

Seasonal Incidence of Major Insect Pests of Soybean (*Glycine max* (L.) Merrill) and Their Natural Enemies

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ABSTRACT

The present investigation titled “Seasonal incidence of some major insect pests of soybean [*Glycine max* (L.) Merrill] and their natural enemies” was conducted during the Kharif 2024-25 at the experimental field of the Department of Entomology, ICAR-National Soybean Research Institute, Indore, Madhya Pradesh (India). The study aimed to evaluate the seasonal incidence of major insect pests. Observation revealed that the population of tobacco caterpillar (*Spodoptera litura*) peaked with 16.00 larvae/meter row length (l/mrl) in the 33rd Standard Meteorological Week (SMW), showing a significant positive correlation with minimum temperature ($r = +0.56$). The green semilooper (*Chrysodeixis acuta*) reached its maximum density (3.36 l/mrl) in the 34th SMW, positively correlated with maximum temperature ($r = 0.53$). Whereas peak infestation of the girdle beetle (*Oberopsis brevis*) and stem fly (*Melanagromyza sojae*) were recorded in the 37th SMW (3.72%) and 34th SMW (18.10%), respectively, with stem fly showing a significant negative correlation with minimum temperature ($r = -0.55$). Entomopathogenic fungal activity peaked in the 36th SMW (4.10 l/mrl), though no significant correlation with abiotic factors was observed. Spider population peaked at 1.42 spiders/mrl in the 40th SMW, showing a significant positive correlation with maximum temperature ($r = +0.56$). The study provides important insights for integrated pest management in soybean agroecosystems.

Keywords: Seasonal incidence, Major insect pest of soybean, Natural enemies

1 | INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] belongs to the family Fabaceae, one of the most important economic oilseed and legume in the world, in terms of total production and international trade. It is considered “Wonder Crop” and “Golden bean” of the 20th century and “Miracle Crop” of the 21st century owing to its good quality vegetable protein and edible oil. It is an excellent source of protein (40%) and edible oil (20%), carbohydrates (30%) and fibre (5%). Soybean oil contains about lecithin (0.5-1.0%) which is essential for building up of human nerve tissues. Due to high protein content, soybean is known as “poor man’s meat”. It is a native of China and was introduced in India subcontinent about 1000 AD (Hymowitz and Kaizuma, 1981). The global soybean production reached 385.524 million metric tonnes in the year 2021-22, with Brazil leading (144 MMT), followed by the USA (119.88 MMT), Argentina (52 MMT), China (19 MMT) and India (11.2 MMT), (Anonymous, 2024). In the 2023-24, India cultivated soybean in 13.26 million hectares area, with a productivity of 985 kg/ha and a total production of 13.06 million tonnes. Madhya Pradesh is known as “Soya State” and contributes significantly to soybean production in the country with 5.749 MMT production during 2022-23 from 5.97 Mha (Khound *et al.*, 2024). In short period of time soybean became a major Kharif crop in Madhya Pradesh, Maharashtra, Rajasthan, North Karnataka, etc.

However, the soybean crop is facing huge problems and challenges of decreasing yield at farmer’s field. More than 270 insect pests have been recorded to infest different stages of soybean crop in India (Lutytska, 2019), while in Madhya Pradesh over 99 insect pests are found on soybean (Gangrade, 1976). About 15-25% of soybean output is lost due to insect pests (Biwas, 2013). Girdle beetle, *Oberopsis brevis* (Sweden board), stem fly, *Melanagromyza sojae* (Zehnter), tobacco caterpillar, *Spodoptera litura* (Fabricius), semiloopers, *Gesonia gemma*, *Diachrysa orichalcea* and *Chrysodeixis acuta* (Walker) and sucking insect pests like white fly, *Bemisia tabaci* (Gennadius) and aphid, *Aphis glycine* are a few of them that are important. Seasonal incidence studies help in planning need-based application of insecticides as it clearly reveals the insect’s peak activity-free period during growth. Evaluating the most effective chemical solutions for current pest control issues involves assessing the efficacy of new insecticides, which is determined by identifying the dosage required to achieve optimal pest control.

