

Original Research Article

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

A. S. Sapekar, M. M. Sonkamble and Y. B. Matre*

Department of Agricultural Entomology, Vasanttrao Naik Marathwada Krishi Vidyapeeth,
Parbhani - 431 402, Maharashtra, India

*Corresponding author

ABSTRACT

The field experiments were carried out at the farm of Cotton Research Scheme, Vasanttrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra during kharif season 2019. “ Studies on Seasonal incidence of major defoliators on Soybean” the results revealed that the incidence of overall season was normal. *S. litura* showed that the first appearance of tobacco caterpillar was recorded during 31st standard week (0.66 larvae/mrl) and recorded highest population (3.66 larvae/mrl) during 36th SMW. First incidence of American bollworm was recorded during 32nd standard week with 0.66 larvae/mrl and recorded highest population (4.66 larvae/mrl) during 35th SMW. First appearance of bihar hairy caterpillar was recorded during 31st standard with 0.33 larvae/mrl during 31st SMW and peak population (4.66 larvae/mrl) during 35th SMW. Semilooper recorded maximum incidence as compared to other defoliators on soybean. Though maximum population of *A. janata* has observed, other semilooper species viz., *G. gemma* and *C. acuta* are also observed during season. First appearance of semilooper was started after 20 days of sowing 0.66 larvae/mrl. The incidence peak population recorded (7.66 larvae/mrl) during 35th SMW. Leaf miner *A. modicella* was observed during initial stage of the crop and recorded 0.7 larvae /plant during 30th standard week. Maximum population of leaf miner (1.6 larvae/plant) was recorded during 33rd SMW. Leaf miner declined 0.6 larvae /mrl after 34th SMW. Seedling mortality due to stemfly *M. sojae* infestation was not observed at seven days after germination but stem tunneling caused by stem fly recorded at physiological maturity was 39.50 per cent. First appearance of girdle beetle was started from last week of July with 0.33 /mrl during 31st SMW, peak population found (3beetle /mrl) during 38th SMW and continue up to the harvesting. The whitefly was noticed from 30th SMW up to harvesting. The incidence was first observed 0.50 whitefly / three leaves during 30th SMW and recorded highest population (7.2 whitefly / three leaves) during 36th SMW. Low jassid incidence was recorded as compared to whitefly on soybean. Jassid was noticed from 32nd MW up to harvesting 41st MW and recorded highest population (4.6 jassid/ three leaves) during 39th SMW.

Keywords

bhat, bhatman,
bhut, kaliyur,
teliakulth etc

Introduction

Soybean, *Glycine max* (Linn.) Merrill belongs to order Fabales, family

Leguminosae and subfamily Papilionoideae. In India, it is known by different names such as Bhat, Bhatman, Bhut, Kaliyur, Teliakulth etc. Hymowitz, (1970)⁽¹⁾ suggested that origin

of soybean although North-eastern China is generally considered as the original home. They named it as a "yellow jewel" which feeds entire population of China. In India, soybean was first time introduced as food in 1870-80 (Andole, 1984)⁽²⁾.

It is an annual crop, fairly easy to grow, that produces more protein and oil per unit of land than almost any other crop. It is a unique crop with high nutritional value, providing 40 per cent protein, 20% oil having about 85% unsaturated fatty acid, 25-30% carbohydrates, 4-5 % minerals, Vitamin A, B, C, D, E and K. Soybean protein provides all the nine essential amino acids. Soybean protein is rich in the valuable amino acid lysine (5 %) in which most of the cereals is deficient. In addition, it contains good amount of minerals, salts and vitamins, that's why, it is known as a 'Wonder crop', 'Miracle crop' and 'Golden crop'.

Various insect feeds on soybean crop from germination to harvesting stage. Soybean crop average losses 20 to 25 per cent yield due to insect pests (Sharma and Shukla, 1997).⁽³⁾ In Maharashtra, especially in Marathwada 19 species of insects have been identified attacking this crop (Munde, 1982).⁽⁴⁾ Among them leaf miner (*Aproaerema modicella* Devanter), stem fly (*Melanagromyza sojae* Zehnter), girdle beetle (*Obereopsis brevis* Sweden board), tobacco caterpillar (*Spodoptera litura*), semiloopers (*Gasonia gemma*, *Achaea janata*, *Chrysodeixis acuta*) and sucking insect pests such as white fly (*Bemisia tabaci*) and Jassid (*Empoasca kerri*) are important.

