

Seasonal Incidence of Major Pests of Soybean and its Correlation with Weather Parameters

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ABSTRACT

The field experiment was undertaken to study seasonal incidence of major pests of soybean during Kharif season 2023-2024. The experiment was conducted at the Department of Entomology, VNMKV, Parbhani. The results revealed that first appearance of tobacco leaf eating caterpillar (*S. litura*) was recorded during 32nd SMW (0.67 larvae/mrl). Highest infestation was recorded in 36th SMW i.e. 3.23 larvae/mrl, after that infestation was reduced. The incidence of *H. armigera* was also observed low to medium. First appearance of *H. armigera* was recorded during 33rd SMW (0.61 larvae/mrl). The incidence of semilooper started from 32nd SMW and recorded 2.66 larvae/mrl. Thereafter, the population increased gradually and was observed highest during 36th SMW (5.23 larvae/mrl). The incidence of girdle beetle was negligible and not observed in the experimental trial. The incidence of stem fly was negligible and not observed in the experimental field. The incidence of white flies was first observed during 32nd SMW (1.6 whiteflies/three leaves/plant) and reached a peak of 7.61 whiteflies/three leaves/plant during 37th SMW. Leaf hopper was noticed from 33rd SMW up to harvesting at 41st SMW and recorded highest population (3.6 leaf hoppers/three leaves) during 39th SMW. First appearance of lady bird beetle was observed (0.53/mrl) during 33rd SMW and recorded highest population (2.63/mrl) during 34th SMW. Spiders were observed during the initial stage of the crop and recorded 0.36 spiders/mrl during 32nd SMW and highest population (4.63 spiders/mrl) during 37th SMW.

Keywords: *Spodoptera litura*, *H. armigera*, Whitefly, Girdle beetle, Defoliator Seasonal incidence

1 | INTRODUCTION

Soybean, *Glycine max* (L.) Merrill, also known as the “Wonder crop” is most important oilseed crops among the pulses and belongs to family Leguminosae and sub family Papilionaceae. The native of soybean is in China and introduced in India in 1970-80 (Andole, 1984).

Recently, soybean is gaining importance because of various quality factors. It is referred to “The protein hope of the future” as well as “Miracle golden bean” (Sarkar *et al.*, 2002) because of its high nutritive value containing 40-45% protein and 20-25% edible oil. Soybean is used as protein supplement in human diet, cattle and poultry feeds (Alexander, 1974). Soya protein also possess major essential amino acids useful in human nutrition and vitamin Band D. It provides 5 times more protein than cereals and twice that of pulses, 6-7% total minerals, 5-6 % crude fiber and 17-19% carbohydrates (Chauhan and Joshi, 2005).

The soybean defoliators mainly include tobacco caterpillar (*Spodoptera litura*, Fabricius) and green defoliators (*Chrysodeixis acuta*). Immature stages (caterpillars) of both damage the crop at vegetative stage and in severe cases, it completely defoliate the crop and dramatic yield loss (Singh and Singh, 1990). *Spodoptera litura* larvae even damages to

soybean pods also (Chaturvedi *et al.*, 1998, Mandal *et al.*, 1998, Singh *et al.*, 2000 and Sastawa *et al.*, 2004).

Defoliators enhance the anthocyanin in leaf and plant systems, thereby reduce chlorophyll content and also reduce levels of proteins, carbohydrates and inorganic ions and alterations in hormone concentrations. Defoliation activity is highly temperature dependent.

Apart from defoliators other pest species, leaf minor, *Aproaerema modicella* (Deventer), stemfly, *Melanagromyza sojae* (Zentener), girdle beetle, *Obereopsis brevis* (Swedenborg), whitefly, *Bemisia tabaci* (Genn.), aphids, jassids are also important. The major defoliators found on soybean are *Spodoptera litura* (Fabricius), *Chrysodeixis acuta* (Walker), *Helicoverpa armigera* (Hubner), *Spilosoma oblique* (Walker) *etc.* Leaf miner, *Aproaerema modicella* alone causes losses from 30 to 50 per cent in grain yield (Singh and Singh, 1990). The tobacco leaf eating caterpillar, *Spodoptera litura* (F.) has been widely recorded as serious polyphagous pest, which damages soybean crop also.

