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Studies on population dynamics of major insect-pests infesting soybean in relation to weather parameters

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Abstract

Studies on population dynamics revealed that the incidence of girdle beetle *O. brevis* and Green semilooper, *Gessonnia gema* was high whereas moderate incidence of *S. litura* and *A. modicella*, was observed also the incidence of *B. tabaci* was very low / negligible. The incidence of girdle beetle studied in 31st MW (1.19%) and reached to peak in 40th MW (54.22%). The incidence of green semilooper, *G. gema* was observed throughout the crop season with peak of 25.33 larvae/mrl during 34th MW.

Keywords: Insect pests, Soybean, *Glycine max*, Weather parameter, population dynamics

1. Introduction

Soybean (*Glycine max* (L.) Merrill) is one of the most important leguminous crops belonging to family Leguminosae syn. Fabaceae, subfamily Papilionoideae. Soybean is native of Asia and the first known records however, indicate that soybean emerged as a domesticated crop around eleventh century BC in China, ^[9] and was introduced in India in 1870-80^[1].

In India, 20 insects-pest species have been recorded infesting soybean crop ^[16]. In Maharashtra, particularly in Marathwada 19 species have been identified attacking this crop ^[8]. Among the pest species, leaf miner (*Aproaerema modicella*), stemfly (*Melanagromyza sojae*), girdle beetle (*Obereopsis brevis*), whitefly (*Bemisia tabaci*), aphids (*Aphis gossypii*) jassids (*Amrasca* sp.) and defoliators (*G. gema*, *Spodoptera litura*, *Alfalfa caterpillar*, *Cutworm*, *C. acuta*) are important. Leaf miner, *Aproaerema modicella* Deventer is a serious pest of soybean and groundnut, but this gelechid prefers soybean as compared to groundnut ^[6] which causes losses from 30 to 50 percent in grain yield ^[16], 100 percent damage to plant population and 75 percent damage to leaflets ^[14]. Stemfly (*Melanagromyza sojae* Zehntner) is a serious pest of soybean in Indonesia causing over 96 percent mortality in seedling stage ^[2]. Meteorological factors (temperature, rainfall, relative humidity, light period and intensity etc.) are the most important environmental resistance factors that affect pest population. Since, it is necessary to study population dynamics of major pests of soybean in relation to weather parameters.

2. Material and methods

The field experiment was conducted during *Kharif* season of 2012-13 at the Farm of All India Coordinated Research Project on Soybean, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). This station was located between 19° 16' North latitude and 76° 47' East longitude with an altitude of 408.50 meter above mean sea level. The experimental plot measured by 10 m x 10 m in the seed of soybean variety MAUS-2 were sown in month of July. They were plot selected following a non-replicated design. The rows and plant were spaced 45 cm and 5 cm apart. The recommended agronomic practices for raising the crop were maintained following the preparatory tillage, fertilizer application, seed and sowing, gap filling and thinning and Inter cultivation were taken up. Observation of insect pests with their after emergence on soybean crop in 7 days interval till harvest of the recorded infestation on soybean crop.

3. Statistical analysis

The average incidence or infestation of leaf miner, stem fly, girdle beetle and tobacco leaf eating caterpillar was worked out. Then correlations and regressions between major insect Pests of soybean and weather parameters were determined as per ^[11].

4. Result and discussion

4.1 Population dynamics of major insect pests of soybean

4.1.1 Leaf miner *Proaerema modicella* Devender

The incidence of the *A. modicella* started during initial stage of the crop and recorded 0.58 larvae/plant during 30th MW and remained more or less constant up to 34th MW. Maximum

population (0.74 larvae/plant) was recorded during 33rd MW when rainfall, maximum temperature, minimum temperature, beforenoon relative humidity, afternoon relative humidity, bright sunshine hours and wind velocity were 4.8 mm, 31 °C, 21.5 °C, 86 percent, 65 percent, 4.7 hrs and 4.7 kmph, respectively.

