CHAPTER 1.4

Nigeria

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Introduction

Cassava (*Manihot esculenta* Crantz) is an important staple food crop in sub-Saharan Africa. In Nigeria, unpublished results of diagnostic surveys by a project for Ecologically Sustainable Cassava Plant Protection (ESCaPP) (Yaninek et al., 1994) show cassava to be the most important crop in the country, followed by yam (*Dioscorea* spp.) and maize (*Zea mays* L.). Cassava has the potential to yield 60 t/ha of storage roots (Nweke and Lynam, 1997). However, average yields in farmers' fields are usually less than 10 t/ha (FAO, 1989). The shortfall is associated largely with pest and disease problems, of which cassava mosaic disease (CMD) is one of the most important. In sub-Saharan Africa as a whole, losses to CMD have been estimated at 15-27 million tons, representing 15%-24% of total production (Thresh et al., 1997). The disease is caused by begomoviruses transmitted by the whitefly *Bemisia tabaci* (Gennadius) and is spread also by man through planting of infected planting materials (Hahn et al., 1981). The ESCaPP survey results showed CMD to be the single most common pest constraint on cassava in Nigeria with, on average, 85% of plants showing symptoms in the dry season and 79% in the wet (IITA, 1997). The surveys indicated the co-existence of *B. tabaci* and *B. afer* (Priesner & Hosny) on cassava in Nigeria, although *B. afer* was less abundant and widespread than *B. tabaci* (Sotomey et al., 1995).

In Nigeria, studies are continuing to examine the begomoviruses infecting cassava and their variability (Ogbe et al., 1998). These have recorded the presence of both *African cassava mosaic virus* (ACMV) and *East African cassava mosaic virus* (EACMV), although earlier less comprehensive studies had suggested the occurrence of only ACMV in Nigeria (Swanson and Harrison, 1994). Genetic heterogeneity in *B. tabaci* populations, which is known to influence CMD epidemiology (Burban et al., 1992; Legg et al., 1994), has yet to be investigated in the country. In preliminary CMD epidemiology trials, current season whitefly infection was consistently lowest in the variety TMS 30001 when compared to other improved or local varieties (Legg et al., 1997; IITA, 1998; James et al., 1998). The development and deployment of resistant varieties has been the main approach to CMD management pursued in Nigeria (Hahn et al., 1980; 1981). Little attention has been given to the potential for using natural enemies to manage the whitefly vector, although Jerath (1967) suggested that the

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parasitoid *Encarsia strenua* (Silvestri) and a predatory mite, *Typhlodromus* sp., were possible biocontrol agents.

This report presents results of a countrywide survey of *Bemisia* whiteflies and CMD conducted in November and December 1997, on 80 farms distributed across the main cassava-producing agro-ecological zones of Nigeria (Figure 1). Sites were sampled in rainforest (25), transition forest (25), wet savannah (20) and dry savannah (10) zones, and cassava plantings selected were 3 to 4 months old. This chapter summarizes the results of the survey and identifies areas requiring subsequent attention in order to further our understanding of the disease and to serve as a basis for developing and implementing the integrated management of CMD in Nigeria.

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

Increased Biological Understanding

The insect vector of CMD, *B. tabaci*, occurred at all survey sites, while a second whitefly species, *Trialeurodes vaporariorum* (Westwood), hitherto unreported on cassava, was identified from nymphs collected from one location in the country. No examples of *B. afer* were found in samples collected. Some farmers recognized whiteflies and 17.5% of farmers knew that the insects caused a serious problem to cassava. In various local languages, farmers recognized *Bemisia* whiteflies simply as "insects". About 24% of farmers knew that CMD caused serious problems and farmers in different localities described the disease in various local languages as *akpa, ekikang, ikwukwo, kpuojuju* and *nkpuk*—mostly terms that refer to the appearance of the disease symptoms. *Bemisia* abundance was less than three adults per cassava shoot tip (defined as the terminal shoot with the first five open leaves) in each of the ecozones.

Five species of hymenopterous parasitoids of *Bemisia* were recorded: *Encarsia sophia* (Girault and Dodd) comprising 93.7% of samples, *Eretmocerus* sp., 3.5%, *Encarsia* sp. (*luteola* group), 0.7%, *Encarsia lutea* (Masi), 1.2% and *Encarsia mineoi* Viggiani, 0.8%. Potential whitefly predators recorded were *Cheilomenes sulphurea* (Olivier) and phytoseiid mites. Diseased whiteflies were not observed in the field and entomopathogens therefore were not collected. The diversity in cassava viruses identified is reported in Chapter 1.11 (this volume). Other cassava pests listed by farmers were grasshoppers, reported by 15% of farmers, termites by 6.3%, and vertebrates by 2.5%.

Increased Socio-Economic Understanding

Cassava farm sizes averaged 0.38 hectares in the rain and transition forests, 0.56 hectares in the wet savannahs and 0.10 hectares in the dry savannahs. Both local and improved varieties were recorded in farmers' fields, although local varieties predominated. The most widely occurring improved varieties were

TMS 30572 (18.8%) and TMS 30555 (2.5%). There was a marked difference in the incidence of improved varieties between ecozones: they were cultivated in 80% of sampled fields in the transition forest but occurred in only about 30% of fields in the rainforest and wet savannah and were not recorded at all in the dry savannah. There was a direct negative correlation between the frequency of cultivation of improved varieties and CMD incidence. Farmers ranked cassava as their most profitable crop followed by maize, yam, sorghum (*Sorghum bicolor* [L.] Moench) and cowpea (*Vigna unguiculata* [L.] Walp.), in descending order. Of the crops planted in association with cassava or in adjacent fields, cowpea is a known host plant of *B. tabaci*. Experimental data from other countries in Africa, however, 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).

