Clover root weevil

Introduction
Clover root weevil (CRW) has been present in New Zealand since at least 1994, but was not discovered until 1996.

The combination of a favourable environment, lack of competition for an abundant food resource, high reproductive capability and a lack of natural enemies has led to clover root weevil becoming one of New Zealand’s most damaging pests of white clover. In the North Island it produces two generations a year with adult populations peaking in early and late summer. In Otago and Southland temperature may limit reproduction to one generation each year, but this has yet to be confirmed. Adult CRW can live for several months with the females laying up to several hundred eggs. In New Zealand CRW is recognised as a severe pest of white clover. Overseas CRW is seen more as a pest of red clover, and recent work by AgResearch suggests that it is also a pest of red clover here. It is not considered to be a problem for other clovers or annual legumes.

The initial stages of CRW larvae mainly feed on clover root nodules. As they mature they move onto the roots and stolons. Adults feed on clover leaves producing characteristic C-shaped notching of leaf margins. Populations disperse by flight during the summer and autumn.

The proportion of adults developing flight or reproductive capability varies from season to season, depending on climatic and pasture conditions. When clover is abundant and summer rainfall high or irrigation available, most weevils become reproductive and stay in the pastures where they hatched. But when there is a drought and clover is limited, a large proportion of weevils cease to be reproductive, develop flight muscles and disperse to new locations. Once they have located a suitable site, the flight muscles atrophy and the weevils again become reproductive. CRW is a very proficient hitch-hiker in hay and on vehicles, which is probably how it is spreading in the South Island at present.

The Ministry for Primary Industries (MPI) has estimated that if left uncontrolled, clover root weevil would have cost New Zealand between $200m and $1b per annum.

Key characteristics and biology
Clover root weevil (CRW) adults are mahogany-brown and 4-6 mm long, with short, blunt noses. It can be difficult to tell adult CRW apart from other pasture weevils. Adult weevils are most abundant in autumn and spring. They lay their eggs on the pasture surface and when these hatch the larvae move into the soil seeking food and shelter. These larvae are legless, creamy white grubs, from 1-6 mm long and with a brown head. They can be located by digging into the root zone under white clover plants. Larvae are present throughout the year but are more abundant from late autumn to spring. The larvae are generally much smaller than grass-grub larvae, which can be common in pastures, and they lack the distinctive curved shape that characterises grass grubs.

Key points
- Clover root weevil is a major pest of clovers, particularly white clover.
- Found throughout the North Island and rapidly spreading through the South Island.
- Larvae are most the damaging stage, destroying clover roots and root nodules.
- Adults feed on clover foliage leaving distinctive C-shaped notches on leaf margins.
- Infested pastures become clover and nitrogen deficient.
- Little is known about its impacts on clover seed crops.
- Biological control is available.
Impacts and damage
Feeding by adult CRW causes distinctive C-shaped notching on the edges of clover leaves. These notches are symmetrical and uniform, unlike the jagged or irregular damage caused by other pests, such as slugs and caterpillars. While this foliar damage can appear serious, generally, it does not cause significant yield loss in established pastures. Adult feeding can however, kill large numbers of white clover seedlings at emergence.

Clover seed crops
Adult CRW feeding can kill large numbers of clover seedlings in newly sown pastures and crops, but very little is known about the impact of adult or larval feeding damage on clover seed yields in stands of mature plants.

Pasture
Although adult feeding damage is most noticeable, larval feeding is more damaging. The young larvae feed on root nodules and later the roots. This reduces the plant’s ability to fix nitrogen from the atmosphere and reduces plant growth. A reduction in nitrogen fixed also impacts on the growth of other pasture plants and leads to an increased requirement for nitrogen fertiliser. Moderate populations of larvae (approximately 300/m²) have reduced clover production in the North Island by 35% (1000kg DM/ha) annually, with the greatest losses in spring. Without additional nitrogen, it has been estimated a typical Waikato dairy farm would suffer a 16% reduction in net profit. Initially, during the invasive period, larval numbers as high as 1800/m² have reduced clover production in the North Island soils are high in organic matter which leads to an increased requirement for nitrogen fertiliser. Moderate populations of larvae (approximately 300/m²) have reduced clover production in the North Island by 35% (1000kg DM/ha) annually, with the greatest losses in spring. Without additional nitrogen, it has been estimated a typical Waikato dairy farm would suffer a 16% reduction in net profit. Initially, during the invasive period, larval numbers as high as 1800/m² have reduced clover production in the North Island farms. On some farms an extra 180 kg N/ha has been required to alleviate the impact of the weevil.

Control
Insecticide
During clover establishment, a foliar insecticide can be applied close to seedling emergence to control adults and provide a window in which clover plants may establish prior to re-invasion by the weevil. Seed coatings do not provide adequate protection against this pest and should not be relied upon.

Clover root weevil is difficult to control with insecticides in established pastures. This is because the larvae live in the soil and are relatively immobile, and because New Zealand soils are high in organic matter which binds up insecticide making it ineffective. The adult weevils are very mobile and although they can be killed by insecticide, clover stands are rapidly reinvaded from surrounding areas. The use of insecticides will also disrupt the weevil’s biological control agent.

Managing clover and pastures to reduce the impact of CRW
Clover root weevil are dependent on clover and cannot survive in its absence. When pastures are severely damaged, destroying the remaining clover with a selective herbicide and leaving the pasture clover free for six to eight months can cause the weevil population to die off, providing a clean pasture in which clover can be re-established. Drilling clover seed into a damaged pasture without removing the older clover plants should not be attempted, as the weevils prefer seedlings and will concentrate their feeding on them.

Another option for improving clover establishment is the use of a brassica or all grass break crop to provide a clean paddock for planting into. Clover management to maintain healthy plants is important. A healthy plant can tolerate more feeding pressure than an unhealthy plant. Adequate fertiliser should be used to keep clover growing in the presence of the weevil and to keep other pasture plants, which would normally benefit from clover nitrogen fixation, healthy as well. When clover is put under pressure by clover root weevil not only do the larvae consume nodules, but the plants respond to the stress by reducing nodule production. Compensatory nitrogen should be applied frequently to infested pastures in small amounts. Clover should not be put under stress by other factors, so do not overgraze and avoid pugging of soil over winter.

Parasitoid biological control
In 2006 AgResearch introduced a small parasitic wasp, Microctonus aethiopoides (Irish strain) as a biological control agent against clover root weevil. This wasp has been released at numerous locations in the North Island and is now very widely distributed. Releases in the South Island have taken place on farms in Nelson, Marlborough, North and mid-Canterbury, Otago and Southland. It has established rapidly where it has been released and appears to be effective at reducing clover root weevil populations. The wasp is also spreading from those areas at about 15-20 km per year. This biocontrol agent will not eliminate clover root weevil or the damage it causes, but it will reduce the pest’s impact.

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