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## STUDIES ON POPULATION DYNAMICS OF THE DIAMONDBACK MOTH, *PLUTELLA XYLOSTELLA* AND SEASONAL INSECT PESTS WITH THEIR NATURAL ENEMIES ON CABBAGE, *BRASSICA OLERACEA* VAR. *CAPITATA* L. IN VINDHAYA REGION OF INDIA

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### ABSTRACT

The experiment was carried out at Instructional Farm of J.N.K.V.V. College of Agriculture, Rewa (M.P.) during *Rabi* season 2020-2021. Studies conducted on the population dynamics of Diamond back moth in the agro climatic condition of Rewa region indicated its incidence of diamondback moth initiated in the 2<sup>nd</sup> last week of February with a mean population of 0.26 larvae per plant. The population increased gradually and touched its peak with a mean of 4.3 larvae per plants during last week of March (13<sup>th</sup> SW). Thereafter, population reduced gradually. It's showed that the pest was more active during the month of March. The weather parameters *viz.*; maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall during the peak period of incidence were 37.64°C, 16.9°C, 56 per cent, 20.71 per cent and 00.00 mm, respectively. Among the different abiotic factors, maximum and minimum temperature exhibited highly significant positive correlation 0.74 & 0.82 respectively with DBM population, whereas, maximum relative humidity showed no significant negative correlation (0.49), while minimum relative humidity showed significant negative correlation (0.57). Rainfall showed no significant positive correlation with population of diamond back moth. During field studies total six species of insects have recorded in Cabbage *i.e.*, Diamond back moth (*Plutella xylostella*), Tobacco caterpillar (*Spodoptera litura* Fabricius), Leaf eating caterpillar (*Helicoverpa armigera*, Aphid, (*Brevicoryne brassicae*), Flea beetle (*Phyllotrea cruciferae*), Green sting bug (*Nezara viridula*). Six natural enemies found during field investigation *i.e.*, Ladybird beetle (*Chilomenes sexmaculata* Fabricius), Dragon fly (*Ashna* spp.), Damsel fly (*Coenagrion* spp.), Rove beetle (*Paederus fuscipes*), Hover flies (*Furcellata Toxomerus geminetus*), Ground beetle (*Ophionea* spp.).

**Key words** : DBM, Cabbage, Insects, Natural enemies, Abiotic factors.

### Introduction

Cabbage, *Brassica oleracea* var. *capitata* L. is one of the important cruciferous vegetable crops grown in India. It is grown more or less in all the state and is used as salad, in curries, pickling as well as dehydration vegetable. The total area under cultivation of cabbage in India is 3.9 lakh ha with an annual production to the tune with productivity of 9037 metric tons (Anonymous, 2018).

The position of Madhya Pradesh in Cabbage production is 3<sup>rd</sup>. Cabbage area and production are respectively 889.74 ha and 686.91 MT (2017-18) in Madhya Pradesh. The yield of cabbage is adversely affected by many bottlenecks including insect, pest, disease environmental stresses, nutritional imbalance etc. Among them, insect pests, *viz.* tobacco caterpillar, *Spodoptera litura* (Fab.), diamondback moth, *Plutella xylostella* (L.), Cabbage borer, *Helula undalis* (Fab.) cabbage looper, *Tricoplusia*

ni Hub and aphid, *Lipaphis erysimi* (Kalt). Among the pest complex of cabbage, diamond back moth (*Plutella xylostella* Linn.) is the most destructive insect pest. Kumar *et al.* (1983) reported 52 percent losses in marketable yield of cabbage due to the infestation of *Plutella xylostella*. Diamondback moth (DBM), *Plutella xylostella* (Lepidoptera: Plutellidae) is a serious pest and has a great economic importance worldwide. In India, diamond back moth was first recorded on crucifer vegetables in 1914 (Fletcher, 1914) and now it is distributed all over India wherever crucifers are grown and outbreak of *P. xylostella* was reported by Ahmad *et al.* (2009) at Aligarh, India. Diamond back moth has been recognized as a cosmopolitan pest of cruciferous crops and it is well distributed and thrives under extremely varied climatic conditions prevailing in different parts of India and world being reported from 80 countries. In its initial attack, the pest firstly feeds on leaves and later on enters inside the curd thus causing qualitative and quantitative losses to this crop. The damage is caused by its larvae which skeletonizes the foliage part of the host plant and renders it unfit for consumption. The aim of the present study was to correlate the insect with abiotic factors to know population level and to see existence of other insects and natural enemies in Cabbage field.

