Prospects for the Biological Control of *Rumex* species in Australia

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Abstract

Biological control of perennial weeds from the subgenus *Rumex* in Australia has to take into account the apparent lack of specificity among insects and fungi found on these plants. This implies that Australian species, closely related to the target weeds, are likely to be attacked by any introduced agent. In addition the rosettes of the plant are considered useful grazing, and control should aim at reducing the density of large plants with flowering stems. Of the candidate agents found in the western Mediterranean region, *Bembecia chrysidiformis* and *Chamaesphacia doryliformis*, are being considered for release in Australia. Both are seedotoxins which attack the roots of the host plants in spring after flowering, and feed over summer when above ground plant parts have died. The timing of attack should ensure seed production and hence the survival of native *Rumex* species whereas the rosette stage of the weed would remain as useful pasture. Both species are currently held in quarantine where their life cycle is being synchronised to southern hemisphere conditions. Other potential agents, the fungi, *Uromyces rumicis*, *Ramularia rubida* and the stem-boring weevil, *Lixus crithicollis*, are present in Australia, but have yet to show potential to control the weed. The fungii could be developed as mycoherbicides. Further introductions of insects should be made in conjunction with control programs against *Emex* species, weeds closely related to *Rumex*.

Introduction

Four species from the subgenus *Rumex*, *R. conglomeratus* Murray, *R. crispus* L., *R. obtusifolius* L., and *R. pulcher* L. (Polygonaceae), are declared targets for biological control in Australia. These perennial species have large fleshy root stocks which enable the plants to survive over summer and to produce rosettes in advance of other pasture species (Allen 1974, 1975). The most important is *R. pulcher* which is mainly a problem in cattle pastures of the Mediterranean climatic area of south western Australia (Allen 1974, 1975). However the rosette leaves of these weeds are useful pasture early in the season (McGhie et al. 1983), and this should be taken into account during control programs against these weeds.

Nine candidate biological control agents for *R. pulcher* have been identified from the western Mediterranean region (Scott 1985), but none is host-specific. At best, specificity is limited to one of the four subgenera of *Rumex* (Scott 1985). Unfortunately, the few native *Rumex* species that occur in Australia belong to the same subgenus as the weeds (Rechinger 1984), and will possibly be subject to attack by any introduced biological control agent. In this paper I report on the current status of the biological control program against *R. pulcher*, and a possible solution to the above problems which might prevent obtaining permission to release agents in Australia.

Potential Biological Control Agents

Root borer

*Bembecia chrysidiformis* (Esper) and *Chamaesphacia doryliformis* (Ochsenheimer) (Lepidoptera: Sesidae) have larvae that feed inside the roots of *Rumex* species from the subgenera *Rumex* and *Acetosa*. There is one generation a year. The adults lay eggs on the dry, seed-bearing stems of the host plant from late spring to early summer, and larvae feed in the root over summer (Scott 1985).
First instar *B. chrysidiformis* and *C. doryliformis* were found to feed and develop in a range of plants in the family Polygonaceae in non-choice specificity tests involving 78 and 77 plant species respectively (Scott and Sagliocco unpublished data). Some initial development of *B. chrysidiformis* was observed on avocado, *Persea americana* Miller (Lauraceae) (Scott 1985), but subsequent tests over longer duration showed this plant not to be a suitable host.

Larvae of both species attacked the only crops found in the Polygonaceae; buckwheat (*Fagopyrum esculentum* Moench) and rhubarb (*Rheum rhabarbarum* L.). Buckwheat is an annual in which larvae are unlikely to complete development, which by contrast, proceeded normally in rhubarb. Under natural conditions attack on either crop is considered very unlikely as both have been grown for many centuries in the native range of the sesiids without recorded attack. A number of insects that feed on *Rumex* species have been recorded from rhubarb in Europe which indicates that this crop has been available for colonization by the sesiids. In contrast, few insects have been recorded from buckwheat which is reputed to be generally resistant to phytophages (Ferault 1984).

While the Polygonaceae crops can be considered safe from attack by the sesiids, this is not the case for the eight Australian native species of *Rumex*. The native species belong to the same subgenus as the target weeds (Rechinger 1984), and *R. brownii* Campd. and *R. damosus* A. Cunn. ex Meisn. are found in pasture together with the main target, *R. pulcher*, with which they even hybridise (Rechinger 1984).

At least four native species, *R. bidens* R. Br., *R. brownii*, *R. crystallinus* Lange and *R. damosus*, occur as weeds (Allen 1974, 1975, Combellack 1973) which suggests that they are locally abundant. *R. bidens* is a problem of waterways and the other species are found in pasture. *R. alcockii* Rech. f. and *R. stenoglottis* Rech. f. have only recently been separated from *R. brownii* and *R. damosus* respectively (Rechinger 1984), and have not been recorded as weeds. *R. crystallinus* and *R. tenax* Rech. f., are found in the dryer central regions of Australia, possibly outside the climatic range of the sesiids. *R. crystallinus* is an annual in which the sesiids could not complete larval development. Lastly, *R. drummondii* Meisn. has an uncertain taxonomic status and it is possibly extinct (Rechinger 1984), or is a synonym or hybrid of *R. damosus*.

The biology of the sesiids provides a rationale for proceeding with the release of these agents. The adult’s behaviour of laying eggs on plants late in the annual cycle of growth ensures that the native species would have produced seed, especially as the native species have similar growth phenologies to the introduced weeds. In addition, the rosettes of weedy species would remain available as pasture. Consequently, it is possible that successful establishment of the insects would lead to a reduction in the population of both weedy and native species. However, in a given season rosettes could still develop and produce seed thus ensuring the survival of species.

