

Population Dynamics and Nymphal Parasitization of *Bemisia tabaci* (Gennadius) on Brinjal (*Solanum melongena* L.)

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ABSTRACT

The present study on the population dynamics of whitefly, *Bemisia tabaci* (Gennadius) and its parasitization by *Encarsia* spp. on brinjal (var. Hisar Shyamal) was carried out at the Research Farm, Department of Entomology, CCS HAU, Hisar during Spring 2017. The whitefly adult and nymphal population and per cent parasitization by *Encarsia* spp. were observed from February to June at ten-day intervals during Spring 2017. The peak population of whitefly adults i.e., 15.7 per leaf was recorded during 22nd April to 1st May 2017. The maximum density of whitefly nymphs i.e., 17.8 per leaf was observed during 2nd to 11th May, 2017. Maximum parasitization of *B. tabaci* nymphs by *Encarsia* spp. on brinjal (25.5%) coincided with the peak population of whitefly nymphs. Correlation analysis with weather parameters revealed that the whitefly population (adult and nymph) and nymphal parasitization had significant positive correlation with maximum temperature [($r = 0.60$), ($r = 0.64$), ($r = 0.59$)] and negative correlation with morning [($r = -0.82$), ($r = -0.83$), ($r = -0.79$)] and evening relative humidity [($r = -0.70$), ($r = -0.71$), ($r = -0.62$)], respectively.

Keywords: Brinjal, *Bemisia tabaci*, *Encarsia* spp., population dynamics, weather parameters, correlation

INTRODUCTION

Brinjal (*Solanum melongena* L.), is a hardy, versatile and highly consumable solanaceous crop grown during Rabi, Spring and Kharif seasons in India. Brinjal is native to Indo-Burman region (Vavilov, 1928) and also known by various names like aubergine, baingan, eggplant or melanzana. Owing to its nutritive value, delicious nature and array of

health benefits, it is often called as the ‘King of vegetables’. Globally, India ranks second in terms of area (0.73 mha) and production (12.66 mt) under brinjal. West Bengal, Orissa, Bihar, Gujarat, Madhya Pradesh, Andhra Pradesh, Maharashtra, Uttar Pradesh and Haryana are the major brinjal growing states of India (Anonymous, 2019).

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Characteristics like luxuriant-cum-succulent vegetative growth, leaf thickness, high density of trichomes and heavy fruiting make it vulnerable to a number of insect-pests right from nursery till harvesting stage (Hasanuzzaman et al., 2016). In India, 70 species of insect-pests including mites are known to infest brinjal crop (Subbarathnam and Butani, 1982). Yield losses to the tune of 25.8-27.9 (Ghosh et al., 2003) and 45.2-48.6 (Yadav and Kumawat, 2013) per cent have been reported in *Kharif* sown brinjal due to insect-pest complex. Among them the whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) poses a serious threat, as it starts infesting the seedlings right from nursery and remain active through the growing season of the crop (Bhadauria et al., 1999). Brinjal is a one of the most preferred hosts of *B. tabaci* (Rafiq et al., 2008; Khan et al., 2011; Lu et al., 2012; Mansour et al., 2012; Kedar et al., 2018; Mehra, 2020). The nymphs and adults of whitefly pierce the leaves from the underside, suck the cell sap and weakens the plants. Indirectly, the honey dew produced by the adults serves as a substrate for the growth of black sooty mold on the leaves and fruits that hinders with the process of photosynthesis. The adults also vector a number of viruses, of these, the tomato yellow leaf curl virus and tomato chlorosis virus are highly virulent on brinjal crop (Fidan and Sarikaya, 2020). Whitefly feeding may cause early wilting of plants, upward curling of leaves, leaf chlorosis, leaf withering, premature drop of the leaves and yield reduction in brinjal. The presence of ample space, succulent leaves and quantity of food source on brinjal plant is an invitation for the whitefly to infest and reproduce in great numbers (Mohd Rasdi et al., 2009). Besides this, the abiotic (temperature, relative humidity, rainfall, etc.) and biotic (predator, parasitoids, pathogens, etc.) factors influence the population build-up of whitefly on brinjal (Indirakumar et al., 2016; Khan, 2019). More than 112 species of parasitoids are known to suppress *B. tabaci* naturally in the field (Liu et al., 2015). Of these, *Encarsia* and *Eretmocerus* genera are the primary nymphal endoparasitoids of whitefly (Kedar et al.,

2014; Karut et al., 2018; Sangha et al., 2018). In Haryana, brinjal occupies a prime position among the cultivated vegetables and is prone to infestation mainly by fruit and shoot borer and whitefly. Studies on the population dynamics of *B. tabaci* and its parasitization on brinjal crop were lacking from our region, henceforth, it was decided to investigate the population dynamics of whitefly and its parasitization by *Encarsia* spp. on brinjal.

