Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(5): 1292-1300

Received: 21-07-2020
Accepted: 28-08-2020

SY Wankhede
Ph.D., Scholar, Department of Agricultural Meteorology, College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

SB Kharbade
Associate Dean, College of Agriculture, Nandurbar, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

VA Sthool
Associate Professor of Hydrometeorology, Department of Agricultural Meteorology, College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AA Shaikh
Associate Professor of Agronomy, Oilseed Research Station, Jalgaon, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

JD Jadhav
Head, Department of Agricultural Meteorology, College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra India

SN Hasabnis
Associate Professor, Department of Plant Pathology, Division of Plant Pathology, College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra India

Rajkumar Bajolage
Scientist, Agricultural Entomology, ICAR- National Institute for Abiotic Stress Management, Baramati, Pune, Maharashtra, India

Corresponding Author:
SY Wankhede
Ph.D., Scholar, Department of Agricultural Meteorology, College of Agriculture, Pune, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Population dynamics and forewarning models for prediction of population of tobacco leaf eating caterpillar, *Spodoptera litura* (Fab.) Under different sowing window and groundnut varieties

SY Wankhede, SB Kharbade, VA Sthool, AA Shaikh, JD Jadhav, SN Hasabnis, and Rajkumar Bajolage

DOI: https://doi.org/10.22271/j.ento.2020.v8.i5r.7687

Abstract
The correlation between weather parameter and population of tobacco leaf eating caterpillar, *Spodoptera litura* (Fab.) larva (mrl^{-1}) on different groundnut varieties at different sowing windows and forewarning models for prediction of population of tobacco leaf eating caterpillar, *Spodoptera litura* (Fab.) during *kharif season*, 2017 and 2018. The experiment was laid out in split plot design with three replications. The treatment comprised of four varieties *viz.*, V_1: JL-501, V_2: RHRG-6083 (*Phule Unnati*), V_3: TAG-24 and V_4: JL-776 (*Phule Bharati*) as main plot and four sowing windows *viz.*, S_1: 25rd MW (18th to 24th June), S_2: 26th MW (25th June to 01st July), S_3: 27th MW (2nd to 8th July) and S_4: 28th MW (09th to 15th July) as sub plot treatments. The correlation of weather parameters with incidence of *Spodoptera litura* showed that the population of *Spodoptera litura* was found to have significant and positive correlation with evening relative humidity whereas maximum temperature and rainfall showed negative correlation with seasonal incidence of *Spodoptera litura*. Prediction of *Spodoptera litura* populations in different sowing window based on regression equations (R^2) 72 to 83 per cent validation based on different weather parameters for variety JL-501, (R^2) 66 to 85 per cent validation based on different weather parameter for variety RHRG-6083, (R^2) 71 to 87 per cent validation based on different weather parameter for variety TAG-24 and (R^2) 69 to 84 per cent validation based on different weather parameter for variety JL-776 for the prediction of *Spodoptera litura* population.

Keywords: Correlation, forewarning models, groundnut, regression analysis, sowing window, *Spodoptera litura* (Fab.), variety

Introduction
Groundnut (*Arachis hypogaea* L.), it belongs to the family *leguminacae* and also known as peanut which ranks sixth among the oilseed crops and thirteenth among the food crops of the world. Groundnut occupies first place in India in respect of acreage and production. Insect pests of groundnut causes damage in both field and storage conditions. Due to the insect pests the annual loss estimated to be around Rs. 1500 million. About 115 insect pest species was reported in India, which causes damage to groundnut crop, in which only 9 species tobacco caterpillar, leaf miner, white grub, thrips, aphid, jassids,, gram caterpillar, red hairy caterpillar and termites are found to be economically important. The above-ground pests include tobacco caterpillar, *Spodoptera litura* Fab. and the groundnut leaf miner, *Aproaerema modicella* Deventer in Asia. Aphids and thrips transmit a number of viral diseases and more foliar damage caused by Jassids reported by Wightman and Amin (2008) [1]. Tobacco caterpillar, *Spodoptera litura* is one of the most important pest which is polyphagous and occur regularly in the field and horticultural crops reported by Murthy *et al*. (2006) [2]. At present it is major threats in intensive agriculture next to the gram caterpillar, *Helicoverpa armigera and Spodoptera litura* causes 26 to 100% yield loss under field conditions reported by Dhir *et al*. (1992) [3]; more than 180 crops reported by Isman *et al*. (2007) [4]. The groundnut bud borer, *Anarsia ephippias* (Meyerick) is minor pest of legumes and occur in Northern states of India. Terminal buds and shoots were preferred by larvae in which they make bore hole reported by Saheb *et al*. (2018) [5].

Most of the pesticides that are used in cotton, rice, pulses, oilseeds and vegetable crops had shown ill effects on human health and environment reported by Raghunathan (1996) [6].
Different strategies have to be involved for keeping the pest in check and stabilizing the productivity of the cropping system. The sowing window is one of the crop habitat desertification that is to be looked into, to minimize the incidence of insect pests on groundnut crop so that its yield can be enhanced. The sowing window takes the advantage of the absence of the pest or avoids susceptible stage of the crop. It prevents carryover of pests from early sown crop to late sown crop and prevents buildup of damaging populations reported by Singh (1999) [7]. The pest forewarning model was able to predict the percent population of *Spodoptera litura* Fab. for different groundnut varieties and sowing windows with good r^2 values. Keeping these facts in view, the correlation between weather parameter and population of tobacco leaf eating caterpillar, *Spodoptera litura* (Fab.) larva (mrl^{-1}) on different groundnut varieties at different sowing windows and development of forewarning models for prediction of population of tobacco leaf eating caterpillar, *Spodoptera litura* (Fab.) was studied during *kharif season*, 2017 and 2018.

