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Seasonal Incidence and Effect of Abiotic Factors on Population Dynamics of Tobacco Caterpillar, *Spodoptera litura* (Fabricius) on Groundnut (*Arachis hypogaea* L.) During *Rabi* Season

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ABSTRACT

Seasonal incidence of Spodoptera litura in groundnut was studied during rabi, 2015-16 at dry land farm, S.V. Agricultural College, Tirupati in two groundnut varieties i.e., Dharani and Kadiri-6 (K6). The results indicated that, the incidence of S. litura on groundnut was observed from 50th standard week of 2015 to 11th standard week of 2016. Foliar damage was high in November second fortnight sown crop (D_1) compared to December first (D_2), December second (D_3) and January first fortnight (D_4) sown crops during 50th standard week of 2015 to 6th standard week of 2016. Weather parameters like maximum temperature, minimum temperature, sun shine hours and wind speed showed negative correlation with S. litura incidence and morning and evening relative humidity showed positive correlation with S. litura damage in groundnut. Among the six weather parameters, Max and minimum temperature and morning and evening relative humidity showed significant influence on S. litura incidence in two cultivars of groundnut (Dharani and K-6) in D_1 D_2 D_3 and D_4 sown crops. Six weather parameters viz., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours and wind speed combinedly influenced S. litura damage to the extent of 86 per cent (R^2= 0.86) and 84 percent (R^2= 0.84) in groundnut cultivars Dharani and K-6 in D1 and in case of D2 incidence of S. litura influenced up to the extent of 88 per cent (R^2=0.88), 87 per cent (R^2=0.87) in Dharani and K-6 and in case of D_3 incidence of S. litura influenced by weather parameters up to the extent of 63 per cent (R^2=0.63), 65 per cent (R^2=0.65) and in D_4 33 per cent (R^2=0.33), 35 per cent (R^2=0.35) in Dharani and K-6 respectively.

Key words: *Abiotic factors, Arachis hypogaea, Spodoptera litura.*

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop of tropical and sub tropical regions of the world. India ranks first in groundnut cultivation with an area of 5.53 m ha and occupies second place in production (9.67 million tonnes) with productivity of 1750 kg ha^{-1}. In India, groundnut is mostly grown in five states *viz.,* Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra which accounts for 80 per cent of total area and 84 per cent of total production of groundnut. In Andhra Pradesh, groundnut is grown in an area of 13.86 lakh hectares with a total production of 7.48 lakh tonnes and productivity of 644 kg ha^{-1}[7].

Studies revealed that 15 - 20 per cent of the total oilseed produced is lost directly or indirectly by the attack of insect and mite pests every year. In groundnut crop, some of the insect pests cause considerable yield losses. Among these insect pests, white grub cause yield losses up to 20-100 per cent, tobacco caterpillar causes up to 15-30 per cent, red hairy caterpillar causes up to 75 per cent, leaf miner causes up to 49 per cent, jassids causes yield losses up to 17 per cent, thrips causes up to 17 per cent yield losses[2].

S. litura is a ubiquitous, polyphagous, multivoltine, lepidopteran pest that feeds on 112 cultivated crops across the world[5]. *S. litura* is a destructive pest that damages groundnut crop extensively by defoliating the plants and thus reducing the photosynthetic capacity of the plant. The *S. litura* moths are found primarily active during night and due to its high mobility, female ovipositing on a wide range of host plants, which promotes or even ensures survival of *S. litura* over a broad range of environmental conditions[1]. Hence the present studies were conducted at S.V. Agricultural College Farm, Tirupati during *rabi*, 2015-16.

MATERIAL AND METHODS

A field trial was conducted with two groundnut varieties Kadiri-6 (K-6) and Dharani to study the seasonal incidence and influence of various weather parameters on incidence of *S. litura* during *rabi* 2015-16. The trial was laid out in observational trial of 5x5m^2 area under four dates of sowing *i.e*., second fortnight of November (D_1), first fortnight of December (D_2), second fortnight of December (D_3) and first fortnight of January (D_4) by following normal agronomic practices except for plant protection developed by ANGRAU.

