A photograph of two farmers in a field. The farmer on the left is wearing a white shirt and a white hat, holding a small bunch of tomatoes. The farmer on the right is wearing a striped shirt and a white hat, leaning over a wooden crate filled with tomatoes. In the foreground, several more wooden crates are filled with ripe, red tomatoes. The background shows a field of tall, thin plants, possibly corn, and a green, hilly landscape under a clear sky.

SECTION THREE

**Whiteflies as Vectors of Viruses in  
Legume and Vegetable Mixed  
Cropping Systems in the Tropical  
Lowlands of Central America, Mexico  
and the Caribbean**

**BLANCA 172**

## CHAPTER 3.1

# Introduction

Francisco Morales\*

### Establishing an International Network

Organizing an international network on whitefly-transmitted viruses in a region as extensive as Central America, Mexico and the Caribbean is, for various reasons, no easy task. First, whitefly-borne viruses have affected more than a dozen countries and commercial crops in this region. Second, most of these countries lack the necessary research infrastructure or resources to study plant viruses. Third, most of the research conducted in the region has been focused on the whitefly *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) as a pest and only rarely as a vector. And, finally, communication among researchers in the region remains difficult. However, this was the first task facing partners in Sub-project 2 of the Tropical Whitefly Integrated Pest Management (TWF-IPM) Project. Sub-project 2, Sustainable integrated management of whiteflies as pests and vectors of plant viruses in the tropics, is led by the Centro Internacional de Agricultura Tropical (CIAT) on behalf of the Systemwide Programme on Integrated Pest Management.

Fortunately, a Regional Action Plan for Whitefly Management had been

created in 1992 under the initiative of various international institutions such as the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) in Costa Rica, the Pan American Agricultural School at Zamorano in Honduras and the Instituto Interamericano de Cooperación para la Agricultura (IICA). The network has promoted annual meetings of regional scientists interested in controlling this important pest, mainly under the coordination of CATIE. Another important network that operates in the region is the Programa Cooperativo Regional de Frijol para Centro América, México y El Caribe (PROFRIJOL), financed by the Swiss Government to promote the production of common bean, *Phaseolus vulgaris* L. (Leguminosae), in the region. A main production problem of common bean in the lowlands and the mid-altitude valleys of Central America, Mexico and the Caribbean has been *Bean golden yellow mosaic virus* (Geminiviridae: Begomovirus), a disease caused by a whitefly-transmitted virus. Both PROFRIJOL and CIAT have given considerable attention to this problem since 1978 through a collaborative research agreement. The existence of these networks greatly facilitated the task of organizing an international network to focus specifically on viruses transmitted by the whitefly *B. tabaci* in legume and horticultural crops in the region.

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To further strengthen this network, Sub-project 2 selected three subregional coordinators and three advanced research institutions with previous research experience in each of the three subregions. The first subregion selected was Central America and the advanced research institution chosen to provide technical support was the Plant Pathology Department of the University of Wisconsin, Madison, USA. The subregional coordinator was Dr. Luko Hilje, an entomologist at CATIE, and the responsible scientist for the University of Wisconsin was Dr. Douglas Maxwell. Subregion 2 was Mexico, and its support research institution was the University of Arizona, in Phoenix, USA. The subregional coordinator was Dr. Rafael Rivera Bustamante of the Centro de Investigaciones y Estudios Avanzados (CINVESTAV) in Irapuato Mexico, and the responsible scientist for the University of Arizona was Dr. Judith K. Brown. Subregion 3 was the Caribbean, and its support institution was the University of Florida, Bradenton, USA. The subregional coordinator was Dr. Colmar Serra, of the Instituto Superior de Agricultura (ISA), Dominican Republic, and the responsible scientist at the University of Florida, Dr. Jane Polston. Later on during the development of the project, Drs. Hilje and Serra stepped down from their respective coordination roles and the coordinator of Sub-project 2, Dr. Francisco Morales, assumed these responsibilities.

### **Assessing Socio-economic and Environmental Impact**

The large number of countries included in Sub-project 2 precluded the implementation of socio-economic surveys in each country. Nevertheless,

four countries in Central America—Guatemala, El Salvador, Honduras and Costa Rica—were selected to conduct these studies, based on the following considerations. First, national institutions were available that were willing to conduct the surveys. Second, a predominant small-scale farming system could be identified in the three countries and study areas selected. Third, a truly diversified agriculture, including legumes and horticultural crops, could be found in the study areas selected. These conditions were not satisfied in most of the areas surveyed in Mexico or the Caribbean region, with the exception of Cuba, which was excluded on the basis of other logistical constraints.

Another consideration was that, in Mexico and the Caribbean region, statutory measures to counter whitefly and virus epidemics have been successfully implemented. The national program scientists who have had the responsibility of implementing the regulatory measures will discuss the case of the Dominican Republic (Chapter 3.11, this volume).

