plants from larger sett-weights initiate flower buds earlier than those from smaller sett-weights, there was no correlation between sett-weights and flowering intensity.

Pages 307-310

Influence of fertilizers on yield, storage and food qualities of yams

M.O Adeniji, G.O Obigbesan, R. Asiedu and M. Bokanga

ABSTRACT

Studies were carried out at the IITA, Ibadan, Nigeria on the influence of chemical fertilizers on tuber yield, storage and food qualities of two *Dioscorea species*: D. *alata* and D. *rotundata*. The

treatments were: Control (No fertilizer), N, NP, NPK, and NPK-Mg, based on the recommended rates for yam in Nigeria, namely: 70 kg N/ha (as Urea), 50 kg P_20_5/ha (as single super phosphate) 20 kg K_20/ha (as muriate of potash) and 2 kg MgO/ha (as Magnesium sulphate). The various nutrient elements portrayed their differential effects on the fresh tuber yields. Whereas yield rose by 35% with NPK application to D. *alata*, only 15% increase was obtained by NP application to D. *rotundata*. Both yam species responded to Phosphorus application with yield improvements of up to 3.9 tons/ha (D. *alata*) and 5.9 tons/ha in D. *rotundata*. Storage attributes in the D. *rotundata* cultivar such as weight loss, percentage of sprouted tubers from 8 to 24 weeks after harvest, were not affected. Application of N alone reduced the general acceptability in the two cultivars when tubers were pounded. Balanced fertilizer combination NPK-Mg resulted in the best product quality.

Pages 311-314

Effect of time of introducing component crops on yield of cassava/groundnut intercrop

J.Y. Asibuo and P. Osei-Bonsu

ABSTRACT

Time of introducing component crops in a cassava/groundnut intercropping trials were conducted between 1996 and 1998 on a Lixisol at Ejura (1° 22‘W and 7°23‘N), in Ghana to investigate the best time to plant the crops for optimum yield. Cassava cultivar ‘Akosua tuntum’ was planted into groundnut ‘Dagomba’ at 0, 14, 28, 42 days after planting, groundnut was also planted into cassava at 14, and 28 DAP; there were sole crops as control. The results of the study showed that there were significant differences ($p< 0.05$) between the groundnut pod yields There were significant differences between the fresh root yields of cassava. Cassava root yield decreased by 58% and 39% when planted into groundnut at 42 DAP in 1996 and 1997 respectively. There were more roots when groundnut was planted into cassava and the roots were also bigger. The stem diameter

was significantly correlated with fresh tuber yield (r = 82.8, p = 0.001 in 1996 and r = 77.8; p = 0.001 in 1997). The land equivalent ratio values ranged trom 1.53 to 1.87 indicating an advantage of intercropping over sole cropping. The advantage of intercropping however decreased as the time of introducing cassava into groundnut was delayed up to 42 days after planting.

Pages 314-321

Improving the technology delivery mechanism: lessons from a pilot study on the diffusion of improved potato varieties using a farmer based seed production system

C. Lung'aho, P.M. Kinyae, H.M. Kidanemariam & P. Ewell

ABSTRACT

Poor linkages between researchers and extensionists frequently hamper the transfer of improved technologies to farmers. This is more so where a central source type of innovation model is used to pass new innovations in a one way progression in the research, extension and adoption process. Three organisations; Kenya Agricultural Research Institute - a public research organization and two non-governmental organisations; World Vision-Kenya and Plan International-Meru forged a partnership through which two late blight tolerant varieties were systematically transferred to small scale growers using a farmer based seed potato production and distribution system. The study, conducted between April 1996 and October 1997, targeted two areas; Maua and Burguret. The procedures that were used included planning/sensitization meetings, a needs assessment survey, verification trials and field demonstrations. The strengths and weaknesses of a partnership between researchers and NGOs in the process of technology transfer are presented. Measures aimed at strengthening these partnerships are suggested and important lessons that were learned discussed.

Pages 322-330

Relative performance of cassava (*Manihot esculenta* Crantz) on the upland in Sierra Leone and Guinea

E.S. Bah, M.T. Dahniya, J.B. George & A. Jalloh

ABSTRACT

The performance of five cassava (*Manihot esculenta* Crantz) clones (four improved and one local) was evaluated at Foulaya in Guinea and Njala in Sierra Leone during the 1993/94 cropping season. The major objective of the study was to compare the relative performance of the cassava clones in the two locations which are the cassava breeding centers in the two countries. The results revealed that all the varieties performed better at Foulaya in Guinea than at Njala in Sierra Leone. The plants produced higher number of roots, heavier roots and higher root yield in Guinea The improved varieties significantly outyielded the local varieties. There was no significant interaction between location and genotypes. Since the two locations represent the centers of cassava breeding in the two countries, adaptability of the genotypes developed in one location could not be a problem in the other. This is likely to facilitate the exchange of elite materials and broaden the cassava genetic base in the two countries.

Pages 330-336

Effects of different seed tuber sizes on sprouting, emergence, haulm development and yield of potato (*Solanum tuberosum* L.) in the western highlands of Cameroon 1. sprouting, emergence and haulm development

P. Demo, M.O. Akoroda, D. Njualem, J.T. Koi, V. Deffo & S.F. Nana

ABSTRACT

Two field experiments were conducted in Bambui, Cameroon in 1995/96 to investigate under field conditions the performance of 10 different potato seed tuber sizes ranging in diameter from < 5 mm to 45-50 mm. For each seed size used, seed tuber characteristics before planting, plant emergence, the number of above ground stems per plant, plant vigour and ground cover were compared. The number of eyes per tuber, the number of sprouts per tuber and the seed tuber weight significantly increased with increasing seed size. All seed sizes from 10-15 mm to 45-50 mm consistently gave similar and highest plant emergence 4 weeks after planting. The number of above ground stems increased significantly with increasing seed size. Seed sizes ≥ 30-35 mm produced more above ground stems than there were sprouts on seed planted. The percentage of ground covered by crop foliage increased with increasing seed size; this resulted in different photosynthetic capacities in plants raised from different seed sizes. It was concluded that each seed tuber size tested had a potential in potato production and that this potential increased with increasing seed size up to 30-35 mm from which there was no significant change.

Pages 337-342

Effects of different seed tuber sizes on sprouting, emergence, haulm development and yield of potato (*Solanum tuberosum* L.) in the western highlands of Cameroon 2. Tuber yield and tuber size

P. Demo, M.O. Akoroda, J. Koi, V. Deffo, D. Njualem & S.F. Nana

ABSTRACT

In 1995/96, two field experiments were conducted in Bambui, Cameroon in order to investigate the effects of 10 different seed tuber sizes ranging in diameter from <5 mm to 45-50 mm on tuber yield of potato. The objectives of the study were (1) to determine the minimum adequate and the optimum seed tuber sizes for potato production and (2) to generate agronomic data required for an objective determination of seed potato price per size grade. Tuber yield, average weight per tuber, and tuber size distribution after harvests were compared. Tuber yield per plant increased significantly with increasing seed size. This yield varied from 308.1 g/plant for <5 mm seed to 663.9 g/plant for 35-40 mm seed in the first experiment and from 256.5 g/plant to 741.5 g/plant for <5 mm and 45-50 mm seed respectively, in the second trial. All seed sizes tested consistently yielded at least 10 tubers per plant. Seed tubers $30-35 mm consistently gave similar and highest tuber yield per plant. Smaller seed tubers were more efficient in converting their unit weight into tuber yield than larger ones. It was concluded that (a) the minimum adequate seed sizes for seed and ware potato production are 5-10 mm (1.31 g) and 10-15 mm (3.03 g), respectively; (b) the optimum seed size for potato production is 30-35 mm (25.51 g). Seed tubers <5 mm diameter (0.56 g) produce >10 tubers per plant in the field but their management is very difficult.

Pages 343-350

Growth and productivity of long-season: efficacy of predictive models and systems research approach

I.J. Ekanayake and O. Lyasse

ABSTRACT

The robustness and practical usefulness of various cassava/crop simulation models (CSM) as guiding tools for researchers and policy makers to improve crop and system productivity is queried. We made an analysis of some CSM based on their applicability to different environments, end-user needs, ease of operation and long-term prediction capacity. Many gaps and predictive errors exist in these CSM and areas of further data collection and validation in order to improve the user interfaces. Scope for use of Geographic Information Systems (GIS) as an affiliated tool in systems modeling and prediction of productivity is high but under utilized. Crop models combined with GIS allow an ecoregional approach to improve crop adaptation to various ecological zones. A systems framework of targeting cassava ideotypes for various agroecological zones, efficient resource use, and mitigating abiotic stress factors is advocated. A global network approach in the use of GIS-based Decision Support Systems (DSS) for cassava would enhance the understanding of cassava based food systems and improve productivity.

Pages 351-362

Diversité enzymatique d'une collection d'ignames spontanées Dioscorea abyssinica Hoch. Du Bénin (Afrique de l'Ouest)

S. Tostain et O. Daïnou

Résumé

Une des voies de l'amélioration génétique des ignames africaines du complexe *Dioscorea cayenensis* - D. *rotundata* est celle de l'exploitation de la diversité naturclle des espèces apparentées, notamment *Dioscorea abyssinica* Hochst. Cette igname spontanée de savane, tétraploïde, sexuée, avec des graines diffiisées par le vent, est répartie de la Guinée à l'Ethiopie. La diversité de huit enzymes foliaires de D. *abyssinica* (estérase, glutamate oxaloacécétate transaminase, isocitrate déshydrogénase, malate déshydrogénase, phosphoglucoisomérase, 6-phosphoglucodéshydrogénase, phosphoglucomutase, et shikimique déshydrogénase) a été étudiée par électrophorése sur gel d'amidon. La présence ou l'absence d'une bande dans le mélange de six plantules provenant de 1, 2 ou 3 plantes de 29 sites de collecte du Bénin ont été notées. Les 49 descendances issues de fécondations libres sont polymorphes pour tous les systèmes enzymatiques. La classification hiérarchique ascendante (CAH) distingue quatre groupes de populations qui ne correspondent pas à une structuration géographique. Les groupes mis en évidence pourrait s'expliquer par l'existence d'échanges entre formes spontanées et formes cultivées de D. *abyssinica* ou entre cette espèce et une autre espèce spontanée de la section Enantiophyllum, D. *praehensilis*.

ABSTRACT

Dioscorea abyssinica Hochst. is a spontaneous yam from northern Benin, tetraploid, reproducing sexually and with wind disseminated seeds. The diversity of eight enzymes (esterase, glutamate oxaloacetate transminase, isocitrate dehydrogenase, malate dehydrogenase, phosphoglucoisomerase, 6-phosphoglucodehydrogenase, phospho-glucomutase, and shikimic dehydrogenase) from 49 accessions has been studied by starch gel electrophoresis. Six seedlings have been analysed per population (29 collection sites). The open pollinated progenies were polymorphic for all the enzymatic systems tested. A multivariate analysis was conducted on these data: a hierarchical ascendant classification (H.A.C.) showed four groups of populations, but not related to a geographical structure. Groups shown might be explained by the existence of exchanges between spontaneous and domesticated forms of D. *abyssinica* or between this and another spontaneous species in the section Enantiophyllum, D. *Praehensilis*. The aim is the utilisation of genetic diversity of those yams for selection and domestication of new clones for cultivation.

Pages 362-368

Sweetpotato evaluation and selection for on-farm research

M.H. Nxumalo

ABSTRACT

In most cases the farmer participates in the generation of his/her technology during on-farm research. This practice, inter alia, may lead to poor management of the on-farm trial by the farmer and sometimes even to total rejection of the technology as the fanner has not been involved in the beginning of the technology generation. To improve adoption of the technologies generated for farmers use, three sweetpotato field days were conducted at Malkems Research Station in Swaziland on April 16, June 18 and July 18 at 3 months, 4 months and 5 months after planting respectively. The objective of the field days was to help researchers select together with farmers sweetpotato cultivars for on-farm research evaluation. Out of twenty-one cultivars evaluated, eighteen cultivars were selected and 10 of these will be evaluated on farmers' field.

Pages 368-377

Statistical analysis of sweetpotato trials in different agroecological zones in Ghana using the additive main effects and multiplicative interaction (AMMI) model

J.A. Otoo, A. Missah, C. Osei, A.G. Carson, E. Okai, R. Sagoe and A.G.O. Dixon

ABSTRACT

A multilocational trial to evaluate seven sweetpotato clones, comprising five improved/exotic and two local clones in sixteen environments (location and year combinations) for three years was carried out in four agroecological zones in Ghana. The hybrid model, Additive Main Effects and Multiplicative Interaction (AMMI) model was used to examine the pattern of interaction of the clones over different environments and select stable genotypes. The model revealed highly significant ($P<0.01$) environment (E), genotype (G) and G x E interaction. Improved genotypes gave better yields than the local types. G1 (TIS 3017) and G3 (TIS 8266) gave the highest unstable yield of 15.1 and 15.7 t/ha respectively, with G7 (TIS 86/0350) and G6 (TIS 84/0320) yielding good stable yields of 14.1 and 14.4 t/ha respectively. Most of the environments were stable, so with limited resource allocation a few of the environment within the same cluster (positive interactions) could be selected. The best environments were Fumesua, Nyankpala and Cape Coast. The highest yielding environment E3 (Nyankpala, 1995) was quite stable and the best stable environment was E2 (Fumesua, 1995). Site specific physical differences and seasonal factors conditioned the G x E interaction pattern in the data set. Since AMMI analysis reflects the expected G x E interaction for different environments, the clones TIS 84/0320, TIS 86/0350 and Sauti are recommended for release at 40% selection pressure.

