Original Research Article

Studies on the Effect of Abiotic ~~factors~~ Factorson the larval population of Diamond Back ~~moth~~ Moth(*Plutellaxylostella* L.)on Cauliflower

ABSTRACT

The field experiments on the effect of abiotic factors on larval population of Diamond Back moth 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 the Diamondback moth, *P. xylostella* population (0.33) appeared in first week of October (41st standard week) and gradually reached up to maximum level of 8.33 diamondback moth larvae/05 plants during third week of December (50thstandard week) during 2017-2018 however it appeared in second week of October (42nd standard week) (1.33) and gradually reached up to maximum level of 8.67 diamondback moth larvae/05 plants during second week of December (49th standard week) during the year 2018-2019.

KEYWORDS: Abiotic factors, Cauliflower, Diamond Back moth, Relative humidity, Temperature, Rainfall.

1. INTRODUCTION

Cauliflower (*Brassica oleracea* var. *botrytis* Linn.) ~~isan important vegetable crop of Cyprus and Mediterranean origin andintroduced in India for~~ is an important vegetable crop of Cyprus and Mediterranean origin and was introduced in India for the first time in 1822. Now, it is grown more or less in all the states of our country. It contains proteins and minerals such as potassium, sodium, iron, phosphorous, calcium, and magnesium. It is low in fat~~,~~ and 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~~ , i.e., insect pests responsible for its qualitative and quantitative production, sometimes cause the complete failure of the crop. It is subject to be attacked by ~~number of insect pestsi.e., tobacco caterpillar (*Spodopteralitura*), diamondback moth (*Plutellaxylostella* L.), cabbage butter fly, cabbage leaf webber, cabbage semi lopper, painted bug, mustard saw fly~~a number of insect pests, i.e., tobacco caterpillar (Spodoptera litura), diamondback moth (Plutellaxylostella L.), cabbage butterfly, cabbage leaf webber, cabbage semi lopper, painted bug, mustard sawfly, flea beetle and aphids (Chaudhuri *et al.,* 2001).

The present investigationwas undertaken to study the effect of abiotic factors like temperature, relative humidity, ~~extent and distribution of rainfall, etc. on the Diamond back~~the extent and distribution of rainfall, etc., on the Diamondback moth larval population.

2. MATERIAL AND METHODS

Gurugram is ~~situated between 28.45^{0}N' latitude and 77^{0} 02 E' longitude at an altitude of~~ between 28.450N' latitude and 770 02 E' longitude at an altitude of

28.450N' latitude and 770 02 E' longitude at 217 meters above mean sea level just ~~south west~~southwest of New Delhi. The district Gurugram falls under ~~northern plains of~~ the northern plains of the upper Gangetic plains~~. The total geographical area of 732 km2 is 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~~ summers and cold winters. During summer~~ maximum temperature reaches up to 45˚C whereas minimum temperature is 4-5˚C during~~ , the maximum temperature reaches up to 45˚C, whereas the minimum temperature is 4-5˚C during the winter season. The average annual rainfall is ~~about714 mm of which about 75-80 percent is received through south west~~about 714 mm, of which about 75-80 percent is received through southwest monsoon during the month of July to September. Few rain ~~shower occasionally occur in the winter and summer season~~showers occur in the winter and summer seasons. The meteorological information of Gurugram, Haryana~~ was obtained from the meteorological laboratory of the KrishiVigyan~~, were 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~~tractor-drawn harrow to expose the immature larval stage of soil-borne insect pests. The field was ploughed deep (20-25 cm). Thereafter, cross harrowing (2-3) was also done to make the soil friable and loose. Planking (1-2) was done to make the surfaces smooth and ~~levelled~~leveled.

TRANSPLANTING

~~Nursery bed was irrigated just one day before transplantation to make the soil soft~~The nursery bed was irrigated just one day before transplantation to soften the soil. Twenty-five days old ~~seedlings of cauliflower was transplanted in thethird week of October, 2017-2018 and 2018-2019 respectively~~was cauliflower seedlings 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~~, keeping two seedlings per hill. 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~~to maintain the optimum plant population. All agronomic practices were followed upto harvesting.

