Tropical Root Crops

PRODUCTION AND USES IN AFRICA

Proceedings of the International Symposium of the International Society for Root Crops —
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TROPICAL ROOT CROPS: PRODUCTION AND USES IN AFRICA
ABSTRACT

A mixture of original research, updates on procedures, literature reviews, and survey reports, this document resulted from the second symposium of the International Society for Tropical Root Crops — Africa Branch, with 77 participants from 16 countries. The focus was cassava, yams, cocoyams, and sweet potatoes, from the perspectives of breeders, agronomists, soil specialists, plant pathologists, entomologists, nutritionists, food technologists, etc. Learning from past successes and failures, many of the researchers directed their efforts toward problems obstructing progress in reaching improved production and use of root crops and attempted to view, realistically, the context in which their results would be applied.

RÉSUMÉ

Résultats de recherches récentes, mises à jour sur les méthodes de recherche, revues de publications et rapports de sondages sont contenus dans ce document issu du Deuxième symposium de la Société internationale pour les plantes-racines tropicales — Direction Afrique, qui a réuni 77 participants de 16 pays. Des communications sur le manioc, le taro, le yam et la patate douce ont été présentées par des phytoselecteurs, des agronomes, des pédologues, des phytopathologistes, des entomologistes et des spécialistes de la nutrition et des aliments, entre autres. Tirant leçon de leurs succès et de leurs échecs, beaucoup de ces chercheurs ont dirigé leurs efforts vers la solution des problèmes qui entravent l’augmentation de la production et de la consommation des plantes-racines et ont tenté de considérer d’un œil réaliste le contexte qui sera celui de l’application de leurs recherches.

RESUMEN

Una mezcla de investigaciones originales, actualizaciones de procedimientos, reseñas de literatura e informes de encuestas, este documento es el resultado del segundo simposio de la Sociedad Internacional de Raíces Tropicales, Filial Africana, que contó con 77 participantes de 16 países. El simposio se centró en la yuca, el tåro, el cocoyam y las batatas, desde la perspectiva de los fitomejoradores, los agrónomos, los especialistas en suelos, los patólogos vegetales, los entomólogos, los nutricionistas, los tecnólogos alimenticios, etc. A partir de los éxitos y fracasos anteriores, muchos de los investigadores encaminaron sus esfuerzos hacia los problemas que obstaculizan el avance para lograr una producción y un uso mejorados de las raíces y trataron de obtener una visión realista del contexto en que los resultados pueden ser aplicados.
TROPICAL ROOT CROPS:
PRODUCTION AND USES IN AFRICA

EDITORS: E.R. TERRY, E.V. DOKU, O.B. ARENE, AND N.M. MAHUNGU

PROCEEDINGS OF THE SECOND TRIENNIAL SYMPOSIUM OF THE INTERNATIONAL SOCIETY FOR TROPICAL ROOT CROPS — AFRICA BRANCH HELD IN DOUALA, CAMEROON, 14 – 19 AUGUST 1983
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SWEET-POTATO PRODUCTION POTENTIAL IN RWANDA

G. NDAMAGE

Screening trials conducted under the ecological conditions prevailing in Rwanda enabled staff at Institut des sciences agronomiques du Rwanda (ISAR) to identify sweet-potato varieties for all ecological regions except the acid soils of the Zaire Crest–Nile highlands. Rusenya, Caroline lee, Nyiramujuna, and Rutambira clones have proved to be highly stable producers, but early, stable varieties that are adapted to the conditions existing at high altitudes have yet to be developed. Various planting techniques have been tested, and fertilization trials showed that two treatments, i.e., 0.02 t N, 0.05 t K2O, and 35 t of manure; and 35 t of manure/ha alone, improved yields. In the dry regions, mulching produced spectacular results, increasing yields by 285%. The most beneficial effects were achieved with mixed stands of sweet potato–soybean–climbing bean–maize (land-equivalent ratio — LER = 1.53) and soybean–sweet potato–soybean–maize (LER = 1.60). Farm experiments on hillsides revealed that Rusenya, Caroline lee, Rutambira, and Nyiramujuna produced good results and that ridge cropping was adopted by the local farmers.

Sweet potatoes, together with beans, form the mainstay of the population's diet in Rwanda. Grown throughout the country up to altitudes of 2300 m, sweet potatoes generally produce well at elevations as high as 1900 m, but do poorly at higher elevations because of the cold. At an annual yield of 7.8 x 10^5 t, they represent 20% of the national food-crop production. Mean national yield is roughly 8 t/ha.

In rural areas, sweet potatoes are generally cultivated in fallow land. They are often grown in pure stands but are occasionally intercropped with beans, sorghum, or cassava. They are grown on the hillsides from September to May and in the lowlying and flooded marshlands from May to July. In marshlands, they are planted in large, raised ridges to facilitate drainage. When grown on the hillsides, they are generally planted in ridges or mounds.

