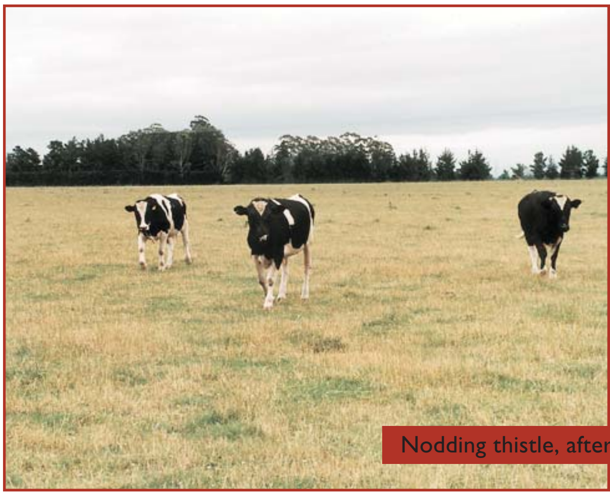
BIOLOGICAL CONTROL SUCCESS STORIES

Nodding Thistle (*Carduus nutans*)

Since the 1950s nodding thistle has seriously infested many pastures throughout New Zealand. The plant can be controlled with herbicides but, because it is not often economic to do so, three biological control agents have been released. A receptacle weevil (*Rhinocyllus conicus*) and a gall fly (*Urophora solstitialis*), damage the seeds, and a crown weevil (*Trichosirocalus horridus*) attacks the rosette plants (see *Nodding thistle crown weevil*, *Nodding thistle gall fly* & *Nodding thistle receptacle weevil*). The crown weevil kills many rosettes and any that do survive an attack are stunted, producing fewer flowering stems and fewer seeds. A mathematical model has been developed that predicts nodding thistle populations will decline if 65% or more of the seeds are destroyed. Levels of seed predation greater than this have already been observed in New Zealand. Combined with improved pasture management, this model explains why many people report that nodding thistle is now declining throughout the country.

Similar results are being observed in Australia where the same three agents are being used. Researchers there have measured that the crown weevil alone can reduce the number of seeds that the thistles produce by 67% and this figure rises to over 80% when the two seed feeders are included in the equation. Furthermore, the receptacle weevil is reported to have reduced thistle density by up to 95% in Canada and by 80–99% in the USA.


Nodding thistle, before


Nodding thistle, after

St John's Wort (*Hypericum perforatum*)

Earlier this century St John's wort (*Hypericum perforatum*) was one of the worst four weeds in New Zealand. The plant displaced pasture in the dry high country and poisoned stock. As a consequence, two beetles that defoliate the plant and a midge that stunts growth by deforming the plant were imported (see *St John's wort beetles*). The lesser St John's wort beetle (*Chrysolina hyperici*) was the first to be released in 1943. The closely-related greater St John's wort beetle (*C. quadrigemina*), and a gall midge (*Zeuxidiplosis giardi*) were released about 20 years later. All three agents established, but the lesser St John's wort beetle had the greatest impact. Only 4 years after their release the beetles had cleared over 180 ha of the weed in Marlborough. The beetles were distributed to other parts of the country where they achieved equally dramatic results. Hordes of beetles could be seen advancing across the landscape devouring all St John's wort plants in

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their path. The results were so dramatic that no formal measurement of the beetles' impact was made. Today the weed has declined to the point where it is no-longer considered a problem.

St John's wort has also been successfully controlled in other parts of the world. The lesser St John's wort beetle has performed well in Canada. In places with a Mediterranean-type climate such as Chile, Western and South Australia, North America, and South Africa the greater St John's wort beetle has been extremely damaging. For example, this beetle is attributed with restoring 1 million acres of infested rangeland in California, and grateful landowners erected a monument in its honour.

Ragwort (*Senecio jacobaea*)

Ragwort was another of the worst four weeds in New Zealand earlier this century. Like St John's wort, it displaces pasture and is toxic to stock. Cinnabar moth (*Tyria jacobaeae*) was released to attack ragwort in the 1920s. Efforts to increase its distribution were made in the 1980s but it is still patchy. Damaging outbreaks of defoliating caterpillars occur from time to time. A seedfly (*Botanophila jacobaeae*) was released in the 1930s and established in the centre of the North Island. Little effort has been made to increase its distribution as its impact is too small. The ragwort flea beetle (*Longitarsus jacobaeae*) was released in the late 1980s and has been highly successful, dramatically reduced ragwort populations throughout much of New Zealand, often only 4–5 years after release. Two new agents are currently being released in areas, such as the West Coast of the South Island, where conditions do not allow the ragwort flea beetle to be effective against ragwort.

See *Cinnabar moth, Ragwort crown-boring moth, Ragwort flea beetle, Ragwort seedfly, Ragwort plume moth.*

The results currently being achieved in New Zealand reflect a similar successful programme

Alligator Weed, before

Alligator Weed, after

in the USA where ragwort infestations have been reduced in many places by 93–99%. Good results are also being achieved in Australia with *L. jacobaeae*, another closely-related beetle (*L. flavicornis*), and the ragwort crown-boring and plume moths.

