Studies on Root-Rot Disease of Cocoyam (*Xanthosoma sagittifolium*) in Cameroon caused by *Pythium myriotylum*. Some Aspects of Epidemiology and Control Measures

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ABSTRACT

Root-rot disease caused by *Pythium myriotylum* is the major constraint of cocoyam cultivation in Cameroon. Epidemiological studies led to the following conclusions: disease evolution is influenced by rainfall and temperature; disease is propagated by soil and planting material; high population density favors the disease evolution, while low population density slows it.

Root-rot disease can be controlled with Ridomil (dimēthyl phenyllalaminate de methyl), a systemic fungicide. Aliette (ethyl-phosphite d'aluminium) has a negative effect.

Introduction

Cocoyam or macabo (*Xanthosoma sagittifolium*) is one of the most important root and tuber crops (19) grown in Cameroon. A root-rot disease called "APOLLO" by farmers in the major growing area (4, 19, 22, 23, 24) is a limiting factor of macabo production. This disease, caused by *Pythium myriotylum* (22, 23, 24), was noticed 12 to 15 years ago. *Pythium* spp. are among the more important pathogens and considerable research has been done on their identification, mode of spread and control (3, 8, 12, 13, 14, 15, 16, 17, 25). Generally soil moisture, water logged soil conditions, high soil temperature and high planting density favour development of *Pythium* diseases (1, 7, 11, 16). *P. myriotylum* has been reported to cause root-rot of several grasses, vegetables (8, 9, 11, 18, 20, 25) and cocoyam in Papua New Guinea (McGregor pers. com., 1980). In all cases, disease spread is either through infested soil or infested planting material. Recently a number of fungicides for controlling *Pythium* spp. and *Phytophthora* spp. diseases became available (6, 27).

In Cameroon, macabo is a staple food in the forest area. The Cameroon National Root Crops Improvement Program (C.N.R.C.I.P.) has put more emphasis on the study of cocoyam root-rot for 4 years. This paper presents results of studies on mode of spread of the disease, in space and time, effect of planting density on disease evolution, and some control measures, using two systemic fungicides (Ridomil and Aliette). Results of studies on the symptomatology and etiology of this disease were presented elsewhere (24).

Materials and Methods

Site: All experiments were at Nyombe (80 meters) during the rainy season from the middle of March to the end of November and in volcanic soil. Main crops grown in the area are bananas and pineapple.

Studies on the epidemology of the disease were in 1979, 1980, and 1981. The same cultivar (white) of cocoyam was used each time. For all experiments described below: planting time--15 through 30 March; observations on disease symptoms--June until October; harvest time--end of December.

Investigations on the mode of spread of root-rot

The development of the disease was studied on 625 m^2 plots (planting density--10,000 plant/ha), with the following treatments: (a) infested planting material--infested soil; (b) infested planting material--uninfested soil; (c) healthy planting material--infested soil; healthy planting material--uninfested soil. Disease symptoms were scored as described below.

Evolution of disease in space and time

These studies were in 1979, 1980, and 1981 on experimental (2,500, 1,600, 1,600 m^2) plots, respectively. In 1979 apparently healthy corms were used on a plot previously planted with bananas then fallow one year; in 1980 the same type of planting material was used on a plot previously cropped with sweet potato; in 1981, diseased planting material was used on a plot previously cropped with bananas then fallow one year. Planting density was 10,000 plants/ha.

Disease symptoms were rated on each plant using a 0-4 scale, (0 = no symptoms (0%); 1 = yellowing of 1 to 2 leaves (25%); 2 = yellowing of 3 to 4 leaves (50%); 3 = yellowing of 5 to 6 leaves (75%) and 4 = yellowing of all leaves (100%). These were observed every 2 weeks from the end of May until middle of October. Disease incidence and infection were evaluated at each observation.

Effect of close spacing on disease development

High planting density provided favorable conditions for a fast spread of root-rot of cocoyam. In 1980 and 1981 experiments compared the effect of different population densities on the development of the disease on corms and cormels yields. Planting densities tested (plants/ha): A (10,000); B (6,700); C (4,500); D (3,400) and E (2,500); plot size: 64 m^2; four replications for each treatment; completely randomized block design; disease symptoms were rated as above.

Effect of fungicides on the development of disease

Planting material: Natural infested corms were used.

Chemicals: Two fungicides were tested: N-[2-6 dimethylphenyl[-N-[2 methoxyacetyl]-alanine methyl esterl] (ridomil) and [Phosethyl-al] (Aliette) formulated as 25% a.i. and 80% a.i. wettable powder, respectively. All concentrations are given as active ingredient (a.i.).

