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Distribution of yam anthracnose disease in Nigeria

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Abstract

Yam anthracnose disease, characterized by leaf necrosis and shoot die-back, is a major constraint to the cultivation of yam, especially water yam (*Dioscorea alata* Linn.). Studies were conducted on the distribution of the disease in the major yam growing zones in Nigeria. Yam anthracnose disease was found to be widely distributed in 148 farmers' fields in three agroecologies. The incidence was 52.2% in the southern Guinea savanna, 51.3% in the forest/savanna transition, and 40.3% in the humid forest, with *D. alata* having the highest severity score followed by *D. rotundata*. *Colletotrichum gloeosporioides* (Penz) was the pathogen most commonly associated with the symptoms of anthracnose based on isolations from leaf samples collected from the farmers' fields. *Fusarium* spp., *Rhizotonia solani* (Kuhn), *Botryodiplodia theobromae* (Pat), and *Macrophomina phaseolina* (Tassi) were also isolated from the infected yam leaves.

Keywords: Yam, *Dioscorea* species, anthracnose, yam diseases

Introduction

Yam (*Dioscorea* spp.) are an important food crop in many tropical areas of the developing world, in particular the yam growing zones of West Africa (Farhat et al 1999). Anthracnose disease is a major constraint to the production of *D. alata* (Abang et al 2002). The disease is caused by the pathogen *Colletotrichum gloeosporioides* Penz. (Wharton 1994, Abang 1997), which has been reported to infect a wide range of host species throughout the world (Bailey and Jeger 1992; Sutton 1992). It also survives as a saprophyte on senescent plant material. *Colletotrichum gloeosporioides* is a large species aggregate that has been isolated from several host plants (Lourd et al 1979), such as avocado (*Persea americana* Mill.), banana (*Musa* spp.), cacao (*Theobroma cacao* L.), coffee (*Coffea arabica* L.), mango (*Mangifera indica* L.), pawpaw (*Carica papaya* L.), rubber (*Hevea brasiliensis* Willd.), and a variety of other tropical plants (Jeffries et al 1990). Diseases caused by *C. gloeosporioides* have been reported in a variety of forms, including anthracnose of stems and leaves, die-back, root rot, leaf spot, blossom rot, fruit rot, and seedling blight.

Foliar anthracnose of yam caused by *C. gloeosporioides* is widespread in the tropics. It causes considerable

crop losses in the Caribbean (Degras et al 1984), India (Singh and Prasad 1967), the South Pacific (Van Wijmeersch 1987), and West Africa (Nwankiti and Ene 1984; Abang et al 2002). In the Caribbean, for example, yield losses of over 90% have been reported (Degras et al 1984). Akem and Asiedu 1994 reported its attack on all widely cultivated species of *Dioscorea* in Nigeria and some varieties of *D. alata* are particularly susceptible to the disease. The objective of this study was to determine the distribution of anthracnose disease in different agroecological zones (AEZ) of Nigeria as influenced by the dominant yam species grown.

Materials and Methods

A survey was conducted in major yam growing zones of Nigeria between September and October 1999. The survey covered 14 States across three AEZ (humid forest, forest/savanna transition, and Guinea savanna) in 14 States, Oyo, Kwara, Niger, Kaduna, Nasarawa, Benue, Taraba, Cross River, Abia, Enugu, Ebonyi, Akwa Ibom, Rivers, and Imo. The States and villages were selected based on the previous work of Green (1995) on the distribution and severity of foliar diseases of yam. Within each State, fields were sampled at about 20 km from each other. A global positioning system receiver (Magellan GPS NAV DLX-10™, Magellan System Corporation, 960

Overland Court, San Dimas, California 91773, USA) was used to record the geographical coordinates of each of 148 yam fields visited. Fields were first scored for the presence or absence of anthracnose. Where the disease was present, the severity of the attack was determined. The results of Winch et al (1984) and Akem and Asiedu (1994) in an earlier study confirmed typical anthracnose symptoms to be leaf spots, superficial blackening, underside lesions, and blight. For the determination of disease severity (DS), at least 10 adjacent plants selected at random were observed in each field. Plants were then rated visually on a scale ranging from 1 to 5 as follows:

Healthy looking plant or with a trace of disease – 1
Symptoms of anthracnose – 2 in 2-10 % of leaf area
Symptoms of anthracnose – 3 in 11-25% of leaf area
Symptoms of anthracnose – 4 in 26-50% of leaf area
Symptoms of anthracnose - 5 in >50% of leaf area
Percentage disease incidence was calculated using the following formula:

$$PI = n/N \times 100/1$$

Where PI= Percentage incidence; n = number of plants showing anthracnose symptoms; N = total number of plants.

