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BIOLOGICAL CONTROL OF GORSE: GORSE SEED WEEVIL

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 Western Australia, South Australia, New South Wales 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 across 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.

Originally from Europe, the gorse seed weevil, *Exapion ulicis*, was introduced to Tasmania from New Zealand in 1939 and was the first gorse biological control agent released in Australia. The weevil is now widespread in Tasmania, Victoria, South Australia the ACT and NSW and is now one of a guild of biological control agents being used on gorse.

Description

Adult gorse seed weevils (Fig. 1) appear greyish due to the presence of minute hairs covering the body, but the underlying colour is black. The body length ranges from 1.8-2.5 mm. The adults have a long curved snout (rostrum) which is characteristic of the weevil family. Generally, females are larger than the males with longer rostrums. Eggs are yellow and the larvae are white, legless grubs approximately 2 mm long with brown head capsules. The pupae are white when newly formed but change to grey as they develop.

Life cycle and biology

Adult weevils live for up to 12 months and can be found on gorse bushes all year round. However, there is only one generation each year. Development times vary between locations depending on the prevailing weather conditions. Adults over-winter then mate and commence egg-laying in spring. The females bore a hole in the developing seed pods through which they insert an average of nine eggs per pod, although the number of eggs laid can vary considerably. Eggs can be laid from early spring through to the end of summer with peak egg production occurring in mid to late spring. Eggs take about 4 weeks to hatch. Larval numbers per pod also vary considerably averaging around six per pod. Larvae feed on the seeds either internally or externally and are usually active only from spring through summer, with maximum numbers occurring in late spring to early summer. Each larva takes about six weeks to develop into the pupal stage. Pupation occurs inside the pod and takes about four weeks. Depending on site conditions, some larvae start to pupate from late spring, with others pupating in summer. Adults emerge when the mature pods burst open and can disperse by flying.

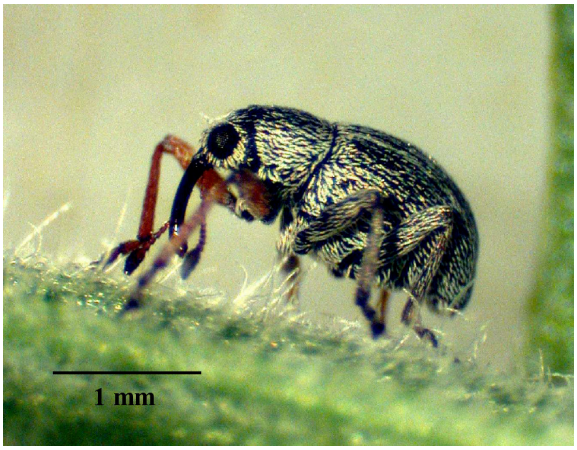

Figure 1. *Adult gorse weevil (Photo: W. Chatterton, TIAR).*

Damage to gorse

The adult stage of the weevil feeds on the flowers and foliage but the damage is insignificant. The main damage (Fig. 2) results from the larvae feeding on the developing seeds within the pods. However, the impact of the larvae on seed production is not high enough to significantly affect plant densities (Fig. 3). Flowering and pod production of gorse varies considerably not only between sites but on individual bushes within sites. At some sites, particularly those in cool, high altitude localities most gorse bushes flower in late winter/spring. At other sites, such as those in warmer, coastal localities, flowering occurs in autumn and winter as well as in spring. The larvae of the weevil only feed on a proportion of seed produced in spring and summer and, as they are not present during the autumn/winter period, a significant proportion of the annual seed crop escapes attack. A study in Tasmania showed that the percentage of mature seed destroyed annually ranged from 12-55%. This is much lower than the estimated levels of seed

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Figure 2. *Open gorse pod showing larvae and pupae of the gorse seed weevil and seed damage (Photo: R. Holloway, TIAR).*

destruction of around 75-85% that New Zealand modelling studies have indicated would be necessary to cause a decline in gorse densities. The introduction of an additional seed-feeding agent to act in combination with the weevil would further reduce seed production levels.

Prospects for gorse control

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

The gorse spider mite, *Tetranychus lintearius*, was released in 1998 and is now widespread in Tasmania, Victoria, South Australia, the ACT and parts of NSW. The mites feed on mature gorse foliage and studies have shown they can reduce the growth of gorse by around 36%. 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*, was first released in Tasmania and Victoria in 2001 and has since been released in South Australia and NSW. The gorse thrips prefer to feed on young shoots and seedlings. 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.

Another foliage feeding agent, the gorse soft shoot moth, *Agonopterix umbellana*, which attacks the newly developing spring growth of gorse, was released in Victoria and Tasmania in spring 2007. Further releases are planned, but it is still too early to tell whether establishment has been successful. Its impact alone or in combination with the other agents will be determined by future research. Research is also being conducted for possible host specific fungal pathogens and additional seed feeding agents.

It is important to remember that biological control is a long-term process that will not eradicate gorse. However, it is hoped that the combined impact of complementary biological control agents will reduce gorse vigour, seed output and rate of spread and make it more susceptible to grazing, weather stresses and herbicides as part of an integrated management program.

		Winter			Spring			Summer			Autumn		
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Gorse seed weevil	Eggs												
	Larvae												
	Pupae												
	Adults							E	E	E			
Gorse seed Production[1]	Cooler sites												
	Warmer sites												

[1] Cooler sites are generally at high altitude and/or inland; warmer sites are generally at low altitude and/or near the coast. Note: minor seed production on some plants can occur outside the periods indicated.

E = Emergence of adult weevils from pods.

Figure 3. *Main periods of activity in the gorse seed weevil life cycle in relation gorse seed production patterns at 'cooler' and 'warmer' sites. Note that the main period of larval activity is October to January, so a large proportion of seed produced annually is not attacked.*

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For further information on this project contact:
John Ireson
Tasmanian Institute of Agricultural Research,
13 St. John's Avenue, New Town, 7008.
Phone: (03) 6233 6821; Fax: (03) 6233 6145
Email: John.Ireson@dpiw.tas.gov.au