CHAPTER 1.8

Tanzania

Joseph Ndunguru, Simon Jeremiah*, Regina Kapinga*** and *Peter Sseruwagi****

Introduction

Cassava (*Manihot esculenta* Crantz) and sweetpotato (*Ipomoea batatas* [L] Lam.) are important staple food crops, especially in the rural communities of Tanzania. The two crops have a long history of providing food security in the country, particularly during famine. However, their production is currently threatened by cassava mosaic disease (CMD) and sweetpotato virus disease (SPVD). CMD is caused by cassava mosaic begomoviruses (CMBs) transmitted by the whitefly *Bemisia tabaci* (Gennadius) and through virus-infected planting material (Harrison, 1987). On the other hand, SPVD results from co-infection by two distinct viruses, *Sweetpotato chlorotic stunt virus* transmitted by *B. tabaci* and *Sweetpotato feathery mottle virus* transmitted by the aphid *Myzus persicae* (Sulzer) (Gibson et al., 1998).

CMD was first reported in Tanzania under the name "Krauselkrankheit" (Warburg, 1894), although it was not recorded as causing serious losses until the 1920s. Between 1920 and 1960, comprehensive studies were conducted in the country, emphasizing the development of CMD-resistant varieties through a breeding program conducted at Amani in the Usambara Mountains (Jennings, 1994). Resistant varieties developed by the programme were effective in controlling CMD and restored the crop's productivity. Data obtained in 1989 and 1990 during the first phase of the Collaborative Study of Cassava in Africa (COSCA) indicated that Tanzania had the lowest CMD-incidence (37%) of the six countries surveyed (Thresh et al., 1994). Another extensive survey, conducted between 1993 and 1994 in mainland Tanzania and the islands of Zanzibar and Pemba, rated the incidence of CMD at 28%, with infected cuttings (24%) providing the major source of infection (Legg and Raya, 1998). During the latter part of the 1990s, CMD research has been reinvigorated and has included work to assess the development of the disease in the country.

Recent epidemiological studies on CMD elsewhere in East Africa have provided evidence of the north-to-south spread of an epidemic of severe CMD, firstly within Uganda (Otim-Nape et al., 1997; Legg and Ogwal, 1998; Chapter 1.6, this volume) and subsequently into parts of western Kenya and Tanzania

* Root and Tubers Programme of the Lake Zone Agricultural Research and Development Institute (LZARDI), Ukiriguru, Mwanza, Tanzania.
** Centro Internacional de la Papa (CIP), Kampala, Uganda.
*** International Institute of Tropical Agriculture-Eastern and Southern Africa Regional Center (IITA-ESARC), Kampala, Uganda.

bordering Uganda (Legg, 1999). This expansion has been associated with the spread of a novel CMB variant (Harrison et al., 1997). The pandemic poses an immediate threat to cassava production in the areas of Tanzania bordering Uganda and eventually to the country as a whole. Research towards controlling the disease is the focus of continuing work by the Root and Tubers Programme of the Lake Zone Agricultural Research and Development Institute (LZARDI) based at Ukiriguru, Mwanza. The institute is supported in this effort by other international research institutions and networks, including the International Institute of Tropical Agriculture-Eastern and Southern Africa Regional Center (IITA-ESARC), the East African Root Crops Research Network (EARRNET) and the Southern African Root Crops Research Network (SARRNET). SPVD, and its effects on the production of sweetpotato, has received less attention in Tanzania. However, the disease poses a threat to the production of the crop if left unchecked.

Diagnostic surveys were conducted in mid-1998. Three target areas were chosen to represent the major cassava and sweetpotato growing areas in the country: the "lake zone" (i.e., bordering Lake Victoria), which includes Mwanza, Shinyanga, Mara and Kagera regions; the "southern coast", which includes Lindi and Mtwara regions; and the "northern coast", which includes Tanga, Dar-es-Salaam and Pwani regions (Figure 1). The study aimed at identifying whiteflies and whitefly-transmitted viruses and characterizing producer knowledge and responses to these problems on cassava and sweetpotato in Tanzania.

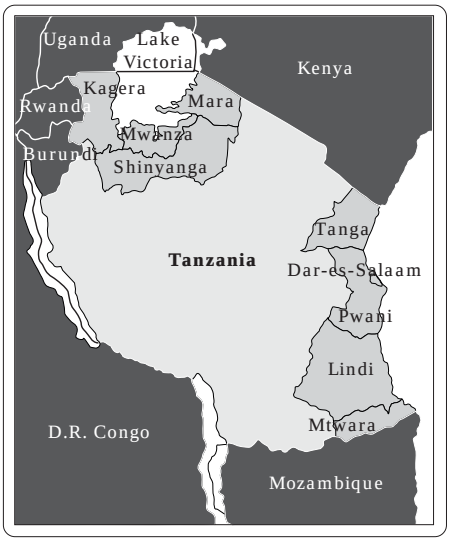

Figure 1. Cassava- and sweetpotato-growing areas surveyed for whitefly incidence in Tanzania.

