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Distribution and current status of bacterial blight and fungal diseases of cassava in Nigeria

T.J. Onyeka, A.G.O. Dixon, R. Bandyopadhyay,
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Executive summary

Two hundred and seventy-seven cassava fields were surveyed in the humid forest, derived savanna, southern Guinea savanna, northern Guinea savanna, midaltitude, Sudan savanna agroecological and Sahel zones of Nigeria. Each field was assessed for the incidence and severity of cassava bacterial blight (CBB), cassava anthracnose disease (CAD), *Cercospora* leaf blight (CLB), and brown leaf spot (BLS). Samples of root rot disease were also collected where present for identification of associated pathogens.

The study identified a regional importance of CBB in the savanna ecozones and of CAD in the humid forest zone. CBB was observed in 32.53% of the fields in the humid forest, 66.43% of the fields in derived savanna zone, 95.45% of the fields in southern Guinea savanna, 90% of fields in northern Guinea savanna, and 94.12% of fields in the Sudan savanna zone. CAD was observed in the humid forest and derived savanna zones but not in any of the other ecological zones. CLB and BLS were observed in all the ecological zones; however, the severity of both diseases was generally low and did not seem to pose a serious threat to cassava tuber yield. With the increasing production of cassava in Nigeria, disease management will become crucial as production expands to the marginal zones. Fungal pathogens isolated from root rot samples included *Aspergillus niger*; *Botryodiplodia theobromae*; *Fusarium* spp.; *Rhizopus* sp.; *Sclerotium rolfsii;* and *Trichoderma* spp. *B. theobromae* which was the most frequently isolated pathogen was obtained from 84.48% of the collected samples while *Fusarium* spp was observed in 39.66%.

The evaluation of the health status of stem cuttings from farmers' fields showed that 82.7% of cuttings from farmers' fields were infected with cassava mosaic disease (CMD). There is a need for multiplication and cutting sanitation program from which clean improved planting materials could be supplied to farmers.

A total of 135 isolates of *C. gloeosporioides* and 83 isolates of *Xanthomonas axonopodis* have been assembled from the different ecological zones in this survey; further study to establish the level of pathogenic variation and the distribution of this variation across ecozones in Nigeria is recommended.

Distribution and current status of bacterial blight and fungal diseases of cassava in Nigeria

Introduction

Cassava is a major food crop particularly in the developing countries of sub-Saharan Africa (Hah et al. 1989). In the past, cassava production in most of these countries was mainly for its starchy tuberous roots that are valuable sources of cheap calories particularly for low-income earners and resource-poor farmers. However, cassava in recent times is gradually gaining a strategic position in the world trade as a result of the effort by various governments and the private sector in developing novel, value-added cassava-based products for human consumption and industrial uses. Cassava can serve as an important engine for growth in many countries if production diversification and commercial use are improved (Anon 2000). With increased production and an improved market, cassava can help fight hunger and poverty in developing countries.

Despite the potentials of cassava in addressing the increasing food demand of the growing population in Africa as well as diverse uses to which it is subjected, the average production of cassava in Africa is currently below the world average (IITA 1990). The activities of various disease agents are some of the major constraints to achieving the full potential of cassava production in Africa. In cassava, losses in tuber yield due to diseases can be as high as 90% (Wydra and Msikita 1998). The need to protect cassava against diseases is, therefore, a crucial aspect of enhancing the production of the crop.

The effectiveness of any disease management practice will depend on the availability of adequate information on the occurrence, distribution, and importance of the disease in a zone or locality. Detailed farm survey data collected from evenly distributed cassava fields in an ecological zone are therefore a prerequisite to effective disease management, and consequently, effective crop improvement effort.

In Nigeria, the combined effect of the recent "Presidential initiative for cassava expansion" and the special project on the "Preemptive management of cassava mosaic disease (CMD) in Nigeria" at the International Institute of Tropical Agriculture (IITA), have led to increased cassava cultivation by the farmers. Therefore, detailed information on the current status of cassava diseases in Nigeria is required for the overall success of these initiatives. In the framework of the preemptive management of CMD project, a comprehensive survey of the current status of cassava diseases on farmers' fields across the various agroecological zones in Nigeria was conducted. This report presents the occurrence and distribution of

bacterial blight (CBB), anthracnose (CAD), brown leaf spot (BLS), *Cercospora* leaf blight, (CLB) and root rot diseases in farmers' fields.

Materials and methods

Farmers' fields from the 36 states and the Federal Capital Territory were surveyed across the 7 agroecological zones of Nigeria between May and November 2003. The survey followed the method described by Ogbe et al. (2003). The number of cassava farms examined in each ecozone varied depending on availability. A total of 277 farmers' fields were surveyed: derived savanna (143); humid forest (83); northern Guinea savanna (10 farms); midaltitude (1); Sahel (1); southern Guinea savanna (22), and Sudan savanna (17). In each farm, the assessment of disease severity was made on randomly selected 30 plants. Each plant was rated on the scale of 1–5 for CBB, CAD, and *Cercospora* leaf blight; and on a scale of 1–4 for BLS, following the scoring system described by Wydra and Msikita (1998) as follows:

CBB: 1 = no symptom; 2 = only angular leaf spots; 3 = angular leaf spots, wilting, blighting, defoliation, and some exudates on stem/petioles; 4 = blighting of leaves, wilting, defoliation, exudates, and tip dieback; 5 = blighting of leaves, wilting, defoliation, exudates, tip dieback, and plant stunting.

CAD: 1 = no symptom; 2 = cankers only on lower parts of the stem; 3 = cankers spread from lower to mid-parts of the stem; 4 = cankers spread from lower to green parts of the stem and stem wilting; 5 = severe leaf wilting, leaf and stem distortions.

Cercospora leaf blight: 1 = no symptom; 2 = necrotic leaf area < 5%; 3 = necrotic leaf area 5–25%; 4 = necrotic leaf area > 25%; 5 = blighted leaf area over 50% and leaf fall.

BLS: 1 = no symptom; 2 = leaf spots only on older and lower leaves; 3 = spots on older and green young leaves on the upper portion of the plant; 4 = spots on older and younger leaves, blighting and defoliation from upper and lower parts of the plant.

In addition to these diseases, samples of cassava root rot were collected where present for identification of the associated pathogens. Leaf and stem samples with CBB and CAD symptoms were also collected for the isolation of pathogens. The geographic position of the each farm was recorded with the aid of a GPS.

Assessment of the health status of stem cuttings from farmers' fields

To assess the health status of stem cuttings from farmers' fields, stems were obtained from representative farms for establishment in the screenhouse. These stems were cut to planting sizes and planted on sterilized soil in plastic pots. The pots were watered every alternate day and maintained for six weeks. The plants were assessed for CBB, mosaic disease, and fungal wilt at 3, 4, 5, and 6 weeks after planting.

Isolation and identification of *C. gloeosporioides* f.sp. *manihotis* isolates

Cassava stems with anthracnose cankers were collected from infected fields during the survey. Small pieces of the infected stems were cut from the edges of the cankers, surface sterilized for 3 min in 10% sodium hypochlorite solution and rinsed in 5 changes of sterile

distilled water. The stem pieces were dried on sterilized filter paper and placed on acidified potato dextrose agar (PDA). The inoculated plates were incubated at 27°C. Identification of the fungus was carried out under the microscope and confirmation made using the procedure of Barnett and Hunter (1987).

Single spore isolation of *C. gloeosporioides* isolates

To obtain single spore cultures of *C. gloeosporioides* isolates, pure culture of each isolate was obtained on quarter strength PDA for 7 days. Conidia from sporulating acervuli were transferred into a sterile test tube containing 1 m of sterile distilled water (SDW). The test tube was shaken thoroughly and a drop of the suspension was streaked on water agar. The plates were incubated at 19°C for 17 h. Using a binocular microscope, colonies originating from single conidia were identified and transferred to PDA plates. Two colonies from single conidia were transferred for each isolate to different PDA plates.

Isolation and identification of *Xanthomonas axonopodis* pv. *manihotis*

The culture medium used was potato yeast glucose agar (PYGA). 20 g of agar, 10 g of calcium carbonate, 5 g of glucose, and 5 g of yeast were added to one liter of SDW in a conical flask. The flask was plugged with non-absorbent cotton wool and wrapped with aluminium foil. The mixture was stirred, heated to boiling, and sterilized for 15 minutes in an autoclave at 1.05 kg/cm^2. The medium was allowed to cool to about 45°C before being poured aseptically into sterile plastic petri dishes and allowed to solidify.

Leaves and stems showing CBB symptoms were collected from infected fields during the survey. The plant materials were cut into 2–3 mm pieces, sterilized for 2 minutes in 10% sodium hypochlorite and rinsed in sterile distilled water. The treated plant materials were aseptically transferred with a pair of sterile forceps to a few drops of SDW in sterile petri plates. The tissues were triturated and the suspension was allowed to stand for up to five minutes (Bradbury 1978). Loopfuls of the suspension were streaked on freshly prepared potato yeast glucose agar. The plates were incubated at 28°C for 72h and observed for bacterial growth. The colonies were purified 3 times by single colony transfer on fresh medium plates until an axenic culture was obtained.

Results

Geographical distribution of cassava diseases

Cassava bacterial blight (CBB). CBB was present in all the 5 major ecozones (humid forest, derived savanna, southern Guinea savanna, northern Guinea savanna, and Sudan savanna). The disease was observed in 32.53% of the fields visited in the humid forest and in 66.43% of the fields surveyed in the derived savanna zone. In the southern Guinea savanna, CBB was observed in 95.45% of the fields visited, while in the northern Guinea savanna it was found in 90% of the field. When the disease severity is considered across different ecological zones, higher severity scores of 3–4 were obtained for cassava farms in the derived savanna, southern Guinea savanna, northern Guinea savanna and Sudan savanna, while farms in the humid forest zone generally had severity scores less than 2 (Fig. 1).

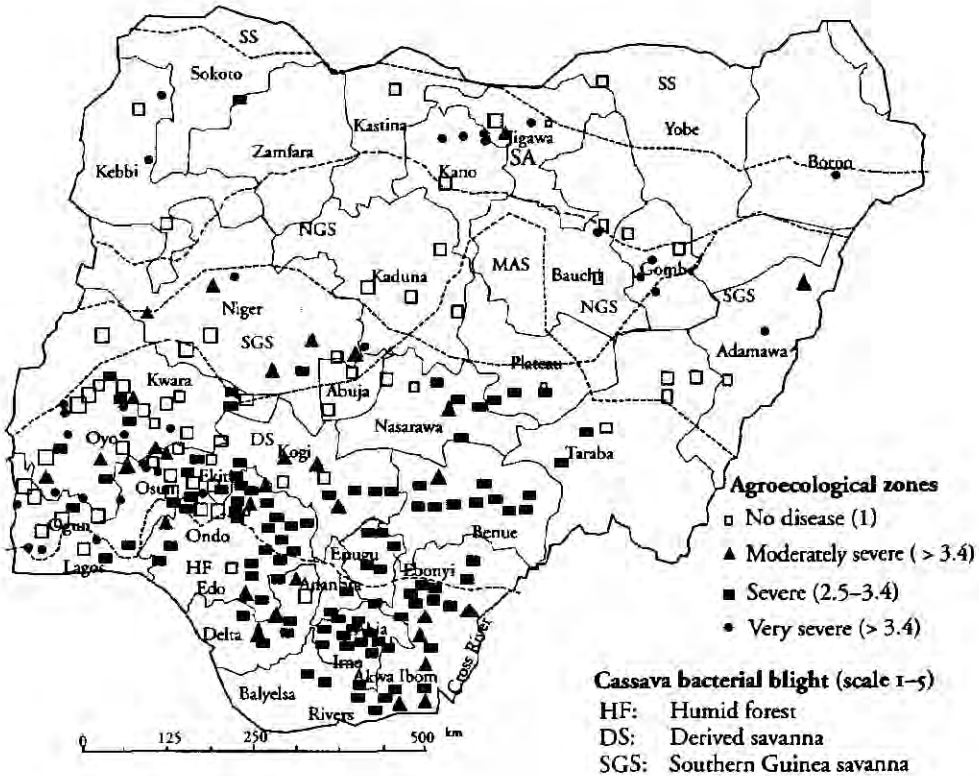

Figure 1. Map of Nigeria showing the distribution of CBB across the various agroecological zones.

