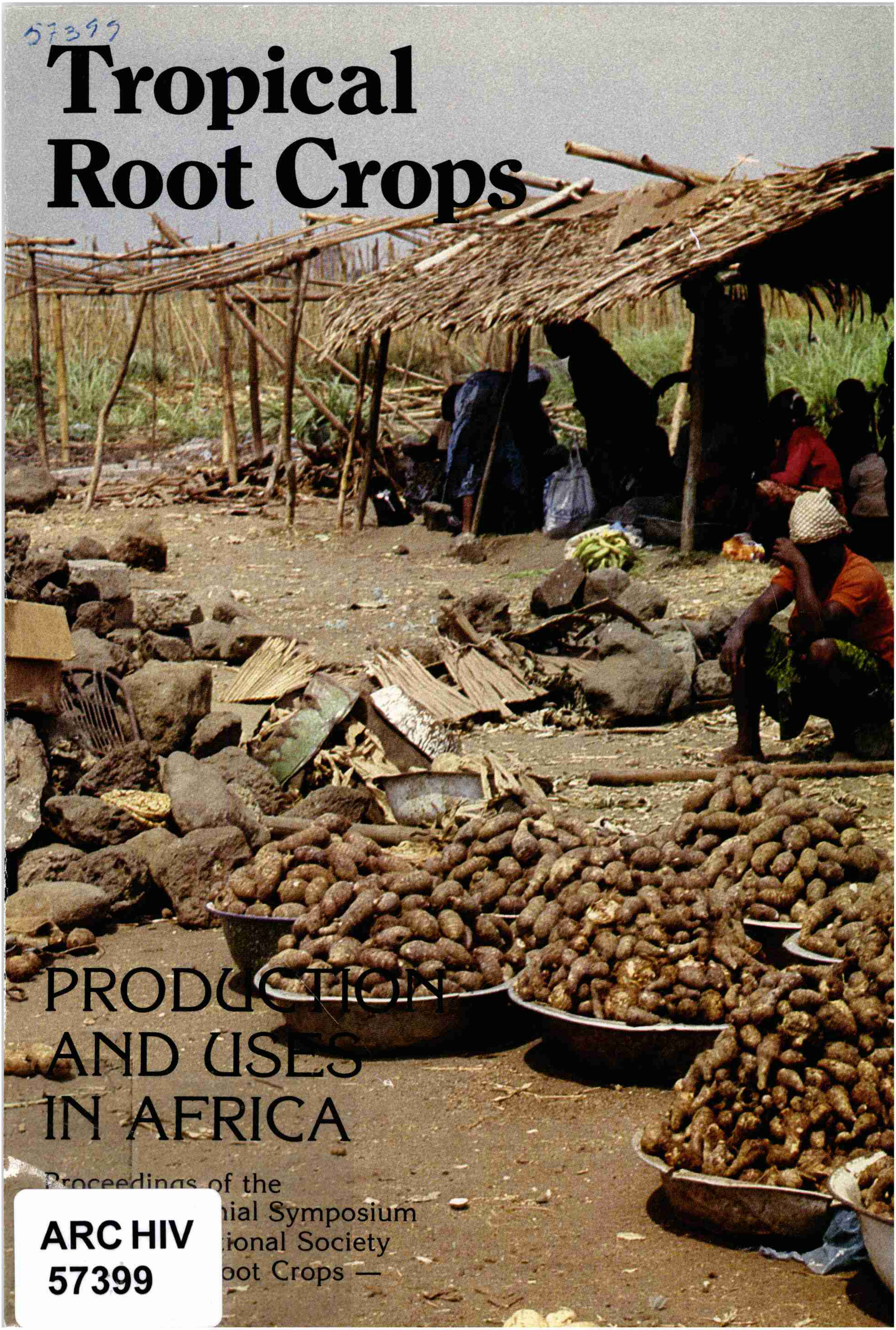
Tropical Root Crops



PRODUCTION AND USES IN AFRICA

Proceedings of the
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...oot Crops —

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IDRC-221e

Tropical root crops: production and uses in Africa : Proceedings of the second Triennial Symposium of the International Society for Tropical Root Crops — Africa Branch held in Douala, Cameroon, 14–19 August 1983. Ottawa, Ont., IDRC, 1984. 231 p.: ill.

/Cassava/, /root crops/, /plant production/, /Africa/ — /genetic improvement/, /planting/, /plant diseases/, /pests of plants/, /intercropping/, /fertilizers/, /crop yield/, /sweet potatoes/, /plantains/, /agriproduct processing/, /nutritive value/, /food enrichment/, /feed/, /agricultural research/, /conference report/, /list of participants/.