Material and Methods

Location of the experimental site and climatic condition

The experiment was conducted in a Split plot design with three replications and sixteen treatment combinations formed considering different varieties and sowing windows. The gross and net plot size was 4.5 x 4.5 $m^2$and 3.6 x 3.6 m^2, respectively for two consecutive years at Department of Agricultural Meteorology farm, College of Agriculture, Pune during *kharif*, 2017 and 2018. The geographical location of the site (Pune) was 18° 32'N, latitude; 73°51E, longitude and 557.7 m above mean sea level (MSL). The soil is medium black having depth of about 1m. The experimental site is situated in the sub-tropical region (Plain Zone) on the latitude 18^0 22' N and longitude 73^0 51' E and having an altitude of 557.7 m above the mean sea level. The average annual rainfall of Pune is 675 mm, which is distributed from second fortnight of June to second fortnight of October. Out of total rainfall, about 75 per cent is received from June to September from south-west monsoon, while remaining is received from north-east monsoon during October and November. Urea and single superphosphate were used as source of N and P and applied as per recommended dose *i.e.* 25 kg N and 50 kg P_2O_5. Seed of groundnut was inoculated with *Rhizobium* culture @ 250 g 10 kg^{-1} seed.

Number of *Spodoptera litura* larvae m row $length^{-1}$ $week^{-1}$

Number of *Spodoptera litura* larvae m row $length^{-1}$ $week^{-1}$ observations on larval population was made at three randomly selected spots of one meter row length in each plot, leaving the border rows. Larval count was made by shaking plants gently over a white cloth placed between the rows.
The effect of weather factors *viz;* maximum and minimum temperatures (^{0}C), relative humidity in per cent (morning and evening), bright sunshine hours, rainfall (mm) and rainy days, wind speed, evaporation rate from meteorological weeks 25th to 44th in *kharif*; 2017 and 2018, on *Spodoptera litura* were studied. The influence of weather parameters on pest population and was estimated by using prediction equation as,
Y = a + b1x1+ b2x2 + b3x3 +.....+ bnxn.
Where, Y= *Spodoptera litura* population, 'a' as constant and 'b' as regression coefficients of independent variable 'x'. Correlation analysis of mean weather parameters and mean data of two years on resultant crop growth characters, yield attributes and yield including water utilized for analysis. Snedecor and Cochron (1968) [8] studied the influence of weather parameters on crop growth yield and yield attributes, initially simple correlations were carried out. After establishing the relationship between weather parameters and *Spodoptera litura* multiple regression analysis Drapper and Smith (1998) [9] was carried out considering those weather parameters that had significant influence on *Spodoptera litura* of groundnut. The forewarning models for different sowing windows and varieties of groundnut were worked out by statistical analysis using SPSS8.0 software by multiple linear regression method. The correlation coefficient values were further used for results and discussion.

Result and Discussion

Population dynamics of *Spodoptera litura* on groundnut

The study was conducted during both the years of *kharif* season (2017 and 2018). During the course of study, the incidence of *Spodoptera litura* was recorded on different groundnut varieties were sown at different sowing windows. The incidence of *Spodoptera litura* was recorded all varieties during the year 2017 and 2018 in Table 1 to 4 across all the windows of sowing.

Population dynamics of *Spodoptera litura* larva (mrl^{-1}) on different groundnut varieties under sowing window (S_1) 25th MW

During the year 2017, first sowing window 25th MW (S_1) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) the mean incidence was 2.97, 1.93, 3.24 and 1.34 larvas (mrl^{-1}) and which were at peak with 4.51, 2.93, 4.92 and 2.03 larvas (mrl^{-1}). During the year 2018, the first sowing window 25th MW (S_1) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) recorded the mean incidence of larva (mrl^{-1}) was 2.62, 1.71, 2.86 and 1.18, which was peak with 4.03, 2.59, 4.35 and 1.80 larva (mrl^{-1}), resulting the peak population of larva (mrl^{-1}) was noticed at 34th MW with sowing window 25th MW, during both the year 2017 and 2018. These results are in conformity with the results of Rathod (2006) [10], Arvind kumar (2014) [11], Harish *et al.* (2014) [12], Roopa and Ashok kumar (2014) [13] and Nath *et al.* (2017) [14].

Population dynamics of *Spodoptera litura* larva (mrl^{-1}) on different groundnut varieties under sowing window (S_2) 26th MW

During the year 2017, second sowing window 26th MW (S_2) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) the mean incidence was 2.13, 1.38, 2.32, and 0.96 larvas (mrl^{-1}) and which were at peak with 3.57, 2.32, 3.89 and 1.61 larvas (mrl^{-1}). During the year 2018, the second sowing window 26th MW (S_2) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) recorded the mean incidence of larva (mrl^{-1}) was 1.90, 1.22, 2.05 and 0.85, which was peak with 3.19, 2.05, 3.44 and 1.42 larva (mrl^{-1}), resulting the peak population of larva (mrl^{-1}) was noticed at 35th MW with sowing window 26th MW, during both the year 2017 and 2018. These results are in conformity with the results of Rathod (2006) [10], Arvind kumar (2014) [11], Harish *et al.* (2014) [12], Roopa and Ashok kumar (2014) [13] and Nath *et al.* (2017) [14].

