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Genome-wide association and genomic selection in genetics and breeding root and tuber crops

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DNA marker technology has been increasingly used in locating genes, tracking desired loci or genes, pyramiding genes –particularly for host plant resistance– understanding quantitative traits, or for increasing efficiency when selecting complex traits. Association mapping,which is a linkage disequilibrium-based technique that exploits diversity observed in existing cultivars and breeding lines without developing new mapping populations, involves searching for genotype-phenotype correlations in unrelated individuals and is often more rapid and cost-effective than traditional linkage mapping. Ithas become the preferred method for tagging chromosome regions bearing genes or quantitative trait loci.Genome-wide association mapping has been used in several plant species including a few root and tuber crops, e.g. potato.Genome-wide selection (GWS) or genomic selection has been defined as a type of marker-assisted selection (MAS) without identifying markers with significant effects.It appears to be more effective than MAS that uses only a subset of markers with significant effects. GWS changes the role of phenotyping that in this approach serves to update prediction models rather than for selecting breeding materials.As shown by recent cassava breeding research, GWS can significantly accelerate selection cycles, thereby increasing gains per unit time. This marker-aided breeding needs further research to validate its routine use for breeding root and tuber crops.

Keywords: asexual crops, DNA markers, marker-assisted breeding, vegetative propagation

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Production and Evaluation of the Quality of Yam Bean (*Pachyrhizus erosus*) Fortified *Gari*

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Abstract

Yam Bean (*Pachyrhyzus* spp.) is an underutilised legume crop which produces edible and starchy tubers relatively rich in proteins. Studies reported that Yam Bean tubers can be processed into *gari*, a widespread cassava-based food consumed in West Africa. In the present study, Yam Bean tubers were processed into *gari*, singly or mixed with cassava (fortification). Three different types of fortified *gari* were produced (25% Yam Bean *gari*, Yam Bean 50% *gari* and 75% Yam Bean *gari*). Physical characteristics, proximate composition and sensory quality of the *garis* obtained were assessed. Results showed that low and medium (25% and 50%) Yam Bean fortified *gari* processing yielded better than 75% and 100% Yam Bean *gari* processing. Low and medium Yam Bean *gari* were the closest to conventional *gari* regarding the brown index (18.0 and 18.3 respectively), had good swelling capacity (≥ 3) and had higher relative bulk density (0.57 and 0.53 respectively). The proteins content of the processed Yam Bean *garis* increased with increasing incorporation rate of Yam Bean but, similarly, the crude fibres content increased going over the recommended level of 2% maximum. The processed *garis* were used to cook *èba* which were submitted to panellists' appreciation. Panellists scored better, low and medium Yam Bean fortified *garis* and the resulted *èba*. Combining physical characteristics, chemical composition and panellists appreciations, the highest incorporation rate suggested was 50% Yam Bean tubers. The present work showed a way for Yam Bean utilization in West Africa and its contribution in *gari* consumers' nutritional status improvement.

Key words: Legume tuber-root crop, yam Bean, gari fortification, physical characteristics, chemical composition, sensory evaluation

Effect of agglomeration-roasting process and the addition of cowpea and OFSP (Orange fleshed sweet potatoes) on the viscosity of porridge made of sun dried cassava flour

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Abstract

The aim of this study was to investigate the effect of addition of cowpea and orange fleshed sweet potato flours and the agglomeration-roasting process in porridge made of cassava flour. Individual flours, cowpea (CP), cassava (C) and orange fleshed sweet potato (OFSP), with particles size of 50-100, 10-40 and 20-50 μm, respectively, were agglomerate and obtained particles with 200-500 μm. To agglomerate cassava (C), blend of cassava-cowpea (CCP) and cassava-orange fleshed sweet potato (COFSP) flours, water was used as a bind followed by heating and drying. The viscosity of porridge made of blend flours (CCP and COFSP) was measured before and after agglomeration-roasting process and the result was compared with cassava, maize and commercial instant porridges. The addition of about 20% (w/w DM) of CP and OFSP flours without agglomeration-roasting process to cassava flour decreased the porridge viscosity in 61 and 24%, respectively, while the agglomeration-roasting process of blend flours, CCP and COFSP, decreased the porridge viscosity in 81 and 93%, respectively, in comparison to their non agglomerate blend flours. The agglomeration-roasting process of cassava roots decreased the porridge viscosity by 82% when compared to the dried cassava flour. Porridges made from non agglomerate-roasted cassava flour and the blend of COFSP had viscosity of about twice high of that from commercial instant and similar to maize porridges, although, the energy density of commercial instant porridge was two times higher than the other porridges here reported. The agglomeration-roasting process of cassava flour and the blends (CCP and COFSP) resulted in porridge with low viscosity than commercial instant porridge. This can be an alternative to decrease the viscosity of porridges.

Keywords: Cassava, Cowpea, sweet potatoes, orridges, viscosity, agglomeration

What is the consumers' perception of bakery products made with vitamin A rich sweetpotato and wheat?

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Abstract

Manufacturers who import agricultural commodities like wheat are facing increasing costs due to rising commodity prices. Sweetpotato can replace up to 40% of the wheat in many bakery products. This can lower firm production costs, save a country foreign exchange, and increase rural farmers' incomes. We produced bread, biscuits, queen cakes and doughnuts in a commercial bakery, using different combinations of ingredients as follows: wheat flour only; a mixture of wheat flour and orange-flesh sweetpotato (OFSP) flour; and, a mixture of wheat flour and OFSP puree. The products were then subjected to sensory testing, using 120 consumer panelists drawn from a rural primary school, an urban girls' secondary school, and a university. Each of the testers was given a sample of each product marked with a circle, diamond, or square. We used means t-tests and ordered-logit to analyze the evaluations. The results showed that bread made out of a mix of 30% OFSP puree and 70% wheat flour was preferred to that made of 100% wheat flour. Consumers showed no preference between doughnuts and queen cakes made from 100% wheat flour and those made from a mix of 60% wheat flour and 40% OFSP puree. Biscuits made of 40% OFSP puree mixed with 60% wheat flour were preferred to those made with 100% wheat flour. Therefore, sweetpotato puree can be a good substitute of some percentage of wheat for the analyzed products, helping to bring down production costs and food prices
Key words: Orange flesh sweetpotato, vitamin A, Beta Carotene, Sensory test, Sweetpotato puree.

Physiochemical Characteristics of Yam Flour Supplemented with Whole Wheat and Soy Flour

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Abstract

Yam tubers are often dried and milled into flour which can be reconstituted with hot water to form a doughy product called 'amala' and eaten with different soup but its nutritive value can be improved on by substituting the yam flour with whole wheat and soybean flour. The effect of soy and whole wheat flour substitution on the proximate composition, physiochemical and acceptability of 'amala' as sensory properties was examined.

The yam flour was prepared using conventional method adopted from traditional method of yam flour production along with whole wheat and soy flour. The blend of yam-whole wheat-soy flour (3:6:1, 6:3:1, 4.5:4.5:1) was used in preparing 'amala' and compared with pure yam and pure whole wheat flour.

Data from the analysis showed that the substitution caused a reduction in the swelling power, water absorption, and water binding capacity while an increase was noticed in the solubility index.

Sensory evaluation indicated that 'amala' made from the blend of 3:6:1 was acceptable to consumers there was preference for 'amala' from 6:3:1 blend in terms of smoothness, texture, color, taste and flavor.

The preferred blend has low moisture content- 9.9, it has high protein- 12.6, ash-1.6 and fibre - 2.0 which makes it a good blend, nutritious and serve as an acceptable and affordable healthy diet for diabetic and obese patient.

Keyword: Yam flour substitution

Simple and rapid Colorimetric Method for total quantification of cyanogenic glycoside (CNp) in fresh and processed cassava products

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Abstract

The aim of this research work was to develop a simple and rapid quantification method of total cyanogenic glycoside (CNp) in fresh and processed cassava roots. Based on a colorimetric reaction, hydrolytically liberated cyanide from CNp reacts with aquacyanocobyrinic acid. For comparison, the quantification method based on Chloramine-T and Isonicotinic acid/barbituric acid sensor was used. The affinity of the aquacyanocobyrinic acid sensor to cyanide is high and can be instantaneously monitored with spectrophotometric methods. The procedure is simple, rapid, does not require many chemicals, and it is safe and simple to handle.

Key words: Cassava, Cyanogenic glycoside, aquocyanocobyrinic acid

The Effect of catalytic flameless infrared (CFIR) drying on the functional properties of sweetpotato flour

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Abstract

In this work, functional properties of sweet potato flour were investigated to compare CFIR drying to solar and oven drying methods. The results showed that, the different drying techniques had significant effects on the functional properties. Bulk density ranged from 0.69±0.01 to 0.81±0.04ml/g with CFIR dryer having the highest. Amylose content ranged from 23.09±0.00% (Solar) to 37.87±0.00% (CFIR) with pH also ranging from 6.04±0.01 for CFIR to 6.23±0.00 for Solar dryer. Swelling power (3.40±0.02), solubility index (20.31±0.15) and water binding capacity (171.72±1.25) were observed to be lower for CFIR as compared to the other drying methods. Pasting profile of the various flour samples were observed to have high viscosities for CFIR dryer compared to the other dryers. CFIR produced flour with high retrogradation ability but had the best overall flour quality because of the high final viscosity (153.00±2.83 BU) observed for CFIR. All the differences were found to be significant ($p < 0.05$). Different drying methods affected the final quality of particular flour based products; hence in using CFIR dryer, the type of product the flour will be used for should be taken into consideration.

Key words: The Effect, catalytic flameless infrared (CFIR), drying, functional properties, sweetpotato flour

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Testing the Adaptability & Acceptability of Elite Sweetpotato Genotypes in Ghana in 2011

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Abstract

The goal of the Ghana sweetpotato improvement programme is to release new varieties in response to growers & consumer preferences. A combined approach of multi-locational testing and farmer participatory research is used to incorporate grower & consumer preferences in the development and release of new varieties. The objective of this trial was to test four promising sweetpotato genotypes for their genotype x location/environment interaction prior to possible varietal release. There were 13 entries made up of four promising or elite clones tested against nine released varieties as checks. The elite materials were Mohc, 199062.1, Cemsa 74-228 and Kemb 37. The released varieties were Apomuden, Otoo, Ogyefo, Hi-Starch, Sauti, Faara, Okumkom, Santom Pona and Tek Santom. On-Station locations used were Fumesua (Forest ecozone), Ejura (Forest-savanna transition ecozone), Pokuase (Coastal savanna ecozone) Ohawu (Coastal savanna ecozone) and Komenda (Coastal savanna ecozone). The trial was planted in RCBD, 3 reps, 4 rows, 4.8m row length, 1m row width, 17 stands/row, 0.30cm between plants. Genotype (G) x Location (L)/Environment (E) analysis indicated that: G x L/E was significant for vine yield, marketable root yield and total root yield. This was a confirmation of results obtained for 2010. Mean yield components across the five locations indicated that the elite genotypes Cemsa 74-228 ranked 2nd; Mohc ranked 3rd; and 199062.1 ranked 4th when the 13 genotypes were evaluated for marketable root yield, total root yield and root DM (%). There was evidence of yield depression in the elite genotypes due to virus infection. Virus free planting materials have the potential to significantly boost yields and provide foundation seed if the varieties are released.

Key words: Cultivar Selection, virus, multi-locational testing

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Agronomic responses of Dioscorea rotundata under low moisture stress

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Abstract

Low moisture stress has been one of the main climate change effects. Although white yam is apparently tolerant to low moisture stress at the initial stages, the efficiency of the development process of breeding lines with this trait (s) is still low as there is not available a scientific selection protocol. Research effort to improve the efficiency of yam breeding in this area has not been reported in the literature. This research is one of the components to develop a drought tolerance screening protocol for yam. A pot experiment was conducted at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria to evaluate 12 clones of white yam (*Dioscorea rotundata)* and determine their responses to low moisture stress. The clones were arranged in a factorial combination of 12 clones (CL), two mycorrhiza (MC) and three water (WL) levels in a randomized complete block design with three replications. Mean yam sett of 50g was planted in sterilized soil. Data were collected on vegetative and reproductive traits during a period of 20 weeks after planting. Data were processed through analyses of variance, Pearson correlation coefficient analysis and T - test. There were significant ($P \leq 0.0001$) differences on all the measured variables with respect to the three main effects. Genotype CR03 had a significant highest fresh tuber weight (56.54g), dry tuber (13.14g) and dry root weight (18.02g) while genotype CR05 recorded the least fresh (13.35g) and dry tuber weight (3.56 g). For all the variables, performances corresponded with the water levels in this order WL1> WL2> WL3. Treatment with Mycorrhiza equally enhanced the performances of the clones. Clones of *D. rotundata* differed in their response to the imposed stress conditions. It was concluded that having a significant response to different water stress level, it will possible to develop a protocol based on low water stress; however interactions with other climate variables must be explored; complementary, evaluated clones constitute a good set to be used for breeding purposes.

Key words**:** *D. rotundata,* Mycorrhizal inoculation, water stress, yam breeding

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Evaluation of biological control agents (BCAs) for the control of tuber rot of yam (*Dioscorea* spp.)

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Abstract

The efficacy of four BCAs, *Trichoderma asperellum* strain NGT158, *T. longibrachiatum* strain NGTI67, *Bacillus subtilis* and *Pseudomonas fluorescens,* for the control of tuber rot caused by *Botryodiplodia theobromae, Aspergillus niger, Penicillium oxalicum, Rhizoctonia solani, Sclerotium rolfsii* and *Fusarium oxysporum* in four yam species, *Dioscorea rotundata, D. caynensis, D. alata and D. dumetorum,* was evaluated. The agar pairing method was used to test for antagonism between the test pathogens and BCAs using three inoculation regimes *in vitro.* Evaluation of rot development was done by the destructive sampling method and percentage rot reduction by the antagonists was estimated. The mycelial growth of the test pathogens were significantly inhibited by the BCAs ($P \leq 0.05$). Inhibitory zone measuring 1.5 cm was clearly established between the pathogens and *B. subtilis*. Inoculation of the BCAs 24 h ahead of the pathogens was most effective and was in the order *T. longibrachiatum* (88.1%) > *T. asperellum* (87.4%) > *B. subtilis* (77.5%) > *P. fluorescens* (64.8%) in the *in vitro* trials. Mean rot reduction values across the yam species ranged from 87.1-97%, 89.3-95.7%, 85.7-96.2% and 71.2-90.8% for *T. asperellum, T. longibrachiatum, B. subtilis* and *P. fluorescens,* respectively, when paired with the antagonists *in vivo* at 14 days after inoculation (DAI). The mechanism of control by *Trichoderma* spp. was mycoparasitism, Whie *B. subtilis* and *P. fluorescens* controlled by antibiosis. The potential of the four BCAs used in this study recommends their use in the integrated management strategy for the control of post-harvest fungal rot pathogens of yam.

Key words: Evaluation, biological control agents (BCAs), control, tuber rot of yam (*Dioscorea* spp.)

N and K uptake Efficiency and Leaf protein content of Organically grown Sweet potato in Abeokuta Southwestern Nigeria

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Abstract

Field and Laboratory experiments were conducted at the University ofAgriculture Abeokuta, Nigeria in the rain seasons of 2010 and 2011 to determine the optimum rate of composted poultry manure and NPK 15-15-15 on N uptake efficiency and Protein content of sweet potato leaves. Vines (20cm length) of three cultivars of sweet potato cv. TIS 87/0087, Shaba and 86/0086 were planted at 0.5m distance on ridges spaced 0.75m apart. Four weeks after planting, composted poultry manure at 0, 5.0t/ha, 10t/haOF and 200kg/ha NPK 15:15:15. The treatments were arranged as a split- plot in randomized complete block design with 4 replicates. Data on leaf fresh and dry weight, weight of tubers were collected. Sweet potato plants that received 10t/ha of Poultry manure gave significantly ($p<0.05$) longer vines (215.8, 286.1cm), larger leaf area (4564.6, 5456cm^2), more leaves (978., 1058.0), more branches (32.3, 45.0) and higher tuber weight (6.3,10.9 t/ha) for the two years respectively. These values were significantly ($P<0.05$) higher than those obtained from Sp plants grown without fertilizer (control) and those that received other fertilizer treatments. Sweet potato Var. TIS86/0536 produced significantly longer vines with more branches than the other two cultivars, while cv TIS 86/0087 produced significantly more leaves and tuber yield than the other two cultivars. Sweet potato TIS 87/0087 treated with 10/ha PM had the highest tuber weight value of 10.9 t/ha, showing significant ($p< 0.05$) differences as compared to the yield values obtained in cultivars that received other fertilizer treatments except those grown with 5.0 t/ha. This was followed by cv. 'shaba' treated with 5.0 t/ha kg/ha NPK with tuber yield value of 9.6 t/ha. The least tuber yield value of 2.7t/ha was obtained in 'shaba' with no fertilizer treatment (control). Since tubers weight is a function of growth parameters (vine length, number of leaves, number of branches, leaf area etc), PM at 7.5 t/ha in combination with the three Sp cultivars was therefore recommended for adoption in this study. Other sweet potato cultivars need to be evaluated for performance under different rates of organic and inorganic soil amendments and agro-ecology.

