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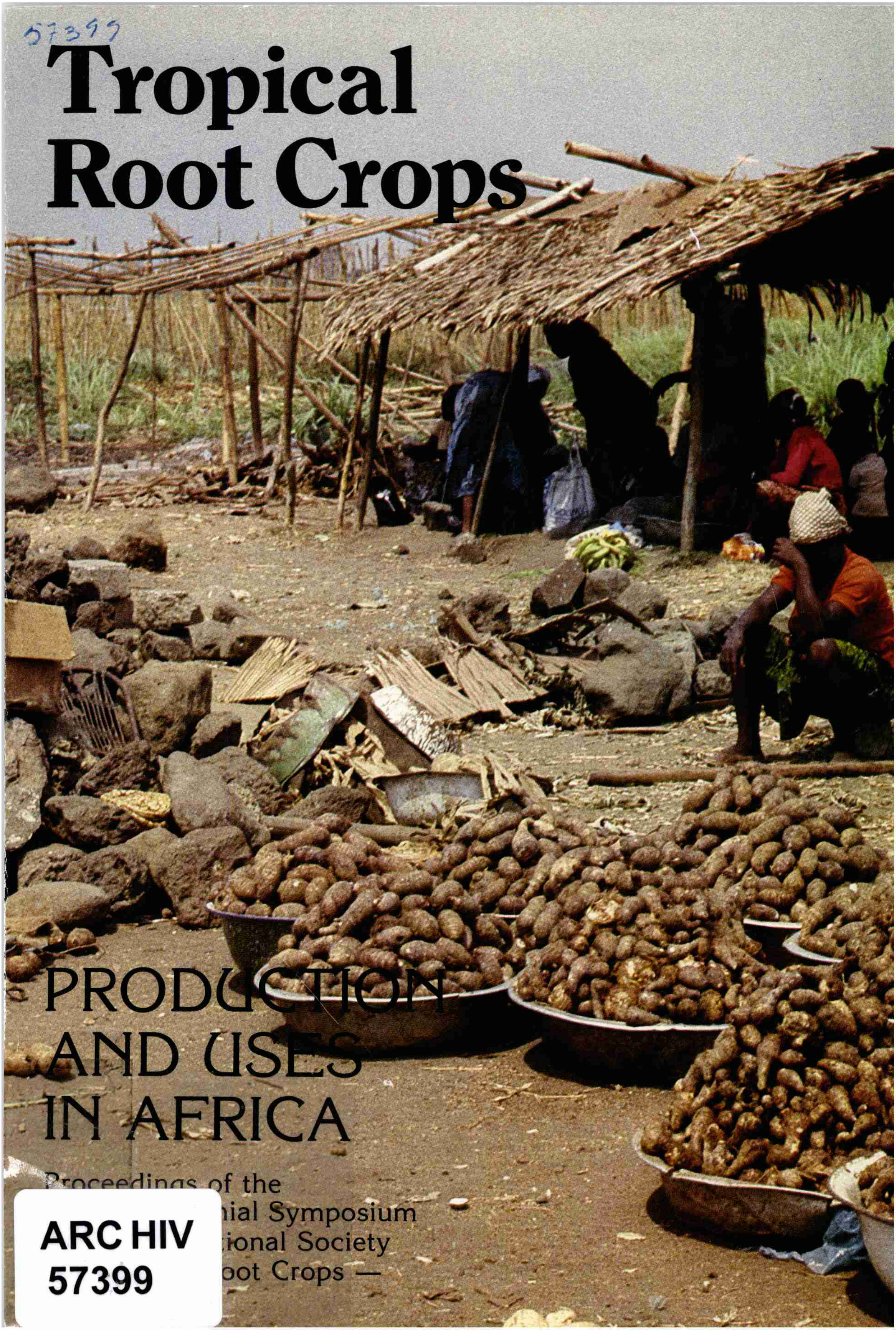

Tropical Root Crops

PRODUCTION AND USES IN AFRICA

Proceedings of the
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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

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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.

