



Research Note

Natural enemies of whitefly, *Bemisia tabaci* (Gennadius) on cotton in Punjab, India

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ABSTRACT: The whitefly, *Bemisia tabaci* (Gennadius) is a polyphagous pest, widely distributed in diverse agroecosystems across the globe. Several bioagents including predators and parasitoids from diverse groups have been recorded against whitefly worldwide. A field survey was conducted during 2016 and 2017 in different cotton growing districts of Punjab to record the natural enemies associated with whitefly. Sixteen species of natural enemies were recorded, including 7 species of insect predators; 2 species of parasitoids and 7 species of spiders. *Coccinella septempunctata* Linnaeus, *Cheilomenes sexmaculata* (Fabricius) and *Brumoides suturalis* (Fabricius), *Serangium parcesetosum* Sicard, *Chrysoperla zastrowi sillemi* (Esben-Peterson), *Zanchius breviceps* (Wagner), *Geocoris* sp. and spiders were most commonly recorded predators. Out of these, *Chrysoperla* was the predominant species. *Encarsia lutea* (Masi) and *Encarsia sophia* (Girault & Dodd) were the two parasitoids that emerged from whitefly pupae. The mean parasitization of whitefly by *Encarsia* spp. in different cotton growing areas of Punjab was 5.20 per cent (range = 1.5 to 9.1 %).

KEY WORDS: Cotton, parasitoid, predator, whitefly

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Cotton is an important commercial and industrial fibre crop of India which played a key role in economic and social development of the country. Area wise, India ranked first in global scenario contributing about 37 per cent of the world cotton area with a production of 37.7 million bales (170 kg lint/bale) and average lint yield of 524 kg ha⁻¹ in 2017-18 (Anonymous, 2018). The successful adoption of genetically modified cotton with genes from soil inhabiting spore forming bacterium, *Bacillus thuringiensis* Berliner has changed the entire pest scenario in the country. The pest status of bollworms and leaf feeding insects has declined, but sap feeders, including whitefly, *Bemisia tabaci* (Gennadius), leafhopper, *Amsasca biguttula biguttula* (Ishida), mealybug, *Phenacoccus solenopsis* Tinsley, thrips, *Thrips tabaci* (Lindemann), aphid, *Aphis gossypii* (Glover) and mirid, *Creontiades biseratense* (Distant) are emerging as serious pests (Mann *et al.*, 2010; Kumar *et al.*, 2015).

The whitefly, *B. tabaci* (Hemiptera: Aleyrodidae) is a destructive pest of many vegetable, horticultural, ornamental and agricultural crops in tropical and subtropical countries of the world (Oliveria *et al.*, 2001; Simmons *et al.*, 2008). It feeds on more than 900 diverse host plants, including species of economic

importance belonging to the 63 families (Perring, 2001; Buxton, 2005). It is a phloem-sucking insect, the nymphs and adults of which cause damage by sucking cell sap. The development of sooty mould on honey dew secreted by them invariably affects photosynthesis of plants. Moreover, it also transmits more than 111 plant viruses (Jones, 2003) including cotton leaf curl virus (CLCuV) in American cotton (Hassan *et al.*, 2016). Several bioagents from diverse groups have been recorded against whitefly across India (Rao *et al.*, 1989; Natarajan 1990; Kedar *et al.*, 2014; Boda and Ilyas 2017; Rawal *et al.*, 2017). Huge populations of whiteflies were recorded during 2015 in Punjab, Haryana and Rajasthan leading to considerable economic losses to the farmers. This epidemic infestation resulted in large reduction in area under cotton in the subsequent years. It is therefore, essential that we reestablish the diversity of native natural enemies. Keeping in view economic importance of this pest, surveys were undertaken to explore natural enemy fauna associated with whitefly in cotton agro-ecosystem under Punjab conditions.

Regular surveys were conducted in cotton growing areas of Punjab (Fazilka, Bathinda, Mansa and Muktsar districts) during *kharif* seasons, 2016 and 2017 to record natural enemies associated with whitefly on cotton crop. For sampling, each

cotton field was divided into 4 equal plots. In each plot, 25 plants were selected at random for recording observations on natural enemy fauna. Each plant (as a whole) was visually examined for recording population of different predators, i.e. coccinellids, chrysopids, mirids and spiders. The collected predators were identified from the specimens available in the Department of Entomology, Punjab Agricultural University, Ludhiana. The samples of green bug were sent to Professor C.A. Viraktamath, Emeritus Scientist, Department of Entomology, University of Agricultural Sciences, Bengaluru for identification up to species level.