Pages 378-383

Farmers evaluation of cassava varieties in the semi arid areas of Kenya

J.W. Kamau, J.M. Kinama, S.N. Nguluu, Lutta Muhammad, J.B.A. Whyte, S.M. Ragwa, E.N. Migwa and P.M. Simiyu

ABSTRACT

Two promising varieties of cassava, KME 1, selected from the local germplasm and KME 61 (TMS 63397-9) from the 1ITA collection, were identified and evaluated by farmers in the semi- and areas of eastern Kenya. A local variety was included for comparison during the farmer assessment. Participatory rural appraisal (PRA) techniques were used to assess the social acceptance by farmers of the two varieties. The evaluations were conducted by women and men farmers in four sites covering three districts. The two new varieties were assessed and compared with the local farmer variety in three categories; raw, roasted and boiled. For each variety in each category the following criteria were nominated by the farmers for use in the evaluation: root appearance, taste, texture and fibre. Results of PRA assessment showed that there were differences within the categories. Variety KME 1 was rated best while raw, KME 61 was best while roasted and the farmers variety best when boiled. The farmer's local variety scored higher points than the other two varieties for its root appearance, taste, texture and fibre qualities. The farmer assessment results are not consistent with yield results from the cassava breeding program. In the National Dryland Research Centre, Katumani which showed that KME 1 was higher yielding than KME 61 producing root yields of 55 t/ha and 47 t/ha respectively. Both varieties had good root quality, medium cyanogenic potential (4.0) and tolerant to cassava mosaic disease (CMD). In contrast, farmers' varieties are low yielding 6-8 t/ha late maturing and susceptible to insect pests and diseases. This study demonstrates that farmers consider different criteria from those of scientists when selecting varieties and underscore the importance of involving them in varietal development and testing.

Pages 384-390

Evaluation of newly improved low cyanide cassava varieties in different agroecozones of Nigeria

E.C. Nnodu and A.G.O. Dixon

ABSTRACT

Eight newly developed low cyanide cassava varieties - NR Series— 84292, 84151, 8420, 84104 (from NRCRI, Umudike), TMS Series-71762, 30474, 82/00033 and 82/00447 (from IITA, Ibadan) were evaluated for yield and resistance to major cassava pests and diseases in different agroecologies in Nigeria during the 1995/1996 and 1996/1997 cropping seasons. They were evaluated with and without fertilizer applied. Variety TMS 4(2)1425 which is a low cyanide variety already released to farmers in Nigeria was used as the control. Also Vars. NR 8082 and TMS 30572 which are high cyanide varieties were included to compare their performances against the low cyanide varieties. Pest damage and disease seventy scores were also taken. The results showed that the varieties responded differently to different environments but varieties TMS 82/00447, TMS 82/00033 and TMS 71762 were the top three yielders across most locations during the first year with or without fertilizer applied. The same is true for the second year. When the yields for the two years were combined, TMS 82/00447 was the best yielder followed by TMS 82/00033 and then TMS 71762. They had same or better yield than the control at many locations and in some. The same is true when compared with the high cyanide varieties. All varieties evaluated were tolerant to bacterial blight, anthracnose and mealybug attack. African cassava mosaic virus disease and cassava green mites damage was respectively the most important pests and diseases observed. Based on the two year data varieties TMS 82/00447, TMS 82/00033 and TMS 71762 are recommended for release to farmers to increase their stock of low cyanide cassava varieties.

Pages 391-394

Relating early growth traits to root productivity for cassava breeding schemes

M.O. Akoroda, A.G.O Dixon and R.U. Okechukwu

ABSTRACT

The use of plants at full-term maturity to select genotypes in cassava breeding is normal. This paper expresses concerns on the conduct of plant breeding in many poor programs where shortage of funds stalls the process of breeding. It is considered that some shortened way to the selection of genotypes must be found so that early characteristics of the cassava plant could be used as indicators to identify genotypes with greater likelihood of identifying superior types. The review of available data show that early ability to sprout and establish in the field as well as other growth variables within the first few weeks of crop life may be useful in identifying a good proportion of the elite genotypes. This form of research requires a wider use of data from more diverse agroecologies and covering many genotypes to be more reliable as a tool. It would, if eventually be useful in greatly reducing the amount of work undertaken by breeders.

Pages 395-400

Amelioration culturale de quelques especes d'ignames cultivees au Togo

Komi Odah, Atsou Aidam, Yézoumi Akogo et Koffi Tozo

Résumé

Des fragments uninodaux de tiges d'ignames prélevés dans le champ ont été stérilisés dans de l'hypochlorite de calcium et mis en culture sur milieu de Murashigue et Skoog (1962) additionné de saccharose et de charbon actif avec ou sans phytohormones et solidifié par la gélose (agar-agar). Les résultats montrent que: a) le taux de survie des explants lors de la phase d'initiation est de 1'ordre de 70%; b) la morphogenèse, la croissance de vitroplants et la production de microtubercules dépendent de la teneur en sucre, des phytohormones et du charbon actif. La multiplication végétative par microbouturage est optimale en présence de 3% de saccharose tandis que les formations tubéreuses sont favorisées par 6% de ce sucre après 3 mois de culture. La combinaison AlB/Kin (0, lmg/l; 0, lmg/l) favorise le débourrement de vitroplants tandis que l'associationANA/BA (5mg/l, lmg/1) favorise 1'enracinement et la multiplication végétative après 3 mois de culture. Les microtubercules obtenus sur des vitroplants âgés de 5 à 10 mois possèdent une bonne capacité de germination et peuvent donc être utilisés comme semences; Le taux de survie des vitroplants et microtubercules après sevrage est d'environ 80%. Cette voie de multiplication rapide permettra de résoudre le problème de pénurie qui se pose très souvent aux planteurs, de sélectionner les cultivars et de réaliser les cultures hors-saison.

Pages 401-409

Selection du manioc au Rwanda avant 1994 et etat actuel de la recherché

M.L. Rutikanga

Résumé

Le programme de recherche sur la sélection du manioc au Rwanda a commencé en 1979 par 1'introduction à partir de 1'IITA du matériel de base amélioré (graine) en vue d'obtenir une plus grande variabilité génétique. La collection du matériel local a été également intensifiée durant cette

même periode. Depuis 1984, les contraintes phytosanitaires causées par les maladies et ravageurs (la bactériose et la mosaïque, la cochenille farineuse du manioc et 1'acarien vert) ont sensiblement baissé la production du manioc au Rwanda. Des variétés sélectionnées productives et tolérantes aux différentes maladies ont été mises au point et diffusées chez les agriculteurs avec une moyenne de production de 25 a 30 tonnes à 1'hectare. Les ennemis naturels à la cochenille ont été lâchés (*Epinocarsis lopezi*) et semblent contrôler efficacement ce ravageur. Cependant à la reprise des travaux de recherche en mars 1995 après les évenements de 1994, une grande partie du germoplasme en milieu paysan et en Station de recherche à été détruite. En 1997 quelques matériels génétiques de manioc ont été réintroduits à partir de 1'IITAet l'EARRNET sous forme des graines et des clones sélectionnés en vue de la poursuite du Schéma de sélection et la mise au point des nouvelles variétés.

Pages 404-409

Can yam domestication and participatory breeding be new ways to improve this crop and conserve its genetic resources?

Julien Berthaud, Mustapha Bousalem, Ogoubi Daïnou, Jean Dubern, Bernard Malaurie, Serge Tostain

ABSTRACT

Genetic diversity found in tuber crops like yams is large and should be conserved. This diversity within genetic resources should offer to farmers new forms adapted to their changing needs. A classical multistep approach has recently been used to tap these resources: collection ‡ characterization/evaluation > conservation/propagation > distribution/utilization. But this tuber crop is quite specific in terms of conservation as it is vegetatively propagated and the propagules have no long term conservation capacity. It is then difficult to rely only on this classical approach

for conservation and utilization of these genetic resources. We propose to use the knowledge currently being acquired on farmers' strategies of yam domestication and on genetic diversity of yams and their pests and diseases to explore new ways to create yam varieties more tolerant to pests and diseases and new ways for conserving their genetic resources. A sanitation approach is also considered to produce virus-free yam seed especially in the site of Pilimpikou valley (Burkina Faso) This new material will be evaluated for its contribution to improvement of yam production.

Pages 410-416

Performance of cassava genotypes at low, mid and highland altitude in Uganda

P. Ntawuruhunga, P. Rubaihayo, J.A.B. Whyte, D.S.O. Osiru and A.G.O. Dixon

ABSTRACT

A crop's ability to productively exploit its environments depends on many features which are controlled by multiples genes interacting among themselves and with the environments in complex ways. A study of cassava (*Manihot esculenta* Crantz) adaptation was conducted at three different land altitudes (Bulisa, Namulonge and Kapchorwa at 650, 1150 and 1750 m a.s.l respectively) in Uganda. Ten cassava genotypes originated from 5 different sources were used in randomized complete blocks design in three replications at each location. The aim of the study was to investigate the performance of cassava at different altitudes. Some of the parameters evaluated are plant height, tuberous root number, fresh weight and cyanogenic potential (Cnp). The results indicated a highly significant source, clone (source), location and clone (source) x location interaction for the parameters evaluated, with the clones SS4 producing the highest yields at low (Bulisa) and mid land altitude (Namulonge) while it was the clone TMS I 92/0067 better yielding in the high land altitude. Across the three locations the clone well yielding was TMS I 92/0057.

The yield was highest in the low land (Bulisa) while it was low at high land altitude (Kapchorwa). The clones and sources reacted differently to locations. Clones from source 1 (low land altitude from Uganda) failed almost to sprout in the high land altitude. The clone TMS I 92/0057 was the tallest over locations. Clones Migyera followed by TMS I 92/0067 produced high number of tuberous root per plant in both locations, mid and high land, while it was the other way round in the low land altitude, TMS I 92/0067 followed by Migyera. Overall they produced 9.8 and 9.3 tuberous number per clone while clone Eala 07 produced the least (3.5). The coefficient stability parameter used indicated variation between genotype coefficient for the genotypes tested and clone TMS I 92/0057 was identified the highest yielding and stable. No effect due to altitude was identified on cyanogenic potential in cassava.

Pages 417-423

Preferences and selection criteria of sweetpotato varieties in rural and urban areas of Tanzania

D.Rees, R. Kapinga, S. Jeremiah and E. Rwiza

ABSTRACT

Sweetpotato is an important staple crop in many areas of Tanzania although countrywide it ranks third after cassava and round potato. Surveys indicate that lack of high yielding, early maturing varieties with desirable storage root quality characteristics is a major constraint. For a successful breeding program to address this it is vital to define the quality characteristics preferred by consumers. A review of existing information on farmers' preferences showed that post-harvest qualities ranked almost as high as production characteristics in their variety selection. The main criteria in order of importance were: high yield, early maturity, sweetness, disease and pest tolerance, low fibre content, root firmness, and extended in-ground storability. Root shape, size and processing qualities were specific to particular locations which reflected very much on the utilization aspect. As no information existed on the preference of urban consumers, an increasingly

important group in Tanzania, a survey was conducted for consumers and traders in three districts of the Lake Zone. The main criteria mentioned for both groups were: starchiness/flouriness, taste, cooking time, and color of root flesh/skin. To help define these complex criteria, information was collected on specific varieties preferred or rejected and the main reasons. Work is on to use an expert taste panel on-station to assess a range of cultivars for these criteria and compare them. With varieties preferred by consumers, the feasibility of using this method within a breeding program will be assessed.

