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Study on Parasitoids of Whitefly Associated with Brinjal Plants

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Abstract

Whitefly is a worldwide pest causing yield loss and economic injury in many crop species including brinjal plants. The integrated control concept emphasizes the importance of biological control for pest suppression in agricultural systems. Therefore, this study was directed at developing biological control of whiteflies by identifying for native parasitoids of whiteflies on brinjal plants at the Agronomy farm, Eastern University of Sri Lanka. For that, brinjal leaves infested with whitefly nymphs were collected from the Agronomy farm, Eastern University of Sri Lanka and cultured in a humidity-controlled container at Agricultural Biology Laboratory until the parasitoids' emergence. Then, the emerged parasitoids were identified to species level based on their morphological characteristics using the guidelines of Schmidt *et al*. (2001) and the browsed images from online. *Encarsia cibcensis* Lopez Avila and *Eretmocerus californicus* were the parasitoids identified from the research site. Among the identified parasitoids, *Encarsia cibcensis* Lopez Avila were more abundant than *Eretmocerus californicus* at the research site.

Introduction

Brinjal is a popular vegetable in Sri Lanka which occupies second largest extent compared to other vegetables [8]. It is cultivated largely on small, family-owned farms where weekly sale of its produce brings in a ready cash income [16]. The crop seedlings are normally transplanted in March to April and remain on fruiting till October [7]. Due to the long cropping season, the crop is exposed to the attack of a large number of insect and mite pests which inflict considerable losses in crop vigour and yield [7]. Among the pests that attack brinjal, whitefly *Bemisia tabaci* causes severe damage to plants by feeding on sap, by secreting honeydew where black sooty mold grows and by transmitting viral diseases [11].

Large populations of *Bemisia tabaci* develop during summer months leading to the extensive use of insecticides for whitefly suppression [13]. Although insecticides remain the primary tactic for managing *Bemisia tabaci* in affected crops [10], considerable research has focused on the development of alternative control tactics, including the use of biological control [15]. Recent reviews have cataloged 114 species of predatory arthropods, nearly 50 species of parasitoids and 11 species of naturally occurring fungi known to be associated with *Bemisia tabaci* worldwide [4].

Parasitoids attacking *Bemisia* whiteflies are much easier to assess but, taxonomic problems make it difficult to positively enumerate the species involved. 34 species of *Encarsia*, 14 species of *Eretmocerus* and several species belonging to the genera *Amitus* and *Metaphycus* attack *Bemisia tabaci* worldwide [4].

Therefore, this study was directed to develop biological control of whiteflies by identifying for native parasitoids of whiteflies on brinjal plants.

Methodology

Crop Plant:

Brinjal, *Solanum melongena* L. (cv. Palugamum purple) was planted at the Agronomy farm, Eastern University, Sri Lanka for the collection of whitefly-infested leaves.

Sample Collection:

Brinjal leaves infested with whitefly nymphs were detached from the lowest node of plants and were collected in polyethylene bags and brought to the laboratory. The insect pests, except *Bemisia tabaci* nymphs in the collected leaves were removed in the laboratory with the help of brush and needle while observing through the magnifying lens (×10).

Placement of Samples in Plastic Bottles:

Petiole of the brinjal leaves was wrapped by moist cotton to reduce the water loss from the leaf. Then leaves were placed individually in small plastic bottles and covered with muslin cloth and tied by rubber band to prevent the escape of emerging parasitoids.

Humidity Maintenance:

Bottle with leaf was placed in a glass cage containing salt solution to maximize humidity [3]. Then cage was covered by muslin cloth and tied by rubber band as shown in Figure 1. During this experiment, humidity was maintained at 75 ± 2% to enhance parasitoids emergence. Samples were kept for five days to allow parasitoids emergence from the host and then the emerged parasitoids were collected.

Dehydration and Slide Mounting:

Collected parasitoids were placed on watch glass and dehydrated by alcohol series (70% to 80% to 90% ethanol).

A small drop of Canada balsam was placed on the centre of the microscope slide and then the specimen was placed dorsal side up in balsam. Wings, antenna and legs were extended before the placement of cover slip on top of the specimen. Then gentle pressure was applied to the top of the cover slip until the balsam reaches the cover slip edge. Then, slides were placed in a drying oven until dry.

Observation:

Specimens were observed under light microscope (×40) for the identification of parasitoids.

Identification:

Parasitoids were identified to Genus level with the help of pictorial guide [12], Taxonomical guidelines [17] and the browsed images from online [9] were used for species level identification.

Results

Parasitoids of whitefly on brinjal plants were identified based on both the colour of the parasitized whitefly nymphs and the morphological characteristics of parasitoids.