Singh and Singh (1990)⁽⁵⁾ reported the incidence and damage by *M. sojae* on soybean. They recorded 30.26 per cent yield loss due to it. Ansari and Sharma (2000)⁽⁶⁾ observed 19.5 per cent to 30.72 per cent infestation due to girdle beetle. The tobacco

leaf eating caterpillar, *S. litura* (F.) has been widely recorded as serious polyphagous pest, which damages soybean crop also. During *kharif* season (2008-09) in Maharashtra particularly in Marathwada and Vidarbha regions, soybean was adversely affected by *Spodoptera litura* and greatly reduced the yield. During last 3-4 years particularly in Marathwada, the incidence of leaf miner (*A. modicella*) is found decreasing every year whereas the incidence of girdle beetle (*O. brevis*), stem fly (*M. sojae*), green semilooper (*Gesononia gemma*) is showing increasing trend (Anonymous, 2011).⁽⁷⁾

The soybean defoliators mainly include tobacco caterpillar *Spodoptera litura* (Fab.) and green semilooper, *Chrysodeixis acuta*. Immature stages (larva or caterpillar) of both tobacco caterpillar and green semilooper damages the crop at vegetative stage and in severe case, it completely defoliate the crop and dramatic yield loss. *Spodoptera litura* larvae even damages to soybean pods also (Chaturvedi *et al.*, 1998)⁽⁸⁾. The studies on seasonal incidence of pests gave us an idea of the environmental factors that regulate cyclic occurrence of the pests. It shows the insect's peak activity period as well as insect free period in crop's life cycle. This information is valuable in devising the management strategy.

Materials and Methods

In order to study the seasonal incidence of major pests of soybean, the crop was sown at cotton research scheme, VNMKV, Parbhani *kharif* season 2019. The soybean crop variety MAUS-162 was grown in plot size of 10 x 10 m keeping 45x5 cm spacing between row to row and plant to plant. The plots were divided into four quadrant and all the agronomical operation were adopted as per the scientific recommendation. The crop under the experiment was kept free from

pesticides throughout the season. Method of recording observations: the observation was recorded at weekly interval on 1. Defoliators: Observations on number of larvae of lepidopteran pests were recorded at three places of one meter row length (mrl). 2. Leaf miner: The ten plants were randomly selected from experimental plot. Number of leaflets, and number of larvae per plant were recorded. 3. Girdle beetle: One meter row length was marked at 3 places. Healthy and girdled plants were counted and percent infestation was calculated at the time of harvest. 4. Stem fly: Seedling mortality – Total number of plants and number of plants succumbed to stem fly infestation /m at 3 places were recorded on 7-10 DAG and seedling mortality was expressed in percentage. 5. Stem tunneling – Plant height and length of stem tunneled in 10 plants at physiological maturity were measured and expressed in percentage. 6. Sucking pests of soybean: Number of sucking pests (whitefly and jassid) (nymphs and adults) on 3 leaves/plant (upper, middle and lower leaf) in 10 plants were recorded. 7. Grey Weevil: Populations of Grey Weevil per mrl (meter row length) were recorded from three places and mean was worked out. 8. Natural enemies (predators) Populations of lady bird beetle, Pentatomid bug, Stink bug, and Spider (predators) per mrl (meter row length) were recorded from three places and mean was worked out.

Results and Discussion

Tobacco leaf eating caterpillar (*Spodoptera litura*)

The data presented in Table 1 showed that the first appearance of tobacco caterpillar was recorded during 31st standard week (30 July to 5 August). The larval population of tobacco caterpillar was 0.66 larvae /mrl during 31st SMW, The incidence increased

slowly in next few weeks, During 35th SW and 36th SMW population was similar and recorded highest population (3.66 larvae /mrl) during 36th SMW (3 Sep-09 Sep). During this week the maximum and minimum temperature were 30.1^oC and 21.6^oC, respectively, and morning and evening relative humidity were 83.0% and 70.0% respectively. Whereas rainfall was 13.2 mm. Population was suddenly declined to 1.0 larvae /mrl after 37th SMW (10 September to 16 September). During this week, the maximum and minimum temperature was 30.0^oC and 21.2^oC, respectively, and morning and evening relative humidity were 88% and 68% respectively, whereas rainfall was 86.4 mm. They disappeared up to the 40 SMW (01 Oct-07 Oct). The result of present investigation is discussed in the light of findings of previous workers. Sonule *et al.*, (2019)⁽⁹⁾ found similar result 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.

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors and *S. litura* was non-significant. The correlation of rainfall ($r = 0.141$), morning relative humidity ($r = 0.052$) and evening relative humidity ($r = 0.289$), was positive but non-significant while with maximum temperature ($r = -0.278$) and minimum temperature ($r = -0.021$) showed non-significant and negative correlation with *S. litura* population.

