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EFFECT OF ABIOTIC FACTORS ON LARVAL POPULATION OF TOBACCO CATERPILLAR (*SPODOPTERA LITURA* FAB.) ON CAULIFLOWER

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ABSTRACT

The field experiments on effect of abiotic factors on larval population of Tobacco Caterpillar (*Spodoptera litura*) was conducted at research field of Khanpur, block Pataudi of district Gurugram, Haryana during two rabi seasons i.e., 2017-2018 and 2018-2019. Data revealed that maximum population of S. *litura* was recorded as 3.42, 2.95 larvae / 05 plants in 51st standard meteorological week during 2017-2018 and 2018-2019 rabi seasons in the range of temperature 9.80 ºC to 22.70 ºC and 7.50 ºC to 21.50 ºC. The relative average humidity was 60.40% and 59.10 % was recorded respectively. Coefficient of correlation of average temperature indicated negative (r = -0.899 and r = -0.647) and average humidity indicated positive (r = 0.230 and 0.729) with relation to larval population of *S. litura* during both cropping seasons.

***Keywords*:** Abiotic factors, Cauliflower, Tobacco caterpillar, Relative humidity, Temperature, Rainfall, *Spodoptera litura.*

Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* Linn.) isan important vegetable grown more or less in all the states of India. It contains proteins and minerals such as potassium, sodium, iron, phosphorous, calcium and magnesium. It is low in fat, high in dietary fiber and water content. It also has anticancerous value (Zhao *et al.,* 2002) due to glucosinolates which are helpful in detoxifying human blood. Apart from abiotic factors, there are certain biotic factors i.e. insect-pests responsible for its qualitative and quantitative production sometimes cause complete failure of the crop. (Jat *et al*., 2017) It is subject to be attacked by number of insect pests i.e., tobacco caterpillar (*Spodoptera litura*), diamondback moth (*Plutella xylostella* L.), cabbage butter fly, cabbage leaf webber, cabbage semi lopper, painted bug, mustard saw fly, flea beetle and aphids (Chaudhuri *et al.,* 2001). Hence the present investigation was undertaken to study the effect of abiotic factors like temperature, relative humidity, extent and distribution of rainfall, etc. on Tobacco caterpillar larval population.

Material and Methods

Gurugram is situated between 28.45^{0}N' latitude and 77^0 02 E' longitude at an altitude of 217 meters above mean sea level just south west of New Delhi. The district Gurugram falls under northern plains of upper Gangetic plains. The total geographical area of 732 km^2 is covered by this district in Haryana. Gurugram district is listed in semi-arid and sub-tropical climatic regions and is characterized by hot summer and cold winters. During summer maximum temperature reaches up to 45˚C whereas minimum temperature is 4-5˚C during winter season. The average annual rainfall is about 714 mm of which

about 75-80 percent is received through south west monsoon during the month of July to September. Few rain shower occasionally occur in the winter and summer season. The meteorological information of Gurugram, Haryana was obtained from the meteorological laboratory of the Krishi Vigyan Kendra, Gurugram, Haryana.

Field preparation

The experimental field was ploughed by tractor drawn harrow to expose the immature larval stage of soil borne insect pests. The field was deep (20-25 cm) ploughed. Thereafter, cross harrowing (2-3) was also done to make soil friable and loose. Planking (1-2) was done for making the surfaces smooth and levelled.

Transplanting

Nursery bed was irrigated just one day before transplantation to make the soil soft. Twenty-five days old seedlings of cauliflower were transplanted in the third week of October, 2017-2018 and 2018-2019 respectively in the main field. Transplanting was done manually keeping two seedlings per hills. Spacing between row to row and plant to plant was kept 60 x 45 cm respectively. Gap filling was done one week after transplanting from the same raised nursery for maintaining the optimum plant population. All agronomic practices were followed upto harvesting.

Fertilizer application

Farm Yard Manure (FYM) 20-25 t/ha incorporated in the soil three weeks before transplanting of Cauliflower saplings i.e., 100 kg/ ha, 125 kg/ha and 150 kg/ha N, P and K fertilizers respectively in field. After 5-6 weeks of transplanting, three to four split doses of liquid nitrogen (100 kg N/ha) were also applied.

