CHAPTER 1.2

Ghana

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Introduction

Cassava mosaic disease (CMD) is a major food production constraint in Africa (Thresh et al., 1994). It is caused by begomoviruses, which are vectored by the whitefly *Bemisia tabaci* (Gennadius) and can be spread through infected planting material. Yield losses caused by the disease are higher if vegetative planting materials sprout with symptoms (cutting infection) than if initially disease-free material becomes infected by *B. tabaci* following sprouting (current season whitefly-borne infection) (Fauquet and Fargette, 1990). In Ghana, recent work on *Bemisia* whiteflies and CMD has been carried out under the auspices of a regional project, Ecologically Sustainable Cassava Plant Protection (ESCaPP) (Yaninek et al., 1994). Unpublished results of ESCaPP diagnostic surveys showed cassava (*Manihot esculenta* Crantz) to be the most widely planted arable crop in the country (45% site incidence), followed by maize (*Zea mays* L.) (15%) and yam (*Dioscorea* spp.) (5%).

Whitefly survey samples consisted largely of *B. tabaci*. *B. afer* (Priesner and Hosny) was unevenly distributed and less abundant (Sotomey et al., 1995). Across ecozones and seasons, CMD was the most common cassava pest constraint both in terms of field data and farmer perceptions. In the field, total plant incidence of CMD was 76% in the dry season and 68% in the wet and, in 56% of the villages, farmers ranked CMD as the main disease. On an ascending 1-5 scale of damage classes, 22% of plants were in class 2 (mild), 51% in class 3 (moderate), 26% in class 4 (severe) and none in class 5 (very severe). Previous attempts to develop CMD control measures in Ghana have included preliminary evaluation of local cassava varieties in relation to their susceptibility to CMD and laboratory studies to produce virus-free tissue culture materials of local germplasm (Bieler et al., 1996; Kissiedu et al., 1996). In subsequent collaborative epidemiology trials, 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 role of parasitoids, other natural enemies, genetic heterogeneity in *Bemisia* populations and the identity of cassava viruses/viral strains are yet to be investigated in the country.

This chapter gives results of a countrywide survey in Ghana, conducted in November and December

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1997, on 80 farms. These included 25 sites in each of the rainforest and transition forest, 10 sites in the "coastal" savannah and 20 sites in the wet savannah (Figure 1).

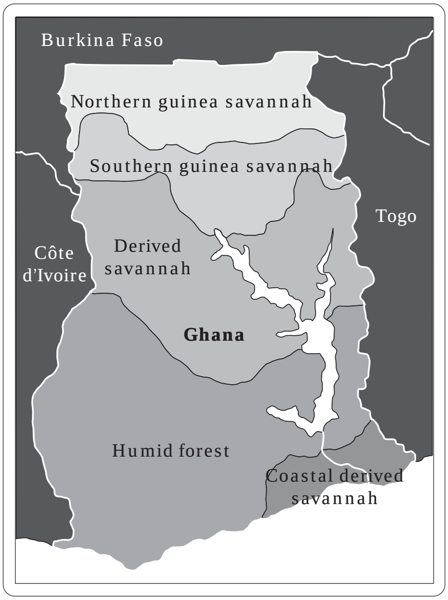

Figure 1. Areas surveyed for whitefly incidence and cassava mosaic disease in Ghana.

Increased Biological Understanding

B. tabaci, *B. afer* and *Trialeurodes vaporariorum* (Westwood) were identified from adult whitefly samples collected from cassava in Ghana. Whilst *B. tabaci* occurred at all survey sites, *B. afer* was recorded from only 3.8% of the sites and comprised 1.9% of the 151 specimens determined. *T. vaporariorum* was collected from only one location. Generally, farmers were unaware of *Bemisia* whiteflies and did not recognize them by specific local names; only 2% of them knew that the insects caused serious problems to cassava. By contrast, 54% of farmers knew that CMD caused serious problems and described the disease symptoms in various local names. Some of these, for example, *bankye kwata* and *kwata*, described the appearance of CMD symptoms. Such indigenous knowledge will facilitate farmer participatory learning and research activities. *Bemisia* whitefly abundance averaged 1.3 adults per cassava shoot tip in the rainforest, 1.0 in transition forest, 11.8 in coastal savannah and 0.3 in wet savannah (see also Figure 2 in Chapter 1.14, this volume). Whitefly mean abundance (logarithm transformed counts) was significantly higher in the coastal savannah than in each of the other ecozones ($t > 12.1$; $P < 0.05$). The natural enemy fauna associated with the whiteflies included the hymenopteran parasitoid *Encarsia sophia* (Girault and Dodd), which was reared from *Bemisia* mummies at four survey sites.

