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In this issue

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Editorial

*Mus*Africa is taking on board new partners

In its first incarnation, *Mus*Africa was produced by IITA with the aim of serving *Musa* scientists across sub-Saharan Africa. The aim of the newsletter you have in your hands has not changed, only the people behind it. CARBAP and INIBAP have joined forces with IITA to reflect the whole range of research being carried out in Africa on this important crop and to avoid duplication of efforts.

The three organizations are similarly dedicated to helping farmers make a better living by conducting or coordinating research and outreach activities on diverse aspects of banana production. They are also working together on projects such as germplasm improvement and evaluation. In addition, IITA is an active member of the *MUSA*CO regional network for Central and West Africa and the BARNESA regional network for Eastern and Southern Africa, for which INIBAP provides the coordinators and secretariats. Being located in West Africa, CARBAP is an active member of *MUSA*CO.

Adding to the existing knowledge on *Musa* and disseminating it is at the core of these organisations' mission, hence their decision to pool their resources to make *Mus*Africa an indispensable source of information for anyone interested in bananas and plantains. Finally, *Mus*Africa will also be published in French thanks to CARBAP.

We hope you enjoy this first issue and that many of you will contribute articles to future issues, which will continue to appear twice a year.

Short communications

Assessment of rooting depth in banana (*Musa* spp.) under two cropping systems

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Introduction

The root system of plantains and bananas consists mainly of laterally spreading shallow roots, with a limited number growing downward (Simmonds 1966). Their distribution is, among others, related to the physical properties of the soil (Irizarry ***et al***. 1981). For example, increased soil porosity will enhance banana root growth (Delvaux & Guyot 1989). Soil structure and porosity are enhanced under mulch (Salau ***et al.*** 1992) and may thus affect ***Musa*** root distribution. The objective of this study was to assess the effect of mulching on the rooting depth of different ***Musa*** spp. genotypes.

Materials and methods

This study was carried out at the IITA High Rainfall station at Onne in southeastern Nigeria. This station represents the humid forest ecological zone (Ortiz e***t al.*** 1997). The average annual rainfall and potential evapotranspiration at Onne station are 2460 mm and 1240 mm, respectively. Rainfall is distributed monomodally from February until November. The relative humidity remains high throughout the year, with average values ranging from 66% in January to 80% or more between July and October. On average, there are only 4 h of direct sunlight each day. The range is from 2 h·per day in September to 6 h in February. The soil at Onne station is an Acrisol (FAO ***et al. 1***998) derived from coastal sediments, poor in nutrients and highly acidic (pH of 3.5-4.5 in 1:1 H_2O). This soil is characterized by an increase in clay content with depth. It has a low effective cation exchange capacity and a low base saturation, but high extractable P, arising from marine depositional influences.

Table 1. Rooting depth of *Musa* spp. genotypes in mulched (M) and unmulched (U) fields at Onne. Mean (n=3) and standard error.

Genotype	0-15		15-30		>30		MDepth	
	M	U	M	U	M	U	M	U
Calcutta4	40±1	90±2	36±4	7±2	24±3	3±1	63±4	75±6
Valery	34±8	76±1	47±7	20±2	19±0.5	4±3	73±2	46±13
Yangambi km5	53±5	72±2	27±2	23±2	20±6	5±0	73±11	43±2
Agbagba	59±2	77±6	29±1	16±3	12±2	6±3	59±5	65±9
Cardaba	66±8	53±5	22±8	34±2	13±0.1	13±4	52±2	51±2

0-15: percentage of cord roots in the 0 cm to 15 cm soil layer, 15-30: percentage of cord roots in the 15 cm to 30 cm soil layer, >30: percentage of cord roots below 30 cm depth, MDepth: maximum depth at which roots were found (cm)

Five genotypes were assessed in this study: the diploid banana 'Calcutta 4' (AA), the dessert bananas 'Valery' and 'Yangambi km5' (AAA), the plantain 'Agbagba' (AAB) and the cooking banana 'Cardaba' (ABB).

Suckers were used as planting material and were pared before planting. The size of the planting hole was 30 x 30 x 30 cm. Field grown plants were assessed during the late vegetative phase in sole crop conditions (with no mulch applied) and in mulched fields. The mulch (twigs and leaves) was obtained from multispecies (shrubs / trees) alleys, which were growing at a distance of 1.5 m from the banana plants. The multispecies alleys were pruned every two months and 0.5 tonne of dry mulch / ha was obtained after each pruning.

The spacing of the banana plants was 3 m x 3 m. Three plants were evaluated per genotype and per cropping system. These three plants were randomly taken from plants growing in a completely randomized design.

The experimental area was treated with the nematicide Nemacur (fenamiphos) at a rate of 15 g / plant (3 treatments / year). Fertilization was done with muriate of potassium (K_20, 60% K) at a rate of 600 g / plant^{-1} year^{-1}, and urea (47% N) at a rate of 300 g plant^{-1} year^{-1}, split over 6 equal applications during the rainy season, from March until November. The fungicide Bayfidan (triadimenol) was applied three times a year at a rate of 3.6 ml / plant to control black leaf streak disease (caused by ***Mycosphaerella fijiensis*** Morelet). Density was maintained at 3 plants / mat. Weeding was done as needed.

A trench was dug 25 cm from the main pseudostem in line with the axial sucker, uncovering the root profile. The trench was 60 cm wide, 250 cm long and 100 cm deep. The distribution of

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adventitious roots (i.e. cord roots) was assessed in three distinct layers: from 0 to 15 cm, 15 to 30 cm and deeper than 30 cm. To facilitate the assessment, a plastic sheet was held against the wall of the trench and the presence of cord roots was marked on the sheet. The number of cord roots per soil layer could then easily be counted on the plastic sheet.

Results and discussion

In general cord roots did not grow deeper than 90 cm, while the majority of cord roots were found in the 0 cm to 30 cm soil layer (Table 1). The genotypes 'Calcutta 4', 'Valery', 'Yangambi km5' and 'Agbagba' developed deeper roots under mulched conditions compared to sole crop conditions (Table 1). This may be related to the higher organic matter content and more favourable soil structure at greater depth under mulched conditions (Kang ***et al.*** 1990). In contrast, the cooking banana 'Cardaba' did not develop a deeper root system under mulched conditions, indicating that the rooting pattern may be genotype specific.

