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Population dynamics of insect pest complex of soybean [*Glycine max* (L) Merrill] in relation to weather parameters at Prayagraj, (U.P.)

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Abstract
The experiment was conducted during the *Kharif* season of 2018. Population dynamics of major insect pests of soybean are highly affected by weather parameters like; temperature (maximum and minimum), relative humidity (maximum and minimum), rainfall, and sunshine hours. The result revealed that the highest population of whiteflies 12.0 whiteflies/3 leaves and leafhoppers 3.8 leafhoppers/ 3 leaves was recorded during 44th and 39th standard week respectively. The highest population of pod bug 3.1 pod bugs /3 leaves was recorded during 45th standard week and tobacco caterpillar 3.2 caterpillars/1 mrl was recorded during 41st standard week. The population of whitefly showed non-significant negative correlation with minimum temperature and maximum relative humidity, significant negative correlation with minimum relative humidity and rainfall while it showed non-significant positive correlation with maximum temperature and significant positive correlation with sunshine. The population of leafhopper showed non-significant negative correlation with minimum relative humidity and rainfall, non-significant positive correlation with minimum temperature and sunshine while it showed significant negative correlation with maximum relative humidity and significant positive correlation with maximum temperature. The population of pod bug showed non-significant negative correlation with maximum temperature and rainfall, significant negative correlation with minimum temperature and minimum relative humidity while it showed non-significant positive correlation with maximum relative humidity and significant positive correlation with sunshine. The population of tobacco caterpillar showed non-significant negative correlation with minimum relative humidity and rainfall, non-significant positive correlation with minimum temperature and sunshine while it showed significant positive correlation with maximum temperature and significant negative correlation with maximum relative humidity.

Keywords: Weather parameters, population, major insect pest and soybean

Introduction
Soybean [*Glycine max* (L.) Merrill] is an important oil seed crop belonging to family Fabaceae. Soybean is one of the most important crops of the world largely grown in United States of America, Brazil, Argentina, China, and India and plays crucial role in international trade (Baig *et al*. 2017) [4]. It is a unique crop with high nutritive value, providing 40 per cent protein and 20 per cent edible oil besides minerals and vitamins (Sasvihalli *et al*. 2017) [17]. It supports many industries; in manufacturing antibiotics, paints, varnishes, adhesives and lubricants and also used as protein supplement in human diet, cattle and poultry feed (Alexander, 1974) [2]. The luxuriant crop growth, soft and succulent foliage attracts many insects and provides unlimited source of food, space and shelter. About 380 species of insects have been reported on soybean crop from many parts of the world. About 65 insect species have been reported to attack soybean from cotyledon stage to harvesting stage (Rai *et al*. 1973; Adimani, 1976; Thippaiah, 1997) [14, 1, 21]. Major insect pest in soybean of national importance are stem fly (*Melanagromyza sojae* Zehntner), tobacco caterpillar (*Spodoptera litura* Fabricius), green semiloopers (*Chrysodeixis acuta* Walker, *Gesonia gemma* and *Diachrysia orichalcea* Fabriciussensu Hübner), girdle beetle (*Obereopsis brevis* Gahan), pod borer (*Helicoverpa armigera* Hubner), white fly (*Bemisia tabaci* Gennadius), leafhopper (*Empoasca kerri* Pruthi) and pod bug (*Riptortus pedestris* Fabricius)

Material and Methods
Field experiment was carried out at Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Kharif season of 2018.

Soybean cultivar, JS 95-60 was used for the study. The crop was raised in six plots with 2 × 2 m^2 size of each plot. The plant to plant and row to row distance was maintained as 40 × 10 cm^2. The data related to weather parameter viz., temperature, rainfall, relative humidity and daily sunshine hours throughout the period of investigation was collected from Agricultural Meteorological Department, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, U.P. Observation on the number of sucking pests was recorded on three compound leaves (upper, middle and lower) per plant from five randomly selected plants from each plot. Populations of tobacco caterpillar was counted per meter row length (mrl) at 5 randomly selected places in the experimental plot. The data was recorded early in the morning at weekly intervals from 1 week after germination.

Results and Discussions

Whitefly, *Bemisia tabaci* (Genn.)

