

# Diamondback Moth

## Pest Management

The diamondback moth (DBM), *Plutella xylostella*, is found globally. DBM is notorious for causing significant damage to cruciferous crops, including Chinese cabbage, caixin, xiaobaicai, broccoli, cauliflower, mustard greens and kale. Singapore's hot and humid climate provides an ideal

environment for DBM to thrive, making it a persistent pest. However, heavy rainfall typically reduces the risk of severe DBM outbreaks, as young larvae—particularly first and second instars—are highly susceptible to being dislodged and drowned by heavy rain.

Early signs of DBM infestation include presence of larvae and the bite marks/holes on outer leaves. Severe infestations can cause significant crop damage, leading to substantial yield and economic losses, and forcing farmers to replant and invest more heavily in pest control measures.



**Diamondback Moth**

(Credits: AgNet Media)

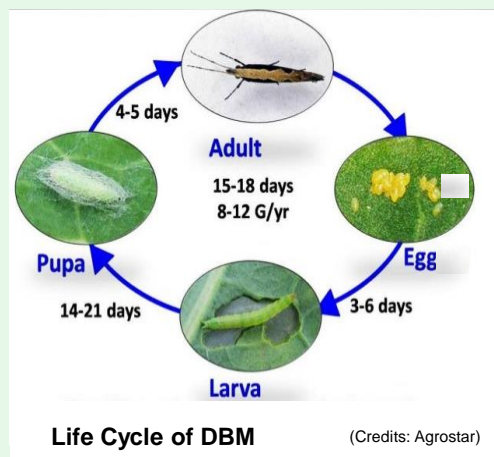
### Understanding the Challenge:

- **Rapid Life Cycle:** In Singapore's tropical climate, DBM thrives particularly well in Controlled Environment Agriculture (CEA) facilities, where consistent temperatures enable year-round breeding. Under these optimal conditions, DBM can complete its life cycle in just two weeks, leading to rapid population growth and multiple generations overlapping throughout the year.
- **Insecticide Resistance:** DBM has gained notoriety for its remarkable ability to develop resistance against various insecticides, often rendering chemical control methods ineffective over time. This resistance development necessitates a comprehensive integrated pest management (IPM) approach that extends beyond traditional insecticide application. Effective DBM management requires combining multiple control strategies, with insecticide rotation being just one component of a broader IPM approach.

### Life Cycle

The DBM is a small, greyish-brown moth bearing distinctive diamond-shaped patterns on its wings. Its life cycle comprises four stages and can be completed in as little as two weeks under favourable conditions, enabling multiple generations per year:

1. **Egg:** The female deposits tiny, oval-shaped, yellowish-white eggs, either singly or in small clusters on the undersides of leaves. These eggs typically hatch within a few days.
2. **Larva (Caterpillars):** The caterpillars emerge small and pale green, gradually developing darker stripes as they mature. These larvae feed voraciously on cruciferous plant leaves, causing significant crop damage. This stage presents the optimal window for implementing control measures, particularly during the early larval instars.
3. **Pupa:** The insect forms a delicate white cocoon, which attaches to the leaves or stems of the host plant. The developing moth remains within this protective casing for several days.
4. **Adult (Moth):** The mature insect is a small, greyish-brown moth with a wingspan of 15-20 mm. When at rest, its folded wings display the characteristic diamond-shaped marking for which it is named. Adult DBM are generally weak fliers, typically remaining within 2 m of the ground. However, they are readily carried by the wind and can achieve long-distance migration.



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### Control Measures

Managing DBM effectively requires a comprehensive integrated pest management (IPM) strategy. This approach reduces reliance on chemical pesticides while addressing resistance development. A successful IPM approach encompasses three key components: prevention of pest establishment, regular monitoring of pest populations, and implementation of appropriate control measures.

#### Prevention

- Install fine-mesh insect netting and ensure regular inspection and maintenance of physical barriers (e.g. sealed environment, double doors).
- Implement strict hygiene throughout the facility.
- Maintain clean growing environments.
- Remove crop residues and weeds that could serve as DBM breeding grounds.
- Thoroughly inspect transplants for eggs or larvae before planting.
- For soil-based farms, implement crop rotation by avoiding consecutive cruciferous plantings in the same field. Introduce non-cruciferous crops (such as bayam or kangkong) at 30-day intervals (one crop cycle).



**Healthy Transplant**

(Credit: Hortiplan)

#### Monitoring

- Population surveillance: Deploy pheromone traps to monitor adult moth populations and detect early infestations.
- Field Scouting: Conduct regular plant inspections for signs of larval feeding damage, paying particular attention to leaf undersides where eggs and larvae are commonly found. Document observations to track infestation patterns.



