Detection of Natural Enemies of the Whitefly (Hemiptera: Aleyrodidae) in Southeastern Anatolia Region, Turkey[1]

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Abstract A survey was conducted between 2019 and 2022 to identify natural enemies of the whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), in the provinces of Şırnak, Siirt, Batman, Diyarbakır, Mardin, Şanlıurfa, Adıyaman, Gaziantep, and Kilis in the Southeastern Anatolia Region of Turkey. Sampling using several different techniques was conducted in agricultural, nonagricultural, and forested areas throughout the duration of the study. We identified natural enemies of *B. tabaci*, which causes significant crop losses in Turkey and worldwide, with the objective of reducing chemical control in favor of promoting biological control of the pest in the coming years. In our survey, we collected and identified 37 species of predators and 2 species of parasitoids as natural enemies. Of those, the greatest number of species were from the family Coccinellidae (Coleoptera). *Coccinella septempunctata* (L.), *Hippodamia variegata* (Goeze), and *Orius laevigatus* (Fieber) were found in all provinces surveyed.

Key Words whitefly, natural enemy, Southeast Anatolia Region, predators, parasitoids

With the implementation of the Southeastern Anatolia Project (GAP) in Turkey, vegetable, fruit, and industrial plant cultivation has increased significantly in the Southeastern Anatolia region. The increase in plant diversity and changing climate conditions have resulted in an increase in the diversity and population of pests in the region. This increase has had a considerable impact on the quality and yield of agricultural commodities. Consequently, conventional agriculture has led to reliance upon excessive and indiscriminate use of insecticides to manage insect pests. However, while using insecticides, the protection of crops against pests should be considered alongside their potential negative impacts on humans and the environment. For sustainable and healthy crop production, proper and efficient plant protection measures are necessary. In this context, integrated pest management (IPM) emphasizes use of an array of strategies and tactics to manage crop pests. Among those tactics is biological control. The emphasis on biological control is motivated by the aim to reduce the adverse effects of chemical insecticides and to utilize beneficial microorganisms and macroorganisms to suppress harmful pests (Uygun et al. 2010).

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The whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), is an important pest of a number of crops globally. In Turkey, it is a formidable pest of cotton due to its rapid reproduction capacity, producing 9–10 generations per year. The increasing chemical use for controlling whitefly has raised concerns regarding its negative impact on the environment and the cost burden for growers. Therefore, the objective of this study was to identify natural enemy species that are occurring in the Southeastern Anatolia Region and that might be used for the suppression of whiteflies.

Materials and Methods

Predaceous species were collected using a standard sweep net and collection with aspirators. In the sweep net method, insects were collected by sweeping 100 times across plants known to be infested with whiteflies. In the aspirator method, adult and larval stages of potential predators were collected by walking around plants infested with whiteflies for 5 min and using an aspirator to collect insects observed.

Whitefly parasitoids were identified by collecting leaves from whitefly-infested plants in the Southeastern Anatolia Region. These were transported to the laboratory where they were examined under a stereoscopic binocular microscope to find whitefly larvae and pupae. All other organisms, except those whitefly larvae and pupae, were removed from the leaf, and the leaves were placed in parasitoid emergence boxes. Emerging parasitoids were collected and identified.

Results and Discussion

Our survey of the 9 provinces in the Southeastern Anatolia Region yielded 37 species of predators (Table 1). *Coccinella septempunctata* (L.), *Hippodamia variegata* (Goeze), and *Orius laevigatus* (Fieber) were collected from each of the 9 provinces. Another 3 species were collected from 8 provinces, and 4 others were from 7 provinces. Twenty-one species were found in 3 or fewer provinces. From greatest to fewest, the number of species by taxonomic family were Coccinellidae (25) $>$ Miridae (5) $>$ Lygaeidae (3) $>$ Anthocoridae (2) $>$ Nabidae (1) $=$ Chrysopidae (1).

Previously, 28 predatory species were reported from the province of Adıyaman, 23 species from Şanlıurfa, and 31 species from Diyarbakır (Gözüaçık et al. 2012). Additionally, 29 species were reported from Siirt (Güneş 2014), 20 species from Mardin (Kaplan 2014), and 5 species from Şırnak (Ayaz 2019). While we identified a total of 10 species belonging to 4 families of the order Hemiptera and 1 species of Chrysopidae of the order Neuroptera (Table 1), 5 species of Geocoridae were reported by Çakır and Önder (1990), while 19 species of Anthocoridae, 9 species of Nabidae, and 146 species of Miridae were reported in the same region by Bolu (2019). In fact, Kansu and Uygun (1973) and Kansu (1973) suggested that these species are widespread throughout all regions of Turkey. The similarities and differences from our study in comparison to previous studies are characteristic of faunistic studies.

