BIOLOGICAL CONTROL OF GORSE: GORSE SOFT SHOOT MOTH

Background

Gorse, *Ulex europaeus*, is native to western Europe and was introduced to Australia in the early 1800's. Gorse has since become a significant agricultural and environmental weed and is now listed as a Weed of National Significance. Gorse occurs in, South Australia, New South Wales, Western Australia and the ACT, but the heaviest infestations are in Victoria and Tasmania. Gorse is common in agricultural and urban areas, riparian environments and disturbed areas of bushland. It significantly reduces pasture and animal productivity and in forestry plantations, reduces tree establishment and growth. It also provides a habitat and shelter for vertebrate pests. The annual cost of gorse management to agricultural and forest industries in Australia has been estimated at $7 million. Because of the difficulty and expense of controlling gorse by traditional methods such as herbicides, mechanical clearing and cultivation, biological control continues to be investigated as a possible cheaper and long-term control option.

The gorse soft shoot moth, *Agonopterix umbellana*, is one of a guild of agents of European origin being used for the biological control of gorse in Australia. It was first released in Tasmania and Victoria in spring 2007 following tests that showed it feeds only on gorse.

Description

Adult gorse soft shoot moths are approximately 1 cm long with a 2 cm wingspan. Their forewings are a uniform light brown colour and have dark brown veins with occasional black flecks (Fig. 1 inset). The eggs are elongate-oval in shape, about 0.7 mm long and 0.4 mm wide. The dorsal surface of the egg has longitudinal striations and is slightly raised but the ventral surface by which it is attached to gorse is distinctly flattened. Eggs are white when first laid. As they develop, the colour changes to cream with an orange ring visible on the dorsal surface. Just prior to hatching the eggs appear darker in colour with the black head capsules clearly visible through each shell. Larvae pass through six moults or instars before reaching the pupal stage. Newly hatched larvae have black head capsules and black thoracic plates with creamy coloured white thoracic and abdominal segments. The black colour of the head capsules and thoracic plates are retained throughout development. However, when feeding commences the colour of the dorsal body segments quickly changes initially to khaki and then to dark brown through to the fifth instar. During the final instar (Fig. 1), the colour of the dorsal body segments changes from dark brown to light brown, then olive green and finally lime green by the time the pre-pupal stage is reached.

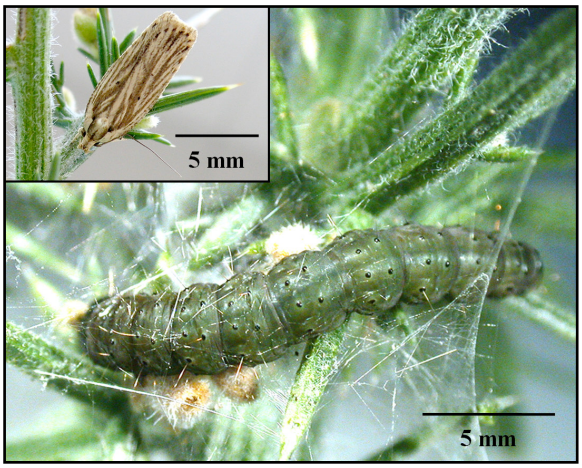

Figure 1. *Final instar larva of gorse soft shoot moth and adult (inset) (Photo of larva: R. Holloway, TIA; photo of adult: W. Chatterton, TIA.).*

Pupae are approximately 10 mm long and 3 mm wide, lime green when first formed but changing quickly to light brown and then dark brown.

Life cycle and biology

Gorse soft shoot moths have only one generation per year. Eggs are laid in October/November and larval stages are present from October to January. Larvae start to pupate during January. Adults emerge during February and eventually move into the gorse bushes to begin their winter diapause. Once temperatures start to increase in early spring the adults become active, mate and lay eggs near buds in the axils of gorse spines and stems. Egg hatching coincides with the availability of succulent new growth. Newly hatched larvae migrate to young buds, spinning a protective silken tube-like shelter whilst feeding on the developing spines of the apical tip. As the larvae develop they spin larger shelters (Fig. 2) and feed on the lateral spines of the growing shoot.

Figure 2. *Gorse soft shoot moth larva in webbed shelter (Photo: W, Chatterton, TIA).*

At 18°C, egg to adult development takes around 12 weeks. Eggs take about 16 days to hatch, larval development takes about 47 days and pupal development takes another 29 days before the adults emerge. Females can lay up to 250 eggs.

Damage to gorse

The early instar larvae will cause some damage but the later instar larvae have the greatest impact. If larval feeding fails to kill the shoot, the destruction of spines from larval feeding destroys the plant's reproductive buds thereby reducing or preventing flowering and seed set the following spring.

Release and establishment

Gorse soft shoot moth larvae and pupae were imported from New Zealand to a quarantine facility operated by the Department of Primary Industry Victoria (DPI Victoria) at Frankston in December 2006. They were then reared through one mandatory generation to ensure they were free of disease. In September 2007 the moths were cleared from quarantine and releases have since been made in Tasmania, Victoria and South Australia. Field surveys in these states indicate that the moth will eventually establish across south-eastern Australia. In Tasmania, populations have started to reach high levels at one site in the Tasmanian midlands. This site will be used as a collection site (nursery site) to transfer egg laying moths each spring to new sites across south-eastern Australia in order to accelerate their spread. Other sites will also eventually be used as nursery sites once populations reach high enough densities to enable easy collection.

Prospects for gorse control

The gorse soft shoot moth is one of four agents of European origin that have been released for the biological control of gorse in Australia.

The gorse seed weevil, *Exapion ulicis*, was first released in 1939 and is now widespread in gorse infestations across south eastern Australia. The weevil larvae feed on gorse seeds within the developing pods during spring and summer. However, seeds produced during autumn and winter are not attacked so its impact is limited.

The gorse spider mite, *Tetranychus lintearius*, was released in 1998 and is also widespread across south-eastern Australia. The mites feed on mature gorse foliage and studies have shown they can reduce the growth of gorse by around 37%. However, predators such as the Chilean predatory mite, *Phytoseiulus persimilis*, and species of mite eating ladybirds, *Stethorus* spp., have reduced its effectiveness.

The gorse thrips, *Sericothrips staphylinus*, which prefers to feed on young shoots and seedlings, was released in 2001 and has also established. A glasshouse study in Tasmania showed that a combination of gorse thrips, ryegrass competition and simulated grazing caused 93% mortality of gorse seedlings, thus indicating the potential of gorse thrips in an integrated control program. However, at field sites, thrips population densities have not yet reached high enough levels to cause observable damage.

It is important to remember that biological control is a long-term process that will not eradicate gorse. However, it is hoped that once all the biological control agents become widespread their combined impact will eventually result in a reduction in gorse vigour, seed output and rate of spread, making it more susceptible to grazing, weather stresses and herbicides as part of an integrated management program.

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Further information

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