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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

CONTENTS

Root rot of *Xanthosoma sagittifolium* caused by *Pythium myriotylum* in Cameroon

Samuel Nzietchueng[1]

In Cameroon, root rot of macabo (or new cocoyam) (*Xanthosoma sagittifolium*) is a disease caused by *Pythium myriotylum*. It is widespread in the major areas of cultivation. Its development is directly related to certain environmental factors, such as heavy rainfall accompanied by high temperatures. The disease is transmitted primarily via infected seed (corms) and soil. High plant densities accelerate spread. Metalaxyl has proved effective against *P. myriotylum*, whereas Aliette has not.

*Pythium myriotylum*Drechsl has been cited as the pathogenic agent responsible for root decay in several graminaceous and leguminous plants (McCarter and Littrell 1968, 1970; Littrell and McCarter 1970; Ridings and Hatran 1976; Csinos 1979; Lipps 1980; Lipps and Bruell 1980; Minyogok 1981; Devay et al. 1982). The most characteristic symptoms are stunting and yellowing of the leaves (Csinos 1979; Nzietchueng 1980a,b; Devay et al. 1982). *Pythium* spp. organisms are major phytopathogenic agents, and a number of studies have been published dealing with identification and modes of dissemination as well as means of controlling these pests (Bell 1967; Gary and McCarter 1968; Adegbola and Hagedon 1969; Cox 1969; Frank 1968, 1972; Watanabe 1977). In general, heavy rainfall along with high temperatures and high plant densities promote the development of *Pythium* spp. diseases (Hendrix and Campbell 1973; Nzietchueng 1983a,b). In every instance, the disease is transmitted primarily via infected soil and seed. Fungicides have recently appeared on the market that have proved effective against *Pythium* spp. and *Phytophthora* spp. (Bakala and Trocme 1978; Bruck et al. 1980; Farih et al. 1981).

In this paper, I report the results of studies on macabo root rot in Cameroon that were carried out from 1979 to 1982 under the National Root Crop Improvement Program.

Disease symptoms on vegetative portions are stunting of the plant and yellowing of the leaves. In acute cases, the attack is brutal. The planted corms (seeds) are incapable of germinating or else germinate but fail to grow properly. This poor development of the plant is related to inadequate root formation, as the newly produced roots are destroyed by the parasite. The disease occurs as pockets of infection that gradually spread. These symptoms are characteristic of damping-off caused by soil-borne fungi.

In chronic forms, yellowing of the leaves is observed once the plants are firmly established (at roughly 3 months). This is by far the most common symptom. Yellowing begins by more or less regularly shaped spots on the edge of the lamina, which becomes chlorotic. The entire lamina then loses its colour, turns yellow, and shrivels up. As with the acute form, the disease occurs as pockets of infection that extend little by little.

According to Viennot-Bourgin (1964), organic disorders in herbaceous plants caused by soil-borne fungi generally develop when the plant is young. They may also occur when bulbs, tubers, and rhizomes begin to store reserves. In the case of the macabo, the onset of root rot coincides with cormel formation. As a result, infected macabo plants bear a number of cormels, but these are no larger than palm nuts.

Rot starts at the tip of the corms but lesions may occur anywhere on the root. The decayed tissue is initially dark brown but later turns black. When the infected root (soft rot) is pressed between the fingers, a central cylinder is found to be intact. This suggests that in the early stages of infection, the causal agent is a cortical endophyte that develops intercellularly. *Pythium myriotylum* is known to develop an in-

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Table 1. Influence of the amount of inoculum (*P. myriotylum*) on the development of the disease in the field in macabo planted on 8 April 1981 and artificially inoculated on 12 June 1981.[a]

