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Pradeep Kumar and R. P. Singh

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# Population Dynamics of *Spodoptera litura* (Fabricious) and their Response with Correlation with Meteorological Factors in Chilli (*Capsicum annum*) Crop

Pradeep Kumar\*<sup>1</sup> and R. P. Singh<sup>2</sup>

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## ABSTRACT

A field experiment on seasonal incidence of tobacco caterpillar, *Spodoptera litura* (Fab.) of chilli, *Capsicum annum* (L.) crop in correlation to weather parameters was laid out at Agriculture farm, Karguwa ji, Jhansi (U.P.) during *Kharif* season of 2019 and 2020. Adult population (0.85 adults/trap) appeared second week in 16<sup>th</sup> to 22<sup>nd</sup> August (34<sup>th</sup> standard week) with the maximum and minimum temperature 32.0°C and 24.70°C respectively, average relative humidity 86.0 per cent was recorded. Adult population increased recorded maximum i.e., 8.93 adults per trap during 39<sup>th</sup> standard weeks (20<sup>th</sup> to 26<sup>th</sup> September) when the maximum and minimum temperature 30.60°C and 23.50°C respectively, average relative humidity 87.50 per cent during *Kharif* 2019. During the year in (2020), adult population (0.26 adults / trap) appeared with the maximum and minimum temperature 31.10°C and 25°C respectively, average relative humidity 89.50 per cent was recorded. Adult population increased and recorded maximum i.e., 7.25 adults per trap during 39<sup>th</sup> standard weeks (20<sup>th</sup> to 26<sup>th</sup> September) when the maximum and minimum temperature 34.20°C and 23.30°C respectively, average relative humidity 77.0 per cent. Adult population on the basis of pheromone trap during both the years.

**Key words:** Seasonal incidence, Fruit borer, Meteorological abiotic factors, Chilli crop

Chilli *Capsicum annum* (L.) is the most important universal spice-cum-vegetable crop which belongs to the family solanaceae and originated from Mexico [1]. The crop is grown largely for its fruits all over the India. It is used in India as a principal ingredient of various curries, and chutneys. It is widely cultivated for use as spice or vegetable in temperate and tropical countries. It is also known as red pepper [1]. Chilli fruit is mainly used as green or dried to impart pungency to food. Dried red chilli powder is used as a condiment for preparation of vegetable and it is rich in vitamin 'A' and 'C' and the chilli seeds contain traces of starch, which are used as ingredient of certain medicines. It has medicinal significance in dyspepsia and prevents blood cancer [2]. In India, major chilli producing states are Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Madhya Pradesh. In Andhra Pradesh, as on 26<sup>th</sup> September 2018, about 116,578 hectares was reported under red chilli. Till now, chilli area coverage in Guntur, Kurnool and Krishna regions is reported as 65,259 hectares, 15,584 hectares and 12,816

hectares respectively [3]. Its high remunerative return allures the farmers to undertake its extensive cultivation not only in the state, but all over the country. In the state of Rajasthan, the productivity of chilli is 988 kg which low as compared to other states and average productivity of the country. The various factors are responsible for low yield of chilli, among which, insect and mite pests are of prime importance which significantly affects both the quality and production of chilli fruit borers viz., *Helicoverpa armigera* (Hubner) and *Spodoptera litura* (Fabricius) are accountable for substantial yield loss [4]. The yield losses range from 50-90 per cent due to insect pests of chilli [5-6]. Due to variation in the agro climatic conditions of different regions insects show varying trends in their incidence also in nature and extent of damage to the crop. Besides, some known and unknown factors also play a key role in determining the incidence and dominance of a particular pest or pest complex. Available scientific literature shows that not much information is available especially on seasonal incidence and influence of various environmental factors on the fluctuation of fruit borers on chilli crop in semi-arid region conditions of Rajasthan. Hence a region-oriented study on the seasonal incidence of fruit borers would give an idea about peak period of their activity and may be helpful in developing pest management strategy. *H. armigera* commonly known as gram pod borer is a polyphagous pest. A number of limiting factors have been attributed for low productivity in