On a state basis, states in the south-south and eastern region generally had low disease severity scores, while states in the northern region had high disease severity scores. The highest mean severity score was recorded in Kano (3.19); other states with high severity scores were Borno (3.07), Katsina (3.00), and Kebbi (2.96) (Fig. 2).

Cassava anthracnose disease (CAD). Anthracnose disease was observed in the humid forest and derived savanna zones, while the disease was not recorded in any of the other ecological zones (Fig. 3). In the humid forest zone, CAD was observed in 98.80% of the fields visited, and in the derived savanna zone, the disease was observed in 62.24% of the fields surveyed. On a state basis, the disease was not observed in any of the northern states (Fig. 2). Higher mean severity scores were obtained in Abia (2.95), Ekiti (2.89), Akwa Ibom (2.87), Imo (2.86), and Ogun (2.83).

Brown leaf spot (BLS) and *Cercospora* leaf blight (CLB). These two fungal foliar diseases were observed in all the ecozones. Their distribution across the ecozones followed the same trend (Figs 4 and 5). CLB was observed in 93.98% of the fields visited in the humid forest, and in 92.31% of the fields in the derived savanna. In the southern Guinea savanna, CLB was observed in 68.11% of the fields, in 30% of the fields in the northern Guinea savanna and in 11.76% of the fields in the Sudan savanna.

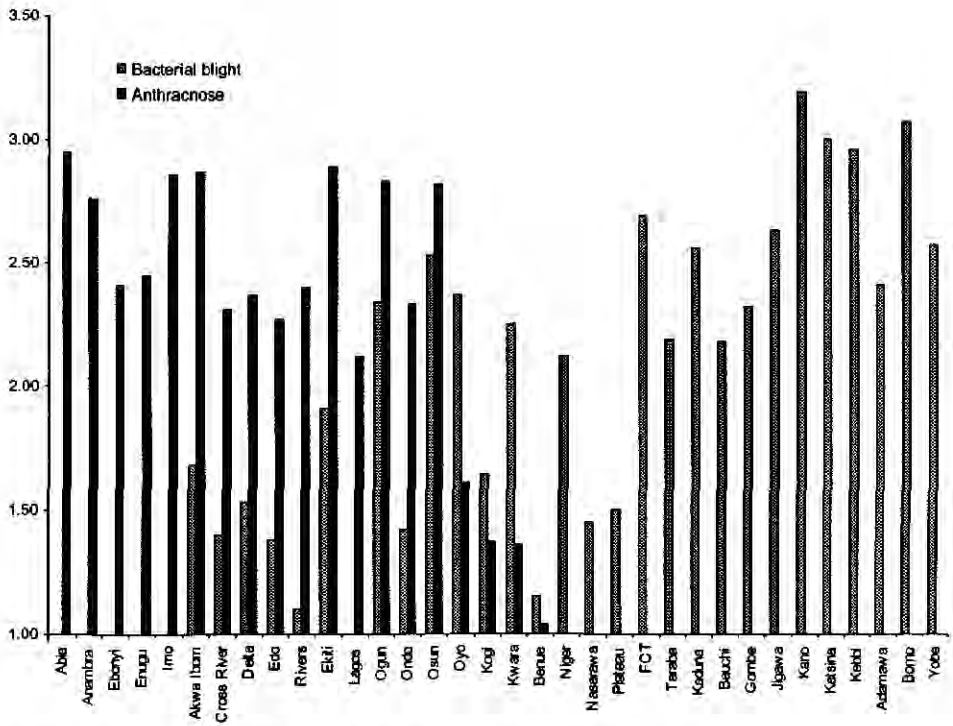

Figure 2. Severity of CBB and CAD in various states of Nigeria.

BLS disease symptoms were recorded in 90.36% of the fields in the humid forest, 95.10% in derived savanna zone, and 77.27% of the fields in southern Guinea savanna zone. In the northern Guinea savanna and Sudan savanna zones, the disease was observed in 20% and in 17.65% of the fields.

The severity of both diseases across the states showed the same trend. Mean severity scores of 1.8–3.0 were obtained for states in the eastern, western, and south-south regions, while scores below 1.8 were obtained for the states in the northern region (Fig. 6). The highest severity scores of 2.31 for BLS and 2.24 for CLB were obtained in Ebonyi state.

Health status of stem cuttings from farmers' fields

The stem cuttings from 52 locations were observed for 6 weeks in the screenhouse. CBB and fungal wilt were not recorded on the plants grown in the screenhouse throughout the duration of the study. CMD was observed starting 3 weeks after planting (WAP) through to 6 WAP in most of the plants. CMD incidence for each location was determined as the pooled incidence of the scores at 3 WAP, 4 WAP, 5 WAP, and 6 WAP. Ranking the pooled disease incidence gave the severity index on which the locations were separated into levels of CMD severity (Table 1). Stem cuttings from 43 locations (82.7%) recorded CMD incidence while cuttings form 9 locations (16.98%) were observed to be free from CMD.

Cassava root rot pathogens. Samples of root rot disease were collected from 58 locations: humid forest zone (22), derived savanna zone (34), and southern Guinea savanna (2). Fungal pathogens isolated from these samples included: *Aspergillus niger*, *Botryodiplodia theobromae*; species of *Fusarium*; *Rhizopus* sp.; *Sclerotium rolfsii*, and *Trichoderma* spp. (Table 2). The most frequently isolated pathogen is *B. theobromae* that was isolated from 49 locations (84.48%), followed by *Fusarium* spp., which was observed in 23 locations (39.66%).

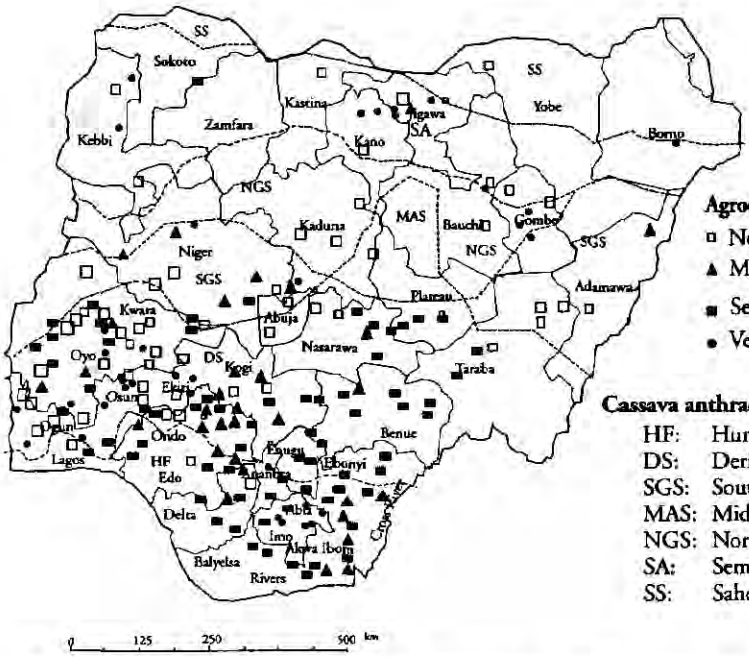

Figure 3. Map of Nigeria showing the distribution of CAD across the various agroecological zones.

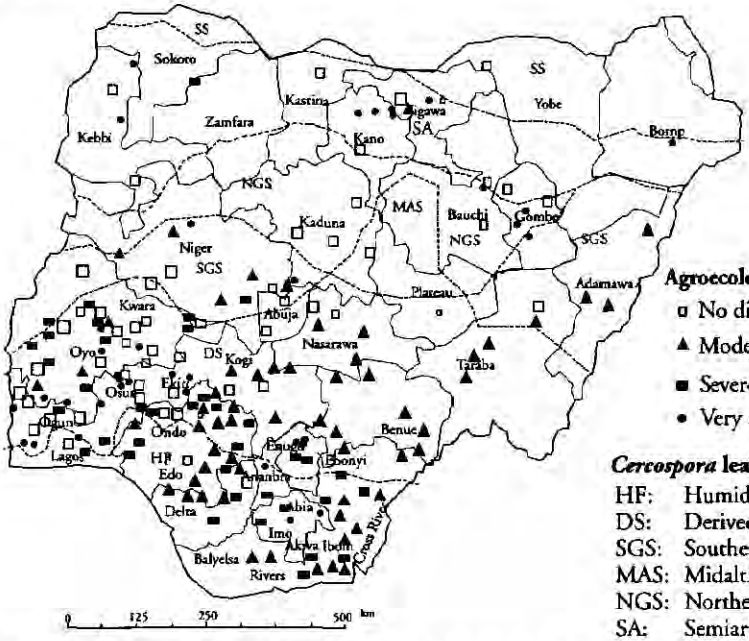

Figure 4. Map of Nigeria showing the distribution of CLB across the various agroecological zones.

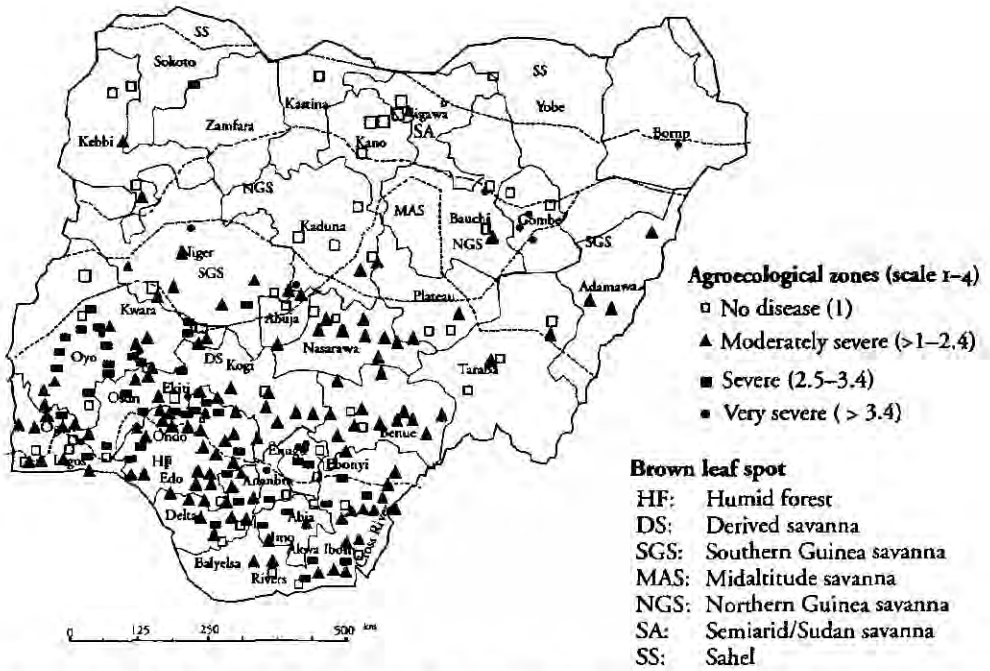

Figure 5. Map of Nigeria showing the distribution of cassava brown leaf spot across the various agroecological zones.

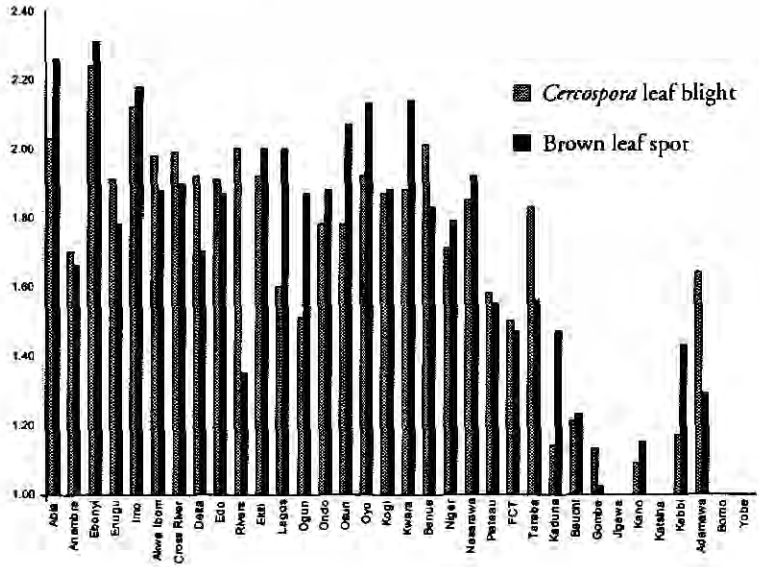

Figure 6. Severity of CLB and BLS diseases in various states of Nigeria.