Key words: N Uptake efficiency, sweetpotato

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Mechanization, fertilization and non-staking options for environmentally sound yam production

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Abstract

This study spans from 2009 to 2012 with the wider objective of investigating the use of chemical fertilizer, mechanized seedbed preparation and staking options to curtail the annual shifting of land and deforestation associated with yam production. Two on-station and two on-farm studies were conducted in Fumesua (forest). The study started with **a Randomized Complete Block Design** on-station experiment at Fumesua in the forest zone of Ghana to evaluate the effect of vertical, horizontal (80% of the number of stakes in vertical staking) and no staking on the yield performance of a promising non-staked yam line **TDR89/19177. There were significant** ($p \leq 0.05$) **differences** in the shoot (Leaf and vine) growth and yields of the treatments. Thus shoot development was enhanced by vertical staking compared to horizontal stake and no staking. This translated into significantly ($p \leq 0.05$) higher yields of the vertical stake as compared to the no stake and the horizontal stake treatments. However, no staking and horizontal treatments resulted in a 32.5% and 43.3% yield reduction respectively, suggesting that yam varietal selection and breeding approach can be used to at least minimize the use of stakes in yam production. A split-split plot on-station study at Fumesua (Forest zone) and Ejura (Forest-savannah zone) with two yam varieties (Pona and Dente), seedbed option (ridges and mounds) and NPK fertilizer rates (0, 45-45-60, 60-60-60 and 60-60-80 kg ha^{-1} N-P_20_5-K_20) revealed significant ($p \leq 0.05$) **increases** in soil carbon and phosphorus with fertilizer application to yam. Texture and aroma of boiled yam tubers under fertilizer application were better than non fertilized yam and the **negative perception of farmers of poor taste and greater tuber rot when yam is fertilized was disproved. On –farm studies on 8 farmers' fields in** the Ejura/Sekyedumase district in the forest-savannah transitional zone of Ghana showed that, **continuously cropped fields can be used for yam cultivation with fertilizer application, with greater response to fertilizer application on ridges than mounds. Also ridging resulted in** significantly ($p \leq 0.05$) **higher yam plant population and higher yields than farmers' mounds. These results present hope of minimizing the problem of drudgery, deforestation and land degradation associated with yam production** in West Africa.

Keywords: Mechanization, Fertilization, Non-staking options, Environmentally sound yam production

Cassava Varietal Response to Leaf Harvest on Two Contrasting Soil in the Democratic Republic of Congo

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Abstract

Cassava leaves are a major component in the diet of rural and urban populations in lowland DR Congo. With the arrival of the cassava mosaic disease (CMD) in the 1990s cassava production declined and leaf supplies were severely reduced. IITA introduced CMD tolerant cassava germplasm and commenced breeding varieties with improved tolerance to CMD and with locally acceptable food properties. However, these new varieties have not been tested for their suitability for leaf supply and their root yield response to leaf harvest. We determined root and leaf yield of 11 improved and 1 to 3 local varieties on clay and sand soil. On clay soil across 12 varieties, harvesting cassava leaves 3 times over the year reduced root fresh yield significantly ($p<0.001$) from 15.7 to 12.8 Mg ha^{-1} or 18.7%. On sand soil across 14 varieties, harvesting cassava leaves 2 times over the year did not significantly affect root fresh and root dry matter yield. On sand soil, root and leaf production were strongly incompatible. None of the cultivars that produced high root yields produced high leaf yields. On the clay soil, one of the three best leaf producers produced the second highest root yield and is thus suitable for combined leaf and root production. The cultivar that produced the highest root yield took 5th place in leaf production andcan thus be recommended for combined leaf and root production where roots have a higher importance. Root yield reductions were related to a shift towards a higher frequency of lighter roots.

Key words: Cassava varietal response, contrasting soil, Yield, leaf harvest

Development of an Informative set of Simple Sequence Repeat (SSR) markers for Sweetpotato Fingerprinting and Diversity Assessment in the West African sub-region

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Abstract

The assessment of levels of genetic diversity in sweetpotato is important for conservation and utilization of genetic resources. Molecular markers can play an important role in determining genetic diversity. A number of informative markers have been developed for sweetpotato. Different research groups have identified different markers, and there is little overlap among the sets of markers. This study was conducted to validate polymorphic SSR markers for sweetpotato diversity studies in the West Africa sub-region. A collection of twenty one sweetpotato genotypes was assembled from Ghana and Nigeria. They were assessed with twenty five expressed sequence tag (EST) and twenty one simple sequence repeat (SSR) markers. Popgene software was used to assess results. A set of informative markers was identified for the rationalization of sweetpotato germplasm conservation and uilization in Ghana and West Africa.

Key words: Molecular marker, germplasm utilization, breeding

Ploidy level, morphological traits and secondary metabolite profile of *Dioscorea dumetorum* (Kunth) Pax., to determine breeding strategy

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Abstract

Most cultivated and studied yams belong to the species *Dioscorea rotundata* Lam., *Dioscorea alata* and *Dioscorea cayenensis Poir*. Whereas *Dioscorea dumetorum* (Kunth) Pax, has received little attention from the conventional research. Research efforts have been oriented to identify metabolites and no studies have reported the use of genetic diversity and genetic constraints for breeding objectives. The purpose of this study was to integrate ploidy level, morphological traits and secondary metabolite profile of *Dioscorea dumetorum* to set up a breeding strategy. Ploidy level was determined using flow cytometry and twenty traits of above and underground parts were recorded. A qualitative screening allowed to identify presence of Saponins, Alkaloid and Flavonoids. Gower distance and Ward's Minimum Variance Cluster Analysis were used to generate an Agglomerative hierarchical Dendogram. Association between variables was determined using the Crammer's V coefficient and the Spearman's rank correlation coefficient. Thin Layer Chromatographic and quantitative analyses of important metabolites were carried out on 15 accessions from the clusters. Observed ploidy levels were diploid and triploid. Saponin had the highest yield across most of the accessions. Accessions were clustered in three groups. The significant differences between sex and ploidy level provided a better understanding of these traits and will be useful for handmade crosses. It was concluded that variability among the clusters could be useful to establish a breeding strategy based on phytochemicals and morphological traits.

Keywords: *Dioscorea dumetorum*, flow citometry, phytochemical screening, ploidy levels, secondary metabolite, morphological traits

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Genetic inheritance of farmer preferred traits in cassava varieties adapted to mid-altitude tropical climatic conditions

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Abstract

Information on genetic inheritance of farmer preferred traits is fundamental in selection of parents and breeding strategies for an effective participatory plant breeding. Forty sibs representing each of the 24 full-sib families generated using 6 x 4 North Carolina II mating design from ten popular cassava varieties grown in mid-altitude tropical climatic conditions. The sibs were evaluated in two distinct environments using α-lattice design. Crosses, general and specific combining ability (GCA and SCA) effects and their interaction with the environments were significant for most traits evaluated indicating significant genotypic, additive, non-additive gene action and their interaction with environment. Significance of genotypic, GCA, SCA and their interaction with environments imply selection of superior genotypes and parents should be based on multi-location evaluation. The presence of both additive and non-additive gene action for most preferred traits indicates the need to have specific breeding strategies that exploits both gene actions. However, the importance of additive over non-additive gene action varied between traits indicating the need specific breeding approaches for these traits. Over 50% of variability within the crosses for all traits evaluated except height to first branching and plant height was due to SCA effect indicating the importance of non-additive gene action. The GCA effects for the parents did not generally correlate with their *per se* performance also the best performing crosses were not always developed from parents with high GCA effects. These implied selection of parents based on their *per se* performance may not necessarily lead to development of superior hybrids.

Key words: Cassava (*Manihot esculenta* Crantz), general and specific combining ability, participatory plant breeding, farmer preferred traits.

Enhancing genetic potential of orange fleshed sweet potato varieties in Papua New Guinea

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Abstract

Sweetpotato (*Ipomoea batatas* L.) is an important staple food crop in Papua New Guinea (PNG). However, its yield potential, agronomic and quality attributes were not fully exploited due to limited breeding efforts particularly on the inheritance of agronomic traits. The crop improvement program at the National Agriculture Research Institute (NARI) has initiated research aimed at improving genetic potential of β-carotene rich orange flesh sweetpotato (OFSP) to combat vitamin A deficiency in parts of PNG. Five hundred genetically recombinant seeds were generated through a polycross mating among eight local and exotic OFSP pedigrees. Selection intensities ranging from 17-69% with an overall selection pressure of 1.39% were employed at different stages and 8 elite clones, NIB-0813-003, NIB-0812-049, NIB-0812-036, NIB-0812-031, NIB-0812-018, NIB-0812-005, NIB-0812-004 and NIB-0811-001 were identified. Field evaluations of these clones under low input subsistence farming practices revealed their higher tuber yield potential of 12.5 t ha^{-1} to 28.8 t ha^{-1} compared to the check Beauregard (20.2 t ha^{-1}). Estimation of carotene level in tuber flesh indicated higher content of β-carotene in four new clones as shown by their deep orange pigmentation. Likewise, dry matter assessment indicated higher content (21.2% to 23.6%) in six recombinant clones compared to Beauregard (20.9%). The current breeding programme has been successful in ameliorating desirable traits and generating promising OFSP clones with better yield and nutritive value.

Keywords: *Ipomoea batatas* (L.), Breeding, polycross, Beta-carotene.

Evaluation of Performance of introduced Yam Bean (*Pachyrhizus spp.*) in Rwanda

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Abstract

Root and tubers crops are key staple crops for both rural and urban populations in Rwanda and supporting more than nine million people living in densely populated areas and sustained on agriculture with diverse range of cultivated species. Yam bean (*Pachyrizhus spp*) was introduced for both its immediate utilization as a high-yielding root crop with high sugar, considerable micro-nutrient concentrations and protein content for subtropical regions compared to common grown tropical root and tuber crops (cassava, potato, sweetpotato and yam).The yields of these species are up to 100 tons fresh weight per hectare, with dry matter contents of up to 25%. Recent introduction of different yam bean accessions in different agro-ecological zones of Rwanda produced high yield storage roots. Higher storage roots yield with strict pruning was produced by *Erosus* genotype 209018 (111.33 t/ha) and genotype 209019 (108.00 t/ha) followed by *Ahipa* genotype 209029 with 76.33 t/ha respectively. Dry matter was relatively low with a range of 20.84-19.14 % for all introduced genotypes. As a root crop with capacity of fixing atmospheric nitrogen and which does not require good-quality soil and resists pests and diseases which can fix yields abundantly and produces well even in area with scanty rain, it might be well indicated for Rwanda.

Key words: Yam bean, pruning, high Storage yield roots, dry matter, Rwanda

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Correlation and Path coefficient studies of cocoyam *(Xanthosoma sagittifolium L.)*

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Abstract

In the present investigation endeavors have been made to evaluate the local accessions of cocoyam cultivars collected from thirteen aroid growing districts. Genotypic and phenotypic correlation and path coefficients of different characters were estimated in *X. sagittifolium* L. Plant height, petiole length, petiole breadth, leaf number, leaf length, leaf breadth, LAI, Inflorescence length, peduncle length, spathe length, spathe breadth, corm length, corm breadth, cormel number, cormel length, cormel breadth, corm weight, cormel weight, total fresh weight, total dry weight, yield per plant were taken in this study. In cocoyam, plant height, leaf length, leaf breadth, leaf number, LAI, corm length, corm breadth, corm weight, sucker number in both genotypic and phenotypically exhibited positive correlation with yield per plant. Leaf length, leaf number, corm length showed the direct influences in yield per plant. In the genotypic level yield per plant exhibited highest positive direct effect with corm length followed by cormel breadth, sucker number, which deserves priority in selection on the basis of characters toward yield per plant. The residual effects indicated that the characters studied contributed only about 70.00 % of the variability towards the yield per plant. In phenotypic level residual effect was 0.5742 which indicate that nearly 43 % variability contributed through studied characters which were significant. The characters corm length, cormel breadth, sucker number, leaf number, leaf length can play the significant role for increasing yield per plant. These characters could thus be utilized by breeders as selection criteria to isolate higher yielding genotypes.

Implementing Biosafety Policies for Sustainable Roots and Tuber Crop Productivity in Nigeria

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Abstract

The increasing wave of biodiversity deterioration, unprecedented thermal temperature rise, flooding and high rainfall patterns occasioned by global warming have culminated into negative impacts on roots and tuber crops productivity in Nigeria. The role of roots and tubers in nutrition and health security of Nigerians is enormous as it is a major staple in the food basket of the country. Current government polices in respect of roots and tuber crops were mainly aimed at achieving increased yields and disease resistance. Policies required to address the current climatic challenges is yet to be put forward. Such policies should aim at protecting the vast heritage of agro biodiversity of the various roots and tuber crop species in Nigeria. The policy option must be able to address the challenges of climate change on biodiversity, on the productivity of roots and tuber crops. Such policies must be able to attract farmer's interest in adopting environmentally- friendly agricultural practices and requires good governance, collaborative efforts among various stakeholders namely researchers, farmers and policy makers. Farmers should be part of the decision –making process so as to facilitate easy adoption of the biosafety policies of the government in respect of the development of a sustainable roots and tuber crops enterprise in the country.

Key words: Biosafety, policy, climate -change, Roots, tubers,

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Evaluation of a Trader-focused Marketing Strategy for the sustained uptake of Orange flesh Sweet Potato in Zambézia province, Mozambique

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Abstract

Traders still tend to be maligned in the marketing of surplus food crops. Tropical root crop traders are vital in sourcing produce from farmers and selling it to urban purchasers. In 2006 marketing diagnostic work for a HarvestPlus project introducing vitamin A-rich orange fleshed sweet potato (OFSP) in four districts of Zambézia province, Mozambique showed i) the importance of small-scale traders in meeting demand of preferred types and ii) that there was no significant trade in OFSP. Introducing OFSP to farmers with the expectation that they would be able to sell excess production proved unrealistic because sweet potato traders were uninformed about the benefits of the new varieties and did not believe that consumers would be willing to try them. A trader training programme emphasising the financial benefits of trading OFSP, health benefits to customers and novel ways of preparation was delivered. Traders were also linked to OFSP farmers to obtain supplies. Project farmers received training in group marketing, market requirements and were linked to traders identified from a trader database.

Following this training there was an increase in the proportion of OFSP sold, from 18% in 2008 to 50% in 2009. In three of four target markets a significant price differential developed and market segmentation occurred. Feedback from traders indicated they were obtaining greater benefits from trading OFSP and that they actively seeking it out to meet growing consumer demand and others were entering this market. Evidence from farmers indicated the growth of demand for OFSP and remunerative prices paid.

Key words: Evaluation, trader-focused Marketing Strategy, sustained uptake, orange flesh Sweet Potato, Zambézia province, Mozambique

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Inventory of Indigenous Knowledge in Yam Production and Storage in the Upper West Region of Ghana

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Abstract

A formal survey using structured questionnaire was conducted in the Upper West Region of Ghana as part of a study of the indigenous knowledge of yam production and storage practices in northern Ghana.Data were obtained from a sample of one hundred and twenty (120) farmers randomly selected from the six yam growing districts of theregion. In each district, three communities were selected and at least seven farmers in each community recognized as having experience in yam cultivation were interviewed.The study revealed that most production and storage techniques are indigenous and parents and grandparents have been the key sources of knowledge of the techniques. Only a little of the production and storage practices is modern with the agriculture extension officers of MoFA being the main sources of information. Many pests and diseases of yam production and storage are recorded now than before but information on how to control them still needs to be intensified.

The production of yam is said to be in decline in most of the study area due to high cost of production and low yields. Labor is one of the major constraining factors. The inability of respondents to obtain loans from the banks has also contributed to the lack of assets and limited inputs which consequently lead to low output.

Key words: Yam; indigenous knowledge; production; storage

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Cassava Value Chain Development in Benin Republic: Impact on Product and Rural Income Diversification for Enhanced Livelihood

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Abstract

The cassava value chain development project in Benin Republic selected beneficiaries, mainly women from four villages to provide enabling environment for increased productivity and enhanced livelihood. The project intervention covered the entire value chain of cassava, which ranged from demonstration/distribution of three cassava high yielding varieties to farmers, provision of four well equipped micro processing centers (MPCs) for diverse products, storage facilities, hybrid solar drying house and capacity strengthening of the beneficiaries to produce commercially competitive products, with regular monitoring at all levels. On output, 595 farmers benefited directly and 240 indirectly with reported increased yield of 15-20 tons per hectare and 295 ha of land cultivated to produce 5,218 tons of roots. Altogether, 310 processors across the four centers benefited directly and 120 indirectly, market was appropriately linked for them. As impact, the processors who were trained on few products diversified into more; one of which was *kimpouka*, a Congolese cassava based food for diverse household (HH) consumption and commerce. They also increased income by diversifying into piggery, a building was provided by them from the proceeds of their cassava enterprise and the pigs fed on cassava peels. They reported HH economic advancement, and improved health and food security. However, no to low working capital for processors and lack of all season drying facilities limited the expected increase in productivity.

Key word: Beneficiaries, cassava, diversify, income, products

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Building Sustainable Market linkages through Innovations Platforms for Technology Adoption: Case studies from Uganda, Kenya and Tanzania

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Abstract

Finding and sustaining markets for Orange-fleshed sweetpotatoes is a challenge in many parts of East Africa. Farmers face numerous difficulties in identifying credible business partners, while traders and other market chain actors are frustrated by inconsistencies in supply. In the Dissemination of New Agricultural Technology in Africa (DONATA) OFSP project, Innovation Platforms for Technology Adoption (IPTAs) in Ethiopia, Kenya, Rwanda, Tanzania and Uganda have brought together relevant value chain stakeholders to develop institutional mechanisms which have supported the up-scaling of OFSP technologies (e.g. new varieties, agronomic practices, and post-harvest activities) and marketing strategies. This paper presents key strides attained in accessing equitable markets by IPTAs in three DONATA project countries. While some IPTAs have segmented the market and differentiated the producer groups along product lines, others have supported various chain actors to strengthen their businesses thus increasing throughput to the markets. Hence in the former case, groups are classified along major OFSP products marketed (vines, roots and processed products), while in the latter, specialized actors take on these functions. Successes include firm contracts for supply of OFSP flour to supermarkets in Kenya, supply of roots to urban markets in Uganda, and sale of vines to individuals and organizations in Tanzania. The major challenges include aligning production to demand for consistent supply, poor market infrastructure and low consumer awareness of the benefits of OFSP. Future prospects lie with newly established relations with big buyers and also working closely with other initiatives to consolidate gains achieved to date.

