



FACT SHEET

REVISED MAY 2019

IDENTIFICATION AND MANAGEMENT OF PORINA

KEY POINTS

- Porina damage is often predictable
- High populations cause catastrophic pasture damage
- Low populations contribute to loss of sown species and reduced pasture persistence
- Damage most often occurs 2-4 years after pasture establishment by either cultivation or by direct drilling following break crops
- Pasture to pasture renewal using direct drilling can avoid porina attack
- Damage can occur 2-3 years after very dry summers—this can be widespread
- The degree of potential damage can be estimated 2-3 months before damage shows
- Timing of control measures can be determined from the times moths fly. These vary between regions and sometimes within localities. Learn to recognise porina moths and note when they fly in your area.
- High pasture cover when porina moths are flying favours egg and young caterpillar survival
- AR37 endophyte in ryegrass, Happe endophyte in ryegrasses and festolium, and U2 endophyte in festolium protect against porina feeding
- Other ryegrasses, clovers and plantain are favourable plants for porina caterpillars
- Tall fescue, cocksfoot and lucerne are tolerant or resistant to porina feeding



Typical damage from 100 porina caterpillars/m²

BIOLOGY

Porina is the common name for a group of moths and caterpillars, belonging to the genus *Wiseana*, some of which are pasture pests. All porina species have one generation per year. Moth emergence from the soil and subsequent flights usually occur on mild nights with high humidity, often during light rain. Male moths appear slightly before females and mating occurs almost immediately the females emerge. The 2–3 cm long moths can be recognised easily. They are soft bodied and at rest hold their wings in a characteristic tent-like shape (Figure 1). Although a few moths can be seen in most regions from October to March, each of the main flight periods in any one locality are usually strongly synchronised with large numbers of moths seen over a period of a few nights to 2–3 weeks. There may be 1–3 main flight periods per season depending on location. Generally, South Island locations experience a late spring and a mid-summer main flight while many North Island areas have a main flight in late summer/early autumn but the specific timings vary (Figure 2).

The moths do not feed and live only a few days, but during this time each female can lay several thousand eggs, usually within a few hours of mating. Eggs are jettisoned indiscriminately by

female moths during flights over several hundred metres; some will fly greater distances. Eggs usually hatch after three and six weeks, earlier at higher temperature, but above 25°C the eggs will die. Moisture is essential for eggs and newly hatched caterpillars to survive. Very hot, dry, weather can decimate young porina populations, particularly in short, open pastures. High, dense pasture cover can protect young porina from hot, dry weather, allowing porina numbers to build up.

At first, newly-hatched caterpillars live on the top of the soil in leaf litter and at plant bases, where they feed on soil microflora, detritus and plant matter. As they grow they construct burrows in the soil that eventually reach around 30 cm deep. Caterpillars emerge from these at night to feed, in most cases severing leaves close to ground level and taking these back to their burrows where they may feed on them for several days. Caterpillars are reluctant to move far from their burrows and consequently focus their feeding within a 5 cm radius of the burrow entrance, often killing plant crowns and opening bare areas within the pasture. When feeding on plantain the caterpillars graze on the base of the plant, not the leaves. Such feeding can cause the plant to break off.



Figure 1. Wiseana copularis (male left, female right), the most widespread pest porina species. Although wing colours and patterns vary the wing shape and position make porina moths easily recognisable. Photo: AgResearch Ltd