### Materials and Methods

The experiment were conducted at Instructional farm College of Agriculture, Rewa (M.P) during *Rabi* season 2020-2021. Cabbage was sown in 150 sq. meter area following the standard package and practices for this crop. Population dynamics of DBM of cabbage was studied on variety CLX 3945 by raising crop following all recommended agronomic practices. Meteorological data was collected from the Agro meteorology, College of Agriculture, Rewa, MP and the data were correlated with the population of DBM (*Plutella xylostella*). The crop will be sown in plots of size 15 m × 10 m with plant spacing 50cm × 50 cm. Larval population of DBM were counted per plant on five randomly selected plant plot<sup>-1</sup> from first appearance to till harvest of the crop. Meteorological parameter, *viz.*, temperature, humidity and rainfall were recorded at weekly interval and correlations were worked out. The data on the larval count of each insect were subjected to statistical analysis and to find out the correlation between pest population and various meteorological parameters *viz.* temperature, humidity and rainfall etc. Observations were recorded at weekly intervals between 8-11 AM. The observations on insect pest populations and natural enemies were recorded from five selected plant at fortnightly interval from the

appearance of insect pests and natural enemies till harvesting of the crop.

## Results and Discussion

### Population dynamics of Diamondback moth (*Plutella xylostella*) in cabbage

Diamondback moth (*Plutella xylostella*) was studied in Cabbage under the climatic condition of Rewa district during the *Rabi* season 2021. The incidence of diamondback moth started in the 4<sup>th</sup> standard week to 16<sup>th</sup> standard week have been presented separate Table 1 and Figs. 1 & 2 and along with the climatic data and the coefficient correlation value (r value).

With the view to provide a complete base for the management of insect pests, a quantitative estimation of population build up was carried out in relation to abiotic factors, *viz.* maximum and minimum, temperature, maximum and minimum relative humidity and rainfall under the prevailing agro-climatic conditions of the locality. The starting of infestation caused by diamond back moth was noted in the 8<sup>th</sup> standard week (*i.e.*, Feb.20<sup>th</sup> /2021). With an average population of DBM 0.2 larvae / plant. A gradual increase in the pest population was noted up to 13<sup>th</sup> standard week (*i.e.*, Last week of March 2021) with highest DBM was recorded 4.2 larvae per plants and the number of DBM was recorded 2.0 to 4.2 larvae per plants during entire month of March. Afterwards, population declined and an infestation of 0.8 larvae was noted in 16<sup>th</sup> SMW (2<sup>nd</sup> last week of April 2021).

The environmental conditions during the peak period of investigation indicated a mean rainfall of 00.00 mm, maximum relative humidity 56 % per week and minimum relative humidity 20.7% per week. Maximum and minimum temperature was recorded 37.64°C and 16.90°C, respectively per week. The weather parameters *viz.* maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall during the total period of mean incidence were 32.32°C, 12.46°C, 62.44 per cent, 29.04 per cent and 0.015 mm, respectively. The correlation coefficient between number of DBM per plants and total rainfall was worked out and was positive and non-significant correlated (r = 0.20).

The initiation of diamond back moth infestation was noted in the 8<sup>th</sup> standard week (*i.e.*, Feb. 2<sup>nd</sup> last 2021). With an average population of diamond back moth 0.26 larvae / plant. The average weekly population of 0 to 0.53 larvae per plant during the month of February 2021.

Increased numbers of diamond back moth were observed during the month of February 2021. The

