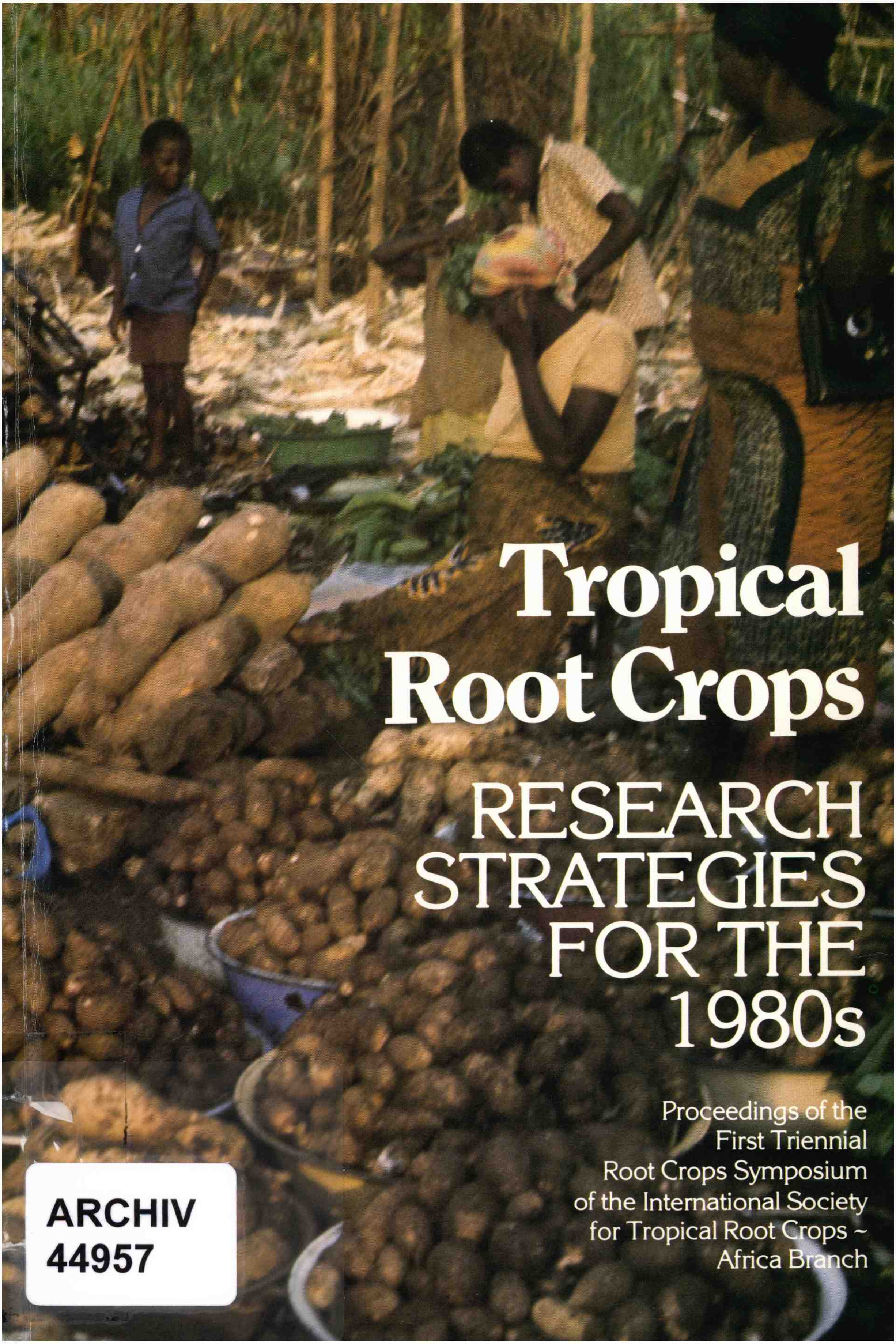

Tropical Root Crops

RESEARCH STRATEGIES FOR THE 1980s

Proceedings of the First Triennial Root Crops Symposium of the International Society for Tropical Root Crops ~ Africa Branch

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Tropical Root Crops: Research Strategies for the 1980s

Proceedings of the First Triennial Root Crops Symposium of the International Society for Tropical Root Crops — Africa Branch, 8–12 September 1980, Ibadan, Nigeria

Editors: E.R. Terry, K.A. Oduro, and F. Caveness

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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 is 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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CANADA

CONTENTS

BREEDING CASSAVA RESISTANT TO PESTS AND DISEASES IN ZAIRE

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Cassava in Zaire is attacked by three major diseases, namely mosaic, bacterial blight, and anthracnose. Recently two pests, mealybug and green spider mite, have attained considerable importance in cassava production. Stem dieback observed in 1978 is now becoming important with some varieties at M'vuazi. The causal agent for the disease is not yet known. Keeping in mind the sequential appearance of the diseases and pests in cassava and the factors favouring their development, I developed a procedure for a thorough screening of the breeding material. The results obtained with this procedure allowed the identification of clones with tolerance to diseases. Some plants showing least damage by mealybug have been identified and are again being screened to confirm the results. Resistance to mealybug appears to be very low in the population tested. Success in artificial hybridization between wild cassava plants possessing genes for resistance and cultivated types has been obtained.

