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STATUS OF THE HIBISCUS MEALYBUG (HMB) *MACONELLICOCCUS HIRSUTUS* AND THE EXOTIC NATURAL ENEMIES IN TRINIDAD

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ABSTRACT: The HMB was first reported in Trinidad in 1995. Following short term control strategies a classical biological control programme was initiated in 1996 as a long term sustainable control strategy. The exotic natural enemies released were *Cryptolaemus montrouzieri* (Cm), *Scymnus coccivora* (Sc) and *Anagyrus kamali* (Ak). Since 1996, six islandwide surveys were conducted to determine spatial distribution of HMB and the exotic natural enemies to assess the impact of the natural enemies, and to quantify plant damage. The methodology was developed by the FAO under the Technical Cooperation Project (TCP). The data from these surveys were compared to determine the impact of the natural enemies on HMB. Generally few Ak and Sc were recovered. However, Cm appears to be established in the environment. The HMB population after releases was also low for all counties. *Hibiscus spp.* continue to be the most susceptable host plants. Although crinkling and curling symptoms appeared in surveyed plants, damage was not critical. Data from these surveys also served to provide supportive information on the status of the HMB population and facilitated the resumption of regional trade.

INTRODUCTION

The Hibiscus Mealybug (HMB), *Maconellicoccus hirsutus* Green (Homoptera: Pseudococcidae), which is native to South–East Asia has a wide host range attacking over 125 plant species (Peterkin, et al , 1999). It was first reported in the Western Hemisphere in Grenada in 1994. In August, 1995 it was recorded in Trinidad (Mc Comie, 1995). The pest is now widespread in the region (FAO, 1999) (Table 1).

* Table 1: Current reported distribution on Pink Hibiscus Mealybug in the Caribbean Sub – Region

Country	Date of Reporting
Grenada and Carriacou	November 1994
Trinidad (and) Tobago	August 1995, November 1996, respectively
St. Kitts (and) Nevis	November 1995, December 1995, respectively
Netherlands Antilles:	
Aruba, Saint Maarten, St. Eustatius, Curacao	?, September 1996, May 1997, June 1997, respectively
St. Lucia	
Anguilla	October 1996
Guyana	1996 ? / February 1997
British Virigin Islands (Tortola)	April 1997
St. Vincent and the Grenadines	May 1997
United States Virgin Islands:	
St. Thomas, St. John, St. Croix	May 1997, May 1997, June 1997, respectively
Puerto Rico:	
Culebra, Vieques, PR Mainland (E. Farjado)	December 1997, June 1997, April 1998, respectively
Montserrat	January 1998
Guadeloupe	April 1998
Martinique	March 1999

* Source: FAO Circular Letter No. 1/99

Chemical and cultural practices were adopted as short-term control strategies which however were not effective (Mc Comie, 1996). Following these measures a classical biological control programme was initiated in 1996 as the main component of an IPM system for long-term control. Two (2) exotic ladybird beetles *Cryptolaemus montrouzieri* (Cm) and *Scymnus coccivora* (Sc) (Coleoptera: Coccinellidae) were introduced together with the parasitic wasp *Anagyrus kamali* (Ak) (Hymenoptera : Encyrtidae) were used for the control of the HMB. In 1999, another exotic parasitic wasp, *Gyranusoidae indica* (Gi) (Hymenoptera : Encyrtidae) was reported in Trinidad (CABI, 1999). This wasp was one of the complex of biogents used in controlling HMB in St. Kitts, and Grenada, however, it was never officially introduced in Trinidad.

Large scale surveys are necessary to demonstrate the impact of exotic natural enemies on pest populations (Neuenschwander, 1996). This requires large numbers of field units, randomly selected for sampling in order to obtain empirical data.

In 1997 as part of the FAO Technical Cooperation Project (FAO/TCP) on the Hibiscus Mealybug, a survey protocol was developed for implementation by individual countries. This survey was previously designed to capture data on the status of levels of HMB infestations, impact of natural enemies, data to determine establishment of natural enemies and to quantify plant damage. Collection of other mealybugs for identification was also sought. Data from these surveys also serve to determine future control programmes. In 1999 the FAO / TCP Protocol was slightly modified to include sites on secondary roads to capture farms with sorrel and ochro.