MATERIALS AND METHODS

Population dynamics of whitefly and its nymphal parasitization by *Encarsia* spp. was studied on brinjal (var. Hisar Shyamal) grown in an area of 30 square meters at the experimental area of Department of Entomology, CCS HAU, Hisar during *Spring* 2017. Four-week-old seedlings with 3-4 leaves were transplanted on 20th February, 2017 and the crop was raised as per the recommended package and practices of CCS HAU, Hisar expect insecticidal application. Whitefly adult population was recorded from the upper, middle and lower leaves of 10 randomly selected plants from the experimental plot at 10-day intervals from February to June, 2017. Further, 30 leaves were brought at 10-day intervals to the laboratory in polybags to examine the healthy and parasitized nymphs under a stereo zoom binocular microscope. Black pupae of whitefly were confirmed under the microscope for the presence of *Encarsia* spp. (Sharma et al., 2003). The observations on whitefly parasitoid, *Encarsia* spp. were recorded by counting the black parasitized pupae on sampled leaves at ten days intervals and converted into per cent parasitism. The data on mean whitefly population and per cent parasitization were subjected to correlation analysis with weather parameters using OP STAT software (Sheoran et al., 1998).

RESULTS AND DISCUSSION

Population dynamics and nymphal parasitization of *B. tabaci* on brinjal

On brinjal (*S. melongena*), whitefly remained active throughout the cropping period i.e., February to June, 2017 (Fig. 1). The population of whitefly adults attained its peak i.e., 15.7 per leaf during 22nd April to 1st May when

temperature ranged from 22.7°C (T_{\min}) to 39.6°C (T_{\max}) and relative humidity (RH) ranged from 25.0 (evening) to 51.0 per cent (morning). While, the maximum population of whitefly nymphs i.e., 17.8 per leaf was recorded during 2nd to 11th May when temperature ranged from 22.4°C (T_{\min}) to 40.8°C (T_{\max}) and RH ranged from 23.0 (evening) to 57.0 per cent (morning). The peak population in our study was much higher than the recorded threshold for *B. tabaci* on eggplant i.e., 4.6 adults per leaf (Shen et al., 2005). Similarly, peak incidence of whitefly adults (14.0 per leaf) and nymphs (8.0 per leaf) was reported by Lu et al. (2012) on brinjal crop

at Hangzhou, China. In accordance with the present studies, Ahmad (2013) recorded the peak population of whitefly adults (19.2 per leaf) and nymphs (16.1 per leaf) from 1st April to 7th April on *Spring* brinjal at Aligarh, Uttar Pradesh when temperature ranged from 17.6°C (T_{\min}) to 32.4°C (T_{\max}) and RH ranged from 33.0 (evening) to 64.7 per cent (morning). Deole (2015) observed the peak activity of *B. tabaci* adults (15.4 per leaf) during the first week of May (T_{\min} : 25°C, T_{\max} : 40°C and mean RH: 55.0%). Likewise, Patel et al. (2015) noted the peak level of whitefly adults (15.3 per leaf) on brinjal during the last week of April.

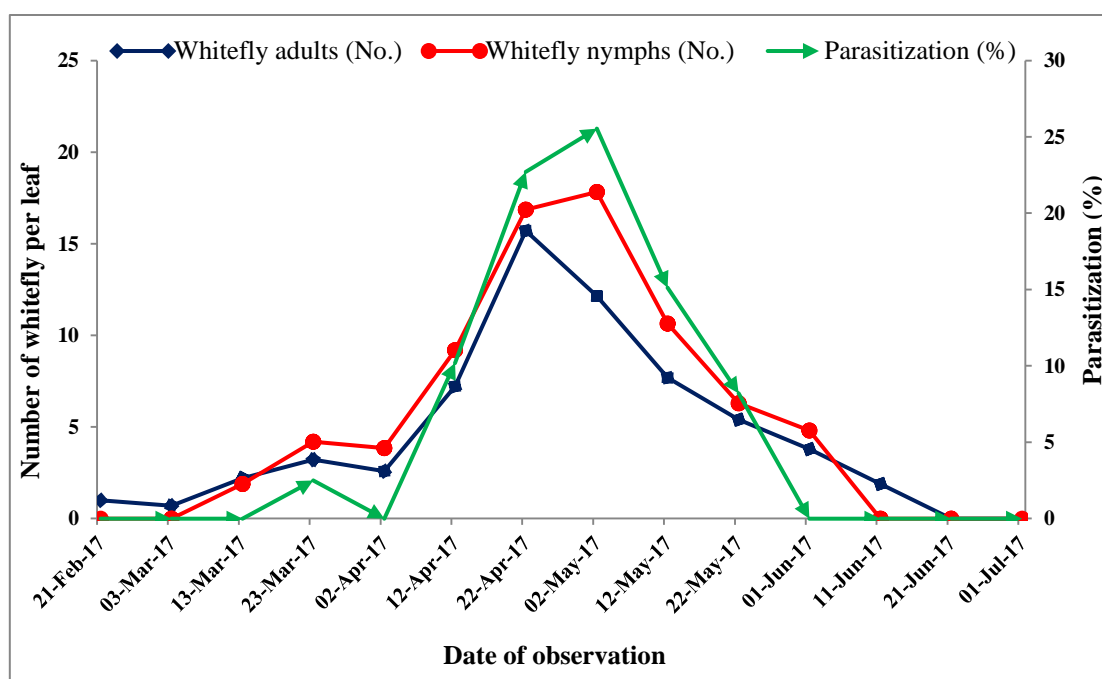


Fig. 1: Population dynamics and nymphal parasitization of *B. tabaci* on brinjal (2017)

