BIOLOGICAL CONTROL OF PRICKLY ACACIA IN AUSTRALIA

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Summary The introduced tree *Acacia nilotica* (L.) Willd. ex Del. subspecies *indica*, commonly known as prickly acacia, has become a major economic and environmental weed of the Mitchell grass downs of western Queensland. Studies to find biological control agents commenced in 1980. Surveys of Pakistan and Kenya resulted in the introduction and release of two insects, one of which became widely established. An analysis of all the records of insects attacking prickly acacia throughout its native range suggest that there may be many species of insects still to be found on this plant. The Department of Natural Resources is commencing further work on biocontrol as part of a broader research program on this weed. Areas of research that will be addressed in this next phase include a release of *Weisiana barkeri* Jacoby, a survey of the insects already attacking this plant in Queensland, a survey of insects in southern and, possibly, western Africa, and host range studies of four Kenyan insects.

INTRODUCTION

Acacia nilotica, or prickly acacia, has become one of the worst woody weeds of northern Australia. It was introduced as a shade and fodder tree but now infests over 7 million hectares of the Mitchell grass downs of western Queensland (Marohasy 1995); an area being rapidly converted from a natural grassland into a woody savanna.

Acacia nilotica is endemic to an area including the sub-continent of India and Pakistan, a sub Saharan belt from Somalia to Liberia, and an area from Kenya to South Africa (Ross 1979). In many of these countries it grows sympatrically with many of its congeners. In countries such as India and Sudan it is a tree valued for its timber and gum and is commonly grown in plantations. The subspecies *indica* which is present in Queensland comes from the sub-continent (Marohasy 1995).

Recognition that prickly acacia had potential to become a serious weed occurred in the late 1970s after a dramatic increase in its abundance in the mid 1970s. At this stage the then Department of Lands commenced efforts to find biological control agents. In the first phase, a five year (1980–84) project in Pakistan was commissioned (Mohyuddin 1986). In a second phase, a three year study in Kenya was undertaken between 1989 and 1992 (Marohasy 1993).

The Department of Natural Resources is about to commence further efforts to bring about biological control. These studies will form part of a broader research program which has been nominated for inclusion in the CRC for Tropical Pest Management. In addition to biological control the CRC project on prickly acacia will include studies on ecology, management and population modelling.

This paper summarizes our progress so far in biocontrol and indicates the areas of activity for the future.

PRESENT STATUS

***Bruchidius sahlbergi* Schilsky** This seed feeding beetle was introduced from Pakistan into Australia in 1985 and has since established throughout most areas in Queensland. Levels of infestation can be as high as 50% (Willson 1985).

***Cuphodes confluens* (Meyrick)** This tiny moth from Pakistan attacks the new shoots of prickly acacia; particularly those growing from damaged trees. It was introduced in 1983 (Willson 1985) and was thought to have established in one or two areas soon after its release. It has not been seen since that period and may not have established.

The known insect fauna In addition to the surveys on our behalf in Pakistan and Kenya there is other information on the insects found on prickly acacia in its native range (Bhasin and Roonwall 1954, Beeson 1961, Browne 1968). These are mostly forester's reports from areas such as India and Sudan; areas where prickly acacia is deliberately grown for its gum and timber.

At present we know of 259 insect species which have been recorded on this plant somewhere in its natural range. This is not a large number of insects to be found on a perennial tree with a geographic range from India to South Africa. It is generally expected that the size of the insect fauna is directly related to (a) size of plants (trees having more than shrubs which have more than herbs, (b) perenniality (perennials having more than annuals), (c) distribution (plants with a wider distribution having a larger fauna than those with narrow range) (Strong *et al.* 1984).

Secondly the proportion of Lepidoptera is much higher than is usually encountered in such surveys. Usually about 10–20% of the total fauna are Lepidoptera collected as larvae (Table 1). This group is a good indicator by which to compare different surveys because larvae are relatively immobile (i.e. they do not fly) and if reared out to adult we can be reasonably confident that they are true associates of the plant. The proportion of Lepidoptera on prickly acacia is about 46%. This may be related to difficulties of thoroughly searching and catching mobile insects in such a generally difficult and unpleasant plant.