	Observation dates (day/month)						
Crushed mycelia/ 50 mL water	26/06	09/07	23/07	07/08	21/08	08/09	17/09
200 cm^2	0.0	1.8	2.5	3.1	3.8	3.9	3.9
100 cm^2	0.0	1.0	2.0	2.8	3.0	3.1	3.2
50 cm^2	0.0	0.9	1.2	1.8	2.4	2.5	3.0
0	0.0	0.0	0.5	0.9	1.5	2.0	2.8

[a]Scoring system: 0 = healthy plant; 1 = 25% infected; 2 = 50% infected; 3 = 75% infected; 4 = 100% infected.

ter- and intracellular mycelium in the hypocotyl tissues of the bean *Phaseolus* sp. and secrete proteolytic and pectolytic enzymes (pectin-methylesterase) in culture media (Dow and Lumsden 1975; Nzietchueng 1983a,b, in press).

Artificial infection tests using either the local white macabo cultivar or F_1 hybrids (Nzietchueng 1979, 1980a,b) were conducted in greenhouses and in the field. They demonstrated that *P. myriotylum* was the causal agent (Steiner 1981; Nzietchueng, 1983a,b, in press) (Table 1). However, two other parasites, i.e., *Rhizocgonia solani* and *Fusarium solani*, are often found associated with this agent (Nzietchueng 1983a,b, in press).

History, Distribution, and Development

It is difficult to pinpoint when the disease first made its appearance in Cameroon. According to most authors, it was first observed in the 1970s (Nzietchueng 1980a,b; Minyogok 1981). In heavily cultivated areas, the disease, referred to as Appollo by the peasants, seems to have been present since 1969 (Minyogok 1981).

Macabo root rot is found predominantly in forest areas (Nyong et Kellé, Sanaga Maritime, Nkam, Mungo, Fako et Memé departments). These departments correspond to areas in which the mean temperature ranges from 22° to 27°C from June to October and the mean rainfall is approximately 1800 mm.

The minimum and maximum temperatures for mycelial growth of *P. myriotylum* are 10° and 45°C, respectively, with optimal temperatures in the 25–37°C range. Bell (1967) showed that *P. myriotylum* was particularly virulent in *Arachis* sp. at temperatures ranging from 18° to 35°C. In the forest areas of Cameroon where macabo root rot is prevalent, the temperature is between 18° and 34°C from July to October. In the high western plateaus where the disease is not a serious threat, the temperature for the same period ranges from 13° to 24°C. In the large macabo-growing areas of Cameroon, the pH of the soil is above 5.0. Only in the ferrallitic soils of the western region is the average pH under 5.0. *Pythium myriotylum* mycelium grows best at pH

Table 2. Development of root rot (planting date — 25–30 March).[a]

	15/06	30/06	15/07	30/07	15/08	30/08	15/09	30/09
1979								
% diseased plants	2.8	13.5	32.2	51.8	80.6	95.6	96.6	96.6
Infection index	0.1	0.4	1.2	2.0	3.2	3.9	3.9	3.9
1980								
% diseased plants	13.2	19.2	26.2	56.4	72.0	92.1	95.5	95.6
Infection index	0.4	0.8	1.0	2.2	2.9	3.7	3.9	3.9
1981								
% diseased plants[b]	—	45.0	70.0	80.0	93.8	93.8	93.8	96.0
Infection index	—	1.8	2.8	3.2	3.8	3.8	3.8	3.9

[a]Scoring system: 0 = healthy plant; 1 = 25% infected; 2 = 50% infected; 3 = 75% infected; 4 = 100% infected.
[b]Infected seed used.

Table 3. Influence of seed density on the development of disease and corm yields (planting date: 25 March 1981).

Seed density (plants/ha)	Diseased plants (%)	Infection index	Yield/ plant (kg)[a]	Yield (t/ha)
10000	92.7	3.7	0.95b	9.5
6700	92.5	3.7	1.30bc	8.6
4500	40.1	1.6	2.50a	11.1
3400	45.0	1.8	2.80a	9.3
2500	50.0	2.0	1.90c	5.0

[a]The figures followed by the same letter are not significantly different ($P < 0.05$).