The main factors limiting production are viral diseases transmitted mainly by lice (Myzodes persicae) and white flies (Bemisia tabaci); anthracnose, which is the most common fungal sweet-potato disease in Rwanda and is especially serious in the highlands; black weevils (Cylas spp.); leaf caterpillars (Acraea acerata); the cold, particularly at high altitudes; and drought in the western portion of the country.

RESEARCH RESULTS

In 1977, the germ-plasm collection at ISAR comprised 37 varieties, 9 of which, from IITA, were introduced for the first time. In trials since, Rusenya (17 t/ha) has proved to be the most stable clone and is well adapted to hillsides as well as marshlands. TIS 2544 (14 t/ha), which was introduced from IITA, is both a good and an early producer (4 months) but, like TIS 2534, has a high water content (35.5% dry matter) compared with Rusenya (37.5% dry matter). They have another drawback: at the plant densities common in Rwanda, these two clones grow poorly and cannot compete with or control weeds.

Along with screening operations, in 1979, ISAR began work to improve sweet-potato varieties by natural crosses. Some of the resulting clones are currently in the final stages of evaluation. Three varieties, Rusenya (17 t/ha after 6 months, highly versatile), Cordes Rouges (14.5 t/ha), and Nyiramujuna (14.5 t/ha), which were consistently high yielders at the research station as well as on farmers' plots, emerged from comparative tests conducted in several localities in 1979 and 1980.

In 1980, the five clones best adapted to high altitudes were Nsasagatebo (17.7 t/ha), Bukarasa (16.4 t/ha), Nyiranjyojo (15 t/ha), Di Virosky 16 (14.8 t/ha), and Rusenya (14.2 t/ha). At medium altitudes, Rusenya (26.5 t/ha), 6634

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Cordes Rouges (26.1 t/ha), and Nyiramujuna (23.5 t/ha) proved far superior to the other varieties. Nsenyakaniga (12.7 t/ha), Nyiramujuna (9.9 t/ha), and Gahungezi (9.6 t/ha) produced well at low altitudes. In all the ecological systems studied, the clone Nsasagatebo yielded moderately well.

Again in 1981, Rusenya was a good producer (mean 16 t/ha). An old clone, Anne Marie (17 t/ha), which is highly susceptible to viral diseases and cannot be distributed without a strict phytosanitary check in all the breeding plots, was the only clone that outyielded Rusenya.

In the northern region (Rwerere and Ruhengeri), Anne Marie and Nsulira 1026 produced 14.8 t/ha; Nyiramujuna 332. 12.3 t/ha; Rusenya, 12 t/ha; and Caroline lee 1668, 11.5 t/ha. At medium altitudes, Rusenya and Anne Marie came out in front with 23.5 t/ha, followed by Nyiramujuna 322 (21.3 t/ha), Cordes Rouges (20 t/ha), TIS 2544 (19.3 t/ha), Cordes Rouges (18.5 t/ha), and Nyiramujuna (18.3 t/ha).

In the dry region of Rwanda, the clones Caroline lee 1666 (21.8 t/ha), TIS 2544 (18.3 t/ha), Caroline lee (15.5 t/ha), and Nyiramujuna (15.5 t/ha) performed well.

In 1981, yields were highest at ETAB (25 t/ha), Rubona (18 t/ha), PNA (13 t/ha), and Rwerere (14 t/ha).

Another series of clones were tested in 1982. The trials were begun late (mid-April) on the hillsides, and the acid soil of Mata proved early to be unsuitable for sweet potatoes if not previously cultivated. The average overall yield was low (9.1 t/ha), with the productive clones yielding only about 6 t/ha. The four best clones, in order of yield, were TIS 2498/16 (11.3 t/ha), Red Jersey 1220 (10.2 t/ha), Di Virosky 16/820 (10.0 t/ha), and TIS 2544 (10.4 t/ha). The best environments proved to be at Rwerere (19.6 t/ha), Rubona (11.7 t/ha), and Ruhengeri—PNA (8.5 t/ha).

The clone Rusenya confirmed its yield potential under the conditions of the Rubona district (16.2 t/ha). It was followed by Anne Marie (14.5 t), which, however, was characterized by a thick cortex and stringy flesh. The new selections, Red Jersey 1220 (13.6 t/ha), Nsulira 1026 (13 t/ha), and Di Virosky 16/820 (12.8 t) rivaled the two local clones.

At high altitudes, the new varieties TIS 2498/16 (17.3 t/ha), TIS 2544 (16.6 t/ha), Di Virosky 16/820 (15 t/ha), and Red Jersey 1220 (14.2 t/ha) proved the most productive, whereas TIS 2498/16 (10.3 t/ha) headed the list in low-altitude regions, followed by Caroline lee (9.8 t/ha), Red Jersey 1220 (8 t/ha), and Caroline lee 1666 (7.7 t/ha). In other words, the new selection TIS 2498/16 produced good yields and exhibited considerable environmental adaptability.