In the present study, the maximum parasitization of whitefly nymphs by *Encarsia* spp. (25.5%) was recorded during 2nd to 11th May. Investigating the biological control of *Bemisia argentifoli* (Bellows and Perring) on *Spring* crop of brinjal, Stansly et al. (1997) reported 12.2 to 15.9 per cent parasitism by *Encarsia pergandiella* Howard during March-May. Likewise, Simmons et al. (2002) noted 6.8 to 22.9 per cent parasitism of *B. tabaci* nymphs by *Encarsia lutea* (Masi) and *Eretmocerus mundus* Mercet on brinjal crop. Remarkable parasitism (45.0%) of whitefly nymphs by *Eretmocerus hayati* Zolnerowich & Rose was reported by Sivasubramaniam and Subramaniam (2015) on
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brinjal crop. Likewise, Karut et al. (2018) reported 18.0 to 51.1 per cent parasitization of *B. tabaci* nymphs by *Er. mundus* on greenhouse grown eggplants during *Spring* season.

Correlation of *B. tabaci* population and nymphal parasitization with weather parameters on brinjal

The correlation analysis (Table 1) revealed that whitefly adult and nymphal population had significant positive correlation with maximum temperature ($r = 0.60$) ($r = 0.64$) and significant negative correlation with morning ($r = -0.82$) ($r = -0.83$) and evening RH ($r = -0.70$) ($r = -0.71$), respectively. (Table 1). In conformity, Gerling et al. (1986) reported that an extreme RH (high

and low) adversely affects the survival of whitefly nymphs. Likewise, Ahmad (2013) reported a significant positive correlation of *B. tabaci* adult and nymphal population with maximum temperature ($r = 0.86$; $r = 0.79$) and significant negative correlation with morning RH ($r = -0.91$; $r = -0.74$) and evening RH ($r = -0.71$; r

$= -0.56$), respectively on *Spring* crop of brinjal. The results are in close conformity with Ghosh and Bhattacharyya (2018) who reported significant and positive correlation of maximum temperature with whitefly population on brinjal.

Table 1: Correlation of *B. tabaci* population and nymphal parasitization with weather parameters on brinjal (2017)

Weather Parameters	Correlation coefficient (r)		
	Whitefly Adult	Whitefly Nymph	Parasitization by <i>Encarsia</i> spp.
Maximum Temperature (°C)	0.60*	0.64*	0.59*
Minimum Temperature (°C)	0.26	0.28	0.29
Morning Relative Humidity (%)	-0.82*	-0.83*	-0.79*
Evening Relative Humidity (%)	-0.70*	-0.71*	-0.62*
Total Rainfall (mm)	-0.40	-0.33	-0.33

*Significant at $p=0.05$

However, the findings of Anjali et al. (2012) and Indirakumar et al. (2016) are in contradiction with present study as they found significant negative correlation of *B. tabaci* population with maximum temperature and positive correlation with RH. Correlation analysis of the parasitization potential of *B. tabaci* by *Encarsia* spp. with weather parameters is first of its kind and the per cent nymphal parasitization by *Encarsia* spp. showed a significant positive correlation with maximum temperature ($r = 0.59$) while, it correlated negatively with morning ($r = -0.79$) and evening RH ($r = -0.62$). Better and timely management of the whitefly on *Spring* brinjal based on the population dynamics and mortality factors on brinjal will significantly help reduce the carry-over to the brinjal and cotton in the upcoming *Kharif* season.

CONCLUSION

It is concluded that the peak activity of whitefly and nymphal parasitization by *Encarsia* spp. on *Spring* season crop of brinjal was observed during April-May. Further, the whitefly population (adult and nymph) and nymphal parasitization had significant positive

correlation with maximum temperature and negative with relative humidity.

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Authors' contribution:

Krishna Rolania was the major advisor. Swati Mehra conducted the experiments, collected and analyzed the data and led the writing of the manuscript in assistance with Roomi Rawal.

Research content:

The research content is original and has not been submitted or published elsewhere.

Conflict of Interest:

The authors declare that they have no conflict of interest.

Consent to publish:

The authors agree to publish the paper in the Indian Journal of Pure and Applied Biosciences.

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