Table 1: Population dynamics of Leaf miner *A. modicella*. infesting soybean

Sr No.	Met. Week	Period	Rainfall (mm)	Temperature (°C)		Humidity (percent)		BSS (Hrs/day)	Wind velocity (km/h)	Leaf miner larvae /plants
				Max	Min	AM	PM			
1	30	23-29 July	21.0	30.0	23.4	88	70	6.8	6.8	0.58
2	31	30-05 Aug	18.9	31.1	22.4	89	59	7.1	7.1	0.52
3	32	06-12 Aug	5.9	31.2	22.7	88	61	6.2	6.2	0.57
4	33	13-19 Aug	4.8	31.0	21.5	86	65	4.7	4.7	0.74
5	34	20-26 Aug	35.4	31.1	22.2	92	60	4.3	4.3	0.54
6	35	27-02 Sept	40.6	31.7	23.0	90	67	3.7	3.7	0.00
7	36	03-09 Sept	108.4	30.2	22.3	95	72	4.3	4.3	0.00
8	37	10-16 Sept	28.4	31.2	22.1	90	62	5.5	3.9	0.00
9	38	17-23 Sept	61.9	30.8	22.2	90	68	6.0	3.9	0.00
10	39	24-30 Sept	21.8	32.1	21.6	91	58	7.8	3.2	0.00
11	40	01-07 Oct	49.0	30.4	22.8	89	68	3.3	3.6	0.00
12	41	08-14 Oct	0.0	33.3	18.6	82	38	9.3	2.0	0.00
13	42	15-21 Oct	0.0	33.9	15.6	73	26	10.1	3.2	0.00

4.1.2 Girdle beetle *Obereopsis brevis* (Swedenborg)

Infestation of girdle beetle *O. brevis* commenced from one month after sowing and recorded 1.19 percent infested plants during 31st MW. In next week the infestation reached to 7.80 percent. Thereafter, the infestation increased gradually up to the end of the crop. The girdle beetle infestation crossed the economic threshold level (15 % infested plants) during 34th

MW by recording 28.00 percent infestation. Peak infestation of 54.22 percent was recorded during 40th MW when the corresponding rainfall, maximum temperature, minimum temperature, before noon relative humidity, afternoon relative humidity, bright sunshine hours and wind velocity were 49mm, 30.4 °C, 22.8 °C, 89 percent, 68 percent, 3.3 hrs and 3.6 kmph, respectively.

Table 2: Population dynamics of Girdle Beetle *O. brevis* infesting soybean

Sr. No.	Met. Week	Period	Rainfall (mm)	Temperature (°C)		Humidity (percent)		BSS (Hrs/day)	Wind velocity (km/h)	Girdle beetle infested plants (percent)
				Max	Min	AM	PM			
1	30	23-29 July	21.0	30.0	23.4	88	70	6.8	6.8	0.00
2	31	30-05 Aug	18.9	31.1	22.4	89	59	7.1	7.1	1.19
3	32	06-12 Aug	5.9	31.2	22.7	88	61	6.2	6.2	7.80
4	33	13-19 Aug	4.8	31.0	21.5	86	65	4.7	4.7	14.76
5	34	20-26 Aug	35.4	31.1	22.2	92	60	4.3	4.3	28.00
6	35	27-02 Sept	40.6	31.7	23.0	90	67	3.7	3.7	43.05
7	36	03-09 Sept	108.4	30.2	22.3	95	72	4.3	4.3	50.00
8	37	10-16 Sept	28.4	31.2	22.1	90	62	5.5	3.9	52.60
9	38	17-23 Sept	61.9	30.8	22.2	90	68	6.0	3.9	52.60
10	39	24-30 Sept	21.8	32.1	21.6	91	58	7.8	3.2	53.22
11	40	01-07 Oct	49.0	30.4	22.8	89	68	3.3	3.6	54.22
12	41	08-14 Oct	0.0	33.3	18.6	82	38	9.3	2.0	54.22
13	42	15-21 Oct	0.0	33.9	15.6	73	26	10.1	3.2	54.22

4.1.3 Stemfly *Melanagromyza sojae* (Zehntner)

Seedling mortality due to Stemfly *M. sojae* infestation was not observed at seven days after germination. The infestation of Stemfly commenced 30 days after sowing, supporting the

present findings where incidence was not observed in initial stage of the crop [5]. Whereas the stem tunneling caused by Stemfly recorded at physiological maturity was 9.05 percent.