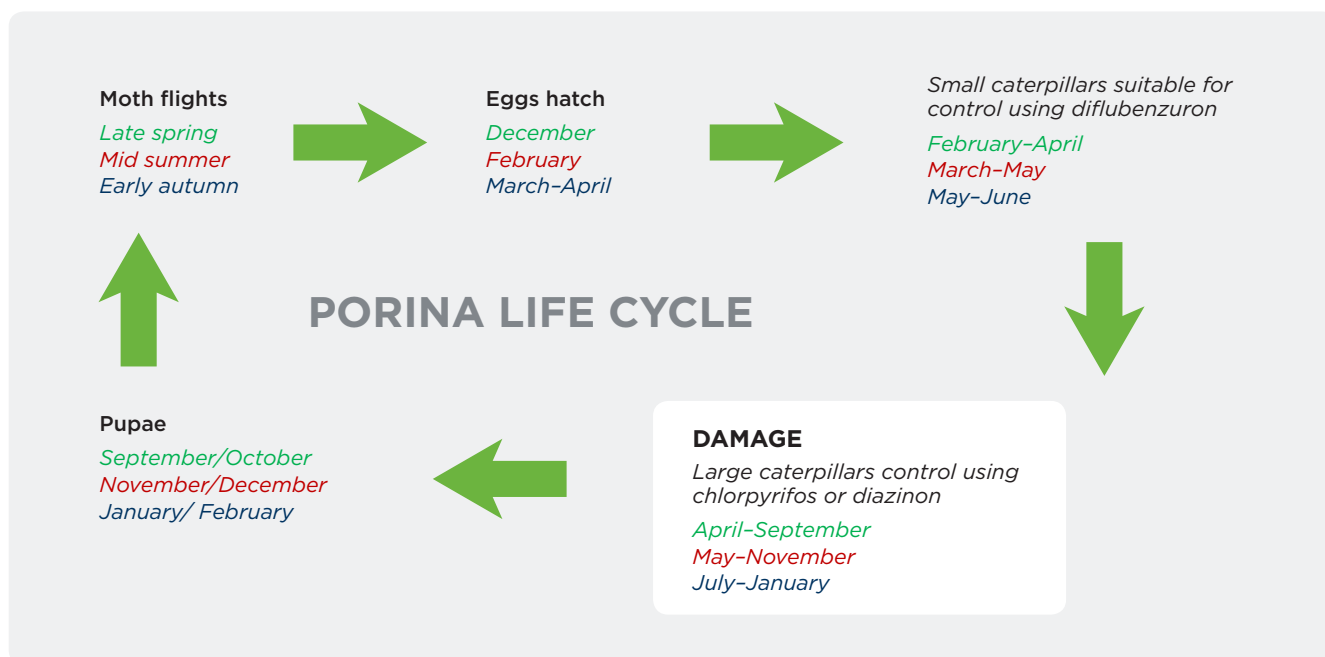


Figure 2. Porina life cycles and damage phase determined by moth flight times. Different colours represent development from different moth flight times

Porina caterpillars (Figure 3) will moult seven or eight times over their lifetime. The periods between moults are shortest when the caterpillars are smallest, becoming longer as the caterpillars become larger. When pasture growth is high while the caterpillars are young, their feeding often goes unnoticed for several months. As the caterpillars grow towards their maximum size, their food intake and the associated pasture damage increases, particularly when this coincides with slowed or stalled pasture growth over winter.



Figure 3. *Wiseana copularis* caterpillar. It is impossible to visually distinguish between porina species. Caterpillars, when fully grown, reach about 3–4 cm long and live in permanent burrows in soil. Photo: AgResearch Ltd

At low densities (less than 40/m²) porina graze pastures and are direct competitors with stock. As caterpillar densities increase, caterpillar to caterpillar contact also increases, which they try to avoid by limiting their travel and concentrating their feeding close to burrow entrances. As a result, plants near to burrows are overgrazed and killed. This creates characteristic bare patches in pastures, which are invaded by weeds, reducing pasture yield and subsequent pasture quality. When caterpillar densities are high, these small bare areas merge together into large areas with sparse, or no vegetation cover. In extreme situations the entire paddock can become almost completely bare, with only unpalatable plants such as mouse eared chickweed or daisies remaining.

Porina numbers are strongly influenced by disease incidence from naturally-occurring pathogens in pasture. In a stable environment, such as tussock grasslands and old pasture, porina pathogens regulate porina numbers so that densities are low (typically less than 15/m²). Many pathogens are completely dependent on porina—i.e. for pathogens maintain effective control, porina must be present in sufficient (but not damaging) numbers. When this interaction between pathogens, disease incidence and porina numbers is disrupted, by drought, cultivation, or application of some insecticides, a damaging outbreak of porina is likely. Typically, large numbers of porina infest pastures 2–4 years after disruption. This means we know which pastures are at risk of attack.

There are seven porina species. Moths of different species can be difficult to tell apart as colour, wing patterns and size vary widely within species and overlap between species. Caterpillars of different species are impossible to distinguish visually. It is only very recently, using molecular DNA technology, that the species living in pastures have been able to be identified and differences in behaviour recognised. Elucidation of which species cause pasture damage is being supported by B+LNZ but this is still in its infancy. Initial indications are that just one species, *W. copularis*, is the major pest although other species may be locally important. Knowledge regarding which porina species are/are not damaging may be significant in developing future control technologies. For current on-farm management, it is not critical to identify correctly which species are present before making management decisions.