For parasitoids, twenty cotton leaves infested with immature stages were collected from each field during survey and brought to the Biocontrol laboratory to record parasitization. Assessment of parasitism (%) was determined based on the number of parasitized nymphs as against un-parasitized ones in the host leaves. The leaves with parasitized nymphs were kept in glass jars covered with muslin cloth for the emergence of parasitoids. The emerging parasitoids were collected using aspirator and preserved in vials containing 70 per cent ethanol. The specimen of parasitoids were got identified from Dr Mohammad Hayat, Aligarh Muslim University, Aligarh.

Natural enemy fauna comprising 9 species of insects under 5 families; 7 species of arachnids in 4 families constituting a total of 16 species were recorded from the cotton field during the study. The collected insect fauna comprised of 7 species of predators and 2 species of parasitoids. The insect predators included *Coccinella septempunctata* Linnaeus, *Cheilomenes sexmaculata* (Fabricius), *Brumoides suturalis* (Fabricius), *Serangium parcesetosum* Sicard, *Chrysoperla zastrowi sillemi* (Esben-Peterson), *Zanchius breviceps* (Wagner) and *Geocoris* sp. (Table 1). The collected spider population included *Neoscona* sp., *Argiope* sp., *Oxyopes* sp., *Thomisus* sp., *Runcinia* sp., *Hyllus* sp. and *Chrysilla* sp. In 2016, population of *Chrysoperla* was low during 1st week of June

and attained its peak in the 4th week of June (Fig. 1). During 2017, the population of *Chrysoperla* was maximum till 3rd week of July and declined thereafter. The peak population of spiders was

Table 1. List of arthropod predators and parasitoids recorded on cotton crop in Punjab

Natural enemies	Family	Order
Insect Predators		
<i>Coccinella septempunctata</i> Linnaeus	Coccinellidae	Coleoptera
<i>Cheilomenes sexmaculata</i> (Fabricius)	Coccinellidae	Coleoptera
<i>Brumoides suturalis</i> (Fabricius)	Coccinellidae	Coleoptera
<i>Serangium parcesetosum</i> Sicard	Coccinellidae	Coleoptera
<i>Chrysoperla zastrowi sillemi</i> (Esben-Peterson)	Chrysopidae	Neuroptera
<i>Zanchius breviceps</i> (Wagner)	Miridae	Hemiptera
<i>Geocoris</i> sp.	Geocoridae	Hemiptera
Spiders		
<i>Neoscona</i> sp.	Araneidae	Araneae
<i>Argiope</i> sp.	Araneidae	Araneae
<i>Oxyopes</i> sp.	Oxyopidae	Araneae
<i>Thomisus</i> sp.	Thomisidae	Araneae
<i>Runcinia</i> sp.	Thomisidae	Araneae
<i>Hyllus</i> sp.	Salticidae	Araneae
<i>Chrysilla</i> sp.	Salticidae	Araneae
Parasitoids		
<i>Encarsia lutea</i> (Masi)	Aphelinidae	Hymenoptera
<i>Encarsia sophia</i> (Girault & Dodd)	Aphelinidae	Hymenoptera

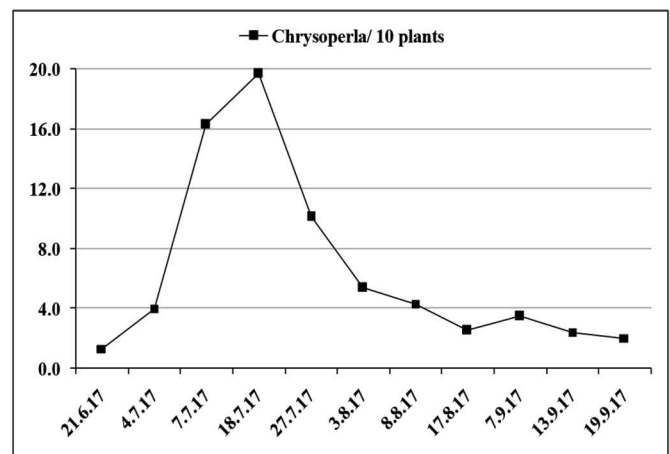
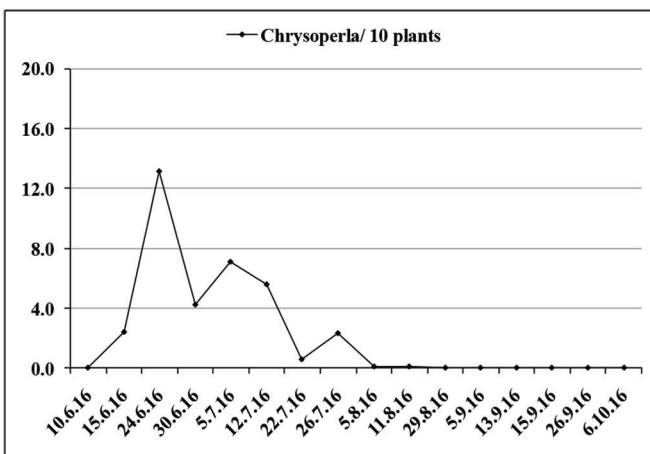