Table 1. Severity of cassava mosaic disease on stem cuttings from various ecological zones.

Ecozone	State	CMD3	W1	CMD4	W2	CMD5	W3	CMD6	W4	Index	Rank
Derived savanna	Oyo	1.00	1.00	1.00	2.00	1.00	3.00	1.00	4.00	10.00	5
Derived savanna	Oyo	1.00	1.00	1.00	2.00	1.00	3.00	1.00	4.00	10.00	5
Derived savanna	Osun	1.00	1.00	1.00	2.00	1.00	3.00	1.00	4.00	10.00	5
Derived savanna	Oyo	1.00	1.00	1.00	2.00	1.00	3.00	1.00	4.00	10.00	5
Derived savanna	Ogun	1.00	1.00	1.00	2.00	1.00	3.00	1.00	4.00	10.00	5
Derived savanna	Ogun	1.00	1.00	1.00	2.00	1.00	3.00	1.00	4.00	10.00	5
Derived savanna	Oyo	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Osun	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Oyo	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Ogun	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Ekiti	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Osun	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Osun	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Niger	0.89	0.89	1.00	2.00	1.00	3.00	1.00	4.00	9.89	5
Derived savanna	Oyo	0.78	0.78	1.00	2.00	1.00	3.00	1.00	4.00	9.78	5
Derived savanna	Oyo	0.78	0.78	1.00	2.00	1.00	3.00	1.00	4.00	9.78	5
Derived savanna	Kogi	0.78	0.78	1.00	2.00	1.00	3.00	1.00	4.00	9.78	5
Derived savanna	Osun	0.67	0.67	1.00	2.00	1.00	3.00	1.00	4.00	9.67	5
Derived savanna	Ogun	0.67	0.67	1.00	2.00	1.00	3.00	1.00	4.00	9.67	5
Northern Guinea savanna	Gombe	0.50	0.50	1.00	2.00	1.00	3.00	1.00	4.00	9.50	5
Derived savanna	Oyo	0.89	0.89	1.00	2.00	1.00	3.00	0.89	3.56	9.45	5
Northern Guinea savanna	Bauchi	0.33	0.33	1.00	2.00	1.00	3.00	1.00	4.00	9.33	5
Sudan savanna	Jigawa	0.83	0.83	1.00	2.00	0.89	2.67	0.89	3.56	9.06	5
Derived savanna	Ogun	0.39	0.39	0.83	1.66	1.00	3.00	1.00	4.00	9.05	5
Sudan savanna	Katsina	0.89	0.89	0.89	1.78	0.89	2.67	0.89	3.56	8.90	5

Where: CMD3, CMD4, CMD5, and CMD6 are the CMD scores at 3, 4, 5, and 6 weeks respectively. W1=CMD3 *1; W2 = CMD4*2; W3 = CMD5*3; W4 = CMD6*4; Index = weighted mean of symptom severity across the four scoring periods (W1+W2+W3+W4).

Rank = ranking cutting sources in terms of CMD severity (1 = no symptom; 2 = mild; 3 =s evere; 4 = very severe; 5 = extremely severe).

Table 1 (contd). Severity of cassava mosaic disease on stem cuttings from various ecological zones.

Ecozone	State	CMD3	W1	CMD4	W2	CMD5	W3	CMD6	W4	Index	Rank
Sudan savanna	Kano	0.78	0.78	0.89	1.78	0.89	2.67	0.89	3.56	8.79	5
Southern Guinea savanna	Niger	0.78	0.78	0.78	1.56	0.89	2.67	0.89	3.56	8.57	5
Southern Guinea savanna	FCT	0.00	0.00	0.67	1.34	1.00	3.00	1.00	4.00	8.34	5
Sudan savanna	Kebbi	0.89	0.89	0.89	1.78	0.78	2.34	0.78	3.12	8.13	5
Sudan savanna	Kebbi	0.56	0.56	0.67	1.34	0.89	2.67	0.89	3.56	8.13	5
Derived savanna	Nasarawa	0.00	0.00	0.56	1.12	1.00	3.00	1.00	4.00	8.12	5
Derived savanna	Nasarawa	0.00	0.00	0.22	0.44	1.00	3.00	1.00	4.00	7.44	4
Sudan savanna	Gombe	0.00	0.00	0.11	0.22	1.00	3.00	1.00	4.00	7.22	4
Sudan savanna	Kebbi	0.67	0.67	0.67	1.34	0.67	2.01	0.67	2.68	6.70	4
Derived savanna	Benue	0.00	0.00	0.44	0.88	0.44	1.32	0.78	3.12	5.32	3
Derived savanna	Kogi	0.00	0.00	0.22	0.44	0.22	0.66	0.89	3.56	4.66	3
Southern Guinea savanna	Niger	0.22	0.22	0.22	0.44	0.56	1.68	0.56	2.24	4.58	3
Southern Guinea savanna	Taraba	0.00	0.00	0.33	0.66	0.56	1.68	0.56	2.24	4.58	3
Derived savanna	Kogi	0.00	0.00	0.33	0.66	0.33	0.99	0.67	2.68	4.33	3
Southern Guinea savanna	Adamawa	0.00	0.00	0.22	0.44	0.22	0.66	0.78	3.12	4.22	3
Derived savanna	Benue	0.00	0.00	0.11	0.22	0.11	0.33	0.89	3.56	4.11	3
Derived savanna	Taraba	0.33	0.33	0.33	0.66	0.33	0.99	0.44	1.76	3.74	2
Southern Guinea savanna	Kaduna	0.17	0.17	0.17	0.34	0.28	0.84	0.28	1.12	2.47	2
Derived savanna	Kwara	0.00	0.00	0.22	0.44	0.22	0.66	0.22	0.88	1.98	1
Southern Guinea savanna	Kaduna	0.00	0.00	0.00	0.00	0.11	0.33	0.22	0.88	1.21	1
Derived savanna	Kwara	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1
Derived savanna	Kwara	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1
Derived savanna	Kwara	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1
Derived savanna	Kwara	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1
Southern Guinea savanna	Niger	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1
Southern Guinea savanna	Niger	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1
Southern Guinea savanna	Niger	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1

Where: CMD3, CMD4, CMD5, and CMD6 are the CMD scores at 3, 4, 5, and 6 weeks respectively. W1 = CMD3 *1; W2 = CMD4*2; W3 = CMD5*3; W4 = CMD6*4; Index = weighted mean of symptom severity across the four scoring periods (W1+W2+W3+W4).

Rank = ranking cutting sources in terms of CMD severity (1 = no symptom; 2 = mild; 3 = severe; 4 = very severe; 5 = extremely severe)

Table 2. Fungi isolated from root rot samples.

Ecozone	State	ID	Lat.	Long.	*A.niger*	BT	*Fusarium*	*R. stolonifer*	*S. rolfsii*	*Trichoderma*
Derived savanna	Anambra	C1	6.97	6.33	-	+	+	-	-	-
Humid forest	Anambra	C3	6.25	6.95	-	+	+	-	-	-
Humid forest	Anambra	C6	6.16	7.04	-	+	+	-	-	-
Humid forest	Abia	C8	5.47	7.43	-	+	-	-	-	+
Humid forest	Abia	C11	5.73	7.81	-	+	-	-	-	+
Humid forest	Abia	C16	5.42	7.57	-	+	-	-	-	-
Humid forest	Abia	C18	5.59	7.72	-	+	-	-	+	-
Derived savanna	Enugu	C19	6.44	7.54	-	-	+	-	+	-
Derived savanna	Enugu	C20	6.87	7.40	-	+	-	-	-	-
Derived savanna	Enugu	C22	6.89	7.59	-	-	+	-	-	-
Derived savanna	Enugu	C23	6.78	7.71	-	+	-	-	-	+
Derived savanna	Enugu	C24	6.91	7.50	+	+	-	-	-	-
Derived savanna	Ebonyi	C27	6.46	7.79	-	+	+	-	-	
Derived savanna	Ebonyi	C28	6.37	8.37	-	+	-	-	-	-
Humid forest	Ebonyi	C29	6.32	8.19	+	+	-	-	+	-
Humid forest	Ebonyi	C30	6.09	8.01	+	+	-	-	-	-
Humid forest	Ebonyi	C31	5.98	7.98	-	+	-	-	-	-
Derived savanna	Ebonyi	C32	6.57	7.76	+	+	-	-	-	-
Derived savanna	Ebonyi	C33	6.52	7.76	-	+	+	+	-	-
Humid forest	Imo	C35	5.66	6.82	-	+	+	-	-	+
Humid forest	Imo	C36	5.77	7.03	-	+	+	-	-	-
Humid forest	Imo	C37	5.54	7.01	-	+	+	-	-	-
Humid forest	Imo	C42	5.79	7.28	-	-	+	-	-	-
Humid forest	Imo	C44	5.32	7.27	-	+	+	-	-	-
Derived savanna	Oyo	B2	7.85	3.96	-	+	-	-	-	-
Derived savanna	Oyo	B3	8.11	4.21	-	+	-	+	-	-
Derived savanna	Oyo	B8	8.77	4.11	-	+	-	-	-	+
Derived savanna	Oyo	B10	8.93	3.88	-	+	-	-	-	-
Derived savanna	Ogun	B22	7.25	3.54	-	+	-	-	-	-
Derived savanna	Ogun	B23	7.36	3.65	-	+	-	-	-	-
Derived savanna	Ogun	B25	7.12	3.69	-	+	-	-	-	-
Humid forest	Ogun	B27	6.94	3.62	-	+	-	-	-	-
Derived savanna	Ogun	B30	7.43	2.95	-	+	-	-	-	-
Derived savanna	Ogun	B33	7.07	2.90	-	+	-	-	+	-
Derived savanna	Ogun	B36	6.70	2.94	-	+	-	-	-	-
Humid forest	Ogun	B39	6.60	2.96	-	-	+	-	-	-
Humid forest	Ogun	B40	6.73	3.53	-	+	+	+	-	-
Derived savanna	Ogun	B41	6.84	3.85	-	-	+	-	-	-
Derived savanna	Osun	B43	7.36	4.15	-	+	-	-	-	-
Derived savanna	Osun	B47	7.50	4.32	-	+	-	-	-	-
Derived savanna	Osun	B51	7.96	4.80	-	+	-	-	-	-
Derived savanna	Osun	B53	8.00	4.66	-	+	-	-	-	+

Table 2. Fungi isolated from root rot samples.(contd)

Ecozone	State	ID	Lat.	Long.	*A.niger*	BT	*Fusarium*	*R. stolonifer*	*S. rolfsii*	*Trichoderma*
Derived savanna	Ekiti	B59	7.48	5.45	-	+	-	-	-	+
Derived savanna	Ekiti	B62	7.67	5.45	-	+	-	-	-	+
Derived savanna	Ondo	B70	7.26	5.47	-	+	-	-	-	+
Derived savanna	Ondo	B75	7.50	5.75	-	+	-	-	-	+
Derived savanna	Ondo	B78	7.18	5.77	-	+	+	-	-	-
Derived savanna	Kwara	N1	8.41	4.63	-	-	+	-	-	-
Derived savanna	Kwara	N2	8.29	4.78	-	-	+	-	-	-
Southern Guinea savanna	Niger	N17	9.51	5.28	-	-	+	-	-	-
Southern Guinea savanna	Kaduna	N24	9.77	7.45	-	-	+	-	-	-
Humid forest	Delta	D4	6.29	6.49	-	+	-	-	-	-
Derived savanna	Edo	D11	7.11	6.22	-	+	-	-	-	-
Derived savanna	Edo	D12	7.31	6.09	-	+	-	-	-	-
Humid forest	Edo	D16	6.73	6.04	-	+	+	-	-	-
Humid forest	Edo	D18	6.19	5.80	-	+	-	-	-	-
Humid forest	Akwa Ibom	D28	4.68	7.60	-	+	+	-	-	-
Humid forest	C/River	D36	5.98	8.26	-	+	+	-	-	-
Totaloccurrence					4	49	23	3	4	10
% of total sample					6.90	84.48	39.66	5.17	6.90	17.24

+ : isolated; - : not isolated.; BT = *Botryodiplodia theobromae*.

