EPIDEMIOLOGY OF AFRICAN CASSAVA MOSAIC ON A REGIONAL SCALE IN THE IVORY COAST

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African Cassava Mosaic Virus (ACMV) is transmitted in two different ways:

- by the aleurode Bemisia tabaci,

- by man, when he plants contaminated cuttings.

Tests on the east coast of Kenya have shown that farmers play the main role in the spread of the disease, and the insect vector only a minor one (Bock, 1983). These conclusions, based on the results of epidemiological investigations in East Africa, contrast with those of workers in West Africa, where the dynamics of contamination of healthy cassava are extremely rapid and therefore seem to indicate that the spread by the vector is more effective (Leuschner, 1977; Fargette et al., 1985). In order to define the exact role of the vector in various ecological conditions, and in the context of comparative epidemiological investigations, we have performed a multi-site experiment at a regional level in the Ivory Coast. To do this, we took into consideration the dynamics of contamination of healthy cassava plants, the vector populations, the environmental situations in the fields, and the growth of the plants.

MULTI-SITE TRIALS. PLANTING MATERIAL

Most of the trials involved planting with the clone CB (a moderately susceptible clone originating in the Congo), and the several other cassava clones used included H58 (a very susceptible clone from Madagascar) and BR (Bonoua Rouge, a resistant clone from the Ivory Coast).

GEOGRAPHICAL LOCATION

The experiments were done in two very different places in the Ivory Coast:

- the first is in the south of the country, in the forest region, where there are two rainy seasons and an annual precipitation of 2000 mm;

- the second lies in the savanna region, in the centre of the country, where there is only one rainy season and an annual precipitation of 1000 mm.

EXPERIMENTS

In the forest region, we worked for one year with only one clone (CB), but in various environmental conditions.

In the savanna region, we compared clones H58 and BR in two different environments, also for one year.

Finally, we compared the two regions with each other, by monitoring the reinfestation of the fields planted with several clones for several years, or at different planting dates for a single clone.

In each region, the areas of the fields ranged from 0.06 to 1 ha, but they were all oriented in the direction of the prevailing wind, in order to obtain a homogeneous contamination of the plots (Fargette et al., 1985).

VARIABLES MEASURED

Every month for 9 months, we recorded the contamination of the plants, the vector population, and the plant growth. The whitefly populations were estimated by counting the adults directly on the apical leaves of 25 plants per plot. The growth of the plant was evaluated by measuring the diameter and the height of the main stem of 25 plants per plot.

The percentages of contamination and of whitefly populations were analysed by comparing the cumulative numbers. We also compared the cumulative numbers of whitefly per plant and the cumulative percentages of contaminated plants per plot, in order to obtain the apparent transmission power (ATP) of the whiteflies, as a function of time and region.

COMPARISON OF FOREST AND SAVANNA REGIONS

Regardless of year and clone, the contamination was always higher in the forest than in the savanna. The overall percentage of contamination for all clones and years ranged from 10 to 88% in the forest, whereas in the savanna it ranged from 1 to 20% (Table 1).

Table 1. Percentage of contamination of clones in forest and savanna regions.

Clone		BR	H57	CB	TA49	H58	BB
Forest	1982	32	45	82	--	88	81
Forest	1983	10	25	74	67	84	69
Forest	1984	--	--	49	--	--	
Savanna	1982	3	3	1	--	5	20
Savanna	1983	1	2	3	1	2	7
Savanna	1984	--	--	4	--	--	

In the same way, the cassava plots planted at various dates, in the same year, were more contaminated in the forest than in the savanna: from 42 to 91% in the forest and from 4 to 43% in the savanna for the same period, March - July 1984 (Table 2).

Table 2. Percentage of contamination of cassava plots in forest and savanna regions.

Date of Planting	March	April	May	June	July
Forest 1984	91	58	49	42	50
Savanna 1984	4	43	11	4	12

COMPARISON OF TWO SAVANNA SITES

We compared the levels of contamination of two different clones, H58 and BR, in the savanna region (Table 3). In one case the fields were so situated that there were no diseased cassava plants upwind, and in the second case the fields were in the middle of a large plantation of diseased cassavas. In the second case, the contamination was 25 times as great as in the first case for clone BR, and 40 times as great for clone H58. The number of whiteflies was always higher in the most contaminated site, but the difference was not proportional to the level of contamination.

Table 3. Levels of contamination of two clones at different sites.

	Number of whiteflies per plant		
Clone	Savanna 1	Savanna 2	Forest
Clone BR	2.4	9.5	3.0
Clone H58	3.7	9.2	4.3

COMPARISON OF FOREST SITES

Five different 0.06-ha fields were planted with clone CB, in the forest region, along a North-South axis, starting at the seashore (field 1) and ending 10 km inland (field 5). Each site differed both in the environment provided by nearby cassavas and in the area of diseased cassava which had already been crossed by the prevailing southwest wind before it reached the particular experimental field.

A sixth field planted at the ORSTOM research station was used as a reference (field 6). The highest contamination was recorded in fields 2 and 5, and the lowest in field 1. Field 1 harboured the largest whitefly population, and fields 3 and 4 harboured the smallest. The ATP was similar in all the fields, including the reference field, except field 1, where it was approximately a tenth as great. The differences in plant growth in the fields did not account for these differences in contamination.

DISCUSSION

Differences between the dynamics of the contamination of cassava fields were very variable within a single region and between the different regions. Neither the climatic conditions nor the plant growth could account for the level of contamination. In some sites, there was a good correlation between the number of whiteflies and the level of contamination (Leuschner, 1977; Fargette et al., same publication). However, these were not linked from site to site or from region to region. In comparing the ATPs we found two radically opposite situations:

1) field 1 in the forest with an ATP of 300 and field 1 in the savanna with an ATP of 1000,

2) in all the other situations the ATPs ranged between 40 and 80.

The fields with high ATPs had no diseased cassava upwind, whereas those with low ATPs were surrounded by fields of virus-infected cassava. These results support the hypothesis that cassava is a reservoir both of ACMV and of its vector B. tabaci. As the wind passed over fields of virus-infected cassava, it picked up the viruleferous whiteflies, which then landed in the healthy experimental plots. These whiteflies were more numerous and more viruleferous when they came from virus-infected cassavas upwind of the healthy plots.

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