2 | MATERIALS AND METHODS

A field experiment to evaluate the seasonal incidence of major insect pests of soybean [*Glycine max* (L.) Merrill] and their natural enemies was conducted at ICAR-National Soybean

Research Institute, Indore (MP), during *kharif* - 2024. All recommended agronomic package of practices were followed for raising of the crop. The crop was sown in randomized block design. Observations on the incidence of major insect pests of soybean were recorded from the first appearance of the pest till maturity of the crop at weekly intervals, and data was correlated with meteorological parameters (maximum and minimum temperature (°C), morning and evening RH (%) and rainfall (mm).

2.1 | Method of Recording Observations

Stem fly: Infestation of stem fly was recorded from 3 randomly selected plants in each plot, uprooted and split up vertically to observe the infestation. Stem tunnelling was expressed in per cent.

$$\text{Tunnelling (\%)} = \frac{\text{Tunnelling length (cm)}}{\text{Total plant height (cm)}} \times 100$$

Girdle beetle: The observation of girdle beetle was recorded by counting the total number of healthy and girdled plants in a one-meter row length at three randomly selected places.

$$\text{Infestation (\%)} = \frac{\text{No. of girdled plants}}{\text{Total no. of observed plants}} \times 100$$

Larval population: Observation of larval population was recorded in one meter row length (MRL) by shaking the plants on white paper from three places, and the mean was calculated.

Natural enemies: The population of natural enemies (spiders and entomopathogenic fungi) was recorded in one meter row length (MRL) by shaking the plants on a white paper sheet from three places, and the mean was calculated.

3 | RESULTS AND DISCUSSION

The incidence of insect pests and natural enemies showed distinct population dynamics influenced by meteorological parameters. The tobacco caterpillar exhibited a significant positive correlation with minimum temperature ($r = 0.56^*$), suggesting that higher night temperatures favoured its growth and survival. Increased metabolic activity and egg-laying rates at moderate temperatures (23–30°C) likely contributed to this trend. Similarly, the green semilooper (*C. acuta*) peaked at higher maximum temperatures ($r = 0.53$), indicating its preference for slightly warmer daytime conditions.

Among natural enemies, *B. bassiana* infestation increased under high humidity and low rainfall conditions but showed no significant correlation with weather parameters. This suggests that its occurrence was influenced by localized microclimatic conditions rather than broader meteorological trends. Spiders, on the other hand, displayed a significant positive correlation with maximum temperature ($r = 0.56$), indicating that warm and dry conditions promoted their predatory activity.

The girdle beetle (*O. brevis*) showed a significant negative correlation with minimum temperature ($r = -0.55^*$), implying that lower night temperatures restricted its activity and development. This could be due to reduced metabolic efficiency and oviposition at cooler temperatures. Interestingly, stem fly (*M. sojae*) infestation exhibited no significant correlation with any weather parameters, suggesting that its population dynamics were likely influenced by other factors such as host plant growth stages or parasitoid activity.

Overall, the results indicate that temperature plays a crucial role in regulating the population of insect pests and their natural enemies. These findings underscore the importance of integrating weather-based pest forecasting models for effective pest management strategies.

Recent studies have investigated the seasonal incidence and management of key insect pests affecting soybean crops, highlighting consistent patterns and agronomic influences. Kumari *et al.* (2020) identified *Spodoptera litura* and *Chrysodeixis acuta* as major defoliators, with peak larval activity in early September (1.8–1.9 larvae/mrl). Predators such as ladybird beetles and lynx spiders preyed on these pests, though their impact remains unquantified. Rajashekar *et al.* (2023) found lower *S. litura* incidence in mid-June sowings (2.81–2.97 larvae/mrl) compared to late June sowings (4.34 larvae/mrl) across two *kharif* seasons (2017–2018), emphasizing the importance of sowing timing in pest management. Priya *et al.* (2024) confirmed *S. litura* and *C. acuta* as key defoliators, with peak incidences during the 35th–37th SMW. *S. litura* correlated with minimum temperature, while *C. acuta* was linked to rainfall, indicating different climatic drivers for pest surges.