### **Emergence of Whitefly-Transmitted Viruses**

A number of historical, economic and biological factors have been identified as being associated with the emergence of whitefly-borne viruses in legumes and horticultural crops in the region covered by Sub-project 2. These will be discussed in the individual country papers and in the concluding chapter of this section (Chapter 3.14, this volume). However, in introducing this section, two crosscutting trends can be highlighted. First, the presence of whitefly-transmitted viruses is frequently associated with the cultivation of large-scale commercial or non-traditional horticultural crops,

especially for export. Second, the disintegration of national agricultural research programs throughout the study region has had a negative impact on the management of whitefly-related production problems. Basically, the lack of technical assistance to control the whitefly vector has left producers in the hands of pesticide vendors. As a consequence, pesticide abuse has resulted, with serious biological and environmental consequences.

The economic situation in Latin America has been deteriorating since the late 1970s, when the oil crisis generated a gigantic debt for most countries in the region. Possessing only an incipient industrial capacity, most countries had to resort to the export of non-traditional crops such as soybean (*Glycine max* [L.] Merr.) and vegetables. This strategy produced complex changes in the region's agricultural environment that national agricultural research programs in Central America, Mexico or the Caribbean have not addressed. The cropping systems involved have been difficult to analyse in this project because the production losses caused by whitefly-transmitted viruses have forced growers to abandon and replace crops frequently. Nevertheless, the Sub-project partners have been able to document the rapid turnover of crops in whitefly-affected areas and to analyse some of the consequences.

## Looking Ahead

A wealth of information, characterizing problems associated with whitefly-transmitted viruses affecting legumes and horticultural crops in Central America, Mexico and the Caribbean was accumulated during this preliminary phase of the TWF-IPM Project. Considerable progress was made in the use of a geographic

information system to analyse the data collected, and in the creation of an interactive system to allow potential users to access these data. The amount of data collected across this diverse region considerably exceeded expectations and further analysis will be required to extract all the valuable information it contains. However, when this task is complete, the knowledge gained will provide a sound foundation for developing and implementing sustainable management strategies for whiteflies and whitefly-borne viruses in the region. Figure 1 shows the areas affected by whitefly-transmitted viruses.

In the following chapters, the reader will find a brief description of the different historical, geographic, biological and socio-economic factors that contributed to the emergence of the whitefly *B. tabaci* as a major pest and vector of viruses (referred to here as geminiviruses or, more specifically, as begomoviruses). Concluding chapters draw together results regarding the biotypes and reproductive hosts of *B. tabaci* in this region and, based on a synthesis of all results, make recommendations for further research and implementation directed towards achieving more effective and sustainable management of whiteflies and whitefly-borne virus diseases in the region.

## Acknowledgements

The following chapters were written by the senior author based on results obtained at the Plant Virology Laboratory (CIAT, Cali, Colombia) from samples collected by the senior author or collaborators in participating countries, as well as on the available literature and personal observations and experience in the region. Hence, co-authors are not responsible for

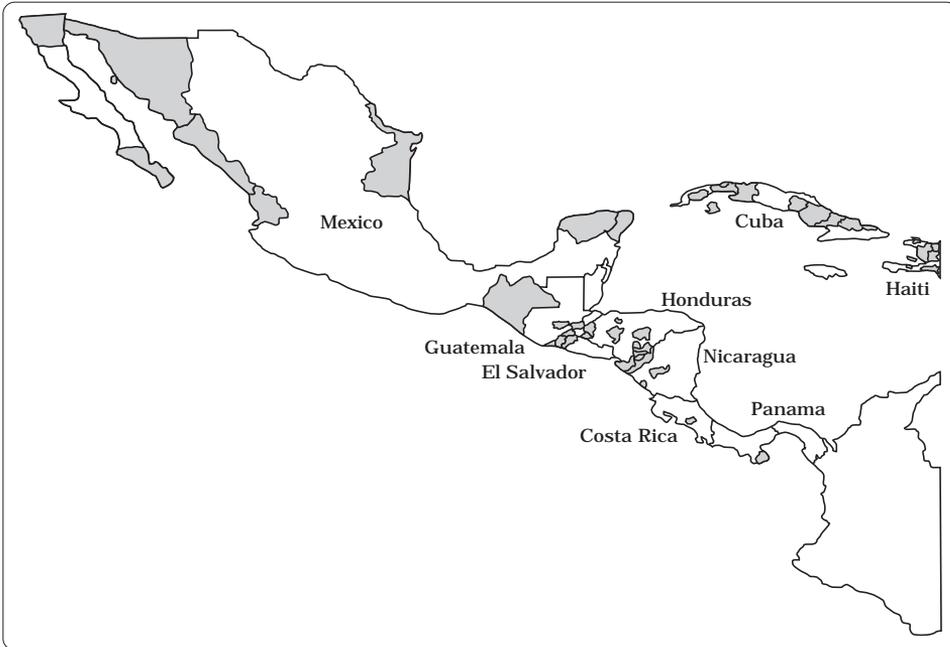


Figure 1. Regions in the Neotropics affected by whitefly-transmitted viruses (shaded areas).

omissions or errors found in these chapters. Data provided by collaborating national scientists are dutifully acknowledged in the corresponding chapters. Several national scientists and students collaborating in the project conducted socio-economic studies. Most of the survey data presented have been published as theses by their main authors, also included as co-authors in the corresponding chapters. Special acknowledgements are due to the professional personnel of the CIAT Plant Virology Laboratory, who processed most of the samples of whiteflies and viruses analysed in this

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