Keywords: Market access, strategies, value chains, innovations, technology uptake.

What will influence uptake of OFSP by traders?: Experiences from Uganda.

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Abstract

Orange Fleshed Sweet Potato is a relatively new crop in Ugandan markets. Little was known about how traders would react to its introduction and the factors likely to influence its uptake as a tradable staple crop prior to a project component to facilitate its marketing. To gain a better understanding, 157 traders were interviewed in three urban markets in Uganda in 2009. The markets were in the proximity of areas in which OFSP had been promoted at household level. Results indicate that OFSP was sold mainly by bicycle traders and farmer traders, also selling yellow and white fleshed sweet potatoes; with the yellow fleshed types being the most prevalent. The main reasons for trading in a particular sweet potato type were availability and consumer preference. Price was not an important consideration and there were no differences in the prices at which the three sweet potato types were sold. Traders were aware of OFSP, particularly that it contains vitamin A, and its orange colour. The main factors that influenced uptake of OFSP were its visual and sensory attributes; bicycle traders and farmer traders; and price and profitability of OFSP being comparable to non-OFSP. To promote uptake of OFSP by traders, it is important to institute interventions that will enhance its availability, and increase awareness of its nutritional benefits among traders and consumers.

Keywords: Orange Fleshed Sweet Potatoes, traders, marketing, uptake

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Eco friendly Approaches for the Management of Major Pests of Cassava in India

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Abstract

Cassava is an important root crop grown in tropical and subtropical countries for food, feed and industry. Quality and quantity of roots are severely affected due to the infestation by many arthropod pests. *Paracoccus marginatus*, first reported from Caribbean islands in 1995, was reported from India (Coimbatore, Tamil Nadu) in 2008, and now it becomes a major pest over 60 plants, including cassava. Management of mealy bugs, even with higher dose of synthetic insecticide, is a failure due to the presence of thick mealy substances all over its body. To identify a solvent for its removal, chemical nature of the mealy substance was studied. The insecticidal principles from seeds, leaves and tuber rinds of cassava were isolated, and in combination with the solvent identified as mealy substance remover, a biopesticide was formulated. On confirmation of its effect on mealy bugs and other sucking pests, large-scale field trial was conducted. A Pilot Plant designed by us has been fabricated and commissioned at our laboratory to scale up the production of biopesticides.

Bemisia tabaci, Aleurodicus disperses and certain Tetranychid spider mites are also the major pests on cassava plants; but natural enemies can check their multiplication. Cassava chips are severally infested by stored-product pests, but these can be effectively controlled by the biofumigant isolated by us from cassava plant. Treatment of chips with 3% common salt, and drying the chips and maintain their moisture content below 12% were also found to protect the chips from infestation. Irradiation at 100 Gy kills grubs and adults.

Key words: Eco friendly approaches, management, major pests, cassava, India

Viruses Infecting Sweet potato in Jamaica.

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Abstract

Sweet potato (Ipomoea batatas L.) is an important food crop grown primarily in the tropics and subtropics that ranks in the top 10 root crops cultivated worldwide. While Asia is the largest global producer, accounting for 80% of global yield, Jamaica is the largest producer in CARICOM countries, accounting for 68% of production in the region. Various viral diseases responsible for yield loss, production decline and severe stunting have been reported in sweet potato, but only a few have been well characterized compared to viruses of other crops. Thus far, more than 20 viruses are known to infect sweet potato, 15 of which are classified in recognized taxonomic groups. These viruses have the potential to cause significant losses without the development of apparent symptoms, particularly in single virus species infections. More severe disease can occur through synergistic mixed infections. In 2006, a survey of the major sweet potato growing regions in Jamaica reported on the detection (2-78%) of potyviruses, carlaviruses, criniviruses, cucumoviruses and a caulimo-like virus. Virus detection was positive for at least one virus group in 1-3 of the 8 regions surveyed. It was noted that the majority of sweet potato samples collected were asymptomatic (99.8%) and that virus was not detected in symptomatic samples. Recommendations from that study were to conduct further investigations into the identity of the viruses infecting the latter samples and to examine other host plants that potentially function as reservoirs for sweet potato viruses. Surveys of the same regions in 2011 indicate an increase in disease incidence and distribution. Of the 420 sweet potato samples collected, most (97%) exhibited expression of virus-symptoms, including variations of chlorosis (40%), necrosis (22%) and leaf deformation (17%) in all survey regions. The frequency of symptom expression was however lower (25%) in weed samples (210), which included members of the family Convolvulaceae collected within sweet potato fields or their perimeter. Assessment of the virus species has recently begun using polyclonal antisera in nitrocellulose membrane enzyme-linked immunosorbent assays (NCM-ELISA). The findings and implications for the local sweet potato industry will be discussed. This study represents the first step toward the development of management strategies of sweet potato virus diseases in Jamaica and further investigations will provide additional insights into the genetic diversity and phylogenetic classification of sweet potato virus isolates in the region.

Pest and Diseases of 16 Local and Exotic Sweet-Potato Varieties in Benin and Their Agronomic Characteristics

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Abstract

Morphological characteristics and agronomic parameters were studied on 16 sweet-potato varieties (5 East Africa, 9 Benin, 1 China and 1 Bolivia) in April to August 2011 in southern Benin. Varietal variability was observed for length of internodes, leaf petiole, stem and leaf number. Positive significant correlations existed between stem length, number of leaves and number of tubers and tuber yield. In the same trial, incidence and severity of pests and diseases and effects on yield were observed. Six pests, *Ptyelus* sp., *Aspidomorpha* sp., *B. tabaci, Blosyrus* sp., *C. puncticollis* and *P. grossipes* and one disease, anthracnose were observed. The density of pests was low (less than 0,2 insect by plant on the average). Incidence of leaf-eating pests such as *Ptyelus* sp., *Aspidomorpha* sp., *Blosyrus* sp. reached 100% from the 7th week, while severity evolved linearly reaching over 50% for all varieties 17 weeks after planting. Anthracnose was identified at the end of the growing season on all exotic varieties and on some local varieties (Manouga, Fornonwinka and Gboadobodouaho). Anthracnose increased on 400166 (25%); 440029 (35%); Carrot-c (10%) and Manouga (9%). Yield was not affected by the pests and diseases. Damage from termites, *C. puncticollis*, rodents, nematodes and *Alternaria* sp. were observed on less than 15 tubers. Highest yield was observed for 440029, Vobodouaho, Kolidokpon and Manouga. There was no effect of pests on yield; we suggest that this study is repeated in all the agro-ecological zones of Bénin.

Key words: Pest, diseases, exotic sweet potatoes, agronomic characteristics

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Monitoring Survey and Status of the Cassava Anthracnose Disease (CAD) in Luapula and Eastern Provinces of Zambia

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Abstract

Cassava is an important food crop in urban and rural areas of Zambia and plays a principal role in the food economy. The low cassava productivity is partly due to cassava anthracnose disease (CAD). Though the disease has been reported in cassava fields, disease status has not been evaluated. Because of the economic importance of CAD, a survey was conducted in Luapula and Eastern Provinces. The objective was to determine incidence and severity of CAD in Zambia. The disease severity for CAD was scored on scale of 1-5 (Muimba, 1982). Incidence was made in a "Z" configuration. Fifteen plants per field were counted equidistant from each other within the row. There were significant differences (P>0.05) in the CAD severity. In Luapula province the mean CAD severity was 1.7. Samfya had highest CAD severity and Nchelenge had lowest severity (1.2). The highest incidence for CAD was observed in Mansa district (75%) and lowest in Nchelenge district (21.5%). There were also significant difference (P>0.05) in the CAD severity in Eastern province. The mean CAD severity being 1.7. Lundazi had highest (1.8) and Rufunsa had lowest (1.5). The incidence for CAD was highest in Chipata district (60%) and least in Rufunsa district (53%).

Key words: Cassava; cassava Anthracnose disease; severity; incidence; Zambia

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Sweetpotato Weevil Resistance in Sub-Saharan Africa: a Viable Mechanism for Reducing Cylas Damage

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Abstract

Sweetpotato (*Ipomoea batatas,* L) is the third most important crop in Sub-Saharan Africa contributing significantly to food security, nutrition and income. Weevils, *Cylas* spp., are the most important insect pest of the crop. The weevils damage both vines and roots, causing unacceptable odour, discoloration, and bitter taste making them unfit for consumption. Depending on conditions, weevils can cause complete losses of the harvestable crop. Host plant resistance seems to be the only viable option for management of the pest. Studies in Uganda reveal existence of active resistance in some sweetpotato genotypes. Field and laboratory experiments show that clones HMA 519, ARA 230, LIR 302, APA 356, ARA 228, RAK 865 (local), and New Kawogo (improved), have varying levels of resistance compared to the susceptible varieties NASPOT1, Kakamega, and Tanzania. The resistant clones were evaluated for field resistance against the susceptible checks; root and vine damage was less in the resistant clones. No-choice bioassays using roots conducted in the laboratory to show that feeding and oviposition was less on the resistant clones indicating that the observed field resistance was not simply escape. The resistance has been linked to some hydroxycinnamic acid esters which occur in higher concentrations in the roots of resistant compared to the susceptible clones. The compounds were extracted from the roots, analysed and synthetic derivatives used to conduct toxicity & deterrence tests. Different concentrations (0.001, 0.01, 0.1mg/ml) of synthetic derivatives of the compounds were applied to the root surfaces of the susceptible variety (NASPOT 1) and showed that weevil species from both Uganda and Malawi fed less and laid fewer eggs on the treated roots compared to the untreated ones confirming the activity of the compounds against weevils. Preliminary studies indicate that the compounds have an additive effect with Cry7a proteins which are the target for the development of clones transformed with the Bt toxin. The findings have important implications for the breeding program in Uganda and will be used to map QTLs in segregating populations from a cross between the US variety Beauregard and the Ugandan variety New Kawogo.

Keywords: *Cylas spp*, Hydroxycinnamic acid esters, resistance, sweetpotato varieties, weevil damage.

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Extrusion Characteristics of Yam (*Dioscorea* alata) Flour Extrudates

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Abstract

Five varieties of fresh Yam tubers (*Dioscorea* alata- Da 332, Da 333, Da 340, Da 405 and Sree karthika) were processed for flour. The peel content of the tuber varied between 29.29-35.48%. The percentage of dried chips and fine flour recovery ranged between 19.07-22.48% and 15.49-21.96%, respectively. The variety Da 405 had less peel (29.43%) and yielded more dried chips (22.48%) and fine flour (21.96%). The biochemical analysis of the yam flour showed that the starch content varied from 68.19 to 70.31%, sugar 3.74-5.10%, fat 1.00-1.83%, fibre 0.64-1.34%, ash 4.53-5.72% and moisture 15.74-17.42%.

The extrusion experiments were carried out in a single-screw laboratory extruder. The temperatures of feed zone, compression zone and metering zone were set at, 60, 70 and 80˚C, respectively. The die temperature of the extruder varied from 160 to 180˚C and extruder screw speed varied from 60-80 rpm in steps of 10˚C and 10 rpm, respectively. The flour was conditioned to 16% moisture content and fed into the extruder. The physical properties of the extrudates showed that the expansion ratio, bulk density and moisture content of the extrudates varied between 2.54-3.01, 0.4934–0.6516 g/cm3 and11.08-12.65%, respectively. The textural properties of the extrudates showed that the hardness and toughness values decreased when the die temperature increased from 160-180˚C. The colour intensity of the extrudates reduced when the die temperature increased from 160 to 180˚C. The study showed that good quality ready-to-eat snack extrudates can be produced from yam flour.

Key words: Extrusion, *dioscorea* alata, recovery of flour, expansion ratio, bulk density-Hardness

Potential Preferences of Benin Consumers for gari made from Ahipa roots

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Abstract

Gari is cassava's derivative which is largely consumed everywhere in Benin, but lacking in nourishing element. So, in order to improve gari's nourishing quality, cassava is mixed with Pachyrhyzus ahipa's root which is richer than cassava's root. Indeed, ahipa is a leguminous plant whose root can be used to process gari. So, to propose good products to consumers, conjoint analysis was used to examine and compare, in urban and rural area, potential preferences of Benin consumers for gari made from Ahipa roots, using simple regression. The study was conducted in ten localities, and based on 20 personal interviews of gari consumers per locality. According to results, gari is consumed particularly because it is easy to prepare and because it is an alimentary habit of consumers. The study also revealed that two different types of consumers were derived. Urban consumers prefer gari which have fine texture, without dirt, white or cream in color, with little or no sour taste and swells. Rural consumers like sour gari, with fine texture, no dirt, white or creamin color and swells. The white color is the most desired everywhere, therefore, it is essential to work more on the gari made from ahipa in order to correct (improve) its color which is not yet desired by consumers.

Key words: Conjoint analysis, ahipa's roots, gari, urban consumer, rural consumer.

Up-scaling Orange-fleshed Sweetpotato (Ipomea batatas (L) Lam) Technologies in Western Kenya

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Abstract

Vitamin A deficiency is a major nutritional problem in Kenya, leading to night blindness and high mortality rate in infants. Consumption of orange-fleshed sweetpotato (OFSP) that is high in -carotene (pro-vitamin A), can reduce the risk of the deficiency. The utilization of the OFSP in Kenya despite its nutritional advantage is limited. Efforts by the Government extension service to promote the crop has had limited impact. The Kenya Agricultural Research Institute in collaboration with the International Potato Centre and farmers developed a number of OFSP technologies that can enhance its utilization. The ASARECA/AfDB-supported **project** "Dissemination of New Agricultural Technologies in Africa" (**DONATA**) for Orange-fleshed sweetpotato (**OFSP**) was initiated in Bungoma and Busia counties of Western Kenya in 2008. The project used the Innovation Platforms for Technology Adoption (IPTAs) approach in up-scale the proven OFSP technologies. IPTA acts as the institutional mechanism bringing together different stakeholders for scaling out and scaling-up of OFSP technologies along the value chain. Within three years 29 technologies on seed systems, agronomic practises, postharvest processing and marketing were promoted to 7500 beneficiaries. This was achieved through training of 215 extension agents and 1250 farmers on different aspects of OFSP. Thirteen information products were made available to the users through 15 different uptake pathways. Area under OFSP root production increased by over 600% while productivity per unit area increased from 8 to 16 tons/ha in the project counties.

Key words: Beneficiaries, innovation platforms, technologies, uptake pathways, value chain**,**

Nutritional and functional profiles of two tuber crops (*D. bulbifera* and *C. esculentus)* *consumed in Northern Cameroon*

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Abstract

Two tuber crops (*Dioscorea bulbifera* and *Coleus esculentus*) from two origins (Garoua and Ngaoundere, Cameroon) and two treatments (raw and cooked) were studied for their nutritional and functional profiles. After processing tubers into flour samples, proximate composition, starch, free sugars, minerals (Ca, Fe, P), total phenolic compounds, phytate, total oxalate, functional characteristics (flour density, solubility index, swelling, water and oil absorption capacities) were determined following official analytical methods. Notable differences in flour properties are reported depending on the measured variables. The most significant changes were observed in starch (82.20 – 92.77g/100g DM) free sugars (2.99 – 4,13 g/100g DM), phytate (32.91 – 83.35 mg/100g DM), total oxalate (530.95 – 772.8 mg/100g DM), total phenolic compounds (369.9 – 2795.7 mg/100g DM) and calcium (29.69 – 37.86 mg/100g DM). Cooking induced losses in protein (14.46 – 50.45%) as well as starch (10.2 – 11.8%) contrary to free sugar (+ 41.00 to + 47.18%). *C. esculentus* sampled in Ngaoundere showed the highest water absorption capacity (513.12%) compared to the others. These findings represent a serious contribution to raise the profile of food composition and biodiversity work undertaken in Cameroon for the Central Africa Food Data System.

Keywords: *D. bulbifera*, *C. esculentus,* cooking, chemical and functional properties

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Experiences in Establishing new Cassava Value Chains for improved smallholder livelihoods: Lessons from High quality cassava flour commercialization under C: AVA Project in Malawi

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Key words: Value chains, HQCF, livelihoods

Abstract

The contribution of cassava to improving livelihoods of resource poor households has always been limited to food security but not cash income generation in Malawi. This situation changed with the launching of the Cassava: Adding Value for Africa Project which was initiated to stimulate and expand markets for High Quality Cassava Flour (HQCF) with funding from Bill and Melinda Gates Foundation. The project has established a viable and sustainable HQCF industry based on two value chains involving sun-drying operations for village processing groups, and artificial drying (flash dryers) using commercial processors. The two value chains targeted different markets but complemented each other, with the latter adopting an inclusive business model. The project demonstrated that cassava can be used as a cash income earner for smallholder farmers and processors, and has potential to create employment in rural areas. In addition, end users at both the small scale and larger industrial manufacturers can benefit by reducing reliance on imports of wheat flour and corn starch. One of the pre-requisites for establishing sustainable new value chains was appropriate technology, also enabling the production of a product of consistent quality demanded by end users. Some key lessons learnt were that quality management was crucial in sustaining markets and that processing technology and capacity dictates the type of market segment to target. The paper also highlights some of the requirements for facilitating private sector investment in new processing technology which have potential to provide sustainable market opportunities for smallholder farmers. The paper concludes by highlighting some of the key lessons that can be used to develop new value chains, including scaling up within countries with similar conditions to Malawi.

