What is responsible for the low establishment rates of the South African *Crioceris* sp. leaf beetle on bridal creeper infestations in Australia?

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Summary The leaf beetle *Crioceris* sp. was released in 2002 for the biological control of bridal creeper (*Asparagus asparagoides* (L.) Druce), one of southern Australia's worst environmental weeds (Morin *et al.* 2006a). The leaf beetle feeds on very young bridal creeper shoots and emerges at the beginning of the growing season before the other biological control agents become active (Morin *et al.* 2006b). However, establishment and population build-up of the leaf beetle has so far been disappointing, because it only established at three of the 16 sites where it was released in 2002 and 2003.

Field and glasshouse experiments were undertaken in 2005 to determine possible causes for low establishment rates. The leaf beetle rearing colony was found to be highly fecund (averaging 205 eggs per female) and larvae hatched from more than 60% of eggs produced. However, initial field experiments showed that parasitism and/or predation might influence survival and establishment of leaf beetles (Morin *et al.* 2006b).

A more rigorously designed experiment was undertaken to verify these initial observations. It was first conducted at a site on the NSW south-coast in March-April 2006, and will be repeated at the same site in July-August 2006. Twenty-five plastic buckets (38 × 30 × 14 cm) containing actively growing bridal creeper shoots were placed onto metal trays (64 × 41 cm) in groups of five within a natural bridal creeper infestation. Each bucket in a group was randomly allocated to five treatments. The first treatment consisted of an open control to allow full access by both parasitoids and predators. The second treatment was covered in 0.11 mm^2 nylon mesh and opened at ground level to allow access by ground predators only. The nylon mesh of the third treatment was sealed at the base to prevent entry by ground predators, but a 15 × 20 cm hole was cut into the side to allow access by parasitoids. Treatment four was a combination of treatments two and three and allowed access by both ground predators and parasitoids. The fifth treatment was fully enclosed in nylon mesh to exclude all predators and parasitoids.

Five pairs of mating beetles were added to each treatment at the beginning of the experiment. Eggs and/or larvae in each treatment were counted twice during the experiment. Pupae produced in each treatment were recovered at the end of the experiment.

Similar numbers of eggs were found between treatments nine days after the leaf beetles were introduced, indicating that the insects remained on the potted bridal creeper after release. Although numbers of larvae fluctuated considerably between treatments, there was a significant difference in numbers of pupae recovered at the end of the experiment. Numbers of pupae were similar between the fully open treatment and the mesh-covered treatment opened to parasitoids and ground predators. Pupae numbers in these treatments however, were less than half the numbers recovered in the fully enclosed treatment.

These results further support that parasitoids and/or ground predators affect leaf beetle survival. Although we have evidence that egg parasitism is not occurring, we have not yet been successful at identifying the major predatory or parasitic species. Based on this work we recommend releases of large numbers of beetles to compensate for any predation or parasitism that may occur. Alternatively, exclusion cages at the time of release could be used to enhance initial increase of leaf beetle populations.

Keywords Biological control, leaf beetle, *Crioceris* sp., bridal creeper, *Asparagus asparagoides*, WoNS.

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