Alligator Weed (*Alternanthera philoxeroides*)

Alligator weed was first recorded in New Zealand earlier this century and it has infested many water bodies in the North of New Zealand, and as far south as Waikato, since that time. The plant is difficult to control with herbicides, and not many are approved for use in waterways. Mechanical clearance can result in new infestations growing from small fragments. Therefore, a beetle (*Agasicles hygrophila*) and moth (*Arcola malloi* previously known as *Vogtia malloi*) that defoliate the plant were released during the 1980s (see *Alligator weed beetle* & *Alligator weed moth*). These agents have not proved to be effective at controlling terrestrial infestations or aquatic infestations that are regularly flooded or frosted, but they have done a good job of controlling mats of the weed on lakes and ponds. Similar results have been achieved using the same two agents in Australia and America. The beetle alone provides good control in China and Thailand. Additional agents are being sought.

Prickly Pear (*Opuntia* spp.)

Biological control of prickly pear is the most famous example of weed control using insects. Prickly pear was introduced to Australia for growing cochineal, hedges, and drought fodder. Huge areas of valuable land soon became overrun by the cactus. In 1912, two scientists were sent overseas to look for biological control agents and five potentially useful species were introduced over the next 2 years. One of these, the cochineal mealybug (*Dactylopius ceylonicus*), successfully controlled the drooping pear tree (*Opuntia* *vulgaris*), but the other major prickly pear (*O. stricta*) continued to spread. Later 48 more prospective biological control agents were imported for testing but only 12 were actually released. One moth (*Cactoblastis cactorum*) proved to be an outstanding success. At the time the moth was released in 1926, 24 million ha were infested with prickly pear. The impact of the moth was felt almost immediately and by 1933 it had cleaned up the last of the big cactus areas. By 1939 the infestation of prickly pear in Queensland had been reduced by more than 99%. The moth has kept the plant under control ever since.

Occasionally the plant outbreaks during times of drought but it is quickly brought back under control again as soon as wetter summers return.

Since its success in Australia, the moth and another mealybug (*D. opuntiae*) have been released in many other countries. In nearly all areas they have established easily and rapidly controlled pest cacti.

Red Sesbania (*Sesbania punicea*)

Red sesbania has been grown in South Africa as an ornamental shrub for more than a century. During, the 1960s the plant began to spread rapidly, invading riverbanks and wetland areas, excluding native plants and restricting access to water bodies. As a consequence, three beetle species were released during the 1970s and 1980s to attack the plant and they have achieved excellent results. The combined actions of a stem borer (*Neodiplogrammus quadrivittatus*), seed feeder (*Rhyssomatus marginatus*), and a bud feeder (*Trichapion lativentre*) have meant that no other control measures are now necessary for this weed. The bud feeder alone reduces seeding by 98%, and stunts the growth of plants by 60%.

Prickly pear, after

Prickly pear, before

Wattles (*Acacia* spp.)

Wattles were deliberately planted in South Africa to stabilize sandy areas and to provide a tannin industry. The Cape Flats became dominated by these trees, and they didn't stop there. The wattles began to invade the mountains and river systems, displacing native vegetation, increasing the fire risk, interfering with agriculture, and sucking rivers dry. Biological control has successfully reduced the impacts of some of these trees. A fungus (*Uromycladium tepperianum*) that galls the buds of the Port Jackson willow (*Acacia saligna*) was released in 1987. After only 6–7 years the fungus reduced the density of this wattle by at least 80% at all sites and up to 100% at others, providing substantial control. A seed-feeding weevil (*Melanterius ventralis*) and a gall-forming wasp (*Trichilogaster acaciaelongifoliae*) were also released in the 1980s to attack long-leaved or Sydney golden wattle (*Acacia longifolia*). Both cause extensive damage, reducing seed production to only 1% of its former levels and providing substantial control of this tree.

Mist flower (*Ageratina riparia*)

Mist flower was accidentally introduced to Hawai'i in 1925. By 1972 it had occupied 52,000 ha of rangeland. A plume moth (*Oidematophorus beneficus*), a gall wasp (*Procecidochares alani*), and a smut fungus (*Entyloma ageratinae*) were introduced to attack this weed in the mid 1970s and were an outstanding success. Of the three agents the fungus was the most effective and it achieved total control of the plant in wet areas within 8 months, and in dry areas within 3–8 years. The plant has remained under control ever since. Dense stands of mist flower have been reduced to isolated patches of sickly, stunted plants on dry rocky outcrops, where there is little competing vegetation, and the rangeland has been returned to productive use.

Until recently mist flower was increasingly become a problem in northern New Zealand. A feasibility study showed that New Zealand was likely to be suitable for the mist flower agents, so the fungus and gall fly were released in 1998 and 2000 respectively. These agents have quickly proven to be equally successful here, stopping the plant from further spread and reducing its abundance to much lower levels.

See *Mist flower fungus, Mist flower gall fly.*

Mist flower, before

Mist flower, after

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