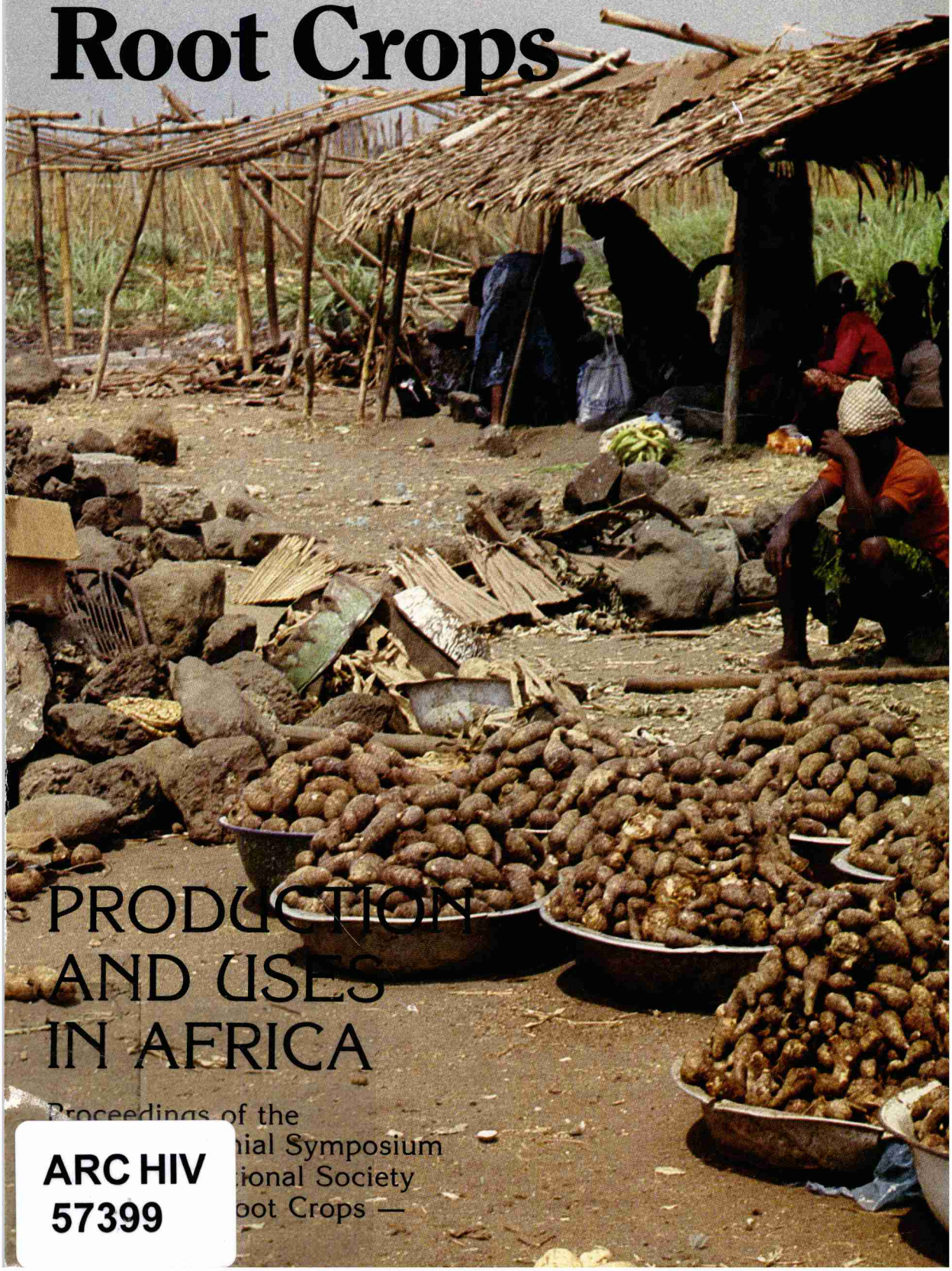
Tropical Root Crops



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

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

SUSCEPTIBILITY OF CASSAVA TO *COLLETOTRICHUM MANIHOTIS*

MUIMBA-KANKOLONGO A.,[1] M.O. ADENIJI,[2] AND E.R. TERRY[3]

Studies were conducted to determine how inoculum concentration, pathogen virulence, cassava host, insect mediation, planting time, and location influence the susceptibility of cassava to anthracnose. The results indicated that the severity of infection is directly related to inoculum concentration and virulence of the isolate, although no specific races were identified among the isolates. A latent phase of *Colletotrichum manihotis* exists, during which its acervuli can be recovered from tender, symptomless stems. *Pseudotherapus devastans* feeding on cassava mediate the initiation of infection, and the degree of infection varies according to planting season and location.