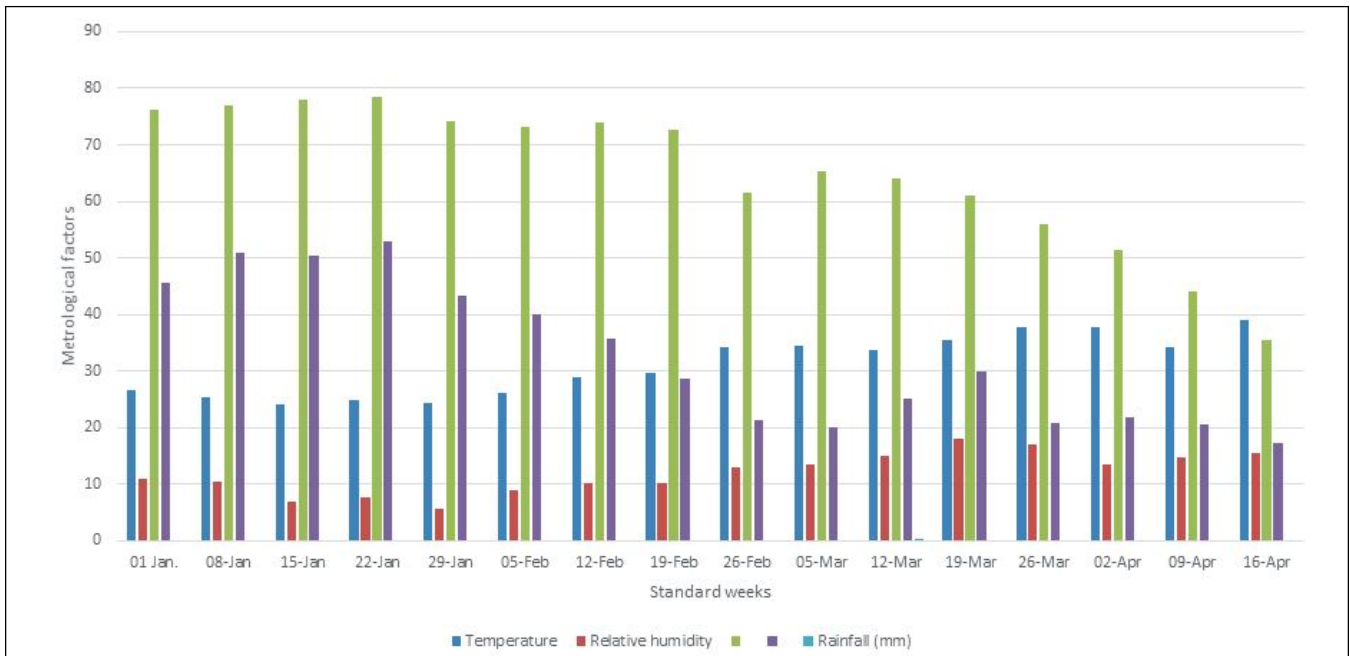


Fig. 1 : Metrological data during the Rabi 2020-21.

