JULY 2013

DIAMONDBACK MOTH FACT SHEET

GRDC
Grains Research & Development Corporation
Your GRDC working with you

SOUTHERN AND WESTERN REGIONS

DIAMONDBACK MOTH IS A SPORADIC BUT SERIOUS CANOLA CHALLENGE

Crop monitoring from July onwards is key to making effective decisions for controlling diamondback moth.

KEY POINTS

- Diamondback moth (DBM) can be a serious pest of canola and is found in all grain-growing regions.
- DBM outbreaks have become more frequent and severe in some regions, particularly in seasons with mild winters.
- The key to DBM control is to monitor crops from mid-July onwards.
- Resistance to commonly used insecticides is a major concern.
- Use thresholds to guide spray decisions and rotate insecticide groups between years.
- High-risk situations may require two sprays applied within seven days to control DBM.
- Spray application withholding periods before harvest or windrowing are the same, and must be observed.

PHOTO: DAFWA

When DBM larvae are disturbed they will wriggle, and may drop from the plant by a silken thread.

Diamondback moth (DBM) is an occasional pest of canola, brassica vegetables and forage crops.

DBM larvae feed on plant foliage, stems, flower heads and pods, and can be responsible for yield losses of up to 80 per cent.

In some regions, the frequency and severity of DBM outbreaks have increased markedly in the past decade, exacerbated by mild, dry winter conditions and the ability of the moth to rapidly develop insecticide resistance.

About diamondback moth

DBM (*Plutella xylostella*) are 10 millimetres long and grey-brown in colour. They have a white diamond-patterned stripe of uneven width down the centre of the back when the wings are folded over the body.

Eggs are pale yellow, oval and about 0.5mm in length.

DBM larvae grow to 12mm long, are pale yellowish-green and tapered at both ends. The larvae go through four growth stages and have a dark head in the first two stages. They wriggle when disturbed and often drop from a plant on a silken thread.

Mature larvae spin gauze-like cocoons, usually on the underside of leaves. The pupa is visible inside the cocoon and starts off green in colour, turning brown before emerging as an adult moth.

DBM are active at dusk and throughout the night, but usually do not fly far within a crop. However, outside the crop, they can migrate long distances on prevailing winds, especially when their host plant has died.

Level 1, Tourism House | 40 Blackall Street, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604 | **T** +61 2 6166 4500 | **F** +61 2 6166 4599 | **E** grdc@grdc.com.au | **W** www.grdc.com.au

PHOTO: KEVIN WALDEN

Canola can tolerate considerable leaf damage from DBM larvae before crop yield is affected. However, severe infestations of DBM larvae can cause complete defoliation and substantial yield losses.

Diamondback moths are so named for the distinctive diamond-shaped pattern on their back.

Life cycle

DBM survive between growing seasons on summer brassica weeds such as wild radish and Lincoln weed. Summer rainfall increases the 'green bridge' and DBM populations.

In autumn to early winter DBM fly from such alternate hosts into canola crops.

Female moths can lay more than 100 eggs in their lifetime, singly or in small clusters along the leaf vein on both sides of plant leaves. Eggs hatch after four to six days and the first stage of the larvae burrow into the leaf tissue.

The next three stages of the larvae feed on the plant surface and are usually found on the undersides of leaves.

The rate of development from eggs to moths depends on temperature. It is faster in warm weather and slower in cool weather.

For example, at a constant temperature of 28°C the DBM life cycle takes 14 days, whereas at 12°C the life cycle takes more than 100 days.

In warm weather there is often considerable overlap in generations and all life stages of DBM may be present in a crop at any one time.

DBM populations can suddenly crash and the reason for this is only partially understood. One factor may be the outbreak of insect fungal diseases during wet, warm weather.

Damage

DBM larvae can cause extensive damage to canola, but this does not happen in all years.

The damage caused by newly hatched larvae appears as characteristic pale-white traces. Older larvae feed on the underside of the leaves and often cause holes with the upper surface intact, which creates a see-through window effect.

Larvae can be found at any stage of a canola crop's development, with their numbers often increasing in the lead-up to flowering. Canola can tolerate considerable leaf damage before crop yield is affected. However, severe infestations of DBM larvae can cause complete defoliation and substantial yield losses.

As flowering progresses, increasing numbers of larvae move to the floral buds, flowers and pods. Large larvae may feed on small young pods.