Although anthracnose development and the establishment of its causal agent (*Colletotrichum manihotis*) have been associated with environmental factors (Chevaugeon 1956; Lozano and Booth 1974), the factors contributing to sudden outbreaks of the disease are poorly understood. This paper gives results of several studies of these factors and their influence on the susceptibility of cassava to anthracnose.

MATERIALS AND METHODS

For studies of the effect of inoculum concentration, 7-week-old plants (clones TMS 70775, TMS 63385, and TMS 30001) were sprayed until runoff with spore suspensions of a 7-day-old culture of OW37 isolate containing 0.5×10^3, 1.5×10^4, 4.5×10^5, and 1.5×10^6 spores/mL. In each suspension, including the control, a drop of Tween-80 was added as a wetting agent. The plants were covered with moist, plastic bags to increase humidity and then maintained for 72 h in a controlled environment chamber (26–31°C, 60–80% relative humidity). Defoliation was monitored at 4-day intervals for 20 days.

For studies on the virulence of the causal agent, 18 isolates were collected from different parts of Nigeria. At 1 month old, plants were inoculated with 7-day-old colonies of each isolate by stem puncture at four places in the internodal areas. The inoculation was made with a hot needle, and the length of cankers recorded 10, 20, and 25 days after inoculation.

The possibility of a latent phase of *C. manihotis* on symptomless cassava stems was also investigated. Tender, symptomless tops from 6-month-old plants of 40 cassava genotypes were cut into four small segments (6 cm long) and washed thoroughly in running tapwater. They were surface-sterilized for 5 minutes in 95% ethanol; rinsed in three changes of sterile, distilled water; and allowed to dry for 1 minute. Each segment was maintained at 27–30°C and 68–85% relative humidity in petri dishes containing moist filter paper. When the stem tissues collapsed, they were observed under a stereoscopic microscope for the presence of acervuli of *C. manihotis*. Log transformation of data was used for the analysis of variance.

A study of the biological association between *P. devastans* and *C. manihotis* was conducted. Plants of TMS 30001 were subjected to various treatments, including spray inoculation with conidial suspensions of isolate IITA 11; spray inoculation followed by feeding of *P. devastans*; feeding followed by inoculation; feeding alone; and no feeding and no inoculation (control). Feeding lasted 4 days (three insects/plant), and the inoculum was adjusted to 1×10^4 spores/mL with the hemocytometer. Data on canker formation and size as well as plant death were recorded.

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The reaction of four cassava genotypes (15, 21, 44, and 52) to anthracnose after natural infection was studied for two successive seasons (wet and dry seasons) at four locations (block CS8, C7, C6, and CS4) within the IITA farm. The score on a scale of 1–5 for disease severity was determined by the number of cankers per plant, with 1 representing no cankers and 5, more than 90. The number of cankers was recorded at 1-month intervals from the time that symptoms appeared until cankers coalesced to form tip dieback. The sum of scores for individual plants was divided by the number of plants multiplied by 5 and then expressed as a percentage — the infection index.

Results

The rate of defoliation increased with concentration of inoculum (Fig. 1). Defoliation was 95.8% on TMS 63385 sprayed with 4.5×10^5 spores/mL, whereas it was 17.8% on TMS 70775 sprayed with 0.5×10^3 spores/mL. The three clones did not differ significantly ($P < 0.05$), and none of the untreated plants lost leaves.

Virulence studies indicated that the isolates differed significantly ($P < 0.05$) in their ability to induce cankers (Table 1). Isolates Ib10, ON26, ON27, ON30, OW33, and OW37 were highly virulent on TMS 70775 as were Ab4, Ab25, ON26, ON27, and OW37 on TMS 30001.

Aj40 and IK46 were the least-virulent isolates on all three clones and ON26, OW33, and OW37 were among the most virulent. Clone TMS 70775 was more susceptible than either TMS 63385 or TMS 30001. There was no significant clone–isolate interaction.

The number of acervuli on stem segments of genotypes 2, 14, 29, 40, and 47 (mean log being 2.39, 2.21, 2.04, 1.93, and 2.11, respectively) was significantly higher ($P < 0.05$) than that on genotypes 8, 21, 25, 49, and 50, in which the number was 0.50, 0.58, 0.48, 0.48, and 0.40 respectively. Stem segments of genotypes 8, 15, 23, 27, 31, 32, 38, 44, and 51 did not produce acervuli of the fungus until the completion of the experiment.