Banana roots are predominantly found where the organic matter content is high. For example, when thick layers of mulch (e.g. elephant grass) are applied, some roots tend to grow at the soil surface (just under the mulch) and even come out of the soil to grow in the mulch. Mulch obtained from multispecies alleys is however not very thick and may not always cover the whole soil surface.

Mulching increases the soil organic matter content, not only at the surface, but also at deeper soil levels. Hence, roots will not only grow near the soil surface but, as shown in this study, also at deeper soil levels. This increased rooting depth under mulched conditions, as observed in the majority of genotypes tested, may positively enhance plant anchorage and thus reduce the incidence of toppling.

Baiyeri ***et al.*** (1999) reported higher yields for plants growing between multispecies alleys, which may have been linked to a deeper rooting system as observed in this study.

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Relationship between plant growth characteristics and bunch weight in plantain (*Musa* spp. AAB genome)

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Introduction

Root growth affects nutrient supply and thus subsequently plant growth and yield. Obviously, root growth is then positively correlated with yield. This was observed in dessert banana (Lassoudière 1978, Robinson 1996). However, a detailed study has not been undertaken for plantains (***Musa*** AAB). Therefore, the objective of this preliminary study was to fill this gap, but also to look at relationships between shoot traits and bunch weight.

Materials and methods

This study was carried out at the IITA High Rainfall station at Onne in southeastern Nigeria. Its soil is an ultisol derived from coastal sediments, well drained but poor in nutrients and with a pH lower than 4 in 1:1 H_2O. The average annual rainfall is 2400 mm distributed monomodally from February until November. Details of the site have been

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described by Ortiz ***et al***. (1997). Twelve plants of the small French plantain 'Mbi Egome' (AAB genome) (Swennen 1990) were assessed. The trial site had been under fallow of ***Mucuna pruriens*** DC. and ***Pueraria phaseoloides (Roxb.) Benth.*** for 5 years. The field was manually prepared. Suckers were obtained on station and pared prior to planting. Planting was done in July 1997. The field layout was a completely randomized design. Plant spacing was 3.5 m x 3.5 m to avoid overlapping of adjacent root systems.

The plants were grown under a monocropping system and no mulch was applied. Routine field maintenance practices were carried out. In addition, plants were irrigated during the dry season at a rate of 100 mm per month.

The plants were completely excavated at harvest. The excavation of the complete root system was started by digging a small trench at about 2 meters from the pseudostem. As roots can reach up to 3 meters, a garden fork was used for careful removal of the soil. A trench was dug a little deeper than the deepest roots, i.e. 50 cm deep, followed by a small cave under the roots. The upper soil layers were then gradually removed with a garden fork or by hand. First a 45° section of the root system was dug out. This facilitated the removal of the root system in the remaining 315° soil area. The excavation was carefully done to avoid breakage of the roots. Roots were washed on a large sieve to facilitate the removal of all soil particles. Then the suckers were separated from the mother corm to facilitate the assessment.

Various parameters were assessed. Growth data measured on each plant included plant height (from ground level to the point where the petioles of the last two leaves meet), pseudostem circumference at soil level and length of the tallest sucker. In addition, leaf area was calculated as: length x width x 0.8 (Obiefuna & Ndubizu 1979). Corm fresh weight was measured. Root characteristics included the number of adventitious roots (cord roots) and root dry weight. Cord root length was measured using the line intersect method (Tennant 1975). The line intersect method consists of scattering cord roots on a grid and counting the number of root-gridline interaction points. The number of interaction points were then multiplied by the conversion factor 2.3571 appropriate for the 3 cm by 3 cm grid used. Other root system characteristics were total root dry weight of the mat (i.e. mother plant and suckers) and total cord root length of the mat.

Results and discussion

At harvest, bunch weight was recorded and shoot, corm and root parameters measured. There was considerable variation in root, shoot and bunch development (Table 1). The average bunch weight was 4.5 kg and much lower than previously observed for this genotype at Onne (Swennen & Vuylsteke 1987), perhaps due to poor soil fertility.

There was a significant positive correlation between plant height and bunch weight (Table 1), as already reported by Swennen and De Langhe (1985) for 'Agbagba', a medium-sized false horn plantain.

However, the low r^2 value (0.34) indicates that only a small percentage of the variability in bunch weight could be explained by plant height.

In this study, the fresh corm weight was positively correlated with bunch weight. This is explained by the presence in the corm of starchy parenchyma containing numerous vascular bundles responsible for transporting water and nutrients to the pseudostem, leaves and developing bunch (Skutch 1932). The corm is also an important storage organ for sustaining growth of the bunch and the developing suckers (Robinson 1996).

Banana roots determine the water and nutrient uptake potential (Robinson 1996). In this study, the number and length of cord roots of the mother plant were positively correlated with bunch weight, indicating that a large root system may result in a high yield. Similar positive correlations between root traits and bunch weight were observed for dessert bananas by Lassoudière (1978) and Robinson (1996).

Cord root length of the mat was positively correlated with bunch weight, indicating that suckers may not only be sinks but could at a certain developmental stage contribute to shoot and bunch development. These results are in accordance with ^{32}P translocation studies by Walmsley & Twyford (1968) and Shanmugavelu ***et al***. (1992), which indicate that suckers also transfer nutrients to the plant. Similarly, Teisson (1970) reported that the sucker could contribute to the nutrition of the mother plant. Hence, the maiden suckers observed at flower emergence in this study are not only important for the next ratoon crop but also for the main plant from which they originate.

Table 1. Correlation coefficients for plant characteristics of the plantain 'Mbi Egome'

	BW (kg)	PH (cm)	PC (cm)	CW (g)	NR	LR (cm)	DR (g)	TL (cm)	TD (g)	HS (cm)
BW	1	0.58*	0.42	0.71*	0.65*	0.69*	0.54	0.73**	0.56	0.41
Mean	4.5	227	48	4434	179	3284	127	12 225	478	207
CV (%)	48	10	8	23	39	49	59	41	43	29

BW: bunch weight, PH: plant height, PC: pseudostem circumference, CW: corm fresh weight, NR: number of cord roots, LR: cord root length, DR: root dry weight, TL: cord root length of the mat, TD: root dry weight of the mat, HS: height of the tallest sucker.
*, ** Significant at P<0.05 and 0.01 respectively.