The studies on seasonal incidence give us an idea about the environmental factors that regulate cyclic occurrence of the pests. Thus, its study will help us in planning need based

application of insecticides as it clearly reveals the peak activity as well as insect free periods during crop growth.

2 | MATERIAL AND METHOD

Field experiment was conducted on 'seasonal incidence of major pests of soybean' during *Kharif* season 2023-2024 at

Research Farm, Department of Entomology, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS).

2.1 | Seasonal Incidence of Major Insect Pests of Soybean

Details of the experimental trial

Sr. No.	Particulars	Details
1.	Design	Non replicated design
2.	Plot size	10m x10m
3.	Spacing	45cm x 5cm
4.	Crop	Soybean
5.	Variety	MAUS 162
6.	Fertilizer	30:60:30:20 (NPKS kg/ha)
7.	Season	<i>Kharif</i> 2023-24
8.	Date of Sowing	15th July, 2023

2.2 | Method of Recording Observations

Observations were recorded at 7 days intervals starting from 7 days after germination (DAG) following uniform procedure as described below for different insect pests.

Defoliators: Observations on number of larvae (*Spp.* wise) were recorded per meter row length (mrl) at three places and mean was reported in per meter row length (mrl).

Leaf minor: No. of larvae per plant in 10 plants. No. of leaf lets and damaged leaflets were recorded and presented in percentage.

Stemfly:

a. Seedling mortality: Total number of plants and number of plants succumbed to stem fly infestation/mrl at 3 places on 7-10 DAG. Seedling mortality was expressed in percentage.

b. Stem Tunnelling: Plant height and length of stem tunnelled in 10 plants at physiological maturity was recorded and stem tunnelling was expressed in percent.

Girdle beetle: Total number of plants and girdled plants were recorded from 1meter row length at 5 places and data was presented in percent plant infestation.

Sucking pests of soybean: Number of sucking pests; whitefly, aphids and leaf hoppers (nymphs and adults) on 3 leaves/ plant (upper, middle and lower leaf) in 10 plants each, were recorded.

Natural enemies: Observations on natural enemies *viz.* ladybird beetle and spiders were recorded from three rows of one meter row length and mean was worked out.

3 | RESULTS AND DISCUSSION

3.1 | Semilooper (*Chrysodeixis acuta*)

The data presented in Table 1 revealed that among defoliators, comparatively more incidence of semilooper was observed during *Kharif* 2023. The incidence of semilooper started 30 days after sowing and recorded 2.66 larvae/mrl during 32nd SMW. There after, the population increased gradually and recorded a peak of 5.23 larvae/mrl in 36th SMW. After 36th SMW semilooper population decreased naturally affected and reached to 1.23 larvae/mrl during 41st SMW. The continuous rainfall in 34th SMW the population of semilooper naturally. Anonymous 2009, 2010 and 2011 reported that the menace semilooper to soybean was increasing every year which supports the findings of present investigation. Brahman *et al.* (2018) also observed that beginning of semilooper on soybean crop was observed during the 31st standard week (0.33 larvae/mrl). Chaudhari *et al.* (2020) recorded that semilooper population was commenced from 33rd SMW and continued till 40th SMW which ranged from 1.33 to 8.67 larvae/mrl and existed in the field with 8.67 larvae/mrl during 38th SMW. Similarly, Meena *et al.* (2017) reported that semilooper were active from August to October. Whereas, Sapekar *et al.* (2020) reported that first appearance of semilooper was started after 20 days after sowing (0.66 larvae/mrl). The peak population was recorded (7.66 larvae/mrl) during 35th SMW.

