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A DISCUSSION OF THE LIMITED ESTABLISHMENT OF *PERAPION ANTIQUUM* AND A REVIEW OF THE CURRENT STATUS OF BIOLOGICAL CONTROL OF *EMEX* SPP. IN AUSTRALIA

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ABSTRACT

Colonies of the weevil, *Perapion antiquum* (Gyllenhal), were collected from different climatic areas in South Africa and released in Australia to control *Emex* spp. Progeny of these colonies were released in areas which matched as closely as possible the climates where they were collected. It is now approximately six years since the first field releases but *P. antiquum* has become established and is persisting only at three sites and no significant damage to *Emex* spp. has been observed.

Several other organisms have been imported and studied but only a second weevil, *Lixus cribricollis* Boheman, was considered suitable for use as a control agent. It was released into the field in 1979. Other organisms occurring in both South Africa and the Mediterranean region are thought to have potential as control agents but no further work is planned for the immediate future.

INTRODUCTION

The exotic weed *Emex australis* Steinheil (Polygonaceae) has invaded agricultural, pastural, recreational and wasteland areas in much of temperate Australia and has become an economically serious pest. Gilbey (1974) estimated losses of $5 million annually could be attributed to infestations of *Emex* sp. in Western Australia. Another closely related exotic species, *Emex spinosa* Campdera, has a broadly similar but more patchy distribution and is at present relatively unimportant. However this latter species has the potential to become a serious problem (Weiss and Julien 1975, Weiss 1977).

In 1974, *Perapion antiquum* (Gyllenhal) (Coleoptera:Apionidae) was introduced from South Africa (Harley and Kassulke 1975) and released in Australia (Julien and Harley 1978). *P. antiquum* attacks both species of *Emex* and by 1975, 32 000 adults had been released at 22 sites throughout the Australian distribution of both weeds. Julien and Harley (1978) reported establishment of the weevils during the plant growing season but poor survival over the ensuing summer period when host plants are normally not available. They suggested that closer attention should be given to importing *P. antiquum* from specific areas of South Africa where the climate resembled more closely infested regions of Australia.

This paper outlines attempts to establish colonies of *P. antiquum* using material from selected areas in South Africa and progress so far in importing, assessing and field release of other organisms for biological control of *Emex* spp.

METHODS AND MATERIALS

Early releases of *P. antiquum* in Australia (beginning in 1974) were the progeny of colonies collected from Franskraal, Cape Province, South Africa, an area of Mediterranean climate (Walter and Leith 1960) (Figure 1). Field release of this colony was continued until 1976 when 70 700 adults had been released at 64 sites. In 1976 and 1977 colonies were introduced from other South African areas; Ladismith, which has a subtropical, hot and arid climate influenced by the Mediterranean winter rainfall climate occurring in adjacent southern

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regions (Walter and Leith 1960); and Grahamstown, which has a warm, temperate humid, climate (Walter and Leith 1960) (Figure 1).

Areas in Australia climatically similar to Franskraal, include southern coast and hinterland of South Australia, south and central Victoria and southern and south-western coast and hinterland of Western Australia; Ladismith, include north and north-western Victoria, south-east inland areas of South Australia and non-coastal southern and central Western Australia; and Grahamstown, include the western slopes of New South Wales (Figure 2).

In addition to the Franskraal material 34 900 adults from the Ladismith colony and 33 500 from the Grahamstown colony were released at 30 and 32 sites, respectively. Field releases of *P. antiquum* ceased in 1978. The main release sites and the colony released at each site are shown in Figure 3.

A weevil, *Lixus cribricollis* Boheman (Coleoptera:Curculionidae), collected from *E. spinosa* in Morocco, was imported in 1976. Larvae of *L. cribricollis* are internal stem tunnellers and adults feed on the foliage. They have one or two generations per year; adults may live for several years and diapause during summer. in 1977 a moth, *Microthrix inconspicuella* Ragonot (Lepidoptera: Pyralidae), was imported from South Africa where it was collected from *E. australis*. The gregarious larvae of *M. inconspicuella* feed on leaves and sometimes terminal parts of the stems (Harley *et al.* 1979).

Two weevils, *Perapion violaceum* (Kirby) and *P. neofallax* (Warner) (Coleoptera:Apionidae), natural enemies of *E. spinosa* in Portugal and Morocco respectively, were imported into Australia in 1976 (Julien and Harley 1978). These were held in quarantine but attempts to break diapause and rear them for host specificity testing were unsuccessful. The feeding behaviour of these weevils is similar to that of *P. antiquum* described by Harley and Kassulke (1975).

