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## Study of seasonal abundance of diamondback moth and natural enemies in cauliflower, crop and their relation with the environmental factors

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### Abstract

The infestation of diamondback moth was started from the 2<sup>nd</sup> SMW and reached its peak in 8<sup>th</sup> SMW during the year. The maximum temperature showed significant positive correlation with larval population of diamondback moth. Coccinellid predator, *Coccinella septempunctata* L. was recorded as a major predator in cauliflower ecosystem which was the maximum in the 11<sup>th</sup> SMW of the year. The maximum and minimum temperature significant positive correlation with the population of *C. septempunctata*

**Keywords:** *C. septempunctata*, coccinellid

### Introduction

Cauliflower, *Brassica oleracea* var. *Botrytis* L. is one of the important cruciferous vegetable crops grown in India. It is grown more or less in all the states and used as salad, boiled vegetable, in curries, pickling as well as dehydrated vegetable. The nutritional value/ 100 g of Cauliflower, consists of carbohydrates 5.3 g, fat 0.2 g, protein 2.4 g, vitamins (thiamine or vitamin B<sub>1</sub> 0.1 mg, riboflavin or B<sub>2</sub> 0.1 mg, niacin or vitamin B<sub>3</sub> 0.5 mg, pantothenic acid or vitamin B<sub>5</sub> 0.7 mg, folate or vitamin B<sub>9</sub> 57.0 mg, vitamin C 46.4 mg, and vitamin K 16.0 mg), minerals (Ca 22.0 mg, Fe 0.4 mg, Mg 15.0 mg, Mn 0.2 mg, P 44.0 mg, K 303 mg, Na 30.0 mg, Zn 0.3 mg) (Copyright 2017 Nutrition Value org.). The total area under cultivation of Cauliflower, in India is 372 thousand hectares with an annual production to the tune of 8534 thousand tonnes with productivity of 18.3 metric tonnes. The total area under cultivation of Cauliflower, in Rajasthan is 346 hectares with an annual production to the tune of 7588 tonnes (Anonymous-2010) [3]. China is major Cauliflower, producing country with 47 per cent of the world followed by India with 12 per cent of world production.

The yield of Cauliflower is adversely affected by many bottlenecks including insect pest, diseases, environmental stresses, nutritional imbalance etc. Among them insect pests, viz., tobacco caterpillar, *Spodopteralitura* (Fab.); diamondback moth, *Plutellaxylostella* (L.); Cauliflower borer, *Hellulaundalis* (Fab.); Cauliflower, looper, *Tricoplusiani* (Hub) and aphid, *Lipaphiserysimi* (Kalt.) (Sachan and Srivastav, 1972) [11]. Out of these, aphid and diamondback moth are major pests causing significant loss in North India. The diamondback moth, *P. xylostella* was first reported on cruciferous vegetables in 1914. It is sometimes called Cauliflower, moth, is a European moth believed to be originated in the Mediterranean region that has since spread worldwide. The moth has a short life cycle (14 days at 25 °C) is highly fecund, capable of migrating long distance, most important pest of cruciferous crops in the world that produces glucosinolates. The moth has a wing span of about 15 mm and body length of 6 mm. The forewings are narrow brownish grey with fine dark speckles. A creamy coloured stripe with a wavy edge of the posterior margin is sometimes constricted to form one or more light coloured diamond shapes, which is the basis of common name of the diamondback moth. The hind wings are narrow, pointed towards the apex and light grey with a wide fringe. Moths are active usually at twilight and at night feeding on cruciferous plants but also fly in the afternoon During the mass outbreak.

### Materials and Methods

The climate of the region is typically semi-arid which is characterized by extremes of the temperature both during summer and winter.

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During summer, the temperature may rise as high as 50 °C and in winter, it may fall as low as -3-4 °C. The total rainfall is 628.6 mm which is mostly received from last week of June to September. This region provides a safe long growing season for most of the crops.

In order to study the incidence of Diamondback moth and an abundance of natural enemies in cauliflower ecosystem and to work out their relationship with prevailing weather parameters, the experiment was laid out in five plots of 2.25 x 2.25 m<sup>2</sup> size during Rabi, 2016-17. These plots were contiguous to each. The observations on the abundance of diamondback moth and natural enemies were recorded from the very beginning of their appearance on plants till harvesting of the crop.

