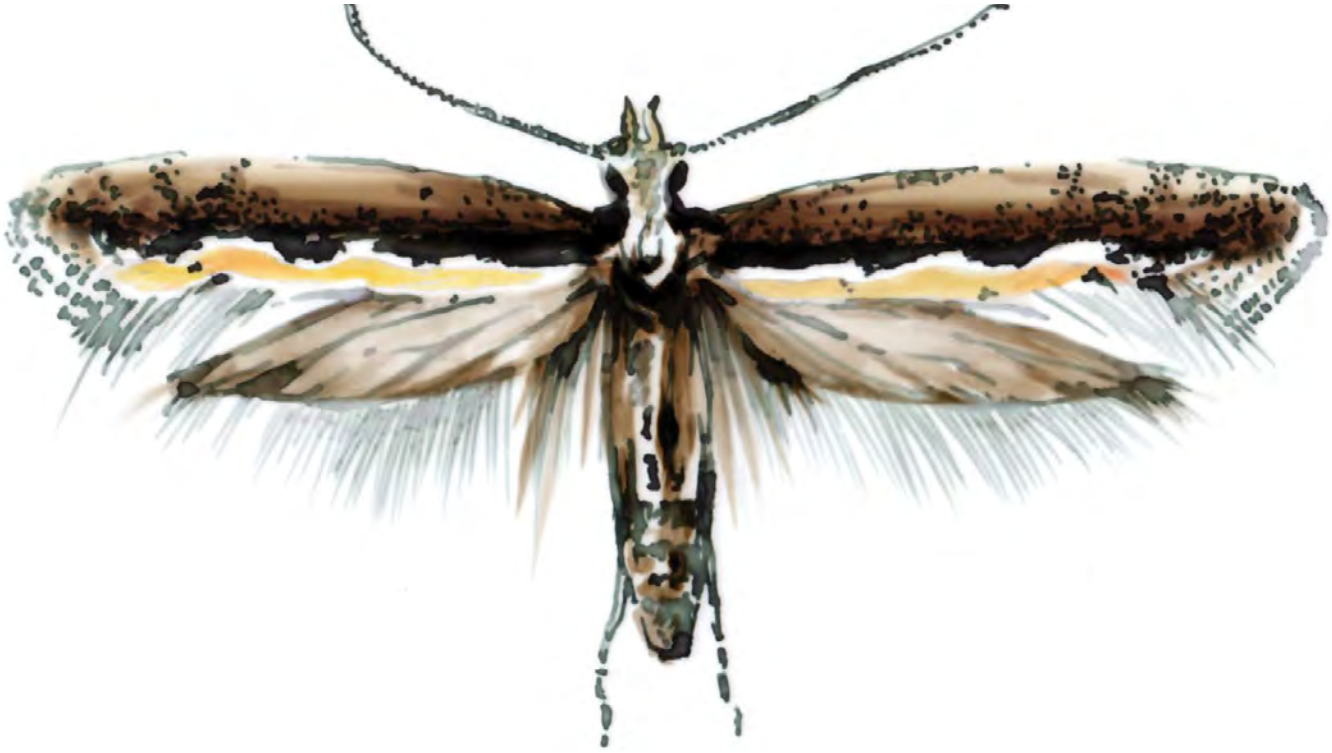
TAKE BACK YOUR CROP:



Modernizing Your Approach to Diamondback Moth

Suterra®

ALSO INSIDE:

- 3 Ways to Protect Your Crop from DBM
- Mating Disruption Offers a New Solution

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3 WAYS TO SAVE YOUR VEGETABLE CROPS FROM DIAMONDBACK MOTHS

By Bonnie C. Wells

THE DIAMONDBACK MOTH (DBM) is the most destructive pest of broccoli, cabbage and other cruciferous vegetables worldwide, and one of the planet's worst agricultural pests, wreaking billions of dollars' worth of havoc for growers annually. From causing major problems for the Australian canola industry in recent years, to causing a short supply of Brussels sprouts in the U.K. in 2017 due to a termed "biblical" migration of the pest, to becoming increasingly hard to control in the U.S., the DBM has growers globally concerned.

DBM is a perennial problem in the southern U.S., the region that leads North America in the production of cabbage and collard crops. DBM can overwinter and breed continuously in the warmer region producing as many as 15 generations per year.

The caterpillars of this pest moth are extremely efficient at developing resistance to all classes of insecticides. They are highly dispersive and adaptive to new environments, making outbreaks of the pest unpredictable. Experts believe Insecticide resistance and the lack of natural enemies are the reasons why DBM is increasingly hard to control.