RESULTS

Perapion antiquum

In Table 1 are listed the sites where *P. antiquum* became established; i.e. where they survived the first summer and reproduced in the following *E. australis* growing season. At one of these sites, Ma Ma Creek in south-eastern Queensland, which has a warm temperate to subtropical summer rainfall climate, the population was well established, had spread up to 20 metres and was active on green plant material throughout the second *E. australis* season but did not survive the second summer. At several sites not listed in Table 1, recoveries were made during the second *Emex* growing season but viable populations did not develop.

Progeny of the Franskraal colony, and later the Ladismith colony, readily became established at Loxton, South Australia. This is an area influenced by both Mediterranean, winter rainfall climate and subtropical arid climate (Walter and Leith 1960). Recent observations suggested that the Ladismith colony, although released 22 months after the Franskraal colony, is more vigorous (J. Furness, pers. comm.). Within 200 km, at Merbein (Figure 3) (subtropical arid climate), the Franskraal colony failed but the Ladismith colony became well established. At both the Loxton and Merbein sites the weed receives additional water from irrigation. Field-collected material from both colonies has been distributed to and established at several other irrigated horticultural sites in the Loxton area. The only other site where *P. antiquum* (Franskraal colony) has become established is on Flinders Island, Bass Strait, (Figure 3) a Mediterranean, winter rainfall area.

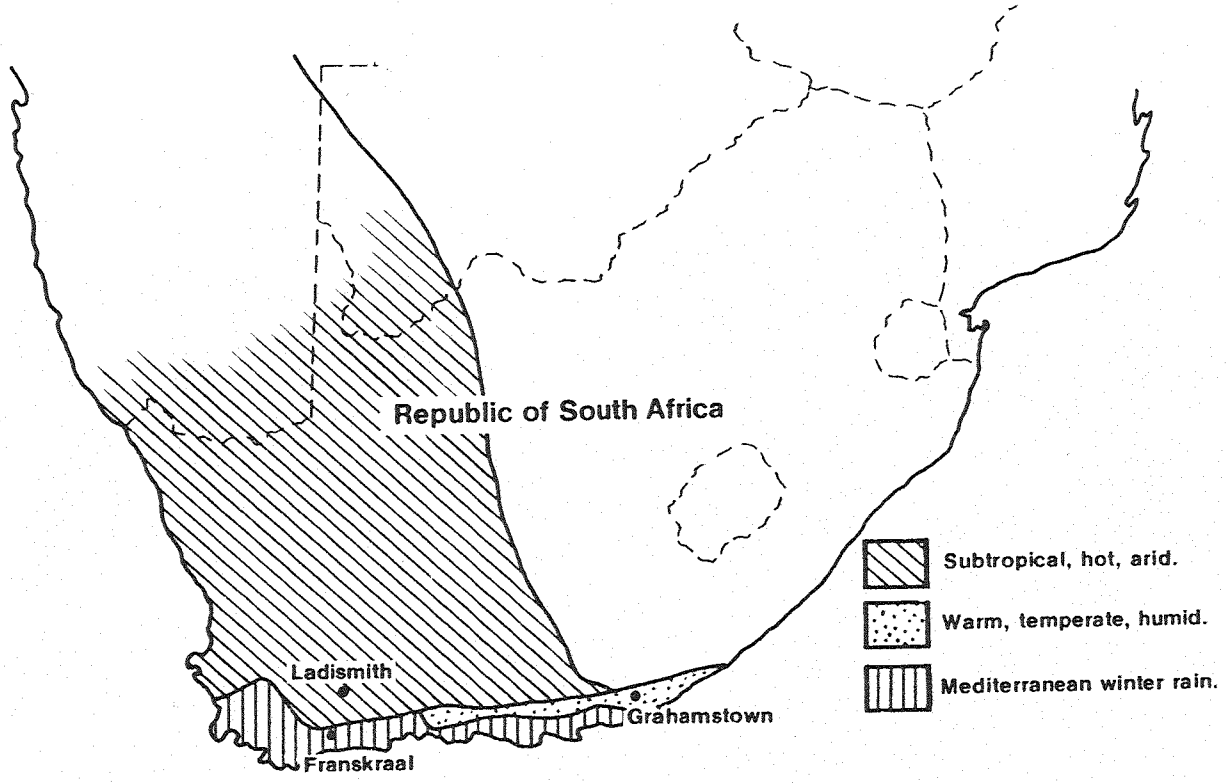

Figure 1. The climatic regions (Walter and Leith 1960) and sites in South Africa from which *Perapion antiquum* were collected for release in Australia.