FERTILIZATION

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 liquidnitrogen (100 kg N/ha) was~~was incorporated into the soil three weeks before transplanting Cauliflower saplings, i.e., 100 kg/ha, 125 kg/ha and 150 kg/ha N, P, and K fertilizers, respectively, in the 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~~, but heavy irrigation should be avoided at the head formation stage because irrigation after long dry spells causes Cauliflower heads to burst. The estimated daily irrigation water requirement of the Cauliflower crop is 4.66 l/4 plants during the early stage and 6.62 l/4 plants during the peak growth stage. Water management is done on a 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~~, each containing seven treatments, including a control. Pusa Snowball-1 variety of Cauliflower was used in this study. The plot size for each treatment was 3.5 × 4.0 m2, with spacing between row to row and plant to plant 60 cm and 45cm, respectively.

~~To record the population fluctuation of Diamondback moth larvaerandom sampling was carried out from experimental field~~Random sampling was carried out from experimental field to record the population fluctuation of Diamondback moth larvae. Five plants were taken randomly from each experimental treated plot ~~including~~ , including the control. The field observations were taken at weekly ~~interval~~intervals. Weekly meteorological data on temperature (minimum ~~&maximum) relative humidity~~ and maximum), relative humidity, and rainfall was also recorded throughout the crop season. ~~Simple~~ The simplecorrelation was done using the 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,

X1Y1 = Simple correlation coefficient
X1 = Infestation percent
Y1 = Meteorological parameter
N = Number of observation

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~~investigation was subjected to statistical analysis using the analysis of

variance technique (ANOVA) for Randomized Block Design, as suggested by Panse and Sukhatme (1978). The data was transformed necessarily. In each case, the standard error of the mean and critical difference were computed at the 5% ~~level of probability~~probability level.

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

Where
SE(m) = Standard error of mean
EMSS = Error mean sum of square
r = Number of replication

- 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 freedom).

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

3. RESULT AND DISCUSSION

Diamondback moth larvae was found to be the dominating pest species in Gurugram district. Population buildup of diamondback moth 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 Pataudi 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. (Jat*et al*., 2017)

RABI,2017-18

The observations recorded for incidence of diamondback moth larval population in relation to abiotic factors during Rabi, 2017-2018 was presented in Table-1 and depicted in Figure1. Data revealed that diamond black moth population (0.33) appeared in first week of October (41st standard week) and gradually reached up to maximum level of 8.33 diamondback moth larvae / 05 plants during third week of December (50th standard week) when temperature ranged from 22.20 to 11.10^{o}c (mean temperature 16.65^{o}c) and relative humidity 86.10 and 55.10 percent humidity (mean humidity 70.60 percent) respectively. The population of diamondback moth decreased very fast during 51 standard week.

Table 1:Larval population of Diamondback moth, *Plutellaxylostella* Linn.onCauliflower during Rabi October, 2017 to January, 2018

S.W	Crop stage (week after planting)	Average population (DBM/05 plants)	Temperature (^{0}c)			Relative humidity (%)			Rain fall (mm)
			Max. (^{0}c)	Min. (^{0}c)	Average (^{0}c)	Morning (%)	Evening (%)	Average (%)	
41	1	0.33	35.20	22.20	28.70	70.20	33.70	51.95	0.00
42	2	1.67	34.70	19.70	27.20	66.0	31.50	48.75	0.00
43	3	2.67	33.40	18.70	26.05	69.00	27.00	48.00	0.00
44	4	4.67	30.90	18.50	24.70	80.50	42.70	61.60	0.00
45	5	5.00	29.20	15.50	22.35	83.40	40.80	62.10	0.00
46	6	5.67	27.30	15.00	21.15	80.10	43.40	61.75	0.00
47	7	6.33	25.10	10.50	17.80	59.40	28.80	44.10	0.00
48	8	7.33	27.00	11.80	19.40	64.50	28.00	46.25	0.00

49	9	7.67	24.60	11.80	18.20	58.20	31.40	44.80	0.00
50	10	8.33	22.20	11.10	16.65	86.10	55.10	70.60	0.00
51	11	6.00	22.70	9.80	16.25	78.80	42.00	60.40	0.00
52	12	5.66	23.90	9.40	16.65	83.70	40.60	62.15	0.00
1	13	3.12	19.10	7.50	13.30	95.80	58.70	77.25	0.00
2	14	2.68	22.00	7.70	14.85	82.50	38.70	60.60	0.00
3	15	2.11	24.00	8.00	16.00	88.00	38.70	63.35	0.00

