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CONTENTS

Seasonal abundance of predatory coccinellid beetles in different cropping ecosystems at Pantnagar

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ABSTRACT: The purpose of this study was carried out to find out the seasonal abundance of predatory coccinellid species in various crop ecosystems at Pantnagar. Four species *viz.*, *Coccinella septempunctata* (Linnaeus), *Coccinella transversalis* (Linnaeus), *Cheilomenes sexmaculata* (Fabricius) and *Propylea dissecta* (Mulsant) were observed throughout the study period with their highest populations observed during 12th, 1st, 15th and 12th standard week respectively, from field crops (Wheat, Mustard, Cotton, Maize, etc), fruit crops (Mango, Guava, Pomegranate), vegetable crops (Potato, Brinjal, Cabbage, etc.) and ornamental plants (Rose, Chrysanthemum, Hibiscus, etc.). Some other coccinellid species like *Anegleis cardoni* (Weise), *Illeis koebelei* (Timberlake) and *Hippodamia variegate* (Goeze) were considered rare at Pantnagar as these were observed only 50th, 14th and 15th standard weeks respectively in Rose, Dahlia and Hibiscus flowers in very small numbers.

Key words: Coccinellid species, predators seasonal abundance

Coccinellids are one of the potential remedies in pest management plans with good host range (Nelaballe and Beula, 2015). The coccinellids belong to the coccinellidae family of the order Coleoptera. These are also known as lady beetles, lady bugs and lady birds. The coccinellidae is a very well known, diverse and abundant family of natural enemies. More than 6000 species of coccinellids are recorded all over the world (Vandenberg, 2002). Ladybird beetles are mostly predatory in nature and they feed on the phytophagous insects of agricultural, horticultural and forestry species like aphids, whiteflies, mites, psyllids, plant hoppers, coccids, pseudococcids, thrips, eggs and larvae of other insects (Omkar and Pervez, 2002; Evans, 2009).

Although the fauna of coccinellids in the Indian subcontinent is diverse and rich, it remains very poorly studied when compared to other zoogeographical regions of the world. This is the major disadvantage of this predatory beetle in India to using it in bio-control program (Kumar *et al.,* 2017). Keeping in view the importance of the seasonal abundance of coccinellids, the present study was carried out with the objective of determining the effect of weather parameters on predatory coccinellid beetle populations from different field locations in Pantnagar. The primary aim of this research is to shed light on the effects of abiotic factors on the coccinellid beetle population.

MATERIALS AND METHODS

To study the seasonal abundance of predatory coccinellids field surveys for predatory coccinellid beetles were conducted in different field locations *viz.*, Crop Research Centre, Model Floriculture Research Centre, Vegetable Research Centre, Horticulture Research Centre, Garden Section and Campus Area of Govind Ballabh Pant University of Agriculture and Technology at Pantnagar from November 2020 to April 2021. Sampling was done at weekly intervals from each field location from November, 2020 to April, 2021. Sampling was done in the morning hours from 9:00 AM to 10:30 AM and in the evening hours 4:30 to 6:00 PM. By forming a 'W' shape pattern inside the field, samples of the specific crop were collected (Zehnder, 2014). Each corner of the letter 'W' was explored as a potential location for the collection. A one-meter-square area was chosen, and each plant in the square area was checked for predators. A hand picking method was used to gather the beetles (Hemachandra *et al*., 2010). Adult specimens of each species were examined under a binocular microscope for taxonomic features. The collected specimens were identified by using different morphological and taxonomic descriptions given by coccinellid taxonomists (Omkar and Bind, 1993, 1995, 1996;

Omkar and Pervez, 1999; Poorani, 2002b).

Weekly mean population of coccinellid beetles was correlated with meteorological factors such as maximum and lowest temperature, morning and evening relative humidity, and sunshine hours. Meteorological data was gathered from the Meteorological Observatory at the Norman E. Borlaug Crop Research Centre, Pantnagar. To calculate Pearson's coefficient between weather parameters and coccinellid abundance, SPSS software version 16.0 was used.

