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RESEARCH PAPER

Survey on insect pests of brinjal and their natural enemies in Haveri and Dharwad districts of Karnataka

*K. S. MANOJ[1], R. VEERANNA[1], K. P. GUNDANNAVAR[1] AND P. BABU[2]

[1]Department of Entomology, [2]Department of Horticulture, College of Agriculture, Hanumanamatti
University of Agricultural Sciences, Dharwad - 580 005, India
*E-mail: manojks29899@gmail.com

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Abstract: The extensive roving survey was carried out at monthly intervals during *rabi* 2022-23 in Haveri and Dharwad districts of Karnataka to know the status of major insect pests and natural enemies occurring in brinjal crop. The results revealed an occurrence of six insect pest species and four natural enemies on brinjal crop. Among the insect pests, shoot and fruit borer, *Leucinodes orbonalis* Guenee; whitefly, *Bemicia tabaci* (Gennadius); leafhopper, *Amarasca biguttula biguttula* (Ishida) and aphid, *Aphis gossypii* Glover were found major insect pests that inflicted the significant damage to the crop. Among natural enemies, coccinellids (*Coccinella transversalis* F., *Cheilomenes sexmaculata* F. and *Illeis cincta* F.), green lacewing, *Chrysoperla zastrowi sillemi* and spider fauna (*Neoscona theisi* Walckenaer and *Mecaphesa* sp.) and were major predatory fauna and Hymenopteran parasitoids, *Tarthala flavoorbitalis* (Cameron) and *Bracon* sp were recorded on brinjal. Amongst the various stages examined, the reproductive stage exhibited the highest incidence of all sucking pests when compared to the vegetative stage and the Dharwad district exhibited a higher prevalence of insect pests (sucking pests and shoot and fruit borer) and predatory population compared to the Haveri district in both vegetative and reproductive stage of the crop.

Key words: Brinjal, Fruit borer, Insect pests, Natural enemies, Shoot, Survey

Introduction

Brinjal (*Solanum melongena* L.), belonging to the Solanaceae family is a highly nutritious vegetable and widely cultivated across the world. The global brinjal production in 2023 is estimated to have reached 58.65 million tonnes, marking a 2.16 per cent increase compared to the 57.38 million tonnes recorded in 2019. India ranks second in brinjal production, contributing approximately 21.91 per cent of the world's total production next to China (Anon., 2023a). In India, brinjal is being cultivated in an area of 0.76 million hectare with a production of 12.61 million tonnes and productivity of 16.49 tonnes per hectare. It is a major vegetable crop of the plains. The major brinjal growing states in India are West Bengal, Odisha, Jharkhand, Gujarat, Madhya Pradesh, Bihar, Chhattisgarh, Maharashtra, Assam, Andhra Pradesh and Karnataka. In Karnataka, it was grown in an area of 11.36 thousand hectare with an estimated production of 0.28 million tonnes and productivity of 25 tonnes per hectare and major brinjal growing districts include Belagavi, Haveri, Kolar, Mandya, Dharwad and Bijapur (Anon., 2023b).

Among the various factors responsible for inadequate production of brinjal, the impact of severe insect infestations has become increasingly significant in recent times. Brinjal is subjected to attack by several insect and mite pests right from the nursery stage till harvesting (Raghupathy *et al.,* 1997). In different countries across the globe, approximately 142 insect species, four mite species and three nematode species have been observed to attack this crop (Sohi, 1966). Among the insect pests that afflict brinjal, the prominent ones include the shoot and fruit borer, *Leucinodes orbonalis* Guenee; whitefly, *Bemisia tabaci* (Gennadius); leafhopper, *Amarasca biguttula* (Ishida); aphids, *Aphis gossypi* Glover and hadda beetle, *Henosepilachna vigintioctopunctata* (Fabricius) (Nayar *et al*., 1995). The severe damage inflicted by these insect pests leads to significant losses in the brinjal crop. Consequently, a current investigation was initiated to examine the insect pest population in brinjal fields during the *rabi* season in the major brinjal growing regions of Haveri and Dharwad districts in Karnataka.

Material and methods

A roving survey was carried out at monthly intervals at vegetative and reproductive stages of the crop during *rabi* season of 2022-23 in Haveri and Dharwad districts of Karnataka. From each district three talukas were selected and from each taluka two villages were selected an in each village two farmer's fields were surveyed to know the incidence of major insect pests and their natural enemies in brinjal ecosystem. Observations were made on 20 randomly selected plants and observed for the incidence of different insect pests and natural enemies in brinjal ecosystem. The methodology employed to assess the population of insect pests and per cent damage caused by major insect pests is outlined as follows.