Key words: Experiences, cassava value chains, improved small holder livelihoods

Multi-locational Assessment of some Physicochemical Attributes and Amylase activity of Sweetpotato varieties and Elite materials in Ghana

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Abstract

As part of the breeding objectives to select sweetpotato materials with acceptable quality attributes for adaptation and subsequent utilisation in Ghana, the total amylase activity and physicochemical attributes (flesh colour, Beta-carotene, dry matter, starch and sugars) of 13 sweetpotato genotypes across five locations were evaluated. Near Infrared Reflectance Spectrometry (NIRS), was mainly employed in the study. The flesh colour of the materials ranged from white to deep orange while the dry matter content ranged from 20% to 44%. Starch, fructose, glucose and sucrose contents were 46 – 74, 0.3 - 5, 2 – 8 and 9 – 22% respectively. Apomuden, a deep orange type, recorded the highest total sugar content of 36% and the lowest dry matter and starch content of 20% and 46% respectively. Hi-starch variety had the highest dry matter (45%), starch (74%) and the lowest sugar (11%). Dry matter content correlated positively with starch content whilst orange colour intensity was inversely proportional to dry matter content. The outcome of the study supports the fact that sweet potato contains high extractable amylases. Amylase activity of the materials was fairly stable across locations. Okomkum, Faara, Santom Pona, Kemb, and Cemsa 74-228 recorded the highest activity while Hi-starch, Apomuden, Mohc, and 199062.1 were low. There was no correlation between raw sugars and amylase activity. The potential of individual cultivars for food industry will be discussed in relation to starch content and extractable amylases.

Keywords: Amylase activity, sugar profile, starch, dry matter content

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Yield and Micronutrient uptake of white yam *(Dioscorea rotundata L. Poir)* as affected by organomineral fertilizer ammendment on an alfisol in Ibadan South western Nigeria

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Abstract

Fertilizer use for increased and sustainable yam production in the country is grossly inadequate and inefficient. Most research focused on the macronutrients forgeting the importance of micronutients in plant nutrition. Field trial was conducted in 2004 and 2005 wet seasons, at the International Institute of Tropical Agriculture Ibadan Research Farm to determine the influence of organo-mineral fertilizer Micronutrient uptake of white yam in an organic-based production system. Four cultivars of white yam: "Adaka", "Amula", "Danacha" and "Omiefun" were each subjected to 10 fertilizer treatments comprising sole Organic fertilizer (OF), mineral (NPK 12-12-12) fertilizers combinations of the two (organo-mineral) and control, 2.5, and 5.0 t/ha OF; 0.15, 0.3 and 0.45 t/ha /ha NPK; 1.75 t/ha OF+0.15 t/ha kg/ha NPK; 2.5 t/ha OF+0.15 t /ha NPK; 2.5 t/ha OF+0.3 t/ha /ha NPK and 5.0 t/ha OF+0.3 t/ha /ha NPK. The trials were conducted at Ibadan (Oxic Kandiustalf), Southwest Nigeria. The experiment was a split-plot in randomized complete block design with four replicates. White yam cultivars and fertilizer rates were main and sub-plot treatments, respectively. Tuber yield, Zn, Cu and cl uptake were assessed. Data obtained over two years were analyzed using analyses of variance; means were separated using SED. "Amula" had the highest tuber yield of 10.7 and 22.1 t/ha in 2004 and 2005 respectively. Four fertilizer treatments (5.0 t/ha OF, 0.45 t/ha NPK, 2.5 t/ha OF+0.3 t/ha NPK, 5.0 t/ha OF+0.3 t/ha NPK) significantly ($P < 0.05$) improved the growth and yield of white yam compared to the control. Fertilizer treatment at 5.0 t/ha OF + 0.15 t /ha NPK produced the highest tuber yield of 16.0 t/ha in 2004 and 20.4 t/ha in 2005. They were significantly ($P<0.05$) higher than the control plots in the two years. Similarly, the same fertilizer treatment had the highest Zn, Cu and Cl uptake for both years. There were N, P and K uptakes of 15.8, 17.2 and 11.3 g/plant respectively in 2005 and were significantly ($P< 0.05$) higher than the control. Fertilizer treatment at 5.0 t/ha OF+0.3 t /ha NPK was the best with reference to tuber yield and nutrient uptake. "Amula" had the highest tuber yield during both years of study.

Keywords: *Dioscorea rotundata*, fertilizers, soil type, tuber yield, micronutrient uptake.

Determination of Economically Profitable Doses of Nitrogen, Phosphorus and Sotassium for sustainable Cassava Production in Southern Benin

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Abstract

In 5 sites distributed in southern Benin, six combinations of different NPK doses (0-0-0, 0-90-120, 60-0-120, 60-90-0, 60-90-120 and 90-90-120 kg.ha^{-1}) were tested, in order to determine the most economically viable doses of nitrogen (N), phosphorous (P) and potassium (K) for the production of cassava variety BEN86052 is southern Benin. The trial was carried out during 3 agricultural campaigns with the improved cassava variety BEN 86 052. The experimental design is randomised complete blocks with 4 replicates. From the analysed results it appears that the 60 kg.ha^{-1} of N, 90 kg.ha^{-1} of P_2O_5 and 120 kg.ha^{-1} of K_2O are the most indicated doses to produced improved cassava variety on the degraded land (ferrallitic soils) of Abomey's plateau region. As for the areas like Toffo, Eglimè, Zouzouvou and Adjohoun, the doses of 90 kg.ha^{-1} of N, 90 kg.ha^{-1} of P_2O_5 and 120 kg.ha^{-1} of K_2O are the most indicated with the yields about 28 t.ha-1 and 8 t.ha-1 without mineral fertilizers contribution. The dose most economically profitable for the production of cassava variety BEN86052 is 90 kg.ha-1 of N, 90 kg.ha-1 of P2O5 and 120 kg.ha-1 of K2O. The producer earns 78 for 100 CFA francs invested due for increasing yields of improved cassava variety in each agro-ecological zone in southern Benin.

Keywords: Economically profitable, improved cassava variety, yield, Benin.

Gestion durable de la fertilité des sols par la rotation contrôlée des cultures

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RESUME

Les rotations en agriculture sont reconnues comme une pratique incontournable si l'on veut maintenir la productivité des sols et la qualité des productions. La place du manioc (*manihot esculenta*) dans la rotation et les effets des différents précédents culturaux doivent être bien définie, mesurés et comparés. C'est dans ce cadre qu'il ya trois ans, depuis la campagne 2009/2010, un essai est en cours dans deux sites de la RDC représentant deux zones Agro écologiques différentes, à savoir la forêt à Yangambi et la savane à Ngandajika. Quinze traitements constituants des précédents culturaux du manioc après jachère ont été utilisés.
A la fin du premier cycle de cet essai dans la zone savanicole, il a été constaté qu'en savane parmi 7 successions supérieures au témoin, les rendements du manioc (19,1 – 21,7 t/ha) dans 3 successions culturales ont été significativement supérieures au témoin (manioc – manioc : 12.7 t/ha). Il s'agit des successions suivantes : « maïs – niébé » ; « soja – niébé » et « arachide – niébé » ayant occupées le terrain successivement l'avant dernière et la dernière saison culturale avant la plantation du manioc.
L'augmentation de la productivité de manioc lorsque plantés directement après le niébé, peut s'expliquer par l'importante contribution de l'azote fixé par le niébé en tant que dernier précédent cultural.

Mots clés : rotation, productivité, manioc, précédent cultural.

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Soil Nutrient Recovery after Seven-Year Fallow in Ultisol Grown to Cassava-Pigeon Pea Based Systems for Seven Years in Southeastern Nigeria

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Abstract

A virgin forestland cleared in 1998 was continuously grown to cassava (*Manihot esculenta* Crantz), pigeon pea (*Cajanus cajan*) and their combinations for seven years. After these years of continuous cultivation, the land was left fallow for seven years to evaluate its natural nutrient recovery capacity in relation to the cropping systems. The experimental design was a randomized complete block design replicated three times. The study showed that the solely cassava (SC) plots were able to recover more exchangeable K and Mg. Again the values of soil pH and exchangeable acidity from these plots were also higher than those grown to solely pigeon pea (SP) and plots grown to their combinations (C+P). The plots grown to SP were able to recover more organic matter, available P, and exchangeable Na than other plots, while, the C + P plots recovered more total N, exchangeable Ca, and cation exchange capacity (CEC). Compared to the year the forest was first cleared, exchangeable Ca, Mg, K, and Na were able to recover to about their original values. Thus, other nutrients appear to require more than seven years to recover their original values in an ultisol of Nsukka area

Key words: Soil Nutrient, cassava, pigeon pea, fallow

Facilitating Cassava Market linkages for smallholder groups

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Abstract

The USAID/IITA project "Unleashing the Power of Cassava in Africa" (UPoCA) in Sierra Leone has partnered with Image-AD (Ghana) to facilitate cassava business linkages by customizing mFarms platform for agribusiness solutions. The platform aims to help cassava value chain actors communicate with each other efficiently, establish and maintain business relationships, and manage the flow of services and goods in quantities and qualities required by specified market outlets in Sierra Leone. At the pilot stage of iita.mfarms.org UPoCA project has developed a) a mobile phone application comprising a farmer module to register, locate and send SMS to communicate with farmers; FBO module to register, locate and send SMS to communicate with farmer based organizations, and a processor module to manage information on production of finished products; b) web platform with a database structure and graphic design comprising public interface allowing access of the general public to a limited set of information; buyer interface for potential buyers (log-in users) of cassava products to interact and transact business with various vendors on the platform; and a system administrator's interface which allows the platform manager(s) to facilitate communication between vendors and buyers and where needed on-line visitors. This presentation introduces iita.mfarms.org as a potential tool to enable rural-based smallholder groups/individuals to more effectively commercialize cassava.

Keywords: Cassava, mFarms platform, communication, income UPoCA

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Priorities for a Global Cassava Research Program to Improve Food Security and Incomes in Developing Countries: A Survey of Experts

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Abstract

The resources available for implementing the CGIAR Research Program Roots, Tubers, and Bananas (CRP-RTB) are limited and have an opportunity cost in terms of foregone alternatives. There are many alternative research options that can be pursued to improve food security and incomes for resource-poor farmers in developing countries. This raises the need to identify how to best invest limited resources in order to generate the greatest impacts per dollar invested. The CRP-RTB proposes a six stage process for setting priorities. As an initial step in this process, this study describes the perceptions of cassava research priorities by cassava researchers, development and extension specialists. These experts were asked to rank three top constraints on cassava production, transformation and commercialization and to rate the importance of 13 kinds of research options to reduce poverty and improve food security. The ranking was based on a five-point scale, between 5 as the most important and 1 as the least important research option. Results presented reflect perceptions of critical priorities for cassava research based on tallying of the response and provide the basis for further priority setting in the CRP-RTB.

Key words: Priorities, global cassava research program, food security, incomes in developing countries, survey of experts

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Studies on Nanobiotechnology Control of Postharvest Rot in Yam *(Dioscorea rotundata)*

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Abstract

The biggest challenge facing full utilization of yam (*Dioscore spp*) is post harvest rot. *In vitro* and *in vivo* experiments were therefore conducted to evaluate the bioactivity of nanoparticles of silver and neem (silverneem) solution on some organisms that cause yam rot. A decaying yam tuber was collected from the Department of Crop Science, UNN yam storage barn. In the *in vitro* study, the organisms were isolated and identified as *Fusarium moniliforme and Lasiodiplodia theobromae. The organisms were cultured in* sabourand dextrose agar (SDA). Each of the agar plates was divided into four sections with a marker. Using a cork borer of diameter 8 mm, cups were made at the centre of each of the four sections. Then, 0.05ml silvernem solution was aseptically introduced into the cups starting from the lowest to the highest concentrations. The plates were incubated at 35^0C for 48 hrs and the zones of inhibition were determined. In the *in vivo* study, yam slices, each weighing approximately 15 g was dipped into each level of silverneem solution for 3 minutes and thereafter inserted into the petri dishes containing each of the organisms. The minimum inhibition concentration (MIC) of the silverneem which inhibited the mycelia growth of *Fusarium moniliforme* was 0.8 mg ml^{-1} while the MIC of the silverneem for *Lasiodiplodia theobromae* was 0.5 mg ml-[1]. Fresh yam dipped in the solution and later inserted into cultured organisms was not affected. It is evident in this study that silverneem solution is highly effective in the control of yam rot.

Keywords: Nanobiotechnology, silver, neem *(Azadiractha indica),* yam rot, postharvest

Genetic Improvement of Cassava for Enhanced Beta-Carotene in Nigeria

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Abstract

One major solution to reduce vitamin A deficiency in Sub-Saharan Africa is to develop improved cassava genotypes high in beta-carotene and other agronomic traits adoptable by farmers and other end-users. Three yellow fleshed and three white fleshed varieties were crossed in a 3 x 3 mating design to generate one thousand, two hundred and ten (1,210) botanical seeds from 9 families. These were sown in pots and maintained for 42 days in the screenhouse. Four hundred and sixty four progenies survived and were classified 12 months after planting (MAP) into distinct phenotypic classes. The data obtained were subjected to Chi-square tests to determine the goodness-of-fit to various genetic ratios. Both the quantitative variability of root colour observed and spectrophotometric quantification suggest that two or more genes are involved in the accumulation of beta-carotene. Data on other root qualities, physiology and diseases were collected. Genotypic variation in dry matter content (DMC), total carotene (TC), biomass, root number, harvest index (HI), fresh root yield (FRY) and dry root yield (DRY) were recorded among the families. Mean values for the families for TC were 3.37µg/100g, for DMC was 32.95 %, HI was 0.56, biomass was 6.37, FRY was (36.07t/ha) and DRY was (11.66t/ha). There were very high levels of variation in the segregating F1 progeny for all the traits that will be useful for carotene enhancement in cassava.

Key words: Cassava, Spectrophotometry, Carotenoids, genotypes and vitamins

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Diallel Analysis of Sweet Potato [*Ipomoea batatus (*L.) Lam] genotypes for Beta carotene and Dry matter content in South Africa

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Abstract

Roots of orange fleshed sweet potato (OFSP) varieties contain high quantities of β-carotene or pro-vitamin A but have high moisture content. These varieties have been found to be a cheap and crucially important remedy for vitamin A deficiency. The cream or white fleshed varieties on the other hand, had sweet taste but low percentage moisture content, giving a dry texture, a quality trait preferred by the communities in South Africa. Development of sweet potato genotypes that can combine these two important quality traits is one of the objectives of the breeding programme in South Africa.
A diallel experiment using six parental sweet potato genotypes crossed in all possible combinations were carried out and twenty eight progenies were evaluated for beta carotene (β-carotene) and dry matter content at two locations in South Africa for two years. The trials were conducted at Roodeplaat Vegetable and Ornamental Plant Institute and Fort Cox College of Agriculture Research Farms in 2009 and 2010. Highly significant ($P \leq 0.01$) differences were observed among the genotypes for the traits. The average β-carotene content among the progenies was 2.7 (mg/100g.f.w) while the dry matter content had a mean value of 23.8%. The hybrid progenies Khano x 1999-5-1 and 1999-5-1 x W-119 had the highest β-carotene content compared to all genotypes evaluated. Similarly, progenies 1999-9-4 x W-119 and W-119 x Ndou, revealed the highest dry matter content. Genotypes Khano x 1999-5-1 and 1999-5-1 x W-119 which combined good beta carotene content with acceptable dry matter content are therefore recommended for further evaluation.

Key words: Diallel analysis, β-carotene, dry matter, sweet potato.

DNA fingerprinting of Cassava and Yam Germplasm Collection at IITA using SSR markers to Identify Duplicates

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Abstract

Plant germplasm collections invariably contain varying levels of genetic redundancy, which hinders the efficient conservation and utilization of plant germplasm. The presence of duplicates is more critical or of concern in clonally propagated crops. The genetic conservation and maintenance of these crops are carried out in field conditions, which not only results in losses due to disease or pest attacks or natural disasters but also generates mislabeling/duplication of accessions. The presence of redundancies or mislabeling in germplasm collections is a burden on the gene bank and do not contribute towards genetic diversity of the crop, instead adds to the cost of maintenance. Thus, identification and probable elimination of duplicates or mislabeled genotypes in germplasm collection is very important from both genetic and economic point of view for better gene bank management in a cost effective manner. The Global Crop Diversity Trust (GCDT) thus funded IITA to fingerprint the germplasm collection of cassava and yam using SSR markers to assess the genetic redundancy/identifying unique accessions in the collection. The germplasm collection of both cassava and yam, conserved in the field bank, was therefore genotyped with SSR markers, using a PAGE (polyacrylamide gel electrophoresis) and capillary electrophoresis (ABI3130) system. The genotype profiling was first carried out with a set of SSR markers using PAGE system to identify the potential duplicates.