Since 1996, islandwide surveys have been conducted every year in Trinidad and in Tobago. Data from these surveys have provided supportive information on the status level of HMB and assisted with the resumption of regional trade.

METHODOLOGY

Grids

The island was divided into 50 km squared grids. Only grids that were accessible by main and/or secondary roads were surveyed. A total of 88 grids were accessible in all eight counties as follows:

Caroni	11	Nariva/ Mayaro	14
St. George West	14	St. Patrick East	7
St. George East	8	St. Patrick West	14
St. Andrew/ St. David	14	Victoria	6

Survey Routes

Survey routes were identified on the grid map before going out into the field. Three (3) sampling points were selected along the main road 2.0km apart and another three (3) along secondary roads 1.0km apart. Secondary roads were sampled to capture commercial crops like ochro and sorrel. The first sampling point was selected at random and predetermined at 0.0, 0.5, 1.0 and 1.5km from the edge of the grid.

Sites

Each sampling point was classified as Urban Homestead, Rural Homestead, Farm, Teak Forest, Roadway or Empty Lot. These sampling points were described as follows:-

Urban Homestead - a household in a developed area away from the city.
Rural Homestead - a household in the country.
Farm - an area cultivated with agricultural crops or ornamentals.
Teak Forest - an area intensively cultivated with teak.
Roadway - a site at the side of a main or secondary road.
Empty Lot - a vacant uncultivated area in urban or rural communities.

Indicator Plants

The list of indicator plants selected were those highly susceptible to the HMB. Eight plant species were selected as follows: *Annona spp* - soursop, *Sida spp.*- broomweed, *Hibiscus esculentus* - ochro, *Hibiscus spp.*- ornamental hibiscus, *Hibiscus sabdariffa*- sorrel, *Achrysanthes indica*- man–better-man, *Tectona grandis* - teak, *Malacra sp.*- wild ochro.

Sampling

Sampling units were used according to the parts of the plant that were attacked or available. These include branch / shoot, flowers / fruit or leaves.

Ten plants were sampled for each site and five units per plant were scored. A sample was taken from the first 15cm of the shoot selected within arms reach. For fruits, the first five encountered while walking around the tree were sampled.

The first of the five units per plant sampled was collected, placed in separate plastic bags and taken to the laboratory for further examination and scoring. Each plastic bag was labelled with grid number, site number, sample number, date and collector's name.

Additional samples were collected from sites with more than one indicator plant species.

Field Scoring and Recording

Shoots / Flowers: Mealybug population and plant damage was recorded on a scale of 1-5 as follows: - No Mealybugs, plants show no sign of damage; No Mealybugs, plants show signs of damage e.g. curling and crinkling of leaves; Small inconspicuous colonies of Mealybugs at terminal buds or inflorescences; Conspicuous infestations limited to terminal buds; High infestations, extending to stem, sooty molds may be present.

Fruits (Soursop): Mealybug population and other symptoms were also recorded on a scale of 1-5 as follows: -No Mealybugs, fruit(s) clean, no sooty molds; No Mealybugs, fruit(s) show(s) signs of previous infestation e.g. Sooty mold, Mealybug waxing coating; Small inconspicuous colonies of Mealybugs (<) less than 10% surface area; Conspicuous colonies limited to part of the Fruit 10-30% of surface area; High infestations over 30% of surface area.

Laboratory Scoring of Shoots / Flowers for HMB: In the laboratory the following observations were made from the samples: number of ovisacs; number of crawlers; number of juveniles; number of adult females.

Laboratory Scoring of *A. kamali* and *G. indica*: Actual counts of intact mummies, empty mummies and adult *Anagyrus kamali* and *Gyranusoidae indica* were recorded.

Laboratory Scoring – *C. montrouzieri* and *S. coccivora*: The following observation were made on Cm and Sc. Number of Larvae, pupae and adults and number of other natural enemies. All *C. montrouzieri* and other natural enemies which could feed on *A. kamali* were removed and the number of insects left in the plastic bag were recorded.

Percentage Parasitism: Following counts of *A. kamali*, *S. coccivora* and *C. montrouzieri* all samples from each site were placed in rearing jars for emergence of adult *A. kamali* and *G. indica.* These jars were monitored every 2-3 days for a period of three weeks and the number of emerged parasitoids were recorded.