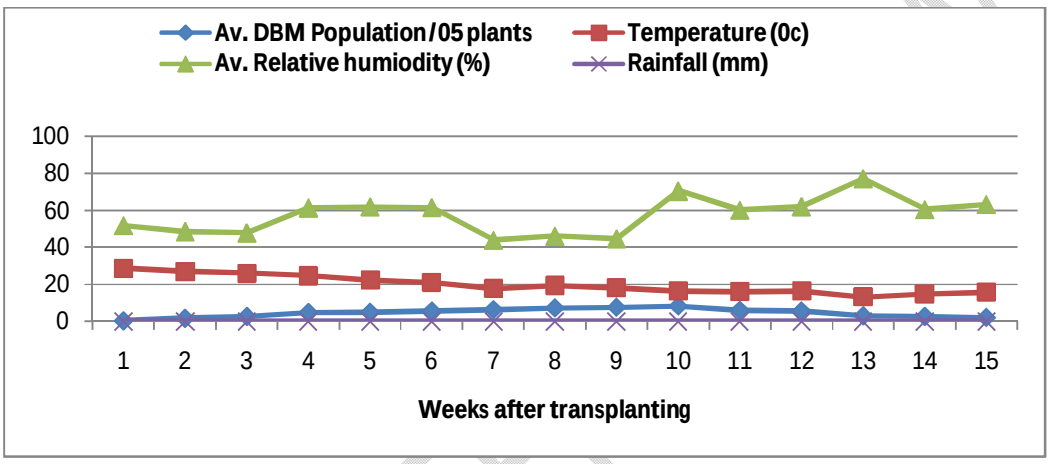

Figure 1:Impact of weather on larval population of Diamondback moth, *Plutellaxylostella* Linn. on Cauliflower during Rabi October, 2017 to January, 2018

The information on ~~seasonal incidence of diamondback moth and its correlation with different abiotic factors was however generated by many workers (Sharma, 2011; and Shyam,~~the seasonal incidence of diamondback moth and its correlation with different abiotic factors was, however, generated by many workers (Sharma, 2011; Shyam*et al.,* 2020) from different regions of India.~~But~~ However,~~in~~ the present investigation study was carried out in Gurugram, Haryana area in farmer field.The coefficient of correlation showed that the average temperature and average humidity indicated negative (r=-0.746) and positive (r=0.257) ~~relationship during 2017-2018 crop season respectively (Table 3~~relationships during the 2017-2018 crop season, respectively (Table 3).Shyam*et al.,* (2020) studiedseasonal incidence of ~~diamond back~~diamondback moth, *Plutellaxylostella*(Linn.) infesting Cauliflower crop and found that the first appearance ~~ofpest~~ of pestwas started during second week of December and reached peak (5.8 larvae/plant) in the last week of January (5th SMW) with significant negative correlation with maximum (r= -0.496), minimum (r= -0.484) and average (r= -0.534) temperature and other weather parameters had non-significant impact on the larval population.

The present findings are in agreement with Malik *et al.*~~, (2000) who also reported that Cauliflower aphid, *B. brassicae* population fluctuated from 51th standard week to~~ *(2000), who also reported that the Cauliflower aphid B. brassicae population fluctuated from the 51st standard week to the* 4thfourthmetrological week. The present findings are dissimilar ~~with Ahmad and Ansari (2010) who has done survey in~~

three locations of Aligarh district and showed that initial infestation of *P. xylostella*occurred when the farmers started transplanting of to those of Ahmad and Ansari (2010), who conducted a survey in three locations in the Aligarh district and showed that initial infestation of P. xylostella occurred when the farmers started transplanting Cauliflower seedlings. The density of *P. xylostella* ranged between 0.90 to 2.38 and 0.27 to 5.84 larvae and pupae /plant in 1st firstweek of July, 2004 and 2005 respectively. During that period temperature and relative humidity of Aligarh varied from 24.15^{0}c to 32.91^{0}c and 68.90 % to 91.30%, the temperature and relative humidity of Aligarh varied from 24.150c to 32.910c and 68.90 % to 91.30%, respectively.