Table 3: Population dynamics of stemfly *M. sojae* infesting soybean

Sr. No.	Parameter	Percent stem tunneling
1.	Seedling mortality due to stemfly at 7-10 DAG	0.00
2.	Stem tunneling at physiological maturity	9.05

The infestation in terms of tunneling was started in the second week of August with a mean tunneling percentage of 6.11 and 8.92 which increased to 21.23 and 24.76 percent in the first week of October (35th MW) during 2003 and 2004, respectively which are corroboratory with present findings [10].

4.1.4 Tobacco leaf eating caterpillar *Spodoptera litura* (Fabricius)

The overall incidence of *S. litura* was observed very low. The first incidence of *S. litura* was observed at nearly 45 days after sowing by recording 0.33 larvae per mrl in 36th MW. The incidence increased slowly in next few weeks and

recorded highest population of 1.30 larvae/mrl during 38th MW when the abiotic factors viz., rainfall, maximum temperature, minimum temperature, before noon relative

humidity, afternoon relative humidity, bright sunshine hours and wind velocity were 61.9 mm, 30.8 °C, 22.2 °C, 90 percent, 68 percent, 6.0 hrs and 3.9 kmph, respectively.

Table 4: Population dynamics of Tobacco leaf eating caterpillar *S. litura* infesting soybean

Sr. No.	Met. Week	Period	Rainfall (mm)	Temperature (°C)		Humidity (percent)		BSS (Hrs/day)	Wind velocity (km/h)	No. of spodoptera larvae/mrl
				Max	Min	AM	PM			
1	30	23-29 July	21.0	30.0	23.4	88	70	6.8	6.8	0.00
2	31	30-05 Aug	18.9	31.1	22.4	89	59	7.1	7.1	0.00
3	32	06-12 Aug	5.9	31.2	22.7	88	61	6.2	6.2	0.00
4	33	13-19 Aug	4.8	31.0	21.5	86	65	4.7	4.7	0.00
5	34	20-26 Aug	35.4	31.1	22.2	92	60	4.3	4.3	0.00
6	35	27-02 Sept	40.6	31.7	23.0	90	67	3.7	3.7	0.00
7	36	03-09 Sept	108.4	30.2	22.3	95	72	4.3	4.3	0.33
8	37	10-16 Sept	28.4	31.2	22.1	90	62	5.5	3.9	0.66
9	38	17-23 Sept	61.9	30.8	22.2	90	68	6.0	3.9	1.30
10	39	24-30 Sept	21.8	32.1	21.6	91	58	7.8	3.2	0.00
11	40	01-07 Oct	49.0	30.4	22.8	89	68	3.3	3.6	0.00
12	41	08-14 Oct	0.0	33.3	18.6	82	38	9.3	2.0	0.66
13	42	15-21 Oct	0.0	33.9	15.6	73	26	10.1	3.2	0.33

4.1.5 Soyabean Semilooper *G. gema*

The incidence of *G. gema* started at twenty days after sowing and recorded 3.0 larvae/ mrl during 30th MW. Thereafter, the population increased gradually and in next two weeks it crossed the economic threshold level during 32nd MW by recording 6.70 larvae/mrl. The larval population was above economic threshold level up to the end of the season. The

population reached to a peak of 25.33 larvae/ mrl during 34th MW when the corresponding weather factors viz., rainfall, maximum temperature, minimum temperature, before noon relative humidity, after noon relative humidity, bright sunshine hours and wind velocity were 35.4 mm, 31.1 °C, 22.2 °C, 92 percent, 60 percent, 4.3 hrs, and 4.3 kmph, respectively.

Table 5: Population dynamics of semilooper *G. gema* infesting soybean

Sr. No.	Met. Week	Period	Rainfall (mm)	Temperature (°C)		Humidity (percent)		BSS (Hrs/day)	Wind velocity (km/h)	No. of Semilooper (<i>G. gema</i>) larvae/mrl
				Max	Min	AM	PM			
1	30	23-29 July	21.0	30.0	23.4	88	70	6.8	6.8	3.00
2	31	30-05 Aug	18.9	31.1	22.4	89	59	7.1	7.1	3.66
3	32	06-12 Aug	5.9	31.2	22.7	88	61	6.2	6.2	6.70
4	33	13-19 Aug	4.8	31.0	21.5	86	65	4.7	4.7	16.00
5	34	20-26 Aug	35.4	31.1	22.2	92	60	4.3	4.3	25.33
6	35	27-02 Sept	40.6	31.7	23.0	90	67	3.7	3.7	13.66
7	36	03-09 Sept	108.4	30.2	22.3	95	72	4.3	4.3	6.33
8	37	10-16 Sept	28.4	31.2	22.1	90	62	5.5	3.9	6.66
09	38	17-23 Sept	61.9	30.8	22.2	90	68	6.0	3.9	3.66
10	39	24-30 Sept	21.8	32.1	21.6	91	58	7.8	3.2	5.00
11	40	01-07 Oct	49.0	30.4	22.8	89	68	3.3	3.6	5.33
12	41	08-14 Oct	0.0	33.3	18.6	82	38	9.3	2.0	4.00
13	42	15-21 Oct	0.0	33.9	15.6	73	26	10.1	3.2	3.00

