International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 01-03-2025, Accepted: 31-03-2025, Published: 16-04-2025
Volume 10, Issue 4, 2025, Page No. 47-49

# The roles of predators, parasitoids, and insecticides in controlling the diamondback moth

**Amit Kumar Patel[1], Dr. R Nisha[2], Dr. Prem Shanker[3], Shalini Singh[4], Hassan Gabrallah Ismail Ali[5]**
[1] Assistant Professor, Department of Agriculture, Dr. C V Raman University Bihar, India
[2] Assistant Professor, Department of Entomology, SRM College of Agricultural and Sciences, Baburayanpettai, Vendhar Nagar, Chennai, India
[3] Scientist, Department of Plant Protection, Krishi Vigyan Kendra Basti, Uttar Pradesh, India
[4] Assistant Professor, Department of Agriculture, Dr. C V Raman University Bihar, India
[5] Department of Plant Protection, Faculty of Agriculture, Sohag University, Egypt

**Abstract**
The diamondback moth (Plutella xylostella L.), a serious pest of cruciferous crops such as cabbage, has evolved resistance to all pesticides used. This necessitates further investigation into factors affecting its survival, particularly the role of natural enemies. This study aimed to identify natural enemies of *P. xylostella* and evaluate their effectiveness in biological control (Talekar *et al*.,1992) [11]. Additionally, it sought to develop sustainable pest management strategies that minimize reliance on chemical insecticides while maintaining crop yields and profitability. Results indicate that various predators in and around cabbage fields consume *P. xylostella* eggs and larvae under laboratory conditions. The most efficient predators included syrphid larvae and spiders from the families Linyphiidae and Salticidae. Lycosid spiders and staphylinid beetles were among the most numerous and effective predators, while sheet-weaving spiders, jumping spiders, assassin bugs (Reduviidae), and damsel bugs (Nabidae) also showed promise in suppressing P. xylostella numbers. Field experiments revealed that interactions between flying and ground-dwelling natural enemies negatively impacted each other (Cheng *et al*.,1992) [3]. Moreover, leaf damage was found to be greater in insecticide-treated fields than in untreated ones due to both insecticide resistance in *P. xylostella* and the detrimental effects of insecticides on natural enemies. Another study investigated the combined effects of parasitoids and biological insecticides (Bacillus thuringiensis, Bt) on *P. xylostella* mortality, highlighting the need for integrated control strategies. Findings suggest that sustainable pest management requires a combination of natural enemy conservation and parasitoid promotion (Tabashnik *et al*., 1994) [9] However, further research is necessary to clarify the specific roles of different predator species.

**Keywords:** Insect predators, natural enemies, plutella xylostella, biological control

## Introduction

The diamondback moth (*Plutella xylostella* L.) is a widespread pest affecting cruciferous crops such as cabbage, cauliflower, broccoli, Brussels sprouts, and turnips across more than 100 countries. It is responsible for severe yield losses globally, including significant economic damage in India, where annual crop losses are estimated at approximately 16 million rupees (Talekar and Shelton 1993) [10]. Despite widespread pesticide use, *P. xylostella* has developed resistance to nearly all insecticides, particularly in tropical and subtropical regions where chemical control is heavily relied upon. This resistance issue was first identified shortly after the large-scale adoption of insecticides following World War II. The moth has also evolved resistance to the biological insecticide *Bacillus thuringiensis* (Bt). Despite increasing resistance, farmers continue to apply chemical pesticides in an attempt to control *P. xylostella* (Arora *et al*., 2000) [2]. While aspects of the moth's biology and population dynamics are well-documented, the factors influencing its population fluctuations remain poorly understood. Simple and cost-effective alternative pest control strategies have not been widely adopted, leading to continued pesticide use. This not only exacerbates resistance issues but also causes environmental pollution, disrupts ecosystem services such as natural enemy regulation, and poses health risks to humans.

## Materials and methods

In this field experiment, four treatments were employed: 1. Control (C), which is a cabbage plant that is not protected; 2. excluding ground-dwelling (-GD) predators; 3. excluding flying (F) natural enemies; and 4. utilising a mixture of the two enclosure techniques, excluding all (-GDF) natural enemies. We placed the potted plant in a tray with water to keep off ground-dwelling (-GD) predators. We employed a tiny net cage with a mesh size of 50 cells per centimetre, held up by 0.6 m x 0.6 m of steel wire, to keep out flying predators, mostly parasitoids and Polybia spp. (vespidwasps). Rain was able to infiltrate the plant despite the net covering it. A 2 cm hole was left in the ground for ground-dwelling predators to go through in order to access the netting. On each occasion, four blocks at each farm had one cabbage plant, one for each of the four treatments. Each block of cabbage plants was positioned between the field crop's three initial parallel rows of planted cabbages and near one of the field's edges. To count the surviving P. xylostella larvae, the experimental plants were examined 24, 48, and 72 hours later (Alam *et al*., 1992) [1].