Weeding

The experimental plots were kept free of weeds throughout the crop period by giving two manual weeding at 30 and 45 days after transplanting with the help of spade/ khurpi.

Water management

Cauliflower requires heavy moisture in soil during early stages but heavy irrigation to be avoided at head formation stage because irrigation after long dry spells causes bursting of Cauliflower heads. The estimated daily irrigation water requirement of Cauliflower crop is 4.66 l/4plants during early stage and 6.62 l/4 plants during peak growth stage. Water management was done on regular basis.

Layout of experiment

The experiment was laid out in randomization block design (RBD) with three replications each contains seven treatments including control. Pusa Snow ball-1 variety of Cauliflower was taken in this study. The plot size for each treatment was kept 3.5 × 4.0 m^2 with spacing between row to row and plantto plant 60 cm and 45cm respectively.

To record the population fluctuation of Tobacco caterpillar larvae, random sampling was carried out from experimental field. Five plants were taken randomly from each experimental treated plot including control. The field observations were taken at weekly interval. Weekly meteorological data on temperature (minimum & maximum) relative humidity and rainfall was recorded throughout the crop season. Simple correlation was done using following formula:

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

Where,

X_1Y_1 = Simple correlation coefficient

X_1 = Infestation percent

Y_1 = Meteorological parameter

N = Number of observations

Statistical Analysis

The data recorded during the course of investigation was subjected to statistical analysis by using analysis of variance technique (ANOVA) for Randomized Block Design as suggested by Panse and Sukhatme (1978). The data was transformed necessarily. Standard error of mean in each case and critical difference was computed at 5% level of probability.

$$SE(m) \pm \sqrt{\frac{EMMS}{r}}$$

Where

SE(m) = Standard error of mean

EMSS = Error mean sum of square

r = Number of replications

- The critical difference @ 5 percent level of probability was worked out to compare treatment mean wherever 'F' was significant.

Critical difference = SE (m) ± x √2x t (at degree of freedoms).

The recorded data was also analyzed with the help of computer software "OPSTAT1" developed by O.P. Sheoren, CCS HAU Hisar.

Result and Discussion

Tobacco caterpillar larvae was found to be the dominating pest species in Gurugram district. Population buildup of Tobacco caterpillar (*Spodoptera litura*) larvae in Cauliflower was studied during two consecutive seasons, November – February of 2017 – 2018 and 2018- 2019 in one of the farmer's fields at Patudi of Gurugram district where no pesticides was applied. Area of observation for each crop comprised 50 cents. Mean population of caterpillars per plant per week was observed from thirty randomly selected plants. The data collected was analyzed and compared with specific growth stages to draw conclusions on the susceptibility of each stage of the insect pests.

The observation recorded as regards the incidence of tobacco caterpillar larvae during 2017-2018 were presented in Table-1 and depicted in Figure 1. Data revealed that the tobacco caterpillar population (0.37) appeared in third week of October (43rdstandard week) and gradually reached up to maximum level of 3.42 tobacco caterpillar larvae / 05 plants during the eleventh week of December (51st standard week) when temperature and relative humidity ranged from 22.70^{o}c to 9.80^{o}c (mean temperature 16.25^{o}c) and 78.80 and 42 percent humidity (mean humidity 60.40 percent) respectively. The population of tobacco caterpillar decreased very fast during 52 standard weeks. The coefficient of correlation showed that the average temperature and average humidity indicated negative (r=--0.899) and positive (r=0.230) relationship during 2017-2018 crop season respectively (Table- 3).

Table 1: Larval population of Tobacco caterpillar, *Spodoptera litura* (Fab.) on Cauliflower during Rabi October, 2017 to January, 2018