Average CMD incidence ranged from 45% to 83% across ecozones, with cuttings providing by far the more important source of infection (43% to 83%) (Figure 2). The incidence of whitefly infection, transformed to allow for the effect of multiple infection (Gregory, 1948), was low in each of the ecozones. Among plants with disease, slight damage symptoms (score 2 on a five-point scale from no damage to severe damage) predominated (Figure 3). Plant damage severity varied little by ecozone. Moderate damage symptoms (score 3) were more pronounced in the rainforest (30% of plants) and wet savannah (20% of plants) than in the other ecozones, whilst serious (score 4) to severe (score 5) damage symptoms were negligible (Figure 3). Plants were less than 4 months old at the time of the surveys, a growth stage during which storage root formation and development is initiated and root yield is particularly vulnerable to pest-induced losses. Very few farmers (1.2%) reported total yield loss in the first planting season but 18.8% of farmers attributed losses of at least one quarter of their yield to the disease. However, about 70% of the farmers provided no yield loss estimates for the first or second crop.

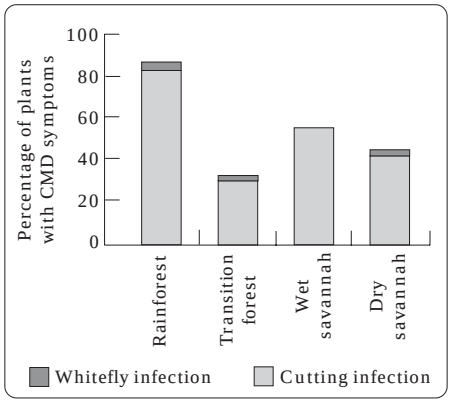

Figure 2. Cassava mosaic disease (CMD) incidence and source of infection in the ecozones of Nigeria.

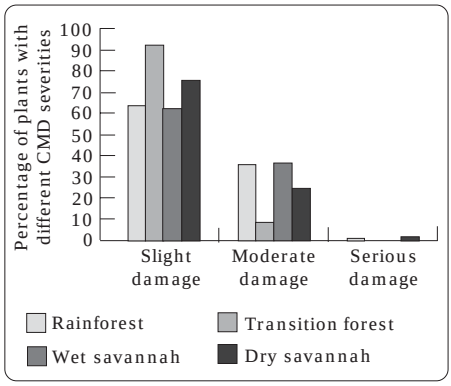

Figure 3. Cassava mosaic disease (CMD) damage severity in the ecozones of Nigeria.

Nearly all farmers reported that CMD occurred every year, while slightly more than half of them confirmed that CMD was most severe during the early growth stages of cassava. More than three-quarters of farmers (77.5%) reported that they had received no technical information or assistance on

CMD or whiteflies. Among farmers who attempted to manage the whitefly/disease problem, the main practices used were selection of planting materials, application of wood ash, roguing and proper weeding. Agronomic features were more important than pest/disease resistance as criteria for the selection of planting material. Since the most frequently cited sources of planting material were neighbours' and farmers' own fields (Figure 4), adoption of appropriate strategies for selecting planting material would be expected to reduce the incidence of CMD appreciably. About 53% of farmers rogued CMD affected plants, usually within 3 months of planting. Most farmers (61%), however, rated roguing as partially effective, with only 4% considering it to be highly effective. In the choice of varieties, 25% of farmers cited "Agric" as the single most commonly planted variety and indicated that the choice was based on recommendations that it was resistant to CMD. Other CMD-resistant varieties commonly recorded were TMS 30572, TMS 30001 and TMS 30555. No farmer used pesticides against CMD and fewer than 2% of farmers used pesticides against whiteflies.

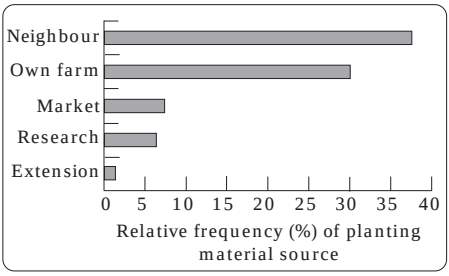

Figure 4. Farmers' sources of cassava planting material in Nigeria.

Conclusions

In Nigeria, whilst incidence of CMD is high, the economic impact of the disease is believed to be only moderate, based on the relatively mild symptoms that were observed in the survey. There is an obvious need, however, to obtain yield loss data for the commonly grown varieties in order to make an accurate assessment of economic impact. In view of the overwhelming importance of cutting infection, as compared with vector-borne infection, in the spread of CMD, research and extension efforts on assuring the health of planting material should be prioritized. The farmers' generally high level of awareness of CMD and their willingness to rogue diseased plants to prevent or slow its spread could provide a good basis for establishing participatory experiments to help farmers multiply clean planting material of their preferred varieties. Action learning activities, involving farmers and extension agents, could help improve their access to information and their understanding of the causes and nature of the disease problem. This will provide opportunities to promote cultural control options such as appropriate methods of selecting planting material, sanitation and roguing. Additionally, training of national program partners would strengthen national capacity to investigate and promote the sustainable management of whiteflies and CMD.

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