RABI, 2018-19

For the second year the observation recorded for incidence of diamondback moth larval population in relation toabout abiotic factors during 2018-2019 was presented in Table-2 and depicted in Figure2. Data revealed that diamond backdiamondback moth population (1.33) appeared in the second week of October (42ndstandard week) and gradually reached up to the maximum level of 8.67 diamondback moth larvae/05 plants during the second week of December (49 standard weekweeks) when temperature ranged from 25.10^{o}c to 11.20^{o}c (mean temperature 18.15^{o}c) and relative humidity 70.80 and 40.80 percent (mean humidity 55.80 percent) respectively. The population of diamondback moth decreased very fast during 50 standard weekmoths decreased very fast during 50 standard weeks. The coefficient of correlation showed that the average temperature and average humidity indicated negative (r=-0.715) and positive (r=0.733) relationship during 2018-2019 crop season respectively (Table-3relationships during the 2018-2019 crop season, respectively (Table 3).

Table 2: Larval population of Diamondback moth, *Plutellaxylostella* Linn.onCauliflower during Rabi October, 2018 to January, 2019

S. W	Crop stage (the week after planting)	Average population (DBM/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	1.33	33.50	18.90	26.20	62.70	32.10	47.40	0.00
43	3	3.12	31.40	16.90	24.15	57.50	32.70	45.10	0.00
44	4	4.68	30.30	17.40	23.85	63.00	40.10	51.55	0.00
45	5	4.11	28.80	12.80	20.80	62.00	36.40	49.20	0.00
46	6	4.33	28.50	15.20	21.85	73.70	44.20	58.95	10.00
47	7	4.67	27.60	13.60	20.60	65.40	37.80	51.60	0.00
48	8	7.67	26.70	12.30	19.50	68.70	41.50	55.10	0.00
49	9	8.67	25.10	11.20	18.15	70.80	40.80	55.80	0.60
50	10	6.68	22.40	10.90	16.65	80.20	52.10	66.15	0.00
51	11	6.11	21.50	7.50	14.50	77.00	41.20	59.10	0.00
52	12	5.34	23.00	7.90	15.45	93.10	49.20	71.15	0.00
1	13	3.33	20.70	8.50	14.60	92.20	62.00	77.10	1.00
2	14	2.67	21.10	8.40	14.75	81.00	41.40	61.20	0.00
3	15	1.68	22.10	8.10	15.10	78.50	44.50	61.50	0.00

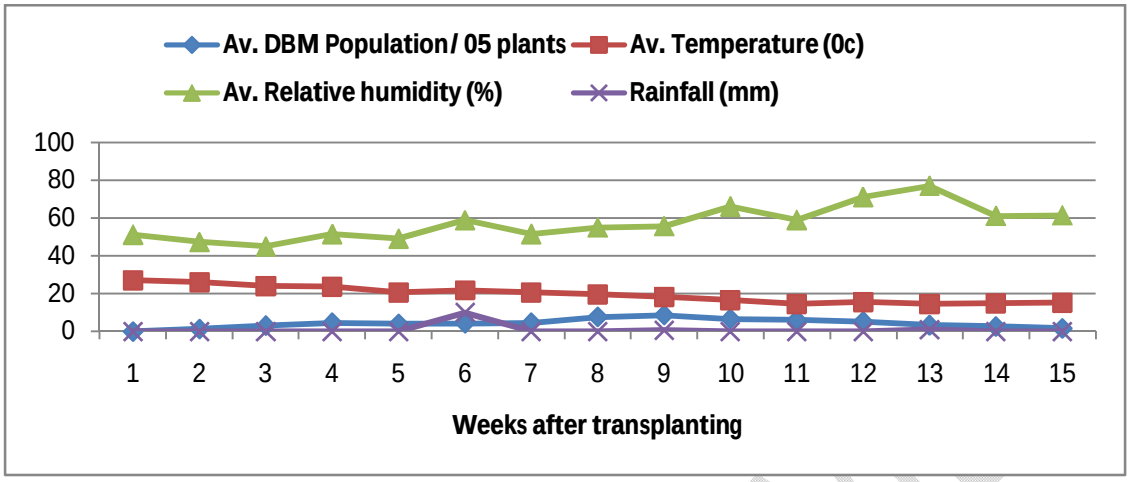

Figure2:Impact of weather on larval population of Diamondback moth,*Plutellaxylostella* Linn. OnCauliflowerduring Rabi , October, 2018 to January, 2019

