CHAPTER 3.9

Haiti

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Introduction

Geographical context

Haiti is a mountainous country; 40% of its territory is located at altitudes above 490 m. The mountain ranges alternate with fertile valleys, the largest being the Plaine du Nord. Annual rainfall varies from 500 in the north-west to 2500 mm in the eastern/southern highlands. Agriculture accounts for one-third of the gross domestic product but subsistence farming predominates. Maize (*Zea mays* L.; 250,000 ha), sorghum (*Sorghum bicolor* [L.] Moench; 160,000 ha), common bean (*Phaseolus vulgaris* L.; 100,000 ha) are the main staples, with rice (*Oryza sativa* L.) and sweetpotato (*Ipomoea batatas* [L.] Lam.) also being important components of the Haitian diet. However, most of the food consumed in Haiti has to be imported. Coffee (*Coffea arabica* L.) is the main export crop (145,000 ha), followed by sugarcane (*Saccharum officinarum* L.), sisal (*Agave sisalana* Perrine ex Engelm.) and cacao (*Theobroma cacao* L.). French-Creole is spoken by 90% of the population and only 10% speak French. Horticultural crops have become increasingly important in Haiti, mainly as an extension of the agricultural export business in the Dominican Republic. Figure 1 shows the main agricultural regions affected by whitefly-transmitted begomoviruses.

The emergence of Bemisia tabaci *as a pest and virus vector*

The whitefly *Bemisia tabaci* was first regarded as a serious pest in Haiti, in the early 1980s. Common bean, tomato (*Lycopersicon esculentum* Mill.), eggplant (*Solanum melongena* L.), pepper (*Capsicum* spp. L.), cowpea (*Vigna unguiculata* [L.] Walp.) and lima bean (*Phaseolus lunatus* L. var. *lunatus*) are the main crops affected by this insect pest (Donis and Prophete, 1997). As a vector, *B. tabaci* already had been observed to transmit *Bean golden yellow mosaic virus* (BGYMV) in 1978 (Balthazar, 1978).

Advances in Biological Research

The main agricultural areas of Haiti were surveyed and plant samples analysed to determine the importance of whiteflies and whitefly-borne viruses. Table 1 shows the different regions visited and the results obtained from the tests practiced with samples collected. Of whitefly-transmitted

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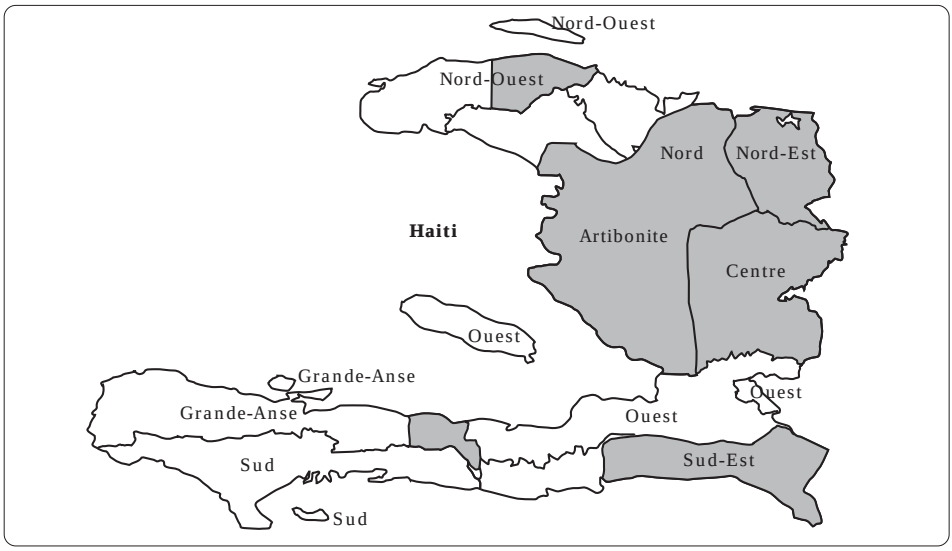

Figure 1. The main agricultural regions affected by whitefly-transmitted begomoviruses, Haiti.

begomoviruses, BGYMV was present in common bean and *Tomato yellow leaf curl virus* (TYLCV) in tomato. As in the case of the Dominican Republic, the specific monoclonal antibody (MAB-GA), which recognizes BGYMV isolates from Central America and southern Mexico, detected the Haitian isolate of BGYMV. This isolate was partially sequenced and compared to the rest of BGYMV isolates from the Caribbean and Central America characterized to date. Table 2 shows the results of these comparative analyses.

As suggested by the serological assay using the Guatemalan (GA) specific MAB, the Haitian BGYMV

Table 1. Results of serological and polymerase chain reaction (PCR) assays of selected samples collected in Haiti.