Increased Biological Understanding

Whitefly species and abundance

Three whitefly species were identified on cassava: *B. tabaci*, B. *afer* (Priesner and Hosny) and *Trialeurodes ricini* (Misra). Only *B. tabaci* and *B. afer* were identified on sweetpotato. Of 303 whitefly samples collected on cassava, 175 were *B. tabaci*, 127 *B. afer* and one *T. ricini*. The 105 whitefly samples from sweetpotato comprised 89 *B. tabaci* and 16 *B. afer*. The species *B. tabaci* and *B. afer* were found in all three survey areas. *B. afer* was more common on cassava than on sweetpotato. It comprised 26% of the whiteflies in samples collected on cassava and 9% of those on sweetpotato from the lake zone, 53% on cassava and 11% on sweetpotato from the southern coast, and 45% on cassava and 27% on sweetpotato from the northern coast (see also Figure 2, Chapter 1.14, this volume).

Adult whiteflies were more abundant on cassava in the northern coast (5.6 per top five leaves) than in either the southern coast (1.1) or the lake zone (0.7). On sweetpotato, estimates of whitefly abundance were highest in the lake zone (40.1 per 1-min count) and lowest in the southern coast (2.8)

Disease incidence and symptom severity

CMD incidence was generally low in the three target areas. The highest incidence was recorded in the northern coast (33.6%) and the lowest (9.4%) in the southern coast (Table 1). The main source of infection in the lake zone (69.3% of the total infection in area) and northern coast (56.8% of the total infection in area) was cutting infection. However, whitefly-borne infection was the predominant source of infection in the southern coast. CMD symptoms were mild in the lake zone and southern coast and slightly more severe in the northern coast.

The incidence of SPVD was highest in the southern coast (12.4%), followed by the lake zone (11.3%), and lowest in the northern coast (4.2%) survey area (Table 1). SPVD symptoms were relatively mild in most of the surveyed regions, with the exception of Shinyanga region in the lake zone, where the disease was very severe (4.5). The low incidence of SPVD should enable the use of phytosanitary measures, including selection of planting material and roguing in the management of the disease.

Whitefly parasitoids

The survey identified two whitefly parasitoids, *Encarsia sophia* (Girault and Dodd) and *Encarsia* sp. (*luteola* group). *E. sophia* was by far the more widely recorded, with 43 samples identified in the southern coast and 19 in the northern coast samples, while only one sample of *Encarsia* sp. (*luteola* group) was recorded, in the northern coast. Little is known about the role of natural enemies in the population dynamics of whiteflies in Tanzania.

Increased Socio-Economic Understanding

Farmers' assessment of whitefly-related problems

A small proportion of both cassava (30%) and sweetpotato (11.7%) farmers were able to recognize whiteflies on the two crops, and even the names given to the insect were non-specific. Moreover, of the farmers who recognized the whiteflies only 16.7% (on cassava) and 3.3% (on sweetpotato) considered them a problem in the production of their respective crops.

Most cassava farmers (70%) could recognize CMD as a disease of cassava, 58% recognized it as a constraint to crop production and 68% as a problem occurring every year in their crops. In contrast, only 38% of sweetpotato farmers recognized SPVD as a disease of sweetpotato, 32% recognized it as a constraint to production and 41% as a yearly recurring problem. One third of cassava farmers considered that CMD severity was increasing, whilst a slightly smaller proportion of sweetpotato farmers considered that SPVD was becoming more important. Forty percent of cassava farmers and 32% of sweetpotato farmers believed that climate influenced the diseases; two-thirds believed that they were more prevalent during periods of low rainfall and high temperatures. Cassava farmers attributed higher losses to CMD than did sweetpotato farmers to SPVD. Using five categories (zero, quarter, half, three quarters and total

Table 1. Incidence (%) of cassava mosaic disease (CMD) and sweet potato virus disease (SPVD), disease severity and whitefly abundance on cassava and sweet potato in selected regions of Tanzania, 1998.