Population dynamics of *Spodoptera litura* larva (mrl^{-1}) on different groundnut varieties under sowing window (S_3) 27th MW

During the year 2017, third sowing window 27th MW (S_3) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) the mean incidence was 2.43, 1.58, 2.65, and 1.10 larvas (mrl^{-1}) and which were at peak with 4.34, 2.82, 4.73 and 1.96 larvas (mrl^{-1}). During the year 2018, the third sowing window 27th MW (S_3) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) recorded the mean incidence of larva (mrl^{-1}) was 2.17, 1.40, 2.35 and 0.97 which was peak with 3.88, 2.49, 4.19 and 1.73 larva (mrl^{-1}), resulting the peak population of larva (mrl^{-1}) was noticed at 36th MW with sowing window 27th MW, during both the year 2017 and 2018. These results are in conformity with the results of Rathod (2006) [10], Arvind Kumar (2014) [11], Harish *et al.* (2014) [12], Roopa and Ashok Kumar (2014) [13] and Nath *et al.* (2017) [14].

Population dynamics of *Spodoptera litura* larva (mrl^{-1}) on different groundnut varieties under sowing window (S_4) 28th MW

During the year 2017, fourth sowing window 28th MW (S_4) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) the mean incidence was 3.36, 2.18, 3.66, and 1.51 larvas (mrl^{-1}) and which were at peak with 5.23, 3.39, 5.70 and 2.36 larvas (mrl^{-1}). During the year 2018, the fourth sowing window 28th MW (S_4) with the varieties JL-501 (V_1), RHRG-6083 (V_2) and TAG-24 (V_3) and JL-776 (V_4) recorded the mean incidence of larva (mrl^{-1}) was 3.00, 1.93, 3.24 and 1.34 which was peak with 4.67, 3.00, 5.04 and 2.09 larva (mrl^{-1}), resulting the peak population of larva (mrl^{-1}) was noticed at 36th MW with sowing window 28th MW, during both the year 2017 and 2018. These results are in conformity with the results of Rathod (2006) [10], Arvind Kumar (2014) [11], Harish *et al.* (2014) [12], Roopa and Ashok Kumar (2014) [13] and Nath *et al.* (2017) [14].

Table 1: Mean number of larva per meter row length (mrl$^{-1)}$ of *Spodoptera litura* on groundnut variety JL-501 as influenced by different sowing windows

Sr. No.	MW	Number of larva per meter row length (mrl^{-1})							
		2017				2018			
		S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)	S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)
1	29	0.00	-	-	-	0.00	-	-	-
2	30	1.47	0.00	-	-	1.31	0.00	-	-
3	31	2.27	0.58	0.00	-	2.03	0.52	0.00	-
4	32	3.24	1.10	1.00	0.87	2.89	0.98	0.89	0.78
5	33	4.41	2.05	1.39	2.22	3.94	1.83	1.24	1.98
6	34	4.51	3.07	2.22	2.76	4.03	2.74	1.98	2.46
7	35	4.20	3.57	3.48	3.59	3.75	3.19	3.11	3.21
8	36	3.66	3.37	4.34	5.23	3.27	3.01	3.88	4.67
9	37	3.26	2.90	3.80	4.75	2.91	2.59	3.39	4.24
10	38	2.68	2.52	3.24	4.11	2.39	2.25	2.89	3.67
11	39	-	1.95	2.74	3.61	-	1.74	2.45	3.22
12	40	-	-	2.25	2.81	-	-	2.01	2.51
13	41	-	-	-	1.33	-	-	-	1.19
14	42	-	-	-	-	-	-	-	-
15	43	-	-	-	-	-	-	-	-
16	44	-	-	-	-	-	-	-	-
Mean		2.97	2.13	2.43	3.36	2.65	1.90	2.17	3.00

Table 2: Mean number of larva per meter row length (mrl$^{-1)}$ of *Spodoptera litura* on groundnut variety RHRG-6083 as influenced by different sowing windows

Sr. No.	MW	Number of larva per meter row length (mrl^{-1})							
		2017				2018			
		S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)	S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)
1	29	0.00	-	-	-	0.00	-	-	-
2	30	0.95	0.00	-	-	0.84	0.00	-	-
3	31	1.47	0.38	0.00	-	1.30	0.33	0.00	-
4	32	2.10	0.71	0.65	0.56	1.86	0.63	0.57	0.50
5	33	2.86	1.33	0.90	1.44	2.53	1.18	0.80	1.27
6	34	2.93	1.99	1.44	1.79	2.59	1.76	1.27	1.58
7	35	2.73	2.32	2.26	2.33	2.41	2.05	2.00	2.06
8	36	2.37	2.19	2.82	3.39	2.10	1.93	2.49	3.00
9	37	2.12	1.88	2.47	3.08	1.87	1.67	2.18	2.73
10	38	1.74	1.64	2.10	2.67	1.54	1.45	1.86	2.36
11	39	-	1.27	1.78	2.34	-	1.12	1.57	2.07
12	40	-	-	1.46	1.82	-	-	1.29	1.61
13	41	-	-	-	0.86	-	-	-	0.76
14	42	-	-	-	-	-	-	-	-
15	43	-	-	-	-	-	-	-	-
16	44	-	-	-	-	-	-	-	-
Mean		1.93	1.38	1.58	2.18	1.71	1.22	1.40	1.93

