Diamondback moth in canola

FS 03/08

Ken Henry, Senior Technical Entomology; Greg Baker Senior Research Officer Entomology

Introduction:

The diamondback moth, *Plutella xylostella*, also known as DBM or cabbage moth, is a pest of canola (*Brassica* spp.), Brassica vegetable and forage crops. The frequency and severity of DBM outbreaks in canola crops has increased in recent years, associated with warmer and drier winter-spring weather. In years when good winter rains occur, DBM are generally held in check below economically damaging densities in canola. Heavy reliance on broad spectrum insecticides as the primary control measure for DBM has resulted in the development of resistance by DBM to many commonly used insecticides across Australia.

Figure 1. Adult moth

Description:

The moths are approx 10mm in length (Fig. 1) and grey - brown in colour, with an uneven white stripe down the centre of the back. When the moths are at rest and the wings are folded over the body the stripe forms a diamond pattern, hence the name ‘diamondback’.

Eggs are pale yellow, oval and about 0.5mm in length. The larvae (caterpillars) are pale green (Fig. 2), slightly tapered at each end and grow through four stages to a length of about 12mm. They have a dark head in the first two stages. They wriggle when disturbed, often dropping from the plant on a silken thread. At maturity the larvae spin a gauze-like cocoon (Fig. 3), usually on the underside of leaves in which to pupate; The pupa is green at first, but turns brown before the adult moth emerges.

Figure 2. Larvae

Life cycle:

Moth Movement

Adults are active at dusk and throughout the night, but usually do not move far within a crop. However, they are capable of long distance migration on prevailing winds, especially when host plant material has died off and the moths have to disperse to survive.

For further information phone (08) 8226 0222, or any office of Primary Industries and Resources South Australia.
Information may be used with acknowledgement.

ISSN 1323-0409
August 2008

Summer rainfall provides an ideal green bridge of summer weeds, especially wild radish and Lincoln weed, for DBM survival. In late-autumn to winter DBM adults migrate from the summer weed sources into canola crops.

Within the Crop

There is considerable overlap in generations (Fig. 3), with all stages being present at any one time. Rate of development depends on temperature, being quicker in warm weather and slower in cool weather.
Approximate rates of are:

- 12° C, the life cycle takes 113 days.
- 15° C, the life cycle takes 47 days.
- 25° C, the life cycle takes 17 days.
- 28° C, the life cycle takes 14 days.

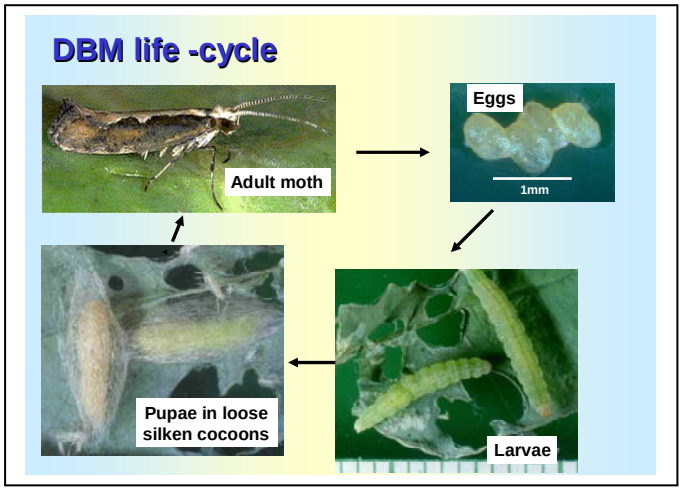

Figure 3. Lifecycle

Female moths commence egg laying shortly after mating, usually laying more than 100 eggs during their life time. Eggs are laid either singly or in small clusters along the leaf vein on both sides of the leaves. The eggs hatch after about 4 – 6 days, the first stage (instar) larva tunnelling into the leaf tissue. The next three larval instars feed openly on the plant surface, usually on the undersides of the foliage or the developing inflorescences.

Damage:

The leaf mines of the newly hatched larvae appear as characteristic, pale white traces. The feeding of the larger larvae on the underside of leaves causes holes (Fig.4), often with the upper surface intact, which produces a window effect. Canola can tolerate considerable foliar feeding damage before crop yield is affected.
However, severe DBM feeding damage can cause complete defoliation, resulting in yield reduction.

Figure 4. Larvae damage

The larvae can cause damage to all developmental stages of the canola plant. They generally feed on foliage before flowering. As flowering progresses, an increasing proportion of the larvae move to the floral buds, flowers and pods. Young pods may be fully eaten by the larvae; maturing pods are usually surface grazed.

Monitoring:

Crops should be monitored at the first sign of damage and throughout the growing season from late winter to late spring using a sweep net. Sampling should commence at the edge of the crop and at regular intervals as you move in towards the centre of the crop. At each selected site, take a sample of 10 sweeps of the net and count the number of DBM larvae collected.

Take a minimum of five sets of 10 sweeps and calculate the average number of larvae per 10 sweeps.

It is also important to re-monitor 5 - 7 days after a spray treatment.

Weather conditions can impact dramatically on DBM populations and sampling. For example, rainfall greater than five to eight mm in 24 hours often reduces their larval abundance. Larvae are either dislodged, drowned or death is caused by disease.