TIMING OF TREATMENT

Do not wait until damage shows before dealing with porina. The most important factor in dealing with porina and their impacts is to be aware of them: porina moths are easy to recognise and generally their peak flights are very obvious. An outside light will attract moths in large numbers and often observing this is all that is needed to recognise major flights. Alternatively, traps can be constructed very simply by hanging a light (fluorescent bulbs are best) above a container containing some water (with a little dishwashing liquid added) covered with a lid, or funnel, with a 5–7 cm hole (Figure 4). These are best positioned where there is direct line of sight to nearby pastures. The light should be turned on around 9:30 pm and can be left on overnight turned off around 1:30 am if using a timer.



Figure 4. A simple light trap to monitor moth flights.
Photo: AgResearch Ltd.

When observing or measuring moth flights it is comparative numbers of moths that are important not absolute numbers. The peak flight numbers are one or two orders of magnitude greater than non-peak levels (Figure 5). Peak flights are key dates on which subsequent actions are based to deal with the porina threat. When moths fly determines when caterpillar feeding will begin to damage pasture production and when porina control measures should be applied.

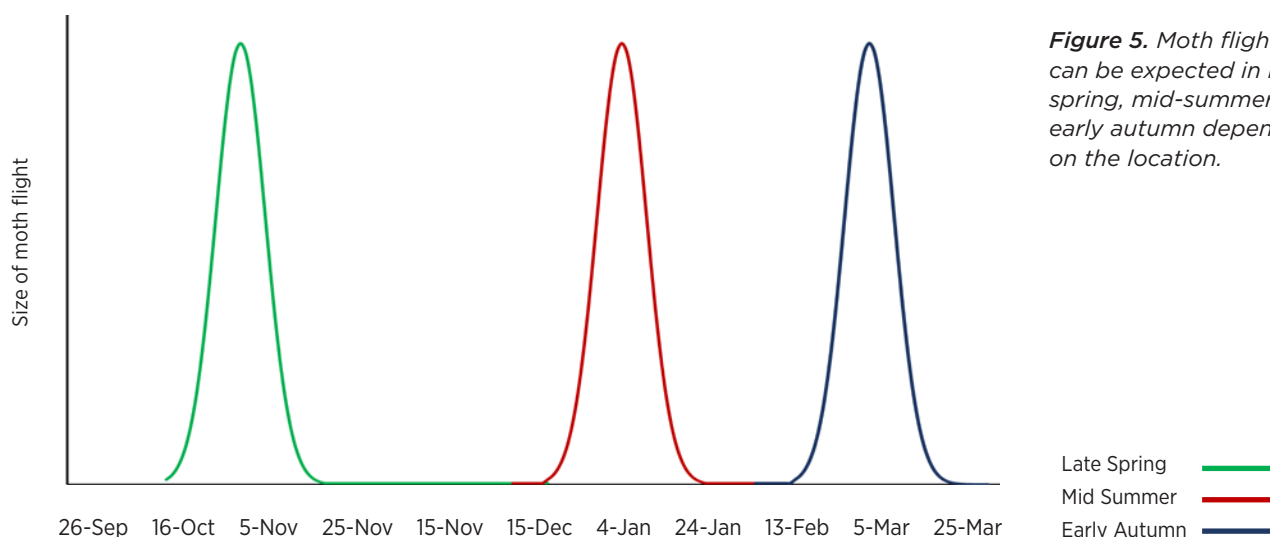


Figure 5. Moth flights can be expected in late spring, mid-summer and early autumn depending on the location.

ASSESSING PORINA CATERPILLAR NUMBERS AND POTENTIAL DAMAGE

To make informed decisions about porina management, it is advisable to sample at-risk pastures 8-12 weeks after peak flights (before damage shows) to determine whether or not control is warranted and what the cost benefit analysis of control is. If the number of caterpillars present is known, the cost of that infestation can be simply calculated and related to the cost of control. (Figure 6).

The easiest way to do this is to dig some holes in at-risk pastures and count the caterpillars present. The earlier this is done, the greater the potential economic return of any control measures used.

