Chapter 1.3

Benin

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Introduction

Preliminary research on cassava pests and diseases in Benin was carried out as part of a regional project for Ecologically Sustainable Cassava Plant Protection (ESCaPP) (Yaninek et al., 1994). Unpublished results of ESCaPP diagnostic surveys show cassava (*Manihot esculenta* Crantz) to be the predominant arable crop (87% site incidence) in the country and the next most common crops to be maize (*Zea mays* L.) with 30% site incidence and cowpea (*Vigna unguiculata* [L.] Walp.) with 26%. Summaries of plant protection aspects of the survey show cassava mosaic disease (CMD) caused by cassava mosaic begomoviruses (CMBs) and vectored by the whitefly *Bemisia tabaci* (Gennadius) to be the most common biotic constraint on cassava in the country, with total plant incidence of 49% in the dry season and 57% in the wet. Survey samples of red-eyed whitefly nymphs comprised *B. tabaci* and *B. afer* (Priesner and Hosny) although the latter was less abundant, occurring in only 4% of the samples (Sotomey et al., 1995). The CMD damage score was low, the average falling within class 2 (indicating "slight damage" on a 1-5 scale) across ecozones and seasons. During the surveys, in focus group interviews at village level, farmers at 68% of survey sites rated CMD as the main disease problem. In subsequent preliminary CMD epidemiology trials (Legg et al., 1997; IITA, 1998; James et al., 1998), current season whitefly infection was consistently lowest in the variety TMS 30001 when compared with other improved or local varieties. In a related population dynamics study, the parasitoid *Encarsia sophia* (Girault and Dodd) was identified from *Bemisia* mummies at each of six trial sites in the transition forest, and wet and dry savannahs (James and Gbaguidi, unpublished data). Genetic heterogeneity in *B. tabaci* populations, which is known to influence CMD epidemiology (Burban et al., 1992; Legg et al., 1994), and the identities of cassava viruses and virus strains are yet to be investigated in the country.

This chapter reports the results of a countrywide diagnostic survey of whiteflies and CMD in Benin, conducted in November and December 1997, on 60 farms distributed in the transition forest (28 sites), dry savannah (19 sites) and wet savannah (13 sites) (Figure 1). Farmer respondents in the survey were mostly men (93%) and landowners with over 5 years of cassava farming experience.

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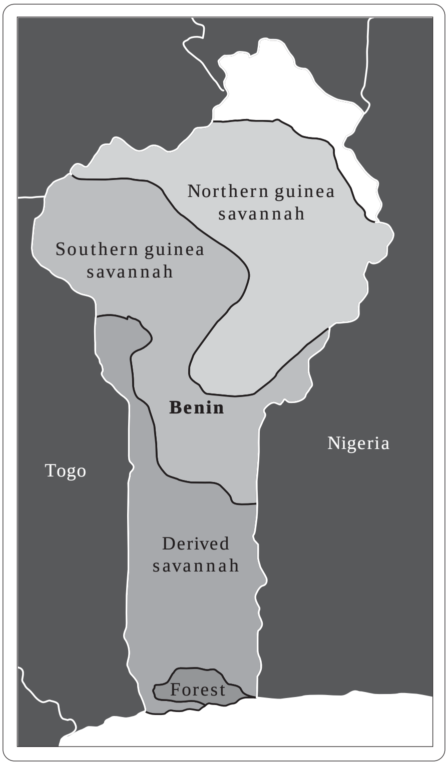

Figure 1. Areas surveyed for whitefly incidence and cassava mosaic disease in Benin.

Based on the survey results, the chapter identifies areas requiring more research attention to further our understanding of CMD in the country and to serve as a basis for developing and implementing an integrated approach to managing this disease.