Table 3: Mean number of larva per meter row length (mrl$^{-1)}$ of *Spodoptera litura* on groundnut variety TAG-24 as influenced by different sowing windows

Sr. No.	MW	Number of larva per meter row length (mrl^{-1})							
		2017				2018			
		S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)	S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)
1	29	0.00	-	-	-	0.00	-	-	-
2	30	1.60	0.00	-	-	1.42	0.00	-	-
3	31	2.47	0.63	0.00	-	2.19	0.56	0.00	-
4	32	3.53	1.20	1.09	0.95	3.13	1.06	0.96	0.84
5	33	4.81	2.23	1.52	2.42	4.25	1.98	1.34	2.14
6	34	4.92	3.35	2.42	3.01	4.35	2.96	2.14	2.66
7	35	4.58	3.89	3.79	3.91	4.05	3.44	3.36	3.46
8	36	3.99	3.67	4.73	5.70	3.53	3.25	4.19	5.04
9	37	3.55	3.16	4.14	5.18	3.14	2.80	3.67	4.58
10	38	2.92	2.75	3.53	4.48	2.59	2.43	3.13	3.96
11	39	-	2.13	2.99	3.93	-	1.88	2.64	3.48
12	40	-	-	2.45	3.06	-	-	2.17	2.71
13	41	-	-	-	1.45	-	-	-	1.28
14	42	-	-	-	-	-	-	-	-
15	43	-	-	-	-	-	-	-	-
16	44	-	-	-	-	-	-	-	-
Mean		3.24	2.32	2.65	3.66	2.86	2.05	2.35	3.24

Table 4: Mean number of larva per meter row length (mrl$^{-1)}$ of *Spodoptera litura* on groundnut variety JL-776 as influenced by different sowing windows

Sr. No.	MW	Number of larva per meter row length (mrl^{-1})							
		2017				2018			
		S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)	S_1 (25th MW)	S_2 (26th MW)	S_3 (27th MW)	S_4 (28th MW)
1	29	0.00				0.00	-	-	-
2	30	0.66	0.00			0.59	0.00	-	-
3	31	1.02	0.26	0.00		0.91	0.23	0.00	-
4	32	1.46	0.50	0.45	0.39	1.29	0.44	0.40	0.35
5	33	1.99	0.92	0.63	1.00	1.76	0.82	0.55	0.89
6	34	2.03	1.38	1.00	1.24	1.80	1.22	0.89	1.10
7	35	1.89	1.61	1.57	1.62	1.67	1.42	1.39	1.43
8	36	1.65	1.52	1.96	2.36	1.46	1.34	1.73	2.09
9	37	1.47	1.31	1.71	2.14	1.30	1.16	1.52	1.89
10	38	1.21	1.14	1.46	1.85	1.07	1.00	1.29	1.64
11	39	-	0.88	1.23	1.63	-	0.78	1.09	1.44
12	40	-	-	1.01	1.27	-	-	0.90	1.12
13	41	-	-	-	0.60	-	-	-	0.53
14	42	-	-	-	-	-	-	-	-
15	43	-	-	-	-	-	-	-	-
16	44	-	-	-	-	-	-	-	-
Mean		1.34	0.96	1.10	1.51	1.18	0.85	0.97	1.34

Number of adults

The moth activity was monitored using sex pheromone traps for different treatments from 25th MW to 41st MW during 2017 and 2018 in groundnut and data are given in Table. 5. Only two pheromone traps was installed in the field during the experimental period in both the years. Data pertaining to adult catches in pheromone trap was not analyzed statistically. Inferences are based on mean values. The pheromone trap catches of *Spodoptera litura* was the highest during 70 DAS (5 moths trap^{-1} and 4.5 moths trap^{-1}) in 2017 and 2018. The moth activity increased from 14 DAS to 70 DAS and thereafter decreased up to harvest. The study revealed that there was a wide fluctuation in the pattern of moth catches across the weeks.

Table 5: Number of adults in pheromone trap of soybean as influenced by different treatments

Number of adults of Spodoptera litura			
MW	**2017**	**2018**	**MEAN**
25	0.00	0.00	0.00
26	0.00	0.00	0.00
27	0.00	0.00	0.00
28	0.00	0.00	0.00
29	0.00	0.00	0.00
30	0.00	0.00	0.00
31	0.00	0.00	0.00
32	0.50	0.00	0.25
33	1.50	1.00	1.25

34	2.20	1.50	1.85
35	3.50	2.50	3.00
36	4.00	3.00	3.50
37	5.00	4.50	4.75
38	4.00	4.00	4.00
39	2.50	2.00	2.25
40	1.50	1.00	1.25
41	1.00	0.50	0.75

Correlation between weather parameter and population of *Spodoptera litura* larva (mrl^{-1}) on different groundnut varieties at different sowing windows and forewarning models for prediction of population of *Spodoptera litura*

The influence of different weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity, wind speed evaporation and rainfall on the seasonal population of *Spodoptera litura* larva (mrl^{-1}) was observed by working out correlation coefficient (r) (Table 6 and 7) and forewarning models were developed are given in Table 8.

Results of the cumulative correlation showed that the population of thrips was found to have significant and positive correlation with minimum temperature, morning and evening relative humidity, wind speed and bright sunshine hours whereas maximum and minimum temperature, evaporation and rainfall showed negative correlation. On the basis of different sowing windows and varieties, the incidence of *Spodoptera litura* with weather factors was studies.

