BIOLOGICAL CONTROL OF BROOM, *CYTISUS SCOPARIUS*, IN AUSTRALIA

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Summary. Broom, *Cytisus scoparius*, is an important weed in the Barrington Tops, NSW. Stands consist of mature, thick-stemmed plants and high seed bank levels occurring in the soil. The main requirement is for agents damaging to established plants and destroying seedlings. Such agents exist in Europe but they may not possess the necessary host restriction whilst tagasaste, *Chamaecytisus palmensis*, is promoted as a fodder. Therefore, biological control of broom has commenced with the release of the moth *Leucoptera spartifoliella* and specificity testing of the plant louse *Arytainilla spartiophila*. Both damage young shoots and should reduce growth and seeding.

INTRODUCTION

Broom, *Cytisus scoparius* (L.) Link (Fabaceae), a native of Europe, is a weed in temperate Australia. Infestations occur in moderate to high rainfall regions over wide areas of Victoria and northern Tasmania and in scattered areas of New South Wales and South Australia (25). The plant is a major problem in open forests and woodland in the Barrington Tops region of New South Wales where dense, tall, mature stands of the weed cover 10,000 hectares (39) preventing access into the National Park and State forest (27). Similar mature stands of broom occur in the Shoalhaven Valley near Braidwood, New South Wales. At both localities the thick-stemmed, woody plants have stored considerable reserves in their stems and roots. High seed bank levels occur in the soil, beneath the stands in Australia as they do in Europe (20, 26).

C. scoparius belongs to the fabaceous tribe Genisteae which is divided into two sub-tribes, Lupininae containing only *Lupinus* and Genistinae containing all other genera including *Genista* and *Cytisus* (5). Tagasaste or tree lucerne, *Chamaecytisus palmensis* (Christ) Bisby and Nicholls, which belongs to the *Cytisus* group within the sub-tribe and which has been promoted as a fodder shrub in New Zealand and Australia (21, 22, 23, 28, 34) is the most closely related plant of importance in Australia. Fodder lupins, *Lupinus* spp., are more important but less closely related to broom. No other crop or fodder Fabaceae grown in Australia belong to the same tribe and there are no Australian native plants in the tribe.

BIOLOGICAL CONTROL AGENTS

Biological control of broom has been undertaken previously by the USA and more recently by New Zealand. Both countries have large areas infested by the weed. The Australian program is, at present, using insects whose specificity has been studied for America and New Zealand (1, 2, 3, 13, 24, 30, 31, 33). The biology of, and damage caused by, the great majority of insects infesting broom has been described in detail in England during a long series of ecological studies (36) but less is known about insects damaging broom in southern Europe. Waloff and Richards (37) demonstrated the impact of insects on growth, longevity and reproduction of broom in England but were unable to distinguish which insect species were responsible.

Two insects have been selected initially as biological control agents for broom in Australia. The first, *Leucoptera spartifoliella* (Hübner), has recently been released after additional host

specificity testing confirmed its host restriction (Cullen unpubl.). The larvae of this small lyonettid moth mine the epidermis of green twigs (36). The second, *Arytainilla spartiophila* (Förster), is a sap-sucking psyllid which also infests new growth (36, 40). Other agents used by America or New Zealand or under investigation now by New Zealand and Australia include seed feeders, the bruchid, *Bruchidius villosus* F., and the weevil, *Apion fuscirostre* (F.), the defoliating geometrid moth *Chesias legatella* (Schiff.), the stem and leaf-tying oecophorid moths, *Agonopteryx* spp., the root nodule feeding weevil, *Sitona regensteinensis* Herbst., the stem galling eriophyid mite *Aceria genistae* (Nalepa) and the stem mining weevil, *Apion immune* Kirby (1, 9, 10, 11, 12, 13, 14, 24, 31, 32, 33, 41).