Table 3. *C. gloeosporioides* isolates and their designations.

Isolate	Site ID	State	Ecozone	Lat	Long
1	C1	Anambra	Derived savanna	6.97	6.33
2	C2	Anambra	Humid forest	6.24	7.13
3	C5	Anambra	Humid forest	5.87	6.91
4	C11	Abia	Humid forest	5.73	7.81
5	C13	Abia	Humid forest	5.37	7.37
6	C15	Abia	Humid forest	4.92	7.23
7	C17	Abia	Humid forest	5.99	7.48
8	C19	Enugu	Derived savanna	6.44	7.54
9	C22	Enugu	Derived savanna	6.89	7.59
10	C24	Enugu	Derived savanna	6.91	7.50
11	C25	Enugu	Derived savanna	6.52	7.38
12	C30	Ebonyi	Humid forest	6.09	8.01
13	C31	Ebonyi	Humid forest	5.98	7.98
14	C34	Ebonyi	Humid forest	6.21	8.06
15	C42	Imo	Humid forest	5.79	7.28
16	C44	Imo	Humid forest	5.32	7.27
17	B1	Oyo	Derived savanna	7.63	3.92
18	B4	Oyo	Derived savanna	8.21	4.19
19	B8	Oyo	Derived savanna	8.77	4.11
20	B8	Oyo	Derived savanna	8.77	4.11
21	B14	Oyo	Derived savanna	8.48	3.42
22	B14	Oyo	Derived savanna	8.48	3.42
23	B20	Oyo	Derived savanna	7.61	3.20
24	B20	Oyo	Derived savanna	7.61	3.20
25	B21	Oyo	Derived savanna	7.46	3.27
26	B22	Ogun	Derived savanna	7.25	3.54
27	B23	Ogun	Derived savanna	7.36	3.65
28	B24	Ogun	Derived savanna	7.14	3.40
29	B25	Ogun	Derived savanna	7.12	3.69
30	B27	Ogun	Humid forest	6.94	3.62
31	B28	Ogun	Derived savanna	7.18	3.27
32	B28	Ogun	Derived savanna	7.18	3.27
33	B30	Ogun	Derived savanna	7.43	2.95
34	B31	Ogun	Derived savanna	7.43	2.80
35	B32	Ogun	Derived savanna	7.28	2.79
36	B32	Ogun	Derived savanna	7.28	2.79
37	B32	Ogun	Derived savanna	7.28	2.79
38	B37	Ogun	No data	6.51	2.72

Table 3 (contd). *C. gloeosporioides* isolates and their designations.

Isolate	Site ID	State	Ecozone	Lat	Long
39	B39	Ogun	No data	6.60	2.96
40	B40	Ogun	Humid forest	6.73	3.53
41	B43	Osun	Derived savanna	7.36	4.15
42	B46	Osun	Derived savanna	7.68	4.29
43	B48	Osun	Derived savanna	7.56	4.40
44	B50	Osun	Derived savanna	7.85	4.62
45	B51	Osun	Derived savanna	7.96	4.80
46	B52	Osun	Derived savanna	8.04	4.86
47	B53	Osun	Derived savanna	8.00	4.66
48	B53	Osun	Derived savanna	8.00	4.66
49	B54	Osun	Derived savanna	7.73	4.62
49	B54	Osun	Derived savanna	7.73	4.62
50	B54	Osun	Derived savanna	7.73	4.62
51	B56	Ekiti	Derived savanna	7.50	4.85
52	B57	Ekiti	Derived savanna	7.53	5.08
53	B60	Ekiti	Derived savanna	7.65	5.60
54	B61	Ekiti	Derived savanna	7.81	5.65
55	B63	Ekiti	Derived savanna	7.67	5.11
56	B66	Ekiti	Derived savanna	7.80	5.31
57	B67	Ekiti	Derived savanna	7.70	5.26
58	B68	Ekiti	Derived savanna	7.46	5.23
59	B70	Ondo	Derived savanna	7.26	5.47
60	B70	Ondo	Derived savanna	7.26	5.47
61	B77	Ondo	Derived savanna	7.35	5.89
62	B77	Ondo	Derived savanna	7.35	5.89
63	N56	Kogi	Derived savanna	7.44	7.69
64	N53	Kogi	Derived savanna	7.33	7.00
65	N53	Kogi	Derived savanna	7.33	7.00
66	N56	Kogi	Derived savanna	7.44	7.69
67	N56	Kogi	Derived savanna	7.44	7.69
68	D3	Delta	Humid forest	6.27	6.22
69	D5	Delta	Humid forest	6.30	6.21
70	D5	Delta	Humid forest	6.30	6.21
71	D6	Edo	Humid forest	6.52	6.22
72	D8	Edo	Derived savanna	6.85	6.25
73	D11	Edo	Derived savanna	7.11	6.22
74	D11	Edo	Derived savanna	7.11	6.22
75	D11	Edo	Derived savanna	7.11	6.22
76	D14	Edo	Derived savanna	7.00	6.10
77	D14	Edo	Derived savanna	7.00	6.10

Table 3 (contd). *C. gloeosporioides* isolates and their designations.

Isolate	Site ID	State	Ecozone	Lat	Long
78	D15	Edo	Humid forest	6.82	5.98
79	D15	Edo	Humid forest	6.82	5.98
80	D15	Edo	Humid forest	6.82	5.98
81	D15	Edo	Humid forest	6.82	5.98
82	D17	Edo	Humid forest	6.49	5.84
83	D17	Edo	Humid forest	6.49	5.84
84	D18	Edo	Humid forest	6.19	5.80
85	D21	Delta	Humid forest	5.72	6.39
86	D22	Delta	Humid forest	6.12	6.53
87	D23	Delta	Humid forest	5.63	6.31
88	D24	Delta	Humid forest	5.57	5.88
89	D25	Delta	Humid forest	5.42	6.04
90	D26	Rivers	Humid forest	4.73	7.23
91	D26	Rivers	Humid forest	4.73	7.23
92	D27	Rivers	Humid forest	4.52	7.42
93	D27	Rivers	Humid forest	4.52	7.42
94	D28	Akwa Ibom	Humid forest	4.68	7.60
95	D28	Akwa Ibom	Humid forest	4.68	7.60
96	D28	Akwa Ibom	Humid forest	4.68	7.60
97	D30	Akwa Ibom	Humid forest	4.73	8.08
98	D30	Akwa Ibom	Humid forest	4.73	8.08
99	D31	Akwa Ibom	No data	4.86	8.11
100	D31	Akwa Ibom	No data	4.86	8.11
101	D31	Akwa Ibom	No data	4.86	8.11
102	D32	Akwa Ibom	Humid forest	4.98	7.98
103	D33	Cross River	Humid forest	5.41	8.20
104	D33	Cross River	Humid forest	5.41	8.20
105	D33	Cross River	Humid forest	5.41	8.20
106	D34	Cross River	Humid forest	5.61	8.11
107	D34	Cross River	Humid forest	5.61	8.11
108	D35	Cross River	Humid forest	5.84	8.10
109	D35	Cross River	Humid forest	5.84	8.10
110	D36	Cross River	Humid forest	5.98	8.26
111	D37	Cross River	Humid forest	5.93	8.46
112	D38	Cross River	Humid forest	5.95	8.72
113	D38	Cross River	Humid forest	5.95	8.72
114	D39	Cross River	Derived savanna	6.28	8.66
115	D39	Cross River	Derived savanna	6.28	8.66
116	D39	Cross River	Derived savanna	6.28	8.66
117	D40	Cross River	Derived savanna	6.50	8.74

Table 3 (contd). *C. gloeosporioides* isolates and their designations.

Isolate	Site ID	State	Ecozone	Lat	Long
118	D41	Cross River	Humid forest	5.82	8.84
119	D41	Cross River	Humid forest	5.82	8.84
120	D42	Cross River	Humid forest	5.18	8.19
121	D43	Akwa Ibom	Humid forest	4.80	7.73
122	D42	Cross River	Humid forest	5.18	8.19
123	D43	Akwa Ibom	Humid forest	4.80	7.73
124	D45	Rivers	Humid forest	5.06	6.59
125	D46	Delta	Humid forest	5.81	5.73
126	D46	Delta	Humid forest	5.81	5.73
127	D46	Delta	Humid forest	5.81	5.73
128	B81	Ondo	Derived savanna	7.40	5.07
129	B83	Ondo	Humid forest	6.66	4.80
130	B84	Ondo	Humid forest	6.55	4.75
131	B89	Lagos	No data	6.49	3.86
132	B89	Lagos	No data	6.49	3.86
133	D29	Akwa Ibom	Humid forest	4.63	7.81
134	D1	Edo	Humid forest	6.46	5.62
135	D20	Delta	Humid forest	5.83	6.16

Table 4. *Xanthomonas axonopodis* isolates and their designations.

Isolate	Site ID	State	Ecozone	Lat	Long
1	N2	Kwara	Derived savanna	8.289	4.776
2	N2	Kwara	Derived savanna	8.289	4.776
3	N15	Niger	Derived savanna	8.680	4.894
4	N14	Niger	No data	9.848	4.545
5	N24	Kaduna	Southern Guinea savanna	9.770	7.448
6	N26	Kaduna	Northern Guinea savanna	10.081	7.900
7	N30	Niger	Southern Guinea savanna	9.262	6.992
8	N33	Kebbi	Sudan savanna	10.979	4.768
9	N33	Kebbi	Sudan savanna	10.979	4.768
10	N33	Kebbi	Sudan savanna	10.979	4.768
11	N34	Kebbi	Sudan savanna	11.852	4.413
12	N35	Kebbi	Sudan savanna	12.529	4.381
13	N35	Kebbi	Sudan savanna	12.529	4.381
14	N35	Kebbi	Sudan savanna	12.529	4.381
15	N36	Kebbi	Sudan savanna	12.717	4.630
16	N36	Kebbi	Sudan savanna	12.717	4.630
17	N36	Kebbi	Sudan savanna	12.717	4.630
18	N38	Katsina	Sudan savanna	12.816	7.687
19	N38	Katsina	Sudan savanna	12.816	7.687
20	N39	Kano	Sudan savanna	12.124	8.399
21	N40	Kano	Sudan savanna	11.525	8.373
22	N42	Kano	Sudan savanna	12.167	8.893
23	N42	Kano	Sudan savanna	12.167	8.893
24	N42	Kano	Sudan savanna	12.167	8.893
25	N43	Jigawa	Sudan savanna	12.291	9.009
26	N43	Jigawa	Sudan savanna	12.291	9.009
27	N44	Jigawa	Sudan savanna	12.331	9.792
28	N45	Jigawa	Sudan savanna	12.334	9.520
29	N45	Jigawa	Sudan savanna	12.334	9.520
30	N45	Jigawa	Sudan savanna	12.334	9.520
31	N46	Jigawa	Sudan savanna	12.119	9.271
32	N46	Jigawa	Sudan savanna	12.119	9.271
33	N47	Kano	Sudan savanna	12.100	8.923
34	N47	Kano	Sudan savanna	12.100	8.923
35	N48	Kogi	Derived savanna	7.608	6.222
36	N48	Kogi	Derived savanna	7.608	6.222
37	N51	Kogi	Derived savanna	7.581	6.738
38	N52	Kogi	Derived savanna	7.414	6.934

Table 4 (contd). *Xanthomonas axonopodis* isolates and their designations.

