Biological control of brooms in Australia: an update

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Summary Biological control of brooms in Australia has so far targeted Scotch, or English (*Cytisus scoparius* (L.) Link) broom and Cape, or Montpellier (*Genista monspessulana* (L.) L.A.S.Johnson), brooms. The key test plants assessed for possible non-target effects are tagasaste, or tree lucerne, (*Chamaecytisus palmensis* (H. Christ) F.A.Bisby & K.W.Nicholls (= *Cytisus proliferus* L.f.)) and several forage *Lupinus* species currently being grown or propagated in Western Australia. Three biological control agents have been released against Scotch broom; the broom twig-mining moth (*Leucoptera spartifoliella* Hübner), the broom psyllid (*Arytainilla spartiophila* (Förster)) and the broom bruchid (*Bruchidius villosus* Fabricius). A fourth agent, the gall mite (*Aceria genistae* Nalepa) has a release permit, but has not yet been released. Against Cape broom, the host specificity testing has now been completed for the Cape broom psyllid (*Arytinnis hakani* (Loginova)) and an application will be submitted to Biosecurity Australia and Department of Environment and Heritage (DEH) for a release permit. In this paper we review the current status of these projects and analyse opportunities and constraints for their further development.

Keywords *Cytisus scoparius*, Scotch broom, *Genista monspessulana*, Montpellier broom, Biological Control Act, international collaboration, tagasaste, *Lupinus*, *Bruchidius*, *Leucoptera*, *Arytainilla*, *Arytinnis*.

INTRODUCTION

In Australia there are 14 naturalised species in the *Cytisus-Genista* group of the exotic tribe Genisteae in the Fabaceae. This does not include a whole suite of horticultural broom hybrids also grown in Australia (Atkinson and Sheppard 2000). Naturalised species of the *Cytisus-Genista* group are in the genera *Calicotome*, *Chamaecytisus*, *Cytisus*, *Genista*, *Retama*, *Spartium* and *Ulex*. Scotch broom, Cape broom, *Calicotome spinosa* (L.) Link (spiny broom), *Genista linifolia* L. (flax-leaved broom), and *Ulex europaeus* L. (gorse) are declared noxious in some parts of Australia, while *Cytisus multiflorus* (L'Hér.) Sweet (white Spanish broom) and *Retama raetam* (white weeping broom (Forssk.) Webb) are on the DEH Alert list for Environmental Weeds. Tagasaste is the only species in the subtribe grown commercially in Australia as a forage crop, but is also escaping cultivation in some areas.

Ignoring *U. europaeus*, which is outside the scope of this paper, Scotch broom, which infests *c.* 200,000 ha (Hosking *et al.* 1998) and Cape broom, which infests *c.* 600,000 ha (Sheppard 2000) are currently the most widespread and invasive species in Australia and are the focus of most control efforts, being ranked 31st and 37th respectively amongst the nominated Weeds of National Significance (WoNS) (Thorp and Lynch 2000). Both have been the target of biological control programs as part of international efforts to manage these weeds. The aim of this paper is to review the current status of these projects in Australia and analyse opportunities and constraints for their further development.

BIOLOGICAL CONTROL BACKGROUND

Scotch broom Efforts to biologically control brooms started in Australia in 1989 with the first meeting of the Management Committee for the Biological Control of Scotch Broom. In 1991, NSW Agriculture made a submission to the Australian Weeds Committee (AWC) to nominate Scotch broom as a target for biological control. No objections came from any state; although a key conflict of interest was identified in relation to possible non-target impacts to tagasaste and states suggested there would be objections to the use of agents with the potential to attack tagasaste. The AWC offered two alternatives; a) seek endorsement through the Plant Production Committee for the project to proceed outside the Biological Control Act or b) apply for target declaration under the Act. NSW

Agriculture, following discussions with the Biological Control Authority about the delays and complexity of declarations under the Act, decided to proceed outside the Act on an agent by agent basis and did not pursue any formal endorsement under a), so the nomination was never formally approved.