During the present study, the crop was found to be abundantly infested with diamondback moth, *P. xylostella*. Among the natural enemies of insect pests of cauliflower, The coccinellid predator, *Coccinella septempunctata* L. was found in the field. Other natural enemies like *Cotesia plutellae* and Syrphid flies were present in traces only.

## Results

in the present study, conducted during Rabi, 2016-17 the cauliflower crop *Brassica Oleracea* Var. *botrytis* L. was found to be infested with diamondback moth, *P. xylostella* from 4<sup>th</sup> January 2017 to 22<sup>nd</sup> March 2017. Among the natural enemies none of the species was recorded parasitizing the diamondback moth. However, the mynah bird was found predated the larvae. Coccinellid species dominating the cauliflower crop ecosystem was *Coccinella septempunctata* (L.) Other minor populations recorded were of *menochitus maculatus* and syrphid fly. The population of diamond back moth and *C. septempunctata* have been registered in table no 4.1 and fig. no. 4.1.

During Rabi, 2016-17, the larval population of diamondback moth first appeared in the 2<sup>nd</sup> standard meteorological week, SMW (2.0 larvae/ 10 plants) and reached to peak (45.2 larvae /10 plants) in the 8<sup>th</sup> meteorological week, SMW. The population level was at declining trend after 8<sup>th</sup> SMW and vanished in the 13<sup>th</sup> meteorological week.

**Table 1:** Seasonal abundance of diamondback moth, *Plutella xylostella* (L.) and natural enemies in cauliflower crop during rabi, 2016-17

S. No.	Date of observation	Standard meteorological week (SMW*)	Temperature(°C)		Mean larval population of diamondback moth/ 10 plants	<i>C. septempunctata</i> population/10 plants
			Maximum	Minimum		
1	4/1/17	02	22.0	10.4	2.0	0.00
2	11/1/17	03	19.2	5.2	10.0	0.00
3	18/1/17	04	20.8	7.4	21.6	8.6
4	25/1/17	05	22.1	11.8	28.2	10.0
5	1/2/17	06	23.3	11.1	33.6	10.8
6	8/2/17	07	23.7	8.9	40.4	11.8
7	15/2/17	08	28.6	13.4	45.2	14.8
8	22/2/17	09	27.4	12.6	40.2	16.8
9	1/3/17	10	29.3	13.6	37.2	17.2
10	8/3/17	11	26.3	13.0	35.4	20.2
11	15/3/17	12	29.1	13.4	33.6	18.4
12	22/3/17	13	35.6	19.1	28.0	14.8

The peak larval population of diamondback moth, *P. xylostella* (45.2/ ten plants) was observed at 28.6°C maximum and 13.4 °C minimum temperatures, thereafter population started declining (Table 1).

The correlation analysis (Table 2) revealed that the larval population of diamondback moth had significant positive correlation with maximum ( $r = 0.51$ ). b Whereas, non significant correlation with minimum temperature.

Among the natural enemies, the ladybird beetle, *Coccinella septempunctata* has been recorded as the major natural enemy-which predated the aphids in cauliflower ecosystem.

In the year of experimentation, the population of *C. septempunctata* was first noticed in the 4<sup>th</sup> SMW (8.6/ ten plants) and reached to maximum in the 11<sup>th</sup> SMW (20.2/ ten plants) at 26.3 °C maximum and 13.0 °C minimum temperatures (Table 1).

The correlation studies (table 2) revealed that during the year, the population of *C. septempunctata* had significant positive correlation with maximum and minimum temperature ( $r = 0.71$  and  $r = 0.66$ , respectively). The population of *C. septempunctata* also had a significant positive correlation with population of diamondback moth ( $r = 0.81$ ).