After *P. devastans* fed on cassava plants, slight pale-green cankers developed, but there was no evidence of *C. manihotis* colonization. Following inoculation, the cankers rapidly spread along the point of puncture to about 15–20 mm apart. Their length varied with treatments (Table 2). The size (mean, 18 mm) of the cankers on plants in which feeding of *P. devastans* came before inoculation was larger than that for other treatments. About 98.7% of plants in the inoculation-plus-feeding treatment had died by the end of the test (Table 3).

Data indicated significant differences ($P < 0.05$) in the infection index between genotypes, locations, and seasons of planting (Table 3). The dry-season crop had a higher infection index than did the wet-season crop. Genotype 15 in field C7 during the dry season had the highest index (70.1%), with significantly

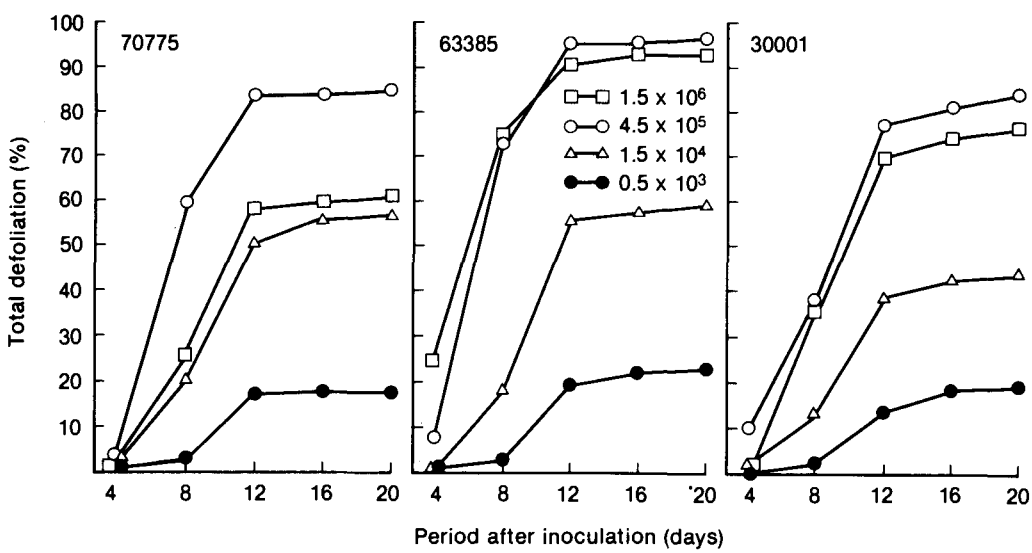

Fig. 1. *Effect of spore concentration on the defoliation of three cassava clones.*

Table 1. Length (mm) of lesions caused by 18 isolates of *Colletotrichum manihotis* on three cassava clones 10, 20, and 25 days after hot stem puncture inoculation.[a]

Isolate	Source	TMS 70775			TMS 63385			TMS 30001		
		10	20	25	10	20	25	10	20	25
Ab4	Ogun	6.0	6.7	6.9	7.3	7.7	8.4	5.9	6.4	6.7
IITA 5	Oyo	9.1	10.1	10.4	5.1	5.5	6.0	6.6	7.0	7.0
IITA 7	Oyo	7.5	8.3	8.3	5.7	6.2	7.2	5.5	5.9	6.2
Ib9	Oyo	6.3	6.9	7.2	6.3	7.3	7.6	6.0	6.2	7.3
Ib10	Oyo	8.9	14.5	15.9	8.4	8.9	10.0	5.6	6.3	6.7
IITA 11	Oyo	7.3	8.5	10.2	6.2	6.9	7.1	4.9	5.5	6.2
Ab12	Ogun	8.0	8.6	8.9	7.0	7.3	7.4	5.1	5.5	6.0
IITA 16	Oyo	9.4	10.4	10.7	6.0	6.6	7.0	5.8	6.2	6.4
IITA 17	Oyo	7.4	8.8	9.6	7.0	7.3	7.8	5.9	6.3	7.0
IITA 19	Oyo	4.0	5.4	6.0	4.5	4.7	5.2	6.0	6.9	7.0
Ab25	Ogun	7.3	11.0	11.3	7.3	7.9	8.1	7.4	7.9	8.2
ON26	Rivers	9.6	11.3	13.2	6.2	6.5	6.5	7.1	7.9	8.1
ON27	Rivers	12.2	14.5	15.7	5.6	6.7	7.1	6.6	7.9	8.0
ON30	Rivers	10.0	11.4	12.2	6.1	6.9	7.1	5.0	5.8	6.0
OW33	Imo	9.4	11.1	12.0	6.0	7.2	7.5	8.9	10.0	10.3
OW37	Imo	10.2	11.5	12.0	6.8	7.0	7.1	6.7	8.1	8.5
Aj40	Ondu	4.2	4.8	5.1	4.1	4.9	5.3	4.2	4.8	5.3
IK46	Ogun	4.1	5.4	6.4	3.9	4.7	4.8	4.4	5.3	5.5

[a]Each value is an average of 4 cankers/plant and 3 replications.

more cankers than any other treatment. The season × location × genotype interaction was not significant ($P < 0.05$).