UDC: 633.68 ISBN: 0-88936-409-5

Microfiche edition available.
Il existe également une édition française de cette publication.

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 phytosélectionneurs, 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 ñame, el cocoñame 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.

IDRC-221e

TROPICAL ROOT CROPS:
PRODUCTION AND USES IN AFRICA

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

Contents

Yams

SEED-YAM PRODUCTION

M.N. ALVAREZ AND S.K. HAHN[1]

We tested several techniques to increase the multiplication ratio in yams, and all showed promise, although the degree varied according to cultivar. Seed-yam production from true seed gave the highest yield per unit area. The use of microsett propagation with the aid of phytohormones increased the multiplication ratio from the traditional 1 : 4 to 1 : 90, and the minisett technique with plastic mulch showed the greatest potential for rapid multiplication at the farm level. Plastic mulch had no adverse effect on the seed yams produced.

White-yam (*Dioscorea rotundata*) production in West Africa has been declining partly because of the scarcity of planting material, which is also the source of food, the underground tuber. The ware-yam producer can obtain planting material by "topping" or milking (Okigbo and Ibe 1973), cutting ware yams into setts, "junking" (cutting the yam head) (Ferguson 1980), or from specially grown yams called seed yams.

The seed yam is merely a small tuber (300–1000 g) with remarkable flexibility and storability under ambient conditions. Although there are many environmental factors affecting performance of yam setts in the soil, the seed yam has performed reliably in a wide range of conditions.

There are many ware-yam producers, but seed-yam production is specialized, labour-intensive, and costly. A yam-based, farming-system survey conducted in three villages in the humid tropics of southern Nigeria revealed that only one village was growing seed yam as a major enterprise (Bachmann 1981). The reduced availability of seed yams has become a major constraint in many ware-yam-producing areas (Bachmann and Winch 1979; Diehl and Winch 1979; Bachmann 1981), with some ware-yam farmers being forced to reduce output or stop production.

Interviews with seed-yam producers disclosed that their major constraint to expansion was labour input. Others have also observed that one of the most serious problems encountered in yam production is the labour requirement.

Several efforts have been initiated to reduce labour cost and inputs in ware-yam production (Okigbo and Ibe 1973; Ferguson 1980). Although the limited supply and the high cost of seed yams are major constraints in yam production (Akoroda 1982), only limited efforts have been made to increase the efficiency and reduce the costs of seed-yam production by the farmer (Akoroda and Okonmah 1982; Okoli et al. 1982).

The objectives of our experiments were to assess the potential of white-yam clones to produce seed-yam-sized tubers from presprouted minisetts and microsetts; to investigate the possibility of improving germination of minisetts by suberization; to determine what inputs of traditional seed-yam production could be modified or replaced (staking, weeding); and to evaluate the potential of seed-yam production from true seeds.

MATERIALS AND METHODS

For propagation from true seeds, selected breeding lines were direct seeded and transplanted to seed beds, prepared with topsoil and compost and lightly shaded with palm leaves. The seeds were treated with a fungicide–insecticide combination and sown 15 cm apart in rows 30 cm apart. The beds were then mulched with rice hull or sawdust. When the vines developed, they were trained on string supported by frames erected over the nursery bed. Tubers were harvested 9 months later.

In a preliminary micropropagation trial, *D.*

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rotundata (cv. TDrs 4001-C226) and *D. alata* (cv. TDa 291) were used as source material. Tubers, ca 500 g each, were cut into small pieces (3–5 g each); 80 pieces were used/treatment. Some pieces served as a control; others were dipped in one of five treatments: naphthalene-acetic acid (NAA) at 500 and 1000 mg/L, 6 benzylamino purine (BA) at 500 mg/L alone, and in combination with the two concentrations of NAA. All the pieces were dusted with Aldrex T and planted in moist, medium-grade vermiculite in jiffypots 6 cm × 6 cm. These were watered as was necessary. After 43–45 days, the number of roots on each section was counted; mean length of roots and percent survival were observed.

Large-scale micropropagation was the next step. Foam trays 66 cm × 40 cm, with cone-shaped compartments, 3.8 cm × 3.8 cm, were used, and the compartments were filled with medium — equal portions of sawdust, medium-grain vermiculite, and soil. Tuber pieces (3–5 g) were dipped in 100 ppm NAA, planted in the compartments, and kept in a propagation house and watered when necessary. As growth started, the plantlets were transferred to partial shade for hardening and, after 5 days, were transplanted to the field on ridges covered with plastic mulch.