Table 6: Correlation between different weather parameters and population of *Spodoptera litura* larva per meter row length(mrl^{-1}) during *kharif* 2017

Treatment		r' values							
Sowing window	**Variety**	**Tmax**	**Tmin**	**RH-I**	**RH-II**	**RAIN**	**WS**	**Epan**	**B S S**
S_1- 25th MW	V_1-JL-501	-0.546*	0.216	-0.356	0.287	-0.202	0.458	0.093	-0.314
S_2- 26th MW		-0.484	0.088	-0.122	0.255	-0.034	0.205	0.230	-0.130
S_3- 27th MW		-0.279	0.047	0.038	0.232	0.019	-0.011	0.345	0.055
S_4- 28th MW		-0.185	0.087	0.002	0.175	-0.059	-0.069	0.360	0.040
S_1- 25th MW	V_2 - RHRG-6083	-0.554*	0.214	-0.365	0.290	-0.203	0.467	0.093	-0.310
S_2- 26th MW		-0.481	0.088	-0.123	0.252	-0.036	0.205	0.228	-0.132
S_3- 27th MW		-0.288	0.048	0.036	0.234	0.021	-0.005	0.341	0.049
S_4- 28th MW		-0.187	0.087	0.003	0.177	-0.058	-0.068	0.361	0.040
S_1- 25th MW	V_3 -TAG-24	-0.550*	0.216	-0.362	0.289	-0.203	0.464	0.092	-0.313
S_2- 26th MW		-0.486	0.088	-0.120	0.257	-0.033	0.206	0.231	-0.128
S_3- 27th MW		-0.289	0.048	0.035	0.234	0.022	-0.004	0.341	0.048
S_4- 28th MW		-0.186	0.087	0.002	0.175	-0.059	-0.069	0.360	0.040
S_1- 25th MW	V_4-JL-776	-0.545*	0.220	-0.358	0.288	-0.204	0.459	0.092	-0.316
S_2- 26th MW		-0.470	0.088	-0.130	0.241	-0.044	0.205	0.222	-0.142
S_3- 27th MW		-0.280	0.047	0.038	0.232	0.019	-0.011	0.344	0.055
S_4- 28th MW		-0.159	0.092	-0.006	0.157	-0.074	-0.086	0.351	0.030

Tmax- Maximum temperature, Tmin- Minimum temperatur, RH-I- Morning humidity, RH-II- Evening humidity, WS- Wind speed, RF- Rainfall, Epan- Evaporation, BSS- Bright sunshine hours

Table 7: Correlation between different weather parameters and population of *Spodoptera litura* larva per meter row length(mrl^{-1}) during *kharif* 2018

Treatment		r' values							
Sowing window	**Variety**	**Tmax**	**Tmin**	**RH-I**	**RH-II**	**RAIN**	**WS**	**Epan**	**B S S**
S_1- 25th MW	V_1- JL-501	-0.731*	0.291	0.090	0.703*	0.066	0.598*	-0.540*	-0.483
S_2- 26th MW		-0.553*	-0.017	0.294	0.525*	-0.068	0.166	-0.328	-0.152
S_3- 27th MW		-0.318	-0.143	0.212	0.312	-0.157	-0.123	-0.080	0.070
S_4- 28th MW		-0.250	-0.176	0.244	0.270	-0.188	-0.186	-0.016	0.111
S_1- 25th MW	V_2 - RHRG-6083	-0.733*	0.298	0.092	0.705*	0.070	0.602	-0.542*	-0.482
S_2- 26th MW		-0.544*	-0.020	0.286	0.517*	-0.070	0.149	-0.313	-0.134
S_3- 27th MW		-0.332	-0.148	0.216	0.322	-0.151	-0.113	-0.090	0.068
S_4- 28th MW		-0.251	-0.176	0.242	0.270	-0.188	-0.186	-0.016	0.110
S_1- 25th MW	V_3- TAG-24	-0.729*	0.284	0.088	0.700*	0.063	0.594	-0.538	-0.483
S_2- 26th MW		-0.548*	-0.019	0.289	0.520*	-0.069	0.156	-0.320	-0.142
S_3- 27th MW		-0.317	-0.143	0.211	0.311	-0.157	-0.124	-0.080	0.070
S_4- 28th MW		-0.250	-0.176	0.243	0.270	-0.188	-0.186	-0.016	0.110
S_1- 25th MW	V_4- JL-776	-0.727*	0.280	0.087	0.698*	0.061	0.592*	-0.537*	-0.483
S_2- 26th MW		-0.550*	-0.018	0.291	0.522*	-0.069	0.159	-0.322	-0.145
S_3- 27th MW		-0.330	-0.147	0.216	0.320	-0.152	-0.114	-0.088	0.068
S_4- 28th MW		-0.245	-0.178	0.251	0.268	-0.187	-0.191	-0.011	0.115

Tmax- Maximum temperature, Tmin- Minimum temperature, RH-I- Morning humidity, RH-II- Evening humidity, WS- Wind speed, RF- Rainfall, Epan- Evaporation, BSS- Bright sunshine hours

Correlation between weather parameter and population of *Spodoptera litura* larva(mrl^{-1}) on groundnut variety JL-501 at different sowing windows and forewarning models for prediction of population of *Spodoptera litura*

During first sowing window 25th MW (S_1) with variety JL-501 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W^{-1}) was correlated significantly positive with minimum temperature (0.216 and 0.291), evening humidity (0.287 and 0.703) and wind speed (0.458 and 0.598) whereas it was negatively significant with maximum temperature (-0.546 and -0.731) and bright sunshine hours (-0.314 and -0.483) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W^{-1}) for variety JL-501 and S_1 sowing window (25th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-15.283-0.217(Tmax)-0.575(Tmin)+0.329(RH-I)+0.123(RH-II)-0.047(RF)