All 2418 cassava accessions maintained at IITA were genotyped initially with 10 SSR markers on PAGE, which resulted in a total of 41 alleles with an average of 4.1 alleles per marker. Based on genetic distance, a total of 895 potential duplicates were identified for further genotyping with additional 15 SSR markers on ABI3130 for capillary electrophoresis.

Similarly, a total of 1320 *D. alata* accessions were genotyped with 18 genomic SSR markers. This resulted in a total of 97 alleles with an average of 5.4 alleles per marker. Based on genetic distance, a total of 664 (419 from international and 245 from national collection) potential duplicates were identified for further stringent analysis with additional markers.

Results demonstrates that SSR markers, together with the statistical tools for individual identification and redundancy assessment, are technically practical and sufficiently informative to assist the management of tropical plant germplasm collections.

Key words: Germplasm collection, cassava, yam, DNA fingerprinting, SSRs, redundancy

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Stability Performance of Cassava Genotypes Combining African and Latin American Germplasm in Ghana

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Abstract

The major goal for cassava breeding is genetic enhancement that aims to increase cassava productivity through the use of broad-based improved germplasm combining multiple disease resistance with high yield and other desirable traits. The stability of eight International Center for Tropical Agriculture (CIAT) derived elite cassava genotypes bred for cassava mosaic disease (CMD) and green mite resistance was evaluated in a randomized complete block design with three replications in three agro-ecological zones of Ghana for two seasons. The genotypes were developed at CIAT through hybridization between African and Latin American germplasm followed by marker assisted selection. The genotype CR59-4 showed excellent resistance to CMD (1.17) but recorded the lowest mean average yield of 27.20 t/ha. Afisiafi (TMS 30572), Cr52A-4, Cr52A-31, CR52 and Sisipe recorded the highest average yields ranging from 54 to 63 t/ha across all locations. Cr52A-25 recorded an average yield of 57.48 t/ha but was very unstable. Genotypes, CR42-6 and CR59-4 were the most stable but with below the average yield of 35 t/ha. Afisiafi recorded high and stable yield. The relative magnitude of the main effects and their interactions for the traits measured as proportion of the total sum of squares showed that the genotype effect was larger than the genotype x environment interaction effect on root weight, CMD and dry matter content indicating that the traits can be improved by direct selection. High variability existed among the cassava genotypes for all traits studied. Genotype by environment interaction was described using AMMI biplots for yield, CMD reaction and stability.

Key words: Cassava mosaic disease, yield stability, genotype by environment interaction

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Breeding un-sweetpotato for West Africa: Progress on population development and improvement in Ghana and Peru

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Abstract

Sweetness of sweetpotato is considered to be a significant constraint to demand for this crop in West Africa where starchy staple root crops with low flavor impact are important. Un-sweetpotato populations and varieties which may have use both for fresh consumption and in processed forms are therefore under development at the Sweetpotato Support Platform for West Africa, and drawing on a global genetic resource base at CIP headquarters in Lima, Peru. In Ghana base populations were assembled from locally adapted regional germplasm, including released varieties, farmers' varieties, breeding lines from IITA reported to be un-sweet, and from exotic germplasm reported to be un-sweet. Seed populations were also introduced for assessment from Sweetpotato Support Platforms in Uganda and Mozambique, and from Japan and the USA. Introduced germplasm was evaluated in field trials in production zones/agroecologies where sweetpotato is important in Ghana, and farmers participated in selection based on field performance and taste. Sugars of raw samples were measured using near-infrared reflectance spectrometry, and cooked samples were tasted to assess sweetness. In Peru, a large breeding population was screened for un-sweet taste (low flavor impact) and these materials, presumed to be Beta-amylase nulls, were crossed with a population of breeding lines developed at IITA and presumed to have good adaptation to West African conditions. Seed from the Peruvian crossing block has been sent to Ghana for evaluation and selection. Together, West African and exotic populations are expected to provide a solid foundation for developing un-sweetpotato and for expanding the range of options available to sweetpotato producers and consumers in West Africa and elsewhere.

Key words: NIRS, amylase, breeding, sensory quality

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Gender issues in Cassava Value Chains (Sub-theme A)

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Abstract

Gender relations are a key part of understanding root and tuber crop (RTC) value chains. The Cassava: Adding Value for Africa (C:AVA) project, which supports the creation of High Quality Cassava Flour (HQCF) value chains in Nigeria, Ghana, Tanzania, Uganda and Malawi, undertook a series of gender studies across participating countries to inform the project strategy and activities. This paper provides an overview of the findings across the five countries, taking into account the various socio-economic and cultural contexts in which gender relations are embedded. Included in the analysis are the trends in men and women's participation at various points in cassava value chains and the terms of their participation. The paper also critically examines the different constraints and opportunities for men and women in the context of interventions aiming to upgrade the cassava value chains, and how these relate to differences in men and women's access and control over key resources, both at a household and community level. Finally, the paper will present the implications for service providers, researchers and other value chain actors working with RTCs, arguing that it is essential to take gender relations into account in the design and implementation of value chain development initiatives. It also considers the possible impacts that gender equity in RTC value chains could have on wider objectives of poverty reduction and food security.

Key words: Gender, cassava, value chain, women's participation

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Market Prospects for Cassava Small Scale Farmers in Zambia

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Abstract

With the development of new varieties and improved methods of farming, cassava production has increased in Zambia since the 1990s. However, the majority of small scale farmers in rural areas still struggle to look for markets. Cassava is either consumed by the household or sold at local markets usually at low market value. Sometimes the crop goes to waste if not properly stored. Despite this, cassava is still the preferred crop in rural areas especially in the high rainfall areas of Region III and parts of Region II, where it grows in degraded soils with minimum labour requirement and no fertilizer added. Several market and export surveys and value chain analyses have been done in Zambia but the commercial market options, for large consumers, are still not clear. Where and what could be the problem? Our research team commenced preliminary market approach to establish the uncertainties in the established cassava market in Zambia and identify strategies for their mitigation through a desk study. A review of the current market status, research findings and strategies being used by other countries were employed to develop the Zambian strategies. This paper shows the importance of such market analysis and how it will give small scale farmers in the rural areas, an opportunity to have an established market for their increased income which will empower them to purchase agricultural inputs to improve their poor soil fertility for agricultural productivity.

Keywords: Market, income, mitigation, uncertainties

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Livelihood Study of the CFC Beneficiaries and Communities: Outcomes of the Cassava Value Chain Project in West Africa

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Abstract

A livelihood study was conducted in the 12 communities of cassava value chain development project in Nigeria, Sierra Leone (SL) and Benin Republic (BR), administering questionnaire among 730 households (HHs). Agriculture was the main reported source of HH income (64.19%) with no education found highest in BR (71.69%) and least in Nigeria (28.395). About 20% of the household heads (HHHs) in SL earned $\leq$ $12.5 monthly, while in BR, 55% reportedly earned $13-20. Comparatively, HHs from Nigeria reported highest physical assets: radio (53.3 %), television (48.93 %), refrigerator (19.74 %), fan (41.59 %) and generator (34.29 %). Use of mechanical agricultural tools was found very low in all the communities (<0.5 %). About half (52.04 %) of all the respondents reportedly had access to land, while 47.96 % used the land for cultivation of mainly cassava and maize. Prior to the project, the beneficiaries were into processing of few cassava products, mainly *gari*, at low production capacity with access/ownership of few equipment, which were either obsolete or non-functioning: 40.62 %, 25.72 % and 22.98 % in Nigeria, SL and BR respectively while 11.6-34 % reported having processing centres, which were just open space. On livelihood outcome of the project interventions, the beneficiaries reported among others, product and income diversification, assets acquisition, ability to meet basic HH needs and increased feminization of HH economy. Rural HH livelihood assets are few and can barely give broad options and appreciable outcomes; economic opportunities should be diversified to increase and stabilize incomes.

Key words: Assets, beneficiaries, communities, households, livelihood

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Productivity and Profitability of Cassava based intercropping systems in the Northern Guinea Savanna of Ghana

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Abstract

A field experiment was conducted during the wet seasons of 2009 and 2010 at the research farm at the University for Development Studies Tamale, Ghana to assess the productivity and profitability of various cassava based intercropping systems. The results showed that except cowpea, grain yield of monocropping, were higher than that of intercropping. Monocropping cassava yields were higher than intercropping cassava except cassava/maize and cassava/cowpea intercropping. Leaf area index of the minor crops and cassava were not significantly affected by intercropping arrangement. The monocropping recorded higher harvest index than intercropping. The cassava/cowpea intercropping recorded land equivalent ratio (LER) and area x time equivalent ratio (ATER) of 1.97 and 1.22, respectively, was more productive than all the intercropping arrangement. The cassava/maize intercropping was more profitable in terms of monetary advantage (MA) than the other intercropping arrangement. The cassava/maize intercropping recorded the highest system productivity index (SPI) value of 7546.0 kg/ha and cassava/soybean intercropping recorded the lowest SPI value of 2415.0 kg/ ha.

Key words: Intercropping, monocropping, cassava, land equivalent ratio, area x time equivalent ratio, monetary advantage

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Social Networks and Cassava Value Chain development in Africa

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Abstract

Cassava is increasingly seen as a pro-poor vehicle for economic development because it is a major food and income source for vulnerable groups, in particular women and the poorest households. Since 2008, the C:AVA project has been supporting value chain development for high quality cassava flour (HQCR) in Africa to improve the livelihoods and incomes of smallholder farmers and small- and medium-scale enterprises. One prerequisite for success is an effective value chain with a well-established network that facilitates information sharing, coordination and advocacy. Strong and effective linkages between the actors are essential to create an efficient and sustainable value chain, in particular to allow effective communication of information, coordination of interventions and distribution of value along the chain. This paper uses Social Network Analysis to identify and explore the networks that support and influence value chain development for HQCF in Malawi and Nigeria. Social Network Analysis explores the relationships between actors and provides insights into patterns of communication, power, trust and influence between actors in social networks. The paper describes the development of the HQCF value chains and their supportive networks over recent years in Malawi and Nigeria, and the lessons learned on stakeholder involvement and advocacy. The paper concludes that strong and diverse social network including stakeholders from the public and private sectors and civil society is important for sustainable value chain development. Visualisation of these social networks is a helpful tool to track the evolving relationships among value chain participants, to inform advocacy activities and engage stakeholders.

Keywords: Cassava, social networks value chains

Effect of Bilge Water on Germination of *Manihot Esculata* (Cassava)

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Abstract

Germination studies on the propagatory part of *Manihot esculata* (cassava) (the seed and the stem cut) was carried out using bilge water as the planting medium. Effect of the bilge water at different concentration on the germination of the seeds radical length and plumule length of the seedlings of the plant was investigated. The bilge water was found to have more inhibitory effect on the germination of the seeds used than that of the stems. The percentage germination decreased significantly with increase in the bilge water concentration. Length of radical and plumule of the seedlings decreased with increase in bilge water concentration. A comparison of the percentage germination of the seed and the stem at different concentrations of 25%, 50%, 75% and 100% showed cassava seeds to be least tolerant to the bilge water than the stem cuttings. Germination inhibition is attributed primarily to the acidity of the bilge water.

Key words: Bilge water, germination, tolerant, inhibition.

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Deployment of CGM Resistance from Latin America to Africa for Genetic Improvement of Cassava

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Abstract

Cassava, is an important starchy staple in Nigeria with a total production of 37 million metric tonnes. Cassava production is highly affected by pests and disease of which the CGM is the most important in the dry season. The cassava green mite (CGM), *M. tanajoa* causes defoliation and destruction of the shoot tips of cassava plants. Severe damage can result in complete leaf necrosis and apical defoliation. Good resistance to cassava green mites (CGM) was identified in 4 inter-specific hybrid families, CW68, CW65, CW67, and CW66, derived from a cross between cassava and an accession of *Manihot esculenta* sub spp *flabellifolia*. The F_1 inter-specific hybrids were back crossed to elite varieties susceptible to CGM and evaluated over 3 seasons in the field at CIAT using an advanced backcross scheme. Selected BC_1 individuals with moderate to high levels of CGM resistance were backcrossed to cassava to generate 43 BC_2 families. The BC_2 families denoted as AR family series, were transferred to partners in Tanzania, Nigeria, Ghana, and Uganda for use in breeding. CGM evaluation was done on a scale of 1 (high resistance) to 5 (severe susceptibility). The genotypes were also improved for cassava mosaic disease (CMD) resistance to improve their adaptation in Africa given that LA germplasm are highly susceptible to CMD. The best selected AR genotypes in Nigeria and Ghana at peak pressure of the infection had CGM severity score of 3, indicating moderate tolerance to the CGM. The results imply that the genes deployed did not offer high resistance in this sub-region. However, in East Africa (Tanzania and Uganda), the introduced germplasm tended to have lower symptom expression to the pest. In East Africa some of the genotypes showed severity scores of 2 indicating resistance, although a good proportion also showed moderate tolerance as observed in West Africa. Differences in CGM response in the germplasm between West Africa and East Africa appeared to have been largely influenced by GXE factor as pest pressure is influenced by the environment. CGM is a dry season pest, and pressure in locations in East Africa (Namulonge, Uganda; Mtwara and Chambezi in Tanzania) were evaluations were done, relatively had shorter dry season periods and longer rain distribution than locations used for evaluations in Umudike, Nigeria. Under the cassava GCP research initiatives in Ghana and Nigeria efforts are underway to screen for more sources of CGM resistance in African germplasm.

Key words: Deployment, CGM resistance, Latin America, Africa, genetic Improvement of Cassava

Genes of Industrial Importance on Cassava Waste Bacteria Plasmids

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Abstract

Cassava wastes, which account for over 50% of the tuber on a wet weight basis, could constitute a potential resource if properly harnessed. In this study, cassava peel and cassava waste water, obtained from cassava processing centres in Abeokuta, Nigeria, were explored for genes of industrial importance, using molecular tools. The 16S rRNA gene of bacteria isolates were amplified by Polymerase Chain Reaction (PCR) using 16S rRNA primers and sequenced alongside plasmid DNA extracted from some of the isolates. Sequences were identified by aligning with sequences in the GenBank. The Open Reading Frame Finder was used to identify protein coding regions on plasmid DNA sequences, translated and searched against publicly available archives using the BLAST-P algorithm. Plasmids were found on 14 bacteria isolates. Genes encoded on the plasmids included tannase from *Lactobacillus plantarum;* beta-glucosidase from *Bacillus coagulans* and *B. circulans*; hydroxynitrile lyase from *Bacillus licheniformis and Lactobacillus fermentum*; poly-glutamic acid (PGA) synthesis regulator from *Lactobacillus fermentum*; glutamate synthase from *Bacillus substilis*; bacteriocin related genes from *Lactobacillus fermentum*, *Lactobacillus fallax* and *Weisella confusa* and hypothetical proteins. Tannase hydrolyzes tannic acid – an antinutrient which precipitates protein, thereby inhibiting its absorption and utilization; beta-glucosidase and hydroxynitrile lyase catalyze the detoxification of cyanogenic glucosides; PGA is used as stabilizer and thickener in foods while glutamate is used in the manufacture of monosodium glutamate-an important food flavour enhancer. Bacteriocin is a microbial polypeptide with antimicrobial properties. This study shows that cassava waste has great potentials as important biotechnology resource for the food industry, considering its rich biodiversity.

Key words: Cassava waste, Bacteria plasmid, Tannase gene, Bacteriocin, Glutamate synthase gene, hypothetical protein

Development of a Multiplex RT-PCR for the Detection of Major yam Viruses in West Africa

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Abstract

The major viruses infecting yams (*Dioscorea* spp.) in West Africa are *Yam mosaic virus* (YMV, genus *Potyvirus*), *Yam mild mosaic virus* (YMMV, genus *Potyvirus*), *Cucumber mosaic virus* (genus, *Cucumovirus*) and *Dioscorea alata bacilliform virus* (DaBV, genus *Badnavirus*). Simultaneous infection of yam with more than virus is frequent in the field. Laboratory diagnostics methods based on enzyme-linked immunosorbent assay (ELISA) and Reverse Transcription-Polymerase Chain Reaction (RT-PCR) assays were available for the detection of these viruses, but they are applied in uniplex detection of each virus or utmost two viruses. In this study a simple multiplex RT-PCR assay was developed using the previously described and newly designed oligonucleotide primers for simultaneous detection of yam infecting viruses. The method was suitable for the detection of viruses in diverse samples, including leaves, vine cuttings, in vitro plantlets, tubers, leaf sap preserved on the FTA cards. This assay is economical, robust and provides reliable results in relatively short time.

Key words: Development, multiplex RT-PCR, detection, major yam viruses, West Africa

Developing an Effective Protocol for Embryo Rescue in *Dioscorea* spp

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Abstract

Embryos were detected in developing seeds of *D. alata* from 40 days after pollination (DAP) in Ibadan, Nigeria. Embryos harvested from 40 to 80 DAP were cultured *in vitro* in Murashige Skoog (MS) medium supplemented with different combinations of growth regulators and vitamins to give six combinations. Medium M1 comprised MS basal salts + 3% sucrose + 0.1 mg/l Indole -3 acetic acid (IAA); M2 comprised MS + 6% sucrose + 0.1 mg/l IAA; and the composition of M3 was MS + 3% sucrose + 0.5 mg/l nicotinic acid + 0.1 mg/l thiamine + 100 mg/l inositol + 2 mg/l glycine. Trans-zeatin, at 0.1 mg/l, was added to medium M1 to produce medium M1TZ; to M2 to produce M2TZ; and to M3 to produce M3TZ. The responses of different ages of embryos of *D. alata* to the six different media under two incubation conditions were studied. The youngest embryos rescued were excised at 50 DAP by embryos cultured at 80 DAP showed the highest ($P<0.05$) percentage (74.1%) germination. The highest germination percentage and plantlet percentage (74.1% and 72.3% respectively) were obtained in medium M2TZ. Germination and plantlet formation varied with embryo age and media. The incubation conditions had no significant effect on percentage germination. The described protocols proved to be successful in regenerating seedlings from immature embryos of intraspecific hybrids in *D. alata*.