Experimental procedure: In 1981 fungicides at different concentrations were applied by soil drenching 1 m^2 away from macabo plant; concentrations tested: control (A) = infested corms; ridomil (B) = 20 g/20 l water/plant in four applications (8-4-4-4); 3, 4, 5 and 6 months after planting; ridomil (C) = 10 g/10 l water/plant in four applications (4-2-2-2) as above; Aliette (D) = 32 g/32 l water/plant and (E) = 16 g/16 l water/plant in 4 applications (8-8-8-8) and (4-4-4-4) respectively as above. Plot size 16 m^2; planting density = 10,000 plants/ha. Five treatments with 4 replications, completely randomized block design. Disease symptoms were rated as above, and yields of corms and cormels evaluated at harvest.

Results

Mode of spread of root-rot

In all cases observed root-rot was spread either by infested soil or infested planting material. Plants from infested corms planted in infested soil developed poorly and remained dwarfed throughout their vegetative cycle. Those from either infested soil with healthy corms or from infested corms with pathogen-free soil developed in most of the cases a yellowing form of the disease (22).

Disease evolution in space and time

Disease spread in foci that develop at the same time in the plot. Most of foci started from water logged sites in the field. Mapping of the disease showed that the rate of the spread is relatively fast. Foci can expand 6 to 8 m a week. In addition, secondary foci developed. Because the spread of the disease is from many foci, it is not always easy to establish the rate of the spread.

Observations on disease evolution showed that the development of root-rot, which usually starts in the middle of June is slow at the beginning then becomes rapid from July until end of August (Table 1 and Figure 1). The disease development curve can be divided in two parts. The first part, from middle of July to end of August, might correspond with the multiplication of pathogen while root surface which can be infected is still adequate. Mean temperature, relative humidity (26°C and 89% respectively) and rainfall (1,800-2,500 mm, July-September) are optimum at the time, in Nyombe, for maximum development of *P. myriotylum* (Nzietchueng, in preparation). The second part from end of August until middle of October might correspond at a time where root surface which can be attacked by the fungus is reduced. A stabilized phase follows where there is mixture of yellowing of leaves caused by disease and those related to the normal senescence of the plant.

Effect of planting density on disease development

The relatively high planting densities provide favorable conditions for a fast spread of root-rot. Experiments in 1980 and 1981 led to the conclusion that low population densities slow disease development (Table 2). At the end of August while disease incidence was greater than 75% in A and B, it was less or equal to 50% in C, D and E. Treatments C and D yielded more corms and cormels than A and B (Table 2).

Table 1. Course of cocoyam root-rot.

Years	Dates Observations	15/06	30/06	15/07	30/07	15/08	30/08	15/09	30/09	15/10
1979	% diseased plants	2.8	13.5	32.2	51.8	80.6	95.6	96.6	96.6	98.1
	Infection index	0.1	0.4	1.2	2.0	3.2	3.9	3.9	3.9	4.0
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*	-	45.0	70.0	80.0	93.8	93.8	93.8	96.0	96.0
	Infection index	-	1.8	2.8	3.2	3.8	3.8	3.8	3.9	3.9

*Infested planting material was used.