In conclusion, good underground growth of the root system and corm is essential for high yield especially in combination with good suckering.

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Shoot and root growth of attached and independent suckers in banana

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Banana and plantain are perennial crops that reproduce through the sequential development of lateral shoots called suckers. There are four types of suckers: peeper (small sucker appearing just above the ground and bearing scale leaves only), sword sucker (large sucker with lanceolate leaves and a broad corm base), maiden sucker (large non-fruiting sucker with foliage leaves) and water sucker (small sucker with foliage leaves, which has a non-existent or weak connection with the mother plant corm due to biotic or abiotic factors.). The first three stages of sucker growth are related to plant age. With the exception of water suckers, all other suckers have a strong vascular connection with the mother plant. Sucker growth initially depends on the supply of nutrients, water and photo-synthesis products from the mother plant. Suckers become increasingly independent as they develop broad foliage leaves (Eckstein ***et al***. 1995, Shanmugavelu ***et al.*** 1992). The relationship between increasing independence and leaf type can be illustrated by the water suckers, which develop foliage leaves, even when they are the same height as peepers or small sword suckers, in an attempt to compensate for the lack of parental support (Robinson 1996).

Sucker planting material consists of a corm (i.e. true stem) and the basal part of the leaf sheets (Swennen 1990). Suckers separated from the mother plant can no longer depend on the latter and will therefore invest in leaf growth (i.e. foliage leaves) and the development of a root system. Sucker-derived plants will form broad leaves even when the planting material is of the peeper or sword sucker type. No detailed knowledge is available on the development of the root system for attached lateral shoots and sucker-derived

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plants of similar height. Therefore, the objective of this study was to compare root characteristics of lateral shoots attached to the mother plant and sucker-derived plants of similar height.

Materials and methods

This study was carried out at the IITA Onne High Rainfall station. Its soil is an Ultisol derived from coastal sediments, well drained but poor in nutrients and with a pH of 4.3 in 1:1 H_2O. The average annual rainfall is 2400 mm (Ortiz ***et al.*** ***1***997). Six genotypes were assessed in this study: the plantains 'Agbagba' and 'Obino l'ewai' (AAB), the cooking banana 'Cardaba' (ABB), the tetraploid plantain hybrids TMPx 548-9 and TMPx 1658-4 (AAAB) and the tetraploid cooking banana FHIA-03. The material assessed were lateral shoots attached to an ***in vitro***-derived mother plant or a sucker-derived mother plant. Suckers were pared before planting. Lateral shoots were assessed at flower emergence on both ***in vitro*** and sucker-derived mother plants. In addition, sucker-derived mother plants were assessed during the early vegetative stage. Sucker and ***in vitro***-derived mother plants were grown in adjacent fields. The data were extracted from plants growing in a randomized complete block design. The trial sites, which had been under grass fallow for 8 year were manually prepared with minimum soil disturbance. The plants were grown under a monocropping system and no mulch was applied. The experimental area was treated with the nematicide Nemacur (a.i. fenamiphos) at a rate of 15 g / plant (3 treatments per year) to reduce the nematode infestation. Fertilization was done with muriate of potassium (a.i. K_20, 60% K) at a rate of 600 g plant^{-1} year^{-1}, and Urea (47% N) at a rate of 300 g plant^{-1} year^{-1}, split over 6 equal applications during the rainy season, i.e. March until November. The fungicide Bayfidan (triadimenol) was applied at a rate of 3.6 ml / plant (3 treatments per year) to control black leaf streak disease (***Mycosphaerella fijiensis*** Morelet).

The lateral shoots and sucker-derived mother plants were completely excavated and aerial, corm and root characteristics were assessed. Leaf blade area was calculated as: leaf blade length x leaf blade widest width x 0.8 (Obiefuna & Ndubizu 1979). In addition, plant height and corm fresh weight were assessed. Root characteristics included the number of adventitious roots (cord roots), root dry weight. The cord root length was measured using the line intersect method (Newman 1966, Tennant 1975). The line intersect method consists of scattering cord roots on a grid and counting the number of root-gridline interaction points. The number of points were then multiplied by the conversion factor 2.3571 appropriate for the 3 cm by 3 cm grid used.

Results and discussion

Lateral shoots were compared individually with sucker-derived plants of similar height because of a lack of plants of similar height to form groups. The sucker-derived plants had a larger leaf area and in most cases a larger root system size compared to lateral shoots of similar height (Table 1).

All lateral shoots were left to develop. Hence, the soil volume that a given lateral shoot could explore was restricted by the roots and corms of the mother plant and the other lateral shoots. This competition for space, nutrients and water may have restricted the development of the suckers' root system. In addition, lateral shoots depend strongly on the mother plant for photosynthetic products, nutrients and water. Consequently, the peeper and sword sucker stages do not need a large root system or leaf area to sustain their growth.

In contrast, sucker-derived plants no longer depend on the mother plant for nutrients and photosynthetic products and need to invest in their own root and leaf systems. There may have been increased activity in the cambium layer of the independent suckers.

In conclusion, young sucker-derived plants invest in leaf development and root growth in order to obtain photosynthetic products, nutrients and water to assure a vigorous overall plant development.

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Table 1. Characteristics of attached lateral shoots and sucker-derived plants of similar height.