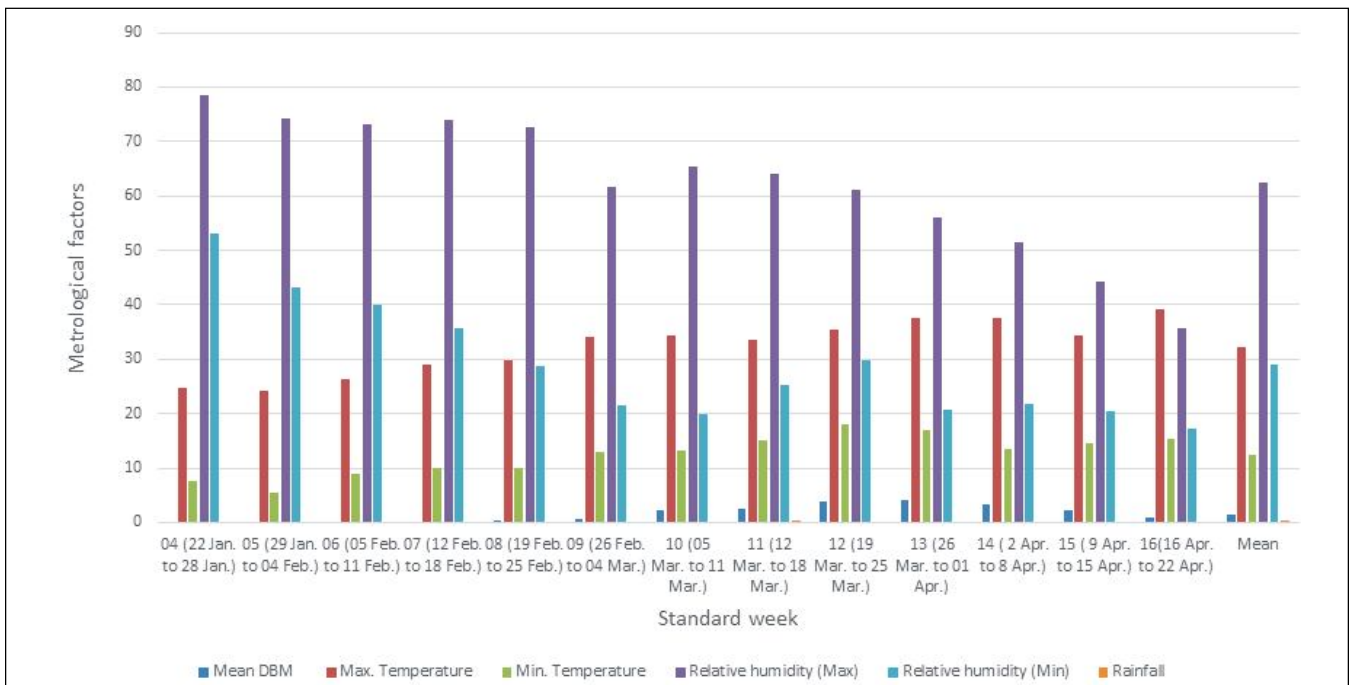


Fig. 2 : Mean population and correlation coefficient between abiotic factor and cabbage DBM population.

maximum number of diamond back moth was recorded 4.3 larvae per plant (13<sup>th</sup> SMW) and the number of diamond back moth was recorded 0.53 to 4.3 larvae per plant during month of March. Thereafter the population of the pest started decreasing gradually during the 1st week of April 2021. Sharma *et al.* (2017) also reported that the population of diamond back moth infestation gradually reached the peak with 18.68 larvae / plant during Rabi, 2014 -15 and 2015-16 in the 14<sup>th</sup> SW.

The correlation studies delineates that the diamond

back moth population was positive and significantly regulated by maximum and minimum temperature ( $r = 0.75$  and  $0.81$ , respectively), whereas maximum relative humidity and rainfall had non-significant correlation and minimum relative humidity has negative significant correlation ( $r = -0.58$ ) with the diamond back moth population. Sahu *et al.* (2020) has also pointed out that the effect of abiotic parameters on Cabbage pest incidence revealed that temperature maximum and temperature minimum showed significant positive correlation ( $r= 0.58^*$ ,

**Table 1 :** Population of Diamondback moth in relation to temperature, relative humidity and rainfall during *Rabi* season 2020-21.

Standard weeks/name week of month	Population	Max. temp. (°C)	Min. temp. (°C)	MaxRH. (%)	Min RH (%)	Rainfall (mm)
04 (22 Jan. to 28 Jan.)	00	24.75	7.6	78.57	53.00	00.00
05 (29 Jan. to 04 Feb.)	00	24.24	5.55	74.14	43.28	00.00
06 (05 Feb. to 11 Feb.)	00	26.20	8.94	73.28	40.00	00.00
07 (12 Feb. to 18 Feb.)	00	28.88	10.10	73.85	35.71	00.00
08 (19 Feb. to 25 Feb.)	0.2	29.74	10.11	72.57	28.74	00.00
09 (26 Feb. to 04 Mar.)	0.6	34.12	12.84	61.57	21.42	00.00
10 (05 Mar. to 11 Mar.)	2.2	34.35	13.35	65.28	20.00	00.00
11 (12 Mar. to 18 Mar.)	2.6	33.61	15.04	64.14	25.14	00.20
12 (19 Mar. to 25 Mar.)	3.8	35.51	17.97	61.14	29.85	00.00
13 (26 Mar. to 01 Apr.)	4.2	37.64	16.90	56.00	20.71	00.00
14 ( 2 Apr. to 8 Apr.)	3.4	37.65	13.45	51.42	21.85	00.00
15 ( 9 Apr. to 15 Apr.)	2.2	34.33	14.67	44.14	20.57	00.00
16(16 Apr. to 22 Apr.)	0.8	39.14	15.44	35.57	17.24	00.00
<b>Mean</b>	1.54	32.32	12.46	62.44	29.04	0.015
<b>Correlation coefficient (r value)</b>	<b>1.00</b>	<b>0.74**</b>	<b>0.82**</b>	<b>-0.49<sup>NS</sup></b>	<b>-0.57*</b>	<b>0.20<sup>NS</sup></b>