An increase of one unit of morning humidity increased the population of *Spodoptera litura* by 0.32 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.12 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 74% (R^2=0.74)

During second sowing window 26th MW (S_2) with variety JL-501 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.255 and 0.525) and wind speed (0.205 and 0.166) whereas it was negatively significant with maximum temperature (-0.484 and -0.553) and bright sunshine hours (-0.130 and -0.152) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety JL-501 and S_2 sowing window (26th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-21.043+0.159(Tmax)-1.105(Tmin)+0.349(RH-I)+0.175(RH-II)-0.038(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.15 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.34 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.17 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 83% (R^2=0.83)

During third sowing window 27th MW (S_3) with variety JL-501 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.232 and 0.312) whereas it was negatively significant with maximum temperature (-0.279 and -0.318) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety JL-501 and S_3 sowing window (27th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-17.436+0.919(Tmax)-2.071(Tmin)+0.179(RH-I)+0.325(RH-II)-0.037(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.91 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.17 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.32 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 69% (R^2=0.69)

During fourth sowing window 28th MW (S_4) with variety JL-501 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.175 and 0.270) whereas it was negatively significant with maximum temperature (-0.185 and -0.250) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety JL-501 and S_4 sowing window (28th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-32.194+1.283(Tmax)-2.413(Tmin)+0.251(RH-I)+0.413(RH-II)-0.502(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 1.28 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.25 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.41 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 72% (R^2=0.72)

Correlation between weather parameter and population of *Spodoptera litura* larva (mrl^{-1}) on groundnut variety RHRG-6083 at different sowing windows and forewarning models for prediction of population of *Spodoptera litura*

During first sowing window 25th MW (S_1) with variety RHRG-6083 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with minimum temperature (0.214 and 0.298), evening humidity (0.290 and 0.705) and wind speed (0.467 and 0.602) whereas it was negatively significant with maximum temperature (-0.554 and -0.733) and bright sunshine hours (-0.310 and -0.482) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety RHRG-6083 and S_1 sowing window (25th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-9.588-0.150(Tmax)-0.357(Tmin)+0.210(RH-I)+0.077(RH-II)-0.030(RF)

An increase of one unit of morning humidity increased the population of *Spodoptera litura* by 0.21 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.41 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 73% (R^2=0.73)

During second sowing window 26th MW (S_2) with variety RHRG-6083 the population of *Spodoptera litura* larva (mrl^{-1})

for one week prior (W-1) was correlated significantly positive with evening humidity (0.252 and 0.517) and wind speed (0.205 and 0.149) whereas it was negatively significant with maximum temperature (-0.481 and -0.544) and bright sunshine hours (-0.132 and -0.152) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety RHRG-6083 and S_2 sowing window (26th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-13.321+0.108(Tmax)-0.727(Tmin)+0.223(RH-I)+0.115(RH-II)-0.025(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.10 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.22 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.11 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 85% (R^2=0.85)

During third sowing window 27th MW (S_3) with variety RHRG-6083 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.234 and 0.322) whereas it was negatively significant with maximum temperature (-0.288 and -0.332) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety RHRG-6083 and S_3 sowing window (27th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-10.714+0.574(Tmax)-1.334(Tmin)+0.117(RH-I)+0.207(RH-II)-0.023(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.57 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.11 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.20 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 66% (R^2=0.66)

During fourth sowing window 28th MW (S_4) with variety RHRG-6083 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.177 and 0.270) whereas it was negatively significant with maximum temperature (-0.187 and -0.251) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety RHRG-6083 and S_4 sowing window (28th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-20.737+0.827(Tmax)-1.558(Tmin)+0.162(RH-I)+0.267(RH-II)-0.037(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.85 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.16 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.26 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 75% (R^2=0.75)

Correlation between weather parameter and population of *Spodoptera litura* larva (mrl^{-1}) on groundnut variety TAG-24 at different sowing windows and forewarning models for prediction of population of *Spodoptera litura*

During first sowing window 25th MW (S_1) with variety TAG-24 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.289 and 0.700), minimum temperature (0.216 and 0.284) and wind speed (0.464 and 0.594) whereas it was negatively significant with maximum temperature (-0.550 and -0.729) and bright sunshine hours (-0.313 and -0.483) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety TAG-24 and S_1 sowing window (25th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-16.046-0.227(Tmax)-0.634(Tmin)+0.349(RH-I)+0.135(RH-II)-0.051(RF)

An increase of one unit of morning humidity increased the population of *Spodoptera litura* by 0.34 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.13 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 71% (R^2=0.71)

During second sowing window 26th MW (S_2) with variety TAG-24 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.257 and 0.520) and wind speed (0.206 and 0.156) whereas it was negatively significant with maximum temperature (-0.486 and -0.548) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety TAG-24 and S_2 sowing window (26th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-22.464+0.177(Tmax)-1.214(Tmin)+0.376(RH-I)+0.192(RH-II)-0.042(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.17 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.37 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.19 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 87% (R^2=0.87)

During third sowing window 27th MW (S_3) with variety TAG-24 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.234 and 0.311) whereas it was negatively significant with maximum temperature (-0.289 and -0.317) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between

population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety TAG-24 and S_3 sowing window (27th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-18.546+0.986(Tmax)-2.245(Tmin)+0.196(RH-I)+0.351(RH-II)-0.039(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.98 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.19 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.35 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 73% (R^2=0.73)