Genotype	Type of sucker*	LA (cm^2)	PH (cm)	CW (g)	DR (g)	NR	LR (cm)
Agbagba	IV	369	83	2123	67	64	1888
	SD	3741	92	1820	25	41	808
	Independent	28434	85	1863	48	128	2831
	SD	701	63	1034	15	51	361
	Independent	12850	58	998	40	94	1450
Obino l'ewai	IV	285	87	1093	34	54	1136
	Independent	19789	78	1678	58	93	2963
Cardaba	IV	25867	139	2948	119	145	2619
	SD	27000	128	1256	118	72	2225
	Independent	30347	120	3236	179	106	5641
TMPx 548-9	IV	13469	115	1435	52	99	1952
	SD	16374	119	1606	80	82	2341
	Independent	38658	117	4130	122	167	4992
TMPx 1658-4	IV	3561	88	1038	19	47	431
	Independent	21346	86	1403	52	90	1862
TMPx 1658-4	SD	4636	135	3614	130	88	3804
	Independent	66461	145	3811	217	203	7104
FHIA-03	SD	35	61	1804	6	42	377
	Independent	17899	63	2323	76	101	2296

*IV: lateral shoot of an *in vitro*-derived mother plant, SD: lateral shoot of a sucker-derived mother plant, Independent: sucker-derived plant.
L A: leaf area, PH: plant height, CW: corm fresh weight, DR: root dry weight, NR: number of cord roots, LR: cord root length.

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Characterization of factors limiting plantain production by smallholders

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In Cameroon, plantain is a widely cultivated crop that plays a major role in the local diet. However, production will have to increase to satisfy the demands of a growing population. Since April 2002, CARBAP is supporting a multi-disciplinary project to survey plantain production in smallholder plots. The main objective is to identify production constraints and characterize commercialization strategies in order to improve the revenues of small-scale farmers. The region under study in southwest Cameroon is supplying Douala with plantain.

Eighteen plots have been selected on farms that represent the existing environmental and socio-economic diversity of the region. The plot is the sampling unit for the analysis of agronomic and pathogenic constraints, whereas the farm is the sampling unit for the analysis of socio-economic constraints. The selection of plots and farms was based on the results of rapid rural appraisals. Plots were selected on the basis of their agro-ecological characteristics and the cropping system (monocropping or intercropping with food or cash crops).

In each plot, the agronomic practices are regularly surveyed as well as 50 banana plants. Each farm is also surveyed to observe production conditions (labour, economic outputs, etc.) thanks to the participation of smallholders.

The first year of data revealed a variety of situations on smallholder farms. The income generated by plantain complements the income from other food crops or cash crop, is equal to the income from all the other food crops, is the only source of revenues besides a salaried job or is the only source of income.

Growth, yield and pest infestation parameters are used to evaluate the efficiency of the cultural practices used by smallholders. Four types of situations have been identified: good performance on old plantations, good performance on recent plantations, bad performance on old plantations and good performance on recent plantations. The type of situation seems to be related to initial factors (varieties available for planting, sanitary status of planting material, previous crops in the plot), available inputs and knowledge of production techniques.

The project makes it possible to characterize the cultural practices, evaluate the sustainability of these strategies and propose improved practices. It can be used for further local studies aimed at improving plantain production and commercialization.

Rational use of chemicals to control black leaf streak disease in Cameroon: elaboration of a bioclimatic forecasting system

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The objective of this study conducted by CARBAP is to improve the biological forecasting system used to reduce the number of fungicide applications as part of a control strategy against black leaf streak disease. Used in commercial plantations of dessert bananas, this technique helps not only to reduce the cost of treatments, but also their impact on the environment. The current forecasting system is based on the weekly observation of biological indicators related to the development of the disease and the sanitary status of the plants in a plot. It is, however, a relatively labour intensive and logistically complicated system and as such cannot be used in smallholdings or semi-intensive plantations.

New biological and climatic indicators are being sought to improve decision-making. Treating with fungicides before symptoms have appeared should reduce the number of treatments. Moreover, simplifying the methodology would allow farmers with small or medium size holdings to adopt it and increase their yields.

A trial in a one-hectare plantain plot that will cover three production cycles was set up on a CARBAP site in Nyombe in October 2002. It should confirm the preliminary results obtained during the first phase of the project:

- The decision to treat should take into consideration the cumulated evaporation over the previous three-week period and the cumulated duration of rainfall, parameters that were associated with positive results in another epidemiological context (Costa-Rica).
- The development of a simplified forecasting system for the culture of plantain that is based on one easy to evaluate biological parameter.

The results should be available at the end of 2003.

Thesis

Genetic characterization of cultivated bananas and plantains *(Musa* spp.*)* in Kenya

M.Sc. Thesis submitted at Kenyatta University, Nairobi, Kenya.

Justus M. Onguso

Bananas and plantains ***(Musa*** spp***.)*** are a major staple food for millions of people in the tropical world. World banana production has been estimated at 80.6 million tonnes of which only 15% is exported. The dessert banana is a major export crop of the Caribbean countries where the Cavendish bananas account for 10% of the world’s production of bananas and plantains. In the East African highlands, the annual ***per capita*** consumption is about 300 kilogrammes, the highest consumption figure in the world.

In Kenya, banana and plantain nomenclature is in great confusion. This is because different communities refer to the local cultivars by different names. The conventional method of describing ***Musa*** germplasm is based on 15 morphological traits identified by Simmonds and Shepherd. Field-testing requires elaborate experimentation and one or two years for the plant to flower and fruit. However, the subjective nature of the scoring process makes it prone to error. Environmental effects on gene expression makes direct comparison of clones growing in different locations impossible.

Cytoplasmic genetic effects on morphology may be an additional factor contributing to ambiguities encountered in the results of key-derived genomic classification. The extent to which cytoplasmic genetic effects confound efforts to differentiate clones based upon their morphological characteristics, especially within the hybrid group AB, ABB and AAB, has not been systematically examined.

Due to the subjective nature of Simmonds and Shepherd's classification, scientists are now complementing this classification with molecular techniques to characterize ***Musa*** groups. In this study, a polymerase chain reaction (PCR)-based approach, namely, random amplified polymorphic DNA (RAPD) was used to estimate the genetic relationships of 20 selected banana cultivars from different regions of Kenya. Nineteen random primers were used. The polymorphism in PCR amplification products were scored as discrete variables. The data were used to calculate Jaccard's Similarity coefficients. The similarity measures were subjected to Unweighted Pair Group Method Analysis (UPGMA) for classification of the cultivars.

