

# Diversity of Arthropods and Population Dynamics of Diamondback Moth Visiting Organically Cultivated Cabbage

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The biodiversity of insects visiting cabbage and population dynamics of diamondback moth was studied on Golden acre variety of cabbage. The experiment was conducted at experimental plot of Ramakrishna Mission Vivekananda Educational and Research Institute, Morabadi, Ranchi, during October to January, 2018-19. During the experiment, Bihar hairy caterpillar, Diamondback moth, Cabbage aphid, Cabbage maggot, Cabbage butterfly, Tobacco caterpillar, Ladybird beetle, Rice bug, Cricket and Spider were noticed. The population of diamondback moth was positively correlated with maximum, minimum, average temperature and maximum relative humidity and negatively correlated with minimum RH, wind speed; rainfall. The highest larval population was recorded during 1<sup>st</sup> week of January (1<sup>st</sup> Standard Meteorological Week, SMW).

*Keywords: Biodiversity; insects; diamondback moth; aphid; cabbage etc.*

## 1. INTRODUCTION

Vegetables are the important constituents of healthy diet as it contains different vitamins and minerals. Among the cole crops, cabbage (*Brassica oleracea* var. *capitata* L.) and cauliflower (*Brassica oleracea* var. *botrytis* L.) are the most important *rabi* season vegetables grown in India. On the basis of acreage, the major cabbage growing state of India are West Bengal, Odisha, Jharkhand, Gujarat and Bihar [1]. The cultivation of the crop is confronted by many factors of environment. One of the major bottlenecks in production of cabbage is the damage caused by insect pests that attack at various growth stages of the crops. In India, cabbage is attacked by about 37 insect pests that cause sustainable loss both quantitatively and qualitatively. Among different insect pest, diamondback moth (DBM), *Plutella xylostella* (L.) (Lepidoptera: Plutellidae) is one of the utmost devastating insect pests of Cole crops [2]. The insect pest is reported to cause 31- 100% yield loss depending on the level of infestation (Lingappa, et al.,2004).

Crops are visited by many arthropods at different growth stages and play crucial role in maintaining the equilibrium of agroecosystem. These arthropods contribute in many activities like pollination, parasitisation and predation of different pest, decomposition of organic matter and also help to improve the physical properties of soil. The richness of diversity of arthropods is the indicator of healthy ecosystem [3,4,5]. The environmental factors play important role in seasonal incidence and population build-up of any insect pest. It is reported that insect pest responds differently in different climatic condition and due to changing climate the level of infestation is also greatly influenced. It is also recommended that the close watch on influence of this changing climatic condition on insects is necessary. This study is necessary to for planning and directing the future management strategies [6]. Considering the importance of diversity of insects and influence environmental factors on population build-up of insect pest present investigation was carried out in organically cultivated cabbage.

## 2. MATERIALS AND METHODS

The experiment was conducted at the experimental plot of Ramakrishna Mission Vivekananda Educational and Research Institute, Morabadi, Ranchi. This experimental site is

situated on the southern part of the Chota Nagpur plateau of Jharkhand state. The experimental site is located at 23.23'58" N latitude and 85020'13" E longitude. The experiment was laid out in Randomised block design with three replications. The variety Golden Acre was cultivated, twenty-eight days old seedlings were transplanted in the plot of 4m<sup>2</sup> area with row to row and plant to plant distances were 60 and 45 cm, respectively. The crop was transplanted in main field plots during Rabi season on 29<sup>th</sup> October, 2018. The crop was cultivated using organic cultivation practices. No plant protection measures were applied. Weekly observations were recorded stating from 1<sup>st</sup> week of transplanting to till full maturity. To study the seasonal incidence of diamond back moth, five plants were selected on random basis from each plot whereas for arthropods diversity whole plot was taken into consideration. The data was recorded from 21 beds. Population of arthropods was recorded through visual count. Observations were taken during morning time (7- 10 am). The correlation between weather parameters and population of diamondback moth was worked out in Microsoft excel using standard statistical procedure.