Fig. 1. Population trends of *Chrysoperla* in cotton growing areas of Punjab during 2016 and 2017.

recorded during 3rd week of July and 4th week of August during 2016 and 2017, respectively (Fig. 2). The activity of chrysopids, coccinellids, spiders and other predators have been reported in cotton and other cropping systems by many workers worldwide (Purohit *et al.*, 2006; Kutuk *et al.*, 2008; Simmons and Rabou 2007; Kedar *et al.*, 2014). Further, these natural enemies have been reported to contribute significantly to reduce the population of *B. tabaci* in cotton and several other crops (Naranjo and Ellsworth, 2005; Naranjo *et al.*, 2009).

The parasitoid species observed parasitizing *B. tabaci* in the field were *Encarsia lutea* (Masi) (Hymenoptera: Aphelinidae) and *E. sophia* (Girault & Dodd) (Hymenoptera: Aphelinidae) that emerged from whitefly pupae. Out of 6349 nymphs observed, 330 were found to be parasitized (Table 2). The mean parasitization of whitefly by *Encarsia* spp. in different cotton growing areas of Punjab was 5.20 per cent. The maximum parasitization (9.12%) was observed in Mansa population followed by whitefly population from Ludhiana (6.49%). The minimum parasitization was recorded in Faridkot population (1.49%). *Encarsia*, the aphelinid parasitoids, are of worldwide distribution and have been reported to parasitize many whitefly species including *B. tabaci* (Gerling *et al.*, 2001; Oliveira *et al.*, 2003; Torres *et al.*, 2014). The parasitization of *B. tabaci* by *E. lutea* has also been reported in Haryana on different crops like okra, cotton, soybean, ricebean and egg plant (Sharma *et al.*, 2003; Kedar *et al.*, 2014)

The present investigations provide information on the predators and parasitoids functioning against whitefly

in cotton agro-ecosystem under Punjab conditions. The insecticide applications to curb whitefly menace should be planned considering pest scouting and injury levels to conserve these natural enemy populations. Further work is needed to explore the possibility of associated arthropod fauna to facilitate a biologically-based integrated pest management in cotton ecosystem.

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Table 2. Parasitization of whitefly by *Encarsia* spp. on cotton in Punjab during 2017

Districts	Number of whitefly nymphs observed	Number of parasitized nymphs	Per cent parasitization
Mansa	2302	210	9.12
Muktsar	1522	36	2.36
Bathinda	952	29	3.05
Faridkot	605	9	1.49
Ludhiana	462	30	6.49
Fazilka	389	16	4.11
Total/Mean	6349	330	5.20

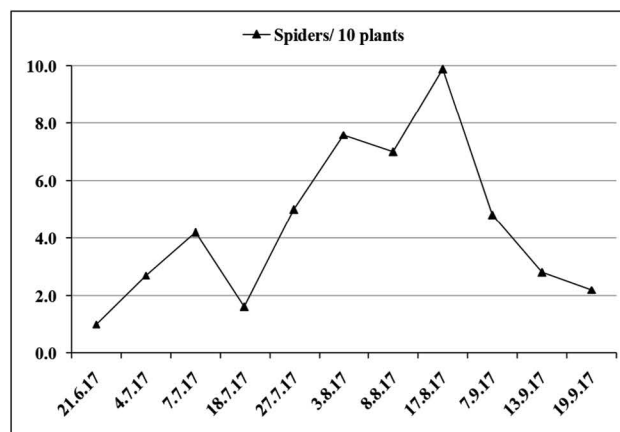
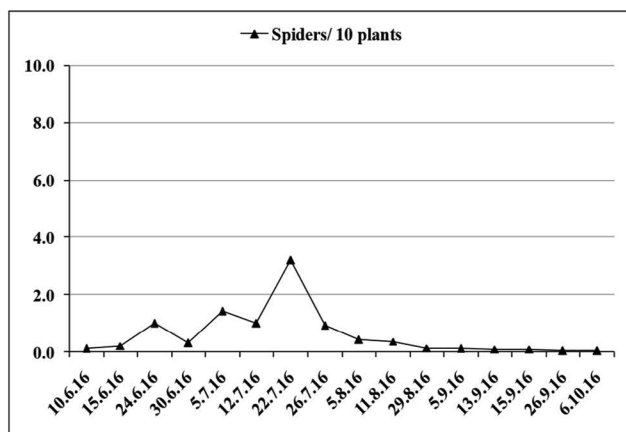


Fig. 2. Population trends of spiders in cotton growing areas of Punjab during 2016 and 2017.

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