Only 2 species of parasitoids were identified in our survey (Table 1). These were *Eretmocerus mundus* (Mercet) and *Encarsia lutea* (Masi), both from the family Aphelinidae of the order Hymenoptera. *Encarsia lutea* was found in all but 1 of

Table 1. Natural enemies of *B. tabaci* identified from Adıyaman, Şanlıurfa, Gaziantep, Kilis, Mardin, Diyarbakır, Şırnak, Siirt, and Batman provinces of Turkey, 2019 to 2022.

Species (Order/Family)	Provinces*								
	Adiy	Şanh	Gazi	Kili	Mard	Diya	Şirn	Siir	Batm
Coleoptera/Coccinellidae									
Coccinella septempunctata (L.)	+	+	+	+	+	+	+	+	+
Oenopia conglobata (L.)	+	+	+	+	+	+	+	–	+
Scymnus levaillanti (Mulsant)	–	+	+	+	–	+	–	–	–
Coccinella undecimpunctata (L.)	+	+	+	+	+	+	+	–	–
Hippodamia variegata (Goeze)	+	+	+	+	+	+	+	+	+
Scymnus rubromaculatus (Goeze)	–	+	–	+	–	+	–	–	–
Stethorus punctillum (Weise)	+	+	–	–	+	–	–	–	–
Stethorus gilvifrons (Mulsant)	–	+	+	–	–	+	–	–	–
Nephus ludyi (Weise)	–	+	–	–	–	–	–	+	+
Nephus nigricans (Weise)	–	+	–	+	–	+	+	–	–
Scymnus mediterraneus (Khnzorian)	–	+	–	–	–	–	–	–	–
Hyperaspis quadrimaculata (Redtb)	+	+	–	–	–	+	–	–	–
Stethorus punctillum (Weise)	–	–	–	–	–	–	–	–	–
Brumus quadripustulatus (L.)	–	–	–	–	+	–	–	–	–
Psyllobora vigintiduopunctata (L.)	–	–	–	–	+	–	–	–	–
Platynaspis luteorubra (Goeze)	–	–	–	–	+	–	–	–	–

Table 1. Continued.

Species (Order/Family)	Provinces*								
	Adiy	Şanh	Gazi	Kili	Mard	Diya	Şirn	Siir	Batm
Exochomus nigromaculatus (Goeze)	–	–	–	–	+	–	–	–	–
Scymnus pallipediformis (Günther)	–	–	–	–	+	–	–	–	–
Synharmonia conglobata (L.)	–	–	–	–	–	–	+	–	–
Scymnus subvillosus (Goeze)	–	–	–	–	–	+	+	–	+
Exochomus quadripustulatus (L.)	–	–	–	–	–	–	+	+	+
Scymnus bivulnerus (Capra & Fürsch)	–	–	–	–	–	–	–	+	–
Scymnus flavicollis (Redtenbacher)	–	–	–	–	–	–	–	+	+
Hyperaspis reppensis (Herbst)	–	–	+	–	–	–	–	+	–
Coccinula sinuatomarginata (F.)	–	–	–	–	–	–	–	+	+
Hemiptera/Anthocoridae									
Orius niger (Wolff)	+	+	+	+	+	+	–	–	+
Orius laevigatus (Fieber)	+	+	+	+	+	+	+	+	+
Hemiptera/Lygaeidae *Geocoris megacephalus* (Rossi)	–	+	+	–	–	+	–	–	–
Geocoris luridus (Fieber)	+	+	–	+	–	+	+	+	–
Geocoris pallens (Stal)	–	+	–	–	+	–	+	–	+

Table 1. Continued.

Species (Order/Family)	Provinces*								
	Adiy	Şanh	Gazi	Kili	Mard	Diya	Şirn	Siir	Batm
Hemiptera/Miridae									
Deraeocoris lutescens (Schilling)	+	+	+	+	+	+	_	+	+
Deraeocoris pallens Reuter	+	+	+	+	+	+	_	+	+
Nesidiocoris tenuis (Reuter)	+	+	+	+	+	_	_	+	+
Macrolophus melanotoma (Costa)	_	+	_	_	_	_	_	+	+
Macrolophus costalis (Fieber)	_	+	_	_	+	+	+	_	+
Hemiptera/Nabidae									
Nabis pseudoferus (Remane)	_	+	+	_	+	+	+	+	+
Neuroptera/Chrysopidae									
Chrysoperla carnea (Step.)	+	+	+	+	+	+	+	+	+
Hymenoptera/Aphelinidae									
Eretmocerus mundus (Mercet)	+	+	+	+	+	+	_	+	_
Encarsia lutea (Masi)	+	+	+	+	+	+	+	_	+

* Provinces are abbreviated as follows: Adıyaman (Adiy), Şanlıurfa (Şanh), Gaziantep (Gazi), Kilis (Kili), Mardin (Mard), Diyarbakır (Diya), Şırnak (Şirn), Siirt (Siir), and Batman (Batm). + indicates species was present; _ indicates species was not present.

the 9 provinces, while *E. mundus* was found in 7 of the provinces. No entomopathogenic agents were found infecting whitefly nymphs and pupae collected in these surveys.