***Diadegma semiclausum*,  
an effective biocontrol  
agent on DBM**

(Credit: Cesar Australia)

#### Control Methods

- **Biological control:** Natural pest control can be achieved by introducing or conserving natural enemies, such as parasitoid wasps (e.g. *Diadegma semiclausum*) and predatory insects (e.g. lacewings). *Bacillus thuringiensis* (BT), a naturally occurring bacterium, serves as a crucial tool for DBM control.

**NOTE:** Licensed farms must engage SFA-certified pesticide farm operators if they want to apply agricultural pesticides. The course and test are conducted by ITE College East. For course details, you may contact ITE (Tel: 1800 222211 / 65902211)



**Lacewings, a predatory  
insect on DBM**

(Credit: Bee Better Naturally)

- **Chemical control:** DBM rapidly develops resistance to insecticides, making rotation crucial. For soil-based farms, effective insecticides include Emamectin benzoate, Indoxacarb and Spinosad. Always follow manufacturer's instructions for optimal concentration and application methods.
- **Trap cropping:** This method involves planting attractive host plants alongside main crops to divert pests. Mustard effectively attracts DBM away from cabbage. Once pests concentrate on trap crops, farmers can implement targeted control measures such as pesticide application or manual removal. These methods should be integrated within a comprehensive IPM approach.



**Mustard as a trap crop**

(Credit: ResearchGate)

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### Pheromone Monitoring System

A pheromone is a chemical substance produced and released by insects to influence the behaviour or physiology of their own species. For DBM monitoring, the system utilises yellow-coloured traps equipped with synthetic female moth pheromone lures and sticky surfaces to capture male moths. These pheromone lures require replacement every 4 to 6 weeks to maintain effectiveness. The pheromone trap is effective to control DBM at low level of pest infestations.

#### Components and Setup

The monitoring system consists of:

- A triangular prism-shaped yellow plastic trap that serves as the base
- Yellow sticky cards or surfaces for moth capture
- A protective cage or clip to hold the pheromone lure (typically in microcentrifuge tubes) away from the sticky surface
- Wire, string, or clips for suspending the trap approximately 1 m above the plant canopy.

#### Trap Placement

For effective monitoring, position traps at least 50 m apart and 2 m from field or greenhouse edges. Note that optimal trap density varies depending on specific site conditions and monitoring objectives.

#### Pheromone Lure Options

The lure can either be prepared in-house following the procedure detailed below or purchased from local vendors.



DBM Pheromone Trap

#### Procedure for In-house DBM Lure Preparation<sup>1</sup>

Required chemicals:

- Hexadecenal – 49.5 ml
- Hexadecenol – 1 ml
- Hexadecnyl Acetate – 49.5 ml
- Dichloromethane – 160 ml

Methods:

1. Pour 160 ml Dichloromethane<sup>2</sup> in a beaker.
2. Add the rest of the chemicals (ingredient a - c) to the Dichloromethane, and mix thoroughly. This mixture is the DBM pheromone lure.
3. Dispense, using micropipette, 100ul of pheromone lure into microcentrifuge tube. This lure could last for 4-6 weeks.
4. Several lures in microcentrifuge tubes could be prepared and placed in a zip-lock bag to store in the fridge (5-10 °C), for ready use and replacement in the trap. The remaining chemical mixture could be placed in the freezer until further use.



DBM pheromone lure in microcentrifuge tubes

#### Purchase Options for DBM Stock

Sources for DBM pheromone lures and individual components are listed below:

- Completed DBM pheromone lures:  
Kok Fah Technology Farm  
Tel: 67656629
- Ingredients a – c  
Pest Control Private Limited  
Email:  
[Ramanraman.knv@pcil.in](mailto:Ramanraman.knv@pcil.in)
- Dichloromethane<sup>1</sup>  
Chemical suppliers e.g. Merck & Sigma-Aldrich

**NOTE:** <sup>1</sup> Information on DBM lure preparation was provided by Plant Science and Health, National Parks Board

**NOTE:** <sup>2</sup> Dichloromethane may pose health hazards. Please use with caution.

- Inhalation Risks: Can cause dizziness, headaches, nausea, and respiratory irritation. High exposure may lead to unconsciousness.
- Carcinogenic Potential: Classified as a suspected carcinogen, meaning long-term exposure may increase cancer risk.
- Skin & Eye Irritation: Direct contact can cause burns, redness, and irritation.
- Central Nervous System Effects: May cause drowsiness and impair cognitive function.

Let us know your  
thoughts



#### About the Author

Leong Weng Hoy is from the Agri-Technology and Food Innovation Department of the Urban Food Solutions Division with over 40 years of experience as a farm extension specialist. Throughout his career, he has provided numerous farm solutions, encompassing technical innovations, knowledge sharing, and expert advice.

#### Reference:

1. "Biological, Ecology and Management of the Diamondback Moth" by Talekar & Shelton.
2. Biological Control of Diamondback Moth. Using Plutella Xylostella Granulovirus by Ahmad Dezanian.