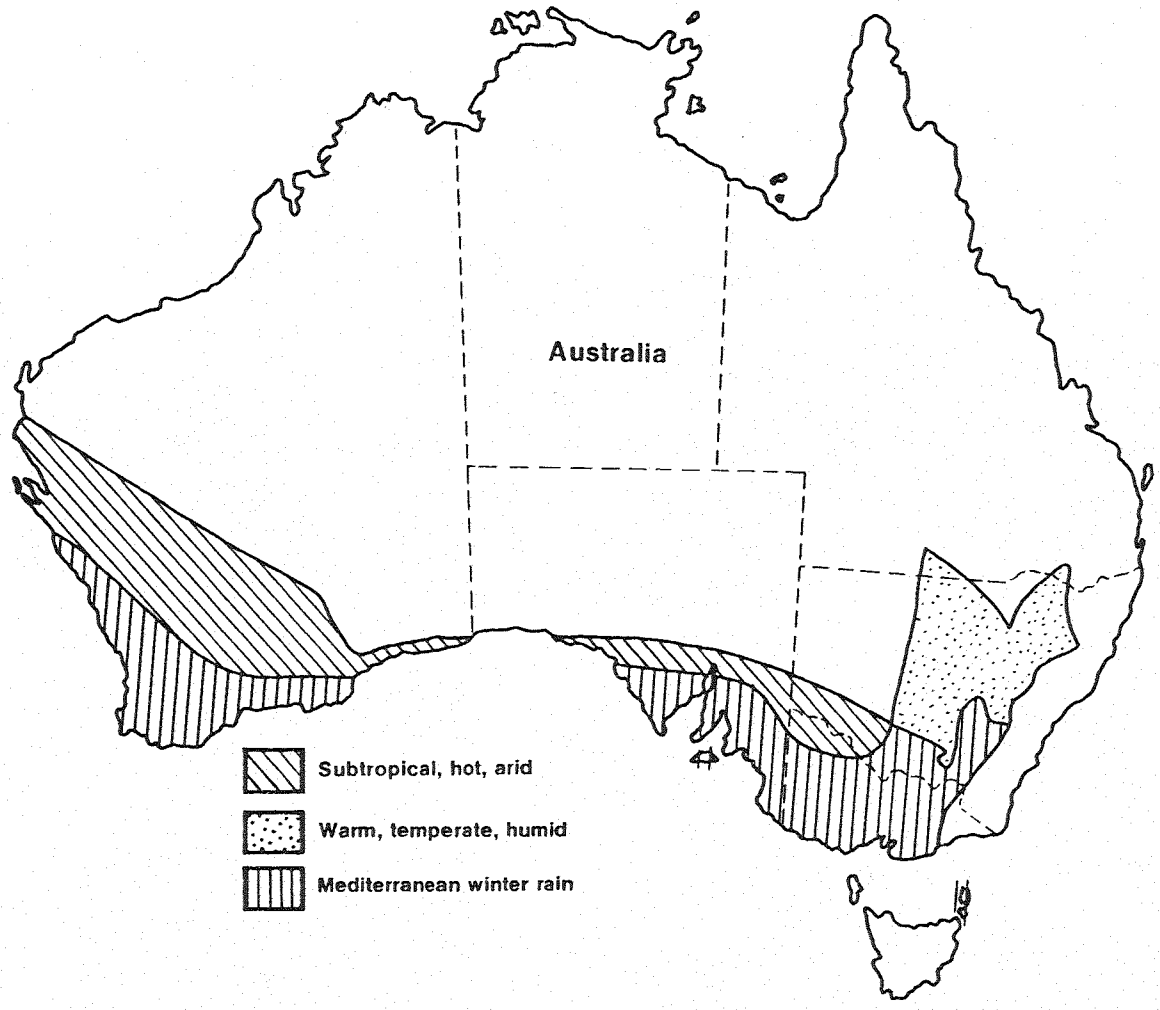

Figure 2. Australian climatic regions (Walter and Leith 1960) similar to those in South Africa from which *Perapion antiquum* were collected.