4.1.6 Whitefly *Bemisia tabaci* Gern

The incidence of whiteflies was noticed from 32nd MW up to harvesting i.e. 42nd MW, however, their population was very low. The incidence was first observed during 32nd MW (0.50/three leaves/plant) and reached to a peak of 1.20/three leaves/plant during 34th MW ranged from 0.50 to 1.20 per 3 leaves with its peak population (1.20 per 3 leaves) in 34th MW when the corresponding weather factors viz., rainfall,

maximum temperature, minimum temperature, before noon relative humidity, after noon relative humidity, bright sunshine hours and wind velocity were 35.4 mm, 31.1 °C, 22.2 °C, 92 percent, 60 percent, 4.3 hrs, and 4.3 kmph, respectively. Presence of whitefly reported in field from July to September [12].

Table 7: Population dynamics of Whitefly *B. tabaci* infesting soybean

Sr. No.	Met. Week	Period	Rainfall (mm)	Temperature (°C)		Humidity (percent)		BSS (Hrs /day)	Wind velocity (km/h)	No. of whiteflies per 3 leaves
				Max	Min	AM	PM			
1	30	23-29 July	21.0	30.0	23.4	88	70	6.8	6.8	0.00
2	31	30-05 Aug	18.9	31.1	22.4	89	59	7.1	7.1	0.00
3	32	06-12 Aug	5.9	31.2	22.7	88	61	6.2	6.2	0.50
4	33	13-19 Aug	4.8	31.0	21.5	86	65	4.7	4.7	0.60
5	34	20-26 Aug	35.4	31.1	22.2	92	60	4.3	4.3	1.20
6	35	27-02 Sept	40.6	31.7	23.0	90	67	3.7	3.7	0.80
7	36	03-09 Sept	108.4	30.2	22.3	95	72	4.3	4.3	0.00
8	37	10-16 Sept	28.4	31.2	22.1	90	62	5.5	3.9	0.50
9	38	17-23 Sept	61.9	30.8	22.2	90	68	6.0	3.9	0.30
10	39	24-30 Sept	21.8	32.1	21.6	91	58	7.8	3.2	0.70
11	40	01-07 Oct	49.0	30.4	22.8	89	68	3.3	3.6	0.40
12	41	08-14 Oct	0.0	33.3	18.6	82	38	9.3	2.0	0.40
13	42	15-21 Oct	0.0	33.9	15.6	73	26	10.1	3.2	0.40

5. Discussion

During later stage of crop growth girdle beetle infestation also noticed and maximum infestation during 37th MW supporting the findings of present investigation^{[15][17]}. The first incidence of leaf miner (0.33 larvae per plant) in fourth week of July (29th MW) was observed and recorded the highest population (2.83 larvae per plant) in third week of August (33rd MW)^[13].^[3] Reported that in Marathwada and particularly at Parbhani location, the menace of green semilooper *G. gema* to soybean is increasing every year which supports the findings of present investigation.^[5] And^[17] also reported that the peak population of *S. litura* during early September partially supporting the findings of present investigation.

6. Conclusion

Studies on population dynamics of major pests of soybean revealed that during the period of present investigation *i.e.* during *kharif*- 2012-13, the incidence of girdle beetle, *O. brevis*, and Green semilooper, *G. gema* was high, whereas moderate incidence of *S. litura* and *A. modicella*, observed the incidence of *B. tabaci* was very low / negligible. Thus, the studies on population dynamics gave us an idea of the environmental factors that regulate cyclic occurrence of the pests.

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