Au Zaïre, les trois principales maladies qui s'attaquent au manioc sont la mosaïque, la brûlure bactérienne et l'anthracnose. Mais tout récemment, les cochenilles et les teignes sont venues ravager les récoltes. La rabougrissement observé depuis 1978 à M'vuazi s'étend à d'autres variétés et la cause de la maladie est encore inconnue. Une méthode de sélection du matériel génétique a été mise au point en fonction de l'apparition séquentielle des maladies et des ennemis du manioc en prenant en compte les facteurs favorisant leur développement. Ce procédé a permis d'identifier des clônes tolérants aux maladies. On étudie également plusieurs variétés moins affectées par les cochenilles afin de confirmer ces résultats. Mais la résistance semble très faible dans la population étudiée. Cependant, les chercheurs ont réussi l'hybridation de plants de manioc cultivés avec des plants sauvages possédant des gènes de résistance aux cochenilles.

Cassava in Zaire is seriously attacked by three major diseases, namely bacterial blight, mosaic, and anthracnose. In addition to the diseases, two pests, mealybug and green mite, have attained considerable importance in cassava production.

Cassava bacterial blight (CBB) was first observed in Bandundu region of Zaire in 1970 (Ezumah and Sebasigari 1976). Since then it has spread to all the regions of Zaire. Mosaic has been prevalent on cassava throughout the republic in various degrees of seriousness probably since cassava introduction. Anthracnose is also recorded in all the regions but is known to be particularly serious in Bandundu region. In the past 2 years, stem dieback has been observed on most of the cassava varieties at M'vuazi. It normally appears only in the old plants and in the dry season. The actual causal agent for this is not yet known. This year the disease has attained a serious proportion in the material at M'vuazi.

Of the two pests, mealybug was first recorded on cassava near Kinshasa in 1973, but it was not widespread at that time. By the year 1976 it became very serious and almost threatened the production of cassava in Bas-Zaire region. Now it is prevalent in scattered pockets in most of the southern regions of Zaire. Green spider mite, which was first recorded in Kivu region, was supposed to have been introduced from Uganda. This pest has now been observed in all the regions of Zaire.

The main vehicle of the fast spread of diseases and pests in Zaire is the uncontrolled movement of infected planting materials from one place to another by business people and the farmers.

IMPORTANCE OF DISEASES AND PESTS

The diseases and pests, particularly CBB, mosaic, mealybug, and green spider mite, cause reduction in root yields as well as cassava foliage. Root-yield losses varying from 57 to 90% in susceptible cassava varieties have been reported from different places (Terry 1978). An average root-yield reduction of 50% from mosaic-infected fields has been reported by Jennings (1970).

Mealybug has been reported to cause a yield reduction varying between 54 and 85%, depending on plant age at infestation (PRONAM 1979).

CBB in its severe form causing leaf drop and stem dieback seriously affects the supply of cassava leaves during the rainy season. The cassava leaves are widely consumed in Zaire as a source of protein. On top of this, mealybug and green spider mite appearing in the dry season restrict the growth of terminal shoots and thus further restrict the foliage production.

The diseases and pests causing losses in root yields and leaf production appear sequentially at different plant growth stages. Although cassava mosaic has been observed even at the beginning of plant growth, blight is generally considered to appear first (February–March) and is followed by mosaic that attains its peak expression in May–June. Anthracnose normally begins to appear in June–July when plants are 6–7 months old, and it continues to spread through the dry season. The dry season also favours infestation by pests. Green spider mite first appears soon after the beginning of the dry season (June–July) when the weather at M'vuazi is relatively cool (18–22°C). Later, in August, when the temperature rises, mealybug infestation starts and continues till the beginning of the rainy season in October.

Keeping in mind the sequential appearance of the diseases and pests throughout the growth of cassava and the advantage of vegetative means of cassava propagation, I developed a procedure for thorough screening of cassava seedlings to identify those that have resistance to three major diseases and mealybug (Singh 1979).