Phenetic analysis separated the 20 cultivars into three clusters. The first cluster consisted of 'Ng'ombe', 'Nusu Ng'ombe', 'Ntobe', 'Sialamule', 'Kimuga', 'Kibuzi', 'Sibusi', 'Bukamba', 'Mfupi' and 'Gitigi'. They were of the genome AAA. The second cluster had 'Manyatta', 'Mokoya', 'Murure', and Horn plantain whose genome was AAB. The third cluster consisted of 'Pekera', 'Muraru', 'Spambia', 'Matumbo', 'Nyar Sausett' and 'Mtama' with the genome AA. The cultivars that clustered together were thought to be similar and distinctly different from those that clustered far away from them. The study revealed that RAPD analysis is useful for clonal identification. This is very important for researchers who do ***Musa*** germplasm classification and management.

News

The revised strategy for BARNESA (2001-2005)

In 1998, the EU group of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA-EU) contracted the European Consortium for Agricultural Research in the Tropics (ECART) to review ASARECA networks, programmes and projects. BARNESA was classified as an emerging network by the evaluation team. It was recommended that support should be given to enable its preparation as a regional network before embarking on major research programmes involving the re-alignment through wide consultation of the BARNESA strategy to comply with ASARECA's market-oriented focus.

The goal and purpose of BARNESA

The strategic objective (purpose) of ASARECA is "to promote regional economic growth by developing, introducing and disseminating agricultural technologies which both create markets and respond to prevailing and future economic opportunities for new technologies as well as maintaining the long-term sustainability of the agricultural resource base". Responding to the need to align their activities with this objective, BARNESA revised the focus of its strategy to accommodate the following goal and objectives:

The Super Goal of BARNESA

In line with the overall goal of ASARECA, the super goal of BARNESA is to enable ***"Increased contribution of bananas to food security and economic growth within ECA".***

The Goal of BARNESA

The specific goal that aligns BARNESA to the purpose of ASARECA will therefore be "***To contribute to increased and sustainable agricultural productivity in the region***".

The Purpose of BARNESA

BARNESA's purpose is to ensure "Appropriate market-oriented banana and banana products technologies adopted and utilized."

Strategic outputs

The purpose of BARNESA will be achieved through the following strategic objectives:

Output 1: BARNESA consolidated as a regional network in ECA region

In response to the ASARECA/ECART report, the BARNESA Steering Committee, with the support of INIBAP, held a meeting in Zanzibar (21-24 February 2001) to discuss the ECART report and to draw up work plans and a budget for Year I. The Committee agreed with the recommendations of the ASARECA Committee of Directors and decided to set up a select committee, composed of:

- marketing economist/consultants,
- a person familiar with ASARECA strategy,
- donor representatives (EU/USAID),
- BARNESA chair and coordinator, to be elected in collaboration with ASARECA to carry out wide stakeholder consultations and draw up a new draft for BARNESA Strategy, which would be validated by a stakeholder meeting and approved by the

ASARECA Committee of Directors.

Output 2: The establishment of a sustainable commercialized banana sector in ECA facilitated

The focus of this objective will be to document and analyse the existing and potential production and market opportunities for bananas and banana products in the region, taking into consideration the changes that have occurred in the recent past. These changes include economic restructuring at national and regional levels, trade liberalization, and formation of economic blocks such as Common Market for Eastern and Southern Africa (COMESA) and the East African Community. The diverse roles of development organizations such as non-governmental organizations (NGOs) and community-based organizations (CBOs), women groups, etc., will also be documented. Analysis of market opportunities will include assessment of the impact of demographic trends such as population growth and structure and urbanization on banana consumption. Experience with commercial banana farming in countries such as South Africa will be used in laying down strategies for market-oriented banana production in the region.

In most areas, the fruit is the main product of banana farming. The banana plant is therefore not tampered with, but is instead nourished to enhance fruit growth and development. Banana is also a major staple in the region where it is cooked (Uganda, Kenya, Tanzania, Rwanda, Burundi and DRC). The fruit is used as a dessert in all BARNESA countries, but commercial production and marketing of this product has only taken root in a few of them (Kenya, South Africa, Somalia and Mozambique). Since both table and cooking bananas depend largely on urban markets, understanding urban consumer requirements will be pivotal to market-oriented production of the crop. The roasting banana market is based on AAB (plantains) and ABB type bananas and is, at the moment, targeting long-distance road travellers. Another emerging market is processed products (chips, crisps, figs, juice blends, liquor) and flour products (cake, bread and biscuits). Processed products probably constitute the single most important but yet to be exploited aspect of commercial banana production and marketing.

Market opportunities for the vegetative parts of the banana plant are very limited. In some regions where bananas are cooked, leaves are harvested green and sold for wrapping peeled bananas in cooking. In areas of extreme land shortage, banana pseudostems are used as animal fodder. Probably the most commercially promising use of the pseudostem is fibre production, which is the foundation for a fast-growing handicraft industry in all banana-growing countries of the region.

Output 3: Dissemination of sustainable production and post-harvest technologies that address end-users' needs

A number of biotic and abiotic factors critically limit the quality and quantity of the marketable banana products in the region. These include factors that reduce the quality and quantity of planting materials; those that reduce the plant's ability to absorb and utilize nutrients and / or manufacture its food; and others that do not favour the plant's ability to maintain optimum production capacity. Technologies will be developed that will facilitate efficient production of clean, vigorous planting materials. Technological solutions will also be sought to reduce losses due to weevils, nematodes, black leaf streak disease, Fusarium wilt, and a host of viral diseases that affect the crop in the region. Availability of high quality planting materials is a crucial factor in market-oriented production of bananas in the region. A number of private companies (e.g. Genetic Technologies Limited in Kenya and Du Roi in South Africa) are already selling planting materials in the form of tissue culture plants. In other countries (e.g. Uganda), there are government laboratories providing tissue-cultured banana plants for sale at subsidized prices. NGOs and CBOs are also teaching farmers how to clean up infested / infected planting materials.

The aim of this objective is to promote regional collaboration as a means of enhancing cost efficiency in identifying and addressing the priority constraints to banana production, marketing and utilization within the region. As part of this objective, BARNESA will also catalyze and support research on critical gaps in the banana commodity chain that are identified as a priority at the regional level.

Output 4: NARS capacity and linkages with research and development partners strengthened

In the absence, for many years, of a specific focus on banana production by the regional NARS, there are few scientists and other professionals and technicians who are specifically trained in banana research methodologies and production / processing technologies. BARNESA will therefore work with the NARS to build up this capacity through regional training courses and, where feasible, by exchange visits and attachment of personnel to commercial production, processing and marketing institutions within and outside the region.

