

Indigenous parasitoid complex associated with whiteflies for major food crops in the Neotropics



A.C. Bellotti*, J. Peña**, P. Anderson*, B.V. Arias*, H. Trujillo*, C. Holguín*, J.M. Guerrero*, M. Rose***, G. Evans****, A. Hamon****

* CIAT, ** U. of Florida, ***Montana State University **** Florida Dept. of Agriculture

Introduction

As direct feeding pests and vectors of plant viruses, whiteflies constitute a major problem of important food crops in the neotropics. Numerous whitefly species have been recorded; 11 species are reported on cassava alone and at least 30 species have been reported on associated crops, such as legumes and vegetables, in Colombia, Central America and The Caribbean region. On cassava *Aleurotrachelus socialis* is the predominant species in northern South America, while *Bemisia tuberculata* and *Trialeurodes variabilis* are reported in lower populations. *Bemisia tabaci* and *Trialeurodes vaporariorum* are the most important and widely distributed species on vegetables and legume crops in the region.

Damage

Whitefly feeding affects crops through direct feeding damage and plant virus transmission. *A. socialis* feeding on cassava leaves induces chlorosis and leaf fall, resulting in root yield loss. Infestations of 1, 6 and 11 months results in a 5,42 and 79% reduction in yield in Colombia. *T. vaporariorum* feeding reduced yields of beans by 50%, and tomatoes by 35%, in Colombia. *B. tabaci*, a pantropical species, is a vector of numerous geminiviruses and has caused millions of dollars in production losses in cassava, vegetables, legumes, cotton and other crops in Africa and Latin America.

The objectives of this study were to determine the indigenous parasitoid complex associated with whiteflies feeding on cassava, beans, tomatoes, cucumbers, eggplant and cotton in different agroecological zones of Colombia.



Cassava damage



Snap bean damage

Methods

Explorations of whiteflies and their parasitoids were carried out in two geographic regions of Colombia: the Caribbean Coast and the mid-altitude central (Andean) highlands. The regions surveyed represent two distinct ecological zones. The Caribbean Coast is hot (27° to 36°C) with a 4 to 6 mo. dry period and 25 to 70% RH. The Andean sites are much cooler (22° to 33°C), with a less severe dry period and a 7 to almost 100% RH. Altitude at Caribbean Coast sites ranged from 0 to 200 m.a.s.l., and 25 to 1750 m.a.s.l. at Andean sites.

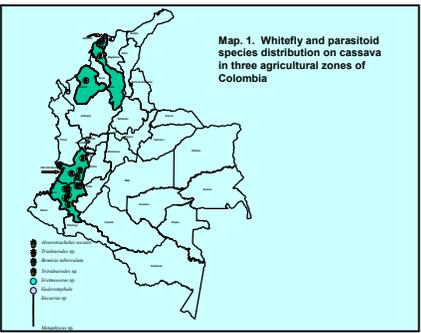
Sampling was done by randomly selecting 100 leaves from each crop host at each collection site. Leaves were initially placed in a plastic bag containing a paper towel, then transferred to 75% alcohol. A one square inch leaf area was examined by stereoscope to determine the whitefly species and record the number of nymphs and pupae. The parasitoid species and level of parasitism was determined by removing 2.5 cm² leaf area from 40 randomly selected host leaves. Only one whitefly species was allowed to remain on each leaf square and the emergence of parasitoids recorded.

Parasitoid and whitefly identification were done at CIAT and sent to collaborating taxonomists for verification.



Results

The whitefly species complex associated with cassava is distinct from that described on cotton, beans and the vegetable crops. Four species of whiteflies were confirmed reproducing on cassava, *A. socialis*, *B. tuberculata*, *Trialeurodes* sp. (probably *T. variabilis*) and *Tetraleurodes* sp. (Map 1). *A. socialis* was the predominant species in both zones, but at higher population levels in Valle del Cauca, lower on the Caribbean Coast and lowest in Cauca (Fig. 1). All four species were collected from the Caribbean Coast, but *Tetraleurodes* sp. was not collected from the Andean Highlands. Pupal populations of *A. socialis* ranged from an average of about 56 per 2.5cm² on leaf samples from Valle del Cauca to 5 on the Caribbean Coast and 2 in Cauca.



Map 1. Whitefly and parasitoid species distribution on cassava in three agricultural zones of Colombia

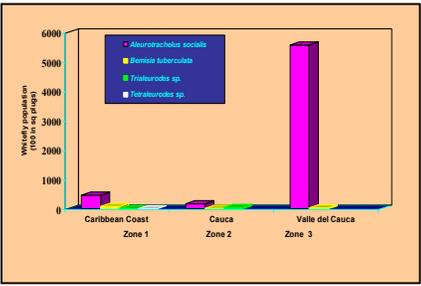


Fig. 1. Whitefly population densities on cassava in three geographic zones of Colombia

Two whitefly species, *B. tabaci* and *T. vaporariorum* were collected from the other crops surveyed. *B. tabaci* was collected from cotton, eggplant and tomato, while *T. vaporariorum* from beans, snap beans, cucumber and tomato. Populations of *T. vaporariorum*, in general, were much higher than *B. tabaci* (Fig. 2). During the period of field collections (Jan. to June, 1999), *B. tabaci* was the only species collected on the Caribbean Coast and *T. vaporariorum* was the only species collected in the Andean Region (states of Caldas, Quindío, Risaralda and Valle del Cauca). (Map 2).