Table 1. Weather parameters and seasonal incidence of major insect pests and their natural enemies during *kharif* 2024 at Indore.

SMW	Week	Total Rainfall (mm)	Temperature (°C)		Relative Humidity (%)		No. of Rainy days	Tobacco caterpillar (l/mrl)	Green semilooper (l/mrl)	Stem fly (% tunnelling)	Girdle beetle (% infestation)	Entomopathogenic fungus/mrl	Spider/mrl
			Maximum	Minimum	Maximum	Minimum							
30	July 23–29	97.54	25.79	23.97	97.00	90.14	5.00	0.80	0.00	0.00	0.00	0.00	0.00
31	July 30–Aug. 05	39.12	26.75	23.57	96.14	84.29	5.00	3.00	0.00	0.00	0.00	0.00	0.10
32	Aug. 06–12	23.11	26.98	23.17	96.29	80.14	3.00	4.00	0.06	6.20	0.00	0.00	0.00
33	Aug. 13–19	24.89	30.32	23.97	95.00	66.57	3.00	16.00	2.10	3.27	0.20	1.20	1.10
34	Aug. 20–26	128.78	27.94	23.49	97.29	80.14	5.00	10.00	3.26	18.10	0.45	1.40	0.80
35	Aug. 27–Sep. 02	58.93	28.81	22.94	94.43	71.43	4.00	1.00	0.50	12.96	0.50	1.10	0.70
36	Sept. 03–09	3.05	26.67	23.33	95.00	89.00	1.00	10.50	0.40	13.28	3.24	4.10	1.30
37	Sept. 10–16	3.81	28.73	22.22	94.86	66.14	1.00	1.00	0.20	2.30	3.72	1.80	0.30
38	Sept. 17–23	11.18	31.51	22.94	94.14	57.00	2.00	1.25	0.50	3.20	3.72	1.30	1.40
39	Sept. 24–30	96.52	29.52	23.33	96.71	71.29	7.00	5.99	1.42	8.50	0.73	1.50	0.20
40	Oct. 01–07	0.00	32.62	23.25	92.71	48.29	0.00	4.89	2.16	6.50	0.60	0.83	1.42
41	Oct. 08–14	9.91	30.87	23.02	89.43	54.00	2.00	0.87	2.72	6.60	0.33	0.70	1.22
42	Oct. 15–21	4.06	31.35	22.86	88.00	47.43	1.00	0.20	1.87	2.42	0.25	0.30	0.24
Rainfall (r)								0.15	0.22	0.38	-0.39	-0.15	-0.38
Maximum temperature (r)								-0.08	0.53*	-0.09	0.09	-0.07	0.56*
Minimum temperature (r)								0.56*	0.17	-0.02	-0.55*	-0.17	-0.20
Maximum RH (r)								0.37	-0.35	0.019	0.04	0.12	-0.30
Minimum RH (r)								0.27	-0.46	0.20	-0.06	0.19	-0.41
Rainy days (r)								0.10	-0.02	0.13	-0.44	-0.26	-0.52

l/mrl = larvae per meter row length; SMW = Standard Meteorological Week; r = correlation coefficient; * = significant at 5% level.

4 | CONCLUSION

The study on seasonal incidence in soybean during the *kharif* 2024 season highlights the critical role of weather parameters – especially temperature and humidity – in influencing the population dynamics of key insect pests and their natural enemies. Pests like *Spodoptera litura*, *Chrysodeixis acuta* and *Oberea brevis* showed clear correlation with specific climate conditions, while others, like *Melanagromyza sojae*, appeared unaffected by weather, indicating the influence of additional ecological factors.

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