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Seasonal incidence of natural enemies in brinjal crop under mid hills of Himachal Pradesh

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Abstract
The present investigation, "Seasonal incidence of natural enemies in brinjal crop under mid-hill conditions of Himachal Pradesh" was carried out in the experimental fields of Department of Entomology, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during the year 2018. Among all the natural enemies, coccinellids and spiders were found as major natural enemies in brinjal crop. The maximum population of coccinellids 2.25 beetles / plant) was noticed during last week of August (34th SW) with corresponding weather parameters; maximum temperature - 28.2 °C, minimum temperature - 20.5 °C, relative humidity - 79% and rainfall - 4.2 mm while the maximum population of spiders (3.0 per plant) was noticed during last first week of September (36th SW) with maximum temperature (27.6 °C), minimum temperature (19.6 °C), relative humidity (76%) and rainfall (28.9 mm). The correlation of coccinellids with maximum temperature (0.594) was positive and significant while it was positive and non-significant with minimum temperature (0.430) and relative humidity (0.291) but correlation with rainfall (-2.022) was found to be negative and non- significant. In case of spiders, all the weather parameters i.e. maximum temperature (0.424), minimum temperature (0.204), relative humidity (0.031) were non-significantly and positively correlated except rainfall (-0.145) which was negatively correlated with spider population.

Keywords: Brinjal pests, natural enemies, mid hills, HP

Introduction
Among solaneceous vegetables, brinjal (*Solanum melongena* L.) is one of the important crops grown throughout India. It is adapted to a wide range of climatic conditions, such as high rainfall and high temperature from North to South and West to East. It is also one among the few vegetables capable of high yields in hot-wet environment.

Brinjal is third most widely grown vegetable species in Asia. The Asia region accounts for almost 50 per cent of the world's brinjal production. It is widely grown in the warmer region hemispheres, although, it is often considered as a Mediterranean or mid-Eastern vegetable. The brinjal fruits are rich in vitamin A and B. The composition of brinjal per 100g of edible portion contains 24 calories, 92.7 per cent moisture content, 4 per cent carbohydrates, 1.4 g protein, 0.3g fat, 1.3 g fiber, 18 mg oxalic acid, 18 mg calcium, 15 mg magnesium, 47 mg phosphorus, 0.38 mg iron, 3.0 mg sodium, 0.12 mg copper, 2.0 mg potassium, 44 mg sulphur, 52.0 mg chlorine, 0.04 mg vitamin A, vitamin B as thiamine, 0.11 mg riboflavin, 0.74 µg beta carotene and 12 mg vitamin C (Gopalan *et al.*, 2007) [6].

India is the second largest producer of brinjal in the world next to China. In India, brinjal is cultivated in 669 thousand hectares of area with production of 12400 thousand MT (Anonymous, 2017a) [1], whereas in Himachal Pradesh area under brinjal is 1.22 thousand hectares with production of 27.80 thousand MT (Anonymous, 2017b) [2].

The insect pests like brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee (Crambidae: Lepidoptera), hadda beetle, *Henosepilachna vigintioctopunctata* Fab. (Coleoptera: Coccinellidae), whitefly, *Bemisia tabaci* Gennadius (Aleyrodidae: Hemiptera), leaf hopper, *Amrasca biguttula biguttula* Ishida (Cicadellidae: Hemiptera) and mealybug *Coccidohystrix insolita* Green (Pseudococcidae: Hemiptera) are considered as major and destructive (Singh, 1970, Bhadauria *et al.*, 1999, Rosaiah, 2001, Saad *et al.*, 2013 and Kalaiyarasi and Livingstone, 2015) [10, 4, 8, 9, 7]. The information on seasonal incidence of these pests is helpful in understanding their population fluctuations in order to devise appropriate strategies for their management. The present studies were therefore, devised to know the incidence of natural enemies in brinjal crop uder mid hills of HP.

Material and Methods

The studies were conducted in the experimental farm of Department of Entomology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) located at an elevation of about 1262 meters above mean sea level, lying between 30°51.607' N latitude and 077°10.951' E longitude. The variety Pusa Purple Cluster (PPC) was grown under natural conditions without spraying any pesticide. The observation on natural enemies was recorded at weekly interval and five plants were selected randomly in the field to record the observations throughout the study period.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion are summarized as follows:

The coccinellid, *Coccinella septempunctata* and spider were recorded as main natural enemies in the brinjal crop. The predatory coccinellids ranged between 0.52 and 2.25 per plant in brinjal crop during August to October, 2018 (Table 1; Fig. 1). The coccinellids were first observed in first week of August (32nd SW), 2018 with 1.25 beetles / plant. The maximum population (2.25 per plant) of coccinellids was noticed during last week of August (34th SW) with corresponding weather parameters; maximum temperature - 28.2 °C, minimum temperature - 20.5 °C, relative humidity - 79% and rainfall - 4.2 mm. The predatory spiders were 2.75 per plant first recorded on the brinjal crop during second week of August (32nd SW). Then there was increase in spider numbers and reached to the highest population (3.0 per plant) during first week of September (36th SW) with maximum temperature (27.6 °C), minimum temperature (19.6 °C), relative humidity (76%) and rainfall (28.9 mm). Spider population gradually declined during third week of September (38th SW) with maximum temperature (25.8 °C), minimum temperature (15.0 °C), relative humidity (73%) and rainfall (99.8 mm). The spider population ranged between 1.12 to 3.0 per plant from August to October months throughout the study period.