3.2 | American Boll Worm, *Helicoverpa armigera* (Hubner)

The data presented in Table 1 revealed that among defoliators, the incidence of pod borer was moderate observed during *Kharif* season 2023. The incidence of pod borer started 30 days after sowing and recorded 0.61 larvae/mrl during 33rd SMW. There after, the population increased gradually and recorded a highest (4.75 larvae/mrl in 36th SMW). After 36th SMW pod borer population decreased naturally and reached to 0.67 larvae/mrl during 40th SMW. Yeotikar (2014) also found that the incidence of *H. armigera* was also found very low/negligible and only 0.66 larvae/mrl were found during

32nd SMW. Also, during experiment period, *H. armigera* was not a major pest of soybean in Marathwada and the availability of preferred alternate host like pigeon pea and cowpea may be pointed out as the reason for low incidence of this pest on soybean.

3.3 | Tobacco Leaf Eating Caterpillar, *Spodoptera litura* (Fabricius)

The data presented in Table 1 revealed that during *Kharif* season 2023, the population was very low. In 32nd SMW infestation of *S. litura* larvae were observed (0.67 larvae/mrl). It was increased up to 3.23 larvae/mrl in 36th SMW. After that population was going to decrease continuously. Thus, continuous rainfall received during the season did not allow the population of *S. litura* to build up. The results of present investigation are discussed in the light of findings of previous workers. Sonule *et al.* (2019) observed similar results of first incidence of *S. litura* 0.20 larvae/mrl in 32nd SMW. The incidence increased slowly in next few weeks and recorded highest population of 1.20 larvae /mrl during 36th SMW. Motaphale *et al.* (2019) also recorded population of *S. litura* at highest level in 36th and 34th SMW. Charjanet *et al.* (2017) observed that *S. Litura* attended its peak in 36th SMW (0.3 larvae / MRL). Channakeshava *et al.* (2020) also observed the attack of *S. litura* from 31st MSW to 37th MSW.

3.4 | Girdle Beetle, *Obereopsis brevis* (Swedenbord)

The data presented in tables revealed that no girdle beetle infestation was observed in seasonal incidence trial. All India coordinated research project on soybean annual report (2023) reported that no girdle infestation throughout the *Kharif* 2022 at Parbhani location in experimental fields supports these findings.

3.5 | Sucking Pests (Whitefly, Leaf Hopper)

In sucking pests, whitefly and leaf hopper were recorded in Table 1, The population of leaf hopper was found low with peak of 3.5 per three leaves per plant in 38th SMW and white fly population was also low with a peak of 6.54 and 7.61 per three leaves per plant during 36th SMW and 37th SMW. The results of present investigation are discussed in the light of findings of previous workers. Netam *et al.*, (2013) observed

that first appearance of whiteflies was recorded on the crop to a greater or lesser extent in the last week of July. Tomar and Bhargawa (2018) revealed peak level of whiteflies (7.1 larvae/ meter/ row) in 2nd week of September (36th SMW). Charjan *et al.* (2017) reported that incidence of leaf hoppers was initiated in 32nd SMW (0.3 leaf hoppers / leaf) and it was continued up to 38th SMW. Bhamare *et al.* (2018) observed that *E. kerri* (17.8 jassids per quadrat) reached its peak population during 39th standard meteorological week on sole soybean. Brahman *et al.* (2018) observed that the attack of *Empoasca kerri* on the soybean crop was initiated in the second week of August 32nd SMW (6 Aug-12 Aug) in vegetative stage when the crop was of about 34 days old up to third week of October 42nd SMW (15-21 Oct) when crop was 71 days old. Bhavasar and Kumar (2019) revealed peak population of 3.8 leaf hoppers/ 3 leaves in 39th standard week. Present investigation findings are in corroboration with the findings of above workers as these references strongly supports the results obtained during present investigation.