Damage to mature plants during the late spring by rising populations of DBM often causes visible scarring of the outer pod walls, but this rarely results in any economic loss.

Monitoring for infestations

Crops should be monitored using an insect sweepnet at the first sign of damage and at intervals throughout the growing season from mid-July through to late spring/early summer.

Numbers are likely to increase quickly if DBM infest canola early in the season and if there is a strong chance of prolonged warm weather for the pest to complete three or four generations.

Sampling should be carried out at a minimum of four separate locations within each canola crop to gain an estimate of DBM numbers and how they vary throughout the paddock.

Two sets of 10-sweep samples (that is, 10 consecutive sweeps with a sweepnet) should be taken at each of the four locations, giving a total of eight 10-sweep samples. Empty the contents of each set of 10 sweeps onto a white or light-coloured surface, for example the bonnet of a white vehicle, and count the number of larvae. Note the sizes of the DBM larvae and the presence of other insects.

If no or low numbers of DBM are detected the crop should be monitored again in two weeks.

When DBM numbers increase, at least three estimates of larval density over 12 days are needed to determine how the population is changing. On each occasion, eight or more 10-sweep samples should be taken throughout the crop.

Cool, wet, windy weather can reduce DBM numbers. Numbers of larvae can also be reduced by beneficial insects and insect diseases.

TABLE 1 DBM threshold guidelines by crop stage

Crop stage	Moisture stress	DBM larvae threshold
Pre-flowering	Y	30 per 10 sweeps
	N	50 per 10 sweeps
Early to mid-flowering*	N	> 50 per 10 sweeps
Mid to late-flowering*	N	>100 per 10 sweeps
Pod maturation*	N	200 per 10 sweeps

* Moisture stress not listed for these growth stages because moisture stressed crops are more susceptible to insect damage. A lower threshold may be used if extended dry periods are expected.

When to act

There is no simple 'one figure fits all' for spraying. Economic thresholds vary from 30 to 200 larvae per 10 sweeps.

The crop growth stage, grain price and cost of spraying will need to be considered when deciding whether spraying will provide an economic return. The higher the grain price, the lower the economic threshold and, conversely, the higher the spray cost, the higher the threshold. Variation in regional and seasonal conditions also influences spray threshold levels.

As canola develops, it can tolerate increasing numbers of DBM without any significant yield loss. Table 1 shows levels as a guide for spray decisions.

A high number of small larvae (less than 3mm long) indicates numbers are likely to increase further.

Moisture-stressed crops are more susceptible to insect damage and a lower threshold may be used if extended dry periods are anticipated. For example, in pre-flowering crops, spraying should be considered if the average number of larvae exceeds 30 in 10 sweeps.

PHOTO: DAFWA

DBM pupae visible through the gauze-like cocoon on the underside of a damaged canola leaf. Pupae start out green, then turn brown in colour before hatching out as adult moths.

Control measures

DBM has developed widespread resistance to many insecticides including synthetic pyrethroids and organophosphates. This is a result of over-reliance and poor application of these insecticides across several agricultural industries.

In 2012 two new insecticides were registered for DBM control in canola: Affirm® (Group 6) and Success® Neo (Group 5). Together with the biological insecticide *Bacillus thuringiensis* (*Bt*) (a range of registered products are available), growers can now choose from three effective insecticide groups.

To reduce the risk of resistance developing to these newer insecticides, spray for DBM only when thresholds are exceeded and alternate between insecticide groups from one season to the next.

Once sweepnetting indicates DBM larval densities are at the spray threshold, a quick response with two spray applications (five to seven days apart) can give adequate control of larvae and reduce yield losses.

Under typical temperature conditions this strategy will ensure that DBM in life stages that survive the first application are controlled.

Sweepnet sampling of canola crops should be undertaken three to five days after the first spray to assess the effectiveness of the spray and to determine surviving numbers before a second spray is applied. High numbers of surviving large larvae would indicate that the first spray was ineffective, due to poor coverage and/or resistance. Higher numbers of only very small larvae would indicate that a new hatching of larvae has occurred, and that a second spray is warranted.

Research in Western Australia's northern grainbelt found a single spray in mid-August on rising populations of DBM had little impact on the damage caused when compared with unsprayed canola. A two-spray strategy therefore ensures DBM eggs and larvae that survive the first application are controlled.

The period between applications may vary with choice of chemical. Growers should note that withholding periods before harvest and at windrowing are the same, because windrowing is considered a harvest event. Users must abide by registration details on the product label.

