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Population dynamics of major insect pest fauna and their natural enemies in Soybean

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ABSTRACT: Soybean, together with all other oilseeds, accounts for the majority of the diet and is hence the most significant crop. During Kharif 2020, this study was carried out in Pantnagar, Uttarakhand, to collect data on the pest complex and natural enemies linked with the soybean. During the course of the study, 35 insect pest species were identified, with 8 major pests (Stem Fly, Girdle Beetle, Bihar hairy caterpillar, Tobacco caterpillar, Green semilooper, White fly and Aphids) being described. To determine the natural potential for addressing insect problems, the accompanying natural enemies were also recorded. The results of this study shows that the peak activity of different insect pest at particular time such as stem fly was observed in the third week of September with 100% of infestation while the peak activity of lepidopterous pests such as *Spodoptera litura* (5.3 larvae per meter row) and *Spilosoma obliqua* (7.3 larvae per meter row) were found in the last and second week of September respectively. The sucking pests (white fly and aphids) were found on their peak at the first week of September with 16.6 pests per plant. The natural enemies including coccinellid, spiders, syrphid flies and pentatomid bug were also noticed preying on the pests. The findings of this study will aid in the development of effective insect pest management strategies, particularly against the mentioned pest with the involvement of natural enemies.

Key words: Insect pest management, infestation, natural enemies, pest complex, Soybean

Soybean (*Glycine max* L. Merrill) is the main staple meal with a high protein and oil content. Soybean is commonly known as “golden bean, miracle bean, crop of the planet”. It is primarily grown as an oilseed rather than a pulse crop, and India is the large producer of this crop including 1.326 million metric ton production with cultivated area of about 1.1 million hectares (FAOSTAT, 2019). Insects wreak havoc on the soybean crop from seeding to harvest. In Pantnagar, over a dozen insect pest species, including stem borer, defoliators, and sucking pests, attacks the soybean crop, with the majority belonging to the Lepidoptera, Hemiptera, Coleoptera, Homoptera, and Diptera orders (Pushpendra *et al.*, 2008). There are numerous insect pests that cause varied degrees of agricultural damage, resulting in lower yields, necessitating efficient pest management. Understanding the diversity of insect in their particular ecological setting is a critical step in designing long-term pest management methods. However, the natural enemies plays an important role in the pest management under biological control using introduced or native parasitoids and predators may render better control over the pest and the yield of soybean may be increased through proper

management or improving the natural enemies. Therefore, there is a great need to explore the native biocontrol agents of this devastating pest so that, these could be incorporated in pest management programmes (Manimala *et al.*, 2021). Thus, the purpose of this study was to gather preliminary data on the occurrence and diversity of insect pests and their natural enemies currently in this region so that proper control measures can be used and this study can be used as a basis for further information for the pests management programme.

MATERIALS AND METHODS

The experiment was conducted during *Kharif* 2020 in the Norman E. Borlaug Crop Research Centre (NEBCRC), G B Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar. Pantnagar is situated near the foot hills of Shivalik range (29.0222° N, 79.4908° E) and has humid subtropical climate with hot dry summer, wet and rainy season and cold winters. The temperature may reach upto 43°C in summer and 4°C during winters. For this study, soybean variety Bragg was sown (100 m²) in last week of June and normal agronomic

practices were followed. Observations on insect pests and their natural enemies were taken at weekly interval from ten randomly selected and tagged plants. Each insect pest was examined and recorded at the time of its first appearance and the stage of crop. The type of damage caused by the insects, as well as their feeding habits was closely examined. The Percentage of infestation was estimated using the formulae below (Suyal *et al.*, 2018).

$$\text{Infestation \%} = \frac{\text{No. of Plants infested}}{\text{Total no. of uprooted plants}} \times 100$$

RESULTS AND DISCUSSION

This study points out the population dynamics of insect pests linked with distinct growth stages of the soybean crop and studies on insect pest succession

indicated that various insect attacked the soybean crop at different stage of development such as whitefly and aphids attack at vegetative stage while Lepidopterous pest attacks at flowering stage. Table 1 lists the most common soybean pests and the predators that were observed, their systemic position as well as status at peak activity. Major pests which were observed are white fly (*Bemisia tabaci* Genn.), Jassid (*Empoasca kerri*), aphid (*Aphis gossypii*), Bihar hairy caterpillar (*Spilosoma obliqua*), Tobacco caterpillar (*Spodoptera litura*), green semilooper (*Chrysodeixis acuta*), stem fly (*Melanagromyza sojae*) and girdle beetle (*Oberea brevis*). Table 2 illustrates the findings of this study, which revealed that stem fly infection increases with growth and is maximum in the month of September, with lepidopteran pests showing up in the third week of August. *S. litura* reached in its peak stage at the last

Table 1: Insect Pests and natural enemies observed on soybean during, Kharif 2020