3.6 | Leaf Miner

The data given in the Table 1 showed that leaf miner, *A. modicella* was reported very low. It started during initial stage of crop and recorded 0.8 larvae/ plant during 31st SMW. The incidence increased slowly in the next weeks. Maximum population (1.5 larvae/ plant) was recorded during 34th SMW. During this week Maximum and minimum temperature were 31.6°C and 21.5°C and morning and evening relative humidity were 89% and 59% and rainfall were 85.1 mm.

Leaf miner population declined to 0.70 larvae/ mrl after 35th SMW. during this week, maximum and minimum temperature were 32.5° C and 22° C and morning and evening relative humidity were 74% and 45% and rainfall was 20 mm. Pest disappeared after 35th SMW. Chavan *et al.* (2018) observed *A. modicella* during initial stage of crop and recorded 0.58 larvae/ plant during 30th SMW and remained more or less constant up to 34th SMW. Maximum population (1.74 larvae/ plant) was recorded during 33rd SMW. Motaphale *et al.* (2019) recorded population of *A. modicella* on soybean between 27th to 35th (0 to 0.3 larvae/ plant) SMW. Present findings are in line with the findings of above workers.

Table 1. Seasonal incidence of major pests of soybean.

S. No	SMW	Period	Whitefly	Leaf hopper	<i>S. litura</i>	<i>H. armigera</i>	Semilooper	Girdle beetle	Lady bird beetle	Spider
1	30	23- 29 July	0	0	0	0	0	0	0	0
2	31	30 Jul - 5 Aug	0	0	0	0	0	0	0	0
3	32	6 - 12 Aug	1.6	0	0.67	0	2.66	0	0	0.36
4	33	13 - 19 Aug	3.6	0.8	1.63	0.61	4.33	0	0.53	0.56
5	34	20 - 26 Aug	3.7	1.92	1.4	1.11	1.96	0	2.63	1.2
6	35	27 Aug - 2 Sep	4.12	1.8	2.56	2.63	4.66	0	1.2	3.23
7	36	3 - 9 Sep	6.54	2	3.23	4.75	5.23	0	0	3.74
8	37	10 - 16 Sep	7.61	1.8	2.11	4.33	4.33	0	0.63	4.63
9	38	17-23 Sep	5.3	3.54	1.32	3.63	4.98	0	1.34	1.62
10	39	24-30 Sep	3.4	3.6	1	2.35	2.31	0	0.63	1.65
11	40	1-7 Oct	3.6	3.2	1.35	0.67	2	0	1.54	1.3
12	41	8-14 Oct	2.8	0.8	0	0	1.23	0	1	0.5
13	42	15-21 Oct	2	0.7	0	0	0	0	0.66	0.32

SMW = Standard Meteorological Week; values are mean number of individuals per meter row length (mrl) for defoliators/natural enemies or per three leaves/plant for whitefly and leaf hopper.

Table 2. Correlation between weather parameters and major pests of soybean.

Weather Parameter	Semilooper	<i>Spodoptera litura</i>	<i>H. armigera</i>	Leaf miner	Whitefly	Leaf hopper
Maximum Temperature (°C)	-0.206	-0.263	-0.336	-0.144	-0.094	0.075
Minimum Temperature (°C)	0.407	0.414	0.383	0.309	0.099	-0.062
Morning relative humidity (%)	0.053	-0.093	0.317	-0.357	0.212	0.497
Evening relative humidity (%)	0.256	0.220	0.418	0.060	0.137	0.115
Rainfall (mm)	0.008	0.233	0.140	0.356	0.049	0.056
Wind speed (Km/hr)	0.239	0.189	0.194	0.427	-0.070	-0.351

Table 3. Correlation between weather parameters and natural enemies of soybean.

Weather Parameter	LBB	Spider
Maximum Temperature (°C)	0.334	0.259
Minimum Temperature (°C)	-0.404	-0.212
Morning relative humidity (%)	0.286	0.258
Evening relative humidity (%)	-0.436	-0.062
Rainfall (mm)	0.233	0.010
Wind speed (Km/hr)	-0.283	0.141

LBB = Lady Bird Beetle.