The biological control program against Scotch broom nonetheless started, building on previous research in the USA and New Zealand. The broom twig-mining moth, *L. spartifoliella* was released in 1993, the broom sap sucking psyllid, *A. spartiophila* in 1994 and the broom seed beetle *B. villosus* in 1995 (Hosking *et al.* 1998, Syrett *et al.* 1999), following evidence from the host testing that tagasaste in addition to other non-target test plants was outside the developmental host range of each agent. A further agent, the broom gall mite, *A. genistae*, also obtained a release permit but, due to lack of funding and other constraints (see below), has never been released. Work also started on several other potential agents, but this was not taken through to completion, due to funding constraints.

In the mid-1990s *B. villosus* was observed developing successfully on tagasaste in the field in New Zealand, contradicting the testing for both New Zealand in the 1980s and Australia in the 1990s (Haines *et al*. 2004, Sheppard *et al*. 2006). In light of the early concerns for such non-target damage, this had a significant impact on the biological control of broom project in Australia. The release permit for this agent was voluntarily withdrawn by the relevant research agencies, and any activities using this agent discontinued until the agent attained successful declaration under the Biological Control Act. All efforts to achieve this, however, became embroiled in the delays and complexities anticipated earlier. Indeed the AWC has indicated that reinstating the release permit and any approving further work to release other agents for Scotch broom should be conditional on first obtaining formal acceptance of Scotch broom as a nominated target for biological control either outside or under the Act. Declaration of any target or biological control agent under the Act, due to its awkward nature, requires significant costs, but no clear payee, and so effectively remains reserved for targets causing very high economic losses.

Australian State Departments have been carrying out some redistribution activities for the first two agents released. New Zealand continues an active biological control program from Scotch broom including the use of *B. villosus*.

Cape broom A combined nomination of Cape broom, flax-leaved broom and *Genista stenopetala* Webb & Berthel. (Portuguese or Madeira broom) as targets for biological control by South Australia was accepted by the AWC in 1997, paving the way for a biological control program. This was initiated by the Weeds CRC and testing of plants on the agreed test list for the first agent, the Cape broom psyllid *A. hakani*, was completed in quarantine in South Australia in 2002. As part of a collaborative project with United States Department of Agriculture – Agricultural Research Service (USDA-ARS) and the California Department of Food and Agriculture (CDFA), research is ongoing on a second potential agent, the pod weevil *Lepidapion* sp. (Sheppard and Thomann 2002, 2003). Extending this work to the other two *Genista* species has been considered for both Australia and California, as these targets also have highly specific natural enemies in their native range, but funding for this aspect has yet to be obtained.

BIOLOGICAL CONTROL: AN UPDATE

Scotch broom The twig-mining moth *L. spartifoliella* is now the most widespread broom biological control agent in Australia. The main nursery site at Krawarree, along Shoalhaven River near Braidwood New South Wales (NSW), where high moth density and damage are clearly visible, has been the source of agents for redistribution through other parts of NSW, Victoria, Tasmania and South Australia. In NSW, releases were made at 48 sites throughout the distribution of broom and where monitoring was possible establishment was confirmed at most sites. In Victoria, releases were made at 98 sites and the moth has established at release sites in the Alpine National Park, at Beechworth and at Kinglake. This agent was also released in Tasmania, where its establishment has not been confirmed. Evidence of parasitism of this agent was found in a shipment collected at Krawarree and sent to Tasmania for release in 2003. Parasitoids included the pupal parasite, *Megadicylus* sp. (near *M. dubius* (Girault) (Hymenoptera: Pteromalidae) and an unidentified ichneumonid wasp (John Ireson pers. comm.)).