Increased Socio-Economic Understanding

Cassava production was characterized by small landholdings, typically less than 1 ha in size, and a preponderance of local landraces. The intensity of cassava farming decreased along the rainforest-savannah axis. The five most profitable crops listed by farmers were cassava (45%), yam (18%), maize (11%), cowpea (*Vigna unguiculata* [L.] Walp.) (6%) and tomato (*Lycopersicon esculentum* Mill.) (5%). These other crops were planted in association with, or near to, cassava fields but cassava was the most common crop (40% site incidence) planted in nearby fields. Among the associated crops, both cowpea and tomato are known host plants of *B. tabaci*. However, experimental data from other countries in Africa show that the *B. tabaci* biotype that occurs on cassava is largely restricted to that crop (Burban et al., 1992; Legg et al., 1994).

Priority cassava pests listed by farmers were vertebrates (16%), weeds (13%), termites and weevils (10% each) and CMD (6%). Overall, CMD incidence was mainly attributable to cutting infection (Figure 2). The incidence of cutting infection averaged 60% in the rainforest, 55% in the transition forest, 63% in the coastal savannah and 51% in the wet savannah. The incidence of whitefly infection, transformed to allow for the effect of multiple infection (Gregory, 1948), was significantly higher in the coastal savannah and rainforest than in the transition forest or wet savannah ($t > 2.9$; $P < 0.05$). Whitefly abundance showed no correlation with the incidence of whitefly infection. In terms of reducing CMD incidence, the transition forest and wet savannah would seem to provide better sites for multiplication of clean planting material.

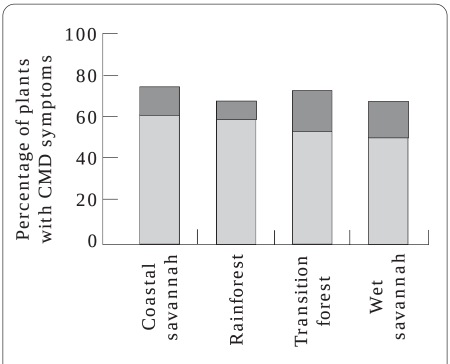

Figure 2. Cassava mosaic disease (CMD) incidence and source of infection in the ecozones of Ghana.

Across ecozones, 24%-32% of plants showed no CMD symptoms. About 10% of the plants showed serious (score 4) to severe (score 5) damage symptoms (Figure 3). The plants were 3-6 months old, a growth stage during which storage root formation and development is initiated and root yield is particularly vulnerable to pest-induced losses. In view of the higher proportion of plants in the moderate and severe damage categories in the transition forest, significant root yield losses could be expected in this ecozone. However, yield loss estimates provided by farmers appeared to be unrealistically high. For example, about 26% of farmers estimated losses at 50% and 20% of farmers at 75%. Such loss estimates would need to be validated, especially since 91% of the farmers reported that they sell their cassava harvest.

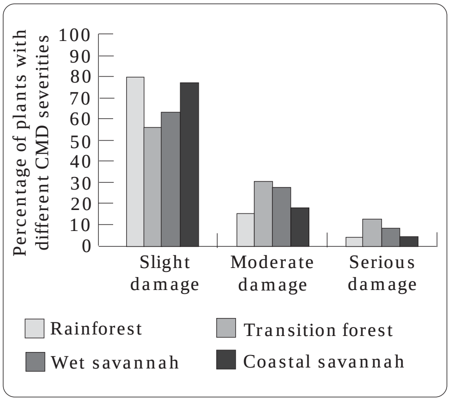

Figure 3. Cassava mosaic disease (CMD) damage severity in the ecozones of Ghana.