Pages 424-430

Characterisation and conservation of yam biodiversity for sustainable use for food and agriculture in Benin Republic

A. Dansi, H.D. Mignouna, A. Sangare, J. Zoundjihékpon, R. Asiedu and F.M. Quin

ABSTRACT

Using IPGRI's descriptors, 560 accessions of cultivated yams (D. *cayenensis* / D. *rotundata* complex) collected throughout Benin, were characterised. Ninety morphotypes were identified and further classified into 26 cultivar groups based on their morphological similarities. The geographical distribution of cultivar groups is presented and two centers of diversity were identified. The flowering and the fruiting capacity of the morphotypes and the ploidy level of some accessions were evaluated and will allow better planning of crosses in breeding programs. Isozyme analysis was also earned out in order to refine the classification based on morphological characters. For some groups, mainly Kokorogbanou, the markers used were not efficient for genotype identification, showing the need to resort to DNA fingerprinting. An on-farm conservation strategy

is proposed, based upon the centers of diversity which this study identified. Adoption of this strategy could assist the sustainable conservation of cultivated yam genetic resources and also enhance the extent of genetic diversity that farmers could utilise. Additional proposals concern in situ conservation of the wild yam species and participatory breeding.

Pages 430-437

Genetic variability for vascular streaking in cassava

Ilona P.C and A.G.O. Dixon

ABSTRACT

One hundred and twenty five cassava genotypes comprising 110 improved clones and 15 landraces were screened for resistance to vascular streaking (VS) in the roots. Varietal differences were significant and damaged roots were more susceptible to VS than undamaged roots. Sixteen varieties did not show VS symptoms when roots were undamaged until 7 days after harvesting under field conditions. Vascular streaking in damaged roots was highly related to that of the undamaged roots (r=0.60**). A significant relationship also exists between VS and root moisture loss (r=0.41 *). In addition, there were significant relationships between days to VS and root flesh colour (r=0.38**), root mealiness (r=-0.33*) and dry matter content (r=-0.23*). It is possible to practice direct, indirect and index selection for resistance to VS using the above mentioned traits.

Pages 434-437

Flowering in yams (Dioscorea spp.)

C.N. Egesi, R. Asiedu and J.K. Egunjobi

ABSTRACT

Yams are a major staple and of income for small-scale farmers in West and Central Africa. Yam production is fraught with serious pest and other problems that could be addressed through breeding. But poor flowering and seed-setting has limited the introduction of valuable genes from some germplasm with desirable attributes. Approaches to promote flowering in yams include multiple planting dates as well as studies involving pollen viability, anthesis time, longevity of stigma receptivity and ploidy levels. Insight into the influences of genotypes, planting dates and geographical locations have been provided.

Pages 438-443

Combining ability analysis of field resistance in cassava to the African cassava mosaic disease

Y. Lokko, A.G.O Dixon and S.K. Offei

ABSTRACT

Thirty-six F_1 crosses were produced in a Design II mating scheme involving 4 improved clones as females and 9 African landraces as males. The parents and their progenies were evaluated for their reactions to cassava mosaic disease (CMD) at 3 months after planting under natural infection in three environments in Nigeria (Ibadan, 1996 and 1997 and Mokwa, 1997). The objectives were to determine the relative importance of general combining ability (GCA) and specific combining ability (SCA), estimate heterosis, and compare line and topcross performance for resistance to CMD. The results showed that the genetic variation among crosses was predominantly due to GCA of the male parents. The one-degree of freedom orthogonal contrast (parents versus crosses) for mid-parent heterosis was significant. Five crosses had significant negative heterosis. Three landraces used as males (TME 8, TME 9 and TME 11) were the best general combiners for resistance. None of the improved lines used as females contributed significantly to the GCA effects for resistance. Line performance was significantly correlated with topcross performance, indicating that parental performance can be used to predict progeny performance.

Pages 443-454

Genetic diversity among Nigerian cassava landraces resistant to cassava mosaic disease and cassava green mite

A.A. Raji, A.G.O. Dixon and T.A.O Ladeinde

ABSTRACT

Eleven landraces suspected to be sources of resistance to cassava mosaic disease (CMD) and cassava green mite (CGM) were selected from IITA's collection of Nigerian landraces, and assessed together with an improved CMD resistant cultivar (TMS 30572) and a susceptible check (Isunikankiyan) for their levels of genetic diversity, for possible utilization in the breeding program. Large genotypic variation was observed among the landraces for their reactions to CMD and CGM and to a lesser extent for CBB. In addition, there were significant genetic variations among these landraces for various agronomic and food quality traits. Additional sources of resistance to CMD and CGM far better than the popular improved cultivar, TMS 30572, were identified. Sources for low cyanogenic potential and mealiness of boiled storage roots were also identified. Principal component analysis using the correlation matrix of 53 agrobotanical characteristics identified five distinct groups of clusters among these cultivars. Within each group, genotypes are genetically related and between groups, genotypes are unrelated suggesting that some of the landraces may have emerged from different genetic backgrounds with different sources of genes for desirable traits like disease and pest resistance TMS 30572, an improved cultivar and an offspring of the *Manihot glaziovi* derivative, clone 58308(sole source of resistance to CMD), is genetically unrelated to the sources of resistance to ACMD identified among the landraces. It is important to make an extensive and complete collection of local germplasm in Africa. Local cultivars generally outyield improved cultivars and usually carry genes for adaptation to local conditions, especially tolerance to drought, resistance to diseases and pests, and posses preferred root quality as this study shows.

Pages 454-459

Evaluating sweetpotato landraces of Western Kenya

P.J.Ndolo, E.E. Carey, J. Malinga and S.T. Gichuki

ABSTRACT
A field genebank of 254 Kenyan sweetpotato landrace varieties collected from western Kenya was evaluated at the KARI regional research centre Kakamega between 1995 and 1997. The objective of the study was to identify virus resistant varieties with good agronomic and culinary qualities. Significant variation in yield, dry matter content and culinary quality existed among varieties. Early maturing varieties performed better than the other varieties. The sweetpotato virus disease affected over 60% of the varieties, with a higher frequency of susceptible accessions originating from Western Province. Selected promising accessions are undergoing further assessment in the Kenyan variety selection programme.

Pages 459-465

Potato variety development in the IRAD-CIP potato project in Cameroon

J.T. Koi, H.A. Mendoza, D. Njualem, P. Demo, V. Deffo and S.F. Nana

ABSTRACT
Until 1994, potato growers in Cameroon mainly cultivated European and a few old local varieties most of which had greatly degenerated and are too susceptible to late blight. Improvement of potato varieties in the IRAD-CIP Potato Project started in early 1988 and has been mainly carried out by selecting varieties from advanced genetic material originating from the International Potato Center (CIP) Lima-Peru. During the past nine years, the Project has evaluated over 30000 advanced genotypes and in 1992, two improved varieties (Cipira and Tubira) were released. In

comparative yield and disease resistance trials carried out in 1996 and 1997 using advanced clones with two European varieties, Cipira and Tubira as checks, Cipira and Tubira both showed a significant superiority in yield stability due to their wide adaptation and tolerance to late blight. From the results of the 1996 and 1997 multilocational evaluations, a new group of 5 advanced clones has been identified with performances equal or better than those of Cipira, Tubira, Famosa and Desiree. Some of these advanced clones are tolerant to late blight and virus diseases, mature earlie and have a shorter dormancy which permits two crops per year. One or more of these will likely be released as a new variety or varieties within 1 -2 years.

Pages 466-471

Evaluation of twelve potato varieties in the North-western highlands of Cameroon

D. Njualem, H.A. Mendoza, J.T. Koi, P. Demo, V. Deffo and F.S. Nana

ABSTRACT

Twelve potato varieties Kondor, Escort, Famosa, Agria, Diamant, Desiree, Baraka, Spunta, Mondial, Premier, Cipira and Tubira were evaluated in two trials in Bambui, Cameroon, in 1995, to investigate the effect of late Blight damage on tuber yield and yield components of potato. Each trial had four replications of 20 plants per experimental unit. The first trial was protected against late and early blights while the second was unprotected. CIPIRA and TUBIRA with yields of 31.3 and 29.3 t/ha respectively in the protected trial, 39.7 and 36.7 t/ha, respectively in the unprotected trial significantly out yielded all the ten foreign varieties in both trials. The best of the foreign varieties were Kondor, Famosa, and Escort with yields of 25.0; 21.0 and 21.7 t/ha, respectively for the protected and 26.3; 27.3 and 23.3 t/ha respectively for the unprotected trial. Seven evaluations on late blight damage were made at weekly intervals for both trials. A 1-9 scale (1: no damage, 9: dead plant) was used to score late blight damage. CIPIRA, TUBIRA and Famosa each had a late

blight score of 2 in both trials. These trials clearly show the superiority of locally selected late blight resistant varieties over all foreign varieties that have been traditionally cultivated in Cameroon.

Pages 471

Participatory research in sweetpotato variety evaluation and selection for the diverse environments of the Lake Zone of Tanzania

R. Kapinga, B. de Steenhuijsen Piters, W. Heemskerk, B. Chirimi, M. Mutalemwa, J. Kabissa and P. Kapingu

ABSTRACT

Sweetpotato plays a great role as a household food security crop for many families in the Lake Zone (LZ) of Tanzania. However, varieties are not adapted to the wide variety of ecological conditions and socio-economics requirements. To address this, on-farm variety trial was conducted from 1995 through 1997 in 7 villages representing 4 different farming systems zones. In 1995/96 cropping season, 6 varieties: Sinia-B, Iboja, Budagala, SPN/0, Mwanamonde and Biganana were tested, and in 1996/97 3 more varieties SP/93/2, SP/93/34 and SP/93/23 were added in 2 locations only. All fields were characterized with respect to biophysical properties and fanners' practices. Some 49 farmers participated in the trial. At harvest, 172 farmers assessed the performance of the varieties through participatory research approach which involved: field assessment and taste test evaluations, preference ranking according to criteria set by fanners and group assessment through pairwise comparison of all varieties. Varieties SPN/0, Mwanamonde and Iboja gave higher yields at several sites indicating their stability over other varieties. New varieties SP/93/23 and SP/93/2

performed well in some aspects. Farmers only rejected variety Budagala due to very low yields, but no other varieties tested, and indicated specific uses for each of them. The experiment provided a flexible recommendation that specifies the properties of all varieties and conditions for the optimal performance. Adaptive trials by extension agents and Farmers Extension Groups (FEGs) can further develop flexible recommendations in other agro-ecological zones. The diffusion of selected varieties is expanding in the LZ through networking with community based organizations which fund aspects of multiplying and distributing planting materials to farmers in several farming systems. To-date a total of 2,974,900 sweetpotato cuttings enough to cover 90 ha have been distributed to farmers through networking with three NGOs: Plan International, ACORD and Christian Center of Tanzania (CCT). Also three Government's Research and Development Projects based in the zone. These include Mara Region Farmers Initiative Project (MRFIP); Bukoba District Rural Development Program (BDRDP); and Southern Africa Root Crops Research Network (SARRNET) all linked up to the Lake Zone Client Oriented Research Program.

Pages 472-478

Effect of age on in vitro culture post flask management of three Dioscorea species

M.D. Ashun & E. Acheampong

ABSTRACT

Tissue culture techniques have been used successfully to produce clean planting material in large quantities of several crops which have established in the field. There is however a problem with the establishment of in vitro plantlets of yam in the field. This experiment was set up to investigate the technique involved in handling yam cultures from the laboratory to the field. Yam cultures of D. *alata* cv. 145, D. *rotundata* cv. 353 and D. *cayenensis* cv. 358 were initiated from apical meristem, multiplied and grown further on Murashige and Skoog's (MS) medium supplemented

with 0.25µM kinetin, 3% sucrose and solidified 0.7% agar. Nodal cuttings with two buds each grown on complete MS medium with or without supplement of 0.0lµM Naphthalene acetic acid (NAA), were transferred into soil at ages 6, 8, 10, 12 and 14 weeks of incubatution. Results indicated that all cultures including those aged 6 weeks survived and developed well in soil in all three *Dioscorea* species used. However, in D. *rotundata*, survival was low in cultures aged 14 weeks. It was also observed that there was no need to incorporate growth regulators in culture medium for root development since plantlets grown on medium without growth regulators formed roots and when transferred to soil, the percentage survival and development was high.

Pages 478-480

Sequence diversity in the coat protein gene and 3' untranslated region of yam mosaic potyvirus isolates infecting D. *alata*, D. *cayenensis*-D. *rotundata* and D. *trifida*

M. Bousalem, D. Fargette, Agnès Pinel, J. Dubern and J. Berthaud

ABSTRACT

The vegetative multiplication of yam (*Dioscorea* sp.), the virus transmission by vectors and the frequent exchanges of infected plant material favour the spread of viral diseases. Yam Mosaic Potyvirus is the most important virus described so far on yam. The study presented here is an evaluation of the molecular variability of YMV. Thirty isolates from different geographical areas and from different species and cultivars of yam were studied. The isolates were collected on three species, D. *alata*, D. *cayenensis*-D. *rotundata*. D. *trifida*. The regions of interest (NIB / CP / 3'-UTR) were amplified by PCR and sequenced. The phylogenetical analysis (cladistic parsimony

method) distinguished nine groups. Comparative analysis with several poty viruses showed that, as for YMV, CP and 3' UTR regions were highly variable. The thirty isolates analyzed were considered as strains of the same virus, although some were very distant one from each other. Links with geographical diversity and host species were established.