Table 4. Multiple regression equations for defoliators, sucking pests and natural enemies with weather parameters during Kharif 2023.

Pests	Year	Regression Equation	R ²
Semilooper	2023	$Y = 69.340 + (0.410) \times B1 + (2.701) \times B2 + (0.087) \times B3 + (-0.081) \times B4 + (-0.007) \times B5 + (-0.724) \times B6 + 2.215$	0.35
<i>H. armigera</i>	2023	$Y = -48.983 + (0.391) \times B1 + (1.537) \times B2 + (0.069) \times B3 + (0.011) \times B4 + (-0.004) \times B5 + (-0.542) \times B6 + 2.098$	0.30
<i>S. litura</i>	2023	$Y = -28.656 + (-0.268) \times B1 + (1.837) \times B2 + (0.094) \times B3 + (-0.146) \times B4 + (0.008) \times B5 + (-0.435) \times B6 + 1.081$	0.46
Whitefly	2023	$Y = -38.188 + (-0.467) \times B1 + (2.292) \times B2 + (0.235) \times B3 + (-0.202) \times B4 + (-0.001) \times B5 + (-0.677) \times B6 + 2.891$	0.17
Leafhopper	2023	$Y = -83.262 + (1.491) \times B1 + (1.463) \times B2 + (0.014) \times B3 + (0.129) \times B4 + (0.005) \times B5 + (-0.919) \times B6 + 0.935$	0.74
Leaf miner	2023	$Y = 766 + (-0.092) \times B1 + (0.131) \times B2 + (0.024) \times B3 + (-0.059) \times B4 + (0.014) \times B5 + (0.223) \times B6 + 0.547$	0.52
Lady bird beetle	2023	$Y = -22.597 + (0.284) \times B1 + (0.436) \times B2 + (0.097) \times B3 + (-0.072) \times B4 + (0.025) \times B5 + (-0.004) \times B6 + 0.674$	0.61
Spider	2023	$Y = -21.465 + (0.122) \times B1 + (1.081) \times B2 + (-0.037) \times B3 + (0.010) \times B4 + (-0.004) \times B5 + (-0.500) \times B6 + 1.943$	0.16

B1 = Maximum temperature; B2 = Minimum temperature; B3 = Morning relative humidity; B4 = Evening relative humidity; B5 = Rainfall; B6 = Wind speed.

3.7 | Correlation Studies

Semilooper: The data presented in Table 2 showed that correlation between all abiotic weather factors and semilooper was non-significant. The correlation of rainfall ($r = 0.008$), morning relative humidity ($r = 0.053$) and evening relative humidity ($r = 0.256$), wind speed ($r = 0.239$) and minimum temperature ($r = 0.407$) was positive but non-significant while maximum temperature ($r = -0.206$) showed non-significant and negative correlation with semilooper population. Kulkarni (2012) found that all weather parameters with semilooper incidence were non-significant. Sonule *et al.* (2019) reported that all weather parameters showed non-significant reaction with semilooper population except Maximum temperature ($r = -0.695$) which was negative significant. Shinde *et al.* (2017) also reported semilooper correlation all weather

correlation as non- significant. Similarly Patel *et al.* (2020) found that morning and evening relative humidity and rainfall had positive correlation but statistically non-significant. Present investigation findings are in corroborating with the findings of above workers.

American Bollworm: The data presented in Table 2 showed that correlation between all abiotic weather factors and *H. armigera* was non-significant. The correlation of rainfall ($r = 0.140$), morning relative humidity ($r = 0.317$) and evening relative humidity ($r = 0.418$) was positive but non-significant while with maximum temperature ($r = -0.336$) showed non-significant and negative correlation and minimum temperature ($r = 0.383$) and wind speed ($r = 0.194$) showed positive and non-significant correlation with *H. armigera* population. Bangale *et al.* (2019) observed similar positive but non-

significant correlation between pest population and rainfall and rainy days. The correlation between the pest population and morning relative humidity and evening relative humidity was positively significant while maximum temperature was negatively non-significant.