\* Pradeep Kumar

✉ pradeepentomology@gmail.com

<sup>1-2</sup> Department of Entomology, Faculty of Agriculture Science, Bhagwant University, Ajmer - 305 004, Rajasthan, India

chilli. Among them ravages caused by insect pests are significant [7]. The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage [1]. Among different insect pests, fruit borers viz., *Helicoverpa* and *Spodoptera*, are known to attack crop in most severe form. The damage caused by *H. armigera* (Hubner) and *Spodoptera litura* (Fb.) during flowering and fruit formation is the great concern. Complete destruction of the fruit contents by *H. armigera* larvae in chilli, which infested up to 92 per cent of the plants and caused 77 per cent fruit damage [8]. As reported by [9] due to severe attack of fruit borers lead to 90 percent flower and fruit drop in chilli. The young capsules dry up and fall, whereas mature fruits remain on the plants. *Spodoptera litura* is another borer found on the chilli crop, it is also a polyphagous pest and damages by making holes in the leaves, scratching the young shoots and feeding on the fruits.

## MATERIALS AND METHODS

In order to study the seasonal incidence of tobacco caterpillar, *Spodoptera litura* (Fab.) in field, the chilli variety “Surya-31” which recommended for this region was used for the experiment, transplanting was done after 43 days i.e., on 13<sup>th</sup> February, 2019 and 2020 in the laid-out fields at the spacing of 45 cm x 60 cm. The experiment was conducted at Agriculture farm, Karguwa ji, Jhansi (U.P.) during *kharif* season of 2019 and 2020. To study seasonal incidence of fruit borers of chilli were done by counting the population of insect pests in pheromone trap were installation. The observation of fruit borers was recorded at weekly intervals during morning hour's between 7: 0 AM. to 8: 00 AM. The population of adult fruit borer was counted in pheromone trap in polythene bag. The weekly meteorological data on temperature, relative humidity and rain fall were recorded during the experimental field in chilli crop.

Where,

Relationship between number of larvae and meteorological variables was worked out using simple correlation analysis. Simple correlation coefficient analysis was done using the following formula:

$$r_{X_1Y_1} = \frac{\sum XY - \frac{(\sum X_1)(\sum Y_1)}{N}}{\sqrt{[\sum X_1^2 - \frac{(\sum X_1)^2}{n}][\sum Y_1^2 - \frac{(\sum Y_1)^2}{n}]}}$$

Where,

$r_{X_1Y_1}$  = Simple correlation coefficient

$X_1$  = Number of larvae

$Y_1$  = Meteorological parameter

$N$  = Number of observation

The correlation coefficient ( $r$ ) values were subjected to the test of significant using  $t$  test.

$$t = \frac{r}{\sqrt{1-r^2}} \times \sqrt{n-2}$$

The calculated  $t$ -value was compared with tabulated  $t$ -value at 5 per cent level of significance [10].