Sucking pests

The leafhopper, aphid and whitefly population of both nymphs and adults were counted on three leaves one from top, middle and bottom canopy on each randomly selected plant in each field and expressed as mean number of pests per three leaves.

Shoot and fruit borer

Observation on incidence of brinjal shoot and fruit borer was observed on each randomly selected plant in each field and per cent shoot and fruit infestation was worked out using below mentioned formula

$$\text{Per cent shoot infestation} = \frac{\text{Number of infested shoots}}{\text{Total number of shoots}} \times 100$$

$$\text{Per cent fruit infestation} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \times 100$$

Natural enemies

Natural enemies like different predators (Coccinellids, chrysopids and spiders) and parasitoids were also monitored and recorded during the survey.

Results and discussion

During the survey, a total of six insect pest species were documented, which included sucking pests such as whitefly, *Bemicia tabaci* (Gennadius); leafhopper, *Amarasca biguttula biguttula* (Ishida); aphid, *Aphis gossypii* Glover and shoot and fruit borer, *Leucinodes orbonalis* Guenee. Additionally, two minor insect pests were observed, namely hadda beetle, *Henosepilachna vigintioctopunctata* Fabricius and ash weevil, *Myllocerus discolor* Schoenherr.

The results obtained in this study align with the findings of Nayar *et al*. (1995) reported 53 species of insect pests of brinjal. Additionally, our current findings are consistent with the observations made by Anjana and Mehta (2008), Borkakati *et al*. (2019), Soren *et al*. (2020) and Sreedhar *et al*. (2020) who identified several notable insect pests that affect brinjal, including *Leucinodes orbonalis* Guenee, *Bemisia tabaci* (Gennadius), *Amarasca biguttula biguttula* (Ishida) and *Aphis gossypii* Glover.

Whitefly, *Bemicia tabaci* (Gennadius)

The whitefly population exhibits a range of 2.86 to 8.96 whiteflies per three leaves. Among the chosen talukas, the highest recorded occurrence of whiteflies was in the Hirekerur taluka, with a density of 6.95 whiteflies per three leaves, followed by Ranebennur taluka, with a whitefly count of 6.07 per three leaves. Whereas, the lowest whitefly population was observed in the Byadgi taluka (5.10 whiteflies /3leaves). In Dharwad district the highest average whitefly population was observed in Kalghatgi taluka, with a count of 9.73 whiteflies per three leaves, followed by Dharwad and Hubballi talukas at 8.30 and 7.39, respectively. Among the crop stages, reproductive stage recorded high incidence (8.77 whiteflies/3 leaves) compared to vegetative stage of the crop (5.74 whiteflies/3 leaves) (Table 1).

Leafhopper, *Amarasca biguttula biguttula* (Ishida)

The highest leafhopper population within Haveri district was documented in Hirekerur taluka with 5.98 leafhoppers per three leaves, while Ranebennur taluka followed closely with 5.18 leafhoppers per three leaves. Conversely, the lowest population was observed in Byadgi taluka, with a count of 4.71 leafhoppers per three leaves. Similarly in Dharwad district, maximum mean population was noticed in Dharwad taluka with a count of 8.89 leafhoppers per three leaves, closely followed by Kalghatgi taluka (8.31 leafhopper/3 leaves). In contrast, Hubballi taluka exhibited the least incidence with 7.19 leafhoppers per three leaves. Within the different stages of crop surveyed, reproductive stage recorded the mean maximum leafhopper population (8.19 leafhopper/3 leaves) than vegetative stage of the crop (5.23 leafhoppers/ 3 leaves) (Table 1).

Ahipd, *Aphis gossypi* Glover

The prevalence of aphids within the chosen taluka of Haveri district exhibited notable variations. Among the taluka, high incidence of aphid population was noticed in Hirekerur taluka with 3.78 aphids per three leaves, closely followed by Ranebennur taluka (3.52 aphids/3 leaves). Conversely, lowest aphid incidence was observed in Byadgi taluka with 2.90 aphids per three leaves. In Dharwad district, among the surveyed taluka, Kalaghatgi recorded the highest mean population of aphid, followed by Dharwad taluka, whereas, least population was noticed in Hubballi taluka with 5.82, 4.75 and 3.70 aphids per three leaves, respectively. Among the different stages of the crop, highest infestation was noticed during reproductive stage compared to vegetative stage of the crop with a mean population of 4.73 and 3.43 aphids per three leaves, respectively (Table 1).