Pages 483-484

In vitro propagation of frafra potato (*Coleus dysentericus*)

Elizabeth Acheampong and Bernice Asante

ABSTRACT

A study was conducted to determine the feasibility of growing frafra potato (*Coleus dysentericus*) in vitro. Nodal cuttings of greenhouse plants were used as explants and grown on Murashige and Skoog medium amended with various concentrations of auxin, napthalene acetic acid (NAA) and benzylamino purine (BA). Results obtained indicate that the crop can be grown on NAA alone and BA alone, and also on various combinations of the two growth regulators. The crop also grew well on hormone-free medium.

Pages 485-489

Etudes cytogenetiques et florales des ignames Africaines D. *cayenensis*-D. *rotundata*, pour les fescondations in vitro

J. Zoundjihékpon, A. Dansi, S. Doukoure, N. Ahoussou, A.M. Kouakou, H. Sanou, J. Sanou, K.M. Kouassi, J.D. Zongo

Résumé

Les études cytogénétiques des ignames africaines D. *cayenensis* - D. *rotundata* du Bénin, de Côte d'lvoire et du Mali ont permis de confirmer Ie nombre chromosomique de base des ignames africaines x = 10. La plupart des groupes variétaux de ces trois pays sont tétraploïdes, mais 1'on observe également des variétés hexaploïdes et octoploïdes. Sur les trente-trois variétés étudiées, 72, 7% sont tétraploïdes et 21, 2% sont hexaploïdes. Un seul octoploïde a été observé au Bénin et en Côte d'lvoire. Au Bénin, au Burkina Faso, en Côte d'lvoire et au Mali, Ie type de floraison (male ou femelle) et son abondance varient selon les groupes considérés. Un seui monoïque a été observe au Bénin et en Côte d'lvoire, tandis que dans chacun des quatre pays, une seule variété n'a jamais fleuri. Pour tout Ie matériel végétal dont les aspects cytogénétiques et floraux sont étudiés, les variétés non florifères sont hexaploïdes et les variétés octoploïdes sont des mâles. De plus, celles qui fleurissent femelles sont toutes tétraploïdes. Les résultats préliminaires d'essai de fecundation in *vitro* entre deux variétés femelles et une variété mâle de Côte d'lvoire montrent que des etudes sont nécessaires pour une meilleure stérilisation des organes reproducteurs des variétés identifiées comme géniteurs potentiels sur la base des résultats cytogénétiques et floraux. Le milieu de culture MS contenant du 2-4 D 10^{-6} M et de la kinétine 10^{-3} M paraît être le milieu le plus favorable à la survie de la fleur fécondée.

Abstract.

Cytogenetic studies on African yams D. *cayenensis* - D. *rotundata* from Benin, Côte d'lvoire and Mali proved that the basic number of chromosomes for African yams is x = 10. Most of the

varietal groups of these three countries are tetraploid, but there also are hexaploid and octoploid varieties. Of the thirty three varieties studied, 72.7% were tetraploid and 21.2% were hexaploid. Only one octoploid variety was identified in each of Benin and Côte d'lvoire. In Benin, Burkina Faso, Côte d'lvoire and Mali, the type (male or female) and intensity of flowering varied among the varietal groups. Only one monoecious type was observed in each of Benin and Côte d'lvoire, while in each of the four countries, only one variety was non-flowering. For all the material which cytogenetic and floral characteristics were studied, the non-flowering varieties were hexaploid and the octoploid varieties were male. Moreover, the female plants were all tetraploid. The results of *in vitro* pollination tests between two female and one male varieties from Côte d'lvoire showed a need for better sterilization of the reproductive organs of the varieties identified as possible mother varieties based on the cytogenetic and floral results. The MS medium culture with 2-4 D 10^{-6} M and kinetin 10^{-3} M seems to be the best medium for the survival of the ovaries.

Pages 490-494

Incidence and severity of cassava anthracnose disease at different ecological zones in Ghana

J.N.L. Lamptey, O.A. Danquah, O.O. Okoli, P.P. Frimpong-Manso, C.Osei, E. Moses

ABSTRACT

Seven exotic varieties of cassava developed at IITA, Ibadan, Nigeria and three local varieties were evaluated for tolerance to cassava anthrcnose disease (CAD) in five ecological zones of Ghana. The trials were conducted at Crops Research Institute, Fumesua (Forest Zone) in 1988, 1989,1990; Aiyinase (High Rain Forest Zone), Pokuase and Ohawu (Coastal Savanna Zone), Ejura (Forest-Savanna Transition Zone) in 1989 and 1990; Techiman (Forest-Savanna Transition Zone);

Nyankpala and Damongo (Guinea Savanna Zone) in 1990. In 1997, 15 exotic varieties were evaluated together with two local varieties at Fumesua, Ohawu and Ejura. CAD damage at six months after planting were scored on a 5- point scale based on the severity of the disease. The disease occurred in all the ecological zones but seventy varied from one eco-zone to the other. The exotic varieties were significantly more tolerant to CAD than the local varieties in areas of high disease pressure like Fumesua and Ohawu in 1988, 1989 and 1990. In 1997, however, CAD severity on the exotic varieties was not signficantly different from the local varieties. The disease was moderately severe on both exotic and local varieties. Greater research effort is needed to develop more resistant varieties to improve the quality of planting materials and root yield.

Pages 494-499

Increasing the availability of disease-free potato seed tubers to smallhold farmers in Kenya

Z.M. Kinyua, J.J. Smith, G.I. Oduor and J.N. Wachira

ABSTRACT

Tuber-borne diseases such as bacterial wilt, caused by *Ralstonia solanacearum*, are a major constraint to potato production due to poor availability of certified seed tubers to farmers-in Kenya. On-farm trials were carried out to demonstrate the potential benefits of small potato multiplication plots to meet individual farmer demands for bacterial wilt-free tubers. Six farms with previous incidence of bacterial wilt were selected in Nyandarua District, Kenya. Certified seed tubers of varieties Tigoni and Roslin Tana were planted at two spacings, 20cm by 20cm (close spacing) and 75cm by 30cm (wide spacing), in plots measuring 3m by 3m on each farm. Data were recorded on tuber yields and disease incidences. Close spacing led to significantly more seed-size tubers per plot than wide spacing for both varieties. Land productivity under close spacing was 2.95 and 2.8 times higher than under wide spacing for varieties Tigoni and Roslin Tana, respectively. Bacterial wilt was noticed on only one farm.

Pages 499-502

Feeding preference of *Typhlodromalus aripo* (Acari:phytoseiidae) for *Mononychellus tanajoa* (Acari: Tetranychidae) infected by *Neozygites floridana* (Zygomycetes: Entomophthorales)

Serge L. Ariori and Surendra, K. Dara

ABSTRACT

The International Institute of Tropical Agriculture (ITTA) has released the predatory phytoseiid mite, *Typhlodromalus aripo* (DeLeon) for the classical biological control of the cassava green mite, *Mononychellus tanajoa* Bondar in Africa. IITA has imported a few isolates of the entomopthoralean fungus, *Neozygites floridana* (Weiser & Muma), which is an important pathogen of M. *tanajoa* in Brazil, for release in Africa for the control of M. *tanajoa*. This study was conducted to evaluate the feeding preference of T. *aripo* for M. *tanajoa* infected by N. *floridana*. The feeding preferences of normal and starved, for 24 and 48 h, T. *aripo* for healthy M. *tanajoa* and those exposed to N. *floridana* infection were compared in choice and no choice tests. In general, T. *aripo* consumed significant quantities of infected M. *tanajoa* along with healthy ones. They appeared to have a slight preference for healthy M. *tanajoa*, significant difference was seen only in no-choice test with the predators starved for 24 h.

Pages 503-507

Seasonal incidence of two fungal pathogens, *Neozygites floridana* (Zygomycotina: Zygomycetes) and *Hirsutella thompsonii* (Deuteromycotina: Hyphomycetes), in mite populations on cassava in Benin

Surendra K. Dara, Chris J. Lomer, Fabien C.C. Hountondji and J. Steve Yaninek

ABSTRACT

Seasonal incidence of two fungal pathogens, *Neozygites floridana* (Weiser and Muma) (Zygomycotina: Zygomycetes) and *Hirsutella thompsonii* Fisher (Deuteromycotina: Hyphomycetes), in populations of two species of mites, *Mononychellus tanajoa* (Bondar) and *Oligonychus gossypii* (Zacher) (Acari: Tetranychidae), on cassava was monitored in Benin for one fall year from November, 1996. Out of the 14 surveyed locations that spread across the four agroecological zones, N. *floridana* and H. *thompsonii* were found in 11 and 10 locations, respectively. While both of them were present in 8 locations, none was observed in one location. In general, the level of infection was low and the pathogens did not appear to show any trend specific to any agroecological zone. When results from all the locations were combined, a maximum of about 1% infection was found in M. tanajoa by each of the pathogens. However, O. *gossypii* had a maximum of 11 % infection by N. *floridana* and close to 1% by H. *thompsonii*. Resting spores of N. *floridana*, which were never reported to be found in Benin, were seen almost throughout the observation period in one location or the other in both species of mites. In general, populations of M. *tanajoa* were more on young leaves than on old leaves, while those of O. *gossypii* were more on old leaves than on young leaves.

Pages 508-513

Integration of host resistance, cultural methods and fungicidal spray for the management of late blight of potatoes in Uganda

P. Kantwatsa, E. Adipala, J.J. Hakiza and H.M. Kidanemariam

ABSTRACT

Late blight (LB), caused by *Phytopthora infestans* (Mont.) de Bary, is the most damaging disease of potato in the highlands of Uganda. Two types of studied were conducted at Kalengyere Research Station the objective of identifying the most effective and sustainable disease management options for development of an integrated disease management (IDM) package for LB in Uganda. The first study evaluated the effects of fungicide, planting date and variety on LB occurrence and severity. In the second experiment, the efficacy of 2 fungicides: Dithane M-45, Ridomil was evaluated singly and in combination to determine a suitable spray interval for controlling LB. Early planting of potatoes resulted in the highest disease severity levels in both season and late planting had the lowest disease severity levels. Higher yields resulted from early plantings of the second season, while late ones, had low yields. Yield gain due to fungicide sprays against LB, in the first and second seasons were in the range of 2-26.8 % and 12-75 %, respectively. In the study to establish the optimum spray interval for controlling LB, a spray interval of 7 days with Ridomil, and Ridomil first followed by Dithane M-45 was highly effective and resulted in high yields.

Pages 513-515

Preliminary investigation on the effects of dipping scale insect-infected ginger rhizome in local plant extracts

J.K.U. Emehute

ABSTRACT

A preliminary investigation was carried out on the effects of plant extracts for the cleaning of scale insect-infested ginger rhizome. Results showed that supernatant solution of powdered dried seeds of piper guineensis and 100% extract from mature fresh fruits of Azadirachta indica cleaned the infested ginger setts. Viability and plant vigour were also better in the ginger setts that were immersed in the two plant extracts. A 100 percent extract from mature fresh fruits of A. indica cleaned infested ginger setts better than the 100% extract from the leaves and the tender stems.

Pages 516-523

Effect of preceding crop, variety and post emergence cultivation (hilling) on the incidence of bacterial wilt

Bekele Kassa and Berga Lemaga

ABSTRACT

To determine the effect of preceding crops, potato varieties with different level of resistance to bacterial wilt (BW) and number of post emergence cultivation on potato bacterial wilt and tuber yield, an experiment was conducted at Ambo Crop Protection Research Centre in 1996-1997. The results showed that wilt incidence was significantly ($P<0.05$) influenced by types of preceding crops. Susceptible potato variety planted after wheat and maize exhibited mean wilt incidence of 8.3 and 9.3%, respectively. Corresponding wilt incidence after beans, tolerant potato variety and susceptible potato variety were 30.5, 41.9 and 25.3%, respectively. There was significant differences ($P<0.001$) in response to disease between varieties. Wilt incidence on the susceptible variety was 23.0% as opposed to 0% on the tolerant variety. In contrast number of post-emergence cultivation did not bring about a significant difference in all parameters considered, except tuber yield. Percent tuber rot at harvest differed significantly ($P<0.05$) with the variety, but not with type of preceding crops and cultivation (hilling) treatments. Percent tuber rot after 3 weeks in diffuse light storage DLS was significantly ($P<0.05$) affected by type of preceding crops and potato varieties. Marketable tuber yield after maize was significantly ($P<0.05$) higher than after the other crops. Tuber yield significantly ($P<0.05$) varied with potato varieties and hilling treatments. There was a negatively and significant correlation between tuber yield and wilt incidence with simple correlation coefficient values of $r = -0.86$, and a coefficient of determination of $r^2 = 0.74$. Interactions among treatments were not significant with all the parameters considered, implying that the influences of the considered factors on BW were independent. From this experiment, it can inferred that the use of maize and wheat as a preceding crops tolerant potato varieties are important components to control wilt.