RESULTS AND DISCUSSION

The present study confined the occurrence of specimens of predatory coccinellid beetles which belong to two subfamilies (Coccinellinae and Chilocorinae), nine genera and eleven species *viz.*, *Coccinella septempunctata*, *Cheilomenes sexmaculata*, *Coccinella transversalis*, *Propylea dissecta*, *Brumoides suturalis*, *Harmonia dimidiata*, *Micraspis discolor*, *Micraspis univittata*, *Anegleis cardoni*, *Illeis koebelei* and *Hippodamia variegata*. The study revealed that weather parameters showed significant influence on coccinellid abundance. The recorded values of mean population of coccinellid beetles are presented in Table 1. The values of correlation of several species of coccinellids population with weather parameters are presented in Table 2. The seven spotted lady bird beetle (*Coccinella septempunctata*) was found in the most crops throughout the year, although its highest population was recorded from the 12th SW (47.5). Simple correlation study indicated that the ladybird beetle *C. septempunctata* had a highly significant positive correlation with maximum (r=0.655**) and minimum (r=0.594**) temperatures. A very significant negative correlation with minimum relative humidity (r=-0.589**), a substantial negative correlation with maximum relative humidity(r=-0.454*), and a significant positive correlation with sunshine hours (r=0.481*). *C. sexmaculata* also shown dominance throughout the research period, with the highest population (30.5) reported during the 50th SW and lowest population was reported during 16th SW. The simple correlation coefficient with meteorological parameters indicated a very significant positive connection with maximum relative humidity (r=0.538**) and a substantial positive correlation with minimum relative humidity (r=0.484*). Maximum temperature (r=-0.446*) and minimum temperature (r=-0.408*) had a substantial negative correlation with the beetle population. And it showed a non-significant negative correlation with sunshine hours (r=-0.337). *C. transversalis* was active throughout the year, with the highest population (7.1) reported during the 11th standard week. The 15th standard week had the lowest activity of these insects. Correlation study indicated that *C. transversalis* had a non-significant negative correlation with maximum (r=-0.030) and minimum (r=-0.075) temperatures. Maximum relative humidity (r=0.362), minimum relative humidity (r=0.092), and sunlight hours (r=0.066) have a non-significant positive association. The presence of *P. dissecta* was observed virtually throughout the research period, with the greatest population (3.1) being recorded during the 12th standard week. Correlation study of beetle population with weather parameters revealed that *P. dissecta* had a non-significant positive correlation with all the weather parameters under study i.e., maximum temperature (r=0.044), minimum temperature (r=0.123), maximum relative humidity (r=0.168), minimum relative humidity (r=0.029) and sunshine hours (r=0.047). *B. suturalis* was reported during the start of the study period i.e., November and showed a peak population (2.4) during the 52nd standard week. Their population was almost diminished from the 1st standard week. Correlation analysis with weather parameters revealed that *B. suturalis* had a highly significant negative correlation with minimum temperature (r=-0.522**) whereas, non-significant negative correlation with maximum temperature (r=-0.293). It showed a non-significant positive correlation with both maximum (r=0.307) and minimum relative humidity (r=0.180). *B. suturalis* showed a non significant positive correlation with sunshine hours (r=-0.147). The activity of *M. discolor* was reported from 45th to 52nd standard weeks with peak population (4.5) was reported during the 50th standard week. The population of *M. discolor* was diminished from 1st standard week

Table 1: Mean population of coccinellid beetles per sq.mt at Pantnagar from November 2020 to April 2021

SW	*C.septempunctata*	*C.sexmaculata*	*C. transversalis*	*P. dissecta*	*B. suturalis*	*M. discolor*	*M. univittata*	*H. dimidiata*	*A. cardoni*	*Illeis koebelei*	*H. variegata*
45	10.8	19.4	4.6	0.8	0.8	0.8	0	0	0	0	0
46	11	16.2	6	0.8	0.2	1.4	0.4	0	0	0	0
47	8	19	4.8	0.4	0.6	1	1	0.4	0	0	0
48	16.2	16	3.6	0.4	0.8	3	0.8	0.6	0	0	0
49	20.3	17.25	1.2	3.5	0.2	0	0	0	0	0	0
50	20.3	30.5	5.3	2.3	0.0	4.5	2.6	0.6	0.1	0	0
51	12.2	16.2	3.2	0.8	0.4	1.8	0.2	0.4	0.0	0.0	0.0
52	12.7	16.4	4.8	0.4	2.4	0.2	0.1	0.1	0.2	0.0	0.0
1	10.4	12.4	1	1	0.4	0.0	0.0	0.0	0.0	0.0	0.0
2	5.8	9.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.2	8.8	1.4	0.4	1.0	0.0	0.0	0.8	0.0	0.0	0.0
4	5.4	6.2	3	0.4	0.0	0.0	0.2	1.4	0.0	0.0	0.0
5	6.8	4	3.2	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0
6	7.4	5.2	2.4	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0
7	14	4.6	0.8	0.5	0.1	0.0	0.1	1.1	0.0	0.0	0.0
8	16.5	5.5	3.1	0.0	0.2	0.0	0.0	0.6	0.0	0.0	0.0
9	24.8	5.3	5.5	0.5	0.0	0.0	0.0	0.6	0.0	0.0	0.0
10	40.3	11.6	4.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	36.4	6.8	7.1	2.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0
12	47.5	4.8	6.5	3.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
13	36	3.2	2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	41.1	1.8	1.2	0.1	0.1	0.0	0.0	0.5	0.0	0.1	0.0
15	33.8	1.7	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.4	0.2
16	14.8	1.2	0.8	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0
17	12.2	2	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SW – Standard week