Tobacco Leaf Eating Caterpillar: The data presented in Table 2 showed that correlation between all abiotic weather factors and *S. litura* was non-significant. The correlation of rainfall ($r = 0.233$), and evening relative humidity ($r = 0.220$) and minimum temperature ($r = 0.414$), wind speed ($r = 0.189$) was positive but non-significant while with maximum temperature ($r = -0.263$) morning relative humidity ($r = -0.093$) showed non-significant and negative correlation and showed positive and non-significant correlation with *S. litura* Bhamare *et al.* (2018) observed that rainfall (0.7697) exhibited significantly direct positive effect on larval population of *S. litura* infesting sole soybean. Present investigation findings are in corroborating with the findings of above workers.

Whitefly: The data presented in Table 2 showed that correlation between all abiotic weather factors and whitefly was non-significant. The correlation of rainfall ($r = 0.049$) and evening relative humidity ($r = 0.137$) and minimum temperature ($r = 0.099$), was positive but non-significant while with maximum temperature ($r = -0.094$) morning relative humidity ($r = -0.093$), wind speed ($r = -0.070$) showed non-significant and negative correlation and showed positive and non-significant correlation with whitefly population. Sonule *et al.*, (2019) found that whitefly and maximum temperature was negatively significant and rainfall, evening relative humidity was positive non-significantly correlated. Present investigation findings is in accordance with the findings of above worker.

Leaf Hopper: The data presented in Table 2 showed that correlation between all abiotic weather factors and leaf hopper was non-significant. The correlation of rainfall ($r = 0.056$) and evening relative humidity ($r = 0.115$) and morning relative humidity ($r = 0.497$) was positive but non-significant while with maximum temperature ($r = 0.075$), wind speed ($r = -0.351$) minimum temperature ($r = -0.062$), showed non-significant and negative correlation and showed positive and non-significant correlation with leaf hopper population. Chaudhary *et al.* (2018) observed similar findings of leaf

hopper with rainfall, morning and evening relative humidity which showed positive non-significant correlation with the leaf hopper population.

Leaf Miner: The data presented in Table 2 showed that correlation between all abiotic weather factors and leaf miner was non-significant. The correlation of rainfall ($r = 0.356$) and evening relative humidity ($r = 0.060$) and minimum temperature ($r = 0.309$), wind speed ($r = 0.427$) was positive but non-significant while with maximum temperature ($r = -0.144$) morning relative humidity ($r = -0.357$) showed non-significant and negative correlation and showed positive and non-significant correlation with leaf miner population. The results of present investigation are discussed in the light of findings of Yeotikar *et al.* (2015) who found all weather parameters were non-significant with population of *A. modicella*

Natural Enemies

Ladybird Beetles: The data presented in Table 3 showed that correlation between all abiotic weather factors and lady bird beetle was non-significant. The correlation of rainfall ($r = 0.233$), maximum temperature ($r = 0.334$) and evening relative humidity ($r = -0.436$) and minimum temperature ($r = -0.404$), wind speed ($r = -0.283$) negative and non-significant and morning relative humidity ($r = 0.286$) showed positive and non-significant correlation with lady bird beetle population. Suyal *et al.* (2018) recorded similar findings and reported that LBB with positive correlation with temperature and negative correlation with other parameters.

Spider: The data presented in Table 3 showed that correlation between all abiotic weather factors and spider was non-significant. The correlation of rainfall ($r = 0.010$), morning relative humidity ($r = 0.258$), maximum temperature ($r = 0.259$) wind speed ($r = 0.141$) and evening relative humidity ($r = -0.062$) and minimum temperature ($r = -0.212$), showed non-significant and negative correlation and showed positive and non-significant correlation with spider population. Sonule *et al.* (2019) also reported that correlation of spider with maximum temperature ($r = 0.148$), morning relative humidity ($r = 0.057$) was positive while correlation of evening relative humidity ($r = -0.192$) was negative.

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