Pages 524-529

Evidence of double infection and Random occurrence of cassava begomoviruses in sub-Saharan Africa

Ogbe F.O, G.I. Atiri, G. Thottappilly, A.G.O. Dixon, H.D. Mignouna and F.M. Quin

ABSTRACT

A better knowledge on the occurrences of cassava geminiviruses namely Afncan cassava mosaic (ACMV) and East African cassava mosaic (EACMV) begomoviruses would enhance effective control of cassava mosaic disease (CMD) in Africa. A diagnostic survey conducted in Nigeria in 1997 indicated that ACMV and EACMV occurred both in single and double infections. These findings together with recent detection of EACMV in Cameroun, Togo, Guinea, western Kenya, western Tanzania and north-eastern Zambia where only ACMV was known to occur provide evidence for probable random occurrences of both viruses in sub-Saharan Africa. The implications of double infection of the two viruses on the development of new strains/variants that could cause outbreak of severe CMD is noted. The need to continually develop cassava clones with durable host-plant resistance is emphasised.

Pages 529-533

The current situation on the establishment of Typhlodromalus aripo DeLeon in Kenya

C.W. Kariuki, B.M. Ngari and T.M. Kusewa

ABSTRACT

Since its initial release in Kenya three years ago, *Typhlodromalus aripo* continues being recorded in some of the release sites in the major cassava growing regions. Recovery surveys have indicated that, where this phytoseeid is still present in some sites, it has spread within a distance of more 35-Km from the initial release field. Observations made on release and non-release plants indicated an average of 0.06 to 11.60 individuals per plant with some plants with >15 individuals. The results also indicated T. *aripo* as occurring at the tip of the cassava plant. In-country variation in T. *aripo* establishment was also observed in Western Region of Kenya showing good establishment compared to the Coastal Region of Kenya. Fluctuation in cassava green mite population has been observed in all cassava growing areas but it is early to associate this with T. *aripo*.

Pages 534-540

Yam diseases in Northern Ghana

S.K. Nutsugah, F.K. Tsigbey, J. Peters and C. Osei

ABSTRACT

There is paucity of information on the primary yam pathogens causing economic losses of yam in northern Ghana. Farmers' fields in some of the major yam-growing areas of the region were surveyed during 1996 rainy season using a participatory rural appraisal approach to obtain baseline information on yam disease and pests. A field work was later designed to investigate the relationship between disease status of yam vines growing in the field and subsequent post-harvest diseases and pests during 1997 rainy season. Farmers identified anthracnose, *Colletotrichum gloeosporioides* as the most important biotic constraint to yam production. Anthracnose was found in over 70% of all yam foliage randomly sampled during the surveys. Viral diseases were also present in 22% of yams grown in the surveyed area. *Scutellonema bradys*, yam nematode was frequently isolated from tuber tissues in the laboratory. The fungicide and nematicide treatment effect in the field trial could restore yields in high disease seed to levels found in low disease seed.

Pages 541-545

Relative resistance of some newly developed cassava cultivars to African Cassava Mosaic Disease

O.A. Ariyo, A.G.O. Dixon and G.I. Atiri

ABSTRACT

Twenty five IITA-improved cassava cultivars were evaluated on the field in IITA, Ibadan for relative resistance to African cassava mosaic disease (ACMD). These cultivars were exposed to natural infection by the viruliferous whiteflies (*Bemisia tabaci*). ACMD incidence (DI) and index of symptom severity (ISS) calculated on a scale of 1 (no symptom) - 5 (very severe) were the two major parameters used in evaluating the relative resistance of these cultivars. The evaluation made was based on the rank sum method (i.e. adding DI and ISS ranks for each cultivar). Isu and TMS

30572 were observed to be highly susceptible to ACMV infection through this method. Clones 94/0270, 82/00058, 91/02322, 92/0326 and 92B/00061 were susceptible. Plants of clones 92/0325, 92/0342, 4(2)1425, 92/0427, M94/0177 and TME-1 were moderately susceptible. Moderate resistance was observed in plants of clones M94/0192, 92B/00068, 92/0057, 94/0237, 92/0398 while plants of clones M94/0461, 91/02324, 91B/00455, 91/02327 and M94/0583 were resistant. Clones 94/0239 and M94/0121 were highly resistant to the virus infection. Immunity as a form of resistance was observed in none of the clones screened.

Pages 545-553

Nermatode problems and solutions of Root and Tuber Crops in Nigeria

Nwauzor, E.C.

ABSTRACT

Root crops reviewed include cassava, *Manihot esculenta*, sweetpotato *Ipomoea batatas* and ginger *Zingiber officinale*, and tuber crops are: yam *Dioscorea* spp., Irish potato *Solanum tuberosum* and cocoyams *Colocasia* and *Xanthosoma* spp. It synthesizes major information on the crops in the field of nematology in Nigeria. The nematode problems of these crops are discussed and solutions suggested. Essentially, *Scutellonema bradys* and *Meloidogyne* spp. are identified as serious pests of yams. *Pratylenchus* spp. is also involved in yam damage. *Meloidogyne* spp; are reported as also critical in cassava culture while *Pratylenchus* is a threat to cassava production. *Meloidogyne* spp. occurs in cocoyams but have not been viewed as critical. Mainly, *Meloidogyne* spp. has been reported on Irish potato. Nematode reports on other crops are scarce or not available. Of the control measures discussed, emphasis is laid on use of resistant or tolerant varieties. Cultural control such as crop rotation is also advocated. Information on chemical control is discussed.

Pages 553-558

Advances in research on severe cassava mosaic edipemic in Uganda

G.W. Otim-Nape, J. Legg, J.M. Thresh and T. Alicai

ABSTRACT

A severe cassava mosaic disease (CMD) was first reported in November 1988 in Buruli county, Luwero district where it had destroyed over two thousand hectares of cassava. It subsequently spread and covered the rest of the country causing serious devastation. Each year since 1988, the epidemic moved southwards, towards Kampala, at a rate approximately 20-30km per annum. It is concluded that the epidemic originated from more than one place from northern parts of Uganda and spread southwards along a broad from several km wide. The cause of the epidemic has been investigated. Because the C isolates differed consistently, and in a characteristic way, from both EACMV and ACMV, they have been subsequently referred to as the Uganda variant (UgV), which has arisen through recombination between the two similar viruses which have been in East Africa since 1894. The role of the whitely in the epidemic development and sustainability of the epidemic and methods of the epidemic control are discussed.

Pages 559-562

Release of the entomopathogenic fungus, *Neozygites floridana* (Zygomycetes: Entomophthorales) for control of the cassava green mite, *Mononychellus tanajoa* (Acari: Tetranychidae): an in vivo approach

Surendra K. Dara, Chris J. Lomer, Fabien C.C. Hountondji

ABSTRACT

Within the framework of a project for the integrated management of cassava pests, the International Institute of Tropical Agriculture is investigating options for the control of the cassava green mite *Mononychellus tanajoa*. One potential control agent is the entomophthoralean fungus, *Neozygites floridana*; Brazilian isolates have been imported for release in Africa as a classical biological control agent. *N. floridana* does not grow in vitro and required a special means of releasing it in the field. An in vivo approach was developed for this purpose where the pathogen in its living hosts was released in the fields. Mites were infected in the laboratory with N. *floridana* and living-infected mites were released. Mite populations were monitored before and after the release to evaluate the establishment of the pathogen.

Pages 562-569

Effect of cassava bacterial blight on cassava root yield in different ecozones and influence of the environment on symptom development

Kerstin Wydra, A. Fanou and A.G.O. Dixon

ABSTRACT

The present studies aimed at elucidating the effect of ecozones on disease development and yield loss due to cassava bacterial blight. In field experiments in five ecozones - the humid forest zone, the coastal and the inland forest savanna transition zone, the dry savanna, and the Sudan savanna - cassava bacteria] blight reduced root yield by 12.5-50% in the susceptible variety and by 24-41 % in the resistant variety in 4 ecozones, when two infection levels were compared. Symptom severity was highest in the humid forest and the forest savanna transition zone, but yield loss was highest in the dry savanna zone. In general, the resistant variety developed less symptoms than the susceptible variety, but the susceptible variety generally yielded higher root weights. Only in the dry savanna zone, relative yield loss was higher in the susceptible variety than in the resistant one. In the stepwise regression of symptoms against root weight, blight was the most important variable determining root yield. A high variability in yield loss over 3 years was observed in trials in 2 ecozones. Since varietal resistance appeared to be variable in different environments, it was concluded that only integrated control methods comprising the use of resistant or tolerant varieties and cultural and sanitary methods can reduce the disease and are recommended especially for the dry savanna zone.

Pages 569-575

Studies on the Survival Mode of *Xanthomonas campestris* pv. *Manihotis* and the dissemination of cassava bacterial blight through weeds plant debris and an insect vector

Fanou, A; Wydra K; Zandjanakou, M; LeGall, P; and Rudolph, K.

ABSTRACT

Cassava bacterial blight (CBB) is an epidemic disease which can cause devastating losses in most regions where cassava is grown. To develop recommendations for an integrated control of the disease, survival modes of the causal agent and the possible propagation of the pathogen by weeds, plant debris and by an insect vector were studied. *Xanthomonas campestris* pv *manihotis* (Xcm) survived epiphytically one most of frequently occurring weeds until the end of their life cycle in cassava fields. Epiphytical survival of *Xcm* was observed up to 30 days on *Brachiaria deflexa, Dactyloctenium aegyptium, Mariscus alternifolius, Pupalia lappaceae, Solanum Nigrum, Talinum triangulare* and *Tridax procumbens* under field conditions. When the leaves of the weeds were infiltrated with *Xcm* in the glasshouse, the survival reached 2 months on *Brachiaria deflexa, Dactyloctenium aegyptium* and *Vernonia cinerea*. Since weeds grow frequently in cassava and close to cassava fields, the pathogen may be disseminated from weeds within and between cassava fields during the wet season. When infected debris were kept on the soil surface, *Xcm* survived at least 2 months, but slightly covered with top soil or buried in soil, the survival did not reach 2 months. Under glasshouse conditions, the survival was less than 2 months or reached at least 2 months, when the debris mixed with soil or unmixed debris were moistened 3 times a week, respectively. When mixed and unmixed debris were not moistened, *Xcm* survived at least 5 and 4 months respectively. Thus, infected leaves wtiich drop in the field at the end of the wet season can be an inoculum source and infect young cassava plants in the new cropping season. After feeding on infected plants, *Xcm* was detected on the mandibles, legs, in the alimentary canal and faeces of the grasshopper (*Zonocerus variegatus*). Angular leaf spots developed when moistened faeces were placed on scarificated leaves, in holes of leaves or on the adaxial as well as the abaxial surface of intact leaves. Thus, the bacterium can also be transmitted by *Zonocerus variegatus*, in fact it was observed in the field that the faeces could be maintained on the adaxial surface of cassava leaves for a while during the wet period.

Pages 575-576

Culturing *Scutellonema bradys* on yam tuber slices

C. Kwoseh, R.A. Plowright, J. Stanfield and R. Asiedu

ABSTRACT

A reliable and high yielding technique to mass-reproduce the yam nematode, *Scutellonema bradys* for screening has been developed. A nematode-tree tuber of white yam (*Dioscorea rotundata*) cultivar 'Puna' was washed, peeled, cut into slices and treated separately with Bio-Supercarb and sodium hypochlorite. Each slice, weighing 3-6 g was plated on l% water agar and kept for three weeks to produce callus. The plates were then each inoculated with 20 to 30 juveniles and adults of S. *bradys*. The nematodes were sterilised in 5 drops of 0.1% malachite green tor 5 minutes and then rinsed 10 times with sterilised distilled water. Inoculated plates were kept at 25°C in the dark S. *bradys* populations increased by 10 to 170 times over a five-month period and 340 to 820 times over twelve months. Sterilised yam tuber slices on water agar medium have been shown to support high reproduction of S. *bradys* and can be used to mass-produce S. bradys for screening purpose.

Pages 580-586

Whiteflies and associated viruses on sweetpotato in Uganda: prevalence, distribution and importance

V. Aritua, J. Legg, P. Sseruwagi, N.E.J.M. Smit and R.W. Gibson

ABSTRACT

A diagnostic survey was undertaken to establish the current distribution of whiteflies and associated viruses on sweetpotato in four major producing areas in Uganda. Whiteflies were more abundant in south/west and central areas than in north and east. Sweetpotato virus disease (SPVD) caused hy the co-infection of sweetpotato feathery mottle virus (SFMV) and sweetpotato chlorotic stunt virus (SPCSV) occurred in 60 of the 80 sweet potato fields sampled. SPVD incidence was greatest in southern areas around the shores of Lake Victoria and the highest incidence was recorded in Mpigi district (29%). 154 fresh leaf samples were collected and tested for SPFMV, SPCSV and sweetpotato mild mottle virus (SPMMV) using ELISA. 100 samples reacted positively to SPCSV monoclonal antibodies. 72 to SPFMV. SPMMV was detected in 9 samples, and these were from the central and southern areas only. The two serotypes of SPCSV, Ugandan and Kenyan, were detected in 6S and 32 samples, respectively. The Ugandan serotype occurred in all districts except for Tororo and Iganga, although it occurred more frequently in the south and west. The Kenyan serotype occurred more frequently in the north and east.