## 3. RESULTS AND DISCUSSION

### 3.1 Arthropod Diversity of Cabbage Ecosystem

During the experiment different arthropods like insects-pest, spider and other natural enemies were recorded. Five different orders of insects like lepidoptera, Hemiptera, Diptera, Coleoptera and Orthoptera were found visiting the crop. On the basis of the role of arthropods in agroecosystem, the recorded insects were categorised and among these, insect-pest species viz. Bihar hairy caterpillar, *Spilosoma oblique* (Lepidoptera: Arctidae); Diamondback moth (DBM), *Plutella xylostella* (Linnaeus) (Lepidoptera: Plutellidae); Cabbage Aphid, *Brevicoryne brassicae* (Hemiptera: Aphididae); Cabbage maggot, *Delia radicum* (Diptera: Anthomyiidae); Cabbage butterfly, *Pieris rapae* (Lepidoptera: Pieridae); Tobacco caterpillar, *Spodoptera litura* (Lepidoptera: Noctuidae) were found to be inflicting damage to crop. The predator, Ladybird beetle, *Coccinella septempunctata* (Coleoptera: Coccinellidae) and one species of spider (unidentified) was also recorded during the study. In addition, Rice bug, *Leptocorisa varicornis* (Hemiptera: Alydidae) and Cricket, *Gryllus* (Orthoptera: Gryllidae) were

other insects visiting the crop. The insects like ladybird beetle, diamondback moth, aphid, tobacco leaf eating caterpillar have also been reported by Senguttuvan and Kuttalam [7], Sahu et al. [8] and Lal et al [9] from cabbage ecosystem.

### 3.2 Succession of Arthropods

The succession of all the visiting arthropods was also recorded throughout the crop growing period and presented in Table 1. During the study, Bihar hairy caterpillar was the first insect species to visit the crop among recorded arthropod and the infestation of pest was recorded during 45<sup>th</sup>-47<sup>th</sup> Standard Meteorological Week (SMW) only, then there was no infestation of the pest during rest period of crop. The initial symptoms of infestation of diamondback moth were recorded during 48<sup>th</sup> SMW and the infestation was continued for next one week only. Thereafter, population of pest was not found from 50<sup>th</sup> to 52<sup>nd</sup> SMW. Reinfestation of pest was recorded from 1<sup>st</sup> to 4<sup>th</sup> SMW. The population of aphid (*Brevicoryne brassicae*) was first recorded during 49<sup>th</sup> SMW

and the infestation was continued up to 52<sup>nd</sup> SMW. The activity of predator, ladybird beetle (*Coccinella septempunctata*) was first recorded during infestation period of its host, aphid. The population of Cabbage maggot (*Delia radicum*) was first noticed during 1<sup>st</sup> to 2<sup>nd</sup> SMW. Cabbage butterfly (*Pieris rapae*) was recorded during 51<sup>st</sup> – 52<sup>nd</sup> SMW. The spider was noticed first during 50<sup>th</sup> SMW and continued for next three consecutive metrological weeks, 51<sup>st</sup>, 52<sup>nd</sup> and 1<sup>st</sup> SMW. The first visit of cricket (*Gryllus sp.*) was noticed during 2<sup>nd</sup> SMW and remains active till 3<sup>rd</sup> SMW. The damage of *Spodoptera litura* commonly known as tobacco leaf eating caterpillar was recorded first time in 51<sup>st</sup> SMW and pest was active till 1<sup>st</sup> SMW. Rice bug (*Leptocoris varicornis*) was noticed during 48<sup>th</sup> SMW. While recording the succession of different insect in cabbage ecosystem, Sahu et al., [8] reported the first appearance of DBM, tobacco leaf eating caterpillar and aphid in the 49<sup>th</sup>, 44<sup>th</sup> and 48<sup>th</sup> SMW respectively. Similar succession of these insects was also found in present study. But early infestation of aphid (44 SMW) is also reported (Sain, et al., 2019).