The percentage of parasitism was calculated as follows:-

$$\text{Percentage Parasitism} = \frac{\text{No. of emerged parasitoids X 100}}{\text{Total no. of susceptible stages+intact mummies}}$$

The Statistical Package for Social Sciences (SPSS) was used for data processing.

RESULTS AND DISCUSSION

Average HMB Score by Plant Species: For most crops there were peaks and fluctuations in average scores for the six surveys. However, scores for most species was <2, indicating relatively clean plants. *Hibiscus spp.* maintained the highest score throughout the surveys while the average score peaked (2.0) in sorrel in the last survey.

It is evident that HMB is established in the environment but their populations have been suppressed. The early short term strategies of chemical use and cultural practices may have initially been efffective in controlling population growth. The long term biocontrol measures afterwards continued to suppress the pest.

Average HMB Score for Commercial Crops: Ornamental hibiscus, sorrel and ochro are preferred hosts of HMB. Although the scores were low (<2.00) for these crops heavy losses can be obtained especially on sorrel and ochro. Management of the pest therefore, should begin early in these species.

Percentage of Samples with HMB score of 2 and above by County: Generally there were peaks and fluctuations in the percentage of samples scoring 2 and above for all surveys. Survey 2 had the lowest percentage of samples scoring 2 and above for all counties. The highest (54.49) percentage was found in St. George East county in Survey 6 (Figure 1). Control strategies should therefore be intensified in this area. This occurred because sorrel was the most predominant plant species in that county. The crop was abandoned in the fields after the final harvest allowing for build up of the HMB population.

Overall the southern counties St. Patrick East, St. Patrick West, Nariva / Mayaro and Victoria had the highest percentage of samples scoring two (2) and above. These counties should be more closely monitored and augmentative releases be made if necessary, to suppress the pest population.

Survey 2 consistently had the lowest percentage of samples scoring 2 and above for all countries. The highest (17.2%) was found in St. Patrick West while the lowest (1.2%) was found in Caroni. At that time major control activities including public awareness were still being executed which resulted in the low pest populations.

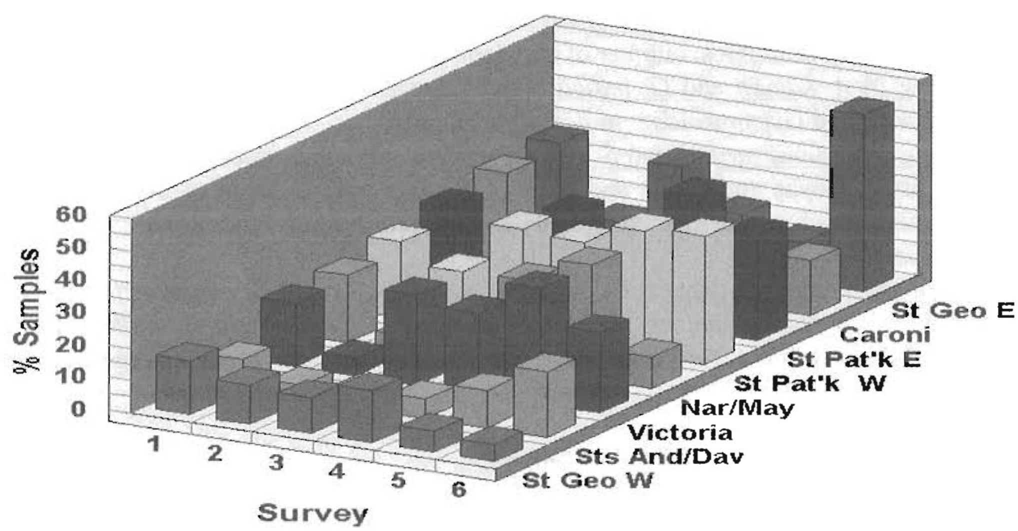

Figure 1. Samples with HMB Score of 2 and above by county.

Cm in the field by County: It is evident that wherever HMB was present, Cm was also present. Peaks in HMB populations, coincided with peaks in Cm populations (Figures 2 and 3). For Survey 6, the percentage of samples scoring 2 and above peaked at 54.49 while the percentage of Cm peaked at 16.33.