S.W	Crop stage (week after planting)	Average population (*S. litura* / 05 plants)	Temperature (^{0}c)			Relative humidity (%)			Rainfall (mm)
			Max. (^{0}c)	Min. (^{0}c)	Average (^{0}c)	Morning (%)	Evening (%)	Average (%)	
41	1	0.00	35.20	22.20	28.70	70.20	33.70	51.95	0.00
42	2	0.00	34.70	19.70	27.20	66.00	31.50	48.75	0.00
43	3	0.37	33.40	18.70	26.05	69.00	27.00	48.00	0.00
44	4	0.65	30.90	18.50	24.70	80.50	42.70	61.60	0.00
45	5	1.13	29.20	15.50	22.35	83.40	40.80	62.10	0.00
46	6	1.63	27.30	15.00	21.15	80.10	43.40	61.75	0.00
47	7	2.20	25.10	10.50	17.80	59.40	28.80	44.10	0.00
48	8	2.55	27.00	11.80	19.40	64.50	28.00	46.25	0.00
49	9	2.75	24.60	11.80	18.20	58.20	31.40	44.80	0.00
50	10	3.05	22.20	11.10	16.65	86.10	55.10	70.60	0.00
51	11	3.42	22.70	9.80	16.25	78.80	42.00	60.40	0.00
52	12	2.63	23.90	9.40	16.65	83.70	40.60	62.15	0.00
1	13	1.85	19.10	7.50	13.30	95.80	58.70	77.25	0.00
2	14	1.78	22.00	7.70	14.85	82.50	38.70	60.60	0.00
3	15	1.68	24.00	8.00	16.00	88.00	38.70	63.35	0.00

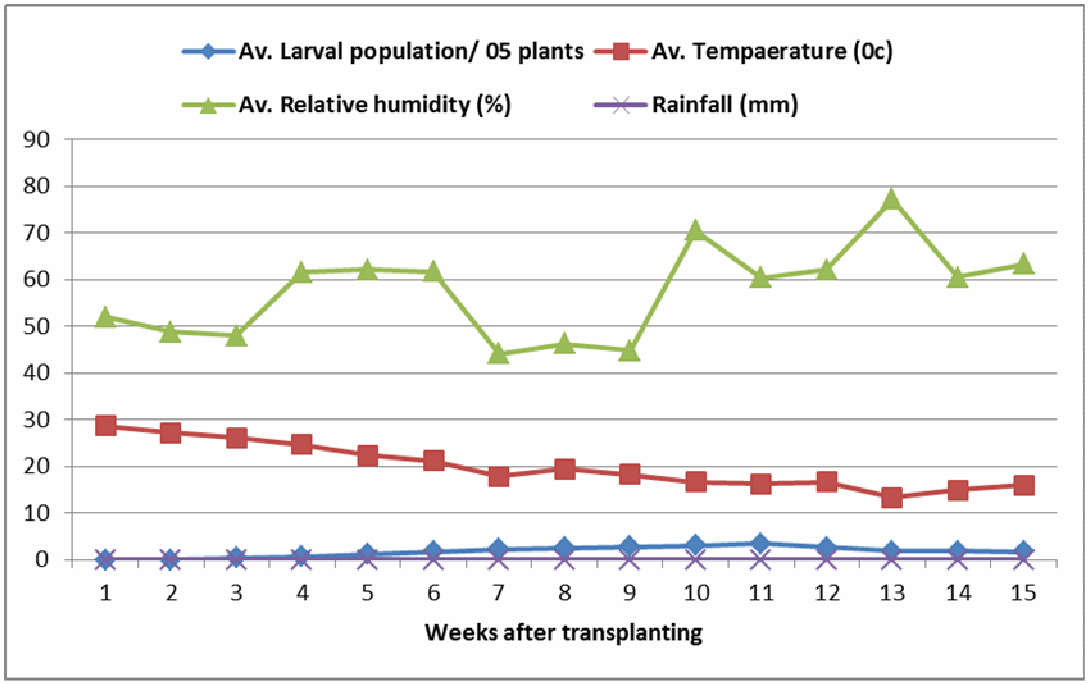

Fig. 1: Impact of weather on larval population of Tobacco caterpillar, *Spodoptera litura* (Fab.) on Cauliflower during Rabi season from October, 2017 to January, 2018

The information on seasonal incidence of Tobacco Caterpillar and its correlation with different abiotic factors was however generated by many workers (Sharma, 2011 and Shyam, *et al.,* 2020) from different regions of India. But in the present investigation study was carried out in Gurugram, Haryana area in farmer field. Murthy (1994) was also of the opinion that November and December months were favorable for multiplication of *S. litura* on Cauliflower in Andhra Pradesh. Lavanya (1995) reported that high population of *S. litura* on Cabbage occurred during January, but slowly declined and reached to a minimum by second week of March and thereafter there was slight increase during third and last week of March. In a study conducted by Dhanaraj (2000) in Dharwad districts during summer, *S. litura* incidence was found throughout the season and the initial population recorded was 4.42 larvae per plant. The population was 6.89 larvae per plant on 40 days old crop during March. The incidence of *S. litura* on Cauliflower was observed from fourth week of November to third week of February and peak population (21.3 larvae per plant) was observed during second week of January in Bhubaneswar.

