

## RECENT ADVANCES IN WEED BIOCONTROL IN NORTHERN AUSTRALIA

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*Summary.* Since 1980 there have been 43 species of insects imported into northern Australia for use against 14 species of weeds. Five of these weeds are considered to be under, or heading towards, effective control. Co-operation between states and agencies has led to rapid and efficient progress.

## INTRODUCTION

Seven of the world's most troublesome weeds (4) occur in northern Australia. The factors that make the north especially prone to invasion by these weeds include the low human population density, the seasonal inaccessibility of much of the land, the lack of intensive agriculture, the tropical climate, and the high level of disturbance to the environment created by grazing, annual burning, and feral animals. These same factors lead to costs of chemical control that can far outweigh any financial benefits that might accrue (6). Biocontrol agents, by contrast, are able to infest low densities of weeds over vast areas, in places inaccessible to man, without the environmental and economic problems that make herbicidal control unattractive (1).

## CURRENT BIOCONTROL PROJECTS

A summary of current biocontrol projects in northern Australia is presented in Table 1. The results of most of these projects are highly subjective. Depending upon the nature of the weeds, what may be considered acceptable, control of one species may be unacceptable for another, and spectacular initial damage may not be maintained over time, as demonstrated by *Teleonemia scrupulosa* on lantana, *Lantana camara* (12).

Between 1914 and 1979 only five species of weeds of northern Australia appear to have been the targets for biocontrol. Since 1980, however, there have been 43 species of insects imported into Australia for use against 14 species of weeds in northern Australia (Table 1). Of the insects, 16 species have been released, 18 have been lost in quarantine due either to a lack of host specificity or to rearing difficulties, and the remaining nine are still undergoing testing in quarantine. Of the 16 species released, 2 are known to have failed and 12 are known to have established. Only three are considered to be exerting effective control, although one (*Epiblema strenuana*) attacks two species of tropical weed.

Of the weed species shown, three, lantana, Noogoora burr, *Xanthium occidentale*, and water hyacinth, *Eichhornia crassipes*, represent continuations of pre-existing projects, and five, water lettuce, *Pistia stratiotes*, parthenium weed, *Parthenium hysterophorus*, Noogoora burr, water hyacinth and salvinia, *Salvinia molesta* are considered to be under, or at least heading towards, effective control in at least part of their range. (Note that water hyacinth is being controlled by *Neochetina eichhorniae*, introduced prior to 1980). The remaining eight are young projects with exploration, importation and host testing still in progress.

Table 1. Insects introduced into Australia since 1980 for the biological control of tropical weeds. Details given are, in order: 1) place of attack (B=bud, F=flower, L=leaf, R=root, Se=seed, St=stem, T=tip), 2) mode of attack (f=feeder, m=miner, g=galler, s=sucker, b=borer), 3) country of origin (Arg=Argentina, Bra=Brazil, Mad=Madagascar, Mex=Mexico, Pak=Pakistan), 4) year of release, 5) state of release, 6) current status (E=established, e=effective control, p=partially effective, n=not effective, s=still spreading; U=establishment unconfirmed; F=establishment failed; Q=in quarantine; RS=rejected, not specific, RU=rearing unsuccessful), and 7) key references in parentheses (Nos. are those listed in the references section; (GD = G. Donnelly, pers. comm.; RK = R. Kassulke, pers. comm.; CW = C. Wilson, unpublished data; RM = R. McFadyen, pers. comm.). NA means that details were not available.

Weed species	Insect species	Details
<i>Pistia stratiotes</i>	<i>Samea multiplicalis</i> (LEP: Pyralidae)	L, f, Bra, 1981, Qld, Ep (10)
	<i>Neohydronomus pulchellus</i> (COL: Curculionidae)	L, f, Bra, 1982, Qld, Ee (2) 1985, NT, U (CW)
<i>Cryptostegia grandiflora</i>	<i>Euclasta whalleyi</i> (LEP: Pyralidae)	L, f, Mad, -, -, Q (RM)
	<i>Steatococcus</i> sp. (HEM: Margarodidae)	St, s, Mad, -, -, RS (RM)
	<i>Schizomyia</i> sp. (DIP: Cecidomyiidae)	L/B, g, Mad, -, -, RU (RM)
<i>Parthenium hysterophorus</i>	<i>Thecesternus hirsutus</i> (COL: Curculionidae)	R, f, Mex, -, -, RU (5)
	<i>Smicronyx lutulentus</i> (COL: Curculionidae)	F, f, Mex, 1980, Qld, F (5)
	<i>Zygogramma bicolorata</i> (COL: Chrysomelidae)	L, f, Mex, 1980, Qld, En (5)
	<i>Epiblema strenuana</i> (LEP: Tortricidae)	St, g, Mex, 1982, Qld, Ee (5)
	<i>Listronotus setosipennis</i> (COL: Curculionidae)	St, f, Bra, 1983, Qld, U (5)
	<i>Stobaera concinna</i> (HEM: Delphacidae)	L/St,s, Mex, 1983, Qld En (5)
	<i>Bucculatrix</i> sp. 'D' (LEP: Lyonetiidae)	L, m, Mex, 1984, Qld, En (5)
<i>Xanthium occidentale</i>	<i>Epiblema streuana</i> (LEP: Tortricidae)	St,g, Mex, 1982, Qld, Ee (RM) 1984, NT, Es (CW) 1987, WA, U (RM)
	<i>Mimosestes ulkei</i> (COL: Bruchidae)	Se,f, USA, -, -, Q (GD,13,14)
	<i>Rhinacloa callicrates</i> (HEM: Miridae)	L, s, USA, -, -, Q (GD,14)
<i>Hyptis suaveolens</i>	<i>Mettriona</i> sp. (COL: Cassidae)	L, f, Bra, -, -, RS (RK)
	Undescribed sp. (COL: Cassidae)	L, f, Bra, -, -, RS (RK)