## RESULTS AND DISCUSSION

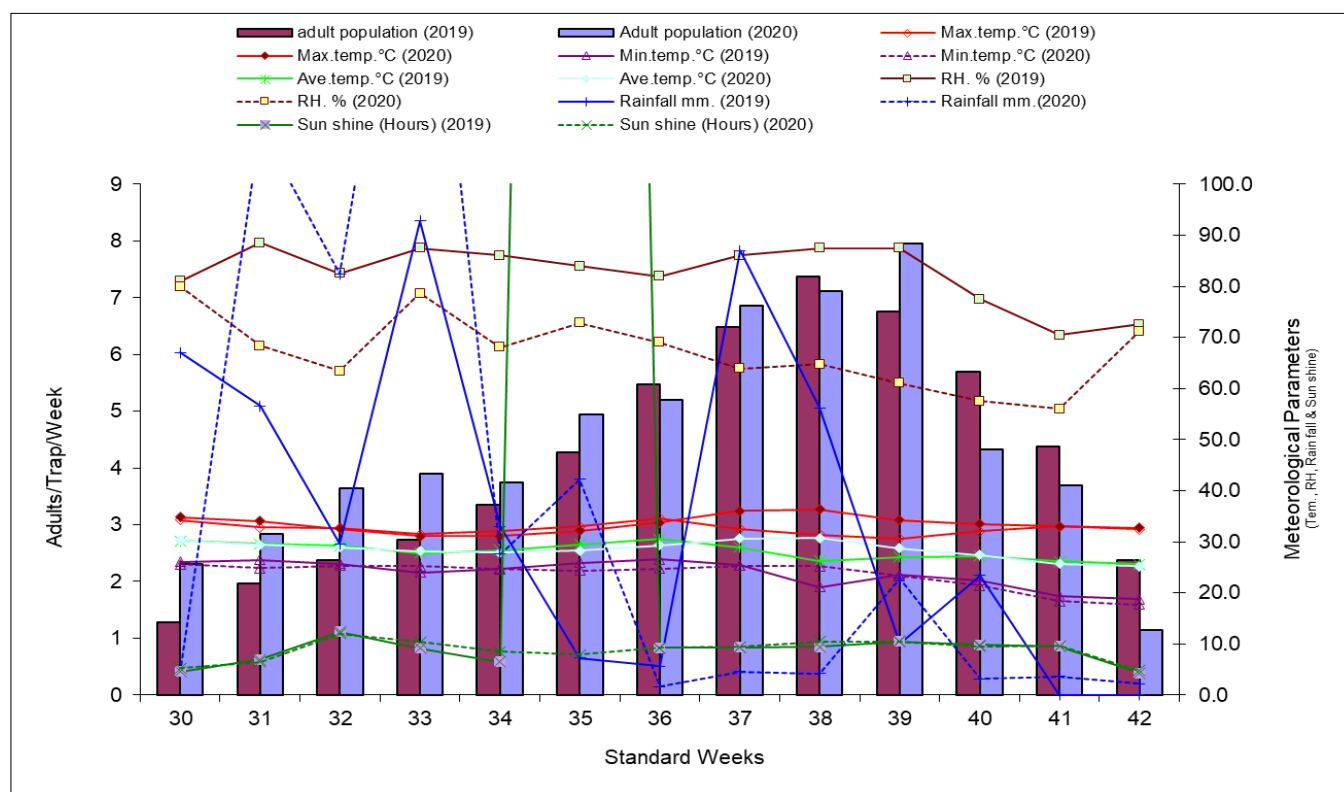
Incidence of the tobacco caterpillar commenced in the data recorded on monitoring of adult population of *Spodoptera litura* during *kharif* 2019 have been presented in (Table 1, Fig 1). It is evident from the (Table 1) that, the adult population and activity continued approximately throughout the crop season. Adult population (0.85 adults/trap) appeared second week in August 16<sup>th</sup> to 22<sup>nd</sup> August (34<sup>th</sup> standard week) with the maximum and minimum temperature 32.0°C and 24.70°C respectively, average relative humidity 86.0 per cent and rainfall 33.0 mm and sunshine (hours) 6.50 was recorded. Adult population increased and recorded maximum i.e., 8.93 adults per trap during 39<sup>th</sup> standard weeks (20<sup>th</sup> to 26<sup>th</sup> September) when the maximum and minimum temperature 30.60°C and 23.50°C respectively, average relative humidity 87.50 per cent and rainfall 10.0 and sunshine hours 10.42 was recorded during second year 2019. The data recorded on monitoring of adult population of *Spodoptera litura* during *Kharif* 2020 have been presented in (Table 2, Fig 1), the adult population and activity continued approximately throughout the crop season. Adult population (0.26 adults/trap) appeared first in August 09<sup>th</sup> to 15<sup>th</sup> August (33<sup>th</sup> standard week) with the maximum and minimum temperature 31.10°C and 25°C respectively, average relative humidity 89.50 per cent and rainfall 174.20 mm and sun shine 10.38 was recorded. Adult population increased and recorded maximum i.e., 7.25 adults per trap during 39<sup>th</sup> standard weeks (20<sup>th</sup> to 26<sup>th</sup> September) when the maximum and minimum temperature 34.20°C and 23.30°C respectively, average relative humidity 77.0 per cent and rainfall 22.80, sunshine 10.42 was recorded [11-14]. The optimum condition for development of *Sodoptera litura* (Fab.) was 25°C and 75 per cent relative humidity [15].