In practice the earliest time for pasture sampling is eight weeks after moth flights, when caterpillars are just 10-15 mm long, so searching has to be thorough. Smaller caterpillars are closer to the soil surface: digging after eight weeks need only be 3-4 cm deep, at 12-16 weeks it is advisable to dig to 5-15 cm, and after 16 weeks 20-25 cm deep. It is useful to sort the soil on a sheet of some type. When sampling early it may also be easier to use a small spade (15 cm) to reduce the soil volume. Dig at least 10 representative holes per pasture and ensure the holes are a spade width wide, square, and with straight edges.

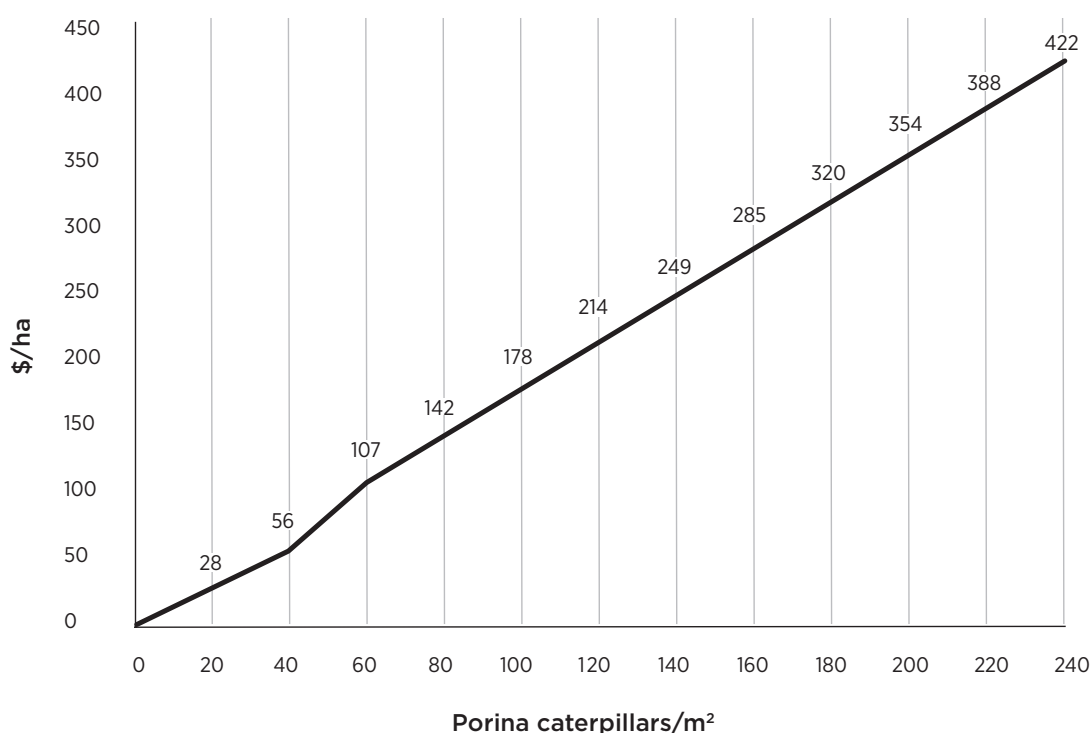


Figure 6. The potential loss (\$/ha) estimated from porina at increasing densities (caterpillars/m²). The figures at the intercepts of the vertical lines and the sloping line are \$lost/ha by supporting the corresponding levels of porina. (Ferguson et al. 2019. Quantifying the economic cost of invertebrate pests to New Zealand's pastoral industry. New Zealand Journal of Agricultural Research. 62(3). 255-315). www.doi.org/10.1080/00288233.2018.1478860



Figure 7. A heat lamp used to extract small caterpillars from turves.
Photo: AgResearch Ltd

An alternative method when sampling for small caterpillars is to collect the turves (3–4 cm deep) dug from the holes, invert these on wire mesh over containers containing 1–2 cm of water and hanging a heat source (an incandescent 150W light bulb or a heat lamp is usually sufficient) immediately above the turves so that the heat drives the caterpillars down into the water-filled container (Figure 7). This may take two nights. The water can then be searched for caterpillars.

Count the caterpillars found in each hole (or turve) and calculate the average. The population density and potential cost can now be calculated using:

For a 15 cm spade

$$\begin{aligned} &\text{Average No caterpillars/hole} \times 44 \\ &= \text{No caterpillars/m}^2 \end{aligned}$$

For a 20 cm spade

$$\begin{aligned} &\text{Average No caterpillars/hole} \times 25 \\ &= \text{No caterpillars/m}^2 \end{aligned}$$

Having calculated the No caterpillars/m², estimate the potential economic loss using Figure 6.