During fourth sowing window 28th MW (S_4) with variety TAG-24 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.175 and 0.200) whereas it was negatively significant with maximum temperature (-0.186 and -0.250) during *kharif* season 2017 and 2018, respectively.The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety TAG-24 and S_4 sowing window (28th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-34.908+1.391(Tmax)-2.617(Tmin)+0.273(RH-I)+0.448(RH-II)-0.056(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 1.39 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.27 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.44 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 71% (R^2=0.71)

Correlation between weather parameter and population of *Spodoptera litura* larva (mrl^{-1}) on groundnut variety JL-776 at different sowing windows and forewarning models for prediction of population of *Spodoptera litura*

During first sowing window 25th MW (S_1) with variety JL-776 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with minimum temperature (0.220 and 0.280), evening humidity (0.288 and 0.698) and wind speed (0.459 and 0.592) whereas it was negatively significant with maximum temperature (-0.545 and -0.727) and bright sunshine hours (-0.316 and -0.483) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety JL-776 and S_1 sowing window (25th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-6.680-0.087(Tmax)-0.271(Tmin)-0.144(RH-I)+0.057(RH-II)-0.021(RF)

An increase of one unit of evening humidity increased the population of *Spodoptera litura* by 0.57 units to an extent of 72% (R^2=0.72)

During second sowing window 26th MW (S_2) with variety JL-776 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.241 and 0.522) and wind speed (0.205 and 0.159) whereas it was negatively significant with maximum temperature (-0.470 and -0.550) and bright sunshine hours (-0.142 and -0.185) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety JL-776 and S_2 sowing window (26th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-9.496+0.069(Tmax)-0.491(Tmin)+0.157(RH-I)+0.078(RH-II)-0.017(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.06 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.15 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.07 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 84% (R^2=0.84)

During third sowing window 27th MW (S_3) with variety JL-776 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.232 and 0.320) whereas it was negatively significant with maximum temperature (-0.280 and -0.330) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety JL-776 and S_3 sowing window (27th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-7.725+0.405(Tmax)-0.926(Tmin)+0.081(RH-I)+0.145(RH-II)-0.016(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.40 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.08 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.14 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 69% (R^2=0.69)

During fourth sowing window 28th MW (S_4) with variety JL-776 the population of *Spodoptera litura* larva (mrl^{-1}) for one week prior (W-1) was correlated significantly positive with evening humidity (0.157 and 0.268) whereas it was negatively significant with maximum temperature (-0.159 and -0.245) during *kharif* season 2017 and 2018, respectively. The overall linear multiple regression analysis was worked out between population of *Spodoptera litura* on groundnut of W0 week with weather parameters of one week prior (W-1) for variety JL-776 and S_4 sowing window (28th MW). The results obtained are given as follows. The multiple regression equation is given below:

Y=-15.596+0.590(Tmax)-1.076(Tmin)+0.118(RH-I)+0.187(RH-II)-0.024(RF)

An increase of one unit of maximum temperature increased the population of *Spodoptera litura* by 0.59 units, one unit of morning humidity increased the population of *Spodoptera litura* by 0.11 units and one unit of evening humidity increased the population of *Spodoptera litura* by 0.18 units. These weather parameter collectively increased the population of *Spodoptera litura* to an extent of 77% (R^2=0.77)
Similar results were reported by Sojitra (1990) [15] and Yadav *et al.* (2015) [16].

Table 8: Forewarning model developed for one week prior (W-1) prediction of incidence of *Spodoptera litura* larva per meter row length (mrl^{-1}) on groundnut

Treatment		Forewarning model's	r^2 Value
Sowing window	Variety		
S_1 - 25th MW	V_1 - JL-501	Y=-15.283-0.217(Tmax)-0.575(Tmin)+0.329(RH-I)+0.123(RH-II)-0.047(RF)	0.74
S_2 - 26th MW		Y=-21.043+0.159(Tmax)-1.105(Tmin)+0.349(RH-I)+0.175(RH-II)-0.038(RF)	0.83
S_3 - 27th MW		Y=-17.436+0.919(Tmax)-2.071(Tmin)+0.179(RH-I)+0.325(RH-II)-0.037(RF)	0.69
S_4 – 28th MW		Y=-32.194+1.283(Tmax)-2.413(Tmin)+0.251(RH-I)+0.413(RH-II)-0.502(RF)	0.72
S_1 – 25th MW	V_2- RHRG-6083	Y=-9.588-0.150(Tmax)-0.357(Tmin)+0.210(RH-I)+0.077(RH-II)-0.030(RF)	0.73
S_2 – 26th MW		Y=-13.321+0.108(Tmax)-0.727(Tmin)+0.223(RH-I)+0.115(RH-II)-0.025(RF)	0.85
S_3 – 27th MW		Y=-10.714+0.574(Tmax)-1.334(Tmin)+0.117(RH-I)+0.207(RH-II)-0.023(RF)	0.66
S_4 - 28th MW		Y=-20.737+0.827(Tmax)-1.558(Tmin)+0.162(RH-I)+0.267(RH-II)-0.037(RF)	0.75
S_1 - 25th MW	V_3 - TAG-24	Y=-16.046-0.227(Tmax)-0.634(Tmin)+0.349(RH-I)+0.135(RH-II)-0.051(RF)	0.71
S_2 - 26th MW		Y=-22.464+0.177(Tmax)-1.214(Tmin)+0.376(RH-I)+0.192(RH-II)-0.042(RF)	0.87
S_3 - 27th MW		Y=-18.546+0.986(Tmax)-2.245(Tmin)+0.196(RH-I)+0.351(RH-II)-0.039(RF)	0.73
S_4 - 28th MW		Y=-34.908+1.391(Tmax)-2.617(Tmin)+0.273(RH-I)+0.448(RH-II)-0.056(RF)	0.71
S_1 - 25th MW	V_4 - JL-776	Y=-6.680-0.087(Tmax)-0.271(Tmin)-0.144(RH-I)+0.057(RH-II)-0.021(RF)	0.72
S_2 - 26th MW		Y=-9.496+0.069(Tmax)-0.491(Tmin)+0.157(RH-I)+0.078(RH-II)-0.017(RF)	0.84
S_3 - 27th MW		Y=-7.725+0.405(Tmax)-0.926(Tmin)+0.081(RH-I)+0.145(RH-II)-0.016(RF)	0.69
S_4 - 28th MW		Y=-15.596+0.590(Tmax)-1.076(Tmin)+0.118(RH-I)+0.187(RH-II)-0.024(RF)	0.77