All larvae that survived 72 hours were collected and reared till pupation to determine the parasitism rate. The same procedure was repeated again with fresh plants and larvae, starting two and four weeks after the original test. To assess the efficacy of insecticides in the control of DBM on cabbage, as well as to obtain insight into the consequences and advantages of natural enemies, we examined the effects of pesticide treatments on DBM, its predators, and parasitoids throughout time. When integrated pest management was first developed, the primary concept was that natural control methods should be used as the primary control approach, with chemicals used as a backup option to minimise interference with non-chemical methods (Kogan *et al*., 1998) [5]. In integrated pest control systems for insect pests across the world, the manipulation of beneficial organisms is still a crucial technique. Here, we enquired: What effects would pesticide spraying have on crop damage, DBM, and its natural enemies? Will Bt spraying harm cabbage by lowering P. xylostella's density? Would the introduction of parasitoids (Diadegma insulare) drastically increase P. xylostella larval parasitism rates in comparison to the background (natural) rate of parasitism in cabbage crops? (Diaz *et al*, 1999) [4].

**Result**

Farmers in the study area sprayed insecticides multiple times on their fields, following common practice and recommendations from insecticide sellers. The decision on how often to spray and which chemicals to use was left to the farmers. Except for one farm, which ceased in 2022, those that did not use pesticides ended spraying in 2023.However, all farms applied the herbicides Gramoxone® or Paraquat (3 Liters per hectare) once before transplanting their crops. Each experimental field was about 25 meters by 60 meters (0.15 hectares) in size.

The study focused on head cabbage (Brassica oleracea var. capitata, variety Izalco). Farmers who avoided insecticides grew their seedlings in a netted rearing area, while those using insecticides grew them in a seedbed. This difference in seedling rearing did not impact plant growth in the field (Mohan and Gujar 2003). All cabbage seedlings were transplanted by hand in rows 0.6 meters apart, with 0.5 meters between plants. Farmers applied inorganic fertilizer (NPK 12-30-10) at a rate of 182 kg per hectare eight days after transplanting, followed by an extra 95 kg per hectare of nitrogen fertilizer (N, 45) after 30 days. The study found that cabbage fields treated with insecticides had higher numbers of diamondback moth (DBM) larvae and pupae compared to fields without insecticides. Both types of farms saw a rise in larvae and pupae over time. During the 2023 Primera season, the density of DBM larvae per plant, the best predictor of pest levels, surpassed the economic threshold (0.3-0.5 larvae per plant) in both treated (Mean = 1.6 larvae/plant, SE = 0.32, N = 54) and untreated fields (Mean = 0.82, SE = 0.14, N = 54). Pest levels were lower in treated fields (mean = 0.72, SE = 0.13, N = 45) than in untreated fields (mean = 0.48, SE = 0.04, N = 45) throughout the 2023 Postrera season. Pest levels were equal in treated and untreated fields over the 2024 Primera season (mean = 0.72, SE = 0.13, N = 30). Only in one of 48 cases did insecticide-treated fields have significantly fewer DBM larvae than untreated ones. The number of DBM larvae increased as the cabbage plants grew, often exceeding economic thresholds in both seasons. This suggests that all farms needed additional pest control measures to protect their crops (Miyata *et al*.,1986) [7]. The higher number of DBM larvae in insecticide-treated fields might be because the moths have developed resistance to the chemicals.

The study also found that many natural predators in and around cabbage fields in Nicaragua could feed on DBM eggs and larvae. Among them, lycosid spiders were the most effective at controlling DBM due to their high numbers and feeding rates. Other predators that may be involved include linyphiid spiders, staphylinid beetles, salticid spiders, and nabid bugs. However, flying and ground-dwelling predators seemed to interact negatively with each other. More research is needed to understand how natural enemies and other factors affect DBM survival. A combination of pest control methods, including promoting natural predators and parasitoids, is likely necessary for long-term and sustainable DBM management (Mitchell, 1997) [6].