Discussion and Conclusions

Infection increased with inoculum concentration up to a maximum with 4.5×10^5 spores/mL, decreasing again with the higher concentration of 1.5×10^6 spores/mL. This phenomenon has been interpreted by Van der Plank (1975) as inhibition of spore germination when the inoculum is abundant. The results suggest that the disease prevalence and severity will be greatest in a location where the pathogen is at its optimal concentration.

The invasion of wounded stems by the isolates always resulted in cankers, the severity depending on the clone and the isolate. *Colletotrichum manihotis* is a weak pathogen (Chevaugeon 1956) that invades weakened tissue. That there was no significant clone–isolate interaction showed a total absence of specific races among isolates, but the difference in the length of cankers indicated that the isolates differ in virulence.

Table 2. Effect of *C. manihotis* inoculum and *P. devastans* feeding on the size of cankers and death of cassava.

	Length of cankers[a] (mm)	% death of plants[b] after		
		4 days	8 days	12 days
P. devastans feeding	11.9	0	0	0
P. devastans feeding then *C. manihotis* inoculation	18.0	60.0	84.6	88.4
C. manihotis inoculation then *P. devastans* feeding	14.9	65.4	98.7	98.7
C. manihotis inoculation	0	0.8	2.9	2.9
Control	0	0	0	0
LSD (0.05)	2.8	4.2	23.8	21.7

[a]Each value is a mean of four replications.
[b]Percent mortality based on plants with tip dieback.

Table 3. Anthracnose infection index as influenced by location and season of planting.[a]

Location (block)	Genotype	Infection index (%)[b] Wet-season crop (month)[c] 1	2	3	4	Dry-season crop (month)[c] 1	2	3	4
CS8	21	40.0	45.0	47.5	47.5	20.0	40.0	43.3	47.5
	15	38.2	43.3	47.5	47.5	25.0	52.5	55.1	57.5
	52	29.1	44.6	44.8	50.0	29.5	57.8	62.7	62.7
	44	20.0	20.0	25.0	27.5	24.8	44.1	47.5	47.5
C7	21	37.5	37.5	37.5	40.0	20.0	40.0	42.5	47.5
	15	20.0	20.0	22.4	27.5	45.0	67.7	70.1	70.1
	52	20.0	35.6	37.4	39.8	34.7	52.5	52.5	52.5
	44	20.0	29.1	29.1	29.1	29.5	52.5	52.5	52.5
CS4	21	29.1	29.1	29.1	29.1	20.0	40.0	42.5	47.5
	15	20.0	20.0	20.0	20.0	20.0	62.7	62.7	62.7
	52	20.0	24.8	27.5	27.5	20.0	50.0	55.1	60.2
	44	20.0	20.0	20.0	20.0	27.5	47.5	47.5	47.5
C6	21	22.4	25.0	27.5	27.5	25.0	37.5	40.0	40.0
	15	20.0	20.0	20.0	20.0	27.5	60.2	62.7	62.7
	52	20.0	20.0	20.0	20.0	20.0	54.6	58.0	58.0
	44	20.0	20.0	20.0	20.0	29.9	44.9	47.5	47.5

[a]LSD (0.05) between seasons was 3.7; between locations 1.7; and within genotypes 0.85.
[b]Each value is a mean of two replications and 4 plants/genotype.
[c]Data were recorded monthly from symptom appearance to 4 months.

The death of stem tissues created a suitable environment for the development of *C. manihotis* acervuli, and the occurrence of acervuli on symptomless stems also shows that sporulating cankers are associated with latent infection, which could cause serious outbreaks of anthracnose within cassava plantations.

The inability of the inoculum alone to induce anthracnose cankers is evidence that more than one factor is involved in the development of the disease. Only in combination with *P. devastans*, did the inoculum produce acute infection. This finding supports the conclusion that *P. devastans* is the most important factor for the occurrence of the disease.

Because anthracnose is caused by the interaction of several factors, natural infection may occur when planting is delayed or it may be dormant until the conditions are more favourable. The analysis of variance showed that the interaction between genotype, location, and season was not significant. The significance of the findings is that factors influencing anthracnose vary between cropping periods and within different ecological areas.

We wish to thank Dr M.S. Ghauri for identification of insects, Dr J.E.M. Mordue for identification of fungi, and M.I. Owolabi for arranging the materials used in the experiments.