Thresholds:

Thresholds are estimates of the density at which control measures should be applied to prevent the infestation causing economic damage. It should be noted these estimates are guides only and may vary with crop development, between regions and between seasons.

Spray when:

> 30 larvae per 10 sweeps for pre-flowering stressed crops.
> 50 larvae per 10 sweeps for pre-flowering unstressed crops.
> 100-200 larvae per 10 sweeps for unstressed crops with the majority of plants in flower

If the average number of larvae per 10 sweeps is well below or well above the spray threshold, five sets of 10 sweeps should be adequate.

However, if the number of larvae per 10 sweeps is close to the spray threshold, it is advisable to take another five sets of 10 sweeps before making a decision to treat (*i.e*. a total of 10 sets of 10 sweeps).

Management:

Biological control

A number of natural enemies attack DBM. The most important of these are small wasp parasitoids – *Diadegma semiclausum* (Fig. 5), *Apanteles ippeus* (Fig. 6) and *Diadromus collaris.* They lay eggs in the larvae or pupae of DBM and the developed adult wasp later emerges, killing the DBM host in the process.

Figure. 5 Adult *Diadegma semiclausum*

Predators such as brown lacewing larvae (*Micromus tasmaniae*), several predacious bugs (*e.g*. *Nabis tasmanicus*), and a range of spiders feed on DBM eggs, larvae and pupae and further contribute to their mortality.

Figure. 6 Adult *Apanteles ippeus*

Outbreaks of the disease *Zoophthera radicans* can also cause greater than 90% reduction in DBM population density. Diseased larvae become yellowish, sluggish and somewhat swollen before death. After death, their flattened, whitish, brittle bodies, are covered with fungal growth and remain attached on the plant surface (Fig. 7). A combination of rainfall, high humidity and warm temperatures are required for a *Z. radicans* disease outbreak.

Cultural Control

The control of summer weeds close to the crop will help break the ‘green bridge’, which DBM may be surviving on over summer. In the future, it may possible that other cultural control

techniques, such as trap crops and resistant varieties, may play a role in DBM management, but more research is required to investigate these options.

Figure. 7 Larvae infected with *Z.adicans*

Insecticides

Throughout the world DBM has developed resistance to many insecticides. Factors which help contribute to the development of resistance by DBM include their high fecundity, their rapid turnover of overlapping generations and the frequent use of insecticides in some Brassica cropping systems.

Resistance to synthetic pyrethroids and organophosphates is widespread in DBM populations, in Brassica vegetable crops throughout Australia and, to a lesser and varying extent in many Australian canola crops.

If monitoring detects a rapid increase in numbers and they pass economic thresholds a two spray policy is thought to be more effective than a single spray. The second spray is applied approximately one week after the first if more than 20% of the initial population remains. It is critical to assess numbers between sprays.

Bacillus thuringiensis (*Bt)* should be considered one of the first options in the suppression of DBM populations, as it is less disruptive to beneficial insects. Regular crop monitoring and prompt spray timing is critical in achieving good control; ideally the majority of larvae should be < 5mm in length (2^{nd} – 3^{rd} instar). *Bt* is broken down by UV, so spraying at dusk will ensure greater effectiveness.

Good spray coverage is critical for effective DBM control as greater than 20% of larvae can be found in the bottom third of the crop.

Table 1: Products Registered for DBM control in canola (Aug 2008)

Note: some products are registered in certain states only

Insecticide Group	Active ingredient	Product Examples	State	WHP Days
1A	methomyl	Electra 225, Marlin, Methomyl 225, Nudrin 225	WA Only	7
3A	alpha-cypermethrin	Alpha-Cypermethrin, Alpha-Scud 100, Astound Duo, Dictate Duo 100, Dominex Duo, Fastac Duo, Unialphacyper 100	NSW, ACT, Vic, Tas, SA, WA only	21
	esfenvalerate	Sumi-Alpha Flex	Vic, Tas, SA, WA only	14
	gamma-cyhalothrin	Trojan	All States	7
	lambda-cyhalothrin	Karate, Kung Fu 250 & Matador	All States	7
11C	Bt (k)	Dipel DF, Dipel SC, BTK Biological, Biocrystal, Delfin WG, Full-Bac WDG	All States	NR*
	Bt (az)	Bacchus WG	All States	
Insecticide	amorphous silica	Abrade Abrasive barrier insecticide	All States	NR
Insecticide	paraffinic oil	Canopy Insecticide	All States	1

Responsible Chemical Use

To preserve Australia's valuable export markets we must be able to guarantee that our commodities that may be exported are free from chemical residues.

When using any agricultural chemical product, protect our valuable export markets from residue violations by **ALWAYS READING THE LABEL OR PERMIT** and:

1. **Only use products with a registration or permit for the crop you are using them on;**
2. **Do not apply the product at a rate that exceeds the maximum crop rate on the label or permit; and**
3. **Always follow the withholding period (minimum time required between chemical use and harvest (which includes windrowing).**

For more information on responsible chemical use go to the PIRSA website * (http://www.pir.sa.gov.au/ruralchem).

** For producers not in SA, check your responsible chemical use requirements with your relevant State Department of Agriculture office or website as legal requirements for chemical use in your State may differ from SA requirements.*

Acknowledgements: the authors gratefully acknowledge the contributions of Dr Cate Paull, Judy Bellati and Dr Angela Lush (all with SARDI Entomology) in reviewing this publication.