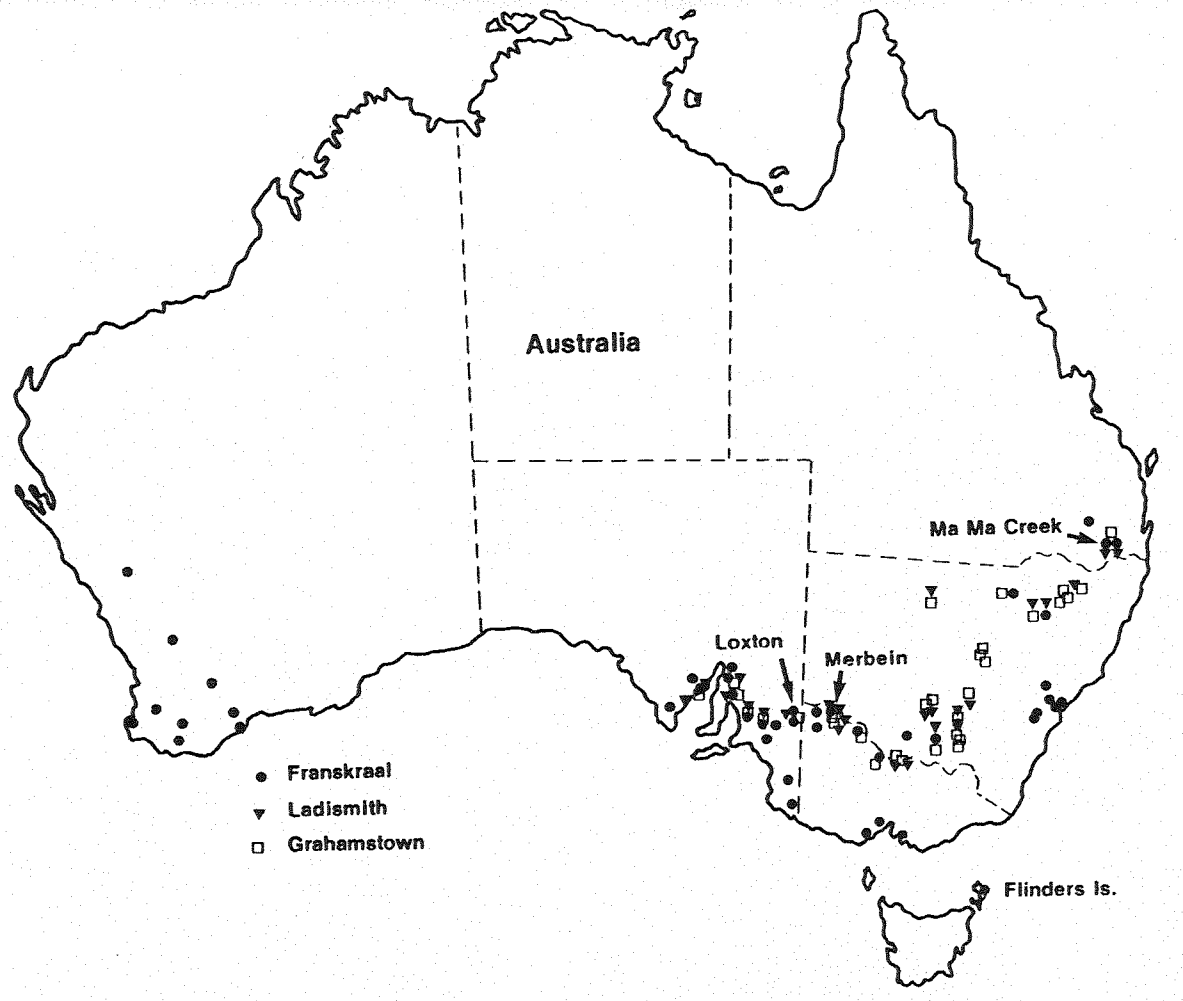

Figure 3. The main *Perapion antiquum* release sites in Australia and the colony released at each site.

Table 1. The origin, release sites, numbers released and current status of *Perapion antiquum* for sites where it became established during the second *Emex* growing season after release.