Our survey results provide important information about the distribution of whiteflies and their natural enemies in the Southeastern Anatolia Region. The whitefly pest is a serious threat to agricultural production due to its high reproductive capacity. The natural enemies identified in this study have the potential to be effective biological control agents for this pest. Biological control offers a more sustainable approach compared to chemical control, considering its environmental and economic benefits. The presence of different species belonging to the taxonomic orders Coleoptera, Hemiptera, Hymenoptera, and Neuroptera indicates the richness and diversity of natural enemies. Onillon (1990) cites a number successful attempts at controlling whitefly pests using natural enemies, and various parasitoids and predators of *B*. *tabaci* have been successfully employed in greenhouses and other agricultural settings (Gerling et al. 2001). The interactions and effectiveness of these species with the pests could be a crucial research area for future biological control efforts. The effectiveness and diversity of natural enemies identified in this study are important for the development of biological control strategies. These strategies can be incorporated into IPM programs to control pest populations and enhance agricultural production.

Indeed, a number of natural enemies identified in our study (e.g., *C. septempunctata, H. variegata, O. niger, O. laevigatus, G. megacephalus, D. pallens, M. melanotoma, M. costalis, N. pseudoferus, Ch. carnea*) are reportedly successful in biological control of *B*. *tabaci*. Further research is needed to better understand the interactions between whitefly pests and their natural enemies. Long-term studies conducted in different seasons and ecosystems can provide more comprehensive insights into the effectiveness and population dynamics of natural enemies. The natural enemies identified in this study can be utilized in IPM programs. Those that are more ubiquitous in occurrence should likely receive priority in evaluating their efficacy and potential in IPM programs aimed at managing *B. tabaci*.

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References Cited

Ayaz, T. 2019. Studies on harmful Lepidoptera species, population densities, and natural enemies in cotton and corn planting areas of Şırnak province. Doctoral thesis. Mustafa Kemal University Institute of Science, Hatay, 84 p.

Bolu, H. 2019. Southeastern Anatolia region insect fauna II (Order Hemiptera I: Suborder Heteroptera I: Gerroidea, Hebroidea, Corixoidea, Notonectoidea, Leptopodoidea, Cimicoidea, Naboidea, Mirioidea) of Turkey. Harran J. Agric. Food Sci. 23(3): 364–379.

Çakır, S. and F. Önder. 1990. Some systematic and faunistic studies on Geocorinae (Het.: Lygaeidae) from Turkey. Turkish J. Entomol. 14(1): 37–52.

Gerling, D., O. Alomar and J. Arno. 2001. Biological control of *Bemisia tabaci* using predators and parasitoids. Crop Prot. 20: 779–799.

Gözüaçık, C., A. Yiğit and N. Uygun. 2012. Coccinellidae (Coleoptera) species in different habitats in Southeastern Anatolia Region. Turkish J. Biol. Contr. 3(1): 69–88.

Güneş, S. 2014. Determination of Coccinellidae (Coleoptera) species and their distribution areas in Siirt province and its surroundings. MS Thesis. Yüzüncü Yıl University Institute of Science, Van, 85 p.

Kansu, I. A. 1973. Insects against insects. A.U. Adana Faculty of Agriculture Publications. 69 Public Conf. 33: 1–21.

Kansu, I. A. and N. Uygun. 1973. Insects as biological agents against citrus pests in the Eastern Mediterranean Region. TÜBİTAK IV. Science Congress Proc. 240. November 5–8, 1–19, Ankara.

Kaplan, M. 2014. Determination of Thysanoptera species, their distributions, damage rates, natural enemies, population fluctuations, and control possibilities in vineyard areas of Mardin province. PhD Thesis, Dicle Univ. Institute of Science, Diyarbakır, 137 p.

Onillon, J.C. 1990. The use of natural enemies for the biological control of whiteflies, Pp. 287–313. *In* Gerling, D. (ed.), Whiteflies: Their Bionomics, Pest Status and Management. Intercept Ltd., Andover, Hants, UK.

Uygun, N., M.R. Ulusoy and S. Satar. 2010. Biological control. Turkish J. Biol. Contr. 6(1): 41–50.