Increased Biological Understanding

The co-existence of *B. tabaci* and *B. afer* on cassava in Benin was confirmed by the determination of these species from adult specimens. In various local languages, farmers recognized whiteflies simply as "insects". On the other hand, among the various local names used to describe CMD, the names *edjekpo*, *ekpo*, *goudou* and *kpanro* refer specifically to the resemblance of CMD symptoms to those of leprosy. This indigenous knowledge will greatly facilitate farmer participatory research and learning activities—activities that seem especially important given that a high proportion of farmers did not know that whiteflies (60% farmers) and CMD (50% farmers) caused serious problems to cassava. Whilst *B. tabaci* occurred at all 60 survey sites, *B. afer* was recorded in 50% of the sites and comprised 15% of the 212 specimens determined. Whitefly abundance was low and averaged 3.2 adults per cassava shoot tip in the transition forest, 0.5 in the wet savannah and 0.9 in the dry savannah. Whitefly mean abundance (logarithm transformed counts) was significantly higher in the transition forest than in either wet or dry savannah ($t > 5.04$; $P < 0.05$). The parasitoids *E. sophia* and *Eretmocerus* sp. were identified in natural enemy collections. The presence of *E. sophia* was confirmed at 15 sites and *Eretmocerus* sp. at only one site. Diseased whiteflies were not observed in the field and hence no entomopathogens were collected. Biotypes of cassava viruses identified are reported elsewhere (Chapter 1.11, this volume).

Increased Socio-Economic Understanding

Across ecozones, cassava was typically produced on farms of less than 0.25 ha. The improved variety "Agric", originating from the International Institute of Tropical Agriculture (IITA), was grown by 13% of farmers. The local variety Odounbo, grown by 7% of farmers, was the next most popular variety, while the remainder comprised a wide diversity of local cultivars. Fifty-eight percent of farmers ranked cassava as their most profitable crop, compared to 33% for maize, 10% each for cowpea and groundnut (*Arachis hypogaea* L.) and 5% for cotton (*Gossypium hirsutum* L.). These crops were planted also in association with cassava or near to cassava fields. Cowpea, groundnut and cotton are known crop host plants of *B. tabaci*, although experimental data from other countries in Africa show that the *B. tabaci* biotype occurring on cassava is more or less restricted to that crop (Burban et al., 1992; Legg et al., 1994). Cassava was also the most common crop planted in nearby fields (38% of all instances) and the intensity of cassava farming gradually decreased from the transition forest (2.4 nearby fields) to wet savannah (1.9 nearby fields) and dry savannah (0.2 nearby fields).

Average CMD incidence ranged from 25% to 49% across ecozones (Figure 2), with infected cuttings providing the more important source of infection. The incidence of cutting infection did not differ significantly between ecozones. The incidence of whitefly infection, transformed to allow for the effect of multiple infection (Gregory, 1948), differed significantly across ecozones and was higher in both the transition forest and wet savannah than in the dry savannah ($t > 2.06$; $P < 0.05$). Across ecozones, whitefly abundance showed no correlation with the incidence of whitefly infection. The pattern of damage was similar across ecozones, with most plants showing no CMD symptoms and, of those visibly infected with the disease, only a very small proportion showing moderate or severe damage (Figure 3). This is important in the context of the age of cassava farms sampled. The plants were 3-6 months old at the time of the survey, an age at which storage roots form and begin to develop and root yield is particularly vulnerable to pest-induced losses. None of the farmers reported total loss of their cassava to CMD, probably a reflection of the mild disease symptoms observed. However, 25% of farmers attributed losses of at least 25% of the yield to the disease. Whilst this high loss estimate seems to conflict with the low damage severity observed, 58% of farmers indicated that CMD is becoming more severe.

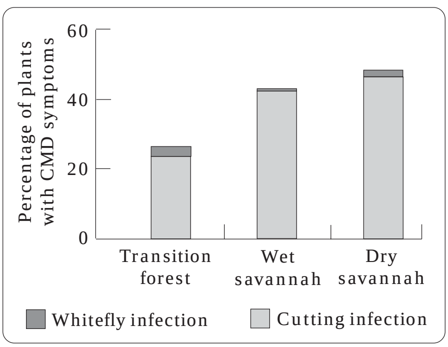

Figure 2. Cassava mosaic disease (CMD) incidence and source of infection in the ecozones of Benin.