Key words: Developing, effective Protocol, embryo rescue, *Dioscorea* spp

Zinc Biofortification of Cassava Storage Roots

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Abstract

Biofortification is the process of enriching the nutrient content of staple food crops as a means of ameliorating micronutrient malnutrition worldwide. Cassava (*Manihot esculenta*), is a major staple food crop for more than 300 million people in Africa but it lacks sufficient amounts of important micronutrients such as Vitamin A, Iron and Zinc. Intake deficiency of zinc is especially a widespread nutrition and health problem in the developing countries. The biofortification of cassava roots using transgenic approaches is found to be more effective than other strategies such as food fortification or nutrient supplements. Although the mechanisms of Zn translocation in cassava plants are not fully understood, it has recently received increased interest. For efficient nutrient accumulation in cassava storage roots, both uptake and storage is essential. To achieve enhance zinc uptake and accumulation in cassava, *AtZIP1*, (a Zn transporter that is localized to plasma membrane) under the control of the A14- root epidermal promoter and *AtZAT1*, (a storage Zn protein in the vacuole that is localized in the vacuolar membrane) under the control of root specific patatin promoter was introduced into cassava via *Agrobacterium* mediated transformation. Twenty one independent transgenic lines were obtained in cassava. Molecular analyses to identify the presence of genes and ICP analysis shows 1.5 fold increase of zinc concentrations in transgenic roots. We present hypothesis of mechanisms for accumulation of zinc in storage roots of the cassava plant.

Key words: Zinc Biofortification, cassava storage roots

Screening of Cassava Germplasm for Poundability in Luapula Province – A Preliminary Study

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Abstract

The cassava (*Manihot esculenta*, crantz) breeding work in Zambia and particularly in Luapula Province has been focussed on developing high yielding varieties with reasonable dry matter content for home consumption. The sweet roots, of this provincial staple, are eaten raw or boiled whereas the bitter varieties are only processed into mealie meal that is used to make a thick porridge called nshima.

Drying of cassava for processing into flour used for nshima posses a challenge during the rainy season for the cassava consumers. However, the sweet varieties are still used as a snack and not for nshima. A small preliminary study done at Mansa Research Station to screen advanced cassava materials for poundability has identified at least 10 varieties that can be boiled and pounded into nshima. Acceptance of this method of preparing nshima by our farmers will alleviate the lack of food experienced in the rainy season. In addition, there will be a reduction in the labour for processing cassava roots into mealie meal and will make it easier to introduce cassava in non-traditional growing areas for nshima; a staple in Zambia. Therefore, we are proposing to screen the available germplasm (both from Research and farmer's fields) in varied environments for poundability and make available the generated information to potential endusers. Further genetic recombination research work will be undertaken to develop additional genotypes for the poundable quality trait.

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Cassava Brown Streak Disease in Mozambique: Diallel Analysis, Yield and Yield Related Characteristics

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Abstract

Cassava is the major source of carbohydrates in the rural communities in Mozambique. Despite that, cassava brown streak disease (CBSD) constitutes the main production constraint in Mozambique after the first in 1999. CBSD may be found in all plant parts, affecting food security and availability and quality of planting material. The aim of this study was to evaluate the relative importance of general (GCA) and specific combining ability (SCA), and inheritance of relevant traits and to identify superior parents for use in further improvement of genotypes for yield and CBSD resistance. The parents were selected from a region where CBSD is the main economic constraint. Chigoma mafia was the best general combiner for average root number and CBSD resistance, Mulaleia also combined well for CBSD resistance. Clone IMM 30025 was the best general combiner for root pulp hardness, but combined poorly for CBSD resistance. Chigoma mafia × Mulaleia had the best mean performance for fresh root yield and CBSD resistance. Macia 1 × Chigoma mafia had the best SCA for fresh root yield, CBSD resistance and root pulp hardness. MZ 89186 × IMM 30025 and the reciprocals IMM 30025 × MZ 89186, Chigoma mafia × Macia 1 and MZ 89186 × Mulaleia had the best resistance to CBSD. This indicates that there is good parental material for CBSD resistance breeding. Chigoma × Mulaleia, MZ 89185 × IMM 30025 and MZ 89186 × Macia 1 had good mid-parent heterosis for the most important traits. Broad sense heritability estimates varied from 38.9 for fresh root yield to as high as 95.5 for harvest index, indicating the potential for effective response to selection.

Keywords: Cassava, cassava brown streak disease, combining ability, Heritability, resistance, yield

Pro-vitamin A Cassava Varieties: Development, Release and Deployment in Nigeria

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Abstract

The scourge of vitamin A deficiency in Nigeria is taking its daily toll on the livelihoods of women and children under the age of five with attendant consequences of diseases such as night blindness, susceptibility to common diseases, poor vitality and death in certain circumstances. The HarvestPlus consortium sought to breed and deploy enriched cassava among other staple foods with pro-vitamin A. The aim was to develop high pro-vitamin A cassava that farmers would adopt, grow and be consumed by poor rural dwellers. The cassava must also have end-user preferred traits and high agronomic performance. This initiative resulted in a recent release and launch of three cassava varieties with enhanced pro-vitamin A contents to Nigerian farmers. The 3 new varieties (TMS 01/1368, TMS 01/1412 and TMS 01/1371) registered and released as UMUCASS 36, UMUCASS 37 and UMUCASS 38 respectively, were preferred over local checks for cassava food products such as gari and fufu in on-farm participatory evaluations with end-users. The total carotene content of the new varieties ranged between 6 – 8 μg/g FW, based on data collected from 9 multi-environments across 4 agro-ecological zones in Nigeria and 104 farmers in 13 states. The varieties were officially released for cultivation by the Nigerian Government. The HarvestPlus target for delivery of these varieties is to reach 50,000 households in 4 pilot states in Nigeria in the first year (2013) and to extend same to other African countries. Modern breeding techniques such as the development of partial inbreds are being deployed to further enhance the beta carotene contents future varieties. Another set of varieties with mean carotene content of 10-12 μg/g FW are currently being tested in national performance trials for eventual release to Nigerian farmers.

Key word: Pro-Vit A, cassava varieties, development, release, deployment.

Next Generation Cassava Breeding: Accelerating the Rate of Genetic Improvement in Cassava Breeding

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Abstract

Cassava is central to food security and livelihoods acrossAfrica, yet this 'poor cousin' of staple crops has received inadequate research and development attention. A long generation time, vegetative propagation, and poor flowering and seed set, considerably constrain cassava improvement, resulting in lengthy cassava breeding cycles. This seriously limits the responsiveness of cassava breeding to emerging threats, and prevents rapid delivery of improved varieties to meet changing farmer and market demands. The Next Generation Cassava Breeding (NGCB) project aims to meet these challenges and revolutionize cassava breeding through the application of cutting edge breeding methodology. Genomic Selection (GS) uses statistical modeling to capitalize on the 'genomic revolution', leading to dramatically reduced breeding cycles. The NGCB projectbuilds on promising preliminary results on GS application in cassava, and aims to develop statistical tools, a database, human and infrastructure capacity, to ensure the long-term application of GS in cassava breeding. Methods to improve flowering and seed set in cassava,in addition to a 'one-stop shop' database (Cassavabase) containing GS algorithms, analysis tools, as well as genotypic and phenotypic data captured for GS implementation, will be developed.This project also aims to take advantage of cassava genetic resources by crossing Latin American and African germplasm. Major investments will be made at NaCRRI in infrastructure and human capacity, in addition to support for the creation of a biotechnology outreach and training hub at this location. The NGCB project holds great promise to dramatically increase the rate of genetic improvement in cassava breeding in Africa, and unlock the full potential of cassava on the continent.

Key words: Cassava, breeding, genomic selection, database, flowering, germplasm exchange

Cassava (*Manihot* esculentaCrantz) improvement in South Africa

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Abstract

Cassava (*Manihot* esculenta *Crantz*) has become an important food security crop in developing regions. While it is characteristically a tropical crop, it copes well in the drought prone, seasonally humid regions of South Africa. In South Africa, cassava is mainly grown as a secondary crop by the resource-poor farmers in the northern regions of the country. Insect pests are a major limiting factor of cassava cultivation. Unlike their commercial counterparts, the smallholder farmers cannot afford pesticides to control primary pests such as aphids, mealybugs and mites. Over the years, cassava has been selected for high yields, low fiber content and until recently, very little emphasis was on insect resistance. Wild cassava relatives have been found with natural resistance to pests e.g.*M. tristis*. While relatively successful inter-specific crosses have been made to introgress genes responsible for pest resistance in landraces into elite cassava cultivars, the molecular basis of insect resistance in cassava is poorly understood. This study aims at identifying candidate genes that are involved in pest resistance in cassava. Cassava mealybug (*Phenacoccus manihoti*) will be the test subject of this study as it is a destructive, sap-sucking pest, which is highly abundant in South Africa. Genomic, transcriptomic and bioinformatics tools i.e. the "Omics technologies" are being used to identify candidate genes that confer pest resistance in cassava. These genes will be used to develop markers that can be used for marker-assisted selection (MAS) to breed insect-resistant and thus low-maintenance cassava cultivars, which are ideal for resource-poor subsistent farmers in South Africa.

Key words: Breeding, candidate genes, mealybugs, omics, pests, resistance.

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Pre-Tuber Application of Fluridone: Vegetative Growth and Seed Tuber Dormancy in Yam (*D. Alata*)

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Abstract

A 10 µm fluridone (FLU) prevents the initiation of dormancy in *D. rotundata* tubers *in-vitro* leading, to precocious sprouting of just-formed micro-tubers. Successful induction of sprouting in seed tubers will promote yam production by increasing the number of cropping cycles. The objective of this study was to determine the effect of a pre-tuber application of FLU on vegetative growth, seed tuber production and dormancy of *D. alata*. The treatments were: water (control), 10 µm FLU, 5 µm ABA, and 5 µm ABA + 10 µm FLU. 1 ml of the treatment was injected into the primary nodal complex of the yam plants. Data collected include plant height, leaf number, leaf length and width, tuber number and dry matter content. Tubers were examined for external signs of sprouting then, prepared for sectioning and anatomical examination to detect internal signs of sprouting. Root dry weight increased ($p=0.05$) by 29 % in FLU compared to the control (10.9 g). In contrast, ABA reduced root dry weight by 17 %. The ABA + FLU treatment, however, reversed the effect of ABA: increasing root dry weight by 13 % as compared to ABA alone. Tuber number per plant increased under FLU, ABA and ABA + FLU compared to the control. The number of nodes per plant reduced ($p=0.05$) in ABA, while ABA + FLU reversed the effect of ABA. Anatomical observations at 75 days after vine emergence did not show any clear effect of 10 µm FLU on seed tuber dormancy. Fluridone (FLU) is a herbicide that cause precocious sprouting in plant organs exhibiting dormancy by inhibiting ABA activity.

Keywords: Dormancy, yam, fluridone, growth

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Development of an Industrial Rasper (Blade Type) for Cassava Starch Extraction

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Abstract

The cassava tubers, being highly perishable, should be immediately processed into starch or flour for value addition, which enhance the income of farmers resulting in food security and rural employment. Starch is generally prepared by wet extraction process, in which rasping or crushing is an important unit operation for the disintegration of the cell wall and washing out of the starch granules by water. In the commonly used raspers, mild steel sheets with nail punched protrusions are fixed around a wooden drum which rotates inside a crushing chamber to crush the tubers. The sharpness of the protruded sheets decreases after crushing about 500 tonnes of tubers and hence necessitated frequent replacement and thereby adding higher cost of processing. Hence a cost effective cassava rasper operated by 3 hp electric motor consisting of a crushing drum of mild steel pipe with high speed blade sets (10 teeth per inches) fixed on its circumference was developed and tested for its performance by changing the rasper speed and water flow rate. The capacity of the machine was found to be about 900-1000 kg/h with a rasping effect of 64.32%. *T*he amount of starch extracted using the developed rasper was 21.53% resulting in the recovery of starch as 85.85 %, compared to the maximum extractable starch measured by chemical method. Maximum fineness modulus of the crushed mash was 4.82. Pasting characteristics of starch extracted with this machine were comparable to that of starch obtained by the manual method.

Key words: Cassava, starch, rasper and asping effect, fineness modulus, pasting characteristics

Formulation and Biochemical Characterization of Sweet potato (*Ipomoea batatas*) based infant flours fortified with Soy and Sorghum

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Abstract

This study aims to contribute to food security of children at the age of weaning by enhancing the valorization of sweet potato in Benin. Two cultivars of sweet potato *Bombo* and *Mansawin* (name in local language fon), soy and malted sorghum were processed into flours; then flours nutritional properties were investigated. Following the creation of a mixture design with Minitab 14 software, weaning flours combining sweet potato and soy flour in ratios 75 % -25 % and 50 % -50 % have been achieved and analyzed initially. Afterwards, optimization of mixtures and their supplementations with malted sorghum flour were performed. Therefore, formulations with sweet potato, soy and malted sorghum flours respectively in specific ratios (52.95 %, 34.00 % and 13.05 %) for *Bombo* and (50.65, 36.30 % and 13.05 %) for *Mansawin* are obtained. These infant flours respectively contained for *Bombo* and *Mansawin* (19.69 % and 19.51 %) protein, (7.45 % and7.55 %) fat and (398.97 kcal and 401.63 kcal) energy that are within recommended weaning foods norms of FAO / WHO / UNICEF. The microbiological analysis results show that infant flours produced, remained in accordance with microbiological norms of FAO and WHO. Sensory pofiles indicated that porridges from these baby flours were appreciated more to those from commercial infant flour VIE VITAL VITE used in Benin; porridge from *Bombo* is highly appreciated by tasters. The formulated food was within the accepted energy density and consistency after heating and cooling. Also all the flour produced were non-toxic to larval toxicity test. To promote the use and valorization of sweet potato crop and to contribute to food security for children in Benin, sweet potato based infant supplement flours fortified with soy and sorghum may be a potential complementary baby food.

Key words: Processing, weaning food, malnutrition, nutritional properties, sensory profiles.

Development of an Uncooked Simultaneous Liquefaction, Saccharification and Fermentation for Bioethanol Production from Cassava Chips

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Abstract

Bioethanol is now produced and used as an alternative energy source that is both renewable and environmentally friendly. Amongst potent raw materials for bioethanol production, cassava is very interesting and potentially the most suitable for Vietnam. Most of bioethanol factories in Vietnam are using conventional process for ethanol production. The conventional process composes of energy consuming liquefaction (95-105˚C), separate saccharification (60-62˚C) and fermentation (30-32˚C). Our study was aimed to develop an energy-saving and cost-effective process for bioethanol production from cassava chips, which was based on decreasing energy consumed for liquefaction by utilizing alpha amylase enzymes capable of hydrolyzing raw starch, and by performing Liquefaction, Saccharification and Fermentation simultaneously. We developed an uncooked process in which a mixture of alpha amylase, glucoamylases and yeast was added to the cassava mash (166 g of starch/L) to conduct a Simultaneous Liquefaction, Saccharification and Fermentation (SLSF) in one vessel and at a unique pH (4.5) and at 30^0C. Moreover, our uncooked process was optimized by using the response surface methodology (RSM). The optimized process took 72 h and achieved 10.6% v/v ethanol equivalent to an ethanol yield of 88.8% which was 2-4% higher than the conventional process. These results suggested our energy-saving and cost-effective process could be interesting for the industrial production of bioethanol.

Key words: Bioethanol, cassava chips, uncooked process

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Influence of Extrusion conditions on Retention of β-carotene and Physical Characteristics of ready-to-eat Orange fleshed Sweet potato flour Extruded snack product

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Abstract

Orange fleshed sweet potato flour was prepared from ST-14 variety of sweet potato tuber and extruded. The extrusion experiments were carried out in a single-screw laboratory extruder. The temperatures of feed zone, compression zone and metering zone were set at, 60, 70 and 80˚C respectively. The extruder screw speed was set at 80 rpm. The die temperature of the extruder varied from 160 to 180˚C in steps of 10˚C. The β-carotene content of the raw flour was 14.0 mg/100g. The flour was conditioned to the required moisture contents (3 levels, 12, 14 and 16%) and fed into the single screw food extruder.

The β-carotene content of the extrudate varied from 7.848-10.512 mg/100g. The maximum retention was observed for the extrudate obtained with 12% moisture content flour processed at a die temperature of 180˚C. The physical properties of the extrudates showed that the expansion ratio, bulk density and moisture content of the extrudates varied between 2.03-2.52, 0.59–1.08 g/cm^3 and 7.20-9.69%, respectively. The textural properties of the orange fleshed sweet potato flour extrudates showed that the hardness and toughness values of the extrudates ranged between 61.84 – 130.53N and 24.85-72.22 N.S, respectively. The snap force and snap energy values ranged between 4.82-16.81 N and 0.83-3.53 N.S, respectively. The colour intensity of the extrudates reduced when the die temperature increased from 160 to 180˚C. The study showed that good quality snack food extrudate can be produced from orange fleshed sweet potato flour.