For the presprouting minisett trial, two *D. rotundata* clones were cut (NRCRI 1980a; Okoli et al. 1982), into half-moons (45–60 g), placed on sand beds, and sprayed with Captan (2.5 g/L). These minisetts were covered with plastic for suberization for 1–2 days before being covered with a 2-cm layer of river sand and palm leaves. Three weeks later, the pieces were transplanted to the field, at a spacing of 0.5 m × 1 m. Seven months later, the field plantings were harvested.

In experiments to determine substitutes for the costly inputs of traditional yam production, *D. rotundata* (cv. Abi and Nwapoko) tubers were cut into pieces (100–150 g), treated with ash, and allowed to dry before being planted. The sites were plowed and ridged (1 m apart) by conventional methods, and the setts planted 50 cm apart in rows, with 240 setts/plot in three replications. One treatment (in 1981) was traditional, exemplifying the cultural practices employed by Nigerian farmers. A second included a modified staking system (arched PVC pipes, 1.27 cm, supporting plastic mesh at 0.75–1 m aboveground), supplemented by preemergent herbicide (a mixture of Cotoran and Dual, 2 g a.i./ha, each, immediately after planting). In a third treatment, the herbicide replaced staking and, in a fourth treatment, black and white polyethylene strips were placed on the plot after germination to serve as mulch. This treatment was unreplicated.

The soil temperature and moisture were monitored toward the end of the rainy season until harvest. Soil thermometers (mercury-in-glass) were installed in one replicate for each treatment 5 cm deep on the crest of the ridges. Readings were taken at 0900 h and 1400 h. Soil-moisture samples were taken from four locations in each of the mulched and unmulched plots and expressed as percent on an oven-dry basis.

Soil samples were also taken for nematode population determination at the time of harvest.

Results and Discussion

The production of marketable seed yams from true seeds was as high as 42 t/ha (Table 1), with the tubers ranging in weight from 100 g to 1200 g. Yield was up to 2.5 times that expected from traditional methods. The promising families are also responding positively to dense plantings, which produce a canopy early and reduce the weed problem. This system has exhibited tremendous productivity on a per-unit-area basis. Tuber size, uniformity, and suitability for rapid, efficient hand harvesting are excellent, although the potential for adapting this system to farm or commercial production has not been evaluated.

In the preliminary micropropagation trial, both concentrations of NAA greatly increased the percentage of surviving *D. rotundata* that rooted but not *D. alata* (Table 2). BA at 500 mg/L reduced percent survival, total number and length of roots in white yam but not in *D. alata*. In water yam, the untreated pieces rooted and sprouted the earliest (about 28 days after planting) and those treated with the NAA–BA combination at 1000 and 500 mg/L had poorest root formation (Fig. 1).

Table 1. Seed-yam yield and percent of total tubers of four promising yam families and one check grown from true seeds in well-prepared seed beds.

Family	Marketable seed-yam yield t/ha	Marketable seed-yam yield % of total tubers
W 370	42	70
W 33	27	50
W 56	22	45
W 71	18	30
Okumodu (check)	15	25

Table 2. Percent survival and rooting of *Dioscorea alata* and *D. rotundata* yam pieces after NAA and BA dips and 5 weeks of growth in vermiculite.

Treatment concentration (mg/L)		Survival (%)		Survivals rooted (%)	
NAA	BA	TDa 291	TDrs 4001-C226	TDa 291	TDrs 4001-C226
0	0	60	90	69	60
500	0	93	100	71	100
1000	0	93	97	56	92
0	500	83	56	46	28
500	500	63	80	51	71
1000	500	93	90	8	93

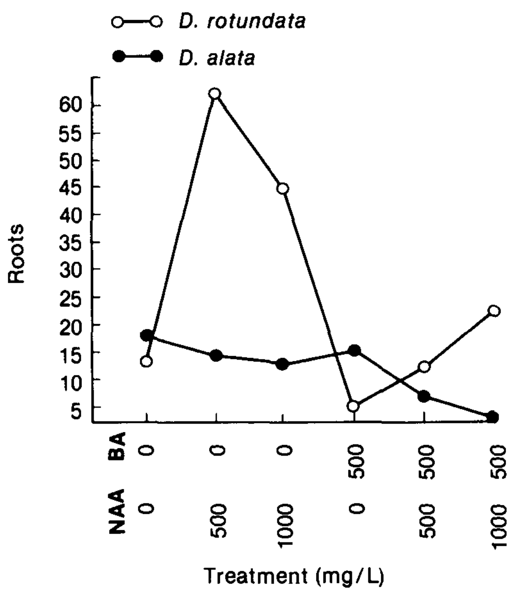

Fig. 1. *Effect of phytohormones (NAA and BA) on rooting of microsetts of* D. rotundata *and* D. alata *yams.*

Table 3. Comparison of herbicide and no staking, herbicide and modified staking, and plastic mulch with traditional practices of seed-yam production.