S. No.	Common Name	Scientific Name	Systemic Position (Order: Family)	Status of peak activity
1.	Stem Fly	<i>Melanagromyza sojae</i>	Diptera: Agromyzidae	Gradually increase till harvesting
2.	Girdle Beetle	<i>Oberea (Obereopsis) brevis</i>	Coleoptera: Cerambycidae	First week of October
3.	Bihar hairy caterpillar	<i>Spilosoma obliqua</i>	Lepidoptera: Noctuidae	Second week of September
4.	Tobacco caterpillar	<i>Spodoptera litura</i>	Lepidoptera: Noctuidae	Last week of September
5.	Green semilooper	<i>Chrysodeixis acuta</i>	Lepidoptera: Noctuidae	Second week of September
6.	White fly	<i>Bemisia tabaci</i>	Hemiptera: Aleyrodidae	Second week of August
7.	Aphids	<i>Aphis glycines</i>	Hemiptera: Aphididae	First week of September
8.	Leaf folder/roller	<i>Hedylepta indicata</i>	Lepidoptera: Crambidae	Second week of September
Natural enemies (Predators)				
1.	Lady bird beetle	<i>Coccinella septempunctata</i>	Coleoptera: Coccinellidae	Last week of August
2.	Syrphid fly	<i>Syrirta pipiens</i>	Diptera: Syrphidae	Last week of September
3.	Pentatomid bug	<i>Eocanthecona furcellata</i>	Hemiptera: Pentatomidae	First week of October
4.	Spider	<i>Oxyopes satticus</i>	Araneae: Oxyopidae	Second week of September

Table 2: Seasonal incidence of major pests and their natural enemies in soybean during Kharif, 2020

SW	Mean % Infestation	Mean no. of larvae			Mean no. of sucking per meter row length			No. of predators/plant pests/plant		
		Stem fly	<i>S. litura</i>	<i>S. obliqua</i>	Total White fly	aphids	Total	Coccinellid	<i>Eocanthecona Sp.</i>	Total
31	45	0.0	0.0	0.0	3	2.3	5.1	1	0	1
32	48	0.0	0.0	0.0	5.6	3.6	9.2	1	0	1
33	51	0.0	1.3	1.3	8.0	4	12	1	0.6	1.6
34	53	0.6	3.3	3.9	4.6	3.6	8.2	2.3	0.6	3
35	59	4	5.6	9.6	7.0	9.6	16.6	2	1	3
36	83	2.6	7.3	9.9	4.3	7.3	11.6	1.3	1.6	3
37	98	2.3	4.6	6.9	5.3	8	13.3	1	2	3
38	100	5	2.3	7.3	7	4	11	0.6	1.6	2.2
39	100	5.3	4.6	8.6	6.3	1.3	7.6	0.0	1.3	1.9
40	100	5.3	3	8.3	5.3	1.6	6.9	0.3	2.3	2.6

SW – Standard week

week of September, while *S. obliqua* reached in its peak stage at the first week of September. This study also revealed that the white fly attacks the plants in seedling stage and the peak activity was found in the second week of August. The aphid population, on the other hand, fluctuates, with the greatest stage of infestation occurring in the first week of September. Natural enemies have a fascinating role to play in pest management. The coccinellid were appeared in the seedling stage of plant and their peak status found in the last week of August as the pest population increases. The population of *Eocanthecona furcellata* has been steadily increasing, with peak activity in the first week of October.

The current findings are consistent with those of Ahirwar *et al.* (2015) lepidopterous caterpillar density grew progressively, peaking at 3.2 larvae per meter row during the last week of August. Whitefly was found in greater numbers among the sucking pests. During the second week of August, the highest density of sucking pests was found, with 6.5 sucking pests/plant. Lady bird beetles, spiders, and lynx spiders were found preyed on sucking insects, while pentatomid bugs were preyed on lepidopterous larvae.

Suyal *et al.* (2018) also reported the prevalence of soybean pests in the JS-335 soybean variety. During the last week of August, the density of defoliators such as *Spodoptera litura* and *Spilosoma obliqua* grew progressively to a peak of 12.5 and 3.9 larva/meter row lengths, respectively, while sucking pests such as *Bemisia tabaci* and *Aphis gossypii* were observed during mid of August. They find out the infestation of stem fly reached upto 100 % significantly related to our finding. They also observed the natural enemies i.e., *Coccinella septumpunctata* and *Eocanthecona furcellata* occurred during third week of August.

According to Paik *et al.* (2007) *S. litura* was seen in large numbers in late August in soybean fields. The results for stem fly infestation were quite similar to those of Kumar *et al.* (2018) who indicated that stem fly infestation lasted until the crop was harvested.

Infestation spiked in the last week of September, reaching a high of 100 per cent.

CONCLUSION

The aforementioned study concluded that the primary pests on soybean variety Bragg were Stem fly, tobacco caterpillar, BHC, green semilooper, whiteflies, and aphids. The third week of September shows the highest levels of stem fly infestation (100 per cent) and mid of September was observed as highest lepidopterous larvae i.e., *S. litura* (5.3 larvae per meter row length) and *S. obliqua* (7.3 larvae per meter row length) activity. During the second week of August, the white fly shows its peak infestation with 8.0 white fly per plant while the aphids (9.6 aphids per plant) shows highest level at first week of September. Natural enemies such as lady bird beetles, *C. septumpunctata*, were discovered dining on whiteflies among the predators, while the spider, *Oxyopes sp.*, and a predatory pentatomid bug, *Eocanthecona furcellata*, were observed feeding on the lepidopterous larvae.

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