Origin (South Africa)	Release site	Number released	Date of release	Date of recovery	Current status
Ladismith	Merbein, Victoria. *E. spinosa* (dominant) and *E. australis*. Headland of irrigated vineyard and adjacent orchard.	1750	9.7.77	1978 to date	Well established
Franskraal	Loxton, South Australia. *E. australis* in irrigated orchard.	2150	15.11.75	1976 to date	Established
Ladismith	Loxton, South Australia. *E. australis* in irrigated orchard.	2000	13.9.77	1978 to date	Well established
Franskraal	Flinders Island, Tasmania. *E. australis*.	1500	13.9.77	1978	Established
Franskraal	Ma Ma Creek, Queensland. *E. australis*.	2000	15.7.75	1976	Did not survive 1976/77 summer

The Flinders Island colony has not been closely observed but is known to be persisting. At Merbein and Loxton, the numbers of *P. antiquum* and the damage to the target weed reaches a peak in late spring prior to plants becoming senescent, but after the development of seed. *P. antiquum* has so far had no significant effect on the density, growth or development of *Emex* spp. in the field.

Lixus cribricollis

Host specificity tests using the plant species listed by Harley and Kassulke (1975) for *P. antiquum*, confirmed that *E. australis*, *E. spinosa* and *Rumex crispus* L. (Polygonaceae) were suitable hosts for *L. cribricollis*. Minor feeding and occasional oviposition occurred on other plants of the family Polygonaceae but larvae died during the first instar in all except *Polygonum lapathifolium* L. where a single individual completed development to the adult stage (K.L.S. Harley and R.C. Kassulke, unpub. rep.).

After permission was given to liberate *L. cribricollis* during 1979 a small release was made in south-eastern Queensland and population increase was observed prior to the next summer. This site is being observed for survival of the weevil through summer and into the current *Emex* growing season. It is anticipated that *L. cribricollis* will be distributed to State authorities as breeding colonies during 1980.

Microthrix inconspicuella

Results of host specificity tests for this moth have been reported by Harley *et al.* (1979). Briefly, feeding by larvae occurred on seven plant species from four plant families, other than Polygonaceae, and on 11 species of Polygonaceae. Feeding was minor on all species except *E. australis*, *E. spinosa*, *R. crispus*,

rhubarb and apple. *M. inconspicuella* has not been observed attacking apple in its native range. However the colony was destroyed but this species may be further evaluated at a later date.

The two weevils, *P. neofallax* and *P. violaceum*, are univoltine and have a summer diapause. The colonies did not survive in quarantine and since field observations in their native ranges suggest that they have low potential as control agents (A.J. Wapshere, pers. comm.) work with these species was discontinued.

DISCUSSION

It has been nearly six years since the first releases of *P. antiquum* were made and although significant control was achieved in Hawaii within three years of release (Nakao 1969), no significant damage has been observed in Australia.

Importation of parental material from selected areas in South Africa, to complement the original Franskraal colony introduction, resulted in establishment at only one additional site (Table 1). *P. antiquum* populations increased in the field while *Emex* spp. were growing and during the season of release but, with few exceptions, they did not survive the summer period. The reasons for this are not known; similar climatic conditions occur in South Africa; there is no known alternative host in the insect's native range; there is little or no competition from other organisms attacking the plant in Australia; and predation, parasitism or disease attacking *P. antiquum* have not been observed. Where populations have become established, irrigation or climate may extend the period of plant growth by a month thus increasing the likelihood of survival by increasing the period when *Emex* spp. are available. However, at other sites where the growth period is equally long, establishment has not occurred.

There are several other species known to have possible potential value for controlling *Emex* spp. including *Coniocleonus excoriatus* Gyllenhal (Coleoptera: Curculionidae), a univoltine, collar and root feeder with a summer diapause; *Sterrha sacraria* L. (Lepidoptera:Geometridae) about which little is known; and two fungi, *Peronospora rumicis* Corda (Peronosporaceae), a downy mildew and *Cercospora tripolitana* Saccardo and Trotter (Dematiaceae), a leaf spot (A.J. Wapshere, pers. comm.). Further work is required before even a preliminary assessment of the host range and suitability of these organisms can be made. The moth, *M. inconspicuella*, should be studied in its native range to assess its host specificity in relation to apple. It is thought that the behaviour of *M. inconspicuella* in attacking apple, reported by Harley *et al.* (1979), is an aberration induced by the necessity of undertaking host specificity tests under artificial quarantine conditions. This is supported by field observation in South Africa (Harley *et al.* 1979).

At present we are not undertaking further work on the control of *Emex* spp. other than the rearing of *L. cribricollis* for distribution to State authorities in Victoria, South Australia and Western Australia. State Departments in Victoria are also undertaking programs for the rearing, releasing and field assessment of *P. antiquum* in the dried fruit producing area near Merbein.

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