**Original Research Article**

# Studies on the Effect of Abiotic factors on larval population of Diamond Back 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 (41$^{st}$ standard week) and gradually reached up to maximum level of 8.33 diamondback moth larvae/05 plants during third week of December (50$^{th}$standard week) during 2017-2018 however it appeared in second week of October (42$^{nd}$ 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 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, 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 factorsi.e. insect-pests responsible for its qualitative and quantitative production sometimes cause 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, 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 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 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 about714 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 KrishiVigyan 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 was transplanted in thethird 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.

**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 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 Diamondback moth larvaerandom 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 also recorded throughout the crop season. Simple correlation was done using following formula:

$$\sum XY - \frac{(\sum X_1)(\sum Y_1)}{}$$

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

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 5% level of probability.

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

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 (41$^{st}$ standard week) and gradually reached up to maximum level of 8.33 diamondback moth larvae / 05 plants during third week of December (50$^{th}$ 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 |

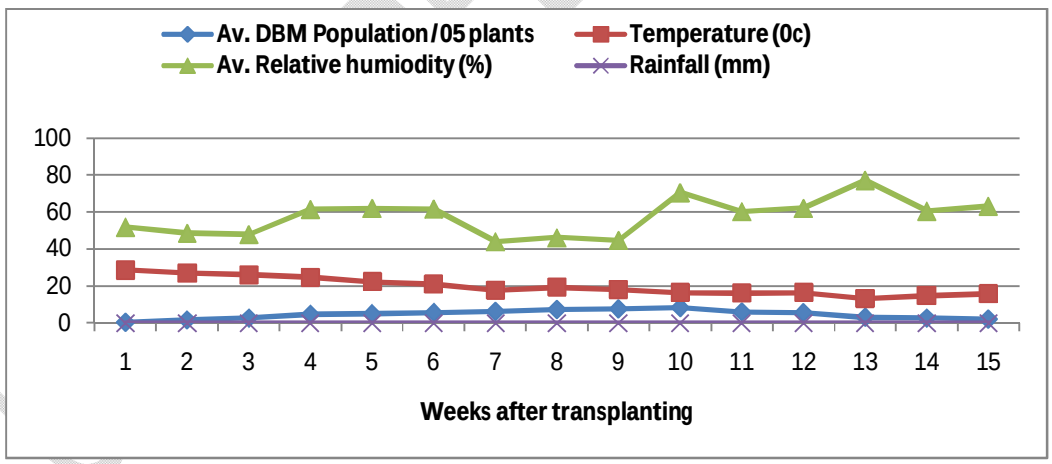


**Figure 1:Impact of weather on larval population of Diamondback moth, *Plutellaxylostella* Linn. on Cauliflower during Rabi October, 2017 to January, 2018**

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, *et al.,* 2020) from different regions of India. But 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).Shyam*et al.,* (2020) studiedseasonal incidence of diamond back moth, *Plutellaxylostella*(Linn.) infesting Cauliflower crop and found that the first appearance ofpest was started during second week of December and reached peak (5.8 larvae/plant) in the last week of January ($5^{th}$ 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 $51^{th}$ standard week to $4^{th}$ metrological 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 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 $1^{st}$ week 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% respectively.

**RABI, 2018-19**

For the second year the observation recorded for incidence of diamondback moth larval population in relation to abiotic factors during 2018-2019 was presented in Table-2 and depicted in Figure2. Data revealed that diamond back moth population (1.33) appeared in second week of October ($42^{nd}$standard week) and gradually reached up to maximum level of 8.67 diamondback moth larvae/05 plants during second week of December (49 standard week) 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 week. 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-3).

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

| S. W | Crop stage (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 |

| S. W | Crop stage (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 (%) | |
| 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 |

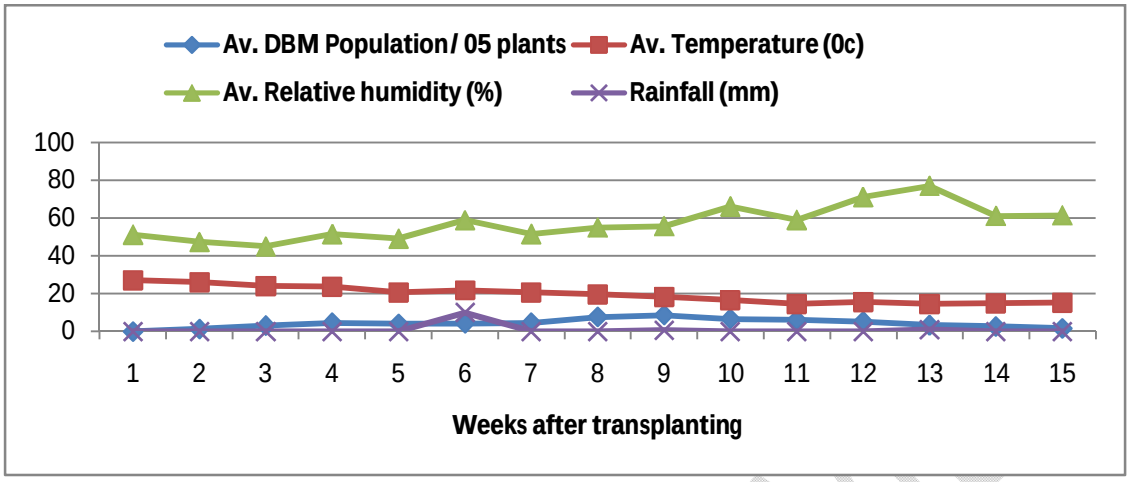


**Figure2:Impact of weather on larval population of Diamondback moth,*Plutellaxylostella* Linn. OnCauliflowerduring Rabi , October, 2018 to January, 2019**

The present results are in conformity with Meena and Singh (2012) findings in which the incidence of diamondback moth 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 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 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 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 non-significant correlation (r=-0.31 and -0.18) with maximum temperature. The relative humidity had positive relationship with larval population while it had 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 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 first week of January. However, Venugopal*et al.,* (2017) found *P. xylostella*damage throughout year from minimum 0.32 percent (second fortnight of February) to maximum 5.98 percent (third fortnight of March) with 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 i.e., 2017-2018 and 2018-2019. It was found that Diamondback moth, *P. xylostella* population (0.33) appeared in first week of October (41$^{st}$ standard week) and gradually reached up to maximum level of 8.33 diamondback moth larvae/05 plants during third week of December (50$^{th}$standard week) during 2017-2018 however it appeared in second week of October (42$^{nd}$ 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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