The present results are in conformity with Meena and ~~Singh (2012) findings in which the incidence of diamondback moth~~ Singh's (2012) findings in which the incidence of diamondback moth was recorded after 35 days of transplanting seedlings along with its peak population in January. The DBM population fluctuated between 2.0 to 11.0 larvae / plant. However, the maximum temperature, low and high relative humidity (RH), rainfall ~~and wind speed had non-significant correlation while positive significant correlation with~~ , and wind speed had non-significant correlations, while a positive significant correlation with a larval population at minimum temperature was recorded. Similar observation was also recorded by Patra *et al.,* (2013) who reported that peak population of diamondback moth was observed on 1st March and 23rd February with 13.60 and 14.33 larvae / plant during the year 2011-12 and 2012-2013 respectively.

Vanlaldiki*et al.,* (2013) reported that ~~larvae of diamondback moth first appeared in end of January, increased gradually and reached its peak by the end of March during~~diamondback moth larvae first appeared at the end of January, increased gradually and reached its peak by the end of March for two consecutive years. The larval population declined by the end of April. The correlation studies indicated a significant positive correlation between ~~*P.xyostella* larval population and temperature except in second year showed~~ *the P.xyostella larval population and temperature, except in the second year, which showed a* non-significant correlation with maximum temperature. The present results ~~are in conformity with Bashir *et al.,* (2015) who reported that minimum temperature (r=0.02 and 0.06) showed positive non-significant correlation whereas negatively~~conformity conform with Bashir et al. (2015), who reported that minimum temperature (r=0.02 and 0.06) showed positive non-significant correlation whereas negative non-significant correlation (r=-0.31 and -0.18) with maximum temperature. The relative humidity had ~~positive relationship with larval population while it had~~ a positive relationship with the larval population, while it had a negative co-relationship with total rainfall.

Table 3: Correlation of Diamondback mothon Cauliflower in relation to climatic factors during Rabi, 2017-2018 and 2018-19

Insect pests	Temperature (^{0}c)			Relative humidity (%)			Rainfall (mm)
	Maximum	Minimum	Average	Morning	Evening	Average	

Diamondback moth	-0.739*	-0.592*	-0.746*	0.212^{NS}	0.233^{NS}	0.257^{NS}	-0.165^{NS}
Diamondback moth	-0.675*	-0.708*	-0.715*	0.385^{NS}	0.711^{NS}	0.733^{NS}	-0.187^{NS}

* Significant at 5% level (p=0.05)

Similarly, Sharma *et al.*~~, (2017) reported significantly negative correlation between maximum and minimum temperature and larval population of~~ *(2017) reported a significantly negative correlation between maximum and minimum temperature and the larval population of the* diamondback moth. However, relative humidity and sunshine hours were non-significantly correlated with ~~diamondback moth population which appeared from third week of November and attained maximum population upto 45.2 larvae /10 plants by~~ the diamondback moth population, which appeared from the third week of November and attained a maximum population of up to 45.2 larvae /10 plants by the first week of January. However, Venugopal*et al.*~~,~~(2017) found *P. xylostella*damage throughout the year from a minimum 0.32 percent (second fortnight of February) to a maximum 5.98 percent (third fortnight of March) ~~with~~ with a significant positive correlation in case of temperature and negative correlation w.r.t relative humidity (R.H), total rainfall and sunshine hours (SSH).

4. CONCLUSION

The effect of abiotic factors on ~~larval population of Diamond Back moth was conducted at research field of Khanpur, block Pataudi of district Gurugram, Haryana during two rabi seasons~~the larval population of the Diamond Back moth was conducted at the research field of Khanpur, block Pataudi of district Gurugram, Haryana, during two rabi seasons, i.e., 2017-2018 and 2018-2019. It was found that the Diamondback moth, *P. xylostella* population (0.33) appeared in the first week of October (41st standard week) and gradually reached up to maximum level of 8.33 diamondback moth larvae/05 plants during third week of December (50thstandard week) during 2017-2018 however it appeared in second week of October (42nd standard week) (1.33) and gradually reached up to maximum level of 8.67 diamondback moth larvae/05 plants during second week of December (49th standard week) during the year 2018-2019.

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