Pages 586-595

Facilitating safe movement of yam (Dioscorea spp.) germplasm. Current Knowledge, facilities, cost and international collaboration

B. Malaurie, M. Bousalem, J. Dubern and J. Berthaud

ABSTRACT

Yam, as a vegetatively propagated crop, is severely affected by an accumulation of pathogens, but only disease-free material can be transfered. Transfer of yam germplasm should be done from pathogen-tested material maintained in aseptic conditions (microtubers, microcuttings, microplantlets, encapsulated apices). In vitro technique allows the production of plants free of all diseases, except from viruses. Production of virus-free material requires indexation, and when needed sanitation. Indexation should be run for all known viruses. Sanitation should be effective and simple. For an integrated international safe movement of yam germplasm, we need to develop a chain of facilities with quarantine, indexation, sanitation and in vitro conservation. All of the elements of this chain, fully efficients, have to be linked, in a unique location or distributed over several locations, and be cost efficient.

Pages 601-607

Host resistance as a potential component for integrated management of late blight in East Africa highland tropics

P.S. Ojiambo, C. Lung'aho, J.K. Karinga and H.M. Kidanemariam

ABSTRACT

Germplasm selected from International Potato Center (CIP)'s population A and B Collection, were evaluated in naturally infected field plots, for major gene and field resistance, respectively, against late blight during the growing seasons of 1997 and 1998. Disease severity measured as percent leaf area blighted was used to compute area under disease progress curves (AUDPC), apparent infection rates (r) and severity at epidemic onset (Yo). AUDPC revealed more district differences among the clones than any other disease assessment parameter. Percent severity measured 67-70 days after planting (DS_{67-77}) explained more variation in AUDPC than measurements made on any other single day. Increase in percent leaf area blighted fit the monomolecular model closely than the Gompertz, logistic or exponential models. Clones with high AUDPC generally had higher DS_{67-77} and faster rates of disease increase (r). Clones 387878.21 and 392151.53 had significantly the lowest disease levels of all the germplasm tested in populations A and B, respectively. A highly significant negative correlation coefficient (r = - 0.70, P - 0.01) between AUDPC and yield was observed among clones from population B. Besides host resistance, other components in integrated management of late blight are discussed.

Pages 608-613

The role of *Bemisia tabaci* (Gennadius) in the epidemiology of the current cassava mosaic virus disease epidemic in Uganda: vector population dynamics and epidemic progress

C.A. Omongo, J. Colvin, G.W. Otim-Nape, J.M. Thresh and R.J. Cooter

ABSTRACT

A severe epidemic of cassava mosaic disease (CMD) has been traversing Uganda from north to south devastating cassava fields and causing food shortages since 1988. Studies were undertaken to better understand the spread of the disease in relation to its whitefly vector by serial plantings of CMD-free cassava var. Bao at eight sites spaced 7-9 km intervals along a N-S transect in southern Mukono district each season from June 1996 to October 1997. CMD incidence increased systematically southwards over the period. Cumulative disease incidences at seven month after planting for example were 4.6% in May 1997, 6.9% in September 1997, 27.1 % in January 1998 and 97.8% in June 1998 at Katosi which was the southernmost location. Corresponding changes in whitefly populations were recorded. Implications of results for the control of CMD are discussed.

Pages 613-615

Characterization of *Colletotrichum gloeosporioides* Penz. From yams (*Dioscorea* spp.) in Nigeria

M.M. Abang, K.R. Green, N.W. Wanyera and C. Iloba

ABSTRACT

Fifty isolates of *Colletotrichum gloeosporioides* from yam-based systems in Nigeria were separated into 6 distinct groups based on conidial and appressorial morphology, cultural characteristics, and production of setae and the ascigerous stage. A detached leaf assay used to determine the virulence of the isolates on leaves of water yam (*Dioscorea alata*) showed that the morphological groups also represented distinct virulence phenotypes. This result was supported by inoculation of whole plants of seven D. *alata* cultivars with representative isolates from the groups. Development of the detached leaf assay and the whole plant inoculation method

demonstrated the necessity to standardize experimental conditions to reduce variability in host response, and the importance of high relative humidity and leaf wetness for infection and symptom development.

Pages 615-619

Virus disease of sweetpotato and cassava in the Lake Zone of Tanzania

Simon C. Jeremiah, Richard W. Gibson, Raphael P. Msabaha

ABSTRACT

Crops of sweet potato and cassava were examined and farmers interviewed in Mara, Mwanza, Shinyanga and Kagera regions in the Lake Zone of Tanzania. Sweet potato virus disease (SPVD) affected sweet potato crops in all four regions and was shown by enzyme linked immuno- sorbent assays (ELISA) to be caused by infection with the aphid-borne sweet potato feathery mottle virus (SPFMV) and the East African strain of the whitefly-borne sweet potato chlorotic stunt virus (SPCSV). SPVD was especially common in sheltered fields and in Kagera region where it averaged 50% incidence at Kyaka near the Uganda border. Whiteflies were also abundant on many crops, again especially in sheltered locations, but their numbers were significantly correlated with SPVD incidence only in Kagera region. Most sweet potato farmers regard as high yielding landraces were susceptible to SPVD. Cassava mosaic disease was also observed in all four districts and was also common in Kagera. Most cassava farmers stated that they selected planting material from disease- free plants and a few also stated that they rogued diseased cuttings for the first few months after crop establishment. However, whiteflies were rare on cassava plants and most mosaic disease appeared to derive from farmers planting infected cuttings rather than from whitefly-borne infection.

Pages 622-630

Influence du potentiel cyanogenique des feuilles de manioc sur l'abondance et les dégâts de l'acarien vert

Norbert G. Maroya

Résumé

Une évaluation de l'effet de la teneur en HCN des feuilles sur l'abondance, et l'incidence de l'acarien vert a été réalisé pour cinq clones de manioc (BEN86052, TMS30572, 1495, Agliki-voto et Akofingnin) à travers deux sites (Sékou et Savè) pendant la campagne agricole 1996-1997. Les dosages par la méthode enzymatique du potentiel cyanogénique des feuilles de chaque clone de manioc ont été réalisées mensuellement à partir du 6ème mois après bouturage. Parallèlement à ces analyses biochimiques, les évaluations mensuelles sont effectuées sur Ie nombre d'acarien vert par feuille et les dégâts occasionnés par l'acarien vert sur chaque clone. Toutes ces observations ont été effectuées jusqu' à la récolte à 12 mois d'âge. L'analyse statistique des résultats enrégistrés pour le potentiel cyanogénique des feuilles révèle sur les deux sites une différence significative entre les clones jusqu'a 12 mois d'âge. Et c'est le clone Akofingnin qui a montré une supériorité stable pour ce caractère. A travers les deux sites, les valeurs moyennes mensuelles du potentiel cyanogenique enrégistrées sont corrélées entre elles pour tous les âges à partir de 6 mois jusqu'à 12
mois. L'analyse & travers les deux sites des resultats du nombre moyen d'acariens verts par feuille de manioc a montré des différences significatives entre clones sauf pour les deux demiers mois de végétation (mai et Juin) qui ont été marqués par une forte pluviométrie. Cette particularité induite par la pluviométrié (lessivage des acariens) n'a pas été observée au niveau des dégâts pour lequel les differences sont significatives entre les clones. En analysant la regression du potentiel cyanogénique en fonction de I'abondance ou des dégâts d'acariens verts entre 6 et 12 mois à

travers les deux sites, on constate que les coefficients de corrélation sont positifs et hautement significatifs pour I'abondance et les dégâts à 7 mois et 12 mois après bouturage.

Pages 631-633

Yam viruses of Nigeria

Odu B.O; Shoyinka S.A; Hughes J. d'A; Asiedu R and Oladiran A.O

ABSTRACT

Yams are an important staple food in Africa. Nigeria produced about 70% of 33 million MT of yams produced globally in 1996. Pests and diseases are still major production constraints. Five viruses have been reported to infect yams in Nigeria: yam mosaic poty virus (YMV), *Dioscorea alata* potyvirus (DAV), cucumber mosaic cucumovirus (CMV), *Dioscorea dumetorum* potyvirus (DdV) and *Dioscorea alata* badnavirus (DaV). YMV, infecting D. *rotundata* and D. *alata* in all the yam-growing areas of Nigeria, was found to cause severe chlorosis, veinal chlorosis, green vein banding, shoe-stringing, leaf distortion and severe stunting. It is transmitted both mechanically and by *Aphis* spp. DAV is transmitted to test plants by A. *craccivora* and *Rhopalosiphum maidis*. It causes mottling, green vein banding, severe chlorosis and leaf distortion. DaV-infected plants have distorted and crinkled leaves. The symptoms of the viruses, their transmission, diagnosis, distribution and possible effects on yam production in Nigeria are discussed.

Pages 634-637

Control of the yam nematode (*Scutellonema bradys*) with neem fruit powder

J.I. Onalo, R. Asiedu and S.O. Adesiyan

ABSTRACT

The effectiveness of neem (*Azadiracta indica*) fruit powder against the yam nematode (*Scutellonema bradys*) was studied in a field trial. Individual stands of yams were inoculated with yam peels infested with S. *bradys*. Tubers and soil were sampled at harvest for presence and abundance of the nematode. Tubers were also assessed for presence and severity of dry rots. Higher mortality (100%) of the nematode was observed in neem treated plots compared to untreated ones.

Treated plots also produced significantly higher yields of tubers which were free of the nematode.

Pages 637-639

Pratylenchus, the dominant genus affecting yam (*Dioscorea* spp.) in Uganda

J. Mudiope, P.R. Speijer, N.R. Maslen and E. Adipala

ABSTRACT

Yam (*Dioscorea* spp.) is a traditional tuber crop in tropical Africa and a principle source of carbohydrates. Crop yields are still low, with susceptibility to nematodes being one of the main constraints. In 1997, a survey was carried out in the major yam growing regions of Uganda to establish the nematode species profile with this crop. Tubers of various cultivars were collected and observed for incidence of root-knot nematode galls and tuber skin cracks. Nematodes were extracted from I cm^3 taken out of the tuber surface. Incidence of root-knot sympsoms and tuber cracks were low, i.e., less than 1 on a scale of 0 (no symptoms) to 3 (severe symptoms). *Pratylenchus* spp. dominated the samples followed by *Meloidogyne* spp. Positive correlations ($P < 0.05$) between

Pratylenchus spp. and severity of cracks were observed. Increasing and sustaining yam production in Uganda should include the search for cultivars with sources of *Pratylenchus* spp resistance and control measures such as selection of clean nematode free tubers and or heat therapy of yam setts.

Pages 639-644

Plant parasitic nematodes associated with soils, intercrops and tubers of yam in Ghana

Augustus Missah and Jeffrey C. Peters

ABSTRACT
Ghana is an important yam-producing country, but information on the incidence of plant parasitic nematodes capable of reducing the yield and quality of yams is limited. Samples of soil, roots of intercrops and tubers of yam were collected from 50 farms in 26 villages in 17 administrative districts of Ghana during mid-season in July 1997, and processed in the laboratory for plant parasitic nematodes of importance to yam. Results indicated the presence of *Scutellonema bradys*; *Pratylenchus* spp; *Meloidogyne* spp; *Helicotylenchus* spp and *Rotylenchulus reniformis* in various populations in the soil and roots of intercrops. Apart from R. *reniformis*, all other nematode species were found in over 55% of soils planted to yam. Pratylenchus was the commonest genus infesting roots of intercrops. S. *bradys* was the most important nematode associated with yam, being found in 35.6% of tubers from 58.6% of farms. Mean population of S. *bradys* per 5 g yam tuber peels was 411, compared with 22 and 8 of *Pratylenchus* and *Meloidogyne*, respectively.

Pages 645-648

Integrated control of sweetpotato weevil, *cylas puncticollis* (Boh) in southeastern Nigeria

T.O. Ezulike, S.C. Anioke and S.O. Odurukwe

ABSTRACT
Two sweet potato varieties (tolerant and susceptible to *Cylas puncticollis* (Boh) were each combined with three other control measures (time of planting, earthing up and dipping vine cuttings in insecticide) and laid out in a randomized complete block design. *Cylas* sp. infested both

the sweetpotato vines and tubers at varying degrees. Severity of damage was higher on susceptible sweet potato variety by 68%. The tolerant variety produced more tubers than the susceptible variety. Sweet potato planted early (June) in the cropping season produced more tubers than the that planted later (July) in the season. The interactions were not significant. Mean tuber yields of tolerant variety were higher than that of susceptible variety. Sweetpotato planted early in the cropping season had higher tuber yield than that planted later in the season. The interactions were also not significant. The use of tolerant sweet potato variety and early planting played major role in the control of *Cylas* sp. And this package must be incorporated in any IPM strategy against the pest.