American bollworm (*Helicoverpa armigera*)

The data presented in Table 1 showed that the first appearance of American bollworm was

recorded during 32nd SMW (6 August to 12 August). The larval population of American bollworm was 0.66 larvae /mrl during 32nd SMW, The incidence increased slowly in next few weeks, During 35th SMW and 36th SMW similar trend was observed with 4.66 and 4.33 larvae respectively, recording highest population (4.66 larvae /mrl) during 35th SMW (27 Aug-02 Sep). During this week, the maximum and minimum temperature was 30.0^oC and 21.2^oC, respectively, and morning and evening relative humidity were 88% and 68% respectively and rainfall was 86.4 mm. They disappeared up to the 40 SMW (01 Oct-07 Oct). Bangale *et al.*, (2019)⁽¹⁰⁾ *Helicoverpa armigera* (Hubner) (0.36 larvae/plant) commenced from 1st week after germination *i.e.* 3rd week of July and reached at peak level (2.4 larvae/plant) at 7th week after germination coinciding with 1st week of September.

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors and american bollworm was non-significant. The correlation of rainfall ($r = 0.220$), morning relative humidity ($r = 0.026$) and evening relative humidity ($r = 0.154$) was positive but non-significant while with maximum temperature ($r = -0.151$) and minimum temperature ($r = -0.006$) showed non-significant and negative correlation with American bollworm population.

Bihar hairy caterpillar (*Spilosoma oblique*)

The data presented in Table 1 showed that the first appearance of bihar hairy caterpillar was recorded during 31st standard meteorological week (30 July to 5 August). The larval population of bihar hairy caterpillar was 0.33 larvae /mrl during 31st SMW, The incidence increased slowly in next few weeks, During

35th SMW and 36th SMW population was at its peak and recorded highest population (4.66 larvae /mrl) during 35th SMW (27 Aug-02 Sep). During this week the maximum and minimum temperature were 31.2^oC and 21.5^oC, respectively, and morning and evening relative humidity were 88.0% and 59.0% respectively and rainfall was 78 mm.

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors and bihar hairy caterpillar was non-significant. The correlation of rainfall ($r = -0.165$), morning relative humidity ($r = -0.304$) and evening relative humidity ($r = -0.028$) was showed non-significant and negative while with maximum temperature ($r = 0.045$) and minimum temperature ($r = 0.051$) positive but non-significant correlation with bihar hairy caterpillar population.

Semilooper (*G. gemma*, *A. janata* and *C. acuta*)

In *kharif* season 2019, Semilooper found more incidence as compare amongst defoliators on soybean. Though maximum population of *A. janata* has observed, other semilooper species viz., *G. gemma* and *C. acuta* are also observed during season and their combine population is given in Table 1.

The data showed that first appearance of semilooper was started after 20 days of sowing and recorded during 30th standard meteorological week (23 July -29 July). The larval population of semilooper was 0.66 larvae /mrl during 30th SMW, The incidence increased ascendingly in next few weeks, During 33th SW and 34th SMW population was at its peak 4.33 and 4.66 larvae respectively, recorded highest population (7.66 larvae /mrl) during 35th SMW (27 Aug-02 Sep). Semilooper population declined to

4.33 larvae /mrl after 39th SMW (24 September to 30 September). During this week, the maximum and minimum temperature were 35.6^oC and 31.3^oC, respectively, and morning and evening relative humidity were 92% and 62% respectively and rainfall was 35.6 mm. Pest population was not observed in 41st SMW (08 Oct-14 Oct).

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors and semilooper was non-significant. The correlation of rainfall ($r = 0.279$), morning relative humidity ($r = 0.113$) and evening relative humidity ($r = 0.226$) was positive but non-significant while with maximum temperature ($r = -0.198$) and minimum temperature ($r = -0.057$) showed non-significant and negative correlation with semilooper population.

Leaf miner (*Approerema modicella* Devender)

The data showed that leaf miner *A. modicella* was observed very low. It started during initial stage of the crop and recorded 0.7 larvae /plant during 30th SMW (23 July -29 July).

The incidence increased slowly in next few weeks. Maximum population of leaf miner (1.6 larvae /plant) was recorded during 33rd SMW (13 Aug -19 Aug). During this week the maximum and minimum temperature were 32.3^oC and 21.5^oC, respectively, and morning and evening relative humidity were 80.0% and 57.0% respectively and rainfall was 9.7 mm. Leaf miner population declined to 0.6 larvae /mrl after 34th SMW (20 Aug - 26 Aug) was noticed. During this week, the maximum and minimum temperature were 32.2^oC and 22.0^oC, respectively, and morning

and evening relative humidity were 80% and 56% respectively and rainfall was 1.2 mm. Pest was disappeared after 35 SMW (27 Aug-02 Sep).