Parasitized Whitefly Nymphs:

Yellow (Figure 2) and black (Figure 3) parasitized whitefly nymphs were collected from the research site. According to the literature [19], the occurrence of yellow and black parasitized whitefly nymphs showed that the parasitoids belongs to *Eretmocerus* (yellow) and *Encarsia* (black) were associated with whiteflies at the research site.

Parasitoids:

Parasitoid 1 (Figure 4)

It has predominantly yellow head and body. Antenna is yellowish with six segmented flagellum. Clava is not very distinctly defined. Tarsus of middle leg is five segmented. Marginal fringe of forewing is as long as half of wing width. Based on the guidelines [17], it was identified as *Encarsia cibcensis* Lopez-Avila.

Parasitoid 2 (Figure 5)

It has yellowish brown head and body with blackish eyes. It has three-segmented long, elbowed antenna. Tarsus formula is 4-4-4. Based on the guidelines [12] and browsed images from online [9], it was identified as male *Eretmocerus californicus.*

Parasitoid 3 (Figure 6)

It is pale lemon yellow with green eyes and clubbed antennae. Antenna flagellum has two short funicle segments and one elongated clubbed segment. Tarsus formula is 4-4-4. Based on the guidelines [12] and browsed images from online [9], it was identified as female *Eretmocerus californicus.*

Discussion

Parasitization of *Bemisia* whitefly on brinjal has been reported by several workers [4]. Parasitoids attacking *Bemisia* whiteflies are much easier to assess but, taxonomic problems make it difficult to positively enumerate the species involved. Due to that, taxonomic guidelines [12], [17] and browsed images from online [9] were used in this study for the identification.

Encarsia cibcensis was identified as a parasitoid from *Bemisia tabaci* by several workers [1], [2]. Since it was originated from Pakistan [17], it has the ability to survive at high temperature. Therefore the possibility for its distribution in Sri Lanka is high.

Eretmocerus male and female were confirmed as primary parasitoids of whiteflies by previous workers [18]. And also *Eretmocerus californicus* was collected from *Bemisia* species of whiteflies by several workers [6]. It is more resistant to higher temperatures and gives good control of the *Bemisia tabaci* [19]. These are some evidences for its occurrence on *Bemisia tabaci* as parasitoids at the research site.

Even though the results of the previous studies [14] suggested that the *Eretmocerus* was a dominant species than *Encarsia*, the results of this study showed that *Encarsia cibcensis* Lopez Avila was the more abundant species than *Eretmocerus californicus*. From this result we cannot say *Encarsia cibcensis* was the efficient parasitoid than *Eretmocerus californicus*. To confirm that further studies regarding their parasitizing ability is needed.

Conclusions

Encarsia cibcensis Lopez Avila and *Eretmocerus californicus* were the parasitoids identified from the research site. Both male and female *Eretmocerus californicus* were identified as parasitoids on brinjal plants. Among the identified parasitoids, *Encarsia cibcensis* Lopez Avila were more abundant than *Eretmocerus californicus* at the research site.

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Figures

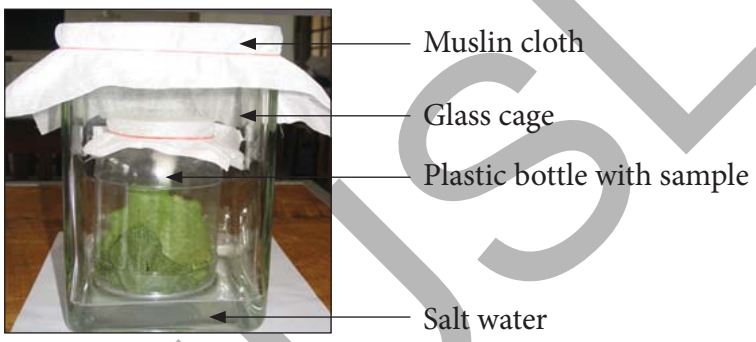

Figure 1 Experimental setup for the parasitoid emergence

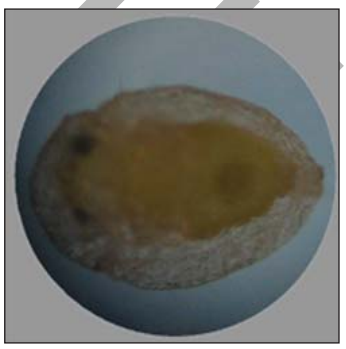

Figure 2: Parasitized nymph by *Eretmocerus* species (×120)

Figure 3: Parasitized nymph by *Encarsia* species (×120)

Figure 4: *Encarsia cibcensis* Lopez-Avila (×120)

Figure 5: *Eretmocerus californicus* (Male) (×120)

Figure 6: *Eretmocerus californicus* (Female) (×120)

References

[1] A. Lopez-Avila, Taxonomy and biology, In: M. J. W. Cock (Ed.), *Bemisia tabaci*–a literature Survey: 3-11, Ascot: FAO and CAB International Institute of Biological Control, 1986.

