

The Biological control of Paterson's curse

Root weevil

Mogulones geographicus

Biological control aims to limit the dominance of Paterson's curse to a point that makes it economically insignificant to farmers; biocontrol is not an eradication program. It will take many years for the insects to reach their full potential although at some sites insects are killing plants and have spread kilometres 8 years after release. Biocontrol typically requires more than one agent to control the target, for Paterson's curse there is a suite of four insects, each attacks a different life stage of the plant. Once all four insects have large widespread field populations, significant reductions in Paterson's curse seed production are most likely to occur. From this time it will take several years for the seed bank to reach a level that will limit Paterson's curse populations; however this process may be hastened through the establishment of competitive pastures.

Biology

The root weevil (*Mogulones geographicus*) has a single generation each year. Adult weevils (4-5mm long) become active from March to June after heavy rain stimulates Paterson's curse germination. After feeding for a week on rosette leaves, females become sexually mature and lay eggs into the leaf stalk of the rosette. Eggs are laid from March to October with females producing 250 eggs on average. The weevil larvae hatch and feed within the leaf stalk mining directly to the taproot where they are protected from grazing. In the taproot, 20-30 larvae can kill a rosette, 15-20cm in diameter. After feeding, larvae leave the taproot to pupate in the soil. The adults emerge in spring, feeding on the leaves and flowers of Paterson's curse until

the plant is dead or late December. During this time adults disperse to seek out new patches of Paterson's curse. After feeding, adults move into the soil and leaf-litter and become dormant to escape the summer heat. The adults do not feed while dormant, living off fat reserves accumulated during spring. Only the healthiest adults survive. Adult weevils remain dormant in the soil until autumn rain stimulates them to become active and start a new generation. The ability of the root weevil to remain dormant in the soil in large numbers until May will allow it to survive late autumn breaks. Feeding in the taproot, the root weevil will be one of the more successful insects in grazed pastures.