| Season | Dependent Variable | Treatment | Mean | SE | N |
|---|---|---|---|---|---|
| Primera 2023 | *Diadegma insulare pupae* | Insecticide | 0.14 | 0.038 | 54 |
| | | No insecticide | 0.26 | 0.056 | 54 |
| | *Rate of parasitism* | Insecticide | 32 | 2.8 | 20 |
| | | No insecticide | 57 | 3.2 | 24 |
| | *Spiders* | Insecticide | 0.04 | 0.0097 | 54 |
| | | No insecticide | 0.072 | 0.010 | 54 |
| | *Polybia sp.* | Insecticide | 0.004 | 0.0017 | 54 |
| | | No insecticide | 0.017 | 0.0058 | 54 |
| Postrera 2023 | *Diadegma insulare pupae* | Insecticide | 0.083 | 0.017 | 45 |
| | | No insecticide | 0.14 | 0.025 | 45 |
| | *Rate of parasitism* | Insecticide | 49 | 2.9 | 24 |
| | | No insecticide | 63 | 3.0 | 20 |
| | *Spiders* | Insecticide | 0.044 | 0.0074 | 45 |
| | | No insecticide | 0.085 | 0.018 | 45 |
| | *Polybia sp.* | Insecticide | 0.012 | 0.0028 | 45 |
| | | No insecticide | 0.017 | 0.0033 | 45 |
| Primera 2024 | *Diadegma insulare pupae* | Insecticide | 0.10 | 0.033 | 30 |
| | | No insecticide | 0.12 | 0.033 | 30 |
| | *Rate of parasitism* | Insecticide | 46 | 3.88 | 15 |
| | | No insecticide | 52 | 5.24 | 15 |
| | *Spiders* | Insecticide | 0.068 | 0.013 | 30 |
| | | No insecticide | 0.16 | 0.030 | 30 |
| | *Polybia sp.* | Insecticide | 0.0033 | 0.0014 | 30 |
| | | No insecticide | 0.017 | 0.0015 | 30 |

Cabbage field

Control Measures for DBM

Damage caused by DBM

## References


1. Alam MM. Diamondback moth and its natural enemies in Jamaica and some other Caribbean Islands. In: Talekar NS, editor. *Diamondback moth and other crucifer Pests: Proceedings of the Second International Workshop*: Tainan, Taiwan: Asian Vegetable Research and Development Center, Shanhua, Taiwan, 1992, 233–43.
2. Arora R, Battu GS, Bath DS. Management of insect pests of coliflower with biopesticides. *Indian Journal of Ecology*,2000:27:156–62.
3. Cheng EY, Kao CH, Chiu CS. Resistance of diamondback moth in Taiwan: Recent developments. In: Talekar NS, editor. *Diamondback moth Management: Proceedings of the Second International Workshop*, 1992, 465–78.
4. Diaz J, Guharay F, Miranda F, Molina J, Zamora M, Zeledón R. *Manejo Integrado de Plagas en el cultivo de Repollo*. Manual Tecnico No 38. Managua, Nicaragua, 1999.
5. Kogan M. Integrated pest management: Historical perspectives and contemporary developments. *Ann Rev Entomol*,1998:43:243–70.
6. Mitchell ER, Tingle FC, Navasero-ward RC, Kehat M. Doamondbacm moth (Lepidoptera: Plutellidae): Parasitism by Cotesisa plutellae (Hymenoptera: Braconidae) in cabbage. *Florida Entomol*,1997:80:477–89.
7. Miyata T, Saito T, Noppun V. Studies on the mechanism of diamondback moth resistance to insecticides. In: Talekar NS, Griggs TD, editors. *Diamondback Moth Management: Proceedings of the First International Workshop*. Asian Vegetable Research and Development Center, Shanhua, Taiwan, 1986, 347–57.
8. Mojan M, Guhar GT. Local variation in susceptibility of the diamondback moth, Plutella xylostella (L.) to insecticides and detoxification enzymes. *Crop Prot*,2003:22:495–504.
9. Tabashnik BE. Evolution of resistance to Bacillus thuringiensis. *Ann Rev Entomol*,1994:39:47–79.
10. Talekar NS, Shelton AM. Biology, ecology and management of the diamondback moth. *Ann Rev Entomol*,1993:38:275–301.
11. Talekar NS, Yang JC, Lee ST. Introduction of Diadegma semiclausum to control with diamondback moth in Tiawan. In: Talekar NS, editor. *Diamondback moth and other crucifer Pests: Proceedings of the Second International Workshop*: Tainan, Taiwan, 10–14 December 1990. Asian Vegetable Research and Development Center, Shanhua, Taiwan, 1992, 263–72.