Thirdly, but possibly related to the above point, is the dearth of leaf feeding Chrysomelids that have been found (Table 1). This is of considerable relevance as a recent review of literature concluded that the Chrysomelidae is the most significant group in biological control of weeds. Only two chrysomelid species have been recorded from prickly acacia; far less than that found on other plants.

NEW INITIATIVES

Release of *Weisiana* A leaf feeding beetle *Weisiana barkeri* has been imported from Kenya and fully tested to determine that it feeds only on prickly acacia (Marohasy 1994). These tests indicated that it was safe to release and permission to release it was duly obtained. The beetle has been shipped to Charters Towers where it will be reared up in large numbers. We anticipate that we will make first releases of this insect in November this year and that mass rearing and releasing will continue for two years.

This beetle has a life cycle adapted to semi-arid conditions. It has 1–2 generations a year and, to ensure that these occur when foliage is acceptable, the eggs require considerable moisture before they will hatch. The larvae feed on the tree's foliage before they drop off to pupate in the soil. The adults then emerge and feed on the leaves for a further two months. In its native environment in Kenya it has been observed to defoliate trees thus doing considerable damage.

Survey of Queensland fauna In the early stages of a biological control project it is highly desirable to conduct a survey of the insects associated with the weed in its 'new' country (Harley and Forno 1992), to gain some base line data on insect attack and to identify if any species might interact with introduced agents. In experiments at Charters Towers we are finding that native cerambycid beetles damage moisture stressed seedlings. A survey of the insects attacking prickly acacia will therefore be conducted over the next two years.

Survey of southern Africa A survey of the insects attacking *Acacia nilotica* subspecies *kraussiana* has recently been commissioned. This subspecies grows in an area from Kwa-Zulu Natal to Zimbabwe. We know virtually nothing about the fauna on prickly acacia in this area. During this survey we hope to use a new technique of fogging the trees and that this will yield species found within the canopy that are not accessible by other methods.

Table 1. A summary of seven faunistic surveys.

Plant	Distribution	Plant structure	Total no. insects	% Lepidoptera	No. chrysomelids
Acacia nilotica (Marohasy 1995)	India, Pakistan, Sudan, Nigeria, Kenya, South Africa	tree	259	46	5
Melaleuca quinquenerva (Cav.) (Balciunas *et al.* 1996)	eastern Australia	tree	336	26	30
Lantana urticifolia Mill. (Winder and Harley 1983, Palmer and Pullen 1995).	Mexico to Argentina	perennial shrub	427	14	>90
Baccharis halimifolia L. (Palmer 1987)	eastern USA	perennial shrub	188	11	24
Mimosa pigra L. (Harley *et al.* 1995)	Mexico to Brazil	perennial shrub	421	17	>100
Parthenium hysterophorus L. (McClay *et al.* 1995)	Mexico, Texas	annual herb	262	20	43
Ambrosia acanthicarpa Hooker (Goeden and Ricker 1974)	western USA	annual herb	87	13	7

We also anticipate that the work in South Africa may lead to work in west Africa on subspecies *nilotica, tomentosa* and *adstringens*, perhaps using facilities in South Africa as a base.

Host testing of promising agents Four species found in Kenya have been identified for further work. These are the psyllid *Acizzia* sp., two geometrid caterpillars *Semiothisa inconspicua* Warren and *Tephrina* sp., and a cecidomyiid gall former *Acacidoplosis spinosa* Gagné. These species will be brought into quarantine facilities in Brisbane for rigorous host testing.

DISCUSSION

The results of previous investigations when a number of potential biocontrol agents were identified and good prospects of finding a large number of new insect associates of prickly acacia give rise to optimism that a suite of biocontrol agents can be found and developed for this weed.

Perhaps the greatest difficulty limiting the number of agents which could be released is the close phylogenetic relationship between *Acacia nilotica* and eight other Australian species in the same sub genus (*Acacia*). These include Queensland plants such as *A. bidwilli* Benth. L. and *A. sutherlandii* (F. Muell.) F. Muell. (Pedley 1987). The relationship to these plants means that a very high degree of host specificity is required and consequently a high rate of rejection of otherwise promising agents.

A second concern is the climatic fluctuations which occur in western Queensland. Here droughts of 5–6 years are not uncommon and the effects this will have on establishment and ultimate effect of introduced insects is unknown.

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