THE COMMENCEMENT OF BIOLOGICAL CONTROL OF BITOU BUSH AND BONESEED (*CHRYSANTHEMOIDES MONILIFERA*)

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Summary. Two biological control agents against bitou bush, *Chrysanthemoides monilifera* spp. *rotundata*, and boneseed, *C. monilifera* spp. *monilifera*, have been released in Australia. The first, the bitou tip moth, *Comostolopsis germana*, was released in New South Wales in 1989. The second, the black boneseed beetle, *Chrysolina* sp. aff. *progressa.*, was released in Victoria later the same year. Potential agents being assessed include two other *Chrysolina* species, two species of seed-feeding flies, *Mesoclanis* spp., and two species of leaf-feeding tortoise beetle, *Cassida* spp. Surveys on bitou bush and boneseed in their natural range in South Africa have found a number of insects and at least one fungus which may be suitable for use as biological control agents.

INTRODUCTION

The South African plants, bitou bush, *Chrysanthemoides monilifera* spp.*rotundata*, and boneseed, *C. monilifera* spp.*monilifera* are serious weeds of nature conservation areas in eastern and south-eastern Australia. Bitou bush is found in coastal areas of New South Wales, Queensland and Lord Howe Island, whereas boneseed occurs mainly in Victoria and South Australia (11). Both subspecies invade natural areas and may result in a decline in floristic diversity and cause structural alterations to native vegetation (3). A project on the biological control of bitou bush and boneseed commenced in 1987.

In South Africa, the genus *Chrysanthemoides* comprises *C. incana* and *C. monilifera*, the latter having six subspecies (8). Neser and Morris (6) list a number of insects and fungi on *Chrysanthemoides* spp. and imply that some may be highly host specific. A more recent survey has identified over 100 phytophagous insect species associated with *Chrysanthemoides* (Scott unpublished observations). In this paper we review the progress towards the biological control of bitou bush and boneseed, and give preliminary assessments of potential biological control agents.

AGENTS RELEASED IN AUSTRALIA

The first agent released in Australia, the bitou tip moth, *Comostolopsis germana* (Geometridae) is found throughout the distribution of *Chrysanthemoides* in South Africa. In subtropical areas of Natal the moth has continuous generations, but in the cooler Mediterranean-type climatic areas of south-western Cape Province the larvae are absent during winter. Bitou tip moth larvae eat newly emerged foliage, stems and buds in the shoot apices of *Chrysanthemoides*. Damage to flower buds may reduce the fruiting capacity of the host and thereby contribute towards its control. In host specificity tests the bitou tip moth proved to be highly host specific and therefore safe for release (1). The first release of 400 larvae was made at Hastings Point, N.S.W. in March 1989. Subsequent releases of around 3000 pupae were made at Port Macquarie, N.S.W. Indications are that only the second release has resulted in establishment (Dodkin, pers. comm. 1990).

The second agent released was the black boneseed beetle, *Chrysolina* sp. aff. *progressa*). This insect is restricted to several sites between Grahamstown and Port Elizabeth in eastern Cape Province. The larvae and adults of the black boneseed beetle eat the foliage of *Chrysanthemoides* and in their natural habitat can cause severe defoliation. In host specificity tests it was only able to complete its life cycle on bitou bush and boneseed. The insect was released on boneseed at Studley Park in Melbourne during October 1989. Further releases on boneseed are planned in south-eastern Australia. It is too early to assess establishment.

AGENTS IMPORTED FOR HOST SPECIFICITY TESTS

Two leaf-feeding beetles, *Chrysolina oberprieleri* (syn. *C. hebe*) and *Chrysolina pulchella* (syn. *C. dissoluta*), are being tested for host specificity. *Chrysolina oberprieleri* is found on *Chrysanthemoides* species in the western Cape Province. *Chrysolina pulchella* has a very restricted distribution in the southern Cape Province. The adults and larvae of these insects cause extensive defoliation. They were host specific in preliminary feeding tests and both have been imported into quarantine in Australia for further study.

Two species of fly, *Mesoclanis dubia* and *M. magnipalpis*, whose larvae feed in the immature putamen, are considered ideal candidates for the control of bitou bush and boneseed (6). *Mesoclanis magnipalpis* was imported into quarantine in 1988. Both species are widely distributed on *Chrysanthemoides* (5). Noble and Weiss (7) calculate that seed predation levels would need to be greater than 95% over the whole year to be effective. Such levels have not been observed in South Africa possibly due to parasitism. These species have not been successfully reared in the laboratory which has prevented host specificity testing.