Sample	Locality	Plant	Reaction[a]			
			MAB-BS	MAB-GA	PTY1	TYLCV
1	Cul-de-Sac	Cowpea	-	nt	-	nt
2	Passereine	Tomato	-	nt	-	+
3	Passereine	Tomato	-	nt	-	+
4	Passereine	Tomato	-	nt	-	+
5	Passereine	Cowpea	-	nt	+	nt
6	Passereine	Common bean	+	+	-	nt
7	Terrier Rouge	Tomato	-	nt	+	+
8	Terrier Rouge	Tomato	-	nt	-	+
9	St Raphael	Tomato	-	nt	-	+
10	St Raphael	Tomato	-	nt	-	+
11	St Raphael	Pepper	-	nt	+	nt

a. Positive or negative reactions to a broad spectrum monoclonal antibody used to detect bi-partite begomoviruses (MAB-BS); a MAB used to detect the original Middle American isolates of *Bean golden yellow mosaic virus*-Guatemala (MAB-GA); a potyvirus-specific monoclonal antibody (PTY1); and PCR detection of *Tomato yellow leaf curl virus*; and nt, no test.

Table 2. Comparative nucleotide sequence homology (%) between a begomovirus isolated from common bean in Haiti and previously sequenced common bean begomoviruses.

Region	BG[a] Haiti	Common bean begomoviruses[b]				
		BGYMV Dominican Republic	BGYMV Guatemala	BGYMV Puerto Rico	BGMV Brazil	BDMV Colombia
Coat protein (*AV1*)	100	90.2	92.0	89.5	68.3	68.7
Replicase (*AC1*)	100	87.5	90.9	88.9	77.6	78.8

a. BG, begomovirus.
b BGYMV, *Bean golden yellow mosaic virus*; BGMV, *Bean golden mosaic virus*; and BDMV, *Bean dwarf mosaic virus*.

isolate assayed is similar to the Central American and Caribbean BGYMV isolates but different from the South American bean begomoviruses, *Bean golden mosaic virus* and *Bean dwarf mosaic virus*. Few of the tomato, pepper and cowpea samples collected in Haiti contained aphid-transmitted potyviruses. All tomato samples were shown by polymerase chain reaction (PCR) to be infected by TYLCV. The composite whitefly sample collected from eggplant resulted in the detection and identification of biotype B of *B. tabaci*. Although preliminary, these results suggest that the whitefly and begomovirus problems in the Hispaniola Island (Dominican Republic and Haiti) are similar.

Socio-economic Analysis

Whitefly-transmitted begomoviruses have been observed to cause significant or even total yield losses in common bean and susceptible horticultural crops in Haiti. In the case of common bean, the cultivation of BGYMV-resistant varieties (available through the Programa Cooperativo Regional de Frijol para Centro América, México y el Caribe [PROFRIJOL] project) and the cultivation of common bean at altitudes above 1000 m should reduce the incidence of BGYMV. The same strategy could be adopted for begomovirus-susceptible horticultural crops, that is, growing vegetables above 1000 m. For valleys below this altitude, where *B. tabaci* thrives, cultural practices such as the implementation of a period free of certain crops that act as reproductive hosts for the whitefly should be adopted following the model implemented in the Dominican Republic. Although there are tomato varieties resistant to TYLCV, these are commercial varieties that small-scale farmers cannot afford. The production of high-value crops (e.g., tomato, pepper and eggplant) by small-scale farmers could greatly benefit from the adoption of integrated pest management (IPM) practices such as the use of micro-tunnels and biological insecticides or mild soaps.

Strengthened Research Capacity

Two collaborating scientists from the Centre de recherche et de documentation agricoles-Ministère de l'agriculture des ressources naturelles et du développement rural (CRDA-MARNDR, Damien), participated in the field survey conducted in Haiti. These scientists were invited to attend international workshops in Central America and to acquire new whitefly/begomovirus characterization techniques at the Centro Internacional de Agricultura Tropical (CIAT) but official and administrative problems prevented their participation in these activities. Nevertheless, as

collaborators in this project, these researchers have benefited from the information generated to date.

The visit to Haiti was also helpful for establishing closer links between the PROFRIJOL project, CIAT and Haiti. As a result, two bean breeders are now actively working to deploy BGYMV-resistant bean varieties in Haiti, and the United States Agency for International Development (USAID) has financed a new project to work on sustainable agricultural practices, including hillside technologies and food security issues in Haiti.

Current Status of Whitefly/Begomovirus Problems

The importance of *B. tabaci* as a pest and vector of plant viruses is expected to decrease in the near future as new bean cultivars possessing resistance to BGYMV are introduced by the USAID-funded project. The introduction of TYLCV-resistant tomato varieties from the Dominican Republic should also reduce the impact of TYLCV in Haiti. However, poverty issues will limit the adoption of resistant cultivars, particularly in the case of tomato. The low economic capacity of most small-scale farmers practicing subsistence agriculture also precludes the use of effective but expensive insecticides (e.g., imidacloprid) to control whiteflies and whitefly-transmitted viruses. The low levels of insecticidal action of cheaper pesticides encourages pesticide abuse, with the consequent development of insecticide resistance in *B. tabaci* populations. Finally, Haiti might benefit from its broken topography to avoid the attack of *B. tabaci* by planting susceptible crops at altitudes above 1000 m.

References

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