Table 4. Influence of Metalaxyl and Aliette on root-rot development and cormel yields (end August 1981).[a]

Chemical	Amount (g)	Water (L)	Diseased plants (%)	Infection index	Yields (t/ha)[b]
Control	—		92.5	3.7	4.7a
Ridomil	20	10	10.0	0.4	5.6a
Ridomil	10	10	7.5	0.3	10.1b
Aliette	32	32	87.5	3.5	2.9a
Aliette	16	32	85.0	3.4	5.0a

[a]Seed density: 10 000 plants/ha.
[b]Figures followed by the same letter are not significantly different ($P < 0.05$).

6.0 and poorly at pH < 5.0 (Nzietchueng 1983a,b, in press).

In the macabo plant, the disease, like most *Pythium* spp.-induced diseases, spreads via infected soil and seeds. Experiments in 1979–80 using infected and clean seed and clean and infected soil revealed that plants from infected corms planted in infected soil developed poorly all throughout the growing cycle. When infected corms were planted in clean soil and healthy corms in infected soil, the resulting plants always developed the chronic form of the disease, i.e., yellowing of the leaves (Nzietchueng 1983a,b, in press).

Root rot spreads from area to area. In most instances, the infection begins in narrow, closed-in sites where drainage is poor. The disease spreads quickly, gaining 6–8 m a week. At the same time, secondary zones of infection form and fuse, which makes the rate of spread hard to assess.

The rot, which usually emerges in mid-June, is initially slow to develop; from mid-July to the end of August, it progresses rapidly (Table 2). Development can be divided into two phases. During the first, from mid-July to the end of August, the parasite spreads rapidly to new surfaces on the corms. The development of *P. myriotylum* is favoured by the mean temperature (26°C), relative humidity (89%), and rainfall (400–700 mm, July–September, Njombe ecological zone). The second phase extends from the end of August to mid-October and corresponds to the time when the surface area of the corm liable to infection is increasingly reduced. This is followed by a stabilization during which there is a combination of symptoms related to the disease and normal senescence of the plant (from mid-October to the end of December).

High plant densities favour the rapid spread of root decay. Trials conducted in 1980–82 provided evidence that, when the density was low, the disease was slow in its progression (Table 3). At the end of August, the prevalence of the disease was higher than 75% in plots with 6700 and 10 000 plants/ha and 50% or less in plots with less than 5000 plants/ha.

Chemical Control

Ten grams Metalaxyl/10 L water per plant led to rot control in macabo plants in 1981, whereas 20 g/plant proved phytotoxic. Concentrations of 10 g Ridomil per plant produced statistically better yields at harvest ($P < 0.05$). Similar results were recorded in 1982 (Table 4). Experiments with Ridomil in concentrations of 9 g/plant conducted in 1979 and 1980 were less conclusive than tests in 1981 in which the compound was used in concentrations of 10 g/10 L water/plant. The fact that Ridomil is effective only in high concentrations (applied by watering the soil with 10 g/m^2/plant) suggests that the substance undergoes biodegradation by soil-borne organisms or else largely leaches out.

Watering the soil with 1000 μg Ridomil/pot completely inhibits sporulation of *Phytophthora infestans*. Bakal and Trocme (1978) observed that Ridomil was ineffective in controlling brown rot in cocoa pods in Barong-Bikang (South West Province, Cameroon) because of the heavy rainfall. After application, the fungicide leaches out completely. This is also true in macabo corm rot in Njombe. Although macabo yields could be increased by 100% with Ridomil (Table 4), the cost of the fungicide prevents its widespread use. Aliette in concentrations of 32 and 16 g/plant proved ineffective in the control of the disease (Table 4).