

The horehound plume moth, the first agent to be released against horehound, a weed that is spreading through pastures and conservation areas in Victoria and South Australia.



• Keeping our agents in control

In a glasshouse at Victoria's Keith Turnbull Research Institute (KTRI), a force of cochineal insects is being marshalled for a renewed assault on the prickly pear.

It's a battle of old adversaries. Cochineal insects were one of 52 insect species brought to Australia early this century as potential prickly pear combatants. Together with the moth *Cactoblastis cactorum*, they had a major impact on the prickly pear in eastern Australia, but few cochineal insects were released in Victoria and they have been slow to disperse to all prickly pear infestations in the state.

Two species of prickly pear, the common prickly pear and the drooping prickly pear,

remain serious weeds in Victoria and the tiger pear has the potential to become so. The tiger pear is common along watercourses of south-eastern Queensland and north-eastern New South Wales. Weed control officers hope cochineal will prevent this occurring in Victoria by thinning infestations to manageable levels.

The redistribution of cochineal in Victoria serves as a reminder that biological control offers no quick fix to the problem of environmental and agricultural weeds. Persistent efforts in establishing biological control agents throughout the weed's infestation are often needed to ensure a natural balance is achieved between a biological control agent and its target. Nor does biological control offer a stand-alone solution. It usually forms part of an integrated approach in which biological, cultural, physical and chemical techniques are combined to achieve a maximum impact while minimising economic, health and environmental risks.

Integrated weed management requires an ecological understanding of both the weed and the invaded system. For example, biological control might be used in a national park where a creeper is invading the forest understorey. But because biocontrol agents typically require 10-20 years to take effect, interim measures are needed to reduce the creeper's spread. These might include herbicide application at a time of year when the native vegetation is least susceptible, mechanical control such as weed pulling, or the use of fire. Knowing the cause of the weed outbreak and how revegetation can lessen the risk of reinfestation is also important.

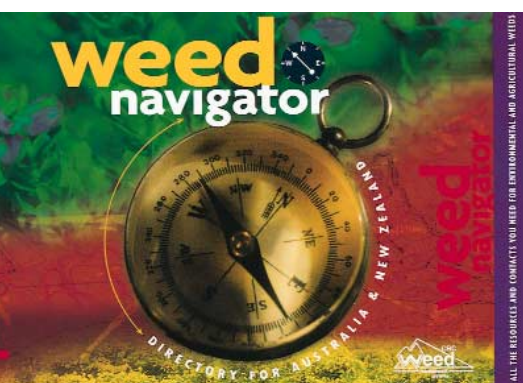
Research into to integration of these techniques is ongoing. In the case of bitou bush, a serious weed in New South Wales, Victoria and South Australia, research by NSW Agriculture has found that many native species tolerate aerial spraying of low concentrations of glyphosate during winter, whereas bitou bush is susceptible. This means large areas of bitou bush can be sprayed with minimal damage to the environment.

A long road to release

Another factor contributing to the long-term nature of biological control is the need to ensure the effectiveness and safety of biocontrol agents.

It takes time to identify and select the natural enemies that will do most damage, and rigorous studies are conducted to determine whether they could have any impact on non-target species. The importation and quarantine of biocontrol agents approved for released into Australia must be arranged, and the agents must be checked for viruses, pathogens and disease. Then the best methods for rearing and mass producing biocontrol agents and ensuring their establishment have to be determined. Finally, developing techniques for incorporating biological control into integrated weed management strategies is necessary to maximise the effectiveness of biocontrol agents. All this can take five years, often more.

This exhaustive process is illustrated by the introduction of biocontrol agents for horehound, one of the most widespread weeds in southern Australia. Horehound is a European native which occurs in high and low rainfall areas, is drought tolerant and is



Everything you might need to know about the weed world of Australia and New Zealand is contained in *Weed navigator*, a guide produced by the CRC for Weed Management Systems. *Weed navigator* lists contacts, publications, websites, databases, strategies, legislation, posters and training opportunities. It is available for A\$30 including postage from the CRC (08) 8303 6590, email: crcweeds@waite.adelaide.edu.au.

avoided by stock due its bitter taste. Horehound burrs reduce the quality of wool and the plant invades both pasture and native vegetation.

A study commissioned in 1990 by KTRI and CSIRO Entomology identified several potential insect predators in Europe. The first, the horehound plume moth, was imported to the KTRI quarantine facility in 1993. A second, the horehound clearwing moth, was imported in 1996. Two other agents, a root boring beetle and a pollen feeding beetle, are also under investigation.

'In Europe, horehound is attacked by 36 insect species and at least 25 of these are host-specific,' KTRI research officer John Weiss says. 'We select for those that do the most damage. Ideally, we want them to be defoliators or root feeders and preferably to stop seed production.'

