Community involvement in the distribution of the biological control agents for bridal creeper, *Asparagus asparagoides*

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Summary

*Asparagus asparagoides* (bridal creeper) is a widespread weed of bushland and remnant vegetation across southern Australia. It is recognized as a major threat to biodiversity in those habitats and is one of Australia’s Weeds of National Significance. The bridal creeper leafhopper *Zygina* sp. and rust fungus *Puccinia myrsiphylli* were released in Australia in 1999 and 2000, respectively. Damage caused by both agents is obvious; the leafhopper’s silver zigzag spotting and the rust’s orange pustules on foliage are readily recognizable. These features of the agents’ biology made them ideal candidates for rearing and distribution by non-specialists. The leafhopper can be reared by school and community groups as it requires little more than a cage and healthy bridal creeper plants. The rust fungus is easy to distribute from infected foliage, following a basic protocol. The mechanisms and infrastructure required to involve community members in distribution of each agent are outlined.

Keywords: *Asparagus asparagoides*, bridal creeper, community involvement, *Puccinia myrsiphylli*, *Zygina* sp.

Introduction

*Asparagus asparagoides* (L.) Druce (bridal creeper) is an exotic weed that poses a major threat to biodiversity and conservation in Australia’s temperate natural ecosystems. Originally introduced as a garden plant in the 1850s, it became naturalized in the early 1900s and is now listed as a Weed of National Significance. In 1991, surveys for biological control agents in the weed’s native range, South Africa, identified several potential agents. Three agents have since been approved for release in Australia following extensive studies on their host range: the leafhopper *Zygina* sp. (Batchelor & Woodburn 2002a), rust fungus *Puccinia myrsiphylli* (Thuem.) Wint. (Morin et al. 2002) and leaf beetle, *Crioceris* sp. (Batchelor & Woodburn 2002b), in 1999, 2000 and 2002 respectively.

Until biological control was implemented, bridal creeper was managed through hand weeding and herbicide application. As bridal creeper fruits are dispersed by birds (Raymond 1996; Stansbury 2001), it has the potential to infest pristine ecosystems as well as reinvade weeded areas, increasing the frustration and apathy amongst land managers trying to control this weed. When the leafhopper and rust fungus were approved for release, suitable release sites were sought using Landcare/Bushcare information networks. The response was immediate and overwhelmingly positive. Rearing facilities at the time were not prepared or funded for a nationwide redistribution program, hence it was decided to involve community groups in the rearing and redistribution of the agents. The simple biology of the leafhopper and its ability to readily establish indicated that it could be reared and released by non-specialists (Batchelor & Woodburn 2002c). Whilst the rust has a complicated lifecycle and requires specific environmental conditions to establish, community members could release the rust by following a set of instructions.

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Both agents damage bridal creeper by attacking the cladodes. The leafhoppers feed on mesophyll cells and their damage is seen as white spotting on the leaf surface (Witt & Edwards 2000). The rust fungus infects stems and cladodes of bridal creeper and is easily recognizable as yellow lesions on the upper side of the cladode and by corresponding orange pustules on the underside. Severe infestations of both agents result in reduced photosynthesis, premature defoliation and reduced tuber production (Batchelor & Woodburn 2002a; Morin et al. 2002).

Participation by community groups in the redistribution of biological control agents is recognized as playing an important part in technology transfer (Briese & McLaren 1997). This paper provides a summary of the techniques especially developed for community and school groups for rearing and releasing the leafhoppers and the rust fungus. It outlines the approaches taken to teach, engage and disseminate knowledge to interested groups and the development of monitoring protocols for such groups to measure the spread of agents and impact of their control techniques. The benefits of community involvement in the biological control of bridal creeper are discussed.

Material and methods

Rearing and release techniques

Rearing of leafhoppers

Batchelor and Woodburn (2002c) outline in detail the technique developed for community/school groups to rear leafhoppers. In summary, rearing leafhoppers requires a stock of healthy bridal creeper plants, a colony of leafhoppers and a rearing cage to prevent adults from escaping. Participating groups established a nursery of 100–200 potted bridal creeper plants to ensure a steady stream of plants for rearing. They then prepared a rearing cage, usually comprised of an old aquarium with a fine mesh cover pegged to the top, and filled it with bridal creeper plants. When plants had sufficient foliage, a colony of leafhoppers, consisting of adults caged on bridal creeper plants plus three-four plants hosting eggs and nymphs, was posted or delivered by the project staff and introduced to the cage. The leafhoppers fed and oviposited into bridal creeper leaves within the cage. Every few weeks or when the plants were 50% white from leafhopper feeding damage, the foliage was rustled to shake off adults and the plants removed and replaced with fresh stock plants.