The incidence of *S. litura* was initiated from 28 days after sowing (DAS). Data on incidence of *S. litura* in terms of damaged plants was recorded from total number of plants/m^2 and number of leaf buds damaged by *S. litura.* Similarly, weather parameters were recorded on daily basis from meteorological station and compiled to standard week wise for analyzing the data.

For *S. litura* per cent damage was calculated by using the following formula

$$\text{Per cent damage} = \frac{\text{Number of plants damaged}}{\text{Total number of plants per metre square}} \text{X} 100$$

RESULTS AND DISCUSSIONS

The data indicated that the *S. litura* damage was first noticed in 50th and 52nd standard weeks of 2015 and 2nd and 4th standard weeks of 2016 in D_1, D_2, D_3 and D_4 sown crops, respectively. Foliar damage was high in November second fortnight sown crop (D_1) compared to December first (D_2), December second (D_3) and January first fortnight (D_4) sown crops. In D_1 damage was ranged from 0.3 to 20.22 and 0.1 to 28.14 per cent in Dharani and K-6 varieties. In case of D_2 sown crop, the incidence was ranged from 0.32 to 11.64 per cent in Dharani and 0.2 to 18.49 per cent in K-6. In D_3 sown crop, the incidence was 1.06 to 7.3 per cent in Dharani and 1.21 to 7.89 per cent in K-6. Similarly, in D_4 sown crop, the incidence was 0.71to 4.6 per cent in Dharani and 0.87 to 5.4 per cent in K-6.

In D_1 sown groundnut crop, foliar damage due to *S. litura* was high during 50th standard week of 2015 to 6th standard week of 2016 which were coinciding with 10th December to 11th February and incidence was 13.53 to 20.22 per cent in Dharani and 12.82 to 28.14 per cent in K-6. Thereafter the incidence was decreased in both Dharani and K-6 to an extent of 0.3 and 0.1 per cent, respectively by the end of the season (Table 1).

The results of the investigation are also supported by the observations of Hanamant Gadad *et al*[3]., who carried out the work on seasonal incidence of *S. litura* and leaf miner in *rabi* and summer groundnut at Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad. They have reported that *S. litura* incidence started from 6th meteorological standard week (MSW) and reached its peak during the 11th MSW with 19.50 per cent leaf damage and declined thereafter. The peak incidence coincided with the reproductive and pod formation stage of the crop.

Correlation studies on influence of weather parameters like maximum and minimum temperature, morning and evening relative humidity, sunshine hours and wind speed on foliar damage due to *S. litura* were carried out during *rabi*, 2015-2016. Weather parameters like maximum temperature, minimum temperature, sun shine hours and wind speed showed negative correlation with *S. litura* incidence in terms of foliar damage. On the contrary, morning and evening relative humidity showed positive correlation with *S. litura* damage in groundnut. Among the six weather parameters, maximum temperature (r= - 0.88, - 0.85), minimum temperature (r = - 0.85, r = - 0.85), morning relative humidity (r = + 0.80, r = + 0.74) and evening relative humidity (r = + 0.81, r = + 0.77) showed significant influence on *S. litura* incidence in two cultivars of groundnut (Dharani and K-6). In case of D_2 sown crop, the influence of maximum temperature (r= - 0.69, - 0.67), minimum temperature (r = - 0.78, r = - 0.78), morning relative humidity (r = + 0.56, r = + 0.55) and evening relative humidity (r = + 0.52, r = + 0.53) was highly significant. Where as in case of D_3 sown crop, maximum temperature (r = -0.51, r = - 0.51), minimum temperature (r = -0.62, r = - 0.62), morning relative humidity (r = +0.49, r = +0.49) and wind speed (r = + 0.60, r = + 0.65) influenced the foliar damage of *Spodoptera* significantly and remaining weather parameters were not significant in D_4 sown crop all weather parameters were not significant (Table 2).

The present results are similar to the findings of Radhika[6] who reported that population of *S. litura* showed positive correlation with maximum temperature (T_{max}) and minimum temperature (T_{min}) and the relative humidity showed significant negative correlation. The influence of weather parameters on the incidence of groundnut leaf miner recorded significant positive correlation with T_{max} and Sunshine hours and significant negative correlation with relative humidity.