Isolate	Site ID	State	Ecozone	Lat	Long
39	N53	Kogi	Derived savanna	7.325	6.999
40	N57	Benue	Derived savanna	7.586	8.231
41	N70	Taraba	Derived savanna	8.315	10.411
42	N70	Taraba	Derived savanna	8.315	10.411
43	N70	Taraba	Derived savanna	8.315	10.411
44	N71	Taraba	Southern Guinea savanna	8.880	11.248
45	N71	Taraba	Southern Guinea savanna	8.880	11.248
46	N71	Taraba	Southern Guinea savanna	8.880	11.248
47	N72	Taraba	Southern Guinea savanna	8.749	11.269
48	N72	Taraba	Southern Guinea savanna	8.749	11.269
49	N75	Adamawa	Southern Guinea savanna	9.584	12.563
50	N75	Adamawa	Southern Guinea savanna	9.584	12.563
51	N80	FCT	Derived savanna	8.811	7.033
52	N81	FCT	Southern Guinea savanna	9.064	7.204
53	N81	FCT	Southern Guinea savanna	9.064	7.204
54	N82	Nasarawa	Derived savanna	8.964	7.675
55	N82	Nasarawa	Derived savanna	8.964	7.675
56	N83	Nasarawa	Derived savanna	8.838	7.927
57	N84	Nasarawa	Derived savanna	8.913	8.277
58	N84	Nasarawa	Derived savanna	8.913	8.277
59	N88	Nasarawa	Derived savanna	8.530	8.577
60	N88	Nasarawa	Derived savanna	8.530	8.577
61	N88	Nasarawa	Derived savanna	8.530	8.577
62	N93	Plateau	Derived savanna	9.108	9.805
63	N94	Bauchi	Northern Guinea savanna	10.282	10.369
64	N96	Gombe	Southern Guinea savanna	10.096	11.124
65	N88	Nasarawa	Derived savanna	8.530	8.577
66	N88	Nasarawa	Derived savanna	8.530	8.577
67	N98	Gombe	Northern Guinea savanna	10.611	11.378
68	N98	Gombe	Northern Guinea savanna	10.611	11.378
69	N99	Gombe	Northern Guinea savanna	10.482	11.093
70	N99	Gombe	Northern Guinea savanna	10.482	11.093
71	N101	Bauchi	Northern Guinea savanna	10.935	10.445
72	N101	Bauchi	Northern Guinea savanna	10.935	10.445
73	N103	Bauchi	Northern Guinea savanna	10.543	10.129
74	D1	Edo	Humid forest	6.461	5.615
75	D1	Edo	Humid forest	6.461	5.615
76	D1	Edo	Humid forest	6.461	5.615
77	D7	Edo	Derived savanna	6.673	6.347

Table 4 (contd). *Xanthomonas axonopodis* isolates and their designations.

Isolate	Site ID	State	Ecozone	Lat	Long
78	D9	Edo	Derived savanna	7.019	6.327
79	D29	Akwa Ibom	Humid forest	4.628	7.809
80	D38	Cross River	Humid forest	5.946	8.717
81	D38	Cross River	Humid forest	5.946	8.717
82	D41	Cross River	Humid forest	5.820	8.840
83	D42	Cross River	Humid forest	5.176	8.188

Discussion

Cassava bacterial blight. This survey showed that there is a high regional variation in CBB incidence between the savanna agroecological zones and the humid forest zone. These results agree with the report of Wydra and Msikita (1998) in which they observed a site incidence of up to 60% in the savanna zone and 24% for the rain forest. The prevalence of CBB in the savanna zones has been attributed to the survival of the causal organism (*Xanthomonas axonopodis* pv. *manihotis*) in plant debris during the dry season (Persley 1979). Also, rain distribution and temperature are two main factors that determine that the severities of CBB are more favorable for disease development in the savanna. Another factor that could possibly account for the high incidence of CBB in the savanna zones of Nigeria is the planting of a single, often susceptible genotype by the farmers in these zones. The only practicable means of controlling CBB is the use of resistant lines, and this may have contributed to the suppression of CBB in the rain forest where an average farm visited had up to 3 different cassava varieties cultivated. The complete absence of CBB recorded in the southeast states is, however conservative, although previous field surveys showed that CBB incidence varies with variety, location, time of year, and the cropping system (Terry 1978). Also, Akle and Gnouhoue (1979) reported variations in the severity of CBB between years in the Central North of Bénin. It will be interesting to monitor the disease in the southeastern states within the next growing season to compare results with those obtained from the region during this survey. The savanna ecozones of Nigeria provide a good environment for establishment of screening trials since disease expression is optimal in these zones. In contrast, the humid forest ecology with low CBB pressure is ideal for establishment of multiplication trials. With the cassava expansion initiatives currently going on in Nigeria, resistance to CBB must be given adequate attention in genotype selection as cassava production is rapidly expanding to marginal areas.

Anthracnose. While CAD was prevalent in the humid forest and derived savanna zones, it was not recorded in any of the fields in the southern Guinea, northern Guinea savanna, and Sudan savanna zones. According to Wydra and Msikita (1998), this observation is in line with the optimal conditions for the development of the pathogen. CAD usually appears after a long of period of rain and tends to disappear with the approach of the dry season. The causal organism (*C. gloeosporioides* f.sp. *manihotis*) requires high humidity of 85–90% and optimal temperature of 20–28 °C for survival (Bruggen et al. 1990). Such conditions are not obtainable in the drier savanna ecozones of Nigeria, although Lamptey et al. (2001) reported high incidence and severity of CAD in two locations from the drier ecological zone of Ghana, which are not typical zones for CAD infection. Such observations, according to Wydra and Msikita (1998), could be as a result of confusing stem symptoms caused by CBB with anthracnose cankers.

CLB and BLS. These diseases were present in all the ecozones; however, severity decreased rapidly towards the savanna zones. Generally, these diseases seem not to pose serious threats to cassava production; however, by reducing the photosynthetic ability of the plant, they could make such plants more vulnerable to the effects of other diseases. According to Jericho et al. (1999), high incidence of BLS was observed on cassava plants infested with mealybug. Therefore, the interaction of *Cercospora* leaf blight and leaf spot with other pests and diseases of cassava will require further study.

Health status of planting materials from farmers' fields. CMD is spread and perpetuated by planting stem cuttings obtained from diseased plants, while CBB is principally disseminated over short and long distances by infected material (Leuschener et al. 1980). The observance of CMD infection in 82.7% of the sampled sites confirms that planting material is a principal means of the spread of the disease across fields. All the stem cuttings used in this study were obtained from the savanna zones associated with high CBB incidence, however, CBB was not recorded in any of the plants at 6WAP. It could be that the 6-week period during which the experiment was maintained was not sufficient for development of the disease. Persley (1979) in an artificially inoculated experiment observed symptom development at only 2 months after planting. To fully assess the health status of the planting materials from farmers' fields, the plants may need to be maintained for the sufficiently long period required for full disease development.

Pathogens associated with cassava root rot. *B. theobromae* and *Fusarium* sp. were the prominent pathogens associated with the root rot samples obtained during this survey. Although systematic survey for root rot was not possible during this survey, the isolation of *B. theobromae* and *Fusarium* sp. is in agreement with the previous survey for cassava root rot disease in Nigeria (Onyeka 2002). Also, Boher et al. (1997) identified *B. theobromae* as the main pathogen responsible for large-scale damage in cassava fields of Danyi plateau zone of southwest Togo. However, *N. mangiferae,* reported in previous surveys (Msikita et al. 1997; Onyeka 2002), was not encountered in this study. There is a need to develop a standard assessment procedure for the survey of root rot disease which will enable the comparison of results from different locations.

Conclusion

This survey established the regional importance of CBB and CAD in the various ecozones of Nigeria. These diseases will become more important as cassava production gradually expands to the marginal zones. Also, there is need for a multiplication program for the supply of clean improved planting materials to the farmers as this remains the only viable option for the management of the diseases.

While the humid forest zone with low CBB pressure is ideal for the establishment of a multiplication program, the high incidence of CAD in the zone is a problem to ensuring disease-free material. The breeding program for cassava must, therefore, continue to emphasize multiple disease resistance in selection.

A total of 135 isolates of *C. gloeosporioides* and 83 isolates of *Xanthomonas axonopodis* have been assembled from different ecological zones from this survey. Further study to establish the level of pathogenic variation and the distribution of this variation in different ecological zones will provide additional information for the management of these diseases.

References

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Annex 1. Survey sheet for scoring the disease status of each field

Date:									
State:								Soil type:	
Location								Varieties:	
Location ID								Crp. system:	
LAT								Weediness:	
LONG								Drainage:	
ALT									
Plant	CBB	CAD	CLD	BLS	ROT			Remarks	
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Annex 2. Locations from which samples were collected and the severity score of various diseases.

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
1	Derived savanna	Anambra	C1	Igbariam farm settlement	6.97	6.33	1.00	2.17	1.27	1.23
2	Humid forest	Anambra	C2	Akwa	6.24	7.13	1.00	4.03	2.40	2.13
3	Humid forest	Anambra	C3	Igbariam junction	6.25	6.95	1.00	1.97	1.00	1.13
4	Humid forest	Anambra	C4	Onitsha/Enugu road	6.25	6.93	1.00	3.33	2.07	2.07
5	Humid forest	Anambra	C5	Umuohi Okija	5.87	6.91	1.00	3.00	2.13	2.07
6	Humid forest	Anambra	C6	Nise	6.16	7.04	1.00	2.07	1.33	1.30
7	Humid forest	Abia	C7	Aba/PH road	5.02	7.31	1.00	2.93	2.33	2.53
8	Humid forest	Abia	C8	Umuahia Aba road	5.47	7.43	1.00	3.80	2.70	2.27
9	Humid forest	Abia	C10	NRCRI Umudike	5.48	7.54	1.00	3.23	1.93	2.07
10	Humid forest	Abia	C11	Okagwe Ohafia	5.73	7.81	1.00	3.13	2.47	2.97
11	Humid forest	Abia	C12	Ebem	5.61	7.79	1.00	3.13	1.93	2.07
12	Humid forest	Abia	C13	Ubakala/Aba road	5.37	7.37	1.00	1.70	2.07	2.57
13	Humid forest	Abia	C15	Aba/PH road	4.92	7.23	1.00	2.73	1.80	1.90
14	Humid forest	Abia	C16	Okwe	5.42	7.57	1.00	3.73	1.60	2.07
15	Humid forest	Abia	C17	Enugu/Okigwe road	5.99	7.48	1.00	1.37	1.13	1.27
16	Humid forest	Abia	C18	Ohafia/Bende road	5.59	7.72	1.00	3.70	2.33	2.87
17	Derived savanna	Enugu	C19	Enugu/PH road	6.44	7.54	1.00	2.00	1.00	1.00
18	Derived savanna	Enugu	C20	Nsukka	6.87	7.40	1.00	2.97	1.83	1.63
19	Derived savanna	Enugu	C21	Agu Amede	6.72	7.75	1.00	2.90	3.23	2.83
20	Derived savanna	Enugu	C22	Obollo Etiti	6.89	7.59	1.00	1.70	1.00	1.17
21	Derived savanna	Enugu	C23	Nkem	6.78	7.71	1.00	1.87	3.33	2.53
22	Derived savanna	Enugu	C24	Obollo Afor	6.91	7.50	1.00	2.60	1.37	1.63
23	Derived savanna	Enugu	C25	Ukana	6.52	7.38	1.00	3.13	1.60	1.67
24	Humid forest	Ebonyi	C26	Enyibichiri Alike	6.18	8.25	1.00	1.67	1.93	1.93
25	Derived savanna	Ebonyi	C27	Nkalagu/Abakaliki rd	6.46	7.79	1.00	2.53	1.77	1.90

