FACTSHEET JULY 2012

Light brown apple moth

Mr David Braybrook
VitiSolutions Pty Ltd

INNOVATORS NETWORK

Australian Government
Grape and Wine Research and Development Corporation

gwrdc
GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

Introduction

The light brown apple moth (LBAM, *Epiphyas postvittana*) is a native 'leaf-roller' that has a wide host range, including numerous broadleaf weeds, horticultural crops and native species. While this moth is found across Australia, its impact on grape production varies significantly between regions, vineyards and seasons, making it important to take a strategic approach to management.

Identifying LBAM

Moths

Moths are pale brown (8–10 mm long) and may be confused with other moths within and around the vineyard. The males are smaller than the females and have dark markings on the lower parts of their wings. Moths are generally active from dusk until dawn.

Eggs

Female moths lay pale blue-green 'scale-like' egg masses of 10–60 eggs (Figure 1). The eggs turn yellow as they develop, and prior to hatching, the dark heads of the caterpillars give the mass a dark, blotchy appearance. Individual eggs are 0.7–1.0 mm across and are laid in an overlapping pattern.

Caterpillars

Newly emerging LBAM caterpillars are pale green to yellow and about 1 mm long, and grow to approximately 1.5 cm in length. Adult caterpillars are pale green with a dark green central stripe.

Damage and loss

Crop loss

Light brown apple moth will feed on both foliage and fruit. While the feeding damage on bunch stems, flowers and berries can directly reduce crop yield, the most significant impact is the increased risk of infection by *Botrytis cinerea* and other bunch-rotting fungi. Damage to berries provides entry points for bunch-rotting fungi and the 'webbing' together of parts of bunches during flowering traps debris inside the bunches, which again further increases the potential for bunch rot development later in the season (Figure 2).

Figure 1: Fresh LBAM egg mass. (Photo courtesy Shane Coster, Research and Development Solutions).

Figure 2: Botrytis bunch rot. (Photo courtesy Shane Coster, Research and Development Solutions).

To determine the impact of LBAM on a particular site, it is necessary to undertake harvest assessments of damage and then to quantify the association of LBAM feeding damage with the incidence and severity of bunch rots.

Lifecycle

Overwintering

Caterpillars hatched from egg masses laid in autumn overwinter in bunch remnants, weeds or cover crop plants, or in neighbouring vegetation. In late winter to early spring, some of these older caterpillars that have overwintered in, or close to, vines may move onto nearby new growth at budburst, while others will have already entered the pupal stage, awaiting warmer temperatures to emerge as moths.

Adult moths and egg lays

Moths mate soon after emerging from their pupae in late winter or early spring, and each female lays her egg masses over a 2–3 week lifespan. The time until the eggs hatch may range from 1 to 3 weeks, depending upon temperature (i.e. 2–3 weeks in spring, and about 7–8 days in summer). Eggs are most commonly laid on the upper surfaces of expanded grapevine leaves. Those egg masses laid in spring are most commonly found on leaves near the base of a shoot, while in summer they tend to be found on leaves in the middle of the shoot. In autumn, egg masses are often laid on vines and broadleaf weeds such as capeweed (*Arctotheca calendula*) and docks (*Rumex* spp.), or on cover crops such as clovers (*Trifolium* spp.) and medics (*Medicago* spp.).

Caterpillars

The youngest caterpillars (1st instars, 1–2 mm long) can often be found on the undersides of leaves along leaf veins at the tips of shoots. As caterpillars grow, they construct webbing shelters and leaf rolls next to veins on the undersides of expanding leaves, just below the shoot tip, or in developing inflorescences and bunches. Often larvae web together a number of leaves, flowers or berries (Figure 3) and later in the season can infest whole bunches. Young caterpillars hatched in the summer generation may move immediately into bunches.

Figure 3: LBAM 5th or 6th instar with webbing and webbed-together flowers. (Photo courtesy Shane Coster, Research and Development Solutions).

After the caterpillars go through 5 or 6 moults (instars), they pupate within the shelter of the vine or other host plant for 7–21 days, depending on the time of year. The pupae are about 10–12 mm long and change from green to brown as they develop.

Favourable conditions

Favourable climate

Light brown apple moth tends to be more of a problem in cooler wine regions, where summer conditions are relatively mild. In warmer climates, such as the Sunraysia region (Vic.), the summer LBAM population is often reduced by hot weather. In cooler regions, such as the Yarra Valley (Vic.) and Coonawarra (SA), the summer generation is more likely to persist and subsequently cause damage to bunches.

Susceptible varieties

While LBAM will attack all varieties, those that are more susceptible to damage tend to be those that are also most susceptible to Botrytis infection (e.g. tight-bunched, thin-skinned varieties such as Chardonnay).