Rao *et al.* (2006) reported that *S. litura* population had no significant relationship with temperature, relative humidity and wind speed whereas Kumar *et al.* (2007) reported that its population had a significant positive correlation with mean temperature and non-significant negative correlation with relative humidity in Meerut. Patait *et al.* (2008) reported that *S. litura* population on Cabbage ranged from 0.6 to 3.2 larvae per quadrat and that it was positively correlated with minimum temperature and negatively correlated with forenoon RH.

During the second Rabi season (2018-2019) the observation recorded in the incidence of tobacco caterpillar larvae during 2018-2019 was presented in Table- 2 and depicted in Figure 2. Data revealed that tobacco caterpillar larval population appeared in third week of October (43rd standard week) as 0.65 and gradually reached up to maximum level of 2.95 tobacco caterpillar larvae / 05 plants during eleventh week of December (51st standard week) when temperature and relative humidity ranged from 21.50^{o}c to 7.50 ^{o}C (mean temperature 14.50^{o}c) and 77 and 41.20 percent humidity (mean humidity 59.10 percent) respectively. The population of tobacco caterpillar decreased very fast after 51 standard week. The coefficient of correlation showed that the average temperature and average humidity indicated negative (r=--0.647) and positive (r=0.729) relationship during 2018-2019 crop season respectively (Table- 3).

The present findings are also supported with Mandal and Patnaik (2011) who reported that *Spodoptera litura* was active from December to March while *Crocidolomia pavonana* populations reached peak levels during the end of January and in the beginning of February. High population of *Plutella xylostella* was observed from mid January to the end of

March. Similarly, the aphid complex (*Lipaphi serysimi, Myzus persicae* and *Brevicoryne brassicae*) populations gradually increased and reached peak levels by the end of January and then slowly decreased by the end of March. The present findings are dissimilar with Venkateswarlu *et al.* (2011) who recorded that maximum yield loss in Cole crops occurred due to substantial damage by aphids, diamondback moth and tobacco caterpillar.

Table 2: Larval population of Tobacco caterpillar, *Spodoptera litura* (Fab.) on Cauliflower during Rabi October, 2018 to January, 2019

S.W	Crop stage (week after planting)	Average population (*S. litura* /05 plants)	Temperature (^{0}c)			Relative humidity (%)			Rainfall (mm)
			Max. (^{0}c)	Min. (^{0}c)	Average (^{0}c)	Morning (%)	Evening (%)	Average (%)	
41	1	0.00	33.70	20.60	27.15	62.20	40.40	51.30	0.00
42	2	0.00	33.50	18.90	26.20	62.70	32.10	47.40	0.00
43	3	0.65	31.40	16.90	24.15	57.50	32.70	45.10	0.00
44	4	1.35	30.30	17.40	23.85	63.00	40.10	51.55	0.00
.45	5	1.08	28.80	12.80	20.80	62.00	36.40	49.20	0.00
46	6	0.92	28.50	15.20	21.85	73.70	44.20	58.95	10.00
47	7	1.22	27.60	13.60	20.60	65.40	37.80	51.60	0.00
48	8	1.42	26.70	12.30	19.50	68.70	41.50	55.10	0.00
49	9	1.85	25.10	11.20	18.15	70.80	40.80	55.80	0.60
50	10	2.73	22.40	10.90	16.65	80.20	52.10	66.15	0.00
51	11	2.95	21.50	7.50	14.50	77.00	41.20	59.10	0.00
52	12	1.58	23.00	7.90	15.45	93.10	49.20	71.15	0.00
1	13	1.42	20.70	8.50	14.60	92.20	62.00	77.10	1.00
2	14	1.25	21.10	8.40	14.75	81.00	41.40	61.20	0.00
3	15	1.05	22.10	8.10	15.10	78.50	44.50	61.50	0.00