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
26	Derived savanna	Ebonyi	C28	Igbeagu	6.37	8.37	1.00	2.20	1.87	2.00
27	Humid forest	Ebonyi	C29	Igbeagu	6.32	8.19	1.00	2.90	2.30	2.50
28	Humid forest	Ebonyi	C30	Izzikworo	6.09	8.01	1.00	1.93	2.40	2.47
29	Humid forest	Ebonyi	C31	Abo Omega	5.98	7.98	1.00	2.60	1.13	1.40
30	Derived savanna	Ebonyi	C32	Amazu	6.57	7.76	1.00	3.53	3.77	3.83
31	Derived savanna	Ebonyi	C33	Amagu Umuhuali	6.52	7.76	1.00	2.30	3.03	2.73
32	Humid forest	Ebonyi	C34	Amazu	6.21	8.06	1.00	2.00	1.97	2.07
33	Humid forest	Imo	C35	Ogbaku/Oguta rd	5.66	6.82	1.00	2.20	2.00	2.10
34	Humid forest	Imo	C36	Owerre Ebeiri	5.77	7.03	1.00	2.90	2.00	2.13
35	Humid forest	Imo	C37	Owerri/Orlu rd	5.54	7.01	1.00	3.40	2.00	2.10
36	Humid forest	Imo	C38	Umungwa Obowo	5.56	7.41	1.00	2.80	2.13	2.30
37	Humid forest	Imo	C39	Anara	5.67	7.16	1.00	2.60	2.47	2.93
38	Humid forest	Imo	C40	Ogbaku	5.56	6.96	1.00	3.97	2.10	2.13
39	Humid forest	Imo	C41	Aboh Mbaise	5.48	7.22	1.00	2.93	2.07	2.13
40	Humid forest	Imo	C42	Amuron Okigwe	5.79	7.28	1.00	2.97	2.40	2.40
41	Humid forest	Imo	C43	Owerri/Aba rd	5.44	7.08	1.00	2.90	2.10	2.07
42	Humid forest	Imo	C44	Okpala	5.32	7.27	1.00	2.33	2.07	1.77
43	Humid forest	Imo	C45	Okwe	5.76	7.23	1.00	2.87	1.97	2.37
44	Humid forest	Imo	C46	Okigwe Umuahia rd	5.73	7.38	1.00	2.40	2.00	1.93
45	Humid forest	Imo	C47	Ada Palm Ohaji	5.46	6.81	1.00	2.87	2.20	2.00
46	Derived savanna	Oyo	B1	Km 17 Ibadan/Oyo rd	7.63	3.92	1.00	2.23	1.60	1.50
47	Derived savanna	Oyo	B2	Oyo outskirt	7.85	3.96	1.70	1.73	2.60	2.63
48	Derived savanna	Oyo	B3	Ogbomosho	8.11	4.21	3.00	3.13	2.90	2.93
49	Derived savanna	Oyo	B4	Onisakara	8.21	4.19	3.10	2.73	2.40	2.60
50	Derived savanna	Oyo	B5	Ogbomosho/Igbeti road	8.41	4.26	1.00	1.00	2.00	2.00

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
51	Derived savanna	Oyo	B6	Olokoto	8.59	4.20	3.03	1.17	2.17	2.20
52	Derived savanna	Oyo	B7	Igbeti outskirt	8.71	4.18	1.00	1.00	2.00	2.00
53	Derived savanna	Oyo	B8	Igbeti/Kishi rd	8.77	4.11	2.30	3.20	2.00	2.00
54	Derived savanna	Oyo	B9	Igbeti/Kishi rd	8.99	3.94	1.00	1.00	1.20	1.00
55	Derived savanna	Oyo	B10	Kishi/Igbowo rd	8.93	3.88	2.60	1.00	2.00	2.20
56	Derived savanna	Oyo	B11	Igbowo	8.83	3.74	3.00	1.00	1.60	2.10
57	Derived savanna	Oyo	B12	Ogbooro/Shaki rd	8.70	3.52	2.30	1.50	2.00	2.10
58	Derived savanna	Oyo	B13	Saki/Ago Are	8.62	3.41	3.80	1.00	1.80	2.00
59	Derived savanna	Oyo	B14	Ago Are	8.48	3.42	3.77	1.00	2.23	2.57
60	Derived savanna	Oyo	B15	Ago Are/Okaka rd	8.23	3.45	3.50	1.00	2.13	2.67
61	Derived savanna	Oyo	B16	Out/Okeiho rd	8.18	3.41	1.40	1.00	1.90	2.60
62	Derived savanna	Oyo	B17	Okeiho	8.03	3.34	1.00	1.00	1.90	2.00
63	Derived savanna	Oyo	B19	Iganna	7.89	3.23	3.00	1.00	1.00	1.80
64	Derived savanna	Oyo	B20	Oye	7.61	3.20	2.00	2.00	2.00	2.00
65	Derived savanna	Oyo	B21	Igboora	7.46	3.27	3.40	2.30	1.10	1.80
66	Derived savanna	Ogun	B22	Odeda/Ibadan rd	7.25	3.54	1.00	3.00	2.00	2.00
67	Derived savanna	Ogun	B23	Akintoye	7.36	3.65	3.10	3.00	2.00	2.00
68	Derived savanna	Ogun	B24	Idi Aba Abeokuta	7.14	3.40	2.20	3.00	2.00	2.00
69	Derived savanna	Ogun	B25	Abeokuta/Ajebo rd	7.12	3.69	1.57	2.77	1.13	2.00
70	Derived savanna	Ogun	B26	Ipira Remo	7.03	3.67	1.00	2.20	1.00	1.00
71	Humid forest	Ogun	B27	Ogere Remo	6.94	3.62	1.00	2.97	1.00	1.00
72	Derived savanna	Ogun	B28	Abeokuta/Ayetoro rd	7.18	3.27	1.70	2.63	1.73	2.33
73	Derived savanna	Ogun	B29	Olorunda	7.24	3.13	4.07	3.27	1.93	2.00
74	Derived savanna	Ogun	B30	Abeokuta/Imeko rd	7.43	2.95	2.20	3.10	2.10	2.50
75	Derived savanna	Ogun	B31	Idofa	7.43	2.80	2.40	2.90	2.10	2.60
76	Derived savanna	Ogun	B32	Imeko/Idofa/Aworo	7.28	2.79	3.53	3.30	1.03	1.83

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
77	Derived savanna	Ogun	B34	Ilaro/Ota rd	6.89	3.08	2.90	2.77	1.00	1.47
78	Derived savanna	Ogun	B35	Ota/Idi Iroko rd	6.68	3.13	3.83	3.30	1.20	2.00
79	Derived savanna	Ogun	B36	Ajilete	6.70	2.94	3.20	3.00	1.00	1.50
80	Derived savanna	Ogun	B38	Owode Ado Odo rd	6.67	2.99	1.80	1.50	1.20	1.90
81	Humid forest	Ogun	B40	Ikorodu/Sagamu rd	6.73	3.53	2.57	2.93	1.50	1.93
82	Derived savanna	Ogun	B41	Agoro Ijebu	6.84	3.85	3.07	3.07	1.70	2.10
83	Derived savanna	Oyo	B42	Ijebu Ode Ibadan rd	7.15	3.88	2.80	2.90	1.70	2.00
84	Derived savanna	Osun	B43	Ibadan/Ife rd	7.36	4.15	3.50	3.10	1.70	2.50
85	Derived savanna	Osun	B44	Ife/Osogbo rd	7.56	4.45	1.97	2.27	1.23	1.77
86	Derived savanna	Osun	B45	Osogbo	7.79	4.50	3.37	3.30	1.83	2.03
87	Derived savanna	Osun	B46	Osogbo/Iwo rd	7.68	4.29	1.87	2.03	1.73	2.00
88	Derived savanna	Osun	B48	Gbongo/Ede rd	7.56	4.40	1.50	2.77	1.90	2.10
89	Derived savanna	Osun	B49	Gbongo/Ede/Osogbo rd	7.75	4.52	3.37	3.73	1.13	2.00
90	Derived savanna	Osun	B50	Osogbo/Ikurun rd	7.85	4.62	2.83	3.10	2.07	2.27
91	Derived savanna	Osun	B51	Ikurun/Ila rd	7.96	4.80	1.70	3.00	2.00	2.20
92	Derived savanna	Osun	B53	Okuku	8.00	4.66	1.60	2.50	2.00	2.00
94	Derived savanna	Osun	B54	Osogbo/Ilesha rd	7.73	4.62	3.40	3.10	2.00	2.00
95	Derived savanna	Osun	B55	Ilesha	7.62	4.80	3.00	2.80	2.00	2.00
96	Derived savanna	Ekiti	B56	Ipetu/Igbara Odo rd	7.50	4.85	3.00	2.93	2.00	2.00
97	Derived savanna	Ekiti	B57	Igbara Odo/Ilawe rd	7.53	5.08	3.00	3.00	2.00	2.00
98	Derived savanna	Ekiti	B58	Ikere	7.49	5.27	2.30	3.00	2.30	2.50
99	Derived savanna	Ekiti	B59	Ise/Agbado	7.48	5.45	1.50	3.80	2.00	2.60
100	Derived savanna	Ekiti	B60	Agbado/Omuo	7.65	5.60	1.00	1.40	2.00	2.00
101	Derived savanna	Ekiti	B61	Ilasa Ekiti	7.81	5.65	1.00	2.70	2.00	2.00
102	Derived savanna	Ekiti	B62	Ikole/Iluomoba rd	7.67	5.45	1.30	3.10	2.00	2.30

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
103	Derived savanna	Ekiti	B64	Aramoko/Ijero rd	7.73	5.05	1.20	2.90	2.00	2.00
104	Derived savanna	Ekiti	B65	Ilogbo	7.85	5.14	1.40	3.30	1.90	2.00
105	Derived savanna	Ekiti	B66	Ifaki/Oye rd	7.80	5.31	2.80	3.00	1.00	1.60
106	Derived savanna	Ekiti	B67	Iworoko/Ado rd	7.70	5.26	1.00	2.60	2.00	1.00
107	Derived savanna	Ekiti	B68	Ikere	7.46	5.23	3.40	3.00	1.80	2.00
108	Derived savanna	Ondo	B69	Akure/Ifon rd	7.27	5.26	2.70	2.80	1.50	2.00
109	Derived savanna	Ondo	B70	Akure/Ifon rd km 28	7.26	5.47	2.30	3.00	2.00	2.00
110	Derived savanna	Ondo	B71	Akure/Ifon rd km 45	7.21	5.61	1.37	2.80	1.97	2.00
111	Derived savanna	Ondo	B72	Akure/Ifon rd km 58	7.11	5.66	1.33	2.43	1.67	1.97
112	Humid forest	Ondo	B73	Akure/Ifon rd km 84	6.91	5.78	1.00	2.03	1.53	1.70
113	Derived savanna	Ondo	B74	Owo/Ikare rd km 14	7.33	5.68	1.17	1.00	1.57	1.57
114	Derived savanna	Ondo	B75	Owo/Ikare rd km 37	7.50	5.75	1.00	1.00	2.00	2.00
115	Derived savanna	Ondo	B76	Akungba/Ido Ani rd km 13	7.45	5.83	1.00	2.93	2.07	2.00
116	Derived savanna	Ondo	B77	Isua/Ipele rd	7.35	5.89	2.00	1.87	2.00	1.97
117	Derived savanna	Ondo	B78	Isua/ipele rd km 37	7.18	5.77	2.50	2.73	2.00	2.00
118	Humid forest	Ondo	B79	Ipetu Jesha/Ondo rd km 25	7.27	4.85	1.00	1.67	1.93	1.80
119	Derived savanna	Ondo	B80	Ondo/Akure rd	7.21	5.04	1.00	1.50	1.57	1.70
120	Derived savanna	Ondo	B81	Akure/Igbaraoke rd	7.40	5.07	1.00	2.97	2.00	1.97
121	Humid forest	Ondo	B82	Ondo/Ore rd km 6	7.04	4.84	1.53	2.80	1.53	1.63
122	Humid forest	Ondo	B83	Ore/Aye/Okitipupa rd km 16	6.66	4.80	1.20	2.50	1.50	1.67
123	Humid forest	Ondo	B84	Ore/Aye/Okitipupa rd km 34	6.55	4.75	1.00	3.00	1.50	2.00
124	Humid forest	Ondo	B85	Okitipupa/Ilutitun rd km 15	6.53	4.65	1.00	2.50	2.00	2.00
125	Derived savanna	Ogun	B86	Ore/Ijebu ode rd km 86	6.77	4.20	1.00	2.30	1.50	1.50
126	No data	Lagos	B87	Epe Magodo	6.58	3.96	1.00	2.60	2.00	2.00
127	No data	Lagos	B88	Epe/Lagos rd km1	6.57	3.94	1.00	3.00	2.00	2.00