**Table 2:** Correlation coefficient between larval population of diamondback moth, *Plutella xylostella* (L.), *Coccinella septempunctata* L. and abiotic factors in Rabi, 2016-17

S. No.	Insect pests and natural enemy	Temperature (°C)		<i>C. septempunctata</i>
		Maximum	Minimum	
1.	Diamondback moth, <i>Plutella xylostella</i> (r)	0.51*	0.43(NS)	0.85*
2.	<i>Coccinella septempunctata</i> (r)	0.71*	0.66*	----

\* Significant at the 5 % level of significance

## Discussion

In the present investigation, the seasonal abundance of diamondback moth of cauliflower was studied for the year, 2016-17 which will be helpful in preparing the proper schedule for effective management of this pest. The study revealed that the cauliflower crop was infested by a major pest, diamondback moth, *P. xylostella*. This insect pest has also been reported as a serious insect pest of cabbage crop by

Sachan and Srivastava (1972)<sup>[11]</sup> and Sharma (2004)<sup>[13]</sup> who support the present findings. Among the natural enemies of pests only coccinellid predator *Coccinella septempunctata* L. was observed in the cabbage ecosystem which feeds on the aphids.

Diamondback moth was observed as a major pest of cauliflower crop attacking throughout the growth stages of the crop. The present finding get support with that of Meena and

Singh (2012) <sup>[10]</sup> who reported diamondback moth as regular and major pest of cauliflower. The infestation of pest on cauliflower crop was started from first week of January (02<sup>nd</sup> SMW) and reached to maximum (45.2 larvae /10 plants) in the third week of February (8<sup>th</sup> SMW) during the year, thereafter, population started declining. Khaire *et al.* (1987) <sup>[7]</sup> observed peak population of diamondback moth in the first week of February. The peak population was observed at 28.6 °C maximum and 13.4 °C minimum temperature. The present findings are in partial conformity with that of Gera and Meena and Sharma (2003) <sup>[9]</sup>, Shukla and Kumar (2004) <sup>[12]</sup> and Goud *et al.* (2006) <sup>[6]</sup> who reported that the infestation of pest started from the second week of November and reached to peak in the last week of January to the first week of February. The larval population of diamondback moth had significantly positive correlation with maximum temperature ( $r=0.51$ ) and non-significant correlation with minimum temperature. The studies showed that the incidence of diamondback moth was only affected by temperature. The present findings are in conformity with Ahmad *et al.* who reported that population of diamondback moth was positive correlated with maximum temperature. Contrary results were also reported by Sharma (2004) <sup>[13]</sup> and Chaudhuri *et al.* (2001) <sup>[4]</sup> who reported non-significant positive and significant positive correlation, respectively between the population of diamondback moth and temperature. Ahmad and Ansari (2010) <sup>[1]</sup> observed that population of diamondback moth started to build up as soon as the cauliflower crop was transplanted. Ahmad *et al.* (2012) observed that the maximum population at 31 °C which is more as compared to the present study.

Among the natural enemies *Coccinella septempunctata* L., a predator of aphid was found in abundance. The population of *C. septempunctata* was maximum (20.2 /10 plants) in the second week of March (11<sup>th</sup> SMW). The population of *C. septempunctata* had significantly positive correlation with maximum ( $r=0.71$ ) and minimum temperature ( $r=0.66$ ). The present findings are in agreement with that of Bhaskar and Virakatham (2002), Shukla and Kumar (2003), Bar *et al.* (2004) observed the parasitization of diamondback moth by *Cotesia plutellae* which was lacking in the present study. Observed parasitization of diamondback moth by *Tetrastichus sokolowskii* which was not evidence in the present study.

### Conclusion

The cauliflower crop was found to be infested by diamondback moth, *P. xylostella*. The infestation of diamondback moth was started from the larval population of diamondback moth first appeared in the 2<sup>nd</sup> standard meteorological week, SMW (2.0 larvae/ 10 plants) and reached to peak (45.2 larvae /10 plants) in the 8<sup>th</sup> meteorological week, SMW. The population level was at declining trend after 8<sup>th</sup> SMW and vanished in the 13<sup>th</sup> meteorological week. The peak larval population of diamondback moth, *P. xylostella* (45.2/ ten plants) was observed at 28.6°C maximum and 13.4°C minimum temperatures, thereafter population started declining. The larval population of diamondback moth had significant positive correlation with the maximum infestation of diamondback moth, *P. xylostella* on cauliflower crop was recorded in the 08<sup>th</sup> SMW. The lady bird beetle *C. septempunctata* was observed as an important natural enemy in cauliflower ecosystem.

Spinosad and indoxacarb was found to be most effective against diamondback moth followed by flubendiamide. The

chlorfenapyr and pyridalyl were found least effective against the pest.

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