Infestation of sucking insect pests observation recorded from soybean had free access to natural insect pest infestation. The initial mean population of whitefly started from 38th standard week (0.4 whitefly/3 leaves) and reached the peak in 44th standard week (12.0 whitefly /3 leaves) (Table 1). The population of whitefly showed non-significant negative correlation with minimum temperature and maximum relative humidity while it showed significant negative correlation with minimum relative humidity and rainfall. The population also showed non-significant positive correlation with maximum temperature and significant positive correlation with sunshine. These findings are similar with the findings of Patel (1992) [11] who reported that *Bemisia tabaci* was at peak during 2nd week of October through 3rd week of November. (Mohapatra 2008) [10] Observed that *Bemisia tabaci* infested the hirsutum cotton crop from 30th standard week to 50th standard week and peak population of *Bemisia tabaci* attained during 44th standard week (October 29th-November 4th). Prasad *et al*. (2008) [12] observed that the peak incidence of whiteflies was started from 44th to 48th standard week (November). (Gosalwad *et al.* 2009) [7] reported the peak population of *Bemisia tabaci* attained in second week of November during 2005. (Rajput *et al*. 2010) [15] Observed the highest population whiteflies in 41st standard week i.e. 8th – 14th October during 2001-02 and during 2002-03 it was maximum in 42nd and 43rd standard week (15th to 28th October). The findings are also supported with (Soujanya *et al.* 2010) [19].

Leafhopper, *Empoasca kerri* (Pruthi)

The pest marked its first appearance during 37th standard week with initial mean population of 0.5 leafhoppers/ 3 leaves followed a gradual increase and attained peak population of 3.8 leafhoppers/ 3 leaves during 39th standard week (Table 1). The population of leafhopper showed non-significant negative correlation with minimum relative humidity and rainfall while it showed non-significant positive correlation with minimum temperature and sunshine. The population also showed significant negative correlation with maximum relative humidity and significant positive correlation with maximum temperature. The present findings are in agreement with those of earlier researchers like (Rachappa *et al.* 2016) [13] who reported that the pest incidence started in 36th MW and peak incidence was observed in 40th and 41st MW thereafter its incidence started declining and was nil on 44th MW. Also (Bhamare *et al*. 2018) [22] observed that the population of *Empoasca kerri* was initialed on sole soybean in 34th MW with its peak of in 39th MW. It is also close to the observations reported by (Manoj and Singh, 2016) [9] who reported that the pest marked its first appearance during 34th MW, followed a gradual increase and attained peak population of during 37th MW.

Pod bug, *Riptortus pedestris* (Fabricius)

The pod bug was noticed for the first time during 40th standard week with a population of 0.4 pod bugs / 3 leaves followed a gradual increase and highest population of 3.1 aphids/ 3 leaves was recorded during 45th standard week.). The population of pod bug showed non-significant negative correlation with maximum temperature and rainfall while it showed significant negative correlation with minimum temperature and minimum relative humidity. The population also showed non-significant positive correlation with maximum relative humidity and significant positive correlation with sunshine. The present findings are similar with the findings of research workers like (Srinivas *et al.* 2017) [16] who noticed the coreid bug, *Riptortus pedestris* incidence on field bean from third week of October (42nd standard week. During the 3rd week of November (47th standard week) the bug population reached the peak of 3.5 bugs per plant and the next peak (3.8 bugs per plant) was recorded during the first week of December (49th standard week). Chanchal *et al.* (2014) [6] in his field experiment on the incidence of pod bug, *Riptortus pedestris* reported that the pod bug activity appeared from 20th standard week, increased subsequently and reached at peak level of population density during 25th standard week. He further reported that the statistical analysis revealed that none of the weather variables have significant association with occurrence of pod bug. While Bharathimeena *et al.* (2008) [5] who assessed the seasonal incidence of pod bug, *Riptortus pedestris* in cowpea reported that the peak population level of nymphs was significantly higher during the first fortnight of May and the succeeding three fortnights while the adult population level peaked during the first fortnight of June. He further reported that minimum temperature was positively correlated with the population of nymphs and adults.

Tobacco caterpillar, *Spodoptera litura* (Fabricius)

The observed data revealed that the population of tobacco caterpillar marked its first notice during 39th standard week with population of 1.0 larvae /1 mrl. The population gradually increased with peak population of 3.2 larvae /1 mrl during 41st standard week. Its population remained in the field up to 46th standard week and attained lowest population of 0.2 larva/1 mrl. These findings are similar with the findings of research workers like (Sundar *et al.* 2018) [3] who reported that the infestation of tobacco caterpillar started at 28 DAG, (2nd week of August) with an average of 1.0 larvae/mrl, increased by 4th week of August and abruptly decreased after 84 DAG with an average of 1.2 larvae/mrl. Also, (Ahir *et al.* 2017) [8] reported that *Spodoptera litura* appeared during 37th MW i.e. 10th- 16th September with a mean population of 0.20 larvae/plant, reached to its peak in the second week of October with a mean population of 1.40 larvae/plant, when the mean atmosphere temperature and relative humidity were 26.25 °C and 56.50 per cent, respectively and reached to a minimum level of 0.40 larvae/plant during 43rd MW i.e. 22 nd-28th October. Thanki *et al.* (2003) [20] reported that minimum temperature, evening relative humidity, morning and evening

vapour pressure showed negative effect on oviposition behaviour and larval development of S. litura, whereas correlation analysis showed nonsignificant difference between various abiotic factors and leaf damage caused by *Spodoptera litura* infesting castor crop in middle Gujarat. Sojitra (1990) [18] reported the infestation of *Spodoptera litura* during July to September in Soybean cultivated at Junagadh.