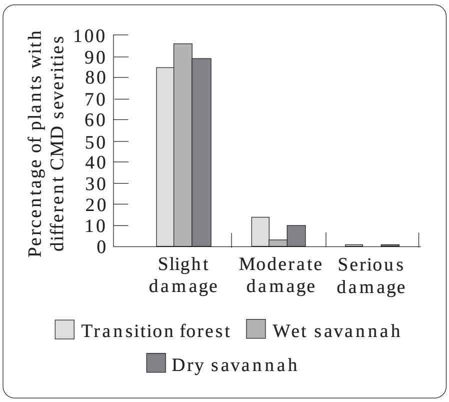

Figure 3. Cassava mosaic disease (CMD) damage severity in the ecozones of Benin.

Most farmers (78%) undertook no specific control measures against CMD or whiteflies, and less than 10% had received technical information or assistance on them. Among farmers who attempted to control the whitefly or disease problem, the main methods used were weeding and application of wood ash. Even though no farmer reported the use of resistant varieties as a whitefly/disease control method, further questioning revealed that 8% of farmers listed "Agric" and 5% listed Odounbo as varieties they had planted on the basis of recommendations that they were tolerant to CMD. Twenty percent of these farmers indicated that the better performance of these varieties was mainly because of better sprouting and establishment of the cutting. Agronomic features were more important than pest/disease resistance as criteria for the selection of planting material. About 12% of the selection criteria related to disease-free stems, health of stems and disease resistance, whilst 23% related to size, maturity, better yield, colour and size of the parent stem.

Where disease-specific criteria were used for selecting planting material, only 10% of the farmers reported that the method was effective and 7% noticed that the "clean" material became diseased after planting. Because the single most frequently cited sources of planting material were farmers' own fields (30%) and neighbours' fields (22%), adoption of appropriate planting material selection would be expected to reduce recycling of CMBs considerably. Whilst no farmer indicated roguing as a specific CMD control method, 7% of them conducted roguing to prevent and reduce disease and 2% because of poor plant growth; 7% of the farmers reported some impact from this control measure. However, the current high incidence of cutting infection would make roguing very labor intensive and unattractive for adoption, unless carried out in combination with the selection of CMD-free planting material. Pesticide use was rare.

Conclusions

In Africa, cassava root yield losses due to CMD have been estimated at 28%-40% annually (Thresh et al., 1994). In Benin, there appears to be a contradiction between field data and farmers' perception of the CMD problem. The research data indicate only a very small proportion of cassava plants with moderate or severe disease damage but 25% of the farmers attribute high losses to the disease. In such cases, farmer participatory trials would help farmers and researchers jointly to better understand the relationship between disease incidence and yield, and to validate loss estimates. The studies would help establish whether losses to CMD really are significant in Benin and, if so, convince farmers of the need to adopt integrated management practices against the disease. Such an approach will provide for action learning by farmers to improve their access to information and understanding of the causes and nature of the disease problem. For example, cutting infection was found to be much more important than *Bemisia* whiteflies in the spread of CMD, suggesting that a participatory learning and extension effort focusing on planting material selection and sanitation and roguing could have a positive impact.

Generally, training of national program partners would strengthen the collaborative links established in the pilot phase of the project and further enhance national capacity to undertake priority CMD and whitefly research activities. For example, field studies on the population dynamics of *B. tabaci* would be needed to understand temporal and spatial changes in the insect's abundance in relation to its ability to spread CMD. There is also the need to quantify the effectiveness of parasitism by *E. sophia*, particularly as a possible factor influencing the importance of the vector in spreading CMD. In view of the low abundance of *B. afer* in the country, it would not be appropriate to commit further resources to investigating its role in CMD epidemiology.

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