onwards. Correlation analysis with weather parameters revealed that M. discolor had a non-significant negative correlation with maximum temperature (r=-0.238), minimum temperature (r=-0.233) and sunshine hours (r=-0.228). It showed a non significant positive correlation with maximum relative humidity (r=0.263) and minimum relative humidity (r=0.269). The activity of *M. univittata* was reported from 46th to 52nd standard weeks with peak population (2.6) was reported during the 50th standard week. The population of *M. univittata* was diminished from 1st standard week onwards. Correlation analysis with weather parameters revealed that *M. univittata* had a non-significant negative correlation with maximum temperature (r=-0.224), minimum temperature (r=-0.158) and sunshine hours (r=-0.230). It showed a non significant positive correlation with maximum relative humidity (r=0.224) and minimum relative humidity (r=0.303). The incidence of *H. dimidiate* was reported from 47th to 10th standard weeks with peak population (1.1) was reported during the 7th standard week. Correlation analysis with weather parameters revealed that *H. dimidiate* had a significant negative correlation with maximum temperature (r=-0.458*), minimum temperature (r=-0.431*) and sunshine hours (r=-0.427*). Whereas, it showed a non-significant positive correlation with maximum relative humidity (r=0.321) and minimum relative humidity

Table 2: Correlation between predatory coccinellid beetles and weather parameters

S. No	Coccinella species	Temp Max	Temp Min	RH Max	RH Min	Sun shine Hrs
1.	*C. septempunctata*	0.655**	0.594**	-0.454*	-0.589**	0.481*
2.	*C. sexmaculata*	-0.446*	-0.408*	.0538**	0.484*	-0.337ns
3.	*C. transversalis*	-0.030ns	-0.075ns	0.362ns	0.092ns	0.066ns
4.	*P. dissecta*	0.044ns	0.123ns	0.168ns	0.029ns	0.047ns
5.	*B. suturalis*	-0.293ns	-0.522**	0.307ns	0.180ns	-0.147ns
6.	*M. discolor*	-0.238ns	-0.233ns	0.263ns	0.269ns	-0.228ns
7.	*M. univittata*	-0.224ns	-0.158ns	0.224ns	0.303ns	-0.230ns
8.	*H. dimidiata*	-0.458*	-0.431*	0.321ns	0.448*	-0.427*
9.	*A. cardoni*	-0.239ns	-0.368ns	0.197ns	0.256ns	-0.174ns
10.	*I. koebelei*	0.511**	0.380ns	-0.661**	-0.539**	0.365ns
11.	*H. variegata*	0.354ns	0.204ns	-0.417*	-0.371ns	0.326ns

*Significant **highly significant ns non-significant

(r=0.448). Activity of the species *viz.*, *Anegleis cardoni*, *Illeis koebelei* and *Hippodamia variegata* was quite uncommon.

The present findings are in accordance with the findings of Soni *et al*. (2013) who reported the highest population of *C. septempunctata* during the first week of March. Chakraborty and Korat (2014) reported that the peak population of *C. transversalis* occurred from the last week of December to the first week of January. Karane *et al*. (2019) reported the highest population of *C. sexmaculata* during the 47th and 48th standard weeks. Khan *et al*. (2009), the population of *H. dimidiata* in the tropical area showed maximum population in August and September.

CONCLUSION

Seasonal abundance of coccinellid species in different crops revealed that three species *C. septumpunctata, C. sexmaculata,* and *C. transversalis* were found active throughout the study period. Present study showed that these predatory coccinellid species were well acclimatized with all the weather conditions at pantnagar, however population of coccinellids was different in various crops and this knowledge could be helpful for the utilization of these beetles in biological control program.

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