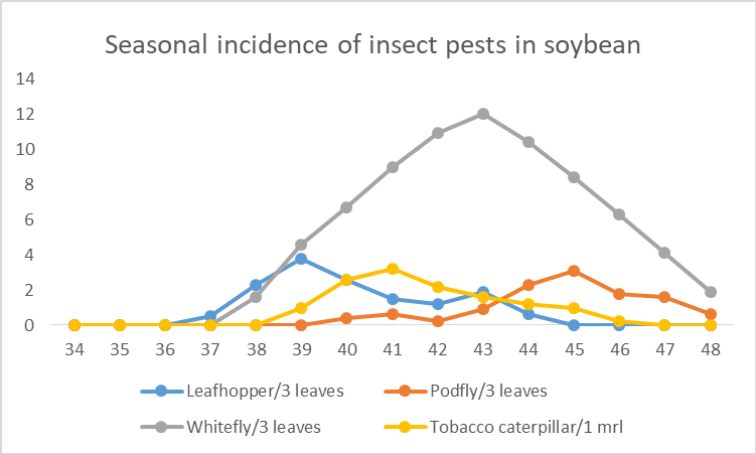

Fig 1: Population dynamics of insect pests of soybean during *Kharif* 2019

Table 1: Population dynamics of insect pest complex in soybean during Kharif 2019

MW	Duration	No. of sucking pests / 3leaves			No. of larvae of Spodoptera litura /1 meter row length	Max. Temperature (℃)	Min. Temperature (℃)	Max. Relative humidity (%)	Min. Relative humidity (%)	Rainfall (mm)	Sunshine (hrs)
		Leaf hoppers	White fly	Pod bug							
34	19-25 Aug	0	0	0	0	34.51	27.51	92.00	67.14	3.88	4.88
35	26-01 Sep	0	0	0	0	33.45	26.08	91.85	60.32	6.31	5.48
36	02-08 Sep	0	0	0	0	32.94	25.94	92.28	68.28	6.71	2.45
37	09-15 Sep	0.5	0	0	0	34.57	26.02	90.14	57.28	0.31	5.08
38	16-22 Sep	2.3	0.4	0	0	36.11	25.65	89.85	55.51	1.11	7.65
39	23-29 Sep	3.8	1.6	0	1.0	34.88	26.05	88.57	60.00	0	7.74
40	30-06 Oct	2.6	4.6	0.4	2.6	35.80	25.68	88.14	56.28	0.028	8.71
41	07-13 Oct	1.5	6.7	0.6	3.2	37.17	23.80	88.43	50.86	0	7.68
42	14-20 Oct	1.2	9.0	0.2	2.2	34.48	20.51	91.00	56.28	0	8.54
43	21-27 Oct	1.9	10.9	0.9	1.6	34.11	19.94	91.28	57.28	0	8.54
44	28-03 Nov	0.6	12.0	2.3	1.2	34.34	18.25	91.87	47.69	0	9.00
45	04-10 Nov	0	10.4	3.1	1.0	33.57	15.42	90.71	54.42	0.71	8.68
46	11-17 Nov	0	8.4	1.8	0.2	33.02	12.42	91.71	56.85	0	8.34
47	18-24 Nov	0	6.3	1.6	0	31.91	11.91	93.28	55.42	0	8.25
48	25-01 Dec	0	4.1	0.6	0	28.91	12.25	93.00	53.19	0	7.97

Table 2: Correlation coefficient of insect pests with weather parameters

Abiotic factor	Whitefly	Leafhopper	Pod bug	Tobacco caterpillar
Coefficient of correlation (r) for population and atm. max. temperature	0.264	0.583*	-0.214	0.574*
Coefficient of correlation (r) for population and atm. min. temperature	-0.358	0.430	-0.730**	0.121
Coefficient of correlation (r) for population and max. relative humidity	-0.234	-0.790**	0.245	-0.647**
Coefficient of correlation (r) for population and min. relative humidity	-0.597*	-0.117	-0.538*	-0.429
Coefficient of correlation (r) for population and total rainfall	-0.615*	-0.388	-0.382	-0.438
Coefficient of correlation (r) for population and sunshine	0.754**	0.340	0.555*	0.488

*correlation is significant at 0.05 level **correlation is significant at 0.01 levels

Conclusion

Study of population dynamics of insect pests is one of the most important objective of pest management. Population dynamics provides the data of seasonal fluctuation and peek activity of insect pests. Correlation study of insect pests with pest's population also provides information about weather influence on insect pest population. The information collected in this study is useful in insect pest management.

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