Keywords: Extrusion, orange fleshed sweet potato, β-carotene**,** expansion ratio, bulk density, porosity, hardness

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Changes in Souring Production and Physico-functional Properties during Co-Fermentation of Cassava (*Manihot esculent Crantz*) and Cowpea (*Vigna unguiculata*) Dough into *Gari*, an African Fermented Food

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Abstract

This work studied the extent to which cowpea fortification and co-fermentation will influence the souring production and physico-functional properties of cassava dough during the production of gari. A 4 x 4 factorial design was used to study the effects of fermentation time (0, 24, 48 and 72 hours) and cowpea level (0, 10%, 20%, and 30%) on the souring production (pH and titratable acidity) and physico-functional properties (pasting characteristics, swelling capacity, water absorption capacity and bulk density) of the cowpea-fortified cassava dough. Increasing fermentation time increased titratable acidity, water absorption and swelling capacities but decreased pH from 6.17-4.57 with 48 hours of fermentation. Increasing levels of cowpea fortification reduced the peak viscosity from 583-368 BU, swelling and water absorption capacities, but increased the bulk density from 0.50-0.71% and titratable acidity from 0.018-0.072 g lactic acid/100g. The reduction in pH and increased titratable acidity and peak viscosity at 20% cowpea level after 48 of fermentation suggest that the techniques could be employed to enhance the nutritive value of gari, while enhancing the safety, and improving the flavour and stability of the product.

Key words: Changes, souring Production, physico-functional Properties, co-fermentation of cassava (*Manihot esculent Crantz*), cowpea (*Vigna unguiculata*)

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Targeting Cassava Processing Research for Development Investments to Upgrade Cassava Value Chains in Tanzania

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Abstract:

There is empirical evidence that traditional cassava processing is labour intensive, high cost and supplies low quality products. This is a binding constraint on adoption of improved varieties and crop management practices and large-scale impact of cassava research investments. This paper uses econometric analysis with survey data collected in the coastal areas of Tanzania in 2011 to develop a typology of processing businesses, identify factors affecting profitability and areas for prioritizing cassava research for development investments. The study finds that processors vary with the scale of operation from hand-manual methods, through buying and selling, partially mechanized to fully mechanized. Research investments need to target simple general purpose processing and drying technology and linking to markets for manual processors; storage facilities, access to markets and transport logistics for traders; processing machines, drying trays, water supply and infrastructure for partially mechanized processors; and access to reliable markets, drying technology and water supply, and access to land for fully mechanized processors.

Key words*:* Cassava, kernel regression, manual processors, partially mechanized processors, fully mechanized processors.

A Commercial High Quality Cassava Flour Hot-Setting Corrugated Board Adhesive Formulation

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Abstract

The corrugated board industry in Malawi uses an adhesive prepared using maize starch which is currently being imported. A hot-setting corrugated board adhesive formulation based on a locally available high quality cassava flour (HQCF) was prepared under standard commercial operating conditions and its composition and properties compared with a maize starch based adhesive (SBA). The HQCF-based adhesive had a Steinhall viscosity of 18 seconds, gelatinisation temperature of 62˚C, with a preparation time of 35 minutes compared with 50 minutes for the traditional SBA. These properties are within the SBA required specifications of viscosity and gelatinisation temperature (18-22 seconds and 60-63 ˚C, respectively). The HQCF-based adhesive required 10% more water and 10 % less HQCF. Results demonstrated that the HQCF-based adhesive provided an excellent bond and would operate as a complete substitute for the maize starch.
The use of a locally available starch alternative will save the adhesive industry foreign exchange of around US $500,000/year. This is significant as the acquisition of foreign exchange is both expensive and problematic in Malawi. In addition, the substitution of the maize starch will provide a business opportunity for a local HQCF processing industry and generate employment. The HQCF is approximately 60% less expensive than the imported maize starch, considerably reducing adhesive batch costs.

Key words: Adhesives, corrugated board, forex, cheaperproduction time

Cassava Value Chain Development by Supporting Processing and Value Addition by Small and Medium Enterprises in Sierra Leone: Experiences, Prospects and Impact

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Abstract

Cassava is the second most important food crop in Sierra Leone after rice; it constitutes a significant portion of the diet of the rural and urban populations of the country. 'Boil and eat' is widespread while marketing is grossly underdeveloped with wide fluctuation in commodity prices within seasons and locations. To adequately develop the value chain, CFC considered and approved the project proposal on the Cassava Value Chain Development by Supporting Processing and Value Addition by Small and Medium Enterprises in West Africa, for three year funding from 2008 to 2011 in Sierra Leone, Benin Republic and Nigeria. This was to sustainably raise rural incomes, improve food security, and permit the transition of subsistent cassava farming system to a sustainable market-driven system and standard cassava products supply lines in the three countries. The beneficiary processors were mainly women, producing *Gari, foofoo*, starch and cassava bread in Bo, Waterloo, Hamdalai/Lunsar, Makeni, Walihun and Njala. All processing centres set up and equipped were formally commissioned to attract policy support and improve awareness and patronage by all. The project implementation was rounded off with a national workshop where development agencies, government and non-governmental organizations were invited, for future support and replication of the project models in other parts of the country. Cassava products from all centres were exhibited and prizes awarded, with beneficiaries giving testimonies to the project's impact on their productivity and livelihood. Activities conducted and results obtained were described.

Key words: Cassava value chain, *gari, foofoo*, cassava bread and food security

Performance and Cost Evaluation of Broilers fed Composite feeds containing processed Cassava leaf and Cassava peels supplemented with xylanase

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Abstract

High fibre and hydrocyanide contents of cassava (*Manihot esculenta*) wastes (peel and leaf) have limited their usefulneless in poultry feed; this necessitated continous quest for processing methods aimed at reducing the contents of these antinutritional factors in finished poultry feeds based on cassava products. This experiment evaluated three processing techniques for cassava peels i.e. sun drying (SCPM), retting (RCPM), and ensiling (ECPM) in replacement (500 g/kg) for maize in practical broiler diets in which sundried cassava leaves were uniformly incorporated (100g/kg) and the diets were fed to experimental birds with (0.1 g/kg) or without xylanase (EC 3.2.1.8) - an exogenous enzyme. The respective diets were fed to 240 marshal broiler chicks from 0- 28d to evaluate their performance (feed intake, body weight, growth rate, feed to gain ratio and mortality). Furthermore, proximate composition (crude protein, ether extract, crude fibre and ash), HCN and feed cost evaluation (cost/kg feed, cost of total feed intake and cost/ kg weight gain) of the experimental diets were determined. The experimental design was a 2 (with or without enzyme) by 4 {control (maize), SCPM, RCPM and ECPM} factorial and was analysed using ANOVA. Birds fed SCPM, RCPM, and ECPM diets had similar ($P>0.05$) performance with control birds meaning that these diets were as good as the control. Furthermore, significant savings were achieved in feed cost/weight gain compared to control diet (maize) when processed cassava peels (SCPM, RCPM, and ECPM) and leaves were incorporated into the diets.

Key words: Broiler feeds, processed cassava peels, cassava leaves, Xylanase

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The Price Support Policy and the Brazilian Cassava Value Chain

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Abstract

This paper describes the value added distribution to all participants in the Brazilian cassava value chain. Data from secondary sources were collected and analyzed to build the cassava value chain. Brazilian production of cassava roots of 24,3 million tons in 2010 accounts for 10,27% of world production, from which 50.2% is used in animal feeding, 33.9% for diverse forms of human consumption, 0.2% for exports, 5.7% for other uses and 10% represents losses. Within the production of cassava roots for human consumption 91.5% is used for flour ("*farinha"*) production, 8.4% used for starch production and 0.1% for fresh, frozen and minimum processed cassava products consumption. The price support policy for cassava products is described and the impacts of this policy over the whole cassava value chain were analyzed. The rent generated by Brazilian cassava sector was estimated in US$ 1.3 billion corresponding to approximately 1% of the gross value of the agricultural production. The sector generates 1 million direct jobs. Cassava in Brazil is mostly cultivated by small farmers with an average size of three hectares. Thus, 74.5% of the cassava farmers cultivate less than 10 hectares, 10% of the farmers between 10 and 100 hectares, 13.3% between 100 and 500 hectares and only 2.2% more than 500 hectares. Under the price support policy prices are always set below the market price allowing free behavior of supply and demand forces. Also, small cassava farmers are favored by specific support policies of financial support for production and buying their production for food security programs.

Keywords: Price policy, cassava, value chain

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Cassava Value Chain Development through Partnership and Stakeholders' Platform in Cameroon

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Abstract

The major challenge to capitalize on the potentials of cassava as a reliable source of income for farmers in Cameroon is attributed to poor organization and planning. In a partnership agreement between IITA and PNDRT to enhance cassava production, IITA adopted the value chain approach in research-for-development that guarantees the coverage of production to consumption and considers all groups from farmers to consumers, including traders, transporters, processors, industrial users and export sector and developed a variety of cassava processing techniques to broaden the range of products derived from cassava. The partnership arrangement led to shared resources, facilities, materials and knowledge in collaboration with universities and national research institute, international and national NGOs and farmer associations for the purpose of generating new technologies and fostering innovations. Other categories of partners in the process are the policy makers that play an important role in influencing the direction of research programs and the private sector that participate in the provision of inputs and uptake of products from farmers. The inclusion of the private sector is necessary for sustainability, market development, and competitive pricing and product provision. To achieve successful partnership, collaboration is formalized through appropriate agreements with MoU or LoA that clearly define responsibilities and expectations and required for a specific level of product based on partner's category, status, geographic location, years of experience, current activities and capacity (technical, financial, human and logistics). This collaborative scheme also requires periodical meetings to review progress and constraints, explore new opportunities and plan for the future. Stakeholders' platform was instituted as mechanism for appropriate knowledge sharing for cassava producers, processors and marketers and in the development of infrastructural facilities. Reinforcement of stakeholders' platform at the community and regional level raised awareness for professionalization of actors in the value-chain and on policies governing each sub-sector for profit oriented and sustainable cassava production. It also enabled actors to identify and address their real needs and constraints and prioritize for collective action. In parallel, small-holder farmers learned to organize themselves and work as legitimate groups and operate independently. Investment in stakeholders' platform and involving a wide range of public- private- sector service providers along the entire cassava value chain is very important to maximize benefits gained from improvement in crop yields.

Key words: Cassava value chain, partnership, stakeholders' platform, maximize benefits, Cameroon

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Effect of Fortification on the Chemical and Sensory Properties of Pre-gellatinised, Cold Extruded Cassava Noodles.

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Abstract

Flours from cassava variety, 98/0505, were fortified with 5-30% levels of soy protein isolate (TTA of 3.85) and carotene from red oil. These blends were extruded through a 2.5mm die nozzle of a locally fabricated manual extruder. Unfortified cassava flour was used as the control. The extrudates were evaluated for chemical and sensory properties. Results showed that hydrogen cyanide reduced from 1.254ppm to 1.165ppm with addition of red oil. Carotene content was higher in oiled flours ($\approx$ 540.12? g/100g) than in the control (52.83? g/100g). There was significant increase in ascorbic acid content of the noodles (167.2mg/100g to 223.4mg/100g) as a result of fortification. The 5% soy protein fortification showed the lowest TTA (0.875) while the pH was highest in the flours ($\approx$ 6.84) and lowest in noodles with soy protein isolate (5.46). Addition of red oil reduced nitrogen solubility of the flours in neutral pH from 2.00 to 0.60% while extrusion reduced it from 3.96 in the control to 0.23%. 1n the 15% soy protein fortification, and in alkaline pH, nitrogen solubility was least (0.61%) in the noodles with oil, and highest in the control (3.033%). Sensory evaluation showed that all the noodles were moderately acceptable except those produced from 15% fortification which was most highly acceptable ($\geq$ 8.0 on a 9-point Hedonic scale) in terms of colour, texture, mouth feet and general acceptability. Fortification with oil improved the carotene level of the noodles made from cassava flours.

Key words: Cassava, carotene, fortification, soy-protein-isolate, extrusion, sensory evaluation

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Combining Ability and Mode of Gene Action in Cassava for Resistance to Cassava Mosaic Disease and Cassava Brown Streak Disease

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Abstract

Diseases are a major threat to sustained cassava production in Malawi. The need to develop new improved disease resistant varieties requires knowledge on the mode of gene action controlling disease resistant traits. Therefore, a study was carried out in the 2010/2011 and 2011/2012 growing seasons at Chitedze Research Station and Chitala Research Station respectively to determine combining abilities and the mode of gene action controlling the expression of major diseases namely, cassava mosaic disease (CMD) and cassava brown streak, (CBSD) resistant traits in cassava using a 7 × 7 diallel mating design evaluated using RCBD under natural infection. Results showed significant GCA and SCA mean squares for CMD, CBSD, average root number per plant, and fresh root weight (Kg plant^{-1}), which indicated the preponderance of significant variability existing in cassava genotypes attributable to additive and non-additive gene effects. There was also significant reciprocal effects in the inheritance of these traits which means cytoplasmic effects are important in the genetic control of these traits. The GCA variances (δ^2gca) for all the traits were lower than SCA variances (δ^2sca), thus, the results suggested that non-additive gene action was more important than additive gene action in influencing the traits under study, that is, crossing and making selection to these crosses, the largest part of improvement for these traits would be expected to come from non additive genes. Mulola was the overall best general combiner followed by TMS4(2)1425 and 01/1316. In terms of SCA effects, ten hybrids were identified as the most promising viz. Mulola × 01/1313, Silira × TMS4(2)1425, Depwete × Silira, Mulola × Silira, Depwete × TMS4(2)1425, Mulola × TMS4(2)1425, Mulola × Maunjiri, 01/1313 × Depwete, Depwete× 01/1316 and 01/1316 × Maunjiri. Broad sense heritability was higher than narrow sense heritability for all the traits which indicted that all the characters had high genetic variance, that is, additive and non additive variance. In general, the results suggested that a breeding program that exploits heterosis would be more efficient in incorporating the traits under study for this set of genotypes.

Key words: Cassava Mosaic disease, CBSD, GCA, gene action, SCA.

Increasing Farmers and Breeders Access to Yam (Dioscorea Spp) Diversity: The Case of Forest-Savannah Transition Agroecology

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Abstract

A study was conducted in five yam growing communities in the Forest Transition Agroecological Zone of Ghana to take inventory of cultivated yam varieties, their distribution and intensity of cultivation and also document the rate of landrace germplasm loss and reasons for such an occurrence. Generally, the cultivated varieties ranged from 9-16 with a mean of 12. The most diversity was found in Sankore (Asunafo South District), followed by Sampa in the Jaman North District, Asantekwa in the Kintampo District, Ejura in the Ejura-Sekyedumase and Mim in the Atebubu/Amantin Districts with 16, 15, 12, 11 and 9 cultivated varieties respectively. *Dioscorea rotundata* is the most widely cultivated specie of yam followed by *D. alata, D. cayenensis, D. praehensilis* and *D. bulbifera* respectively. A wide diversity of *Dioscorea rotundata* yam species were documented in the study areas; 78% in Mim, 58% in Asantekwa, 60% in Sampa, 44% in Sankore and 82% in Ejura. *D. alata* varieties were 22% in Mim, 33% in Asantekwa, 33% in Sampa, 44% in Sankore, 18% in Ejura. Only one variety of *D. cayenensis* (D. cayenensis cv Afun) was found at Sampa and Sankore. It was only at Sankore that *D. bulbifera* cv was documented as a cultivated specie. The maturity period also correlated positively to the harvesting type (r=1), with all D. rotundata varieties except for *D. rotundata* cvs Dente, Serwa and Tempi, being early maturing and thus double harvested. *D. alata, D. cayenensis* and *D. bulbifera* were late maturing and thus singly harvested. Income and food security were major determinants of distribution and intensity of cultivation of a particular variety across all locations, gender and ethnic groupings. Factors such as good culinary characteristics, high yield; seed generation capacity, good storage characteristic and resistance to biotic and abiotic stresses were important criteria for selection of variety.

Keywords: Diversity, Germplasm, Yam

Genotype x environment interaction and yield stability estimates of some sweet potato [*ipomoea batatas* (l.) Lam] breeding lines in South Africa

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Abstract

Genotype x environment interaction and yield stability was evaluated for root tuber yield of 28 sweet potato breeding lines in South Africa using the Additive Main Effects and Multiplicative Interaction (AMMI) and the *Eberhart and Russell's stability parameters*. *Genotypes x environment interactions showed the inconsistency of the performance of the breeding lines over environments and seasons. The analysis of variance showed that the* genotype x environment interaction were significant for root yield. Environment main effect contributed the largest percentage of the total variability. The stability parameters used in this study identified cultivar Monate as high yielding and stable across locations. *The first two interaction principal component axes (IPCA) of the AMMI model accounted for 82.81% of the total genotype x environment interaction sum of squares for root yield. The AMMI biplot depicted the genotypes on the bases of their adaptation patterns. Breeding lines W-119 x Ndou, W-119 x Khano, Resisto, Ndou x W-119, Ndou x 1999-9-4, Monate x Ndou, Ndou x Khano, Ndou x Monate, Khano x Monate and Khano x 1999-9-4 were found to be best adapted to Roodeplaat environment while breeding lines W-119 x 1999-9-4, Ndou, Monate x Khano, Khano x 1999-5-1, 1999-9-4 x Khano and 1999-9-4 are best suited to Fort Cox environment. They are therefore recommended for cultivation in those environments.*

Key words: AMMI model; cultivars; genotype by environment interaction; Stability; sweet potato

Breeding potential of sweetpotato cultivars in Uganda for tuber yield, quality and sweetpotato virus disease resistance

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Absract

Sweetpotato is an important root crop in Uganda, where yield potential and quality attributes have not been fully exploited due to limited breeding efforts and poor knowledge on inheritance of most agronomic traits. A study was conducted at Makerere University to characterize selected sweetpotato cultivars for sweet potato virus disease (SPVD) resistance, growth habit, flowering and seed set ability, tuber yield and shape, tuber skin and flesh color, dry matter, starch, sugar and b-carotene content. A 7 x 6 North Carolina 2 mating design was used to investigate the inheritance of some traits. Cultivar Munyeera displayed the highest level of SPVD resistance followed by New Kawogo and Polyster as exhibited by low relative areas under disease progress curves following natural field infection and graft inoculation with SPVD causing viruses. Virus detection and quantification from the upper most leaves of resistant plants showed that resistant cultivars had the ability to lower the virus titers and recover from the disease. Flowering ability was low in some cultivars and a few did not flower at all. Genetic variability and heterosis was found also for important traits including tuber size and number of tubers per plant. The segregation ratios suggested that up to five genes may be involved in b-carotene synthesis and probably in combination with other genes in different genetic backgrounds that can modify flesh color from white to purple. This study identified potential sweetpotato cultivars and also demonstrated the possibility to further improve sweetpotato yield and quality using the available germplasm.