Achieving good chemical penetration into a canopy crop is important as about 20 per cent of DBM larvae are found on the lower plant canopy.

Trials show that under good spraying conditions, aerial (CP90 nozzles with 30 litres per hectare of water) and ground-based (flat-fan 11015 nozzles with 50L/ha of water) applications can be equally effective in providing water rates and droplet size to achieve good leaf coverage and spray penetration to lower leaves.

Where 'soft' chemicals that are less disruptive to beneficial insects, such as *Bt*, are used the majority of larvae should be less than 5mm in length. *Bt* is broken down by ultraviolet light, so the best results are achieved by dusk application.

Integrated management

A number of beneficial insects attack DBM. These include the parasitic wasps *Diadegma semiclausum*, *Apanteles ippeus*, *Diadromus collaris* and *Oomyzus sokolowskii*. These wasps lay their eggs inside DBM larvae and/or pupae (depending on the wasp species) where the developing wasp larvae feed inside. The parasitised DBM larvae or pupae fail to develop.

Predators such as brown and green lacewings, several predacious bugs and a range of spiders will feed on DBM eggs,

larvae and pupae. Often these insects can be enough to prevent economic damage to canola crops.

Beneficial insects should be encouraged by better targeting and reducing insecticide applications. A fungus, *Zoophthera radicans*, can cause a 90 per cent reduction in DBM larvae numbers. The fungus favours rainfall, humidity and warm temperatures. Diseased larvae become yellowish, sluggish and swollen before dying. Dead larvae are white, brittle, flat, covered with fungus and attached to the plant leaves.

Summer weeds and self-sown canola provide a 'green bridge' on which DBM can survive over summer. Controlling these weeds within districts to be sown to canola is an important management control to restrict the potential DBM risk.

MORE INFORMATION

Greg Baker
SARDI
08 8303 9544
greg.baker@sa.gov.au

Peter Mangano
DAFWA
08 9368 3753
pmangano@agric.wa.gov.au

Svetlana Micic
DAFWA
08 9892 8591
svetlana.micic@agric.wa.gov.au

Dr Paul Umina
cesar
03 9349 4723
pumina@cesaraustralia.com

USEFUL RESOURCES

DBM Development Calculator (Victorian Department of Primary Industries)
www.dpi.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects/ag0512-diamondback-moth/sampling-plan/further-information

Beneficial Insects: The Back Pocket Guide
www.grdc.com.au/GRDC-BPG-BeneficialInsects-SW

Acknowledgements:
Greg Baker, Peter Mangano, Svetlana Micic, Dr Paul Umina

GRDC PROJECT CODE

DAS00094

FREQUENTLY ASKED QUESTIONS

When is the best time to look for DBM?
Start looking for DBM larvae and damage to leaves when canola crops begin flowering. Check crops regularly. Monitoring is the key to assessing the risk of a DBM outbreak.

How do I know the extent of the infestation?
Crops should be monitored with a sweepnet to gain an idea of the prevalence of, and changes in, DBM populations and stages of development, as per the protocol outlined above in 'Monitoring for infestations'.

When do I spray?
As canola develops it can tolerate increasing numbers of DBM without any significant yield loss. In early flowering canola, if more than 10 larvae are found in 10 sweeps then a major outbreak could develop. Continue crop monitoring. During early to mid-flowering and pod formation if average numbers of 50 or more larvae per 10 sweeps are found (and the numbers fail to decline after seven to 12 days) then spraying should be considered. This threshold increases later in the season. When crops are at late-flowering and most pods are formed the average number of DBM larvae needs to exceed 100 larvae per 10 sweeps to warrant spraying.

Are withholding periods before harvest the same as for windrowing?
Yes. Windrowing is considered a harvest event.

What is the best control option?
No single registered DBM treatment completely removes DBM. About 20 per cent of DBM larvae are found on the lower part of the canola canopy, which makes good spray coverage critical. When large outbreaks have occurred, two spray applications five to seven days apart have given significantly greater control of caterpillars and reduced yield loss. This two-spray strategy ensures that DBM eggs and caterpillars that survive the first application are also controlled. Use a sweepnet to sample crops three to five days after the first spray to assess its effectiveness and determine surviving numbers. This will help determine if a second spray is needed.

PRODUCED BY **WWW.CORETEXT.COM.AU**