Except for *A. immune* and *L. spartifoliella* none of these arthropods directly destroy the stems or roots. *A. immune* is recorded on *Cytisus* and *Genista* species (17) and subsequent specificity testing in the laboratory indicated that it could infest tagasaste. This even occurred during field tests although the level of attack on *C. palmensis* was lower than on *C. scoparius* (9, 10, 11, 14). Thus, for this stem feeding weevil both previous records and specificity testing indicate a broad host range in the Genistinae. Other insects which destroy or cause damage to the stems and roots of broom are known in Europe. The most damaging is the scolytid gallery maker, *Hylastinus obscurus* (Marsh.) (36) but as this insect is a pest of perennial clovers, *Trifolium* spp. and lucerne, *Medicago sativa* L. (4) it cannot be introduced into Australia. Another scolytid, *Phloeophthorus rhododactylus* (Marsh.) feeds on dead and dying wood (36) and would therefore be of no value as an agent. Another *Apion* species, *A. striatum* Kirby, mines the stems in a similar way to *A. immune* but adults are recorded on three genera in the Genistinae (17). The cerambycid stem borer, *Deilus fugax* (Olivier), has a broad host range in the Genistinae (35). Even the eriophyid mite, *A. genistae*, which belongs to a group of mites noted for their high specificity and which can produce large galls on broom stems, has a host range considered to include several genera in the Genistinae (7, 8). The extent of the host range of the eriophyid on broom is being clarified by testing in Europe (12). The weevil, *Polydrosus confluens* Stephens, the only insect known to cause direct damage to the roots of broom in Europe, may have a broad host range in the Genistinae (15). Another weevil, *Lixus spartii* Olivier, probably has root feeding larvae but its adults are also recorded from several genera of the Genistinae (16).

Destruction of stems and roots of broom would result in rapid control of existing broom plants. However, successful biological control of broom will require control of seedlings as well as established bushes. Research in England and in France is at present attempting to establish which agents affect seedling survival (12). This research began in 1992 and little obvious damage was caused by insects during that year although many seedlings and young plants were killed by a fungus, *Phomopsis* sp.

DISCUSSION

Although the introduction of seed and pod feeders, defoliators and leaf tiers, sap suckers and root nodule feeders would probably reduce growth and seed production of *C. scoparius*, as they do in Europe (37), it would be some time before there was any change in plant density in the mature broom stands in Australia. *L. spartifoliella* should cause damage to new growth on existing plants and should be as damaging in some areas as it has been in New Zealand, the USA and Europe (13, 24, 29, 36). Agents that reduce reserves in the stems and roots should achieve control of established plants more rapidly. For instance, Australian cerambycids girdling and then boring into thick stems of broom have caused an opening out of the stand canopy at Braidwood. Four cerambycids have been reared from the girdled stems, the larger *Uracanthus*

bivittata Newman and *Strongylurus arduus* Elliott and McDonald are probably causing the girdling and the smaller *Pentacosmia scoparia* Newman and *Sybra acuta* Pascoe are probably secondary borers in the dead, girdled stems. Similar girdling damage has not been observed in the Barrington Tops region. Furthermore, biological control work in South Africa against *Sesbania punicea* (Cav.) Benth., another shrubby fabaceous tree similar to broom, has shown that, although seed feeding agents have reduced seed production by up to 99%, they have had little effect on densities of stands of mature plants. On the other hand, a stem boring weevil has caused marked reduction of densities in thickets of this weed (18, 19).

Because most potential agents for *C. scoparius* in Europe appear to have a broad host range within the Genistinae, *C. palmensis* is at risk from them. At the present time any potential agent infesting tagasaste during field or perhaps even laboratory specificity testing would be unlikely to receive approval for introduction to Australia. Thus, tagasaste is the critical plant species (38) for the biological control of broom but in most cases this testing has not yet been done. However, the limited number of agents damaging stems and roots and their broader host range mean that, for the present, reduction in plant density will probably have to rely on agents that damage other parts of the plant. These agents are being investigated further to determine their host specificity. If tagasaste was no longer promoted as a fodder shrub in Australia then more effective insects should be able to be introduced and released as the host range for the stem and root feeders recorded in the field does, except for the scolytid *H. obscurus*, indicate a restriction to the sub-tribe Genistinae and so they would be unlikely to infest *Lupinus* spp. or Australian natives in tribes related to the Genisteae in the Fabaceae. Furthermore, tagasaste is causing increasing concern as an environmental weed in Victoria (6) and has the potential to become an increasing problem in all areas where it is now grown. If eventually tagasaste should be considered a weed this would relax present restrictions and then biological control of broom could become even more probable than at present.

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