Table 1: Population fluctuations of natural enemies in brinjal ecosystem under mid hill conditions of Himachal Pradesh during summer, 2018

Standard Week (SW)	No. of coccinellids per plant	No. of spiders per plant	Maximum temperature (°C)	Minimum temperature (°C)	Relative humidity (%)	Rainfall (mm)
29	0.00	0.00	27.1	21.0	82	24.20
30	0.00	0.00	25.3	19.9	87	223.8
31	0.00	0.00	28.6	19.4	72	0.00
32	1.25	2.75	26.3	19.7	81	48.8
33	1.81	2.02	27.4	19.7	83	163.6
34	2.25	2.35	28.2	20.5	79	4.20
35	1.75	2.12	27.6	20.0	78	1.40
36	1.70	3.00	27.6	19.6	76	28.90
37	1.65	2.15	27.4	17.5	77	30.60
38	0.89	1.12	25.8	15.0	73	99.8
39	0.75	2.00	25.3	15.1	76	63.60
40	1.12	2.25	26.7	11.4	56	0.00
41	0.70	2.06	25.0	10.2	58	2.60
42	0.60	1.75	24.9	8.30	49	0.00
43	0.52	1.25	23.9	6.90	48	0.00
44	0.00	0.00	22.6	8.7	64	9.00
45	0.00	0.00	22.1	6.8	62	7.20

Table 2: Correlation coefficients (r) of populations of natural enemies on brinjal with weather parameters

Natural enemies	Temperature		Relative Humidity (%)	Rainfall (mm)
	Maximum Temperature (°C)	Minimum Temperature (°C)		
Coccinellids	0.594*	0.430	0.291	-0.022
Spiders	0.424	0.204	0.031	-0.145

*Significant at 5% level

Ghosh and Chakraborty (2012) [5] has reported the appearance of the population of *Coccinella septempunctata* during the month of August which was immediately followed by the moderate peak during last week of August (34th SW) to first week of September (35th SW). Ashfaq *et al.* (2011) [3] has found that the density of spiders was highest from second week of September (36th SW) to last week of September (39th SW) as observed in present studies.

The population of coccinellids showed positive and significant correlation with maximum temperature (r=0.594) (Table 2). The correlation with minimum temperature (r=0.430) and relative humidity (r=0.291) was also found positive but it was non-significant. The spider population was also found positively correlated with maximum temperature (r=0.424), minimum temperature (r=0.204) and relative humidity (r=0.031), however the correlation remained non-significant. The rainfall exhibited negative and non-significant correlation with populations of both coccinellids and spiders.

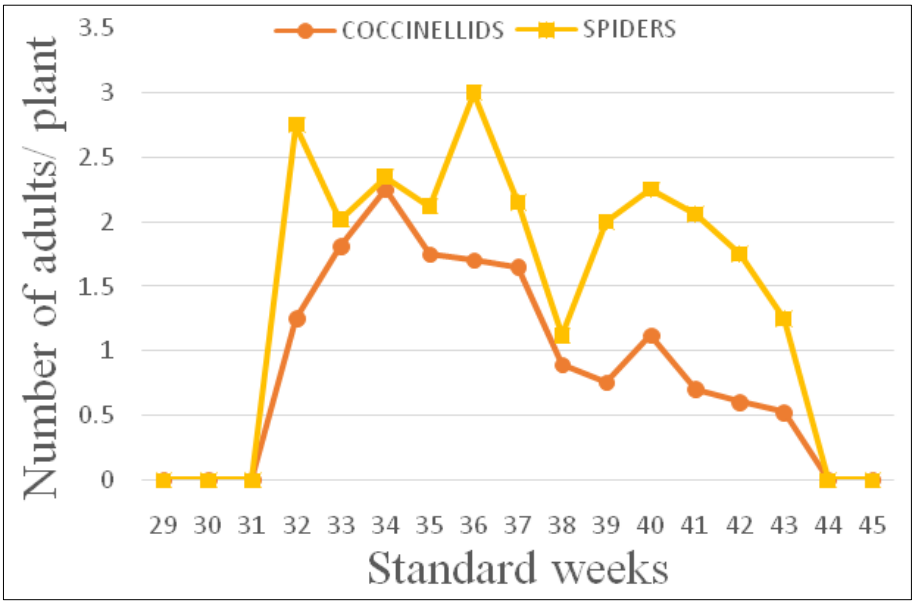

Fig 1: Population fluctuations of natural enemies in brinjal crop ecosystem under mid hills of Himachal Pradesh, 2018

Conclusion

On the basis of results and discussion of the present investigation it is concluded that during the study, the coccinellids and spiders were found as major the natural enemies in brinjal crop under mid hill conditions of Himachal Pradesh.

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