Release of leafhoppers

Plants infested with leafhopper eggs and nymphs were taken to a bridal creeper field infestation and placed amongst the foliage for a release. The eggs on the damaged plants eventually hatched and nymphs moved on to cladodes at the local infestation. After six weeks the potted plants were usually collected from the field site and returned to the nursery.

Release of rust fungus

The release process involves transferring spores from infected foliage to the underside of the plant foliage in the field and maintaining a high humidity for up to a day to facilitate spore germination and hence fungal infection of plants (Morin et al. 2002). To enable community members to infect bridal creeper with the rust fungus, a practical and simple field protocol comprising of five steps was devised:

Materials: Plastic sheet, pegs, spray bottle containing water, bridal creeper with erupting rust pustules, surveyors flagging tape.

Protocol:

1. Find a bridal creeper clump, preferably a “column”, about 0.5m from the ground out of direct sunlight.
2. Rustle the rust-infected foliage vigorously in an upward motion through the field foliage. This will dislodge rust spores ensuring most land on the underside of the cladodes of field plants.
3. Mist the foliage with water using a spray bottle. Rust requires moisture for spore germination and infection.
4. Wrap the “column” of bridal creeper with a plastic sheet (secured with pegs or tape) for 24 hours to ensure high leaf humidity and ensure a good level of infection.
5. Remove plastic sheet and mark the release site with fluorescent flagging tape. First signs of rust symptoms will be visible after 2–3 weeks.

The rust fungus was supplied to community members on either dry-rooted bridal creeper plants or as field harvested foliage. Once the rust fungus had established at a field site, infected foliage could then be harvested and used to infect another site using the method described above. The rust fungus can usually be found in the field from April to October, depending on autumn temperatures and rainfall.

Monitoring protocols

Two types of monitoring protocols were developed and implemented by the project, the first focusing on agent establishment and spread, the second on medium to long term vegetation change at bridal creeper control sites. To gain a broad indication of agent performance, community groups involved in releasing the agents were asked to monitor their establishment and spread from release sites. An accurate indication of the establishment of the leafhopper proved difficult to gain through community groups as small populations of the insect are difficult for the untrained eye to detect. Conversely, community groups could reliably identify the rust fungus due to its greater rate of increase and more obvious symptoms. The second form of monitoring was focused at community groups who had received funding from the Natural Heritage Trust for...
bridal creeper management. A performance indicator of their projects was to measure the impact of their control activities (whether biological control or herbicide). A suitable protocol was thus developed in collaboration with a national steering committee for bridal creeper management, which includes representatives from all states of temperate Australia. The protocol involves recording vegetation types and their percentage cover along a series of permanent transects. Repeated measurements over time, should demonstrate whether or not bridal creeper is declining as a result of the management technique implemented, and if native plants, or other weeds, are subsequently increasing.

Dissemination and collection of information

Workshops/field days

Between 1999 and 2002, a series of “train the trainer” workshops was conducted in Western Australia, South Australia and New South Wales to demonstrate how to rear and release the leafhopper and release the rust fungus (Woodburn et al. 2002). Workshops were advertised through landcare networks, natural resource and agricultural officers in state and local government, teachers and community Landcare representatives. The workshop program provided information on: bridal creeper biology; principles of biological control; the biology of each agent; rearing and release techniques; record keeping; finding and monitoring agents after release; and redistribution of the agents. Workshops were generally conducted adjacent to a bridal creeper infestation to enable practical demonstrations of the release techniques.

Brochure, website and promotion

A brochure and website, www.ento.csiro.au/bridal-creeper, was created to enable community and school representatives unable to attend the workshops to participate in the project. The website outlines: the biology of each agent; a step by step guide to rearing and releasing the leafhoppers; a technique for releasing the rust; agent release site locations; and the monitoring protocols. As many collaborators do not have internet access, some of this information was published in a fold-out brochure outlining, in different sections, the lifecycle of the plant, leafhopper and rust, release techniques and who to contact for more information and/or an initial supply of agents. An additional brochure outlining the processes involved in implementing a biological control program was produced to address community concerns over host-specificity of agents. The project was widely publicised in the media, especially in regional/community print and radio. Community and regional media often feature stories on public-good activities, especially those that involve school children. The project was featured on national television as well as in several national radio and print media.