Survey area	Region	Cassava[a]						Sweet potato[a]			
		No. fields	Whitefly counts	CMD				No. fields	Whitefly counts	SPVD	
				Whitefly infection	Cutting infection	Total incidence	Severity			Incidence	Severity
Lake zone	Kagera	6	2.2	0 (0)	30.7	30.7	2.6	5	18.0	20.0	3.1
	Mara	5	0.1	1.3 (1.4)	7.3	8.6	2.6	6	55.9	5.3	2.8
	Shinyanga	5	0.4	0.7 (0.9)	20.7	21.4	2.6	4	25.3	2.0	4.5
	Mwanza	4	0.2	3.3 (4.1)	18.0	21.3	2.4	5	61.1	18.0	3.1
	Mean		0.8	1.2 (1.7)	19.8	21.0	2.6		40.1	11.5	3.3
Southern coast	Lindi	6	1.0	2.8 (2.8)	0	2.8	2.8	9	2.9	8.3	2.1
	Mtwara	14	1.2	8.1 (9.2)	7.9	16.0	2.5	11	2.7	16.4	2.4
	Mean		1.2	6.5 (7.1)	5.5	12.0	2.7		2.8	12.8	2.3
Northern coast	Pwani	7	8.9	15.4 (18.0)	6.7	22.1	3.0	13	1.8	9.2	2.7
	DSM[b]	3	4.3	14.4 (16.3)	4.4	18.8	3.0	5	5.0	3.3	2.0
	Tanga	10	3.6	13.7 (29.5)	46.3	60.0	3.1	2	5.7	0	2.0
	Mean		5.8	14.4 (21.0)	26.2	40.6	3.0		3.1	6.8	2.5

a. Figures are means for each region. Whitefly counts, whitefly abundance on cassava (number of whiteflies per top five leaves) and on sweet potato (per minute count); whitefly infection, figures in parentheses transformed to multiple infection units to allow for multiple infection (Gregory, P. H. 1948. The multiple infection transformation. Ann. Appl. Biol. 35:412-417); severity of disease measured on an ascending 1-5 scale, from low to severe.

b. DSM, Dar es Salaam.

loss) to assess yield loss attributable to either CMD or SPVD, 20% of the cassava farmers believed that CMD causes at least 50% yield loss, while 23% considered the disease to cause only 25% yield loss. Among the sweetpotato farmers, over 50% considered that SPVD caused only 25% yield loss.

Managing whiteflies and whitefly-transmitted viruses

Both cassava and sweetpotato farmers attempted to control CMD and SPVD by roguing and selecting disease-free planting material. Roguing was used for disease management by 23% of cassava farmers and 5% of sweetpotato farmers. Farmers growing cassava gave three reasons for roguing diseased plants: reducing the spread of the disease (18%), poor growth (3%) and preventing disease (2%). However, only 5% of sweetpotato farmers considered that roguing would reduce SPVD. Most cassava farmers rogued infected plants before the crop was 4 months old. For sweetpotato, there was no specific period during which roguing was done. Seventy-three percent of cassava farmers compared with 47% of sweetpotato farmers selected clean planting material, with absence of disease symptoms as the selection criterion for the two diseases. In both cases, however, farmers considered the two principal methods to be only partially effective in managing the diseases.

Only one sweetpotato farmer and none of the cassava farmers mentioned chemical control as a management tactic. The sweetpotato farmer used the organophosphate pesticide dimethoate, applied 3 times, when whiteflies and damage were observed in the field. Few farmers reported abandoning the production of cassava (10%) and sweetpotato (3%) but many reported occasional shortage of clean planting material. The use of host plant resistance as a management option was mentioned by only 2% of cassava farmers but not mentioned at all by sweetpotato farmers. Only 30% of cassava farmers and 22% of sweetpotato farmers noted differences in response to CMD and SPVD between varieties. Those that did so mainly attributed it to differences in levels of resistance to disease. In general, very few cassava (8%) and sweetpotato (2%) farmers had received any technical assistance in the management of whiteflies and associated virus diseases on either crop. However, most farmers were willing to change the planting dates of their crop and monitor whitefly and disease problems if it would help in the management of either disease.

Conclusions

Both diseases covered in this study are becoming more prevalent in Tanzania (Chapters 1.13 and 1.14, this volume) and therefore measures to reduce their impact are needed urgently.

Farmers are more aware of CMD than of SPVD. However, their knowledge of management options for the two diseases is weak, implying poor communication among researchers, extension workers and farmers. Farmers' knowledge of these diseases should be enhanced through participatory training, while researchers, farmers and other stakeholders should work together to develop and validate cost-effective disease and vector management strategies and encourage their wider adoption by producers.

Varieties that are resistant to CMD and SPVD, acceptable to farmers and well adapted to local conditions are urgently needed. The development, farm-level evaluation and wider

distribution of improved varieties of cassava and sweetpotato should be strengthened and expanded.

The whitefly parasitoid *E. sophia* occurred frequently in the areas surveyed, and studies elsewhere in East Africa have shown that parasitoids can cause *B. tabaci* nymph mortality rates of up to 50%. The deployment of resistant varieties and phytosanitation measures probably will be the most readily applicable CMD and SPVD management measures in Tanzania. However, there may be scope in the future for improved management of the whitefly vector through the development and application of measures designed to conserve and augment the activity of whitefly natural enemies. The farmer field school (FFS) approach is being widely used in Tanzania, and FFS in root crop growing areas may provide an ideal opportunity to strengthen farmers' knowledge of CMD and SPVD and develop a holistic, integrated approach to their management, incorporating all possible components including host plant resistance, cultural methods and biological control.

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