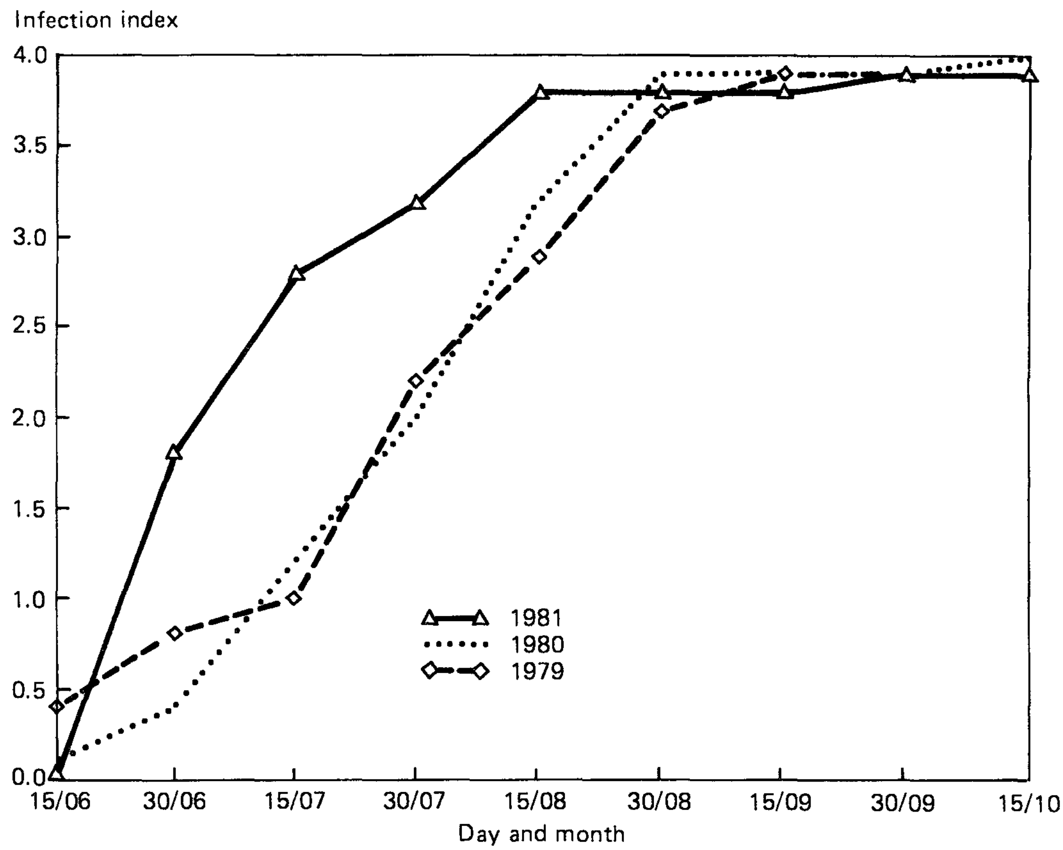

Figure 1. Course of cocoyam root-rot.

Table 2. Effect of planting density on disease development and cormel yield (1981).

Treatments	Planting density	Disease scores (end of August)	Cormels yield/plant (kg)	Yield ton/ha
A	10,000 plants/ha	(1)92.7 (2) 3.7	0.95 b	9.5
B	6,700	(1)92.5 (2) 3.7	1.3 bc	8.6
C	4,500	(1)40.1 (2) 1.6	2.5 a	11.1
D	3,400	(1)45.0 (2) 1.8	2.8 a	9.3
E	2,500	(1)50.0 (2) 2.0	1.9 ac	5.0

(1)% diseased plants.

(2)Infection index; figures followed by same letter are not significantly different ($P = 0.05$).

Effect of Metalaxyl and Aliette on disease development and cormels yields

Metalaxyl showed a positive effect in controlling disease evolution at 10 g a.i./plant. At 20 g a.i./plant, phytotoxicity was noticed. There was also a significant effect ($P = 0.05$) of Metalaxyl on cormels yield at harvest (Table 3). Aliette at concentrations tested did not show a positive effect in controlling root-rot (Table 3).

Discussion

Cocoyam root-rot disease as all *Pythium* spp. diseases is propagated through infested soil and diseased planting material. Disease development is favoured by water logged conditions, high temperature and high rainfall. Close plant spacing enhances disease spread while low planting density slows it.

Metalaxyl was effective for controlling root-rot disease of cocoyam. Previous studies in 1979 and 1980 (19, 23), testing Ridomil at 9 g a.i./m^2/plant show less effectiveness than 10 g a.i./plant in 1981. Effectiveness of Ridomil only at a so high concentration (soil drenching 10 a.i./m^2/plant), indicates possible biodegradation in the soil by microorganisms, or a strong leaching. Metalaxyl used at 1 000 mg/pot as soil drench inhibited completely the sporulation of *Phytophthora infestans* (6, 27). Bakala and Trocme (4) reported that the non effectiveness of metalaxyl for controlling black pod of cocoa (*P. palmivora*) in Barong-Bikang (Sout Province - Cameroon) is due to the high rainfall; fungicide is washed off after spraying. The same is true in the case of cocoyam root-rot in Nyombe (same ecological zone). Although it is possible to increase cormel yields by more than 100% (Table 3), metalaxyl cannot be used at farmers level. Aliette used either at 32 g (a.i.) or at 16 g a.i./plant did not show a positive effect. To reduce disease incidence it is advised to use disease-free material and low planting density. Some degree of control of *Pythium* diseases through resistant cultivars has been reported for beans (2) and a number of other plants (21). More emphasis has been put on this aspect in the control of root-rot disease of cocoyam in Cameroon (Nzietchueng in preparation).

Table 3. Effect of Metalaxyl and Aliette on cocoyam root-rot (1981).

Treatments	Planting Density	Disease Scores (end August)	Cormel yield ton/ha
A	10,000 plants/ha	(1)92.5 (2) 3.7	4.7 a
B	-1-	(1)10.0 (2) 0.4	5.6 a
C	-1-	(1) 7.5 (2) 0.3	10.1 b
D	-1-	(1)87.5 (2) 3.5	2.9 a
E	-1-	(1)85.0 (2) 3.4	5.0 a

(1)% diseased plants

(2)Infection index; figures followed by same letter are not significantly different (P = 0.05).

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