Output 5: Banana R&D in ECA region effectively coordinated

This objective will be fulfilled through an efficient Coordinating Secretariat and Steering Committee. Members of the Steering Committee will guide the national teams and represent the teams at regional planning meetings. The Secretariat will organize biennial meetings of stakeholders to review progress and suggest new regional initiatives. The Secretariat will also play a key role in establishing and maintaining linkages with other networks and institutions, and will publish a regular newsletter to keep the stakeholders informed of new developments in the banana industry within and outside the region. A primary responsibility of the network coordinator will be to spearhead design and implementation of a comprehensive survey of banana production and marketing policies and practices in the region, to provide a central facility for analysis of information and the dissemination of findings to stakeholders.

At the national level BARNESA will encourage and assist, where necessary, the respective NARS to put in place or strengthen a national banana research and development coordination facility. This may take the form of a National Banana Development Committee, which would include representatives of research and extension services, farmers and women organizations, processors, transport / marketing associations, the private sector, NGOs, university researchers, and planning officials in Government Ministries. The role of such committees would be to develop national banana research priorities, some of which may be recommended to BARNESA for addressing at a regional level. A number of such national banana committees already exist in the region. The BARNESA Steering Committee will try to assist the NARS in setting up such committees where they are not yet in place and to strengthen the weak ones. The key objective here is to ensure participation and ownership of the banana research and development agenda by all stakeholders. The national committees will be encouraged and facilitated to participate in the BARNESA Steering Committee.

At the regional level, membership of the Steering Committee will be broadened to include representatives of stakeholders in the private sector such as commercial farming, industrial processing and marketing. Linkages will be developed with NGOs, CBOs and government institutions associated with policy-making and technology transfer, and with ARIs for access to genetic materials and technologies.

Within the family of ASARECA networks and programmes, BARNESA will collaborate with:

- ECAPAPA on socio-economic and policy related research issues;
- FOODNET (an ASARECA postharvest network funded by USAID) on product development;
- African Highland Initiative (AHI), Agroforestry Research Networks for Africa (AFRENA) and Soil and Water Management Network (SWMNET) on natural resource management;
- Eastern African Plant Genetic Resources Network (EAPGREN) on genetic resources; and with
- East and Central Africa Bean Research Network (ECABREN) and ASARECA-Animal Agriculture Research Network (A-AARNET) on baseline surveys and capacity building activities.

Principles of implementation

In fulfilling the above objectives, BARNESA will be guided by the following principles:

- Within the concept of a global approach to banana research and development, including crop management technologies that enhance sustainability of the natural resource base, BARNESA will concentrate its efforts on the critical areas that are most likely to catalyze change.
- Emphasis will be placed on products that create markets or respond to existing market needs.
- Congruence of regional activities to national priorities will be ensured.
- Participation of all stakeholders will be sought in the planning

and execution of activities at the local level.

- Gender issues will be taken into account in all activities of the network.

  Women constitute the main labour force in banana-based production systems and in the majority of cases provide critical management that sustains the staple food sector. Nevertheless, women and children remain severely disadvantaged with regard to access to information, technology and cash income. The special needs of such disadvantaged groups will be specifically addressed in all aspects of project implementation.

- The execution of the agreed research agenda with due considerations to stated milestones, outputs and measurable indicators will be timely.

Report of the workshop on conservation through utilization of banana and plantain in the Great Lakes region of East Africa.

22-26 July 2002, Kampala, Uganda

Background

The project "***Conservation through utilization of banana and plantain in the Great Lakes region of East Africa***" was conceived to establish the status of ***Musa*** biodiversity in the region and to obtain information on where, what and how germplasm was being conserved. The project also aimed to identify the factors influencing genetic diversity, its erosion and the erosion management strategies being used by the communities. A key hypothesis of the project is that communities will conserve ***Musa*** biodiversity if they have use for it, making utilization of biodiversity an integral component of an on-farm biodiversity conservation strategy.

Studies were initiated in May 1999 beginning with a series of planning / consultation meetings at the regional, country and site levels that culminated in a planning workshop at which implementation plans for the project were drawn up. At the end of the 3-year project period, functional benchmark sites had been established with community-based management structures and grass-root platforms to advocate for sustainable ***Musa*** biodiversity conservation and utilization. The socio-economic and ethno-botanical issues as they affect ***Musa*** biodiversity conservation had been analysed, genetic erosion factors identified and tentative strategies and options for addressing them put in place. A workshop was convened to review project activities and achievements, and formulate strategies for enhancing ***Musa*** biodiversity conservation and utilization in future.

Objectives of the workshop

As a result of the studies carried out, and in order to provide an opportunity to the wider stakeholder spectrum to discuss the project, a workshop was organized to:

- Review research on ***Musa*** on-farm conservation and utilization in the Great Lakes region and identify and prioritize information and technology gaps, options and opportunities for carrying forward ***Musa*** biodiversity conservation strategies in the region;
- Strengthen linkages and partnerships for ***Musa*** biodiversity conservation and utilization as a basis for mobilizing resources (human and financial) and broadening ownership of the project;
- Develop the conceptual framework for the next project phase.

Workshop sessions

The workshop was divided in six sessions, the first one being the opening of the workshop whereas the others were technical sessions.

Session 1. Opening ceremony

The meeting was opened by Dr. John Aluma, the Deputy Director General (Research) who represented Professor J.K. Mukiibi, Director General NARO-Uganda. Dr. Aluma welcomed the participants to Uganda and pledged Uganda's continued support for banana research, highlighting the importance of integrated systems approach to agricultural research. He thanked the IDRC (International Development Research Centre*)* for their financial support and requested more support to carry forward the project results to a fruitful end. He underscored the key role played by bananas in the livelihoods of the people of the Great Lakes region. Turning to INIBAP, Dr. Aluma appreciated the effective coordination of the project, the mobilization and involvement of grass-root stakeholders and the horizontal linkages / partnerships during the execution of the project.