In the part of south western Australia where *Rumex* species are a problem two native species only are present aside from the doubtful species *R. drummondii* (Rechinger 1984). Both species, *R. brownii* and *R. damosus*, are possibly introduced into the region from eastern Australia (Rechinger 1984). Thus it appears that native species in Western Australia would not be endangered by the release of sesiids. The native species found in the eastern part of Australia are also unlikely to be endangered by these insects. However, it will be necessary for the Australian wildlife authorities to accept that the benefits of controlling the weeds outweigh the slight risk posed to a small group of weedy native species.

Both sesiids are now being held in quarantine in Western Australia, and the life cycle of *C. doryliformis* has been successfully synchronised to Southern Hemisphere conditions (K. Fisher, pers. comm., 1988). Permission to import the insects has been received from the Australian Quarantine and Inspection Service and the application for release is being assessed by the Australian National Parks and Wildlife Service.

The third root boring insect listed in Scott (1985), *Lixomorphus ocularis* (F.) (Coleoptera: Curculionidae), has not been tested for host-specificity. Given its large size (Spencer 1981) it is likely to attack larger plants, and thus could provide a control of the weed similar to that of the sesiids.
Leaf-mining flies

Most of the leaf-mining fly larvae collected from *R. pulcher* in the Western Mediterranean region were found to be *Pegomya solennis* (Meigen) (Diptera: Anthomyiidae) (= *P. nigrifringis* Zett.). The closely-related *P. bicolor* Wied. was much less abundant (6% of 321 field collected larvae in 1984 and 1985). Larvae were found in leaves of the rosettes at the start of plant growth through to flowering. This implies that if either species was used as a biological control agent then damage to the plant would occur when the plants are of value in pasture.

In specificity tests, larvae of *P. solennis* were found to develop in leaves from a range of Polygonaceae, and *Begonia semperflorens* Link & Otto (Begoniaceae) (Scott and Sagliocco, unpubl. data). Further testing of this insect, especially of its oviposition behaviour is needed. However the timing of attack and the lack of specificity (Hennig 1973) suggest that both *P. bicolor* and *P. solennis* should not be used as biological control agents.

Stem-boring weevils

*Lixus cribricollis* Boheman (Coleoptera: Curculionidae) (= *L. ferrugatus* Olivier) (Hoffman 1954) has been approved for the control of *Emex* spp. and *R. crispus* in Australia (Julien et al. 1982). The larvae feed in the stem and the adults on the leaves. The insect was released on *Emex australis* Steinh. in 1979 but has not established in the eastern states of Australia. Later releases in Western Australia have not been assessed (Julien 1987).

The larvae of *Perapion violaceum* (Kirby) (Coleoptera: Apionidae) also feed in the stem and adults feed on leaves of *Rumex* species. Native Australian species were attacked in preliminary tests (Scott 1985), and further tests will be needed before this insect can be considered for introduction. The remaining stem feeding weevils listed in Scott (1985), *Perapion hydrolapath* (Marsham) and *Erythrapion miniatum* (Germain) (Coleoptera: Apionidae) have not been studied further.

Fungi

Shivas (1987) has recently recorded the rust fungus *Uromyces rumicis* (Schum.) Wint. (Uredinales) from Australia. Its origin is unknown. This fungus has been considered for use in biological control, and was shown to be restricted to *Rumex*, and the closely-related *E. australis* in the dicaryotic stage (Inman 1971, Morris 1982), and to *Ranunculus ficaria* L. (Ranunculaceae) in the haplontic phase (Schubiger et al. 1985). The fungus causes loss of root and leaf dry weight in *R. crispus* and *R. obtusifolius* in laboratory experiments (Schubiger et al. 1986). Another candidate fungus present in Australia (Wilson 1986) is *Ramularia rubella* (Bon.) Nannf. (= *Ovularia obliqua* (Cooke) Oudem.) (Deuteromycotina) which has been tested by Strassle et al. (1986) and found to be specific to *Rumex* species. Since these fungi are present in Australia they could be developed as mycoherbicides for use in localised control of *Rumex*.

Discussion

At present only one insect, *L. cribricollis*, has been approved for release against weeds within the subgenus *Rumex* in Australia. Applications for release are presently being considered for *B. chrysidiformis* and *C. doryliformis*. If control of *Rumex* species continues to be aimed at larger plants and flowering stems as opposed to rosettes, then the next candidate insects for introduction should be *L. oculatis* and the three apionid weevils, especially *P. violaceum*. The prospects for control using the latter weevil, and *L. cribricollis*, are promising as both species are known to cause reductions in seed output in commercially grown *Rumex* crops (Hoffmann 1954, Balachowsky 1963). In addition *P. violaceum* (Julien and Harley 1978) and *E. miniatum* (Scott, unpubl. data) are candidates for the control of *Emex* species, another serious weed in Australia.
The presence of fungi in Australia suitable for the future development as mycoherbicides also allows for the possibility of control of all stages of the plant as opposed to the selective control being attempted with the insects.

Acknowledgments

The overseas exploration for biological control agents for Rumex has been supported by a grant from the Australian Meat Research Committee to the Western Australian Department of Agriculture in cooperation with the CSIRO Division of Entomology. I thank Mr. J.L. Sagliocco for technical help and three reviewers for helpful comments on the manuscript.

References