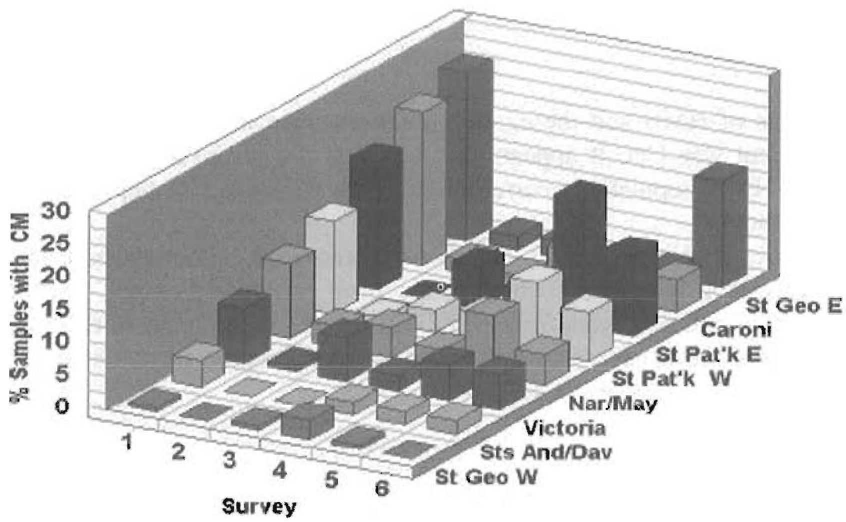

Figure 2. Cryptolaemus montrouzieri (Cm) in the field in relation to county.

HMB and Natural Enemies relative to Field Sites: HMB was most prevalent in Rural (40.34%) and Urban (37.99%) sites. These sites also had the highest percentage of samples with Cm for all six surveys. The percentage of Sc and Ak was quite low in those sites and almost not present in the other sites. At low pest populations it is possible that Cm may feed on Sc and Ak thus accounting for their low populations.

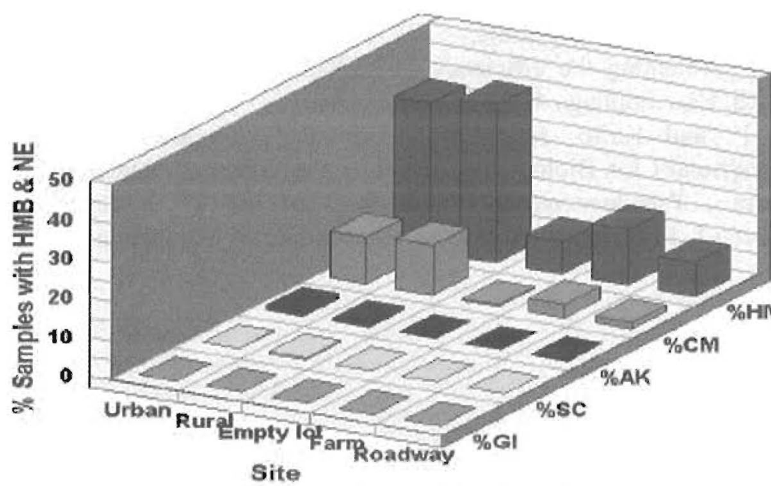

Figure 3. HMB and natural enemies relative to field sites.

The results were consistent for all surveys i.e. peaks and fluctuations in HMB population coincided with that of Cm. Nine months after initial releases of Cm the impact of this Natural enemy on HMB was quite visible and remained so (Mc Comie, 1996). Cm was also reported (Gautam et al., 1996) to be quickly established in the environment.

The peaks and fluctuations in pest and natural enemy populations are typical in classical biological control programmes in which natural enemies are released for controlling pest populations.

CONCLUSION

Generally counts of HMB and the exotic natural enemies were low. The most prevalent natural enemy in the environment was Cm. It appears that this was the preferred coccinellid for release. In all instances the peaks in HMB populations corresponded with peaks in Cm populations. Cm seems to be established in the environment.

Few *S. coccivora, A. kamali* and *G. indica* were recovered. Although these natural enemies were present in the environment, it is doubtful whether they have established or not. Exclusion studies in the short term and long term population dynamics studies will determine the status of these natural enemies.

Data from these surveys have provided supportive information on the status level of HMB and assisted with the resumption of regional trade.

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