Dr Emile Frison, then Director of INIBAP, highlighted the importance his organization attaches to banana R&D in Africa. He applauded the support the NARS in Africa have continued to give to INIBAP's work in the region over the last five years, singling out Uganda as an example of an effective INIBAP-Africa partnership. Turning to IDRC, which played a key role in the conception of INIBAP as a networking CGIAR center, Dr Frison expressed deep appreciation for their continued support and particularly for funding the project. He also thanked the different organizations present, particularly IITA for their continued support and collaboration.

Looking back to September 2001, he acknowledged the welcome reception given to the IPGRI Board of Trustees when they visited the project sites in Uganda. He noted that the enthusiasm with which the project was received and executed by the communities themselves and the spontaneous formation of banana conservation associations in both Uganda and Tanzania to enhance project objectives were all positive developments for Africa-INIBAP partnership.

The workshop was also addressed by Dr Francois Gasengayire of IDRC who highlighted the objectives of the IDRC in general and those of the Sustainable Use of Biodiversity Programme Initiative, in particular. He further elaborated on the on-going activities of IDRC in Africa in general, and East Africa in particular. He noted the large number of benchmark site participants at the workshop, particularly women, as a positive development because the support of the IDRC is for the improvement of the livelihoods of rural communities. He thanked the governments of Uganda and Tanzania for hosting the project and for being effective partners, and INIBAP for coordinating the project effectively. He conveyed greetings from Dr Luis Navarro and Dr Leppan who could not attend the workshop due to other official commitments.

In their address to the workshop, the representatives of the site coordinating committees (Ibwera and Chanika in Tanzania; and Masaka and Bushenyi in Uganda), explained the problems they are facing with respect to banana production and cultivar conservation. They all highlighted the negative implications of the loss of ***Musa*** biodiversity on their livelihoods and concurred on the importance of sustainable utilization of ***Musa*** biodiversity in the quest to address conservation problems. They also elaborated on the objectives of their associations, emphasizing their fragile state and the need to provide them with material and technical support. They thanked their governments, IDRC and INIBAP for the resources in support of banana research in their respective areas and pledged to do all in their powers to support banana R&D in the region.

Session 2. Thematic presentations

The purpose of this session was to provide wide overviews of concepts, prospects and strategies for the management of biodiversity at a global and regional levels for plant biodiversity in general and ***Musa*** biodiversity in particular. Research and development issues in relation to the sustainability of banana-based cropping systems and the livelihoods of communities associated with the systems were discussed. In the issuing discussion, it was observed that any management options for sustainable utilization of ***Musa*** biodiversity will need to take into account gender and related social equity issues as well as genetic erosion control strategies and must be addressed in a bottom-up participatory manner. Strategic options and priorities for on-farm conservation were also discussed. Five papers were presented in this session.

Session 3. *Musa* biodiversity and genetic erosion

The presentations in this session covered aspects of biodiversity and associated genetic erosion factors in the benchmark sites. Presentations also included the agro-ecological, ethno-botanical and socioeconomic analysis of the banana production systems in the sites. It was revealed that over the last decade the diversity of the AAA-EA highland bananas in Uganda has been decreasing. The loss of diversity has been attributed to a number of factors, including selective pest and disease pressures, loss of soil fertility, lack of supportive policies and land shortage.

Despite the importance of the crop in the region, farmers have continued to report the disappearance of some cultivars. The loss of cultivars makes it hard for communities to meet some of their socioeconomic obligations. Furthermore, official policies promoting poverty eradication, sometimes without due consideration for biodiversity conservation, have also encouraged communities to adopt commercial varieties that respond to market demands at the expense of those varieties normally conserved for their socio-cultural values. These policies coupled with land shortage problems have worked against banana diversity conservation and the sustainability of the natural resource base, further threatening the livelihoods of communities.

In terms of ethno-botany, the workshop was told that communities have used banana diversity in numerous different ways to address their livelihood needs. Apart from being a key staple and cash income source, different cultivars are used for the treatment of a host of gastro-intestinal and skin diseases and as stimulants. In addition, different cultivars are used in the performance of socio-cultural ceremonies of birth, death, marriage and peaceful negotiations by communities. The long crop-community interaction, coupled with the resultant evolution of diverse socio-cultural utilization options as well as the rich banana-based indigenous knowledge, may provide a strong foundation on which to base conservation strategies of banana diversity in the region.

The meeting concurred that any effective conservation strategies will need to encompass issues of sustainability of the natural resource base, empowerment of women and children who provide the bulk of family labour, as well as measures to broaden the utilization base of ***Musa*** biodiversity. The need to have a clearer understanding of indigenous knowledge as well as its potential role in biodiversity conservation was underscored in the issuing discussions. The need to strengthen linkages between ***in situ*** and ***ex situ*** genebanks in addition to prospects for establishing community gene-banks in benchmark sites were raised. It was also noted that although the IPM project funded by DFID (Department for International Development) was taking care of the pest / disease aspects of genetic erosion, more effort is needed to scale up the results. Twelve papers were presented in this session.

Session 4. *Musa* biodiversity utilization

The presentations included both on-farm (what the farmers are currently using the diversity for) and on-station research activities. On-farm research reports covered the surveys on ***Musa*** utilization, which is clearly dominated by food security-related options, but also includes aspects of socio-cultural uses. The main problems faced by farmers as revealed in the studies relate to the fact that socio-cultural utilization options, while providing a strong incentive for conservation, have limited commercial prospects. The situation is not helped by land shortages, which force farmers to make very difficult decisions on what they can or cannot conserve.

On-station studies covered qualitative and quantitative analyses of banana and banana products and the prospects for commercialization of ***Musa*** biodiversity. The need for more studies, particularly on those cultivars threatened by genetic erosion was noted. Utilization of ***Musa*** biodiversity was seen as an integral component of sustainable conservation strategies for bananas in the region. It was observed that at the farm level, commercialisation of the crop need not be against conservation but complementary. In this regard, it was recommended that research should be carried out to strengthen the commercial prospects of cultivars threatened by genetic erosion, in order to improve the prospects for conservation. Six papers were presented in this session.