[2] A. Polaszek, G. A. Evans and F. D. Bennett, *Encarsia* parasitoids of *Bemisia tabaci* (Hymenoptera: Aphelinidae, Homoptera: Aleyrodidae): A preliminary guide to identification, *Bulletin of Entomology Research*, vol. 82 (1992), 375-392.

[3] C. H. Pickett, R. Rodriguez, D. Keaveny, D. Overholt and P. Akers, Distribution of *Bemisia* Parasitoids in Central California. *CDFA-Biological Control Program* (February), 2003.

[4] C. Inayatullah and A. A. Goraya, Studies on potential biological control agents of whiteflies in Pakistan: Common Wealth Institute of Biological Control, Pakistan Station Rawalpindi, *Annual Report*, 35 (1980).

[5] D. Gerling, O. Alomar and J. Arno, Biological control of *Bemisia tabaci* using predators and parasitoids, *Crop Protection*, vol. 20 (2001), 779–799.

[6] E. Arnal, A. Chavez and F. Ramos, Parasitoids recorded from whiteflies (Homoptera: Aleyrodidae) collected in Venezuela during 1991-2000, *Entomotropica*, vol.18 (2003), 183-191.

[7] F. Ali, H. Badshah, A. Rehman and S. B. Shah, Population density of cotton whitefly (*Bemisia tabaci)* and mites (*Tetranychus urticae)* on Brinjal and their chemical control, *Asian Journal of Plant Sciences*, vol. 3 (2004), 589-592.

[8] H. H. Fonseka, Sri Lanka Council for Agricultural Research Policy, *Agricultural Research News*, vol. 7 (1) (2006), 6-7.

[9] http://pc54.narc.affrc.go.jp %E5%A4%A9%E6%95%B5%E3%83%8A%E3%83%93%E3%82%B2%EF%BC%8D%E3%82%B7%E3%83%A7%E3%83%B3/%E7%94%9F%E7%89%A9%E8%BE%B2%E8%96%AC.htm

[10] J. C. Palumbo, A. R. Horowitz and N. Prabhaker, Insecticidal control and resistance management for *Bemisia tabaci*, *Crop Protection*, vol. 20 (2001), 739-765.

[11] K. Hirano, E. Budiyanto and S. Winarni, Biological characteristics and forecasting outbreaks of the whitefly, *Bemisia tabaci*: a vector of virus diseases in soybean fields, Taipei: *Food and Fertilizer Technology Center Technical Bulletin*, vol. 135 (1993), 14-15.

[12] M. E. Schauff, G. A. Evans and J. M. Heraty, A pictorial guide to the species of *Encarsia* (Hym: Aphelinidae) parasitic on whiteflies (Homoptera: Aleyrodidae) in North America. *Proceedings of the Entomological Society of Washington*, vol. 98 (1996), 35-36.

[13] P. C. Ellsworth and J. S. Jones, Cotton IPM in Arizona: A decade of research, implementation and education, In: P. Dugger and D. Richter,

(Eds.), Proceedings Belt wide Cotton Conferences, National Cotton Council, Memphis, Tennessee, 2001, 1088–1096.

[14] S. E. Naranjo and D. H. Akey, Conservation of natural enemies in cotton: comparative selectivity of acetamiprid in the management of *Bemisia tabaci*, *Pest management science*, 61 (2005), 555-566.

[15] S. E. Naranjo and P. C. Ellsworth, Challenges and opportunities for pest management of *Bemisia tabaci* in the new century, *Crop Protection (special issue)*, vol. 20 (2001), 707–869.

[16] S. N. Alam, M. A. Rashid, F. M. A. Rouf, R. C. Jhala, J. R. Patel, S. Satpathy, T. M. Shivalingaswamy, S. Rai, I. Wahundeniya, A. Cork, C. Ammaranan and N. S. Talekar, Development of an integrated pest management strategy for Eggplant fruit and shoot borer in South Asia, Shanhua, Taiwan: *AVRDC—the World Vegetable Center, Technical Bulletin No 28 AVRDC Publication No. 03-548* (2003), 56-57.

[17] S. Schmidt and I. D. Naumann, *Encarsia* species (Hymenoptera: Aphelinidae) of Australia and the Pacific Islands attacking *Bemisia tabaci* and *Trialeurodes vaporariorum* (Hemiptera: Aleyrodidae), 2001, Available online: http://www.ento.csiro.au/science/encarsia/refs.htm

[18] T. R. Fasulo, Whitefly Knowledgebase: UF/IFAS, 1995, Available online: http://whiteflies.ifas.ufl.edu/wfly0002.htm (23 Feb 2006)

[19] Technical bulletin, Greenhouse crop management series, The Problem: whiteflies, (2003), Available online: http://www.mailto:%20rocco@ipmofalaska.com (15 May 2006)