Alternative host plants

Light brown apple moth has a wide range of host plants, including a large number of horticultural crops (e.g. citrus, apples), broadleaf weeds (e.g. clover, capeweed) and native plant species. Increased LBAM levels due to the presence of surrounding host plants are often evident as an 'edge effect' in the vineyard, where higher numbers of LBAM are detected closer to the boundaries of a block.

Low beneficial numbers

A number of beneficial species that impact on LBAM numbers have been identified in vineyards, and in many vineyards these species keep populations below threshold levels. If the balance of beneficials is disrupted, then LBAM populations will have a greater chance of increasing across the season.

Monitoring

As LBAM numbers and potential damage can vary among sites, regions and seasons, it is critical to implement and maintain a systematic weekly monitoring program. All stages of the LBAM life cycle can be identified and monitored.

Monitoring moths

Adult moths can be trapped using pheromone traps and port lure traps (1 part port wine to 9 parts water). Pheromone traps use a lure specific for LBAM to attract and trap the male moths, whereas port lures are not selective and will attract a wide range of flying insects, making assessing moth numbers more difficult. While research indicates that trap catches don't reflect the potential larval population and the need for control, they can provide a useful reminder to monitor for other lifecycle stages.

Monitoring egg masses

Many vineyards monitor egg masses to decide if and when to apply controls. Monitoring for egg masses begins when female moths lay eggs on the upper surfaces of leaves in the spring (Figure 4). Monitoring should initially be focused on basal leaves, as eggs laid on young, rapidly growing leaves are often dislodged due to leaf expansion.

To assess egg mass numbers, the upper surfaces of 50 leaves per panel (3–4 vines) are inspected on 20 panels within the block (i.e. a total of 1000 leaves/block). Tagging representative unhatched egg masses in the vineyard and monitoring their development enables timing of controls to be optimised.

Monitoring larvae

Larvae can be found in shoots, flowers or bunches and should be monitored regularly to assess the efficacy of controls and to back up decisions made on egg mass monitoring results. Monitoring involves sampling 100 shoots (Figure 5) and 100 bunches per block and assessing the number and growth stage (instar) of larvae. While an

Figure 4: Empty LBAM egg mass. (Photo courtesy Shane Coster, Research and Development Solutions).

assessment of larval numbers gives the best indication of the LBAM problem, the success of this approach relies on finding small larvae. Larger larvae are easier to find but they are also more difficult to control, as they may be protected in sheltered feeding sites and are less susceptible to some chemical controls.

One of the key times for monitoring larvae is during flowering, when most chemical control options are still available and LBAM larvae are easy to detect due to their webbing in bunches.

Weather-based models

Weather-based models can be used to predict rates of LBAM development during the season, and theoretically provide information to assist with field monitoring and the timing of controls. However, in Australian viticulture the use of such models has been limited, as there are difficulties in accurately determining the start date for the LBAM lifecycle. Another limitation to the effectiveness of computer modelling for LBAM is that it cannot predict population size and therefore cannot be used to make decisions on the need to apply controls.

Monitoring tip

To increase the chance of finding LBAM, first go to a potential 'hot spot' in a more susceptible variety and then extend the sample to give good representation of the block. For example, there is often strong 'edge effect', so monitoring should start on outer rows and end panels.

Management

Thresholds/Interpretation of monitoring results

While thresholds have been established for LBAM, they should be refined for a particular region, site and variety. This requires monitoring over a number of seasons and correlating LBAM numbers during the season with levels of bunch damage associated with LBAM at harvest.

Figure 5: Rolled leaves near shoot tip. (Photo courtesy Shane Coster, Research and Development Solutions).

Some of the considerations for setting a threshold include:

- *History or risk of Botrytis bunch rot*: LBAM damage to berries provides an entry point for Botrytis; vineyards or blocks with a history of Botrytis problems will therefore have a lower tolerance for LBAM.
- *Activity of beneficial insects*: a large population of natural predators and parasitoids in the vineyard may provide adequate control of LBAM and should be noted while monitoring.

Preliminary action threshold levels

For pesticide application, preliminary action threshold levels developed in cooler regions with higher Botrytis pressure are:

- more than 3 viable egg masses per 1000 leaves
- more than 10 caterpillars per 100 shoots
- more than 10 caterpillars per 100 bunches.

Chemical options

Chemical control (specific to caterpillars)

Methoxyfenozide (e.g. Prodigy®) selectively controls caterpillars by initiating a premature, lethal moult. It is specific to caterpillars and does not harm predators and parasites. Timing of sprays to target early-instar larvae is important.