Session 5. Complementary strategies for strengthening *in situ* conservation

The papers presented in this session were based on the conception that ***Musa*** biodiversity conservation is a multi-disciplinary and multi-sectoral challenge that will require addressing from different perspectives, some of which are non-traditional. Thus the work reported here, included biotechnological approaches, conventional breeding strategies and seed multiplication and diffusion options. In the ensuing discussions, the need to have a broad picture of the conservation strategies was underscored. In some cases these approaches may be the only options for addressing / arresting genetic erosion in the shortest time available.

It was thus recommended that current linkages between biodiversity and breeding efforts should be encouraged and strengthened, through joint planning (***e. g.*** in the framework of BARNESA) in the quest to strengthen ***Musa*** biodiversity conservation. Five papers were presented in this session.

Session 6. Working group discussions

The purpose of this session was to develop a conceptual framework for enhancing sustainable on farm conservation and utilization of ***Musa*** biodiversity in Eastern and Southern Africa. The facilitator carried the group through a process of identifying the broad picture emerging from the presentations / discussions.

An array of issues were raised by participants and these were analysed and grouped into five themes: research, indigenous knowledge, technology transfer, market utilization, and institutions and partnerships.

Five working groups were then assigned one theme each to discuss and identify strengths / weaknesses and opportunities / threats before reporting to plenary for comments and agreements. Subsequently, working groups formulated impacts (e.g. change in behaviour of communities) the project should pursue with respect to ***Musa*** biodiversity conservation during the next phase of the project. These recommendations will be incorporated in proposal for the next phase.

Setting up an African *Musa* Information Network

The African ***Musa*** Information Network, a new instrument aimed at facilitating communication and information exchange between ***Musa*** researchers in Africa, is currently being set up by a Regional Information Officer recruited by INIBAP and based at CARBAP.

General objective

The main objective is to contribute to sustainable development and production of bananas and plantains, in order to improve food security in Africa, through transfer of specialized information.

Specific objectives

. Set up a Regional Information Network to optimize the collection, exchange, utilization, dissemination and access to relevant banana information in Africa.

. Assist member institutions in the organization of their own information systems.

. Encourage collaborations and information exchange between scientists and research centers.

. Contribute to the popularization and adoption of research results by all participants of the banana sector in Africa.

. Promote the research networks (***MUSA***CO, BARNESA) and the Regional Information Network.

A specialized documentation centre is currently being set up at CARBAP headquarters, host centre for the information network.

For more information, please contact:

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Instructions to authors

*MusA*frica is the plantain and banana newsletter produced by CARBAP, IITA and INIBAP primarily to serve *Musa* scientists across sub-Saharan Africa. It proposes to highlight to a diverse audience recent progress in relevant areas of *Musa* research. Publication of research findings in this newsletter does not preclude subsequent submission to an international publication. The style of presentation of research results follows that of international journals.

The editorial board welcomes contributions to the sections listed below. Manuscripts should be accompanied by a covering letter signed by all the authors of the manuscript. Authorship is warranted by involvement in at least two of the following four areas: experimental design, data collection, data analysis and interpretation, article composition.

A double-spaced copy of the manuscript, without abstract, should be submitted. Authors are encouraged to also submit a PC-compatible electronic file of their manuscript. Submissions received before 1 February of each year will be considered for the first issue of that year, while submissions received before 1 July will be considered for the second issue of the year. The full postal address of at least one author must be listed on the manuscript to allow readers to contact authors directly. Authors must use internationally accepted standard units of measurement. The quotation of local terms, measurements or currency must be followed by full explanations or conversion factors to international standards. All abbreviations must be explained in the text at first mention.

Focus

Includes articles reviewing progress in a particular discipline of *Musa* research or presenting a topical viewpoint. Focus articles should be a maximum of 3000 words.

Short communications

Includes articles on *Musa* research in Africa or research directly relevant to *Musa* production in Africa. Articles must start with a clear concise **Introduction** to the area of research. **Materials and methods** must briefly but accurately describe the material used and the protocols applied during the study, or make reference to an appropriate international publication containing these details. The description of methods must facilitate the repeat of the procedure by the reader. The experimental design must be clearly defined. **Results and discussion** must add insight to data presented in tables or figures. All data must be accompanied by statistical analysis, as a minimum, presenting standard error or least significant difference. The results of this analysis must be presented in the table, figure, or text and must be interpreted in the text. When possible, comparison should be made with similar reports published previously. The **Conclusion** section is optional and must only be used where further insight or extrapolation is appropriate. **References** must be placed in parenthesis within the text as follows: (Smith 1999), (Smith & Jones 1991) or (Smith *et al.* 1992). **References** must be complete and listed in alphabetical order at the end of the article. Journal titles must be listed in full to minimize ambiguity. References should only be made to international documents/publications (reference to previous issues of *MusA*frica or any other newsletter will not be expected). **Table** titles and **Figure** legends must allow presented data to be interpreted without reference to the text. Figures should not duplicate data presented in tables. Electronic versions of complex figures must be supplied. Research notes should be up to 2000 words with one or two tables or figures.

Germplasm evaluation

Includes articles on the resistance to pests on diseases, and the agronomic and postharvest performance of newly introduced germplasm or synthetic hybrids in Africa. Evaluation articles should be about 2000 words with one or two figures.

Country reports

Includes detailed summaries of national *Musa* production systems and summaries of relevant sections from annual reports of national research institutions. Reports should be up to 2000 words. Country reports should be co-authored by the head of the respective national programme.

Abstracts

Brief summaries of no more than 350 words describing the rationale, objectives, methods, results, and conclusions of small and/or ongoing research projects. Abstracts must be self-explanatory and intelligible without reference to publications elsewhere and should not contain tables or figures. Reviews of articles published elsewhere will also be considered for this section.

News and views

Articles and letters addressing topical scientific issues relating to *Musa* production in Africa together with summaries of ongoing *Musa* research and training activities. Letters for news and views should be up to 1000 words with no more than one table or figure.

Please send your contribution to Josué Tetang Tchinda, Regional Information Officer, C/o *MUSA*CO, BP 12438, Douala, Cameroon

The views expressed in the articles are those of the authors and do not necessary reflect those of CARBAP, IITA or INIBAP. The editorial board welcomes suggestions for how to improve *MusA*frica to better serve the needs of the readership.