CROP DAMAGE AND ECONOMIC LOSSES

Crop damage is caused by DBM caterpillars feeding on leaf tissue. Caterpillars consume the tissue from the underside of the leaves, causing irregular patches that appear window-like, as they leave the upper tissue and leaf veins intact. Economic losses can also occur for crops such as broccoli when caterpillars infest the florets resulting in total rejection of produce shipments. The latest total worldwide estimate for DBM management is $4 billion to $5 billion dollars annually, and $150 million to $200 million annually in the U.S.

Larvae crop damage

Whitney Cranshaw, Colorado State University, Bugwood.org

HOST PLANT RESISTANCE RECOGNITION

DBM caterpillars feed exclusively on crucifers, or plants in the Brassicaceae family, including the head and stem crops such as cabbage, broccoli, cauliflower, and Brussels sprouts; the leafy crops such as Bok choy, collards, kale, and mustards; and the root crops, such as radish, turnip, and rutabaga. Although the moths are crucifer specialists, crop species are not equally preferred, and DBM has a strong preference for collard plants. Mustards, turnips, and kohlrabi are the least preferred.

Plants in this family contain biochemicals called glucosinolates that are used as egg-laying stimulants by the DBM. Leaf color, wax content, head compactness, and levels of glucosinolates all affect a plant's resistance to the DBM. Shiny green or glossy leaves reportedly cause DBM caterpillars to spend more time searching for food, and less time feeding, which also might improve predation of the pest by natural enemies.

WHAT GROWERS CAN DO

Implementing an integrated strategy is critical to managing DBM in cruciferous vegetable production systems. Pest management programs must focus not only on DBM, but also the entire crucifer pest complex, which includes numerous other caterpillar species, aphids, harlequin bugs, stinkbugs, and leaf beetles. This is because the presence of other early season pests is generally the motivation for use of preventative sprays in cropping systems and can decrease the presence of natural enemies and favor insecticide resistance.

A truly integrated strategy will incorporate several complementary tactics that work to suppress multiple pests over large areas. When used together, these tactics can act synergistically to enhance pest suppression, reduce insecticide resistance, and improve the sustainability of the overall pest management program in crucifer cropping systems.

Crop Rotation

Because DBM has a narrow host range, feeding exclusively on cruciferous plants, crop rotation away from a host plant can significantly reduce the number of pests and subsequent damage in cropping systems. However, crop demand and price may dictate if crucifer-free periods are economically feasible for commercial vegetable producers.

2

Trap Cropping

Trap cropping, or using highly pest-attractive plants on field borders, can be used to intercept and retain pests such as the DBM and other crucifer pests.

Collards and Indian mustard are recommended trap crops for suppressing DBM. Because collards are highly attractive to DBM, they can be planted on the periphery of cabbage or broccoli fields for pest management.

3

Insecticide Knowledge and Resistance Awareness

Insecticides have been widely used on cruciferous crops for the control of numerous different pests. Preventative applications have been historically used for the control of early season pests and have led to the use of protective applications for later season pests such as DBM. Use patterns, however, significantly vary between regions and change depending on resistance development and new products becoming available for use.

Because the control of the DBM has relied heavily on insecticide applications, the pest has developed resistance to nearly every class of insecticides. According to the arthropod pesticide resistance database, DBM has developed resistance to more than 80 active ingredients in more than 20 countries. DBM was one of the first agricultural pests to develop resistance to DDT in the 1950s and later to the microbial insecticide *Bacillus thuringiensis* (Bt).

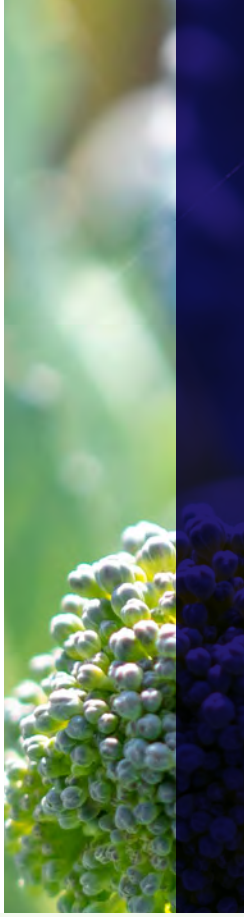
In North America, DBM has developed resistance to all pyrethroids, most carbamates and to Bt; however, the resistance varies greatly by region. DBM is highly adaptable and has proven to develop high levels of resistance to insecticides after only a few years of use. When new insecticides hit the market, it is imperative they are used judiciously and combined with other management tactics for the control of DBM and other cruciferous pest species, so insecticide resistance can be prevented.