Samples of infected leaves were also collected for isolation of the causal organism. On each yam field surveyed, agronomic practices such as staking, mounding, and mulching were recorded to assess their possible relationship with disease severity and distribution in the fields.

Results and Discussion

Yam production systems. A map of Nigeria is presented showing locations where anthracnose-diseased yam leaves (isolates of *C. gloeosporioides*) were collected (Fig. 1). Yam cultivation on the farms differed with respect to practices for intercropping, staking, and land preparation. Intercropping of yam with other crops, such as maize, cassava, vegetables, and cocoyam was more common in the forest/savanna transition than in the two other AEZ.

Staking was commonly practiced and in most fields dead wood was used or live trees/shrubs for this purpose (Table 1). Yam were not staked in 22% of the fields in the humid forest and 30% in the Guinea savanna. The methods of land preparation employed

were mounding and ridging, but mounds were more commonly used across the AEZ: 86% in the Guinea savanna, 68% in the humid forest, and 84% in the forest/savanna transition zone. Ridging was used in 13% of the farms in the Guinea savanna, 32% in the humid forest, and 13% in the forest/savanna transition zone. Across the yam growing zones, *D. rotundata* was the most widely cultivated yam species with an occurrence of 48%, followed by *D. alata* with 32% (Table 2).

Incidence and severity of anthracnose disease in three agroecologies. Anthracnose disease was observed in 98% of the 148 fields sampled. Disease incidence was higher in the southern Guinea savanna and the forest/savanna transition than in the humid forest (Table 3). Severity varied from a few leaf spots to complete necrosis of all yam stands in the field and was highest in the humid forest, followed by the southern Guinea savanna and forest/savanna transition (Table 4). Mean scores of ≥ 3 were recorded for *D. alata* across the three AEZ while *D. rotundata* and *D. cayenensis* had severity scores of < 3 . Severity of anthracnose on *D. dumetorum* was highest (3.29) in the forest/savanna transition zone. *Dioscorea esculenta* and *D. bulbifera* had low (≤ 2) severity scores but these species were present in only two AEZ. A wide diversity of yam cultivation methods were observed in practices for staking and land preparation. Staking of yam vines, according to Nwankiti and Ahiara (1984), Nwankiti and Ene (1984) and Akem and Asiedu (1994), reduces the incidence and severity of anthracnose while intercropping tends to increase its severity. Yam anthracnose disease was most severe in the humid forest, indicating a positive relationship between disease severity and rainfall. This agrees with the findings of Sweetmore et al (1994) and Akem and Asiedu (1994) that rainfall, warm temperatures, and high relative humidity are important factors in the severity of anthracnose disease. *Dioscorea alata* was seriously affected followed by *D. rotundata* in all the AEZ surveyed. The implication of this result is that anthracnose disease is a serious threat to the production of yam in Nigeria and resistant varieties should be used in the expansion of *D. alata* cultivation to take advantage of its superiority in ease of propagation, high yielding potential and vigor.