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
128	No data	Lagos	B89	Epe/Lagos rd km 17	6.49	3.86	1.00	2.50	1.70	2.00
129	Humid forest	Lagos	B90	Lagos/Badagry km 6	6.48	3.05	1.00	1.60	1.50	2.00
130	Humid forest	Lagos	B91	Lagos/Badagry km 28	6.43	2.88	1.00	2.00	1.40	2.00
131	Humid forest	Lagos	B92	Badagry/Iworo rd	6.43	2.98	1.00	1.00	1.00	2.00
132	Derived savanna	Kwara	N1	Ilorin/Ajase km 8	8.41	4.63	2.93	2.57	2.10	2.43
133	Derived savanna	Kwara	N2	Ilorin/Ajase km 31	8.29	4.78	3.03	2.00	2.07	2.77
134	Derived savanna	Kwara	N3	Ilorin/Ajase km 53	8.23	4.95	2.37	2.43	2.00	2.00
135	Derived savanna	Kwara	N4	OmuAran/Eruku rd	8.13	5.41	2.17	1.27	1.70	2.07
136	Derived savanna	Kwara	N5	Southern Guinea Savanna	8.61	5.65	1.50	1.00	2.00	2.00
137	Southern Guinea savanna	Kwara	N6	Isanlu Esa/Pategi rd	8.70	5.73	3.00	1.00	1.60	2.00
138	Derived savanna	Kwara	N7	Pategi	8.76	5.60	1.50	1.00	1.00	2.00
139	Derived savanna	Kwara	N8	Ilorin/Share rd	8.55	4.67	2.47	1.00	2.00	2.00
140	Derived savanna	Kwara	N9	Ilorin/Share rd km 32	8.68	4.88	1.53	1.00	2.00	2.03
141	Derived savanna	Kwara	N11	Ilorin/Igbeti rd, Oko Olowo	8.54	4.48	2.30	1.00	1.97	2.00
142	Derived savanna	Kwara	N12	Ilorin/Igbeti rd km 18	8.64	4.37	1.90	1.00	2.00	2.03
143	Southern Guinea savanna	Kwara	N13	Kishi/Kaima rd, Aboki outskirt	9.53	3.91	2.30	1.00	2.10	2.30
144	No data	Niger	N14	New Busa/Mokwa road Km5	9.85	4.55	1.80	1.00	2.00	2.00
145	Derived savanna	Niger	N15	New Busa/Mokwa road Km52	8.68	4.89	3.00	1.00	2.00	2.00
146	Southern Guinea savanna	Niger	N16	IITA field Mokwa	9.35	5.02	3.00	1.00	1.53	2.00
147	Southern Guinea savanna	Niger	N17	Kusogi Mokwa/ kotagora rd	9.51	5.28	2.17	1.00	2.00	2.00
148	Southern Guinea savanna	Niger	N18	Kaboji Mokwa/ Kontangora rd	10.06	5.41	1.80	1.00	1.27	1.70

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
149	Southern Guinea savanna	Niger	N19	Kontagora/Tegina rd Km22	10.30	5.64	3.13	1.00	1.00	1.37
150	Southern Guinea savanna	Niger	N21	Lambata/Suleja rd Km16	9.47	6.64	1.53	1.00	2.07	2.07
151	Southern Guinea savanna	Niger	N22	kwaka, Lambata/Suleja rd	9.27	7.13	1.73	1.00	1.97	1.53
152	Southern Guinea savanna	Kaduna	N23	Dikko, Suleja/Kaduna rd	9.36	7.29	3.07	1.00	1.33	1.70
153	Southern Guinea savanna	Kaduna	N24	Dikko/Kaduna rd Km 65	9.77	7.45	3.00	1.00	1.33	1.20
154	Northern Guinea savanna	Kaduna	N25	Dikko/Kaduna rd Km 117	10.21	7.34	3.00	1.00	1.00	1.00
155	Northern Guinea savanna	Kaduna	N26	Kaduna/Kachia rd Km 84	10.08	7.90	2.37	1.00	1.33	1.43
156	Southern Guinea savanna	Kaduna	N27	Kachia/Zonkwa rd Km 31	9.79	8.22	1.20	1.00	1.00	2.00
157	Southern Guinea savanna	Kaduna	N28	Zubina, Samaru kataf-Saminaka	9.89	8.50	2.30	1.00	1.00	1.93
158	Northern Guinea savanna	Kaduna	N29	Saminaka/Pambegia rd Km 64	10.68	8.31	3.00	1.00	1.00	1.00
159	Southern Guinea savanna	Niger	N30	Lambata/Bida rd Km 4	9.26	6.99	2.40	1.00	1.97	2.67
160	Southern Guinea savanna	Niger	N31	Lambata/Bida rd Km 62	9.05	6.54	1.00	1.00	2.00	1.00
161	Southern Guinea savanna	Niger	N32	Lambata/Bida rd Km 105	9.05	6.16	1.77	1.00	1.00	1.33
162	Sudan savanna	Kebbi	N33	Birnin Yauri/Kebbi rd Km 27	10.98	4.77	2.13	1.00	1.67	2.00
163	Sudan savanna	Kebbi	N34	Birnin Yauri/Kebbi rd Km 136	11.85	4.41	3.10	1.00	1.00	1.70
164	Sudan savanna	Kebbi	N35	Birnin Kebbi/Argungu rd km 18	12.53	4.38	3.00	1.00	1.00	1.00
165	Sudan savanna	Kebbi	N36	Argungu/Sokoto rd km 36	12.72	4.63	3.60	1.00	1.00	1.00
166	Sudan savanna	Sokoto	N37	Sokoto/Gusua rd km 137	12.65	5.60	1.00	1.00	1.00	1.00
167	Sudan savanna	Katsina	N38	Katsina/Kano rd Km 17	12.82	7.69	3.00	1.00	1.00	1.00
168	Sudan savanna	Kano	N39	Katsina/Kano rd Km 142	12.12	8.40	3.50	1.00	1.00	1.00
169	Sudan savanna	Kano	N40	Kano Exprs/Tudun Wada rd Km 10	11.53	8.37	2.77	1.00	1.47	1.73
170	Sudan savanna	Kano	N41	IITA field Minjibri	12.14	8.66	3.23	1.00	1.00	1.00
171	Sudan savanna	Kano	N42	Gezewa/Gumel rd Km 18	12.17	8.89	3.40	1.00	1.00	1.00
172	Sudan savanna	Jigawa	N43	Gezewa/Gumel rd Km 37	12.29	9.01	2.70	1.00	1.00	1.00
173	Sudan savanna	Jigawa	N44	Hadejia/Ringim/Kano rd Km 29	12.33	9.79	2.30	1.00	1.00	1.00

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
174	Sudan savanna	Jigawa	N45	Hadejia/Ringim/Kano rd Km 60	12.33	9.52	3.50	1.00	1.00	1.00
175	Sudan savanna	Jigawa	N46	Hadejia/Ringim/Kano rd Km 112	12.12	9.27	2.00	1.00	1.00	1.00
176	Sudan savanna	Kano	N47	Hadejia/Ringim/Kano rd Km 132	12.10	8.92	3.07	1.00	1.00	1.00
177	Derived savanna	Kogi	N48	Ogaminana, Okenne/Kabba rd	7.61	6.22	2.63	1.00	1.50	1.50
178	Derived savanna	Kogi	N49	Odo-Ape Bunu, Kabba/Lokoja rd	7.90	6.21	2.00	1.00	1.73	1.73
179	Derived savanna	Kogi	N50	Lokoja/Ajaokuta rd km 7	7.81	6.74	1.67	1.00	1.53	1.60
180	Derived savanna	Kogi	N51	Ajaokuta outskirt	7.58	6.74	2.43	1.00	2.00	2.00
181	Derived savanna	Kogi	N52	Ajaokuta/Ayingba rd km 51	7.41	6.93	1.37	1.00	2.00	2.00
182	Derived savanna	Kogi	N53	Akpagidigbo, Ejule/Idah rd	7.33	7.00	1.60	2.50	2.10	2.10
183	Derived savanna	Kogi	N54	Anyigba/Anpka rd km 27	7.48	7.22	1.03	1.00	2.00	2.00
184	Derived savanna	Kogi	N55	Anyigba/Anpka rd km 39	7.45	7.48	1.00	1.00	2.00	2.00
185	Derived savanna	Kogi	N56	Emere/Markurdi rd km 8	7.44	7.69	1.00	2.80	2.00	2.00
186	Derived savanna	Benue	N57	Markudi/Naka/Adoka rd	7.59	8.23	1.73	1.00	2.07	1.53
187	Derived savanna	Benue	N58	Markudi/Naka/Adoka rd	7.50	8.08	1.00	1.00	2.00	1.50
188	Derived savanna	Benue	N59	Adoka/Otupko rd	7.25	8.08	1.00	1.00	2.00	2.00
189	Derived savanna	Benue	N60	Otupko/Gboko rd km 11	7.25	8.25	1.00	1.00	2.00	1.37
190	Derived savanna	Benue	N61	Otupko/Gboko rd km 42	7.29	8.51	1.00	1.00	2.00	2.00
191	Derived savanna	Benue	N62	Otupko/Gboko rd km 75	7.30	8.80	1.47	1.00	2.00	1.53
192	Derived savanna	Benue	N63	Yandev/Katsina Ala rd km 3	7.35	9.07	1.00	1.00	2.00	2.00
193	Derived savanna	Benue	N64	Tyowanye	7.23	9.21	1.00	1.00	2.00	2.23
194	Derived savanna	Benue	N65	Gboko/Makurdi rd km 20	7.49	8.93	1.00	1.40	2.00	2.00
195	Derived savanna	Benue	N66	Katsina Ala/Wukari rd km 11	7.22	9.36	1.50	1.00	2.00	2.00
196	Derived savanna	Benue	N67	Katsina Ala/Wukari rd km 40	7.42	9.52	1.00	1.00	2.00	2.00
197	Derived savanna	Taraba	N68	Wukari/Jalingo rd km 26	7.85	9.96	1.00	1.00	2.00	1.33
198	Derived savanna	Taraba	N69	Wukari/Jalingo rd km 71	8.22	10.27	1.27	1.00	2.00	1.80
199	Derived savanna	Taraba	N70	Wukari/Jalingo rd km 91	8.31	10.41	2.90	1.00	2.00	1.20