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors and leaf miner was non-significant.

The correlation of rainfall ($r = -0.042$), maximum temperature ($r = -0.157$) and morning relative humidity ($r = -0.259$) negative and non-significant while minimum temperature ($r = 0.291$) and evening relative humidity ($r = 0.190$) showed non-significant and positive correlation with Leaf miner population.

Stemfly (*Melonagromyza sojae*)

Seedling mortality due to stemfly *M. sojae* infestation was not observed at seven days after germination. Yeotikar *et al.*, (2015)⁽¹¹⁾ pointed out that seedling mortality due to stemfly at 7-10 days after germination was not observed where as he recorded stem tunneling at physiological maturity up to 59.45 per cent. The data presented in Table 2. showed that stem tunneling caused by Stemfly recorded at physiological maturity was 39.50 per cent. Stemfly incidence after 30 days of sowing, supporting the present findings where incidence was not observed in initial stage of the crop (Chechani *et al.*, 2002)⁽¹²⁾

Girdle beetle (*Obereopsis brevis*)

The data showed that Infestation of girdle beetle *O. brevis* commenced after last week of July 32nd standard meteorological week (6 August to 12 August) and recorded 3.70 per cent infested plants and remained up to harvest.

Table.1 Seasonal incidence of insect pests on soybean variety MAUS-162 during *kharif*, 2019

S. N	Std. Met. Week	Rainfall (mm)	Temperature (°C)		Humidity (%)		No. of <i>S. litura</i> larvae/ mrl.	No. of <i>H. armigera</i> larvae/ mrl.	No. of <i>S. obliqua</i> larvae/ mrl.	No. of Semilooper larvae/ mrl.	No. of leaf miner larvae / plant	Girdle beetle infested plants (percent)	No. of Whitefly / 3 leaves.	No. of Jassid/ 3 leaves.
			Max.	Min.	AM	PM								
1	29	11.2	34.2	22.9	79	46	0	0	0	0	0	0	0	0
2	30	64.3	30.6	22.6	81	62	0	0	0	0.66	0.7	0	0.5	0
3	31	85.4	28.1	21.8	92	85	0.66	0	0.33	2.33	1	0	1.5	0
4	32	62.2	30.5	22.0	89	65	1.66	0.66	1	2	1.2	3.7	3	0.7
5	33	9.7	32.3	21.5	80	57	1.33	1	3.33	4.33	1.6	7.41	3.3	1.8
6	34	1.2	32.2	22.0	80	56	1.66	2.66	3.66	4.66	0.6	9.25	4	2
7	35	78.0	31.2	21.5	88	59	3	4.66	4.66	7.66	0	14.81	7	2.3
8	36	13.2	30.1	21.6	83	70	3.66	4.33	4	4.33	0	22.22	7.2	2.8
9	37	86.4	30.0	21.2	88	68	2.66	3.66	1.33	5.66	0	24.07	5.2	3.4
10	38	118.8	30.9	21.9	94	67	1	2.33	0.66	3.33	0	27.77	3.6	3.7
11	39	35.6	31.3	21.1	92	62	1.33	0.66	0.66	3	0	31.48	3.2	4.6
12	40	21.2	31.4	20.5	88	60	0	0	0	1.33	0	31.48	2.5	0.8
13	41	5.1	31.5	20.1	87	53	0	0	0	0	0	31.48	2	0.6

Table.2 Incidence of stemfly (*Melonagromyza sojae*) infesting on soybean

Sr. No.	Parameter	Percentage
1	Seedling mortality due to stemfly at 7- 10 DAG	00
2	Stem tunneling at physiological maturity	39.50

Table.3 Correlation between seasonal incidences of insect pests with weather parameters

Weather parameters	<i>S. litura</i>	<i>H. armigera</i>	<i>S. obliqua</i>	Semilooper	leaf miner	Girdle beetle	Whitefly	Jassid
Rainfall	0.141NS	0.194 NS	-0.165 NS	0.279 NS	-0.042 NS	-0.032 NS	0.117 NS	0.226 NS
temp(max)	-0.278 NS	-0.163 NS	0.045 NS	-0.198 NS	-0.157 NS	-0.032 NS	-0.241 NS	-0.066 NS
temp(min)	-0.021 NS	-0.005 NS	0.051 NS	-0.057 NS	0.291 NS	-0.806**	-0.267 NS	-0.258 NS
RH(morning)	0.052 NS	0.010 NS	-0.304 NS	0.113 NS	-0.259 NS	0.503*	0.155 NS	0.412 NS
RH(evening)	0.289 NS	0.171 NS	-0.028 NS	0.226 NS	0.190 NS	-0.049 NS	0.214 NS	0.129 NS