Table 1 Population fluctuation of adult *Spodoptera litura* (Fab.) on chilli crop during *Kharif* 2019

S.W.	Period	Population of <i>Spodoptera litura</i> adult	Temperature (°C)			Relative Humidity (%)			Rainfall (mm)	Sunshine (Hours)
			Max.	Min.	Mean	Max.	Min.	Mean		
30	19 - 25 July, 2020	0.00	34.20	26.10	30.15	88	74	81.00	67.00	4.56
31	26 July - 01 Aug., 2020	0.00	32.80	26.40	29.60	93	84	88.50	56.60	6.95
32	02 - 08 Aug., 2020	0.00	32.70	25.70	29.20	90	75	82.50	29.60	12.40
33	09 - 15 Aug., 2020	0.00	31.50	24.00	27.75	93	82	87.50	92.80	9.15
34	16 - 22 Aug., 2020	0.85	32.00	24.70	28.35	91	81	86.00	33.00	6.50
35	23 - 29 Aug., 2020	1.90	33.00	25.90	29.45	91	77	84.00	07.20	712
36	30 Aug. - 05 Sep., 2020	3.55	34.60	26.50	30.55	89	75	82.00	05.60	9.25
37	06 - 12 Sept., 2020	5.56	32.50	25.40	28.95	92	80	86.00	87.00	9.31
38	13 - 19 Sept., 2020	7.59	31.40	21.10	26.25	93	82	87.50	56.20	9.38
39	20 - 26 Sept., 2020	8.93	30.60	23.50	27.05	94	81	87.50	10.00	10.42
40	27 Sept., - 03 Oct., 2020	6.59	32.00	22.40	27.20	89	66	77.50	23.40	9.80
41	04 - 10 Oct., 2020	5.12	33.00	19.30	26.15	86	55	70.50	00.00	9.55
42	11 - 17 Oct., 2020	3.89	32.40	18.70	25.55	86	59	72.50	00.00	4.33

Table 2 Population fluctuation of adult *Spodoptera litura* (Fab.) on chilli crop during *Kharif* - 2020

S.W.	Period	Population of <i>Spodoptera litura</i> adult	Temperature (°C)			Relative Humidity (%)			Rainfall (mm)	Sunshine (Hours)
			Max.	Min.	Mean	Max.	Min.	Mean		
30	19 - 25 July, 2020	0.00	34.80	25.60	30.20	87.00	66.00	76.50	4.40	5.25
31	26 July - 01 Aug., 2020	0.00	34.00	24.80	29.40	91.00	75.00	83.00	111.20	6.50
32	02 - 08 Aug., 2020	0.00	32.50	25.30	28.90	93.00	81.00	87.00	82.40	11.95
33	09 - 15 Aug., 2020	0.26	31.10	25.20	28.15	93.00	86.00	89.50	174.20	10.38
34	16 - 22 Aug., 2020	0.15	31.10	24.60	27.85	94.00	78.00	86.00	27.60	8.50
35	23 - 29 Aug., 2020	0.95	32.10	24.30	28.20	93.00	76.00	84.50	42.20	7.85
36	30 Aug., - 05 Sep., 2020	4.20	33.80	24.70	29.25	91.00	68.00	79.50	1.60	9.25
37	06 - 12 Sept., 2020	6.15	36.00	25.30	30.65	89.00	59.00	74.00	4.60	9.38
38	13 - 19 Sept., 2020	6.93	36.30	25.20	30.75	89.00	60.00	74.50	4.20	10.50
39	20 - 26 Sept., 2020	7.25	34.20	23.30	28.75	91.00	63.00	77.00	22.80	10.42
40	27 Sept., - 03 Oct., 2020	5.33	33.50	21.35	27.43	88.00	61.00	74.50	3.10	9.50
41	04 - 10 Oct., 2020	4.17	33.00	18.40	25.70	85.00	55.00	70.00	3.65	9.60
42	11 - 17 Oct., 2020	2.23	32.75	17.70	25.23	86.00	55.00	70.50	2.22	4.80