Bonnie Wells, DPM is Commercial Horticulture Extension Agent II at UF/IFAS Extension Brevard County

For more information on the management of DBM and other insect pests of crucifers, the following links might be of help:
http://entnemdept.ufl.edu/creatures/veg/leaf/diamondback_moth.htm
http://edis.ifas.ufl.edu/ig150

MATING DISRUPTION OFFERS A CONTROL SOLUTION FOR DIAMONDBACK MOTH

This integrated pest management tool helps growers protect broccoli and cruciferous crops without worsening pesticide resistance issues.



COLE CROP GROWERS have a common enemy: the diamondback moth (DBM). The larvae of this pest have been wreaking havoc on farms across North America since they first traveled from Europe more than 150 years ago.

"There can be as many as 12 generations of DBM per year, and where there is a sufficient food source, they can be active all year round," explains Suterra technical team member Greg Montez. "The larvae damage the crop by destroying the growing tips of young plants and boring holes in the developing crop—making it unsaleable."

In the last 25 years, however, DBM has become an even bigger issue. Overuse of pesticides led to buildup of resistance in the 1950s and contributed to populations of so-called super bugs that are seemingly immune to certain pesticides even today.

Biocontrol methods are helpful, because they can extend the life of the chemicals in a grower's tool kit.

"Insecticide resistance is a real and ongoing problem for management of DBM, as insecticides are the primary method of control and they are used frequently through the growing season," Montez says. "Populations of DBM around the world are known to be resistant to the organophosphate and pyrethroid classes of insecticides, and DBM has also been documented by researchers as acquiring resistance to newer chemistries."

In addition to pesticide overuse, low application rates allowed DBM populations to rise and superbugs to breed uninterrupted. That's not to say pesticides can't be an effective control option, only that it takes planning and preparation to get it right. Scouting is particularly important because growers want to spray when the larvae are feeding. Traditional products applied at the proper rate also tend to be more effective when pest populations are small.

"When growers use the same tools repeatedly and the bugs build resistance, they're out of luck," Montez says. "Biocontrol methods are helpful because they can extend the life of the chemicals in a grower's tool kit."

Mating Disruption Breaks the Cycle

Growers who want to maximize their tools often look to integrated pest management programs to solve stubborn pest issues. When it comes to preventing DBM populations in check, mating disruption is a powerful option.

Mating disruption works by using an insect's own biology against it. Simply put, many insects communicate with one another via chemical signals known as pheromones. Sex pheromones are used to attract insects of the opposite sex. Female DBMs, for example, release a special blend of chemicals that draw males to them to mate.

Mating disruption works by quite literally disrupting this natural process. Synthetic chemicals that mirror the natural ones can be used. When growers spray or apply a mating disruption product, the

strong scent of the synthetic chemicals confuses male DBMs, preventing them from finding a female partner. Over time, the pest population naturally declines.

"Area-wide management plans using pheromone mating disruption have been successful in cropping systems all over the world," Montez says. "Most importantly, by potentially reducing the amount of conventional insecticides needed, the cost to the grower of keeping DBM in check should fall over time."

Mating disruption can and should be used alongside other control tools. Because mating disruption mimics a natural chemical already found in the air, it is worker and environment friendly. It won't harm beneficial insects, and when combined with trapping and scouting, it can be exceptionally effective against DBM populations.

Mating disruption products check these boxes, but they have other benefits, too. Suterra's CheckMate® DBM-F, for example, is a flowable that can also be sprayed with other products to give growers more crop protection bang for their buck. The pheromone molecules in CheckMate® have no toxic effect on any organism and are therefore safe to use in all situations, even up to the day of harvest.