Table 1. Status of major insect pests of brinjal in Haveri and Dharwad district of Karnataka during *rabi* 2022-23

Districts	Talukas	Sucking pests (Number of nymphs and adults /3 leaves)									Shoot and fruit borer			
		Whiteflies			Leafhoppers			Aphids			SI (%)			FI (%)
		VS	RS	Mean	VS	RS	Mean	VS	RS	Mean	VS	RS	Mean	RS
Haveri	Byadgi	3.16	7.05	5.10	3.25	6.18	4.71	2.55	3.26	2.90	4.46	10.76	7.61	17.11
	Hirekerur	5.41	8.49	6.95	4.24	7.72	5.98	3.06	4.51	3.78	6.27	12.92	9.59	21.62
	Ranebennur	4.32	7.83	6.07	3.44	6.92	5.18	3.00	4.05	3.52	5.45	11.81	8.63	19.00
	District mean	4.30	7.79	6.04	3.64	6.94	5.29	2.87	3.94	3.40	5.39	11.83	8.61	19.24
Dharwad	Dharwad	7.04	9.56	8.30	7.49	10.29	8.89	4.05	5.45	4.75	7.42	16.09	11.75	23.53
	Hubballi	6.35	8.43	7.39	6.20	8.17	7.19	2.90	4.50	3.70	6.26	13.86	10.06	21.58
	Kalaghatgi	8.19	11.28	9.73	6.78	9.85	8.31	5.05	6.59	5.82	9.46	17.36	13.41	25.38
	District mean	7.19	9.76	8.47	6.82	9.44	8.13	4.00	5.51	4.75	7.71	15.77	11.74	23.49
Mean		5.74	8.77	7.26	5.23	8.19	6.71	3.43	4.73	4.08	6.55	13.80	10.18	21.37

VS = Vegetative stage of the crop, RS = Reproductive stage of the crop, SI = Shoot Infestation, FI = Fruit Infestation

Among the sucking pests recorded on brinjal, whiteflies were found to have the highest occurrence in both Haveri and Dharwad districts, with a recorded density of 7.26 whiteflies per three leaves, followed by leafhoppers (6.71 leafhoppers /3 leaves). In contrast, the lowest prevalence was observed in aphids, with a recorded density of 4.08 aphids per three leaves (Table 1).

Shoot and fruit borer, *Leucinodes orbonalis* Guenee

Per cent shoot infestation

In Haveri district, Hirekerur taluka recorded the maximum shoot damage with 9.59 per cent, followed by Ranebennur taluka (8.63%). Conversely, minimum shoot damage was documented in Byadgi taluka (7.61%). Similarly in Dharwad district, Kalghatgi taluka recorded the highest shoot infestation (13.41%) closely followed by Dharwad taluka, while the lowest shoot infestation was observed in Hubballi taluka with 10.06 per cent of shoot damage. Amongst the various growth phases of the crops, the reproductive stage exhibited a notable higher level of Shoot infestation at 3.80 per cent, in contrast to the vegetative stage which experienced a lower shoot infestation rate of 6.55 per cent (Table 1).

Per cent fruit infestation

Within the chosen taluka in Haveri district, it was noted that Hirekerur taluka exhibited the highest fruit damage of 21.62 per cent followed by Ranebennur taluka (19.00%). Contrarily, the lowest incidence of fruit damage was observed in Byadgi taluka, with 17.11 per cent. In case of different taluka surveyed in Dharwad district, it was noted that the highest incidence of fruit damage was observed in the Kalaghatgi taluka with 25.38 per cent fruit damage followed by Dharwad taluka (23.53%). Conversely, the Hubballi taluka showcased the lowest level of fruit damage at 21.58 per cent (Table 1).

It is apparent from the current study that Dharwad district exhibited the highest prevalence of all the sucking pests as well as shoot and fruit borer compared to the Haveri district during both vegetative and reproductive stages of the crop. The current results align with the discoveries of Anand Kumar (2002), who reported that the highest sucking pest population ranging from 2.99 to 6.81 whiteflies per leaf, 0.20 to 1.56 leafhoppers per leaf from Raichur, Gulbarga and Bidar district during survey in northern Karnataka. The current results are in concord with those of Sajjan (2014), who documented the presence of brinjal shoot and fruit borer infestations ranging from 9.4 to 20.1 per cent on shoots and 14.2 to 19.8 per cent on fruits, during survey in Dharwad and Belagavi districts of Karnataka. Among the different stages of the crop surveyed reproductive stage recorded the highest incidence of all major insect pests (whitefly, leafhopper, aphid and shoot and fruit borer) compared to the vegetative stage of the crop. These observations align with the conclusions drawn by Sajjan (2014), who noted that during survey conducted in Dharwad and Belagavi districts of Karnataka, sucking pests were more prevalent during the reproductive stage as compared to the vegetative stage.