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
200	Southern Guinea savanna	Taraba	N71	Jalingo/Mutium-biyu km 13	8.88	11.25	2.53	1.00	1.00	1.00
201	Southern Guinea savanna	Taraba	N72	Jalingo/Sunkani rd km 19	8.75	11.27	2.47	1.00	2.00	2.00
202	Southern Guinea savanna	Taraba	N73	Jalingo/Zing/Yola km 51	9.00	11.68	3.00	1.00	2.00	2.00
203	Southern Guinea savanna	Adamawa	N74	Jalingo/Zing/Yola km 93	8.99	12.01	2.13	1.00	1.93	1.87
204	Southern Guinea savanna	Adamawa	N75	Yola/Gumbi/Munbi rd km 43	9.58	12.56	3.23	1.00	1.00	1.00
205	Mid-Altitude	Adamawa	N76	Yola/Gumbi/Munbi rd km 151	10.26	13.04	1.87	1.00	2.00	1.00
206	Sudan savanna	Borno	N77	Bama/Maiduguri rd km 25	11.65	13.47	3.07	1.00	1.00	1.00
207	Sahel savanna	Yobe	N78	Nguru outskirt	12.84	10.38	2.57	1.00	1.00	1.00
208	Derived savanna	Fct	N79	Wako, Abaji/Suleja rd	8.59	6.91	2.87	1.00	2.00	2.00
209	Derived savanna	Fct	N80	Abaji/Suleja rd km 42	8.81	7.03	2.60	1.00	1.03	1.00
210	Southern Guinea savanna	Fct	N81	Abaji/Suleja rd km 77	9.06	7.20	2.60	1.00	1.47	1.40
211	Derived savanna	Nasarawa	N82	Asokoro/Keffi/Lafia rd km 22	8.96	7.67	2.40	1.00	1.30	1.67
212	Derived savanna	Nasarawa	N83	Asokoro/Keffi/Lafia rd km 56	8.84	7.93	2.40	1.00	2.00	1.73
213	Derived savanna	Nasarawa	N84	Asokoro/Keffi/Lafia rd km 100	8.91	8.28	1.00	1.00	2.00	2.00
214	Derived savanna	Nasarawa	N85	Akwanga/Laffia rd 35	8.67	8.56	1.00	1.00	2.00	2.00
215	Derived savanna	Nasarawa	N86	Laffia/Markudi rd km 12	8.38	8.56	1.00	1.00	2.00	2.00
216	Derived savanna	Nasarawa	N87	Laffia/Markudi rd km 40	8.15	8.59	1.00	1.00	2.00	2.00
217	Derived savanna	Nasarawa	N88	Laffia/Shendam/Jos rd km 5	8.53	8.58	1.80	1.00	1.73	2.00
218	Derived savanna	Nasarawa	N89	Laffia/Shendam/Jos rd km 34	8.58	8.81	1.00	1.00	1.80	1.97
219	Derived savanna	Plateau	N90	Laffia/Shendam/Jos rd km 63	8.68	9.04	1.00	1.00	2.00	2.00
220	Derived savanna	Plateau	N91	Laffia/Shendam/Jos rd km 100	8.78	9.30	1.00	1.00	1.00	1.00
221	Derived savanna	Plateau	N92	Laffia/Shendam/Jos rd km 149	8.83	9.67	2.40	1.00	1.33	1.27
222	Derived savanna	Plateau	N93	Laffia/Shendam/Jos rd km 193	9.11	9.81	1.60	1.00	2.00	1.93
223	Northern Guinea savanna	Bauchi	N94	Bauchi/Gombe rd km 59	10.28	10.37	2.50	1.00	1.63	1.70
224	Northern Guinea savanna	Gombe	N95	Bauchi/Gombe rd km 124	10.31	10.92	3.03	1.00	1.03	1.00

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
225	Southern Guinea savanna	Gombe	N96	Gombe/Kaltungo rd km 23	10.10	11.12	1.23	1.00	1.20	1.10
226	Northern Guinea savanna	Gombe	N97	Gombe/Portiskum rd	10.41	11.19	1.00	1.00	1.53	1.00
227	Northern Guinea savanna	Gombe	N98	Gombe/Portiskum rd	10.61	11.38	2.80	1.00	1.00	1.00
228	Northern Guinea savanna	Gombe	N99	Gombe/Dukku/Darazo rd km 21	10.48	11.09	3.13	1.00	1.00	1.00
229	Sudan savanna	Gombe	N100	Gombe/Dukku/Darazo rd km 81	10.82	10.70	2.73	1.00	1.00	1.00
230	Northern Guinea savanna	Bauchi	N101	Gombe/Dukku/Darazo rd km 115	10.94	10.45	2.60	1.00	1.00	1.00
231	Northern Guinea savanna	Bauchi	N102	Darazo/Bauchi rd km 8	10.91	10.39	1.43	1.00	1.00	1.00
232	Humid forest	Edo	D1	Benin bypass km 2	6.46	5.62	2.30	2.53	1.67	1.67
233	Humid forest	Edo	D2	Benin bypass km 39	6.31	5.87	1.50	3.00	2.00	1.70
234	Humid forest	Delta	D3	Agbor outskirt	6.27	6.22	1.90	2.00	2.00	2.00
235	Humid forest	Delta	D4	Agbor Asaba rd	6.29	6.49	1.90	2.80	1.90	1.90
236	Humid forest	Delta	D5	Agbor/Uromi rd km 5	6.30	6.21	1.00	1.90	1.90	2.00
237	Humid forest	Edo	D6	Agbor/Uromi rd km 35	6.52	6.22	1.00	2.80	1.90	2.00
238	Derived savanna	Edo	D7	IITA field, Ubiaja	6.67	6.35	1.50	2.10	2.00	2.00
239	Derived savanna	Edo	D8	Epkoma/Auchi rd km 7	6.85	6.25	1.30	1.60	1.70	2.00
240	Derived savanna	Edo	D9	Auchi/Agenebode rd km 5	7.02	6.33	1.30	1.50	1.80	2.00
241	Derived savanna	Edo	D10	Leventis farm Agenebode	7.04	6.57	1.30	1.60	2.00	2.00
242	Derived savanna	Edo	D11	Auchi/Igara/Ibilo rd km 8	7.11	6.22	1.00	3.00	2.00	2.00
243	Derived savanna	Edo	D12	Auchi/Igara/Ibilo rd km 36	7.31	6.09	1.30	2.90	2.00	2.10
244	Derived savanna	Edo	D13	Auchi/Igara/Ibilo rd km 52	7.45	6.05	1.70	1.80	2.00	2.00
245	Derived savanna	Edo	D14	Auchi/Afunze rd km 12	7.00	6.10	1.10	2.00	1.90	1.60
246	Humid forest	Edo	D15	Sabongida/Epkoma rd km 11	6.82	5.98	1.30	2.60	1.80	2.00
247	Humid Forest	Edo	D16	Iruepken, Iruepken/Benin rd	6.73	6.04	1.40	1.00	1.80	1.80
248	Humid Forest	Edo	D17	Iruepken/Benin rd km 40	6.49	5.84	1.40	2.70	2.00	2.00
249	Humid Forest	Edo	D18	Benin/Sapkonba rd km 22	6.19	5.80	1.70	2.80	2.00	2.00

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat (N)	Long (E)	CBB	CAD	CLB	BLS
250	Humid Forest	Edo	D19	Benin/Sapkonba rd km 53	6.06	6.01	1.00	2.40	2.00	1.00
251	Humid Forest	Delta	D20	Obiaruku outskirt	5.83	6.16	1.90	1.80	1.90	1.90
252	Humid Forest	Delta	D21	Obiaruku/Amai/Kwale rd km 35	5.72	6.39	1.00	2.60	2.00	2.00
253	Humid Forest	Delta	D22	Kwale/Ogwashi rd km 47	6.12	6.53	2.70	2.90	1.70	1.70
254	Humid Forest	Delta	D23	Kwale/Ughelli rd km 19	5.63	6.31	1.00	3.00	2.00	1.00
255	Humid Forest	Delta	D24	IITA field, Agbaho	5.57	5.88	1.80	2.50	1.80	1.90
256	Humid Forest	Delta	D25	Ughelli/PH rd km 8	5.42	6.04	1.00	2.10	2.00	1.00
257	Humid Forest	Rivers	D26	PH/Ogoni/Bori rd km 9	4.73	7.23	1.00	2.40	2.00	1.00
258	Humid Forest	Rivers	D27	PH/Ogoni/Bori rd km 32	4.52	7.42	1.00	2.50	2.00	2.00
259	Humid Forest	Akwa Ibom	D28	PH/Ogoni/Bori rd km 60	4.68	7.60	2.50	2.50	2.00	1.40
260	Humid Forest	Akwa Ibom	D29	Ikot Enin outskirt	4.63	7.81	1.80	3.00	2.00	1.70
261	Humid Forest	Akwa Ibom	D30	Eket/Oron rd km 19	4.73	8.08	1.60	3.00	2.00	2.20
262	No data	Akwa Ibom	D31	Oron/Uyo rd km 14	4.86	8.11	1.40	3.10	1.90	2.00
263	Humid Forest	Akwa Ibom	D32	Oron/Uyo rd km 35	4.98	7.98	1.30	3.00	2.00	2.00
264	Humid Forest	Cross River	D33	Calabar/Ikom/Ogoja rd km 38	5.41	8.20	1.20	2.30	1.90	1.80
265	Humid Forest	Cross River	D34	Calabar/Ikom/Ogoja rd km 68	5.61	8.11	1.80	2.70	2.00	2.50
266	Humid Forest	Cross River	D35	Calabar/Ikom/Ogoja rd km 98	5.84	8.10	1.70	3.00	2.00	2.00
267	Humid Forest	Cross River	D36	Ofodua	5.98	8.26	1.00	1.80	2.00	2.00
268	Humid Forest	Cross River	D37	Calabar/Ikom/Ogoja rd km 154	5.93	8.46	1.00	2.10	2.00	2.00
269	Humid Forest	Cross River	D38	Calabar/Ikom/Ogoja rd km 185	5.95	8.72	1.60	2.00	2.00	2.00
270	Derived Savanna	Cross River	D39	Ikom/Ogoja rd km 38	6.28	8.66	1.00	2.60	2.00	1.70
271	Derived Savanna	Cross River	D40	Ikom/Ogoja rd km 66	6.50	8.74	1.00	2.50	2.00	2.00
272	Humid Forest	Cross River	D41	Ikom/Ajasso rd km 21	5.82	8.84	2.10	2.40	2.00	2.00
273	Humid Forest	Cross River	D42	Calabar/Ikot Epkene rd km 21	5.18	8.19	1.60	1.70	2.00	1.00

Annex 2. Locations from which samples were collected and the severity score of various diseases.(contd)

S/No	Ecozone	State	Site ID	Location	Lat(N)	Long (E)	CBB	CAD	CLB	BLS
274	Humid Forest	Akwa Ibom	D43	Ikot Akam	4.80	7.73	1.50	2.60	2.00	2.00
275	Humid Forest	Rivers	D44	PH/Ibiama rd km 10	4.93	6.81	1.40	1.70	2.00	1.00
276	Humid Forest	Rivers	D45	PH/Ibiama rd km 46	5.06	6.59	1.00	3.00	2.00	1.40
277	Humid Forest	Delta	D46	Warri/Sapele rd km 27	5.81	5.73	1.10	2.10	2.00	1.60

About IITA

The International Institute of Tropical Agriculture (IITA) was founded in 1967 as an international agricultural research institute with a mandate for improving food production in the humid tropics and to develop sustainable production systems. It became the first African link in the worldwide network of agricultural research centers known as the Consultative Group on International Agricultural Research (CGIAR), formed in 1971.

IITA's mission is to enhance the food security, income, and well-being of resource-poor people primarily in the humid and subhumid zones of sub-Saharan Africa, by conducting research and related activities to increase agricultural production, improve food systems, and sustainably manage natural resources, in partnership with national and international stakeholders.To this end, IITA conducts research, germplasm conservation, training, and information exchange activities in partnership with regional bodies and national programs including universities, NGOs, and the private sector. The research agenda addresses crop improvement, plant health, and resource and crop management within a food systems framework and is targeted at the identified needs of three major agroecological zones: the savannas, the humid forests, and the midaltitudes. Research focuses on smallholder cropping and postharvest systems and on the following food crops: cassava, cowpea, maize, plantain and banana, soybean, and yam.

Integrated Cassava Project (ICP)

Promoting the Cassava Industry

The Integrated Cassava Project (ICP) is made up of two complementary special projects: the Preemptive Management of Cassava Mosaic Disease Project (CMD) and the Cassava Enterprise Development Project (CEDP) both implemented by the International Institute of Tropical Agriculture. While CMD primarily looks at mitigating the impact of cassava mosaic disease and increasing productivity in Nigeria, CEDP focuses on utilization and the development of agribusiness.

ICP has three main aims: to sustainably increase food availability, reduce rural poverty and unemployment, and enhance agroindustrial and socioeconomic growth in Nigeria. This will be achieved by deploying high yielding resistant cultivars, adapting improved and profitable postharvest processing methods, and facilitating policies to ensure that problems along the commodity chain are reduced. ICP aims also to increase private sector investment in production, processing, storage, and marketing. The result will be that incomes are raised, and the livelihood of millions of poor farmers and rural processors will be improved.

ICP is funded by the Federal Government of Nigeria, the Niger Delta Development Commission, Shell Petroleum Development Company of Nigeria, the United States Agency for International Development, and 12 states in southern Nigeria.