Pages 648-652

Reactions of elite cassava genotypes to root rot disease and the role of different micro-organisms

Onyeka T.J; A.G.O. Dixon, T. Ikotun and K. Wydra

ABSTRACT

The pathogenicity of microorganisms associated with cassava root rot was determined by an in-vitro method in which cassava storage root slices were inoculated. The various microorganisms isolated from infected cassava were classified according to their ability to cause root rot disease. Four of the nine pathogens frequently associated with cassava root rot samples were able to initiate rot in the pathogenicity test using root slices assay. Three of the pathogen isolates (*Botryodiplodia theobromae, Sphaerostilbe repens, Fusarium solani*) were used to assess the reactions of six elite cassava genotypes and one African landrace to root rot. The genotypes showed differential response to the three pathogens. *Fusarium* sp did not cause any appreciable rot in the various cassava genotypes. However, with B. *theobromae* and S. *repens*, significant reaction to rot was

observed among the different genotypes. 30572 and 92/0057 were the most resistant while TME-1 and 30001 were the most susceptible to root rot.

Pages 652-654

Three new isometric viruses infecting yams in Nigeria

L.N. Dongo, J. d'A. Hughes and G.I. Atiri

ABSTRACT

Leaves of *Dioscorea* spp. from the major yam growing areas in Nigeria were tested by enzyme-linked immunosorbent assay (ELISA) for known viruses infecting yams. Some samples with mosaic, mottling, leaf necrosis and distortion did not test positive for these viruses. *Vigna unguiculata* cvs 2657 and 84s-2114, and *Glycine max* cv. Malayan, were diagnostically susceptible by mechanical inoculation, to three potentially distinct 17-22 nm isometric viruses (tentatively named *Dioscorea* mild chlorosis mosaic (DMCV), *Dioscorea* mottle (DMV) and *Dioscorea* necrosis (DNV) viruses,). The viruses were transmitted mechanically back to *Dioscorea* spp. seedlings. Spur formation in agar gel double diffusion tests indicated that some of the viral antigens are related, but not identical. The viruses were found to be related to cowpea mottle carmovirus (CMeV).

Pages 655-661

Post-harvest technology for root crops: gender implications and strategies for the 21st century

Joyce A.S. Haleegoah

ABSTRACT

Root crops are very important in the economy of most sub-Sahara Africa countries. They form the bulk of food intake and the major source of income in the sub region. In Ghana, root crops contribute about 60% of the agricultural gross domestic product (GDP). Small-scale root crop farmers contribute significantly to the growth rate of the national agricultural gross domestic product, which ts currently at 2.1%. The needs of these farmers are to be addressed if the growth rate is to be increased. In root crops, a priority area is post harvest technology since the harvested roots are highly perishable. In addition to adding value to the root crop for the food, feed and industrial sector market, post harvest technologies should be given priority. This paper addresses gender issues as a priority area considering the key roles gender play in the production, processing, marketing and utilization of root crops. It also addresses some gender strategies for post harvest technology for root crops.

Pages 661-667

Effect of varying stages of harvest on tuber yield, dry matter, starch and harvest index of cassava in two ecological zones in Nigeria

M. Ngendahayo and A.G.O. Dixon

ABSTRACT

Sets of 35 and 25 earlier cassava cultivars of the IITAs breeding program were planted at Ibadan and Onne in Nigeria at the beginning of the rainy season (May/June) in 1992 and harvested at 3-monthly intervals from 6 to 24 months after planting (MAP). The aim was to assess the effect of harvesting date on the root yield, dry matter %, starch %, dry matter yield, starch yield and harvest index. Results showed that average cassava fresh root yield increased over time up to 24 MAP at both locations Fresh root yield of cultivars increased linearly by different amounts up to 12 MAP and beyond which, different cultivars attained their optimum yield at different times. The trend for dry matter (%) was more closely related to rainfall pattern between 6 and 18 MAP. When harvesting time coincided with the early part of the rainy season following a dry season, usually at 12MAP, dry matter % is generally lower. Dry matter % reached its first peak at six MAP and the second peak between the 15 and 18 MAP, beyond which the dry matter % decreased sharply. The trend for starch % and starch yield was closely related to those of dry matter % and dry matter yield respectively throughout plant growth. For most of the cultivars evaluated the maximun or near maximum starch % was already obtained at 6 MAP. Thereafter, it was dependent on harvesting time, genotype an rainfall pattern. Harvest index (HI) showed very little difference as the crop aged. There was no maturity time for cassava because the optimum harvest time of genotypes for all traits depended on the cultivar and rainfall distribution pattern. Thus, optimum harvest time of cassava genotypes has to be determined at the target agroecologies where they will be grown.

Pages 667-681

Developing value-added markets for cassava in East and Southern Africa

R.S.B Ferris, G. Ntibarikure, S. Kolijn and A. K. Muganga

ABSTRACT

Cassava processing in east and southern Africa is limited to traditional means of processing and these methods are generally of low output and often produce products of low quality. Lack of access to improved processing equipment, combined with poor market information and infrastructure results in cassava being confined to the role of a famine reserve crop rather than being a major primary commodity for cash income and job creation. The research being undertaken by the IITA-Uganda postharvest group in collaboration with national programmes, NGOs and private sector partners aims to introduce new methods of processing into the farming community and through market analysis find new market opportunities for the crop. The aim of the commercially oriented research is to enable farmers to process cassava roots into quality products with increased value and link these products to sustainable and diversified markets.

Pages 686-694

Use of African cassava varieties in Benin for producing sour starch: a traditional Latin American baking product

C. Brabet, N. Bricas, J. Hounhouigan, M. Nago, A.L. Wack

ABSTRACT

Cassava sour starch is a traditional Latin-American product, which is obtained by a natural lactic acid fermentation of wet cassava starch, followed by sun drying. This gluten-free product has a unique baking property: good expansion can be achieved during cooking, without the addition ot yeast and other additives, and preliminary dough fermentation. This has great potential in Africa for enhancing quality of cassava based bakery products, as well as developing new products. Cassava sour starch production trials were conducted in Benin. Starches from four African and one Colombian cassava variety were fermented under different temperatures. The effect of different inocula was also evaluated. It has been shown that sour starch with good bread making quality can be produced under natural fermentation and sun drying conditions in Benin, using Afncan cassava varieties.

Pages 694-698

Investigating the potential for vertical integration of primary cassava flour producers with secondary confectionary processors in Uganda

R.M. Gensi, M. Bokanga, A. Nayiga and R.S.B. Ferris

ABSTRACT

In many African countries, declining production has led to an increasing food deficit. This deficit has been met; to a large extent by an increasing cereal importation. These imports have a negative impact on both foreign exchange earning and internal production. To offset these problems, new and innovative means need to be developed to increase internal production and utilisation of local staple crops. Cassava is a crop with high potential for increased production if its use can be diversified to supply a range of markets as is currently supplied by cereal imports. A study was carried out to investigate the potential market opportunities for cassava in Uganda.

Pages 699-707

Development of sweetpotato snack products in rural areas: case study of Lira district of Uganda

Constance Owori and Vital Hagenimana

ABSTRACT

Product development studies were conducted in phases in Lira district, Uganda, to enhance the role of sweet potato for income generation. Results of the study showed that it is feasible to substitute either 40-60 % fresh grated/boiled sweet potato or 30 % sweet potato flour for wheat flour in fried and baked snack products. Products made with these levels of sweet potato were found acceptable to consumers and they had good demand in rural markets, schools and within the municipality. Analysis of costs and returns showed that by using improved sweet potato processing technology, costs of snack products is reduced by 20-64 % depending on the product and form of sweet potato used. Results obtained have demonstrated that sweet potato processing technology can improve the income generating potential of small scale snack product enterprises. The conclusions highlight the importance of expanding the income generating opportunities by targetting major urban markets with promising sweet potato products.

Pages 711-719

The dynamics of the accumulation of cyanogenic glucosides in cassava during its growth cycle.

Y. Chukwumah and M. Bokanga

ABSTRACT

The accumulation of cyanogenic glucosides in the cassava plant throughout its growth cycle was investigated. Results show that total plant cyanogenic glucosides content increases throughout the plant growth cycle. Cyanogenic glucosides content in the aerial parts (especially leaves and stem) were the major source of whole plant cyanogenic glucosides content up to 25 weeks after planting (WAP). The petioles maintained a relatively low amount of cyanogenic glucosides throughout the growth cycle. From 25 WAP to maturity, the roots had higher cyanogenic glucosides content than the aerial parts. From 16 weeks after planting (WAP) to 48 WAP, cyanogenic glucosides content increased in the root cortex and to a lesser extent, in the root parenchyma. At 48 WAP, cyanogenic glucosides content in root cortex increased to 4 times the amount at 16 WAP while that of the root

parenchyma doubled. The ratio of cyanogenic glucosides content in the underground parts to that in the aerial parts of the cassava plant increases during its growth cycle up to 36 WAP which is the driest month of the growth cycle and when cassava drops almost all of its leaves. It gradually decreases between 40WAP and 52 when the plant starts producing new leaves. The aerial parts accumulate more cyanogenic glucosides than the underground parts from 1 WAP to 25 WAP. Between 25 WAP and 50 WAP, the situation is reversed. This indicates the sink role played by the underground organs of the plants. At 52 WAP, the rams had resumed, leaf growth intensified and the balance of cyanogenic glucosides shifted to the aerial part of the plant indicating a greater source activity. Cyanogenic glucoside concentration in the plant increases rapidly after germination and reaches a peak at 9 WAP. Thereafter, the concentration decreases with age and remains relatively stable from 16 WAP to maturity. Cyanogenic glucosides concentrations were higher throughout the growth cycle in leaves, herbaceous stem, hardwood stem (rind) and root cortex (1.09-5.83 mg.g-1 tissue) than in other parts of the plant (0.18-2.34 mg.g-1 tissue). Root cortex cyanogenic glucosides concentration was found to be 2-10 fold greater than that in the parenchyma throughout the plant growth cycle.We conclude that cassava produces cyanogenic glucosides throughout its growth cycle. The root cortex, the rind of hardwood stems, the leaves and the root parenchyma hold most of the plant cyanogenic glucosides. The mechanism controlling the accumulation of cyanogenic glucosides in specific plant tissues needs to be investigated.

Pages 719-723

L'enrichissement proteine du manioc par fermentation fongique

David Nkeshimana

ABSTRACT

S’inspirant des fermentations traditionnelles en usage au Burundi, en RDC et au Rwanda, une essai a été mis au point basé sur une technique simple de fermentation du manioc en milieu contrôle qui peimet d’obtemr une farine dont la teneur en protéines est nettement améliorée. Le principe de cet

enrichissement consiste en 1'ajout au substrat de 1'azote uréique. Et, ce dernier est transformé en azoté protéique par un champignon naturel du sol, *Rhizopus oryzae*, inoculé en masse sur le manioc. Le manioc râpé et séché est humidifié à 40% d'humidité. Puis il est chauffé pendant une heure et demie à 80°C en atmosphère saturée de vapeur. Après refroidissement jusqu'a une température de 40°C, le manioc est mélangé à une solution contenant de 1'inoculum de *Rhizopus oryzae* et la solution nutritive de composition suivante par Kg de râpures: 30 g d'urée. 13 g de KH_2PO_4, 7g de $MgSO_4$ et 20 gg d'acide citrique. Le manioc ainsi humidifié a 60% est étalé en couches minces de +/- 2 cm d'épaisseur, sur des claies, puis mis à fermenter dans un fermenteur humide et aéré. La fermentation est menée pendant 45 heures. Cette technologie nous a permis de produire de manière fiable une fanne de manioc contenant 10 à 11% de protéines assimilables, dont la valeur nutntionnelle et le risque toxicologique ont été contrôlés en laboratoire, au Burundi et en Belgique, par des analyses chimiques et des tests sur animaux. Sa valeur nutritive et son inocuité ont été évalués.