The higher incidence of insect pests in Dharwad district in comparison to Haveri district can be attributed to several factors like cultivation practices and climatic factors existing during the study may have contributed to this variation. Additionally, the continued use of older chemical pesticides such as cartap hydrochloride and biorationals like neem products for pest management in Dharwad district, whereas in Haveri district adoption of modern insecticides such as chlorantraniliprole and emamectin benzoate, as well as the utilization of combination products by the farmers for pest management has contributed to this issue. Furthermore, Dharwad district employs a lower number of pesticide sprays for pest control when compared to Haveri district. Finally, the prevailing local weather conditions in Dharwad district may also play a role in the elevated incidence of insect pests compared to Haveri district. This was supported by Honnakerappa (2017) who reported that the average number of sprays taken against *Helicoverpa armigera* in chilli was comparatively more in Haveri district (3 sprays) than that of Dharwad district (2.8 sprays).

Natural enemies

During the roving survey, the predators *viz*., coccinellids (*Coccinella transversalis* F., *Cheilomenes sexmaculata* F. and *Illeis cincta* F.), green lacewing, *Chrysoperla zastrowi sillemi* and spider fauna (*Neoscona theisi* Walckenaer and *Mecaphesa* sp.) and Hymenopteran parasitoids, *Tarthala flavoorbitalis* (Cameron) and *Bracon* sp were encountered in brinjal ecosystem.

Table 2. Status of predators recoded on brinjal in Haveri and Dharwad district of Karnataka during *rabi* 2022-23

Districts	Talukas	Mean number of predators/plant								
		Coccinellids			Chrysopids			Spiders		
		V	R	Mean	V	R	Mean	V	R	Mean
Haveri	Byadgi	0.47	0.64	0.55	0.25	0.29	0.27	0.35	0.55	0.45
	Hirekerur	0.55	0.73	0.64	0.31	0.32	0.31	0.45	0.60	0.53
	Ranebennur	0.51	0.71	0.61	0.29	0.31	0.30	0.42	0.58	0.50
	District mean	0.51	0.69	0.60	0.28	0.31	0.29	0.41	0.58	0.49
Dharwad	Dharwad	0.56	0.80	0.68	0.39	0.39	0.39	0.47	0.69	0.58
	Hubballi	0.55	0.77	0.66	0.36	0.39	0.37	0.45	0.67	0.56
	Kalaghatgi	0.65	0.85	0.75	0.41	0.44	0.43	0.52	0.72	0.62
	District mean	0.58	0.81	0.69	0.39	0.41	0.40	0.48	0.69	0.58

VS = Vegetative stage of the crop, RS = Reproductive stage of the crop

The survey revealed that the highest occurrence of natural enemies was observed in Dharwad district, with counts of 0.94 coccinellids, 0.43 chrysopids and 0.64 spiders per plant. Following closely was Haveri district, registering counts of 0.66 coccinellids, 0.31 chrysopids and 0.49 spiders per plant (Table 2). The observations of Anand Kumar (2002) and Sajjan (2014) align with these findings, as they recorded population of natural predators in the range of 0.45 to 0.57 coccinellids, 0.25 to 0.50 spiders and 0.20 to 0.70 chrysopids per plant.

The elevated occurrence of natural predators in Dharwad district could be attributed to a lower frequency of pesticide applications by farmers in comparison to Haveri district. Furthermore, the increased prevalence of sucking pests in Dharwad district may have played a role in the heightened presence of all natural predators observed in that particular district. These findings align with the conclusions drawn by Omprakash *et al*. (2013), who documented a positive and significant correlation between the incidence of sucking pests and biotic factors such as coccinellid beetles and spiders.

Conclusion

The comprehensive survey indicated that the major insect pests responsible for significant damage to the brinjal crop are the shoot and fruit borer, whitefly, leafhopper and aphid. The incidence of these insect pests such as whitefly, leafhopper, aphid and shoot and fruit borer was notably higher during the reproductive stage compared to the vegetative stage of the brinjal crop. Therefore, it is essential to implement effective plant protection measures at regular intervals to control these insect pests in brinjal cultivation.

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