Regression analysis on influence of weather parameters of *rabi* 2015-16 *viz.*, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours and wind speed on foliar damage caused by *S. litura* in groundnut indicated that all the six weather parameters together resulted in 86.3(R^2= 0.863) and 84.8 per cent (R^2 = 0.84) in groundnut cultivars Dharani and K-6 in November second fortnight sown crop. Among the six weather parameters maximum temperature, minimum temperature, morning relative humidity and evening relative humidity influenced *S. litura* infestation to the extent of 86 per cent in Dharani and 83 percent in K-6 respectively. Regression models developed by the forward selection were Y = -5.218 + (1.285) Max temp. + (-2.051) Min temp.+ (-0.107) RH mor. + (0.484) RH eve. +3.196 and Y = 22.452 +(1.438) Max temp. + (-2.685) Min temp. + (-0.387) RH mor. + (0.594) RH eve. +4.095 respectively (Table 3).

In case of D_2 sown crop, all the six weather parameters influenced to the extent of 88 per cent (R^2 = 0.88), 87 (R^2 = 0.87) per cent among these maximum temperature, minimum temperature, morning relative humidity and evening relative humidity influenced damage caused by *S. litura* 66 (R^2=0.66) and 69

(R^2=0.69) per cent in Dharani and K-6 respectively and the regression equations developed by forward selection were Y = 52.114 +(-0.044) Max temp. + (-1.136) Min temp. + (-0.326) RH mor. + (0.095) RH eve. +2.632 and Y = 23.973 + (1.241) Max temp. + (-2.146) Min temp. + (-0.354) RH mor. + (0.295) RH eve. +3.250.

In case of D_3 sown crop, all the weather parameters influenced to the extent of 63 per cent (R^2=0.63), 65 per cent (R^2=0.65) and four parameters showed more influence on the damage caused by *S. litura* regression equations developed by forward selection were Y = -13.027 +(0.469) Max temp. + (-0.698) Min temp.+ (0.137) RH mor. + (0.503) RH eve. +2.106 and Y = -14.202 +(0.513) Max temp. + (-0.757) Min temp. + (0.149) RH mor. + (0.508) RH eve. +2.258 in Dharani 43 per cent (R^2= 0.433) and K-6 43 percent (R2= 0.438) groundnut cultivars, respectively.

Present findings are supported by Harish *et al*[4]., who reported that coefficient of multiple regression (R^2) for *S. litura* on groundnut was 76, 35 and 53 per cent during *kharif*, *rabi* and summer seasons respectively.