Treatment	Yield (t/ha)
Abi	
Herbicide, modified staking	14
Herbicide, no staking[a]	16
Traditional	10
Nwapoko (check)	
Herbicide, modified staking	10
Herbicide, no staking	3
Plastic mulch	10

[a]Resulted in benefit of more than $2000/ha.

Results for root length followed a similar trend. For large-scale propagation under Ibadan conditions, the best planting time would be May–June. In our studies, transplanting of hardened plants in the field resulted in good establishment (90%) quickly followed by new growth.

Mean tuber yield in the presprouting minisetts was 400 g, with a range 80–1252 g. These results demonstrate that some lines have very strong sink or good bulking ability — a character

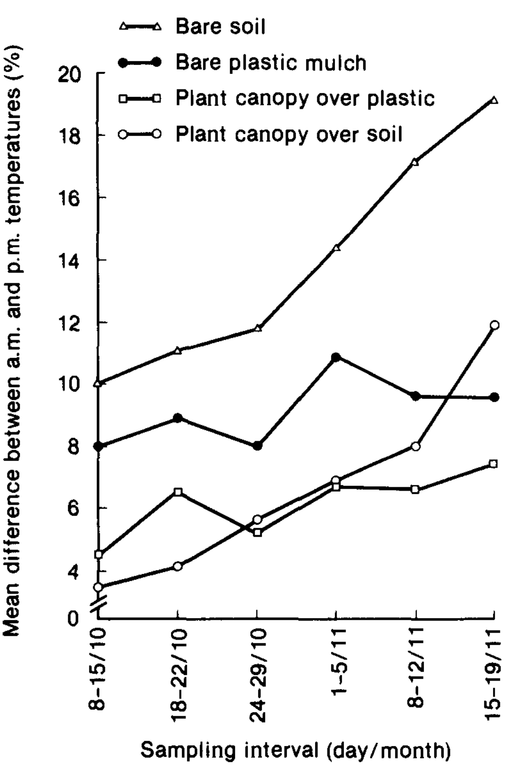

Fig. 2. *Mean difference in soil temperatures at 5 cm deep between 0900 h and 1400 h.*

that may be important for efficiency in seed-yam production from minisetts.

In the studies with Cotoran and Dual as a preemergence herbicide, the control plots required a minimum three weedings, whereas the herbicide-treated plots were sprayed once and weeded once by hand. The herbicide had no noticeable phytotoxic effect on the plants.

The yield from herbicide-treated plots was not statistically different from hand-weeded plots (Table 3). The yield (3 t/ha) of the check cultivar, Nwapoko, with herbicide and no staking was lowest, whereas this treatment gave the highest yield (16 t/ha) for Abi. Abi, a vigorous starter, was able to establish a canopy after one weeding. Besides early establishment, Abi showed resistance to virus and other field diseases.

The modified staking allowed the plants to form a canopy that subsequently suppressed weeds. The PVC pipes and plastic mesh provided good material for stakes, being undamaged by termites and reusable, unlike bamboo stakes.

The use of the plastic-strip mulch gave good weed control and did not adversely affect the plants. At 5 cm deep, bare soil averaged the highest afternoon temperature (40.7°C ± 5.3), followed by bare plastic mulch (36.2°C ± 2.1). The plastic mulch and soil that were covered by yam canopy averaged 33°C each (Fig. 2).

Once there was reduction in soil moisture for plots that were not mulched, the leaves were shed, and the soil temperatures increased markedly in the afternoons. Some plants with plastic mulch still retained green leaves at harvest. Mean soil moisture under the plastic mulch 1 week before harvest was 6.7% and was significantly different ($P < 0.01$) from that (2%) of unmulched soils.

There was no adverse effect of the plastic mulch on the tubers. Termites, mealybugs, and nematodes were present in negligible quantities in all plots; however, *Pratylenchus sefaensis*, root-lesion nematodes, were found only under the plastic mulch and could make a difference if the next crop is a host. Although yield differences were marginal, other than those for Nwapoko, the value of the labour saved and the increased yield was appreciable.