Record collection

When a release of either agent was made, school and community groups were requested to provide information about where and when releases had taken place (Batchelor & Woodburn, 2002c). A “release details” form was supplied with agents and was also available as a download from the bridal creeper website. Returned forms were incorporated into a central database and published online on the bridal creeper website. In July 2002, a letter was sent to all participants encouraging the return of release details forms.

Results and discussion

Involving community groups and schools in a biological control program is an effective method to increase the number of release sites. By the end of 2002, within three years of the first release, the leafhopper and rust fungus had each been released at over 700 locations across southern Australia. The number is likely to be far greater as release site details were supplied by only approximately one third of the people involved in a release, and communities are likely to have redistributed the agents from established sites without providing details to the central database. Over 100 primary schools and community groups have been involved in rearing leafhoppers, contributing to at least 450 release site locations.

Rearing leafhoppers was relatively easy for most schools and community groups, but occasionally the leafhopper colonies took either a long time or failed to establish (Batchelor & Woodburn, 2002c). This was mostly a problem for groups rearing leafhoppers on plants suffering from transplant shock. On the whole, community members had no difficulty releasing the rust fungus in the field following the 5-step protocol. Project staff strongly emphasized the importance of misting the foliage and wrapping with plastic as missing these steps generally resulted in no infection. It is possible to infect foliage with the rust fungus without following the entire protocol, but only on cool rainy days when high humidity persists for at least 8 hours (Morin, unpublished). It was generally advised that if the weather was not predictable over this time period, misting and plastic wrapping for 24 hours was essential.

Involving the community in this project was also extremely effective as a vehicle to communicate the impact of bridal creeper on bushland and raise the profile of other environmental weeds (Batchelor & Woodburn, 2002c). The leafhopper and rust fungus became a valuable educational tool, especially in schools looking for practical assignments to complement weed education lessons. Communities benefited by being able to apply a sustainable weed control technique that had no negative impact on surrounding vegetation. However, community involvement is not appropriate for all biological control programs, especially if rearing is involved. Communities working with agents that are difficult to rear and establish are likely to become disappointed with the process
and have less enthusiasm to continue (Briese & McLaren 1997). Ideal agents for community rearing should be those with a proven ability to establish readily, have a simple lifecycle with multiple generations/year, high fecundity, an exposed juvenile or spore stage and show visible signs of damage throughout development. Both the leafhopper and rust fungus meet these criteria. The weed itself should be easy to propagate and handle. An example of an agent unsuitable for community rearing is the bridal creeper leaf beetle, Crioceris sp., as it has one to two generations/year, and consumes only young, expanding cladodes and shoots. Adults lay eggs only on shooting tips and both the adults and larvae are difficult to handle.

Project staff found that most community groups and school teachers wanting to be involved had limited knowledge of biology and needed considerable help initially to understand the biology and release techniques for the leafhopper and rust fungus. It was therefore found just as essential to first teach the processes of biological control in order for community groups to understand that it is a long-term weed control strategy and that the agents are host-specific. Biological control practitioners considering involving the community in their programs are advised to prepare extensive supporting materials to help community groups understand these concepts.

Obtaining feedback on new releases or spread from release sites was a weakness in the project. All collaborators were encouraged to redistribute from established sites, but many failed to return release details forms, despite being reminded. Although redistribution increases the speed at which the agents reach weed infestations, it reduces the ability for project staff to keep a complete record of releases and monitor the natural spread of each agent. However, those that returned release details forms proved reliable to help study the spread and disease intensity of the rust fungus from the release sites. In 2002, establishment and spread data on the rust fungus for 56 sites across southern Australia were forwarded to the researchers. However, it is unrealistic to expect community groups to participate in the long-term monitoring of agent activities. Community groups are fluid entities and as members and priorities change it will be difficult to maintain consistency in data collection over time.

However, some community groups, such as those that received funding for bridal creeper management, are interested in determining the effectiveness of their management technique and are therefore likely to participate in longer term monitoring activities.

To date, the biological control project for bridal creeper has greatly benefited from the involvement of community groups and schools, and vice versa. The project has introduced these groups to the damage invasive plant species can cause to bushlands, particularly why some introduced plants become weeds. The project’s media exposure in the wider community raised the profile of bridal creeper and biological control as an environmentally-friendly approach for weed management. As a whole, this project will be a useful case study for others who may be interested in involving the community in biological control programs for other weeds.

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