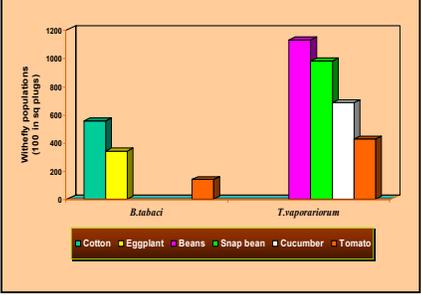
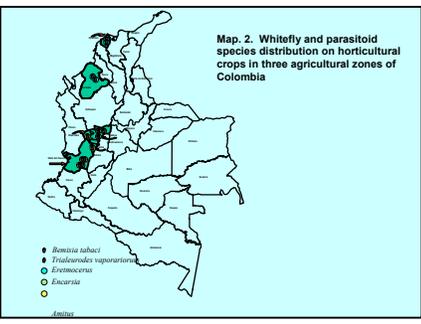


Fig. 2. Whitefly nymph/pupae populations on several crops in six Colombian departments

Numerous parasitoid species were collected from cassava in the different regions (Map 1); these belong to the genera *Encarsia*, *Eretmocerus*, *Metaphycus* and *Euderomphale*. Several are unrecorded species. *Encarsia* was the genera most frequently collected from cassava in the Andean Highlands, while *Eretmocerus* predominated on the Caribbean Coast (Fig. 3). *Metaphycus* was only collected on the Caribbean Coast and *Euderomphale* only from Valle del Cauca. The parasitoid species complex associated with each whitefly species on cassava can be influenced by geographic area. On the Caribbean Coast, *A. socialis* was most frequently parasitized by *Eretmocerus*, while in the Andean highlands it was *Encarsia*. 99.8% of the parasitism of *A. socialis* in Valle del Cauca was by *Encarsia* and 0.4% by *Eretmocerus*. The most numerous complex of parasitoids was found associated with *B. tuberculata*



Map 2. Whitefly and parasitoid species distribution on horticultural crops in three agricultural zones of Colombia

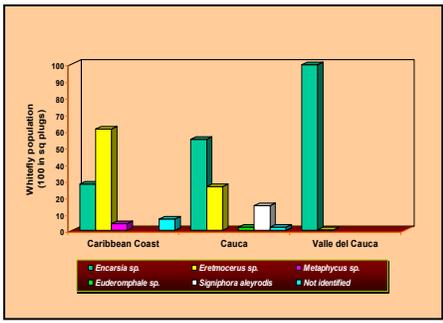


Fig. 3. Parasitoid species (in %) collected from whiteflies on cassava in three geographic zones of Colombia

On the six additional crops (cotton, beans, cucumber, eggplant, snap beans and tomato), parasitoids from the genera *Encarsia*, *Eretmocerus*, *Metaphycus* and *Signiphora* (hyperparasite) were collected from *B. tabaci*; parasitoids of the genera *Amitus*, *Encarsia* and *Eretmocerus* were collected from *T. vaporariorum* (Fig. 4). *Encarsia* was the most widely distributed, whereas *Amitus* was found in higher populations. Parasitoid populations were higher in the Andean highlands than on the Caribbean Coast and highest in Valle del Cauca (Fig. 5). *Encarsia* parasites were collected from all plant hosts while *Eretmocerus* was associated almost exclusively with cotton (Fig. 5). *Encarsia* were collected from *B. tabaci* and *T. vaporariorum*, while *Amitus* was collected only from *T. vaporariorum* (Fig. 4).

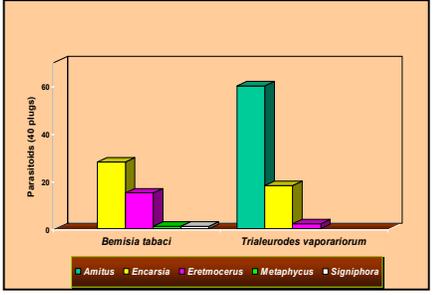


Fig. 4. Relationship between parasitoid complex and whitefly species collected from several crops in six Colombian departments

Survey data on pesticide use show that parasitoid populations were higher in fields where pesticides were not applied and that populations of *Encarsia* were less affected than *Amitus* by pesticide use.

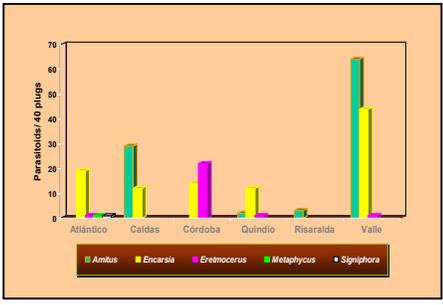


Fig. 5. Whitefly parasitoids collected from several crops in six Colombian departments

Conclusions and Recommendations

The whitefly and parasitoid species complex associated with a range of neotropical crops needs to be better defined and studied. Evidence indicates a rich complex of parasitoid species, many unrecorded, that may be of considerable value in biological control and IPM programs.

In future explorations, more emphasis needs to be given to fields where low whitefly populations exists with the hope of identifying the key parasitoid species regulating whitefly populations.

Present research includes evaluations on the efficacy of specific parasitoid species on corresponding whitefly hosts.

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