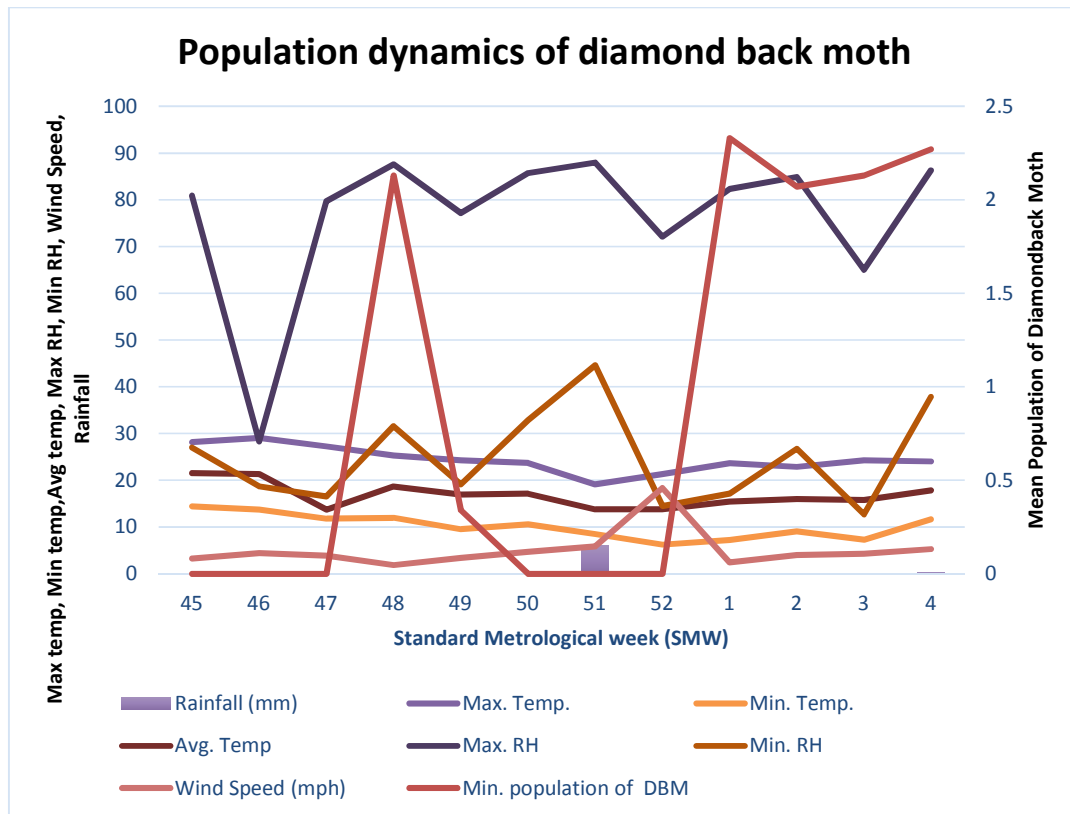


Fig. 1. Population dynamics of diamondback moth on cabbage during rabi 2018-2019 with relation to different abiotic factor

**Table 1. Succession of different arthropods during crop growing period (during different SMW)**

Sl. no	Arthropods	Standard Metrological Weeks (SMW)											
		45 (1)	46 (2)	47 (3)	48 (4)	49 (5)	50 (6)	51 (7)	52 (8)	1 (9)	2 (10)	3 (11)	4 (12)
1	Bihar hairy caterpillar	■	■	■									
2	Ladybird beetle				■	■	■	■	■				
3	Diamondback moth				■	■	■	■	■	■	■	■	■
4	Cabbage Aphid				■	■	■	■	■				
5	Cabbage maggot								■	■	■		
6	Cabbage butterfly							■	■	■			
7	Spider						■	■	■	■			
8	Cricket									■	■	■	■
9	Tobacco caterpillar							■	■	■	■		
10	Rice bug				■								

\* Number in parenthesis indicates the weeks after transplanting of cabbage

### 3.3 Population Dynamics of Diamondback Moth (*Plutella xylostella* L.) Infesting Cabbage

The seasonal incidence of diamondback moth (DBM), *Plutella xylostella* L. on cabbage was studied during the experiment and the population of DBM was recorded during every meteorological week (SMW) throughout the season. The dynamics of population of DBM with relation to environmental factors is represented graphically (Fig. 1). The infestation of diamondback was started during 48<sup>th</sup> SMW and population was found throughout the seasons (1<sup>st</sup> SMW) with slight rise and fall in population correlated with the environmental factors. However, highest population per plant was noticed during 1<sup>st</sup> SMW, the weather condition prevailed during this period was maximum temperature 23.65°C, minimum 6.25°C and average temperature was 15.44°C, Maximum RH 82.28% and minimum 17.14%, wind speed 2.43 mph, no rainfall was recorded. The lowest number of pest population was recorded from 50<sup>th</sup> -52<sup>nd</sup> SMW. During the study, maximum mean population of DBM (2.33 larvae per plant) was recorded 9 weeks after transplanting (1<sup>st</sup> SMW). Present finding is in line with Sharma *et al.* [10] and reported the highest population of the pest in the first week of January. Dalave *et al.* [11] reported that the infestation of the pest was started from third week of December and thereafter population was gradually increased to

attain a peak (8.9 larvae per plant) during fourth week January. However, present research find is in contrast with earlier finding by Aiswarya *et al.* [12], Venugopal *et al.* [13] and Lal *et al.* [9], reported the highest peak of the population of diamondback moth during the month of February and March.