Key words: β-carotene, dry matter content, *Ipomoea batatas, r*esistance, recovery.

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Evaluation of Sweetpotato Local Germplasm in Solwezi District Of Zambia

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Abstract

Sweetpotato (*Ipomoea batatas. Lam*) is one of the most important sources of carbohydrates among small-scale farmers in Zambia and ranking second only to cassava. A study was conducted under field conditions for two seasons at Mutanda Research Station during the 2010/2011, 2011/2012 season to evaluate and maintain local Germplasm for subsequent use in the breeding programme and to avoid genetic erosion of local cultivars as a result of continued use of released varieties. Fifteen cultivars/ clones of sweetpotato were evaluated in a randomised complete block design with three replications at Mutanda Research Station. Mutanda Research Station is in the agro-ecological region III (altitude 500-1300asl, rainfall in the range of 800-1200mm and has acidic soils of pH 4.5-5.1). The results from the 2010/ 2011 season showed that varieties were significantly different ($P \leq 0.05$) for standcount, number of unmarketable tubers, number of marketable tubers, yield of unmarketable tubers and yield of marketable tubers. The variety with the highest standcount was Chitobenge and Kalukuluku at 80% and 73%, respectively while Chilubi had the lowest standcount at 40%. Matembele had the highest mean number of unmarketable tubers at 11 tubers per plot with Kabila having the lowest number at 1 tuber per plot. Matembele and Kalukuluku had the highest unmarketable yield at 23 t/ha and 16.8 t/ha, respectively. Chilubi, Chingovwa and Chitobenge had the lowest unmarketable yield at 0.1 t/ha, 0.2 t/ha and 0.2 t/ha, respectively. Matembele and Kalukuluku had the highest marketable yield at 77 t/ha and 55.5 t/ha, respectively while Chilubi and Chingovwa had lowest marketable yield at 0.4 t/ha and 0.7 t/ha, respectively. Total yield was not significantly different at ($P \leq 0.05$). Sufficient variation exists among the varieties for marketable and unmarketable yields to allow for identification of superior local germplasm for subsequent use in the breeding programme. Agronomically, the materials tested revealed that varieties with combination of suitable characteristics are identifiable. Kalukuluku, Matembele and Chingovwa were identified as the best varieties on the basis of levels of marketable yield, total yield and agronomical performance.

Key words: Evaluation, sweetpotato, local Germplasm

Yield and Quality of Nigerian Ginger: Strategies for Improvement

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Abstract

Ginger (*Zingiber officinale*) is an important spice both locally and globally. It main active ingredients oleoresin and ginger oil are used for a wide range of culinary, confectionary, and pharmaceutical purposes. After nearly a century of production, ginger yields in Nigeria remain below world's average. Despite its reputed "hotness" due to its high oleoresin content, Nigerian ginger is yet to penetrate the highly lucrative European and American markets due to its inability to meet some required quality standards. Reasons for low rhizome yield obtained by ginger farmers include; narrow genetic base, insufficient number of high yielding cultivars, and poor agronomic management practices. Poor quality of Nigerian ginger is largely a result of improper post harvest management. Ginger farmers are either ignorant or are only becoming aware of best practices to apply and critical risk factors to avoid in post harvest management in order to obtain high quality produce. Introduction and adaptive trialing of exotic genotypes to identify and select those that will be suitable for local production is suggested as a quick means of addressing the problem narrow genetic base and increasing number of high yielding varieties. Biotechnological tools enabling the application of techniques such as in-vitro pollination, somatic hybridization, embryo rescue and micro propagation should in the long term provide suitable means of developing improved genotypes of ginger. Farmer enlightenment through trainings and workshops on international quality standards for various forms of ginger and ginger products, best practices and the critical risk factor to avoid during production and post harvest handling will help them obtain products of high quality.

Key words: Yield, quality, Nigerian Ginger, strategies for improvement

Cracker coated peanut snack made from composite cassava-wheat flour dough

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Abstract

Preliminary studies have indicated high commercial potential of using composite flour from cassava and wheat flours dough as coatings for making cracker coated peanut (CCP) snack. This paper presents how frying temperature and time affect quality of CCP snack. Dough was made with composite flour consisting of 20% cassava flour and 80% of wheat flour. A central composite response surface design was used to determine the experimental trial points consisting of frying temperature (150-180^{o}C) and frying time (120-240 sec). The quality indices measured in the products include the Moisture content, fat, free fatty acid contents, peroxide values, CIE-Lab color parameters and sensory acceptability of appearance, texture (crispiness), taste and overall acceptability.

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Effects of blanching pre-treatment and drying methods on the functional and pasting properties of sweet potato (*Ipomoea batatas)* flour

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Abstract

Sweet potato (*Ipomoea batatas*) is a dicotyledonous plant originated in Central America and North Western part of South America. It is used in a variety of forms; it can be boiled, steamed, baked, fried, chipped, candied, canned, frozen, made into flour or starch, and processed into a number of products. Sweet potato outranks most root crops in vitamins, mineral and energy contents. In spite of the tremendous agronomic and nutritional advantages of sweet potato, it is underutilized in West Africa compared to other root crops (e.g. cassava and yam), due to several factors such as sweetness and texture and high perishability of the roots. This study was therefore conducted to determine the effect of blanching pre-treatment (80^{o}C for 3 and 5 min) and drying methods (oven and sun drying) on the functional and pasting properties of flour from two varieties (yellow-fleshed and white-fleshed) of sweet potato. The oven dried samples had higher values for most of the functional properties determined compared to sundried samples irrespective of sweet potato variety. The flour from yellow variety had higher values for water binding capacity (160.50 %), wettability (4.76 sec), and swelling power (7.50%) irrespective of drying method and blanching pre-treatment. There were no significant differences ($p < 0.05$) in the effect of blanching and drying methods on the functional properties of the flour samples from the two sweet potato varieties. Peak viscosity, trough viscosity, breakdown viscosity, final viscosity, setback viscosity, peak time and pasting temperature of the flour samples ranged from 33.75 - 169.83 RVU, 31.33 - 112.33 RVU, 1.00 - 57.00 RVU, 49.67 - 167.42 RVU, 13.67 - 55.09 RVU, 3.61 - 3.97 min and from 79.90 - 82.80 ˚C, respectively. The pasting properties (except peak time) were significantly ($p<0.05$) affected by blanching pretreatment and drying methods irrespective of variety. Flour from yellow-fleshed sweet potato exhibited higher pasting profile than that from white-fleshed variety irrespective of drying methods. The study concluded that the variation obtained in the functional and pasting properties of the flour samples are due to blanching and drying method and not varietal differences.

Keywords: Sweet potato, Blanching, Drying, Functional properties and Pasting properties.

The need for nutrient-dense cassava production in Nigeria through soil mineralization

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Abstract

The 37 million tonnes annual production and the 600 grams daily per capita consumption of cassava in Nigeria make Nigeria the highest producer and consumer of cassava in the world. What, however, should be of concern is the continuous cultivation of cassava on the same piece of land with its attendant consequences. Continuous cultivation leaves soils chronically deficient in nutrients and inorganic fertilizers coupled with intensive cultivation only produce nutrient-deficient crops resulting in "hidden hunger". Hidden hunger affects the health of billions of people around the world, especially in third world countries. Hidden hunger has severe health consequences; it can result in blindness, stunted growth and disease. Iron deficiency is the most common micro-nutrient deficiency afflicting 2 billion people, that is, 30 percent of the world's population. It impairs growth, mental development and learning capacity. In adults, it reduces the capacity to work, and leads to severe anaemia. Every second pregnant woman and about 40 percent of preschool children are estimated to be anaemic in developing countries. Anaemia contributes 20 percent of all maternal deaths. The consequences of Zinc deficiency include dermatitis, impaired growth, diarrhea, mental disturbances including criminal tendencies, recurrent infections, and infertility. A way out of these problems is the production of nutrient-dense cassava through soil re-mineralization. Nutrient-dense crops have higher levels of minerals, vitamins, carbohydrates and anti-oxidants which make the crops ideal for improving health and also to guard against disease. Re-mineralization as advocated by Dr. Julius Hensel in his book "Bread from Stones" using stone dust is a viable way of producing nutrient-dense cassava in Nigeria. This has been successfully done in Brazil among the Quilombo communities. Stone dust is an affordable local material in Nigeria. Its use in crop production creates healthier, tastier, more vitamized foods. It also creates immunity in plants to insect infestation, worms, fungi and plant disease of all kinds. It improves the keeping and transportation of quality foods so that shelf life is improved. Larger crops which are profitable to farmers are produced. Foods raised with stone dust are better for human health and the prevention of human diseases. Nigeria's population is a potential threat to the well-being of the world as it can become an economic burden if nothing is done to improve its quality. Re-mineralization of the soils especially in cassava production is a viable way of improving the quality of cassava production and that of Nigeria's population.

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'Dry and Starchy' Orange-fleshed Sweetpotato Farmer varieties: Implications for fighting Vitamin A Deficiency in East and Central Africa

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Abstract

Sweetpotato is a major staple and co-staple root crop for millions of the rural people in Africa. Recently, it has been demonstrated to be of human health importance by combating vitamin A deficiency. This paper is a summary review of recent findings on the orange-fleshed sweetpotato (OFSP) farmer varieties (FV) from East Africa (EA) and their potential contribution to combat vitamin A deficiency (VAD) in Africa. Between 2000 and 2006, scientists from East and Central Africa collected several OFSP varieties from farmers' fields together with the white- and cream-fleshed sweetpotato (WFSP) farmer varieties. Subsequent characterization studies using selected EA and exotic germplasm revealed critical findings for the future use of OFSP FV in Africa. Overall, molecular characterization showed that EA germplasm is distinct from non-African germplasm. It also showed that OFSP FV and WFSP FV from EA are very closely related. The two findings address suspicions that OFSP FV are of exotic origin. The OFSP FV differed from exotic OFSP on root dry matter (DM), starch and sucrose properties. Whereas the exotic OFSP are characteristically 'sweet and moist' (DM $\approx$ 25.0%, starch $\approx$ 50.0% and sucrose $\approx$ 10.3%), OFSP FV had characteristically high DM ($\approx$ 33.0%), high starch ($\approx$ 65.0%) and similar to the WFSP FV. It is these qualities that make sweetpotato a staple crop in Africa. However, root β-carotene content (BC) of some OFSP FV ['Ejumula', 240pmm; 'Carrot C', 259 ppm; 'Mayai', 264 ppm; and 'Zambezi', 233 ppm] nearly equaled that of 'Resisto' (271ppm), one of the popular OFSP cultivars in USA. These were shown to meet $\geq$ 400% of recommended daily allowance (RDA) with 250 g serving to a 5-8 year old child. Other light orange-fleshed FV like 'ARA244 Shinyanga', 'K-118', 'K-134', 'K-46', 'PAL161', 'Sowola6', 'SRT52', and 'Sudan' had lower root BC than 'Resisto' and were shown to meet between 50-90% RDA of the child. In conclusion, OFSP FV from EA might show similar adaptation to sub-Sahara African environments as their sister WFSP and have a big potential to alleviate VAD. Also, breeding for acceptable high DM and high starch OFSP varieties for African consumers seems possible.

Key words: orange-fleshed sweetpotato, farmer varieties, and vitamin A deficiency.

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Promoting cassava commercialisation with micro- and small-scale enterprises in rural Malawi

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Abstract

To address rural poverty and food security, Southern Africa must diversify its crop portfolio, growing more drought tolerant and less nutrient demanding crops such as cassava. More emphasis should be placed on non-farm incomes such as micro-enterprises to improve household access to food. We describe the processes that Chinangwa, Mbatata, Roots and Tubers Enterprises (CMRTE) has undergone to ensure a stable production of cassava seed, cassava tuberous roots and cassava leaves in response to the growing cassava commercialization in Malawi. CMRTE Enterprises focuses on production and marketing of high quality, fermented cassava flour and dried cassava leaves. To achieve this, CMRTE has catalysed partnerships The Swedish University of Agricultural Sciences (SLU), IITA/SARRNET, University of Malawi, National Agriculture Research and Extension Services (NARS) and the National Association of Business Women (NABW). Funding from international and national agencies has been instrumental in providing the skills and capacity for leading and managing CMRTE enterprises. By providing a readily available market for its members, CMRTE now comprises 2700 farmers of which 85% are women. These rural micro-enterprises have increased production, reduced postharvest losses, improved market access while catalysing cassava commercialization in rural Malawi. Lessons from CMRTE Enterprises could be replicated with other smallholder farmer organizations with similar interest.

Keywords: Cassava, markets, micro-enterprises, Malawi, rural

GROWTH PERFORMANCE OF CASSAVA IN CASSAVA /MAIZE/SUNFLOWER INTERCROP

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Abstract

Field trial was conducted at Teaching and Research farm of the University of Ibadan to evaluate the growth performance of Cassava intercropped with Maize and Sunflower in two spatial arrangements. The experiment was laid out in Randomized Complete Block Design using eight treatments with three replicates each. Data were collected on number of leaves, stem girth, plant height and number of branches between seven and twelve weeks after planting before harvest of the component crops. The data was subjected to analysis of variance and the means separated using least significant difference. The results showed no significant difference in the plant stem girth, number of leaves and branches whereas there was significant difference ($p>0.05$) in plant height from ninth weeks after planting. The plant height of Cassava was suppressed by Sunflower in Cassava/Sunflower alternate row arrangement than other treatments. This observed suppression of Cassava growth height is therefore due to the growth habit of Sunflower and not to alleged allelophatic effect.

Key words: Cassava/Sunflower intercrop

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Root Productivity of Yellow Root Cassava Clones (*Manihot esculenta Crantz*)

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Abstract

Root yield and dry matter content in cassava (*Manihot esculenta Crantz*) are important selection criteria as these are primary factors in acceptability to consumers. The objective of this study was to examine genetic variation for storage root yield of yellow root cassava clones with enhanced proVitamin A content.

Twelve yellow root cassava clones along with two checks (IITA TMS I30572 and IITA TMS I 011371) were evaluated at the uniform yield trial (UYT) stage at three locations representing major cassava agroecological zones: Ibadan (Derived savanna), Mokwa (Northern Guinea Savanna) and Zaria (Northern Guinea Savanna). The experimental design was a randomized complete-block with four replications.

Genetic and environmental variations were observed for all traits. Genotype by environment interactions were highly significant for harvest index, plant height, petiole length and dry matter content. Clone IITA TMS I061673 had highest storage root yield while TMS I061404 and TMS I061640 exhibited high harvest index and dry matter content across all locations. Dry yield, harvest index and dry matter content per were highest in Ibadan while storage root yield was highest in Mokwa. Correlations were significant between dry yield and other traits: fresh yield (0.86), harvest index (0.47), dry matter content (0.46) and plant height (0.49).

Clones were characterized for other important agronomics traits including total carotenoid content of roots, angle and height at first branching, leaf retention,root taste and root shape.

Key words: Pro-Vitamin A cassava, storage root yield, genotype by environment interaction

Combining ability analysis of cassava for resistance to cassava mosaic disease

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Abstract

Despite the importance of cassava as a staple crop in Luapula province and other regions of Zambia, there is a paucity of information on the resistance to diseases and associated combining ability of the locally cultivated cassava cultivars. Therefore, this study was carried out to: i) identify progeny with resistance to cassava mosaic disease (CMD); ii) evaluate the performance of F_1 progeny for agronomic traits; and iii) determine general and specific combining abilities (GCA and SCA) for resistance to CMD. A total of 809 genotypes comprising parents and progeny were evaluated using a 4 x 5 α-lattice design. There were highly significant differences among the F_1 crosses for CMD, fresh root yield, root size, plant height, total fresh biomass and harvest index. The GCA and SCA mean squares (MS) were highly significant ($P<0.001$) for CMD. The sum of squares (SS) for CMD was mainly accounted for by SCA effects (67.9%). For most of the traits GCA MS were significant, while SCA MS for fresh root yield, harvest index, total fresh biomass and root size were not. Significant GCA MS were recorded more for the female parents than for the male parents in most of the traits. No correlation was observed between CMD and all the traits studied. All other correlations among the various traits were positive and significant. In summary the results indicated that the local landraces used as parents may be used as sources of CMD resistance.

Key words: Cassava mosaic disease, general combining ability, specific combining ability