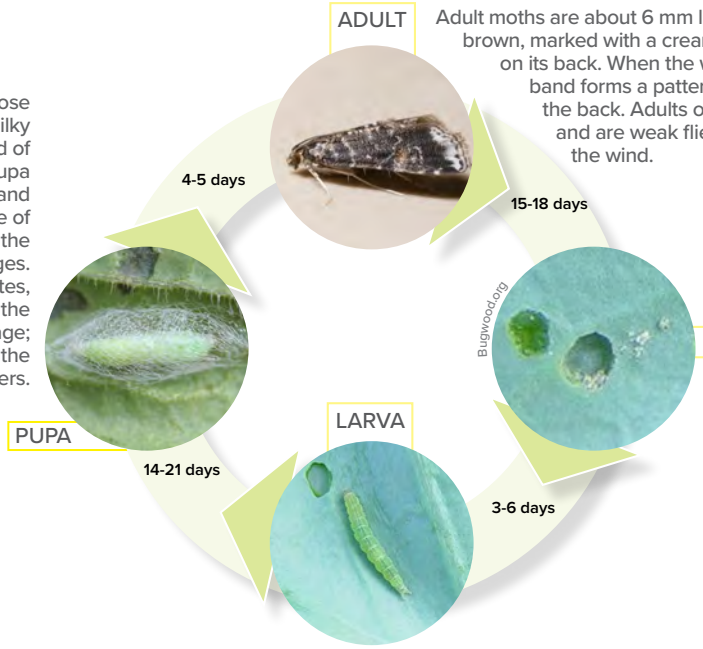
DBM may be a particularly formidable opponent, but it is not invincible. Mating disruption offers a natural way for growers to reduce pest populations, avoid resistance issues and produce the best crops possible.

"By reducing the amount of conventional insecticides needed, the cost to the grower of keeping DBM in check should fall over time."

— GREG MONTEZ, TECHNICAL MANAGER, SUTERRA

Diamondback Moth Lifecycle

ONE OF THE REASONS DBM is such a challenge, is that it can produce four generations per year in cooler climates and up to 12 in temperate regions. The entire cycle usually takes 25 to 30 days, depending on temperature. With so many generations in a season, a strong integrated pest management program is essential. Rotation of insecticidal modes and sites of action to minimize resistance buildup is key. Biological controls such as mating disruption and natural predators, along with cultural control methods also play an important role in protecting the crop.



The larval stage is the destructive one, and this stage also lasts the longest. Depending on temperature and other conditions it lasts between 12 and 32 days, averaging 17 to 18 days. There are four instars, with the colorless first instar creating little damage; it creates small mines between the leaf layers. Instars 2 through 4 are bright green and feed voraciously on the undersides of the foliage, resulting in extensive damage to the crop. If disturbed, the larvae wiggle and sometimes spin down from the plant on a silky thread. At the end of the 4th instar, the larvae are about 11 mm long.

Source: University of Florida (IFAS) Extension

Photos: Pupa: Whitney Cranshaw, Colorado State University, Bugwood.org.
Larva: Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org

Q&A with Greg Montez, Technical Manager, Suterra

What prompted DBM pesticide resistance issues?

Montez: Insecticides have been the control strategy of choice for DBM. Predators and parasites that could otherwise help to control DBM are affected by the constant use of insecticides, and there are no genetically modified cole crops available that are either not attractive to DBM or that produce the Bt protein like other genetically modified crops do.

How does DBM mating disruption work?

Montez: Almost all adult moths do not feed other than taking in water through their straw-like mouthparts, and this is true of DBM. The adult insect has all the metabolic energy that it is ever going to have as a result of feeding as a larva. The lifespan of an adult moth is measured in hours to a couple of days at most.

After adult moths emerge from their cocoons, the females begin to produce a pheromone made of one to several molecules that male moths of their species can sense and orient towards. Pheromones released by insects will have no effect on any but their own species.

As the moths age, metabolic energy is spent until the moth dies. If the female moth expends energy waiting to be mated, the eggs that would have been produced become less viable as time goes on and if the female goes unmated, no viable eggs are produced. The male moth, having used its energy in flying and searching, would be similarly depleted.

What is the future of DBM treatment?

Montez: As the population of insecticide-resistant DBM increases, this pest will become more difficult to control, as there are few if any new conventional insecticides being developed. Also, the development of resistant cole crops that have the ability to protect themselves has not progressed. CheckMate® DBM-F directly impacts the ability of a pest population to increase. It is also an important means of keeping the management tools that are currently available from creating resistance issues. As a pheromone-based mating disruption tool, CheckMate® helps to do that in an environmentally sound manner.

Suterra®

Driven by Science.

Backed by Growers.

Spray CheckMate® DBM-F to Reduce Diamondback Moth Damage

Grower-owned Suterra is proud that CheckMate® is trusted by more pest control advisors than any other brand of mating disruption pheromone.

CheckMate® DBM-F fights Diamondback Moth damage with a unique mode of action.

- Zero pre-harvest interval
- No maximum residue limit
- Does not harm beneficial insects

Contact your preferred ag chem partner today to request Suterra *CheckMate® DBM-F*.

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