POTENTIAL AGENTS FOUND TO BE POLYPHAGOUS

The leaf-feeding beetle, *Ageniosa electoralis*, was considered a potential biological control agent of bitou bush. It is found in Natal where the larvae and adults cause defoliation of their host. It was imported into quarantine and after extensive starvation tests was found to be polyphagous. However the adults had poor survival rates and generally longer preoviposition periods on non-*Chrysanthemoides* hosts. Further testing using multiple-choice tests will clarify the level of specificity of this insect.

Another potential agent, the tortricid moth, *Tortrix* sp., was rejected after tests. It is the most damaging insect on bitou bush and boneseed in South Africa. The larvae feed in the stem apex, tying leaves together, and causing extensive defoliation. The larvae were not observed on neighbouring plants of other species despite observations made at 12 study sites at 3 monthly intervals over three years. In the laboratory larvae developed on a range of other Asteraceae and Rosaceae, but survival was very much lower than on their normal host. The *Tortrix* species on *Chrysanthemoides* may prove to be the same as, or closely related to *T. capensana* which is a pest of apples and other crops in South Africa (2).

POTENTIAL AGENTS UNDER CONSIDERATION

Potential biological control agents for bitou bush and boneseed are listed in Table 1. Species were selected according to the damage they caused to their host and their likely specificity. Eight species were recorded from boneseed and six from bitou bush with only two being shared. Seven species were not recorded from either subspecies, but are being considered, as they occurred on *C. monilifera pisifera* which intergrades with boneseed in the southern and eastern Cape Province. They are also from climatic regions of South Africa which are similar to that occupied by *Chrysanthemoides* in Australia.

Table 1. Potential biological control agents for bitou bush and boneseed.

FAMILY Species	Host in South Africa[1]	Target in Australia[2]	Plant part attacked
ACARI: ERIOPHYIDAE			
Aceria neseri	M P R	bs	new growth
FUNGI:			
Aecidium osteospermi	I M P	bs	new growth
CECIDOMYIIDAE			
Unidentified sp.	M P	bs	stem apex gall
CERAMBYCIDAE			
Unidentified sp. seedlings	P	bs	stem gall,
CHRYSOMELIDAE			
Chrysolina pulchella	P	bs	leaves
Chrysolina oberprieleri	I P	bs	leaves
Chrysolina sp.	P	bs	leaves
Cassida sp.1	I P	bs	leaves
Cassida sp.2	M P	bs	leaves
Altica sp.	P	bs	leaves, roots?
CURCULIONIDAE			
Undescribed genus	P	bs	stem gall
GEOMETRIDAE			
Comostolopsis germana	I M P R	bs & bb	new growth
LYGAEIDAE			
Dieuches sp.	R	bb	predispersed seed
PYRALIDAE			
Unidentified sp.	I M P R	bs & bb	leaf miner & folder
Unidentified sp.	R	bb	capitula, immature seeds
Unidentified sp.	M P	bs	stem girdler
TEPHRITIDAE			
Mesoclanis dubia	M P	bs	predispersed seed
Mesoclanis magnipalpis	I P R	bb	predispersed seed

1. Host plants: I = *C. incana*, M = *C. m. monilifera*, P = *C. m. pisifera*, R = *C. m. rotundata*.
2. Target: bs = boneseed (*C. m. monilifera*), bb = bitou bush (*C. m. rotundata*).

Adults and larvae of the two tortoise beetles (both new species of *Cassida*) eat the leaves of *Chrysanthemoides*. One species is found along the south coast of Cape Province on *C. monilifera*, the other along the west coast on *C. incana* and *C. monilifera*. In preliminary host specificity tests both species were found to feed on calendula, *Calendula officinalis*, an ornamental plant closely related to *Chrysanthemoides* (9). No feeding occurred on the seven other Asteraceae species tested. These insects are never abundant, possibly due to parasitism, and the damage caused in the field is minor (Kleinjan and Scott, unpublished observations).

Little is known of the other potential candidates and only two have been mentioned in the literature. The mite, *Aceria neseri*, is only known from *Chrysanthemoides* (10) as is the rust fungus, *Aecidium osteospermi* (4). Both are very damaging to boneseed, but on bitou bush the mite is rare and the fungus is absent.

Boneseed and bitou bush are weeds of native vegetation and are a threat to nature reserves in Australia; they are of no threat to horticultural or agricultural land. This project is the first attempt at classical biological control of a purely bushland weed in Australia. Although it is too

early to assess the performance of the agents already released, the finding of a large number of potential agents portends the likely successful control of these weeds.

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