Table.1. Population dynamics of *S. litura* on groundnut *rabi*, 2015-16

Standard week	Weather parameters						% of foliar damage by *Spodoptera*							
							D_1 (Nov II FN)		D_2 (Dec I FN)		D_3 (Dec II FN)		D_4 (Jan I FN)	
	Max. temp (°C)	Min. temp (°C)	RH mor. (%)	RH eve. (%)	SSH (hours)	WS (kmph)	Dharani	K6	Dharani	K6	Dharani	K6	Dharani	K6
50 (10-16,Dec)	30.4	20.6	91.9	63.9	6.6	2.2	15.42	16.9	0	0	--	--	--	--
51 (17-23, Dec)	31.0	19.7	91.0	63.6	8.2	2.0	14.23	9.59	0	0	--	--	--	--
52 (24-31 Dec)	29.7	18.1	88.0	60.6	7.7	4.7	16.71	15.69	11.64	10.08	0	0	--	--
1(1-7, Jan), 2016	30.0	16.5	90.1	58.0	8.5	3.8	20.22	28.14	11.24	18.49	0	0	--	--
2(8-14, Jan)	29.6	14.8	89.1	54.7	8.0	3.4	14.56	22.12	8.43	13.26	7.3	7.89	0	0
3 (15-21, Jan)	30.0	17.9	91.9	60.7	5.6	3.0	15.18	16.69	6.18	7.93	6.5	7.2	0	0
4(22-28, Jan)	30.7	20.4	91.7	58.7	6.2	5.1	14.88	17.68	7.19	6.57	5.9	6.1	4.6	5.4
5(29-Jan- 4 Feb)	33.1	16.9	84.7	33.7	9.0	2.9	14.77	13.61	6.68	5.09	4.74	4.95	3	3.31
6(05-11, Feb)	32.4	18.6	89.6	41.7	7.8	3.5	13.53	12.82	4.04	5.02	2.5	3.03	1.34	1.84
7(12-18, Feb)	32.5	19.1	88.9	48.0	8.8	4.3	6.39	5.96	3.49	4.78	2.34	2.65	0.87	0.97
8(19- 25, Feb)	34.6	21.1	87.0	39.1	9.6	4.2	3.84	3.24	4.82	4.49	1.59	1.49	0.79	0.92
9(26-Feb-04-Mar)	33.15	21.29	87.13	43.00	7.26	4.39	1.59	1.81	0.84	1.04	1.06	1.21	0.71	0.87
10(5-11, Mar)	34.54	22.11	86.00	38.14	7.80	3.93	0.3	0.1	0.56	0.40	0	0	0	0
11(12-18, Mar)	36.60	25.53	79.71	41.43	6.24	4.51	0	0	0.32	0.2	0	0	0	0
12(19-25, Mar)	39.19	24.90	72.14	27.00	7.61	3.96	--	--	0	0	0	0	0	0
13(26, Mar -01, April)	36.27	23.43	77.67	33.33	8.35	4.07	--	--	0	0	0	0	0	0
14(2-8, April)	36.4	23.7	77.0	34.0	8.3	4.0	--	--	--	--	0	0	0	0
15(9-15, April)	38.3	25.7	76.7	33.7	8.3	4.2	--	--	--	--	0	0	0	0
16(16-22, April)	39.4	26.0	75.9	30.6	8.9	4.6	--	--	--	--	--	--	0	0
17(23-29, April)	39.9	27.0	74.4	33.0	9.9	4.5	--	--	--	--	--	--	0	0

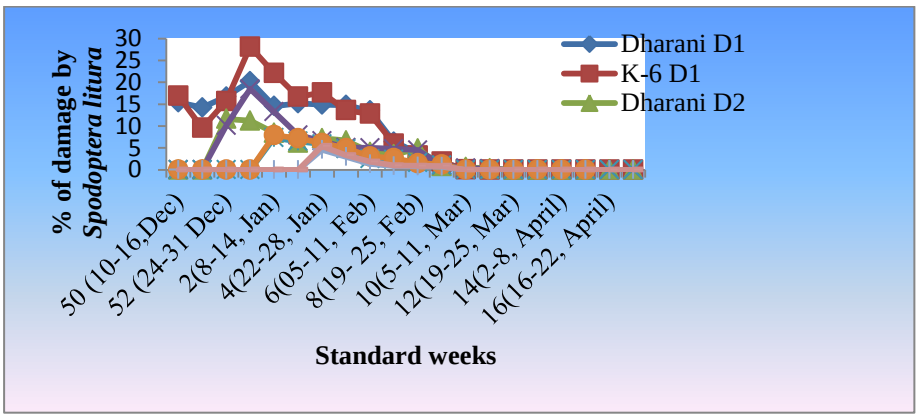

Fig. 1: Incidence of *S. litura* on groundnut during *rabi*, 2015-16

Table 2: Correlation studies of *S. litura* in relation to weather parameters during *rabi* 2015-16

Weather parameter	D_1		D_2		D_3		D_4	
	Dharani	K-6	Dharani	K-6	Dharani	K-6	Dharani	K-6
Maximum temperature (X1)	-0.88*	-0.85*	-0.69*	-0.67*	-0.51*	-0.519*	-0.251	-0.255
Minimum temperature (X2)	-0.86*	-0.85*	-0.78*	-0.78*	-0.62*	-0.627*	-0.267	-0.265
Morning RH (X3)	0.80*	0.74*	0.56*	0.55*	0.49*	0.494*	0.315	0.324
Evening RH (X4)	0.81*	0.77*	0.52*	0.53*	0.32	0.330	0.081	0.085
Sunshine hours (X5)	-0.27	-0.27	-0.07	-0.05	-0.30	-0.315	-0.131	-0.143
Wind speed (X6)	-0.46	-0.36	0.074	-0.000	-0.13*	-0.142*	0.179	0.185

r value at 0.05 is 0.53

* Significant at 5%.

