Tropical Root Crops

PRODUCTION AND USES IN AFRICA

Proceedings of the Special Symposium of the International Society for Root Crops —
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The International Society for Tropical Root Crops — Africa Branch was created in 1978 to stimulate research, production, and utilization of root and tuber crops in Africa and the adjacent islands. The activities include encouragement of training and extension, organization of workshops and symposia, exchange of genetic materials, and facilitation of contacts between personnel working with root and tuber crops. The Society's headquarters are at the International Institute of Tropical Agriculture in Ibadan, Nigeria, but its executive council comprises eminent root and tuber researchers from national programs throughout the continent.

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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 nabo, 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

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CROP PERFORMANCE IN COMPLEX MIXTURES: MELON AND OKRA IN CASSAVA—MAIZE MIXTURE

J.E.G. Ikeorgu,¹ T.A.T. Wahua,² and H.C. Ezumah³

We conducted a 2-year investigation at Ibadan, Nigeria, to determine the economic benefits of including melon and okra in a cassava—maize intercropping system. Fresh-root yields of cassava were reduced by 28% by maize in the mixture but only by 3%, 6%, and 9% by okra, melon, or both, respectively. Intercropping had no adverse effect on the grain yield of maize; rather yield was 19% higher in the maize–cassava intercrop than in monoculture. Fresh-froot yields of okra were reduced by 72%, 89%, and 56% in mixtures with cassava, cassava–maize, and cassava–maize–melon, respectively. Melon-seed yields were decreased by 56% and 76% in mixtures with cassava and cassava–maize, respectively. The cassava–maize cropping system yielded the highest amount of calories per hectare; however, total productivity per unit area of land was highest in the cassava–maize mixture with both okra and melon.

As a long-duration (9–18 months) crop, cassava is suitable for intercropping with plants that mature within 2–3 months (before the cassava canopies close). Okigbo and Greenland (1976) estimated that about 50% of the cassava grown in tropical Africa is intercropped with cereals, grain legumes, leafy vegetables, and fruits as well as tree crops. Although there are several reasons that farmers intercrop (Watters 1971; Norman 1975; Andrews and Kassam 1976; Okigbo and Greenland 1976), the most important is that total productivity per unit of land and total income are higher under intercrops than under monocultures. Furthermore, by intercropping, farmers reduce the risk of losing their base crop. Andrews (1972) and Kassam and Stockinger (1973) showed that intercropping is most rewarding when the crops make their maximum demands on the environment (soil nutrients, soil moisture and temperature, light, etc.) at different times.

Maize is the most common crop grown with cassava in Latin America (Moreno and Hart 1979), Asia (Kumar and Hrishi 1979), and Africa (Okigbo 1978) because of the productivity and compatibility of the mixture. The faster growing maize exploits the microenvironment earlier in the growing season than does the cassava. In Nigeria, maize is intercropped about 80% of the time (Okigbo 1977), and a cassava–maize intercropping package has been recommended to farmers by the National Accelerated Food Production Project (NAFPP 1977). Because cassava–maize constitutes the dominant mixture in many traditional intercropping systems, researchers have tended to ignore the other components of the systems — vegetables such as melon, okra, African spinach, fluted pumpkins, and even tomatoes. For instance, all over West Africa, melon (Colocynthis vulgaris) and okra (Abelmoschus esculentus) are popular, although little attention has been paid to them. In one study, Fagbamiye (1977) showed that melon performed poorly in cropping systems based on cassava, maize, and yams but improved the yields of the base crops. We examined the productivity of the cassava–maize mixture, with or without melon and okra, to see how the vegetables affected the mixture microenvironment.

MATERIALS AND METHODS

The study was conducted at the teaching and research farm of the University of Ibadan. The area has two rainy periods — one from April to July (early season), which accounts for most of the 1250-mm annual rainfall, and the other from August to November (late season). Our investigation was carried out during the early seasons.
of 1981 and 1982 on sandy loam of Egbeda soil series (Oxic Paleustalf) classified as Alfsols or Ferric Luvisols. Initial soil analysis indicated pH 6.5; organic matter 1.34%; total N 0.09%; 12.63 μg/g Bray-L-P; and exchangeable Ca, Mg, and K of 3.11, 0.72, 0.38 meq/100 g.

Two morphologically different cassava cultivars: TMS 30001 (sparse canopy, upright) and TMS 30572 (dense canopy, spreading) were combined with maize (TZPB), egusi melon, and an early maturing okra (V45) collected from the National Seed Service, Ibadan. Along with monocultures of each variety, we investigated cassava—maize—okra—melon; cassava—maize—okra; cassava—maize—melon; cassava—maize; cassava—okra; cassava—melon; and cassava—okra—melon, for each cassava variety. The experiment was a split plot fitted into a randomized complete block design with three replicates. The two cassava cultivars formed the main plots and the various crop combinations formed the subplots. Each subplot was 8 m × 8 m.