Pages 723-729

Agroecological determinants of cassava root taste and cyanogenic glucoside content: preliminary findings

Mkumbira, J; L. Chiwona-Karltun, J. Saka, A.R.K. Mhone, N.M. Mahungu, M. Bokanga; L. Brimer, H. Rosling & U. Gullberg

ABSTRACT

Cassava is grown m diverse agro-ecologies in tropical Africa. Cyanogenic glucosides (CG) in cassava is determined by both the genotype as well as the environment. Changes in cassava CG levels due to environmental effects are important in areas where cassava is utilised with minimum processing. Factors that affect cassava root CG and taste were studied in farmers' fields in Nkhata Bay, a lake Malawi shore district in Northern Malawi in 1996. A total of 40 cassava fields for 30 cassava farmers were used. Root CG levels and taste were determined at Mkondezi Agricultural Research Station and soil nutrient determination was done at Chitedze Agricultural Research Station. Mean root taste scores for cool cassava cultivars had strong correlation with soil nitrogen content (r=0 9), soil pH (r=-0.79), root dry matter content (r=0.64), root weight (r=0.83) and cassava plant age (r=0 78). In contrast, cassava root cyanogenic glucoside content had no significant correlation to any of these variables. There was also no correlation between taste and cyanogenic glucoside content. CG content for bitter cassava cultivars had weak significant positive correlation with phosphorus (r= 22), root weight (0.24) and cassava plant age (0.29). Root taste had no significant correlation with all but plant age (r=0.2). Unlike the cool cultivars, there was strong positive correlation between taste and CG (r=0.87) for the bitter cultivars. There is no consistent trend that can be observed in the means of the cuitivars for each agro-ecological determinant. This may indicate that a combination of factors is involved in the agro-ecology hence multivariate analysis of the data obtained would be more suitable. However, there is indication that cassava plants grown in dambo, places without anthills and those planted on ridges had relatively low mean CG content.

Pages 730-734

Relative cost of using cassava as a substitute for maize in poultry feed production

O.C. Aniedu and D.N. Udozuwe

ABSTRACT
The poultry industry in Nigeria today is plagued by various problems such as capital, poor management and high cost of feeds and feed ingredients. With the ever increasing demands for protein by Nigerians, large importation of cereals, like maize, wheat etc. used in feed formulation has contributed to the massive drain of our foreign exchange reserves. Substitution of cassava for maize in poultry feed formulation at 0%, 50%, 75% and 100% levels proved successful by Ngoka (1984) but the relative cost of substitution is yet to be determined. The main objective of this work therefore was to determine the relative cost of substitution of cassava root meal for maize in poultry feed formulation. Data collection on prices of fresh cassava tubers and feed ingredients was carried out in the following markets and feedmills - Nkwoachara. Nkwoegwu, Ndoro, Ahiaeke and over-rail markets. Imo modern poultry feedmill Avutu, Pfizer feedmill Aba, ADC feedmill Nekede and National Root Crops Research Institute Umudike feedmill. Cassava root meal was produced by the Processing unit, National Root Crops Research Institute Umudike, with 12 month-old fresh cassava tubers of three varieties - TMS 30572, TMS 30555 and TMS 30211. The cost of production of the cassava root meal was determined and it contained 28.0 mg/kg hydrocyanic acid, 2.4% crude protein, 0.9% fat and 3 1% crude fibre. The moisture content was 8.5%. Result showed the cost of 75% substitution was cheaper in cassava root meal based ration (N19,886.70/t of feed) than in the maize-based ration (N27,847 50/t ot teed) Benefit-cost ratio for the cassava-root meal based ration was 1.30 but for the maize-based ration it was 0.94. Consequently it can be concluded that it is profitable to substitute cassava-root meal for maize at 75% level in poultry feed formulation.

Pages 735-741

Impact of the High Quality Cassava Flour Technology in Nigeria

A.B. Abass, A.O. Onabolu and M. Bokanga

ABSTRACT

For several years IITA has conducted research oriented towards increasing the utilization of cassava in baking applications through the development of technologies for processing cassava flour and utilisation. These technologies were demonstrated in Nigeria through training of farmers, staff of national agricultural extension agencies, women groups, home caterers, bakers and industrial food processors. Farmer's co-operatives, women's groups and small-scale processors adopted cassava flour production. Caterers, bakers, biscuits and noodles factories adopted the flour for use in their recipes. A new agro-industry and trade were thus created in Nigeria. In 1996 and 1998, surveys were carried out to assess the impact of the introduction of the cassava flour technology in four south-western states of Nigeria. The data collected showed that cassava flour production generates employment opportunities in the rural areas. Out of all the cassava products made by processors, cassava flour was the easiest and cheapest to make, and the highest income generator. Substitution levels of wheat by cassava flour practised by home caterers ranged from 10% to 100%, from 5% to 20% for bread bakers from 5% to 25% for biscuit manufacture and were 10% for noodles production. Users were able to reduce their cost of production and improve the yield and quality of their products. Four major quality criteria adopted for screening cassava flour are pH (5.0- 8.0), moisture (10 - 12%), white colour, absence of odour, sand, shaft, or any contaminants. Although the use of cassava flour in the baking industry is technically possible and appears economically beneficial to processors, fanners and users alike, its production and use are still hindered by the unorganised state of its marketing structure. While producers consider low market demand as one of the critical problems, major users complained of not getting consistent supply of good quality cassava flour. The use of high levels of cassava flour in bread baking is claimed by bakers to be hindered by the low quality of wheat flow available in the common market. These problems constrain the development of cassava flour as a major industrial commodity in Nigeria.

Pages 741-743

Variation within *Lactobacillus plantarum* concerning the degradation of cyanogenic glycosides (e.g. linamarin) in plant tiss ues. Towards better starter cultures.

Vicki Lei, Mogens Jakobsen and Leon Brimer

ABSTRACT

Some strains of *Lactobacillus plantarum* from cassava hydrolyse linamarin. We investigated the degradation of the cyanogens linamarin, linustatin (flaxseed) and amygdalin (almond) in seven strains. Each micro-organism was grown in pure medium, and with 250 nmol/ml of one of the cyanogens added. Samples taken at regular intervals were analysed: (optical density, pH, total cyanogens, non-glycosidic cyanogens). Five strains degraded all cyanogens within 30h. One needed 80h. One lacked hydrolytic activity, in agreement with an API ZYM screening for β-glucosidase. Molecular analysis (PCR) suggested (LPl, 3,11) to be closely related, as were (LP6 and LP7). LP2 and LP5 differed significantly. Strain LP6 was a fast degrader, LP7 the strain lacking activity. A fast degrader (LP1) showed: optima - temp. 35°C, pH approx. 6; relative activities (prunasin: linamarin: amygdalin: linustatin - 100:83:40:20). The enzyme was intracellular or membranebound. The β-bis-glucoside amygdalin was hydrolyzed in two steps, with low accumulation of the intermediate product. L. *plantarum* has a broad substrate specificity, but the variation between genetically closely related strains is considerable concerning glycosidase activity.

Pages 742-743

Production of ethanol from cassava in Nigeria

O.T. Bamikole and M. Bokanga

ABSTRACT

Ethanol production from starchy substrates is not a new technology in the world. Ethanol production from cassava although theoretically possible is seldom found at an industrial scale anywhere. But in Nigeria, NIYAMCO (Nigerian yeast and alcohol manufacturing company) PLC has succeeded in switching from the use of sugar cane molasses to cassava flour as a raw material for the production of ethanol. The plant started trying cassava as a substitute raw material for ethanol production in 1995, and went into commercial production in 1996. On the average, about 27t of dry cassava chips are consumed daily to produce 12,000 liters of ethanol. The problems associated with the large scale use of cassava by the ethanol plant are reviewed and discussed.

Pages 744-748

Effect of waxing on the food quality of yam (*Dioscorea* spp.) tubers in storage

A.U. Achidi, O. Ojeba and M. Bokanga

ABSTRACT
Four genotypes of *Dioscorea rotundata* and four genotypes of *Dioscorea alata* were studied. Waxed yams lost less weight than non-waxed yams. Amongst the D. *alata* genotypes, DAN 087 lost more weight than others. DAN 087 also increased its dry matter content by 20% when stored waxed and by 36% when stored non waxed. Starch content decreased in both species. Amylose content was lower in non-waxed D. *rotundata* genotypes while the difference was not significant in D. *alata* genotypes. Waxing did not provide an improvement of the sensory attribute ratings at the end of the storage period.

Pages 748-755

Increasing vitamin A intake through promotion of orange-fleshed sweetpotatotoes in western Kenya: a women centered approach

M.A. Oyunga, V. Hagenimana, K. Kurz and J. Low

ABSTRACT
Helen Keller International (HKI) food frequency method, developed to yield understandable information about vitamin A deficiency and consumption of vitamin A-rich foods in communities, was used to survey 15 communities in Ndhiwa division. Western Kenya. Results indicated that vitamin A intake is low-mean score of 4.0, well below the 6.0 cut-off for vitamin A deficiency of public health importance. Four orange-fleshed sweetpotato varieties were introduced to 20 women's groups in Ndhiwa and nearby Rongo. Half the women groups were randomly allocated to receive three interventions to promote orange sweetpotato-nutrition education food processing and participatory methods to identify and overcome barriers to produce and use the new varieties.

In Ndhiwa, the HKI score of the intervention groups rose from 4.8 in April 1996 to 6.4 one year later, despite drought, while the control groups decreased from 4.6 to 2.4, a net increase of 3.8 units. In Rongo, initial scores were higher and the intervention groups decreased slightly (8.9 to 8.4), while the control groups dropped substantially (8.0 to 4.3), a net increase of 3.2 units.

Pages 755-758

Screening cassava varieties for the linamarin-synthesizing enzyme complex activity

I. Dossou-yovo, Y. Chukwumah and M. Bokanga

ABSTRACT

Cassava breeding programs selecting for varieties with low amounts of cyanogenic glucosides usually rely on chemical tests, qualitative or quantitative, of cyanogenic compounds in cassava roots at harvest time. A recent approach is however based on an enzyme system that convert L-valine to cyanohydrin (immediate precursor of linamarin). In this current study, the enzyme complex was extracted from the young leaves of 14 cassava varieties. Enzyme activity was compared to the concentration of cyanogenic compounds in the leaves. The results showed that the rates of biosynthesis of cyanogenic compounds in cassava varieties are highly variable. However, no correlation was found between the biosynthesis of the cyanogenic glucosides and the concentration of cyanogenic compounds. Electrophoresis (SDS-PAGE) of the isolates showed a similar band pattern. Further characterization of the linamarin-synthesizing enzyme is in progress to determine the biochemical basis for the differences in biosynthetic activity.

Pages 759-773

Analyse comparee de la production d'igname pour la transformation en cossette au Benin, Nigeria et Togo: un exemple de sedentarisation de la culture de l'igname

P. Vernier, K.E. N'kpenu and G.C. Orkwor

Résumé

Cette communication présente les résultats d'une série d'enquêtes menées auprès D'agriculteurs cultivant l'igname pour la transformation en cossettes. Ce travail s'inscrit dans le cadre d'une étude globale de la filière cossettes d'ignames réalisées dans trois pays du goife de Guinée (Bénin, SW. Nigeria et Togo) où ce produit a pris une importance significative chez les consommateurs urbains. L'objectif était de caractériser les systèmes de cultures produisant ce type d'igname. La production de cossettes est une spéculation importante chez les exploitations qui la pratique. Elle est fortement orientée vers la vente, tout au moins au Bénin et au Nigeria. L'évolution de cette production sur les cinq dernières années est contrastée, mais elle progresse chez les exploitations produisant le plus d'igname. Cette transformation est majoritairement basée sur l'utilisation des variétés du groupe kokoro, variétés tardives (D. *cayenensis* - D. *rotundata*) à multiples petits tubercules. Du point de vue agronomique, les kokoros donnent lieu, au moins dans certaines régions, à une intégration de l'igname dans des systèmes de cultures relativement fixés. Pour l'igname, traditionnellement inféodée à la défriche brûlis, c'est une situation nouvelle en Afrique. A ce titre ces variétés présentent un intérêt majeur pour le maintien de l'igname dans les systèmes de culture en voie de sédentarisation et la limitation des défrichements agricoles.

ABSTRACT

Comparative analysis of the production of chip-oriented yams (D. *cayenensis* - D. *rotundata*) in three countries (Benin, Nigeria, Togo): possibilities for reduction of shifting cultivation of yam. This paper presents the results of a survey carried out on farmers cultivating yams designated to be processed into sun-dried chips. This work takes place inside a larger study of the yam chip subsector implemented in three countries of the gulf of Guinea (Benin, SW Nigeria and Togo) where this product has taken on a significant importance for urban consumers. The objective was to characterise cropping systems producing this kind of yams. The production of yam chips is an important output for farmers who produce them. It is a strongly market-oriented production, at least in Benin and Nigeria. Its evolution in the last five years is not uniform but the biggest producers have increased production. The processing of yams into chips is mainly based on kokoro type varieties, a group of late maturing cultivars (D. *cayenensis* - D. *rotundata*) that produce several small tubers. From the agronomy point of view, kokoros, at least in some regions, allow the integration of yams into sedentarised (sustainable) cropping system. For yam cultivation, traditionally related to slash and burn practises, it's a new status in Africa. Therefore these varieties allow the cultivation of yams more frequently on the same land, thereby reducing deforestation.