D_1 : Date of sowing: 27-11-2015 D_2 : Date of sowing: 12-12-2015

D_3 : Date of sowing: 27-12-2015 D_4 : Date of sowing: 11-01-2016

Table 3: Regression analysis for *S. litura* on groundnut in relation to weather parameters during *rabi*, 2015-16

Regression model	Regression equation for *S. litura*	R^2
Dharani		
D_1 (Full model)	Y = -2.927 +(1.328) Max temp.+(-2.064) Min temp.+(-0.106) RH mor.+(0.473) RH eve.+(-0.183) SSH+(-0.417) WS+3.408	**0.863**
D_1 (Forward selection)	Y = -5.218 +(1.285) Max temp. + (-2.051) Min temp.+ (-0.107) RH Mor.+ (0.484) RH eve. +3.196	0.861
D_2 (Full model)	Y = 8.082 +(0.884) Max temp.+(-1.754) Min temp.+(-0.217) RH mor.+(0.231) RH eve.+(0.000) SSH+(2.691) WS+1.637	**0.886**
D_2 (Forward selection)	Y = 52.114 +(-0.044) Max temp. + (-1.136) Min temp.+ (-0.326) RH mor.+ (0.095) RH eve.+2.632	0.661
D_3 (Full model)	Y = -57.218 +(2.150) Max temp.+(-1.664) Min temp.+(0.288) RH mor.+(0.117) RH eve.+(-1.415) SSH+(0.721) WS+1.813	**0.635**
D_3 (Forward selection)	Y = -13.027 +(0.469) Max temp. + (-0.698) Min temp.+ (0.137) RH mor.+ (0.503) RH eve. +2.106	0.433
D_4(Full model)	Y = -9.861 +(0.001) Max temp.+(-0.038)Min temp.+(0.163) RH mor.+(-0.069) RH eve.+(-0.172) SSH+(0.485) WS+1.184	**0.337**
D_4(Forward selection)	Y = -19.573 +(0.301) Max. temp. +(-0.131) Min. temp. +(0.150) RH mor. +1.212	0.143
K-6		
D_1 (Full model)	Y= 16.550+(2.716) Max. temp.+(-3.458) Min. temp.+(-0.258) RH mor.+ (0.696)RH eve.+ (-0.917)SSH+(0.994)WS+4.246	**0.848**
D_1 (Forward selection)	Y = 22.452 +(1.438) Max temp. + (-2.685) Min temp.+ (-0.387) RH mor.+ (0.594) RH eve. + 4.095	0.831
D_2 (Full model)	Y = -34.148 +(2.600) Max temp.+(-3.028)Min temp.+(-0.201) RH mor.+(0.469) RH eve.+(-0.271) SSH+(3.141)WS + 2.246	**0.874**
D_2 (Forward selection)	Y = 23.973 +(1.241) Max temp. + (-2.146) Min temp.+ (-0.354) RH mor.+ (0.295) RH eve.+3.250	0.696
D_3 (Full model)	Y = -62.998 +(2.372) Max temp.+(-1.827)Min temp.+(0.317)RH mor.+(0.129) RH eve.+(-1.570) SSH+(0.748) WS+1.906	**0.653**
D_3 (Forward selection)	Y = -14.202 +(0.513) Max temp. + (-0.757) Min temp.+ (0.149) RH mor.+ (0.508) RH eve.+2.258	0.438
D_4(Full model)	Y = -12.553 +(0.008) Max temp.+ (-0.039) Min temp.+(0.200) RH mor.+(-0.082) RH eve.+(-0.215) SSH+(0.579) WS+1.358	**0.355**
D_4(Forward selection)	Y = -23.929 +(0.358) Max. temp. + (-0.144) Min. temp. + (0.184) RH mor. +1.405	0.151

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