PORINA MANAGEMENT

INSECTICIDE

Read instructions for insecticides carefully and always follow manufacturer's withholding periods

Immediate reduction of porina populations relies on insecticides. The earlier these are applied, the greater the economic return. There are two types of insecticide available both of which should be applied as foliar sprays:

Insect growth regulators (IGRs) in which diflubenzuron is the active ingredient

Organophosphate insecticides with either diazinon or chlorpyrifos as the active ingredients.

Diflubenzuron works by disrupting insect moulting and while this makes it a relatively safe product to use, it must be applied when the caterpillars are small and moulting frequently. The larger the caterpillars are when it is applied the less efficient it will be. If the caterpillar's heads are greater than 2.5mm wide, it will give disappointing results. Caterpillar body size is not a good indication of development but if caterpillars are 25mm or longer, diflubenzuron is not a suitable control option. The optimal time of application is 8-12 weeks after the peak moth flight. In areas where there two or more peaks a second application may be required. The level of control provided by diflubenzuron is likely to be around 70% so where populations are very high it may be unsuitable.

However, this level ensures sufficient caterpillars remain to allow pathogen build up and natural population regulation to re-establish.

Diazinon and chlorpyrifos work via insect nervous systems and are not affected by caterpillar development so can be applied to any size caterpillar. Partly as a consequence of this, the level of control obtained from these is usually much higher than for diflubenzuron and frequently exceeds 95%. This level of kill can, however, disrupt the build-up of pathogens and may allow damage to occur in subsequent years. If porina are not controlled until pasture damage is observed these are the only options available. Diazinon will be unavailable after 2028 and chlorpyrifos use is currently under review (2019).

SHORT TERM ALTERNATIVES TO INSECTICIDE USE ARE LIMITED

Ensuring pastures have optimal nutrient levels will help them tolerate caterpillar feeding. Plants with optimal nutrition can compensate for feeding damage and caterpillars may eat smaller volumes of foliage from more nutritious plants. For low to moderate porina levels, this can be an attractive mitigation technique.

Targeted grazing of pastures to create unfavourable conditions (i.e. very low pasture cover) for survival of porina eggs and young caterpillars can be successful. This approach

is limited by stock availability, so it may not be feasible to graze all at-risk pastures. The effectiveness of this strategy is lessened if there is rain over the critical periods.

LONG TERM PASTURE PROTECTION

Grass endophytes offer the best persistent protection for most pastures. This strategy should be the basis for control in porina-prone areas. Several are available: AR37 endophyte in ryegrasses, Happe endophyte in ryegrasses and festolium, and U2 endophyte in festolium. AR37 will kill caterpillars that feed on grasses infected with it. When established, the sown endophyte-infected grass component of pastures will deter, and lessen, porina feeding over the life of the pasture. In pastures with a mix of endophyte and non-endophyte pasture species, porina caterpillars may feed selectively on the non-endophyte pasture species (clovers, herbs, non-endophyte grasses). The presence of endophyte will reduce the overall impact of porina on the pasture sward in most cases. The effectiveness of endophyte protection is reduced by very low temperatures as toxin production by the endophyte decreases, and may cease, over winter. If large porina caterpillars continue feeding into winter, endophyte-infected grasses may still be damaged. Endophyte pastures are at most risk from winter damage when peak moth flight occurs in autumn. Young endophyte-infected pastures should be checked for porina presence as described above. If very high numbers

of porina are present, it may be prudent to use insecticide to ensure the pasture is protected during establishment and that long term benefits are realised.

Tall fescue, cocksfoot and lucerne are resistant to porina feeding. Where these can be used in an overall farm system, the threat from porina can be substantially reduced, if not eliminated.

Clovers can be particularly susceptible to caterpillar feeding and are often damaged more than grasses in pastures. Red clover will tolerate more feeding than white clover but both are favourable. With specialist pastures, particularly those using red and/or white clover and plantain, caterpillar numbers can be very high and warrant extra monitoring.

CONCLUSIONS

Understanding where and why porina are a threat to pasture production and persistence provides the knowledge to combat that threat. Prediction and estimation of the potential impact is straightforward and can be used to mitigate impacts and avoid costly damage.

ACKNOWLEDGEMENTS

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