Fig 1 Population of adult *S. litura* on chilli crop during *kharif* 2019 and 2020Table 3 Population fluctuation of adult *Spodoptera litura* (Fab.) on chilli crop during *Kharif* - 2019

Insect	Ecological Parameters				
	Year	Maximum Temperature (°C)	Minimum Temperature (°C)	Average Temperature (°C)	Morning RH (%)
<i>Spodoptera litura</i>	2019	-0.01814	0.31493	0.25274	0.41627
	2020	0.14909	0.36875	0.35281	0.30269
	Year	Evening RH (%)	Average RH (%)	Rainfall (mm)	Sun Shine (Hours)
	2019	0.41035	0.41831	0.00542	0.02223
	2020	0.33174	0.33046	0.07448	0.21821

The adult of *Spodoptera litura* showed non-significant positive relationship ( $r = 0.13746$ ,  $r = 0.06584$ ,  $r = 0.10139$ ,  $r = 0.24505$  and  $r = 0.11786$ ) with RH (morning, evening and average), rainfall and sun shine hours, respectively and non-significant negative relationship ( $r = -0.17627$ ,  $r = -0.20654$  and  $r = -0.26906$ ) with temperature (maximum, minimum and average), respectively during 2019.

During second year 2020 maximum temperature showed significant positive coefficient of correlation ( $r = 0.62578$ ) and evening RH showed significant negative coefficient of correlation ( $r = -0.56414$ ) with this pest of *Spodoptera litura*. The average temperature and sun shine hour showed non-significant positive relationship ( $r = 0.24313$  and  $r = 0.49878$ ) and minimum temperature, RH (morning and average) and

rainfall also showed non-significant negative relationship ( $r = -0.13920$ ,  $r = -0.15541$ ,  $r = -0.47725$  and  $r = -0.54310$ ) with

this pest during same years 2020 [16-17]. Highest population (17/trap) was recorded in the 51<sup>th</sup> SMW [18].

Table 4 Population fluctuation of adult *Spodoptera litura* (Fab.) on chilli crop during Kharif – 2020

Insect	Ecological Parameters				
	Year	Maximum Temperature (°C)	Minimum Temperature (°C)	Average Temperature (°C)	Morning RH (%)
<i>Helicoverpa armigera</i>	2019	0.09163	0.26036	0.18336	0.44154
	2020	-0.04408	0.19333	0.14416	0.36441
	Year	Evening RH (%)	Average RH (%)	Rainfall (mm)	Sun Shine (Hours)
	2019	0.44570	0.45193	0.29083	0.17263
	2020	0.31459	0.33101	0.21358	0.22662

## CONCLUSION

Adult population (0.85 adults/trap) appeared second week in August 16<sup>th</sup> to 22<sup>nd</sup> August (34<sup>th</sup> standard week) with the maximum and minimum temperature 32.0°C and 24.70°C respectively, average relative humidity 86.0 per cent and rainfall 33.0 mm and sunshine (hours) 6.50 was recorded. Adult population increased and recorded maximum i.e., 8.93 adults per trap during 39<sup>th</sup> standard weeks (20<sup>th</sup> to 26<sup>th</sup> September) when the maximum and minimum temperature 30.60°C and 23.50°C respectively, average relative humidity

87.50 per cent was recorded during second year 2019. adult population of *Spodoptera litura* (Fab.) during 2020 Adult population (0.26 adults/trap) appeared first in August 09<sup>th</sup> to 15<sup>th</sup> August (33<sup>th</sup> standard week) with the maximum and minimum temperature 31.10°C and 25°C respectively, average relative humidity 89.50 per cent and rainfall 174.20 mm and sun shine 10.38 was recorded. Adult population increased and recorded maximum i.e., 7.25 adults per trap during 39<sup>th</sup> standard weeks (20<sup>th</sup> to 26<sup>th</sup> September) when the maximum and minimum temperature 34.20°C and 23.30°C was recorded.

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