The land was plowed and harrowed, and all crops were planted at the same time on the flat: the cassava at 1 m × 1 m; the maize (2 plants/hill) between the cassava rows also at 1 m × 1 m; the okra (2 plants/stand) was alternated with cassava within the row; and the melon was planted between the maize and cassava. Thus, the cassava population was 10 000/ha and that of the other components was 20 000 plants/ha, although, in 1982, the melon population was reduced to 10 000 plants/ha.

NPK fertilizer (15:15:15 — 200 kg/ha in 1981 and 400 kg/ha in 1982) was applied to all plots. Plots without melon were weeded twice (21 and 42 days after planting, DAP) and those with melon, only once (21 DAP).

The melons were harvested at 80 DAP and processed for seeds. Okra was harvested at 3–4-day intervals for 6 weeks, starting at 50 DAP. Maize was harvested 100 DAP, dried to 14% moisture, shelled, and weighed. Cassava was harvested at 10 months (ca 300 DAP), and roots were weighed fresh. All weights were extrapolated to yield/hectare.

We used analysis of variance for a split-plot design to assess treatment effects and compared means by Duncan's multiple-range test at the 5% level of significance. The differences attributable to cassava cultivar were not significant; therefore, the values presented in this paper are means for the two cultivars.

**RESULTS AND DISCUSSION**

Cassava yields were significantly reduced by intercropping (Table 1): in combination with maize, the reduction was 28%. Kang and Wilson (1981) had earlier observed that TZPB maize decreased cassava yields more than an early maturing variety (TZE). The inclusion of okra, melon, or both in cassava—maize mixtures reduced cassava-root yields an additional 3%, 6%, and 9%, respectively.

Intercropping had no adverse effect on maize grain yield: rather, maize yields were 19% higher in the cassava—maize mix than in monoculture, and the reduced cassava yields were compen-

<table>
<thead>
<tr>
<th></th>
<th>Cassava</th>
<th>Maize</th>
<th>Okra</th>
<th>Melon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monoculture</td>
<td>25.46a</td>
<td>20.40a</td>
<td>2.29ab</td>
<td>2.96a</td>
</tr>
<tr>
<td>Cassava—maize</td>
<td>19.40b</td>
<td>13.42b</td>
<td>3.07a</td>
<td>3.17a</td>
</tr>
<tr>
<td>Cassava—maize—okra</td>
<td>17.79bc</td>
<td>13.79b</td>
<td>2.32ab</td>
<td>3.00a</td>
</tr>
<tr>
<td>Cassava—maize—melon</td>
<td>14.90c</td>
<td>15.32b</td>
<td>2.42ab</td>
<td>2.84a</td>
</tr>
<tr>
<td>Cassava—maize—okra—melon</td>
<td>16.40bc</td>
<td>12.61b</td>
<td>2.00b</td>
<td>3.26a</td>
</tr>
<tr>
<td>Cassava—okra</td>
<td>25.63a</td>
<td>20.10a</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Cassava—melon</td>
<td>22.03ab</td>
<td>16.93bc</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Cassava—okra—melon</td>
<td>18.55bc</td>
<td>16.96bc</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

*Means followed by the same letter(s) within a column do not differ at P < 0.05.*

Table 1. Yields (t/ha) of cassava, maize, okra, and melon grown alone and in mixtures.
Table 2. Comparison of caloric equivalents and land-equivalent ratios (LERs) obtained from sole cassava and from four intercropping systems involving cassava, maize, okra, and melon.

<table>
<thead>
<tr>
<th>Combination</th>
<th>Mean for 2 years</th>
<th>Calories (1 × 10^7 cal/ha/day)</th>
<th>LER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sole cassava</td>
<td></td>
<td>9.70</td>
<td>1.00</td>
</tr>
<tr>
<td>Cassava–maize</td>
<td></td>
<td>18.74</td>
<td>1.91</td>
</tr>
<tr>
<td>Cassava–maize–okra</td>
<td></td>
<td>16.80</td>
<td>1.81</td>
</tr>
<tr>
<td>Cassava–maize–melon</td>
<td></td>
<td>17.67</td>
<td>1.92</td>
</tr>
<tr>
<td>Cassava–maize–okra–melon</td>
<td></td>
<td>17.50</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Cassava–maize (already harvested) mixes are popular wherever root crops are grown in the tropics.

Okra yields were reduced by 72%, 89%, and 56% in mixtures with cassava, cassava–maize, and cassava–maize–melon, respectively. Okra performed better in mixtures with melon than in those without, confirming earlier observations (IITA 1975; Fagbamiye 1977) that the yields from crops associated with melon are usually improved.

Yields of melon seed were significantly decreased in combinations with cassava.

All the crop combinations produced higher caloric equivalents and land-equivalent ratios than were obtained under monoculture cassava (Table 2).
sava—maize—melon were superior in terms of land-equivalent ratios. Traditionally, farmers prefer multicrop mixtures to satisfy their dietary needs. Further work is needed to determine the optimal crops and combinations.

We acknowledge, with gratitude, the financial support from the International Foundation for Science under grant 474. We also thank the National Root Crops Research Institute, Umudike; IITA, Ibadan; and the Department of Agronomy, University of Ibadan for providing technical assistance.