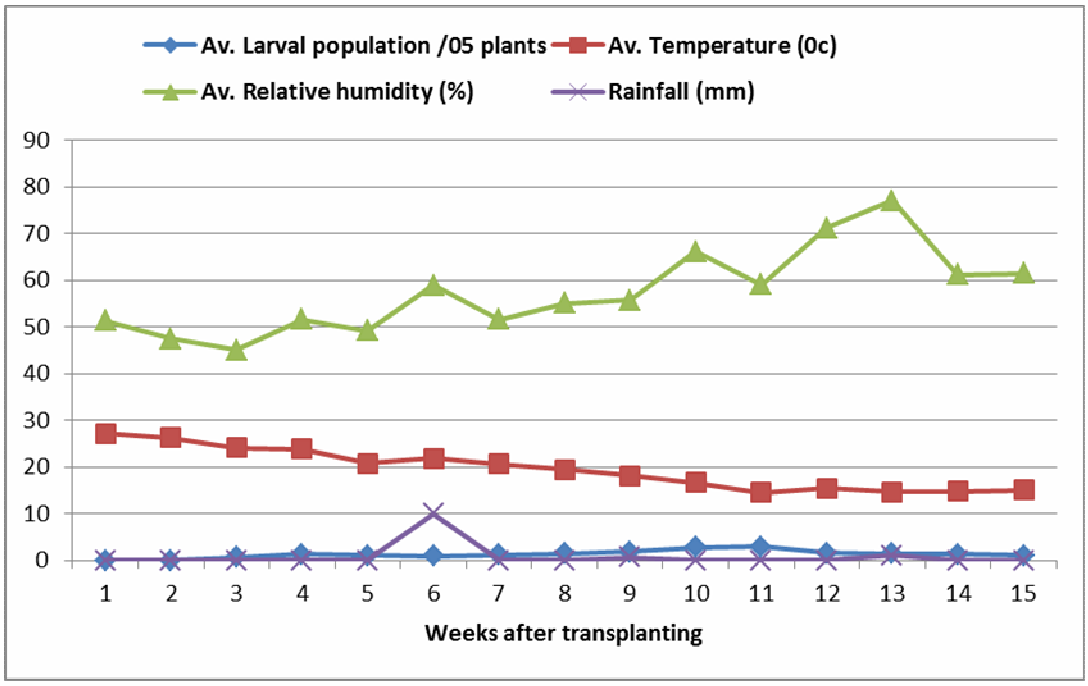

Figure 2: Impact of weather on larval population of Tobacco caterpillar, *Spodoptera litura* (Fab.) on Cauliflower during Rabi, October, 2018 to January, 2019.

Table 3: Correlation between major insect pests of Cauliflower in relation to climatic factors during Rabi, 2017-2018 and 2018-2019

Year	Insect pests	Temperature (^{0}c)			Relative humidity (%)			Rainfall (mm)
		Max.	Mini.	Av.	Morning	Evening	Av.	
2017-2018	Tobacco caterpillar	-0.627*	-0.893*	-0.899*	0.236^{NS}	0.171^{NS}	0.230^{NS}	0.323^{NS}
2018-2019	Tobacco caterpillar	-0.561*	-0.664*	-0.647*	0.494^{NS}	0.666^{NS}	0.729^{NS}	0.241^{NS}

* Significant at 5% level (p=0.05)

The coefficient of correlation showed that the average temperature and average humidity indicated negative (r=- 0.899) and positive (r= 0.230) relationship during 2017-2018 and negative (r= -0.647) and positive (r= 0.729) relationship during 2018-19 crop season respectively (Table-3). However, Jat *et al.,* (2017) reported tobacco caterpillar and diamond black moth population were maximum in the first and second week of February. The cabbage semilooper population was at its peak in the last week of January during 2012-2013 and 2013-2014 respectively. The present findings are dissimilar with Khan and Talukar (2017) who reported positive correlation (r=0.824 and r=0.920) of temperature and population of *S. litura*. However, it had negative correlation with morning and evening relative humidity (r=-0.439 and r=-0.716).

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