* = Significant at 5 per cent level

** = Significant at 1 per cent level NS = Non Significant

The incidence increased ascendingly in next few weeks, recorded maximum per cent infested plants (31.48 per cent infested plant) during 39th SMW (24 Sep-30 Sep). During this week the maximum and minimum temperature were 30.90C and 21.90C respectively, and morning and evening relative humidity were 94.0% and 67.0% respectively and rainfall was 118.8 mm.

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors with girdle beetle was non-significant. The correlation of morning relative humidity ($r= 0.503$), was significant and positive with girdle beetle population while rainfall ($r= -0.032$), maximum temperature ($r= -0.032$) and evening relative humidity ($r = -0.049$) showed negative and non-significant while minimum temperature ($r = -0.806$) was showed negative but highly significant.

Whitefly (*Bemisia tabaci*)

In *kharif* season 2019, more incidence of whitefly was found as compare to other sucking pests on soybean. The incidence of whiteflies was noticed from 30th SMW (23 July-29 July) up to harvesting i.e. 41st SMW (08-14 Oct). The incidence was first observed 0.50 whitefly / three leaves during 30th SMW (23 July -29 July). The incidence increased ascendingly in next few weeks, During 35th SMW and 36th SMW population was similar 7.0 and 7.2 whiteflies / three leaves respectively, having highest population (7.2 whitefly / three leaves) during 36th SMW (3 Sep-09 Sep). During this week the maximum and minimum temperature were 30.1⁰C and 21.6⁰C, respectively, and morning and evening relative humidity were 83.0% and 70.0% respectively and rainfall was 13.2 mm. Whitefly population declined to 5.2 whitefly / three leaves after 37th SMW (10 Sep-16 Sep).

During this week, the maximum and minimum temperature was 30.0⁰C and 21.2⁰C, respectively, and morning and evening relative humidity were 88% and 68% respectively and rainfall was 86 mm. The results of present investigation are discussed in the light of findings of previous workers. Chechani (2002)⁽¹²⁾ reported that first appearance of whiteflies were recorded on the crop to a greater or lesser extent in the last week of July.

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors with Whitefly was non-significant. The correlation of rainfall ($r=0.117$), morning relative humidity ($r=0.155$) and evening relative humidity ($r = 0.214$) was positive but non-significant while with maximum temperature ($r=-0.241$) and minimum temperature ($r = -0.267$) showed non-significant and negative correlation with whitefly population.

Jassid (*Empoasca kerri*)

In *kharif* season 2019, Jassid found fewer incidences as compare amongst whitefly on soybean. The incidence of jassid was noticed from 32nd SMW (6 Aug-12 Aug) and continue up to harvesting i.e. 41st SMW (08-14 Oct). The incidence was started 0.70 jassid/ three leaves during 32nd SMW (6 Aug-12 Aug). The incidence increased ascendingly in vegetative growth period and recorded highest population (4.6 jassid/ three leaves) during 39th SMW (24 Sep-30 Sep). During this week the maximum and minimum temperature were 31.3⁰C and 21.1⁰C, respectively, and morning and evening relative humidity were 92.0% and 62.0% respectively and rainfall was 35.6mm. Jassid declined to 0.8 jassid/ three leaves after 40th SMW (01 Oct-07 Oct).

During this week, the maximum and minimum temperature were 31.4⁰C and 20.5⁰C, respectively and morning and evening relative humidity were 88% and 60% respectively and rainfall was 21.2 mm. Low jassid population was observed upto the harvesting. Charjan *et al.*, (2017)⁽¹³⁾ observed that incidence of leaf hoppers was initiated in 32nd MW (0.3 Leaf hoppers / leaf), and it was continued up to 38th MW. Bhamare *et al.*, (2018)⁽¹⁴⁾ revealed that *E. kerri* (17.8 jassids per quadrat) reached its peak population during 39th standard meteorological week on sole soybean.

Correlation studies

The data presented in Table 3 showed that correlation between all abiotic weather factors with Whitefly was non-significant. The correlation of rainfall (r=0.226), morning relative humidity (r=0.412) and evening relative humidity (r = 0.129) was positive but non-significant while with maximum temperature (r=-0.066) and minimum temperature (r = -0.258) showed non-significant and negative correlation with jassids population.

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