The correlation co-efficient(r) between metrological parameters and population of diamondback moth, *Plutella xylostella* L. was worked out and resented in Table 2. It is apparent that maximum (r=0.54), minimum (r=0.19) and average temperature (r=0.41) temperature had positive effect on mean population build-up of diamondback moth throughout the crop season. Population is positively correlated with temperature (maximum, minimum and average) similarly population is positively correlated with maximum humidity (r = 0.04) but negatively correlated with minimum humidity (r = -0.12). It means that max. humidity had positive effect on population build up. Also, the population was negatively correlated with wind speed (r = -0.48) and rainfall (r = -0.38). The finding of present study in line with the finding of Venugopal *et al.*, [13], reported positive correlation between minimum, maximum and average temperature and population of the pest. It is evident from present study that the infestation was initiated in last week of November and peak population of pest was noticed in the month of January. Therefore, it is necessary to

**Table 2. Correlation co-efficient(r) between metrological parameters and population of diamondback moth, *Plutella xylostella* L**

Meteorological Parameters		Correlation Coefficient (r)
Temperature (°C)	Maximum	0.54
	Minimum	0.19
	Average	0.41
Relative Humidity (RH) (%)	Maximum	0.04
	Minimum	-0.12
Wind Speed (mph)		-0.48
Rainfall (mm)		-0.38

conduct the surveillance of pest after initiation of infestation to know the status of infestation. It may help to direct the management practices. It is also reported that change in weather parameters had great influence on the population of pest [6]. The study on correlation of these factors with population of pest can provide some basis to conduct management practices.

#### 4. CONCLUSION

Among the different insect visiting cabbage during rabi season, Bihar hairy caterpillar was the first arthropod to infest the crop that is during 46<sup>th</sup> SMW. Later on, crop was visited by aphid and its predator, ladybird beetle. The first visit of DBM was noticed during 48<sup>th</sup> SMW also the infestation was noticed up to end of the seasons (except 50-52 SMW). During the latter part of the seasons, the increasing trend in population was noticed. The maximum, minimum and average temperature and maximum relative humidity showed positive correlation and minimum relative humidity, wind speed and rainfall had negative correlation with the population of diamondback moth during the entire cropping seasons.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Anonymus. National horticulture board, the area and production of horticultural crops. Indian Horticulture Database, National Horticulture Board, Ministry of Agriculture, Government of India. 2018;189p. Available:www.nhb.gov.in
2. Xia J, Huang Z, Hu Q. Histopathological study of *Plutella xylostella* infected by three entomopathogenic fungal species. *Advances in Entomology*. 2013;1(2):15-19.
3. Pettersson RB, Ball JP, Renhorn KE, Esseen PA, Sjöberg K. Invertebrate communities in boreal forest canopies as influenced by forestry and lichens with implications for passerine birds. *Biological Conservation*. 1995;74(1):57-63.
4. Høye TT, Culler LE. Tundra arthropods provide key insights into ecological responses to environmental change. *Polar Biology*. 2018;41:1523–1529.
5. Culliney TW. Role of arthropods in maintaining soil fertility. *Agriculture*. 2013;3(4):629-659.
6. Skendžić S, Zovko M, Živković IP, Lešić V, Lemić D. The impact of climate change on agricultural insect pests. *Insects*. 2021;12: 440-471. Available:https://doi.org/10.3390/insects12050440
7. Senguttuvan K, Kuttalam S. Biodiversity of arthropod fauna in Tamil Nadu cabbage ecosystems. *J. Res. ANGRAU*. 2018;46(2):1-14.
8. Sahu B, Pachori R, Navya RN, Patidar S. Pest succession of major insect pest of cabbage. *J. Exp. Zool. India*. 2019;20(10):1-7
9. Lal J., Swaminathan R, Meena AK. Nagar R. Seasonal incidence of major insect pests of cabbage, *Brassica oleracea* var. *capitata* L. *Journal of Entomology and Zoology Studies*. 2020;8(3): 387-391.
10. Sharma P, Kumawat KC, Lal J. Seasonal abundance of diamondback moth and natural enemies on cabbage. *Journal of Entomology and Zoology Studies*. 2017;5(3):176-179.
11. Dalave SK, Raghvani KL, Joshi MD, Ranaware SS, Dabhade, PL, Ghadge SM, Chatar VP. Population dynamics of diamondback moth, *Plutella xylostella* (Linnaeus) on Cabbage. *Asian Sciences*. 2009;4(1 and 2):35-36.
12. Aiswarya VA, Bhosle BB, Bhede BV. Population dynamics of major lepidopteran

- insect pests of cabbage. diamondback moth (*Plutella xylostella* L.)  
Int.J.Curr.Microbiol.App.Sci. 2018;(Special on cabbage (*Brassica oleracea* var.  
Issue-6):236-239. *capitata* L.) under Allahabad condition.  
13. Venugopal U, Kumar A, Hari S, Prasad D, Journal of Entomology and Zoology  
Rajesh B. Seasonal incidence of Studies. 2017;5(6):2477-2480.

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