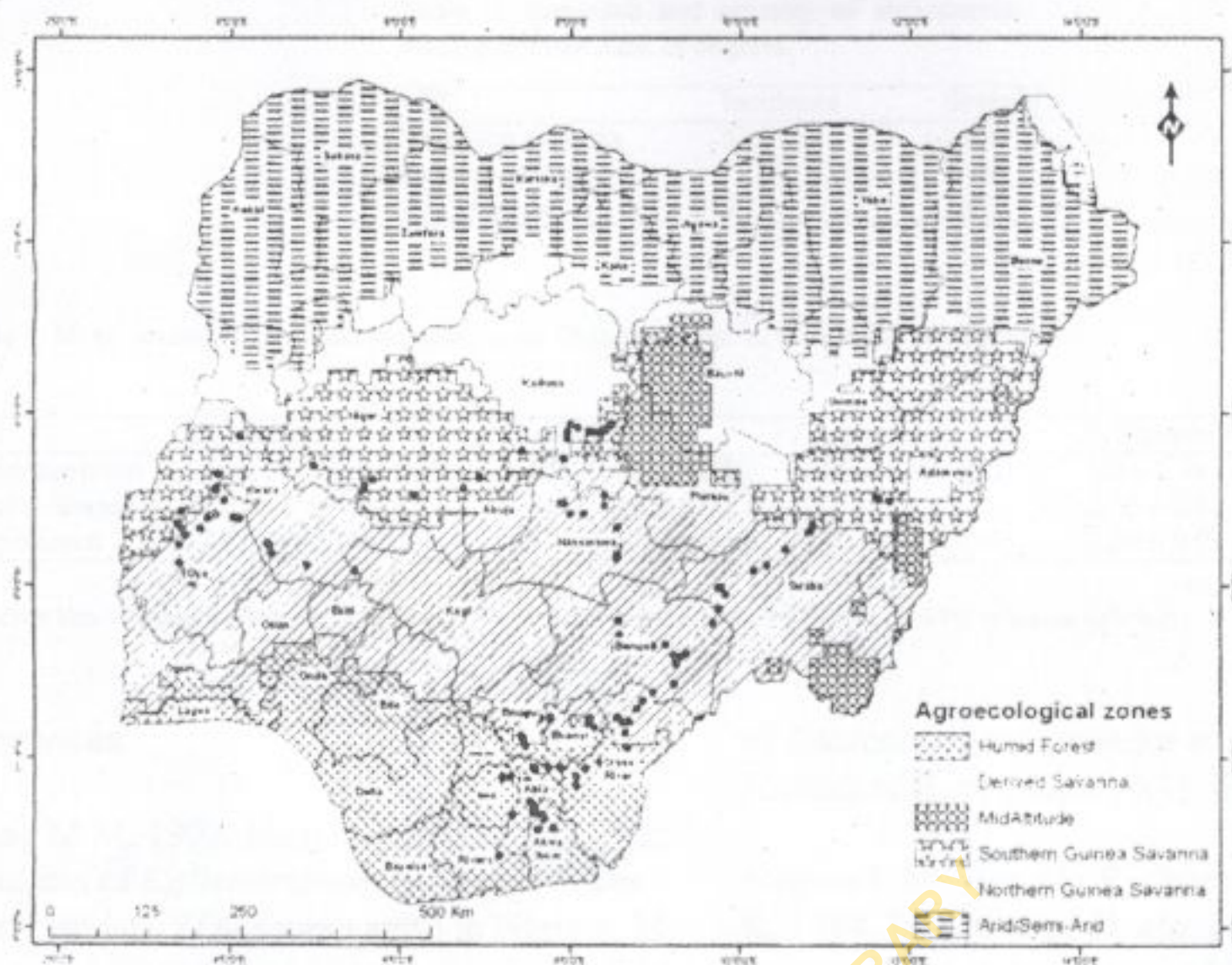


Figure 1. Nigeria, showing locations (●) where anthracnose-diseased yam leaves (isolates of *C. gloeosporioides*) were collected.

Table 1: Cultural practices identified on yam farms in a survey conducted in Nigeria in 1999.

AEZ	Disease severity(1-5)	Land preparation (%)		Material used for staking (%)				
		Ridge/ mound*	Mound	Ridge	Nil	Dead wood	Live tree/ shrub	Cereal stalk
Forest/savanna transition	2.02	3.3	84	13	3.3	11	86	2
Guinea savanna	2.76	0.0	86	13	30	51	19	0
Humid forest	2.95	0.0	68	32	22	75	3	0

*Mixture of ridges and mounds on the same farm

Table 2: *Dioscorea* spp. found in yam fields sampled during a survey in Nigeria in 1999.

Dioscorea sp	No. of fields			Total
	HF	FS	GS	
<i>D. rotundata</i>	48	26	62	136 (48.4)
<i>D. alata</i>	45	19	27	91(32.4)
<i>D. cayenensis</i>	9	-	7	16 (5.7)
<i>D. dumetorum</i>	13	7	9	29 (10.3)
<i>D. bulbifera</i>	3	-	3	6 (2.1)
<i>D. esculenta</i>	1	1	1	3 (1.1)

HF- humid forest

FS – forest/savanna transition

GS –Guinea savanna

Table 3: Incidence and severity of anthracnose disease in three AEZ of Nigeria.

AEZ	Incidence	Severity
Transition savanna	51.33	2.02
Guinea savanna	52.20	2.76
Humid forest	40.30	2.95

Table 4: Mean severity of anthracnose disease on *Dioscorea* spp. in three AEZ of Nigeria.

AEZ	<i>D. rotundata</i>	<i>D. alata</i>	<i>D. cayenensis</i>	<i>D. dumetorum</i>	<i>D. bulbifera</i>
Forest/transition	3.00 ± 0.52 (n=16)*	3.10 ± 0.88 (n=15)	2.86 ± 0.69 (n=7)	3.0 ± 0.76 (n=7)	
Guinea savanna	2.69 ± 0.68 (n=72)	2.94 ± 0.98 (n=31)	-	2.33 ± 0.68 (n=9)	1.83
Humid forest	2.87 ± 0.97 (n=52)	3.50 ± 1.10 (n=43)	2.70 ± 0.71 (n=9)	3.00 ± 0.91 (n=13)	-

*Severity based on scoring categories where 1=1%, 2=2-10%, 3=11-25%, 4=26-50%, 5>50% of leaves infected.

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