Life Cycle of the Paterson's curse root weevil

Feeding is complete adults are dormant in the soil until autumn rains

Adults start laying eggs

Late Spring-Summer

After pupation adults emerge from the soil to feed on the flowering plants

Autumn

Adults become active after rain and feed on seedlings and lay eggs in the leaves

Egg laying ends

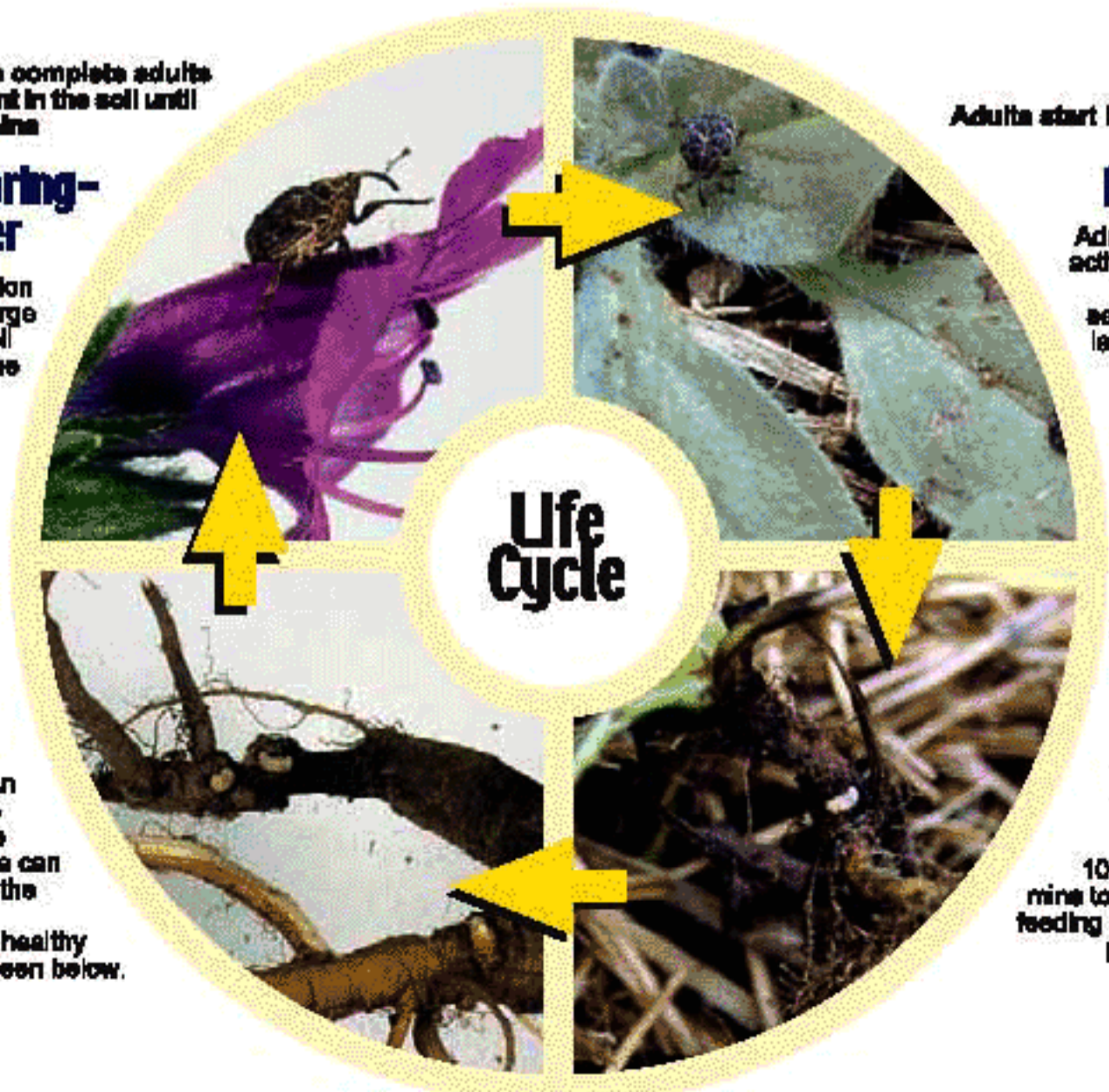
Egg laying continues

Spring

Larval damage can destroy the taproot (the white larvae can be seen in the damaged taproot). A healthy taproot is seen below.

Winter

Larvae, 10-12mm long mine to the taproot, feeding and slowing plant growth



Egg laying continues



Release and establishment of the root weevil

Autumn is the best time to release the adult weevils when Paterson's curse is a seedling or rosette. Releases of 300-500* weevils into "nursery sites" are recommended to ensure a good level of attack in the first season. A nursery site is an area kept free of grazing, cultivation and chemicals for at least 3-4 years to allow the weevils to breed rapidly and become self-sustaining. Nursery sites need only be 0.5 Ha in size (though bigger is better) and are easily created by fencing off the corner of a paddock thick with Paterson's curse. Nursery sites are best located next to paddocks of permanent or long pasture rotations, particularly non-arable land where the weed is difficult to control, and should have free draining soil. After several years, introducing grazing livestock into the nursery site for a limited time over summer (or an application of herbicide if you are in a summer rainfall zone) will help to open up the pasture and promote Paterson's curse germination in the following autumn. Grazing or herbicide use at this time will have minimal impact on the weevils, as they remain dormant in the soil and leaf-litter.

In spring, larger releases (1000+ adults) can also be made using freshly emerged adults easily caught from flowering plants. Such releases are larger to account for subsequent over-summer adult mortality while the weevils are not feeding. The success of spring releases is improved if adults are placed into a cage (made of fine shade cloth) to prevent adults dispersing outside the nursery area and 'getting lost' prior to autumn. Caging a release in spring increases the chance of weevils surviving until autumn by 400%. Your State contact has a limited supply of such cages. The spring release cage must be removed in summer (when the curse has died) to allow free movement of weevils onto new rosettes in autumn. Alternatively increasing the number of weevils free released will promote activity the following autumn. Given the activity of the root weevil (March to June), irrigation of sites to ensure germination will greatly increase the chance of a weevil activity in those sites and years where a late autumn break is likely.

Managing the root weevil in pasture

Once a good level of root weevil activity has been observed in the nursery site (many roots damaged by weevil larvae), spelling or any reduction in grazing pressure in the adjacent curse infested pastures in autumn will encourage wider impact of the weevils. Eggs laid in autumn will be larvae by winter, feeding deep in the taproot where they are protected from grazing. A simple guide for a suitable grazing pressure is when the crown of Paterson's curse is being grazed; reducing the grazing pressure will benefit the insects (and desirable pasture species). In paddocks that are entering a cropping phase, minimum tillage in autumn will offer the best protection for adult weevils.

Targeting an area on your property usually next to your nursery site for biological control gives you the flexibility to continue controlling the weed in other infested paddocks. Managing Paterson's curse on the rest of the property must continue, as the insects will take many years to have a significant impact. While use of herbicides has no direct effect on weevil activity, killing a rosette with herbicide will cause under-developed larvae to starve. The use of insecticides can significantly depress the numbers of weevils and should be used with caution on the paddock you are managing for weevil activity. If insecticide or herbicide must be sprayed in an area where insects are active contact your State officer for advice.

Managing Paterson's curse in pasture

For more information on controlling Paterson's curse with herbicides, grazing and pasture improvement, go to 'Tips and Tools' at the Meat and Livestock Australia; www.mla.com.au or phone **1800 675 717**. For more detailed information the book 'Pasture management for weed control' is available through MLA or NSW DPI phone **1800 028 374**.

Contacts for collaborating organisations

State	Organisation	Contact Person	Telephone
NSW	DPI, Tamworth	Paul Sullivan	(02) 6763 1175
Victoria	DPI, Frankston	Kerry Roberts	(03) 9785 0135
South Australia	SARDI, Adelaide	Ken Henry	(08) 8303 9540
Western Australia	WA Agriculture, Perth	Paul Wilson	(08) 9368 3758
Nationally	CSIRO Entomology, Canberra	Matthew Smyth	(02) 6246 4249

Your local contact

CSIRO Entomology, GPO Box 1700, Canberra ACT 2601, AUSTRALIA.

Tel: (02) 6246 4001 Fax: (02) 6246 4000

www.csiro.au/weeds/