The procedure consists of planting the seed material at the end of October with the onset of the rainy season. Artificial inoculation of 1–2-month-old seedlings is done in December with a syringe or with the tong method (Pacumbaba 1979). The symptoms begin to appear after 3–4 weeks, but wilting of leaves and dieback take a longer time. Therefore, final screening against CBB is done in the month of March. Susceptible plants are rogued out, and in April the remaining plants are detopped to initiate new growth. Symptoms will be clearly expressed. Only the plants showing serious leaf deformation are rogued out. Remaining plants are then screened for anthracnose under natural infestation. As the plants grow older, the susceptible ones begin to show stem cankers and defoliation. Scoring for anthracnose is done as late as harvest time along with final plant selection.

For screening against mealybug, one obtains stakes from the detopped plants and plants them separately in a nursery, taking care that their family identity is maintained. Stakes planted at the end of April have a month of rainy season for sprouting and growth. The following dry season restricts their growth so that they are most susceptible to infestation. In August, one artificially infects the plants by leaving a mealybug-infested twig on the growing tip of each plant in the nursery. The insects move from the twig to the growing tip and start developing a colony. Screening against the pest is done at the end of September or beginning of October before the rainy season. Plants are scored against mealybug on 1–5 scale (PRONAM 1977).

Screening against Diseases

Of 13 970 plants inoculated artificially with CBB, 7392 plants died from the disease. These plants were rogued out. The remaining plants showed some symptoms but no dieback. These plants were detopped for mosaic screening. Some of the detopped plants did not recover and died. Scoring for mosaic revealed very few plants with scores of 4 and 5, the majority being in the 1–3 range. These were retained for screening against anthracnose. Later scoring of plants against anthracnose was done under natural infection, and the plant population showed considerable variation. The results showed that a large proportion of plants fell into scores of 1 and 4 (1208 and 1427, respectively), whereas the frequencies for scores 2, 3, and 5 were 207, 319, and 327, respectively. Because screening against anthracnose has been done under natural infection, all the plants showing a score of 1 may not be resistant, and the results need confirmation. The score of 4 for 1427 plants does not necessarily represent very serious damage because it was recorded even for those that only showed cankers on the top third of the plant but not in serious form.

After the disease screening, single plants showing good plant vigour, tolerance to three diseases, and good root formation were selected for further evaluation, and 438 clones established from the single plants selected from the nursery were screened in 1980 against three diseases (Table 1).

A majority of the plant selections made in the seedling nursery for resistance to CBB and anthracnose have been effective. Selections made for resistance to mosaic, however, showed considerable variation, and a good number of these plants showed scores as high as 4 and 5. The appearance of plants with scores of 4 and 5 reflects the high environmental influence in masking the expression of mosaic symptoms, or, in other words, the character has very low heritability.

Table 1. Scoring of plants at 3 and 6 months in the clonal nurseries against CBB, mosaic, and anthracnose.

Disease	Disease score[a]				
	1	2	3	4	5
			Nursery I plants		
CBB	45	129	41	3	0
Mosaic	47	76	88	8	0
	(46)	(55)	(99)	(19)	(0)
Anthracnose	156	1	32	29	1
	(127)	(4)	(46)	(39)	(3)
			Nursery II plants		
CBB	83	71	37	21	7
Mosaic	31	55	64	50	19
Anthracnose	202	13	4	0	0

[a]Figures in parentheses are the scores for 6-month-old plants.

SCREENING AGAINST PESTS

The mealybug screening nursery established in April 1979 was infested artificially in August, and plants were scored in October before the rains. Single-plant scoring showed that 42 and 1939 plants, respectively, showed scores of 1 and 2, whereas 1906, 1850, and 757 plants, respectively, showed scores of 3, 4, and 5.

It is clear that resistance to mealybug is very rare. Only 0.07% of plants showed no plant damage. Single-plant selection was based on degree of infestation and plant damage. The selected plants (123) belonged to 85 families. Two families, TMS 3055 × P2 and NR 7718, comprised 7 of 56 and 5 of 13 plants with least damage, whereas other families constituted only 1 or 2 plants. Five stakes from each of the selected plants were planted in April 1980 for reinfestation to confirm their level of resistance. Each plant in these clones has been infested and will be scored in October for more reliable estimates.

In addition to the search for resistance in cultivated cassava, a crossing program has been initiated so that gene(s) for resistance to mealybug can be transferred from wild cassava to adapted cassava varieties. Some success in hybridization has been attained. It is noteworthy that the wild cassava is not amenable to cloning through stakes.

A clonal nursery of 1460 lines was screened against infestation by green spider mite. The results showed that 51 and 221 clones respectively were rated with scores of 1 and 2, whereas 538, 348, and 301 clones were, respectively, rated with scores of 3, 4, and 5. The above results indicate that resistance to green spider mite appears to be more frequent than is that for mealybug (PRONAM 1979).

Results obtained so far from the screening clearly indicate the possibility of obtaining clones that will have a reasonable level of resistance to all the three diseases and pests combined with good yield potential.