Tmax- Maximum temperature, Tmin- Minimum temperature, RH-I- Morning humidity, RH-II- Evening humidity, WS- Wind speed, RF- Rainfall, Epan- Evaporation, BSS- Bright sunshine hours

Conclusion

The correlation of weather parameters with incidence of *Spodoptera litura* showed that the population of *Spodoptera litura* was found to have significant and positive correlation with evening relative humidity whereas maximum temperature and rainfall showed negative correlation with seasonal incidence of *Spodoptera litura*. Prediction of *Spodoptera litura* populations in different sowing window based on regression equations (R^2) 72 to 83 per cent validation based on different weather parameters for variety JL-501, (R^2) 66 to 85 per cent validation based on different weather parameter for variety RHRG-6083, (R^2) 71 to 87 per cent validation based on different weather parameter for variety TAG-24 and (R^2) 69 to 84 per cent validation based on different weather parameter for variety JL-776 for the prediction of *Spodoptera litura* population.

References

1. Wightman JA, Amin PW. Groundnut pests and their control in the semi-arid tropics. Tropical Pest Management. 2008; 34:218-226.
2. Murthy S, Thippaiah M, Kitturmmath MS. Effect of neem formulations on larvae of tobacco cutworm, *Spodoptera litura* (Fab.). Insect Environment. 2006; 12:84-85.
3. Dhir BC, Mohapatra HK, Senapati B. Assessment of crop loss in groundnut due to tobacco caterpillar, *Spodoptera litura* (F.). Indian J Plant Protect. 1992; 20:215-217.
4. Isman MB, Machial CM, Miresmailli S, Bainard LD. Essential oil based pesticides: new insights from old chemistry. In: Pesticide chemistry, H. Ohkawa and H Miyagawa, (Eds): Wiley. Weinheim, 2007, 113.
5. Saheb YP, Hari Prasad KV, Swarajya Lakshmi K, Sailaja Rani J. Mechanisms of resistance in groundnut genotypes against leaf bud borer, *Anarsia ephippias* (Meyrick). Journal of Entomology and Zoology Studies. 2018; 6(2):694-705.
6. Raghunathan V. Integrated Pest Management: Eco-friendly approach. The Hindu Survey of Indian Agriculture, 1996, 155.
7. Singh SP. Pest Management. The Eco-friendly approach. The Hindu Survey of Indian Agriculture, 1999, 175-184.
8. Snedecor GW, Cochran WG. Statistical methods. 6th edition, Lowa State University Press, USA, 1968.
9. Draper NR, Smith H. Applied Regression Analysis, edi. Wiley, 1998, 3.
10. Rathod RR. Population dynamics, efficacy and economics of newer insecticides against groundnut (*Arachis hypogaea* L.) pest complex. M. Sc. Thesis, Junagadh Agricultural University, Junagadh, 2006 1-3.
11. Arvind Kumar. Influence of weather parameters on pheromone traps catches of *Spodoptera litura* Febr. J Agri. 2014; (4):238-241.
12. Harish G, Nataraja MV, Jasrotia P, Holajjer P, Savaliya SD, Gajera M. Impact of weather on the occurrence pattern of insect pests on groundnut. Legume Research. 2014; 38(4):524-535.
13. Roopa M, Ashok kumar CT. Seasonal incidence of pests of capsicum in Bangalore conditions of Karnataka, India. Global Journal of Biology, Agriculture & Health Sciences. 2014; 3(3):203-207.
14. Nath P, Rai SN, Keval R. Effect of sowing dates on the tobacco caterpillar [*Spodoptera litura* (Fabricius)], population, leaf damage and yield of groundnut. International Journal of Research- Granthaalayah. 2017; ISSN- 2350- 0530 (O), ISSN- 2394-3629(P).
15. Sojitra BP. Population dynamics of major soybean pests along with bionomics of grey semilooper, Amynaocto (Guenee) on different hosts and its chemical control. M.Sc. (Agri.) Thesis submitted to the Gujarat Agricultural University, Sardar Krushinagar, 1990.
16. Yadav S, Agnihotri M, Bisht RS. Seasonal incidence of insect-pests of blackgram, Vigna mungo (Linn.) and its correlation with abiotic factors. Agric. Sci. Digest. 2015; 35(2):146-148.