**Table 2 :** Qualitative composition of insect pests of cabbage during *Rabi* season 2020-21.

S. no.	Common name	Scientific name	Family	Order	Damaging stage	Population level
1.	Diamondback moth	<i>Plutella xylostella</i> (L.)	Plutellidae	Lepidoptera	Caterpillar	High
2.	Leaf eating caterpillar	<i>Helicoverpa armigera</i> (Hub.)	Noctuidae	Lepidoptera	Caterpillar	Low
3.	Tobacco caterpillar	<i>Spodoptera litura</i> Fab.	Noctuidae	Lepidoptera	Caterpillar	Medium
4.	Flea beetle	<i>Phyllotrea Cruciferae</i>	Chrysomelidae	Coleoptera	Grubs and adult	Low
5.	Green sting bug	<i>Nezara viridula</i>	Pentatomidae	Hemiptera	Nymph and adult	Low
6.	Aphid	<i>Brevicoryne brassicae</i> (L.)	Aphididae	Homoptera	Nymph and adults	High

0.58\*, respectively) and morning relative humidity showed significant negative correlation ( $r = -0.63^{**}$ ) with larval population. The present findings of the significant positive correlation of diamondback moth population with the maximum and minimum temperature were also reported by various workers (Venkateswarlu *et al.*, 2011 and Singh *et al.*, 2023).

#### Seasonal incidence of major insect pest of cabbage and their natural enemies

#### Diversity of insect pests infesting Cabbage crop field

The cultivar of six insect pests after noted were recorded during germination to harvesting of the crop (Table 2) in which Diamondback moth and Aphid showed great diversity in nature, Tobacco caterpillar showed

medium diversity and Leaf eating caterpillar, flea beetle and Green sting bug showed less diversity in the field. The composition of Cabbage insect pests has been studied by various workers. The insect pests of economic importance have been recorded by various workers (Rai *et al.*, 2014; Sarma *et al.*, 2021).

#### Diversity of natural enemies of insect pests in cabbage

Cabbage crop attracts large number of insect pests and their natural enemies (Table 3). The natural enemies help in restricting the population of potential pests to non-damaging level. The interference with the ecosystem particularly because of the misuse of pesticides can results in the destruction of these biotic agents and allows pests population to explode. The natural enemies of insect

**Table 3 :** Natural enemies recorded in diamondback moth during *Rabi* season 2020-21.

S. no.	Common Name	Scientific Name	Order	Family	Host
1.	Dragon fly	<i>Ashna</i> spp.	Odonata	Aeshnidae	Aphids, thrips, Whitefly
2.	Damselfly	<i>Coenagrion</i> spp.	Odonata	Agrionidae	Aphids and whitefly
3.	Lady bird beetles	<i>Menochilus sexmaculatus</i> Fabricius, <i>Coccinella transversalis</i>	Coleoptera	Coccinellidae	Aphids
4.	Rove beetle	<i>Paederus fuscipes</i>	Coleoptera	Staphylinidae	Larvae of Bihar hairy caterpillar
5.	Hover flies	<i>Furcileta Toxomerus geminetus</i>	Diptera	Syrphidae	Aphids , thrips
6.	Ground beetle	<i>Ophionea</i> spp.	Coleoptera	Carabidae	Aphids, moth larvae

pests associated with cabbage were of diversified groups. The cultivar attracted six natural enemies in which lady bird beetle found effectively on aphid, Rove beetle found effectively on larvae of tobacco caterpillar and ground beetle effective of aphid and moth larvae. Predators recorded during the survey in cruciferous crop were comparable with the findings of several authors (Jalali *et al.*, 2003; Agarwal *et al.*, 2007; Sood, 2004).

### Conclusion

The activity of diamond back moth in cabbage was recorded from February to April 2021. The maximum population (4.2 larvae per plant per week) was observed in the last week of March 2021 and thereafter fall in population count was observed. The pest showed a positive and significant correlation with the maximum temperature and minimum temperature; whereas maximum relative humidity and rainfall had non-significant correlation and minimum relative humidity has negative significant correlation with the diamond back moth population. The seasonal incidence studies indicated that there were six insect pests recorded during the entire cropping season in cabbage along with the six natural enemies, among them diamond back moth, aphid is the major insect pest.

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