Chemical control (semi-selective)

Newer chemicals that have been introduced to vineyards in recent years, such as spinosad (e.g. Success®), chlorantraniliprole (e.g. Altacor®), emamectin (e.g. Proclaim®) and indoxacarb (e.g. Avatar®) are promoted as being semi-selective. However, they can be toxic to beneficials at the time of spraying, but once spray has dried there is a reduced risk of non-target impacts.

Chemical control (broad-spectrum)

Organophosphates and carbamate group insecticides are registered for control of LBAM (check state registrations for use), but are highly disruptive to populations of beneficial species and are not recommended for use.

Biological control

Spray tips

- Chemical application is most effective after eggs have hatched, but before caterpillars reach 3–5 mm and build feeding shelters.
- Follow-up monitoring is important to assess spray efficacy and determine the need for additional applications
- Some products take a number of days to kill the LBAM caterpillars so wait one week before reassessing.

Biological products such as *Bacillus thuringiensis* (Bt) sprays are available, but need to be applied soon after egg hatch, targeting early-instar larvae.

Natural predators and parasitoids

A wide range of insects can assist in the control of LBAM, ranging from generalist predators (e.g. lacewings, spiders and predatory shield bugs) to a variety of parasitoids (e.g. *Dolichogenidea tasmanica* and *Trichogramma* spp.). Many vineyards aim to protect beneficial species through careful agrochemical selection, and recently some vineyards have altered the composition of their midrow swards to provide alternative food sources and shelter for key beneficials.

Mating disruption

Disruption of the mating of moths by means of pheromone ties is currently being used in commercial vineyards. This does, however, assume that control will be required for LBAM prior to the season commencing, and is better suited to larger blocks, where the potential impact of LBAM flying into a block from surrounding host plants is reduced.

Cultural management practices

Managing midrow plants

Reducing weeds or broadleaf cover crop growth before budburst can remove any caterpillars overwintering in this vegetation, and reduces the alternative host range for LBAM. However, this needs to be considered in relation to the potential benefits of a mixed sward in enhancing beneficial populations.

Further reading

Bernard M, Horne PA, Papacek D, Jacometti MA, Wratten SD, Evans KJ, Herbert KS, Powell KS, Rakimov A, Weppler R, Kourmouzis T & Yen AL (2007) Guidelines for environmentally sustainable wine grape production in Australia: IPM adoption self-assessment guide for growers. *Australian & New Zealand Grapegrower & Winemaker* 518: 24–35.

Bernard M, Semeraro L, Carter V & Wratten SD (2006) Beneficial insects in vineyards: Parasitoids of LBAM and grapevine moth in south-east Australia. *Australian & New Zealand Grapegrower & Winemaker* 513: 21–28.

Bernard M, Wainer J, Carter V, Semeraro L, Yen AL & Wratten SD (2006) Beneficial insects and spiders in vineyards: Predators in south-east Australia. *Australian & New Zealand Grapegrower & Winemaker* 512: 37–48.

Braybrook D (2001) Managing lightbrown apple moth without broad-spectrum insecticides. *Australian Grapegrower & Winemaker* 453: 15–17.

Emmett RW et al. (1994) Light brown apple moth. In Nicholas P, Magarey P & Wachtel M (eds) *Diseases and Pests*, Grape Production Series No. 1, Winetitles: Adelaide, ISBN 9781875130153, pp. 47–50.

Magarey PA, MacGregor AM, Wachtel MF & Kelly MC (2006) *Field Guide for Diseases, Pests and Disorders of Grapes for Australia and New Zealand*, Winetitles: Adelaide, ISBN 9781875130337, 108 pp. (A companion to Nicholas P, Magarey P & Wachtel M (eds) (2011) *Diseases and Pests*, Winetitles: Adelaide, ISBN 9781875130153, 106 pp.)

Thomson LJ & Hoffmann AA (2008) Vegetation increases abundance of natural enemies of common pests in vineyards. *Australian & New Zealand Grapegrower & Winemaker* Annual Technical Issue 533: 34–37.

Thomson L, Nash M & Hoffmann A (2009) Increasing natural enemy abundance and diversity in vineyards by reducing pesticide toxicity. *Australian & New Zealand Grapegrower & Winemaker* 37th Annual Technical Issue: 17–20.

Thomson L, Danne A, Sharley D, Nash M, Penfold C & Hoffmann A (2009) Native grass cover crops can contribute to pest control in vineyards. *Australian Viticulture* 13: 54–58.

Grape and Wine Research and Development Corporation
Industry House, Cnr Botanic and Hackney Roads, Adelaide SA 5000
PO Box 610, Kent Town SA 5071
Telephone (08) 8273 0500
Facsimile (08) 8373 6608
Email gwrdc@gwrdc.com.au
Website www.gwrdc.com.au