Farmers' opinion was almost equally divided on whether or not CMD was becoming more severe, and a sizeable proportion (34%) considered that the disease was not a yearly occurrence. Extension and training support for whitefly/CMD problems appeared low, since 89% of farmers reported receiving no technical information or assistance with these problems. In view of this, it is not surprising that only 1% of farmers practiced any deliberate whitefly/CMD control. Local varieties predominated (54% site incidence) and 18% of the farmers ranked Busuminsia as their single most preferred variety, followed by three other local varieties, Santom

(6.2%), Bakentenma (5%) and Kokoo (5%). Adoption of improved varieties was low: only 11% of farmers planted TMS 30572 (originating from the International Institute of Tropical Agriculture [IITA]) and "Agric" varieties (a locally adapted material of IITA origin) recommended by the national extension service on the basis of their CMD resistance. Agronomic features were more important criteria for selecting planting material than were disease-specific characteristics.

Where disease-specific selection criteria were used, only 10% of the farmers reported that the method was effective, while 9% noticed that the "clean" material became diseased after planting. Since the single most important primary source of planting material was farmers' own fields (Figure 4), adoption of appropriate procedures for selecting planting material would significantly reduce recycling of cassava mosaic viruses. About 60% of farmers reported that they encountered shortage of planting material in some years. Shortages like these, coupled with the observed high incidence of cutting infection, imply that rapid multiplication schemes would be required to ensure timely availability of clean and healthy planting materials at farm level. No farmer reported pesticide use as a control method against the whiteflies or the disease but about 61% of farmers rogue diseased plants, mostly (55% of farmers) within the first month of planting.

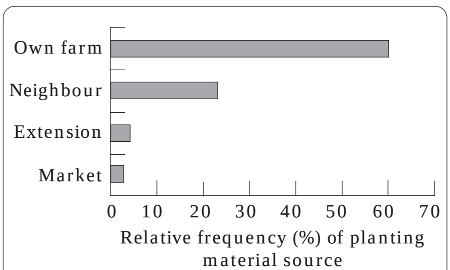

Figure 4. Farmers' sources of cassava planting material in Ghana.

Conclusions

This study has increased field-level understanding of whiteflies and CMD incidence, and provides a strong basis for the development of ecologically sound management practices for whitefly/CMD problems in Ghana. The incidence of CMD infection by *B. tabaci* was low and the disease appears to be spread mainly through infected cuttings. The preponderance of local cassava varieties over proven CMD-resistant improved varieties contributes to the incidence of the disease in the country. Two key issues that need to be addressed are the quantification of yield losses in the preferred local cultivars and, associated with this, an assessment of why CMD-resistant varieties have not been adopted widely.

Assuming that yield losses warrant the use of CMD control measures, farmer participatory learning activities will promote farm-level selection of parent planting material that is CMD symptom free for making cuttings. Related to this, farmer-led rapid multiplication schemes would be required to increase the availability and adoption of CMD-resistant varieties, provided that evaluations linked to such schemes indicate that some of these varieties are acceptable to farmers. Research should also evaluate farmers' preferred local varieties as possible sources of CMD resistance in breeding programs since this approach has provided important new impetus to resistance breeding programs for cassava elsewhere (Dixon et al., 1992).

Little is known about temporal and spatial changes in the abundance of *B. tabaci* in Ghana, particularly in relation to its ability to transmit cassava mosaic viruses over the growing period of the crop. Field studies therefore might be necessary to quantify such changes, assess whether parasitism by *E. sophia* has any significant impact on the insect's abundance and, in epidemiology trials, to ascertain the ability of *B. tabaci* to spread cassava mosaic viruses to a range of cassava varieties.

National research capacity needs to be enhanced in order to allow project partners to undertake further research on the whitefly/CMD issues raised here. In this regard, training of national program partners in appropriate areas would strengthen the collaborative linkages initiated in the pilot phase of the project and provide a strong base for providing sustainable technical support to cassava farmers. Key areas for strengthened national research capacity include post-graduate degree training in *B. tabaci* bionomics and cassava mosaic virology, and field-based training of technicians and extension workers in participatory processes and facilitation. Technician and extension training will increase scientific literacy in farming communities and foster action research and learning with farmers. This will improve farmers' currently poor access to information, will help them understand the causes and nature of the disease problem and will highlight effective cultural control options such as planting material selection and roguing.

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