Possible bio-control of native weeds by native insects

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Summary
The possibility of native insects controlling native weeds arose after scale insects *Austrotachardia* sp. and *Paratachardina* sp. (Hemiptera: Kerriidae) killed large areas of *Cassinia* spp. in New South Wales between 1988-92. Human transmission of *Austrotachardia* sp. on one property assisted in killing 70% (255 ha) of the resident *Cassinia* spp. Subsequently *Austrotachardia* sp. has been established on *c.* 300 properties in NSW by human transmission of infected cuttings just before emergence of the first-instar nymphs. So far predators and parasitoids have inflicted only minor damage on established and establishing scales. It is hypothesised that by understanding the biology of native insects and their enemies and by using human transmission of the insects free of enemies it may be possible to control some native weeds.

Introduction

Cassinia spp. are widespread native weeds in Australia (1,2,3). They grow on infertile soils which restrict economic control (6). The possibility of using native insects to control *Cassinia* spp. arose after scale insects had killed plants throughout New South Wales (NSW) in 1988-92 (4); see Table 1 for an outstanding example of the effect of *Austrotachardia* sp. on *C. arcuata* and *C. longifolia*. The scale spread by natural means and by transfer of infected plants (P.J. Wykes) and killed mature plants and seedlings, the latter being a major problem in control (3).

Table 1. Kill of *Cassinia* spp. by *Austrotachardia* sp. on ``Daydawn''

Year (November)	Hectares	% kill
1987	0	0
1988	3	1
1989	18	5
1990	172	47
1991	255	70

Likely methods by which the scales kill *Cassinia* spp. include: the removal of sap; transmission of viruses, rickettsia, bacteria or mycoplasma (7); or injection of toxins (pers. comm. P. Gullan 1990). It is not clear why the scales, which have killed small patches over the last 20 years, have suddenly begun to kill large areas of *Cassinia* spp. It is possible that they have developed, in some areas, e.g. Kerrs Creek, a toxin or disease transmission that is now proving lethal or have multiplied faster than their enemies in response to the increase in area infested, e.g. *C. arcuata* 93,000 ha in 1975 to 616,000 ha in 1988 (2).

Biology and ecology of the scale insects

The two genera causing most damage are *Austrotachardia* sp. in central and *Paratachardina* sp. in north-western NSW (Hemiptera: Kerriidae). First instars of *Austrotachardia* sp. (orange crawlers 0.5 mm long) emerged at Kerrs Creek in early summer 1990 and established (by walking at 2m/hr) on new stems of *C. arcuata*, inserting their mouthparts,

losing their appendages, turning maroon and covering themselves with resin. By late summer 1991 the red oblong (1.5 x 0.6 mm) male tests contrasted with the red oval female tests (1 mm across). The males (small red fly each with 2 wings and 2 white caudal setae) emerged in early autumn, rear end first through a yellowish operculum. Whether fertilisation occurs then it is not known. In some other scales reproduction is by hermaphroditism, parthenogenesis or some other mechanism (7).

Females grew slowly during winter 1991, 1.5 mm at start to 2.0 mm at end. Emergence of crawlers from these females began in early summer 1991. Thus the time taken for the generation that began at Kerrs Creek in December 1990 was approximately 1 year. Another generation that began in February 1991 had males emerging and females 2 mm across in December 1991; time of crawler emergence has yet to be determined. As each female bears *c* 300 crawlers and with 30 females/cm on a heavily infested stem (1 cm diameter) the reproduction rate is *c* 9,000 crawlers/cm. These crawlers mass at the highest point of a cutting.

Austrotachardia sp. emits honeydew which attracts ants, other insects and fungi. Ants observed collecting honeydew include *Iridomyrmex rufoniger, I. itinerans, I. humilis* and *Camponotus* sp. A healthy infestation of *Austrotachardia* sp. is often covered by a mass of frenzied ants collecting honeydew which could discourage enemies. *Austrotachardia* sp. is commonly covered by sooty mould (*Capnodium walteri*) which blackens the scales and stems of the plant but appears to be harmless.

Host specificity

Despite the genera *Austrotachardia* and *Paratachardina* each having a wide host range (pers. comm. J.F. Donaldson 1992) the scales referred to in this paper have only been observed attacking *C. arcuata, C. longifolia, C. laevis* and *C. quinquefaria*. A laboratory experiment at Orange where *Austrotachardia* sp. crawlers were allowed a choice of 10 cm cuttings from 8 plant species spaced at random in 4 replications 10 cm apart, resulted in 24 and 16 nymphs/cutting on, respectively, *C. arcuata* and *C. longifolia* but none on *Eucalyptus* sp., *Acacia* sp., *Pinus radiata, Rubus fruticosus, Hypericum perforatum* and *Rosa rubiginosa*.

Transference

The possibility of native scale insects controlling *Cassinia* spp. by natural spread is low because of native predators and parasitoids. But if humans aid the spread of scales, and enemies are controlled, the chances of success could be improved. Scale insects have been spread in India (5) and Australia (P.J. Wykes 1988-91) by humans. In 1990 and 1991 *Austrotachardia* sp. was spread from Kerrs Creek by supplying cuttings to *c.* 300 NSW landholders. To proceed from initial establishment of scale insects to ultimate control of *Cassinia* spp. landholders would need to transfer infected material just before emergence each year until all *Cassinia* on their properties was infected.

To determine the best time for transference of crawlers to new plants, cuttings were taken from Kerrs Creek at weekly intervals from early October until mid December 1991, stored dry in a laboratory, and observed. Crawlers emerged from late November to late December from all cuttings. Taking cuttings early appeared to hasten emergence in response to desiccation. Cuttings producing the most crawlers were

those taken 10 to 30 days before emergence. There were no external indications of emergence; it was best ascertained through dissecting females.

Predators and parasitoids

The major parasitoids of *Austrotachardia* sp. appear to be small wasps that emerge with the crawlers and lay one egg either in or under an establishing nymph. Later the larvae feed on female scales and adult wasps eat their way out of the test leaving a round hole. A predator, the larvae of a *Stathmopoda* sp. moth, attacks scales under a protective web. Despite these enemies the populations of scales and their effects expanded markedly betweem 1987 to 1992 (Table 1). Predators and parasitoids have not prevented establishment of scales transferred on cuttings to new areas. The only method used to control enemies has been to select cuttings with visually healthy scales.

Future

By partially understanding the biology and ecology of the scale insects on *C. arcuata* it has been possible to spread them widely in NSW. Spreading crawlers free of enemies could be achieved by treating cuttings to selectively kill predators and parasitoids or spreading the emerged crawlers alone. This may give scales 5 to 10 years without attack in which to control *Cassinia* spp. Methods of replacing *Cassinia* sp. with pastures need to be developed to prevent re-infestation once scale insects have died out.

Other weeds

By understanding the biology and ecology of other native insects that attack other native plants other weeds could be controlled. *Eremophila* spp. and *Myoporum deserti* have been killed by, respectively, the cottony soft scale *Pulvinaria dodonaeae* (Hemiptera: Coccidae) and the mealybug *Rastrococcus stolatus* (Hemiptera: Pseudococcidae) (pers. comm. Nancy Robinson 1990). The insects were spread by Mrs Robinson by transferring infected branches to uninfected trees on random occasions. Some success has been achieved despite no knowledge of the biology of the insects.

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