<i>Sidu acuta</i> and <i>S. rhombifolia</i>	<i>Calligrapha pantherina</i> (COL: Chrysomelidae) <i>Acanthoscelides brevipes</i> (COL: Bruchidae)	L, f, Mex, -, -, Q (RK) Se, f, Mex, -, -, Q (RK)
<i>Acacia nilotica</i> ssp. <i>indica</i>	<i>Bruchidius sahlbergi</i> (COL: Bruchidae) <i>Cuphodes profluens</i> (LEP: Gracillariidae) <i>Tephrina disputaria</i> (LEP: Geometridae) <i>Ascalenia callynella</i> (LEP: Momphidae)	Se, f, Pak, 1982, Qld, Ep (11) T, b, Pak, 1983, Qld, En (11) L, f, Pak, -, -, RS (11) T, b, Pak, -, -, Q (11)
<i>Mimosa invisa</i>	<i>Scamurius</i> sp. (HEM: Coreidae)	St, s, Bra, -, -, Q (RM)
<i>Mimosa pigra</i>	<i>Acanthoscelides puniceus</i> (COL: Bruchidae) <i>A. quadridentatus</i> (COL: Bruchidae) <i>Chlamisus</i> sp. nr <i>sidae</i> (COL: Chrysomelidae) <i>Syphraea flavipes</i> (COL: Chrysomelidae) <i>Syphraea</i> sp. (COL: Chrysomelidae) <i>Neurostrota gunniella</i> (LEP: Gracillariidae) <i>Chalcodermus serripes</i> (COL: Curculionidae) <i>Diplacaspis prosternalis</i> (COL: Chrysomelidae) <i>Sibinia fastigiata</i> <i>S. ochreosa</i> <i>S. peruana</i> <i>S. seminicola</i> (COL: Curculionidae) <i>Cryptocephalus</i> sp. nr <i>graphipterus</i> (COL: Chrysomelidae) <i>C.</i> sp. nr <i>miserabilis</i> <i>Lexiphanes guerini</i> (COL: Chrysomelidae) <i>Aroga</i> sp. (LEP: Gelechiidae)	Se, f, Mex, 1983, NT, Es (RK) Se, f, Mex, 1983, NT, Es (RK) L/st, f, Bra, 1984, NT, Es (RK) L/R, f, Bra, -, -, Q (RK) L/R, f, Mex, -, -, RS (RK) L/St, m/b, Mex, -, -, Q (RK) Se, f, Mex, -, -, RU (RK) L, f, Mex, -, -, RU (RK) Se, f, Mex, -, -, RU (RK) B/F, f, Mex, -, -, RU (RK) B/F, f, Mex, -, -, RU (RK) Se, f, Mex, -, -, RU (RK) L, f, Mex, -, -, RS (RK) L, f, Bra, -, -, RS (RK) L, f, Mex, -, -, RS (RK) T, b, Mex, -, -, RS (RK)
<i>Eichhornia</i> <i>crassipes</i>	<i>Acigona infusella</i> (LEP: Pyralidae)	L, f, Bra, 1981, Qld, F (9)
<i>Salvinia</i> <i>molesta</i>	<i>Cyrtobagous salviniae</i> (COL: Curculionidae) <i>Samea multiplicalis</i> (LEP: Pyralidae) <i>Paulinia acuminata</i> (ORTH: Acrididae)	L/St, f, Bra, 1980, Qld, Ee (8) 1981, NT, Ee (CW) L, f, Bra, 1981, Qld, Ep (8, 10) L, f, Arg, -, -, RS (8)
<i>Lantana camara</i>	<i>Alagoasa parana</i> (COL: Chrysomelidae)	L, f, NA, 1981, Qld, U (RK)

Great co-operation has been displayed between government agencies involved in biocontrol in the north. For example, mimosa, *Mimosa pigra*, arguably the most dangerous weed species in tropical Australia, is presently restricted to the "Top End" of the N.T., but it has the potential to form huge impenetrable thickets in wetlands and adjacent to waterways across all of tropical Australia (3, 7). A joint biocontrol program (Table 1) involving the N.T. Department of Primary Production and the CSIRO Division of Entomology commenced in 1980, and a research program into the management of mimosa in Thailand and Australia was initiated in 1984 with support from the Australian Centre for International Agricultural Research. Parkinsonia, *Parkinsonia aculeata*, forms dense thickets along creek lines and around bores and dams in the drier parts of northern Australia. In 1983 a joint biocontrol project was initiated between the W.A. Department of Agriculture, the N.T. Department of Primary Production and the Queensland Department of Lands (Table 1). Noogoora burr is a toxic annual weed along river banks over a vast area of northern Australia. When the gall moth *Epiblema strenuana* was successfully released in Queensland by the Department of Lands as a biocontrol agent against parthenium weed and Noogoora burr (5), colonies were made available to the N.T. and most recently W.A. Hyptis, *Hyptis suaveolens*, and *Sida* spp. are the subjects of joint biocontrol projects between the N.T. Department of Primary Production and the CSIRO Division of Entomology. They are widespread herbaceous weeds of disturbed land. Salvinia and water lettuce, floating aquatic weeds, were the subjects of biocontrol projects by the CSIRO Division of Entomology. Following successful release in Queensland, colonies of the salvinia weevil, *Cyrtobagous salviniae*, and the water lettuce weevil, *Neohydronomus pulchellus*, were made available to the N.T. Salvinia has now been successfully controlled in the N.T. but the status of the water lettuce weevil is uncertain.

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