Arytainilla spartiophila was released at *c.* 10 sites in NSW and established, at least at Krawarree. In Victoria, after six releases, the insect presence was confirmed at only one release site and there is some anecdotal evidence to suggest it is also established at an initial release site in the Adelaide Hills, South Australia (Q. Paynter pers. comm.). This agent was also released in Tasmania, where its establishment has not been confirmed. The damage levels from this agent are not yet significant.

The seed beetle *B. villosus* was released at five sites on the NSW tablelands and has established at Krawarree, where each year its density is on the

increase. In Victoria *B. villosus* was released at ten sites, but monitoring for establishment of this agent has not been carried out to date.

None of the *A. genistae* gall mites remain in Australia. A release program for this agent will require sourcing a colony from the native range.

Cape broom During the host range testing of the Cape broom psyllid *A. hakani* for Australia and the USA, some successful oviposition and development has been observed on some *Lupinus* species, although not on tagasaste. This is despite field records clearly showing this agent to be specific to Cape broom in the field throughout the native range. Testing found no successful development on either *L. polyphyllus* Lindl. (invasive in Australia and New Zealand) or *L. angustifolius* L. (crop species) from Australia. Further testing is currently underway to ensure all other *Lupinus* species either being used or proposed for use as forage lupins in Australia have been tested, prior to application for a release permit for Australia. This testing includes *L. luteus* L., *L. albus* L., *L. atlanticus* Gladst., *L. pilosus* L. *L. mutabilis* Sweet and *L. cosentinii* Guss.

Field surveys have shown that the pod weevil, *Lepidapion* sp., is host-specific and causes up to 30% seed loss in the field to Cape broom (Sheppard and Thomann 2004), however the agent is proving hard to rear and US-sourced funding is running out.

OPPORTUNITIES, CONSTRAINTS AND FUTURE DIRECTIONS

Scotch broom The biological control program against Scotch broom in Australia is currently in hiatus, despite a very active program over the water in New Zealand. To bridge this impasse the first step will be to obtain a successful nomination for Scotch broom as a target for biological control through the AWC. Without this, government funding cannot be obtained, new agents cannot be imported and even existing activities using the agents that are already released in Australia lacks formal AWC support. A revised nomination needs to undertake significant up-to-date public consultation and adopt a new angle and approach to the problem. With public support, the nomination must clearly declare conditions as to the types of agents that would be acceptable; either a) only agents that cannot complete development on tagasaste and/or b) agents that only attack tagasaste in a manner that would not hinder its value as a forage species e.g. would only attack seeds, as growing tagasaste for seed is of low economic importance in Australia. There is a precedent to such an approach in South Africa where the successful biological control of commercially grown Australian acacias was brokered and achieved using largely seed-feeding agents.

With such a nomination accepted, then the program could continue to seek funding to release *A. genistae*, redistribute existing agents with impunity and consider other agents that are close to release in New Zealand.

Cape broom This target has less stakeholder support for management than Scotch broom despite covering a larger area. This is because it does not invade the alpine biodiversity hot spots invaded by Scotch broom in Australia. To initiate releases of agents for biological control of Cape broom, collaborative programs built around National Heritage Trust and Forestry Industry support are being prepared, and these can build on international collaborative activities with California. A release application for Cape broom psyllid could be submitted very soon if this project were to get off the ground. The agents identified certainly merit introduction as their impacts in the native range are easily seen (Sheppard and Thomann 2004).

International broom initiative The most viable model for biological control funding of brooms, given the varied agro-forestry and environmental impacts of broom, is to build programs through numerous stakeholders and, where possible, through international collaboration. The USA set up the International Broom Initiative (IBI) in 2000 (http://www.calipc.org/gorse_and_broom_information/) to assist this and its first target has been Cape broom, however its originators have also argued that the consistent effects, relatedness and frequent co-occurrence of the alien invasive brooms merits a research strategy that tackles the group rather than individual species. IBI has already funded surveys for potential natural enemies that include a range of targets within the group. To continue this trend, however, matching funding will need to be sought from Australia and other affected countries and nominations for other brooms to be targets for biological control will need to be submitted.

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