In 1983 experiments grouped all the elite material in a single trial so that production stability could be assessed over a 4-season period. Some of the best clones were subjected to correlation analysis, which demonstrated the existence of a relationship between fresh tuber yields and dry tuber weight \( r = 0.66 \), between vine weight and the percentage of dry tuber matter \( r = 0.50 \), proper growth of the aerial portion contributing to dry-matter formation. Varieties producing large tubers also appeared to yield larger amounts of dry matter \( r = 0.55 \).

### Cultivation Techniques

Trials in which sweet potatoes were planted in ridges and mounds and on the flat were carried out during 1977–79, but no significant differences were recorded at the end of the trials. Experiments on planting procedures and spacing were repeated over two seasons (1979). They showed that the interaction between the variety and plant density was not significant and that slightly better results were achieved with 50-cm than with 80-cm ridges. Likewise, results obtained with three stakes per hill did not differ from those achieved with only one stake per hill. There was no obvious advantage in planting presprouted roots instead of vine cuttings.

A trial with mineral and organic fertilizers conducted in 1982 in 15 localities selected in 10 agricultural regions with different soil types included 6 types of fertilizers and 5 sweet-potato clones, i.e., Rusenya, Caroline lee, and the three clones best adapted to each of the 10 trial localities.

Treatment with 20 kg N, 50 kg K\(_2\)O + 35 t manure/ha and with 35 t manure/ha alone proved beneficial in all the localities. Manure alone (35 t/ha) in the dry regions of Bugesera, Mayaga, and Mutara increased yields by 285% when combined with mulch (average yield 12.7 t/ha vs 3.3 t/ha without mulch). During the same trial, the varieties Rusenya and Caroline lee proved well-adapted to all the localities. Nyiramujuna gave good yields at low altitudes and Rutambira at high altitudes. Rusenya's mean surplus was 8.3 t/ha or 66% above control yields.

Mixed-crop trials, in which tubers were inter-
cropped with cereals and legumes, were carried out in a number of localities from 1979 to 1983. At medium altitudes, sweet-potato yields peaked when the tuber was grown as a monocrop. The highest energy per hectare was recorded when sweet potatoes were planted alone or mixed with maize (13.024 kcal and 14.215 kcal, respectively). Land productivity was the highest with pure sweet-potato stands, and when the intercrop was climbing beans. The highest density coefficients were recorded when sweet potatoes were intercropped with dwarf beans (170%), soybeans (169%), climbing beans (160%), and climbing beans plus maize (151%).

A mixed crop of maize—climbing beans—soybeans—sweet potatoes gave better results when one rather than two or three rows were planted with a single species.

Another mixed-crop system that continues to produce superior results (LER = 1.60) combines maize, soybeans, sweet potatoes, and soybeans with spacings of 1.80 m between the rows of maize. The sweet-potato ridges must be at least 50 cm high; otherwise, the plants are choked by adjacent rows of soybeans.

At present, preextension work or farm experimentation is carried out only in areas in the vicinity of ISAR stations but will soon spread to other localities selected for ecological conditions and soil types.

The best sweet-potato varieties (3 or 4) emerging from comparative varietal trials and the best cultural techniques (1 or 2) are used during farm trials. Each variety is planted both on ridges and on mounds so that a comparison can be made between the varieties as well as the two cultivation methods normally used in the rural areas. The block is roughly 16 m². Land preparation is done by the farmer who is joined by the researcher for staking, ridge and mound making, and planting. In general, manure is not applied. Maintenance consists only of manual hoeing, which is done on three occasions. Observations by research personnel are recorded from planting to harvest in the presence of the farmer. The crop is harvested 5 months after planting.

Current farm results indicate that yields are better when sweet potatoes are planted on

*Tib 1, a sweet-potato cultivar developed by IITA, is being grown for multiplication in Cameroon but has yet to prove itself in the conditions of Rwanda.*
ridges rather than on mounds (16 t/ha vs 13.7 t/ha, respectively) and that this procedure represents a more efficient use of the land and labour.

Five of the best clones for the medium-altitude region were tested in 1980 in plots belonging to six farmers located throughout the region. The early variety Caroline lee (23 t/ha), Rusenya (14 t/ha), and Cordes Rouges (12.5 t/ha) demonstrated anew their production potential under farm conditions. Cordes Rouges received a good rating for its consistency, Rusenya for its taste, Rusenya and Nyirokayenzi for their shape, and Caroline lee for its colour (high carotene content).

Similar results were obtained in 1982 throughout the country where the varieties Rusenya and Caroline lee proved to be well adapted to the different localities. Nyiranjyojyo gave good yields at low altitudes and Rutambira at high.