Weiss says another strategy is to select agents that attack the host weed in different ways. For example, plume moth larvae damage the growing tips of horehound plants by feeding on the leaves. Heavy feeding weakens the plant, reducing flower and seed production. The clearwing moth complements this approach by feeding as larvae on growing tissue in the roots and stems, decreasing the flow of water and nutrients. The two moths also have a different climate preference: the clearwing moth preferring drier, hotter conditions than the plume moth.

Testing for host-specificity means ensuring the biocontrol agents will affect only the target weed. The list of test plants includes Australian natives and plants used in agriculture and horticulture. 'An insect is more likely to attack a species closely-related to the host, so we begin with these, then move to more distant relatives,' Weiss says.

The design and results of each testing program must be approved by a formidable list of state research and environmental organisations before AQIS and Environment Australia can allow an agent to be released. The plume moth and the horehound clearwing moth have passed every test with flying colours and were released in 1994 and 1997 respectively.

Plume moths are released onto horehound infestations as pupae and clearwing moths are released as eggs attached to toothpicks which are inserted into the plant's stems. Weiss says the plume moths appear to be killing 20-30% of plants in the vicinity of their release and are having a severe impact on seed production in high rainfall areas. As for the clearwing moth, it's too early to tell, particularly as it emerges from the plant only once a year.

'There's usually a 20-year timeframe before you see a big success,' Weiss says. 'It takes years for the agents to build up numbers and become established, and many weeds have an extensive seed bank which

may be viable for 20 years or longer. So it's important to maintain 'nursery areas' of weeds and their predators in readiness to combat regeneration from seed reservoirs in the soil.'

In the protracted battle between insects and weeds, the success of biocontrol relies on educating land managers about integrated weed management. An important message is that biological control is no silver bullet. This requires shifting people's expectations from that of eradication, to control at a threshold level. 'I don't think we'll be out of a job for some time,' Weiss says.



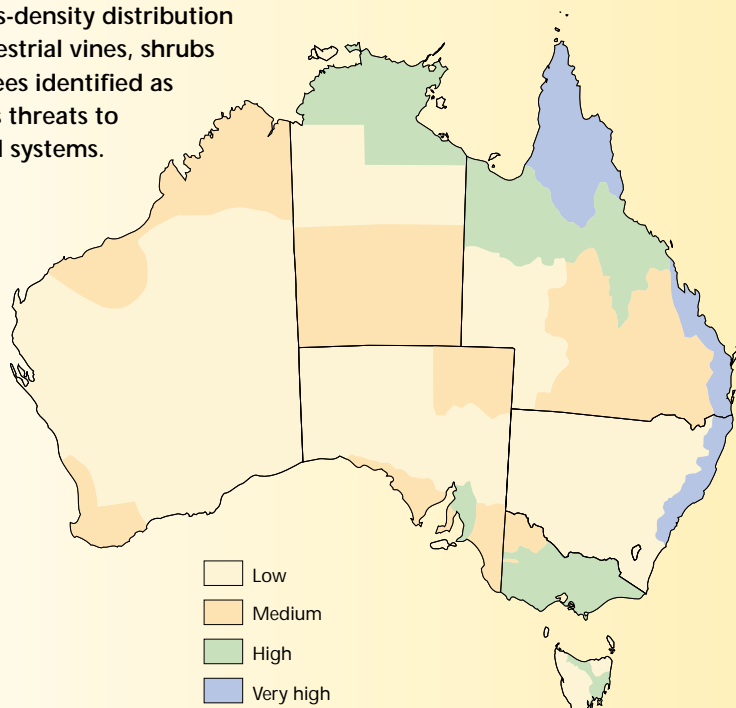
Agents held in high security

THE quarantine facility at CSIRO Entomology in Canberra (pictured) is divided into two levels of security. In the maximum security section, cubicles equipped with strong filters trap particles smaller than three microns. The facility has 'negative pressure' so that when a door to a critical room is opened air rushes in, rather than out, preventing the agents from escaping. Researchers must change their clothing before entering the facility, and shower on the way out. Other safety measures include computer programmed 'fault-tracers', air-tight doors, alarms, double-glazed windows, water treatment and an autoclave. This is the only quarantine facility in Australia approved for the importation of plant pathogens and it houses biocontrol agents such as the bridal creeper fungus.

Microscopic mites and other insects are kept in the high-security section of the facility. 'Insects are somewhat easier to keep in quarantine than fungi,' says facility manager, Andi Walker. This is because insects, being much larger than fungal spores, are more easily contained.

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Species-density distribution of terrestrial vines, shrubs and trees identified as serious threats to natural systems.



Source: Kowari 2, Plant Invasions, The incidence of environmental weeds in Australia. ANPWS.