Biological control of aquatic weeds in Australia

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SUMMARY

Research into biological control of aquatic weeds in Australia is reviewed. In particular on-going programs in which *Neochetina eichhorniae* and *Sameodes albiguttalis* have been liberated against *Eichhornia crassipes*, and *Agasicles hygrophila* and *Vogtia malloi* against *Alternanthera philoxeroides* are discussed. An exploratory program for further potential control agents for these weeds and for *Salvinia molesta* is outlined.

INTRODUCTION

During recent years Australia has become increasingly aware of the serious nature of actual and potential aquatic weed problems. D.S. Mitchell (unpublished manuscript), after completing a survey of the situation, estimated the actual cost of controlling aquatic weeds in Australia at $1.5 to $2.0 million annually. However a recent meeting of the A.W.C. Working Party on Biological Control of Aquatic Weeds agreed that total costs would be far higher when overheads were included. To-date most funds are expended on chemical or mechanical control of water hyacinth (*Eichhornia crassipes* (Mart.) Solms.) and salvinia (*Salvinia molesta* Mitchell), both of South American origin, and Canadian pondweed (*Elodea canadensis* Michx.) of North American origin. However in central coastal New South Wales significant sums are spent on control of alligator weed (*Alternanthera philoxeroides* (Mart.) Griseb.), also of South American origin.

Aquatic weeds generally have exceedingly high growth rates which combined with problems in application, effectiveness, pollution of the aquatic environment and effects on non-target organisms make control with herbicides an expensive, unattractive and virtually never-ending undertaking. Likewise mechanical control is generally expensive and unattractive (Harley, 1977a, b).

Elsewhere in the world, particularly in the United States, considerable progress has been made towards biological control of some of the more serious aquatic weeds, notably water hyacinth and alligator weed.

In 1975 the Division of Entomology, C.S.I.R.O., commenced work on the biological control of water hyacinth, in 1976 on alligator weed and currently is embarking on a program for control of salvinia.

MATERIALS AND METHODS

Water hyacinth - The program commenced with studies on the field ecology of the weed and the importation, pre-liberation study and subsequent liberation of insects selected from the complex

introduced into the United States from South America. To-date a weevil, *Neochetina eichhorniae* Warner and a moth *Sameodes albiguttalis* Warren have been judged suited to Australian requirements and liberated in the field (Table 1).

Alligator weed - This program commenced in much the same way as the water hyacinth program and to-date a beetle, *Agasicles hygrophila* Selman and Vogt (Table 2) and a moth *Vogtia malloi* Pastrana have been liberated.

Salvinia and Canadian pondweed - Introduction of organisms for biological control of these weeds cannot proceed until detailed overseas explanatory studies have been completed.

Overseas exploratory program - The Division of Entomology, C.S.I.R.O., has expanded its overseas exploratory program based at Curitiba, Brazil, in order to seek potentially suitable biological control agents for control of aquatic weeds originating in the region. Initially emphasis will be placed on seeking organisms especially suited to control of salvinia, water hyacinth and alligator weed in the Australian environment.

RESULTS AND DISCUSSION

Water hyacinth - In October 1975 the weevil, *Neochetina eichhorniae* was first liberated in Australia at sites in south-east Queensland. Since then more than 20,000 adult beetles have been distributed among coastal infestations ranging from Ingham in north Queensland to sites close to Sydney. Inland 2,000 beetles have been liberated on water hyacinth in the Gingham watercourse, west of Moree.

Since this insect requires at least 3 months to complete its life-cycle, it may be some years before the full potential of the effect of *N. eichhorniae* is realized in the field. However, at all sites, there is substantial evidence that the weevil has established and that populations are increasing. Survival after frosts and high summer temperatures has been excellent. Populations at early liberation sites in south-east Queensland have now reached a density where field cropping of adult beetles is supplying some of the materials for further distribution of this insect. It is probable that by 1978-79 field cropping may replace insectary rearing for distribution.

Insectary studies have shown that *N. eichhorniae* can cause significant damage to water hyacinth and it is not unrealistic to suggest that this may also occur in the field. Field experiments paralleling these insectary studies are in progress.

In October 1977, *Sameodes albiguttalis* was released in south-east Queensland. A successful mass rearing program has enabled a quick distribution of this moth. Within eight weeks young larvae have been liberated at a total of 21 sites ranging from north Queensland to central New South Wales. Prospects for early establishment are good.

Alligator weed - *Agasicles hygrophila* was first released in January 1977 (Table 2) when alligator weed had reached the peak of its seasonal growth. Following liberations, evidence of field

Table 1. Locations at which *Neochetina eichhorniae* and *Sameodes albiguttalis* have been liberated since October 1975 and October 1977 respectively

Location	*N. eichhorniae* Number of sites	*S. albiguttalis* Number of sites
Ingham	4	2
Townsville	1	1
Ayr-Homehill	5	2
Mackay	1	1
Rockhampton	3	1
Maryborough	2	2
Cooloongatta	1	-
Brisbane	6	2
Beaudesert	3	2
Ipswich	3	-
Gatton	2	1
Lismore	2	2
Grafton	1	1
Kempsey	1	-
Sydney	2	2
Moree	5	2

Table 2. The locations, dates, number of sites and numbers of adult *Agasicles hygrophila* released on *Alternanthera philoxeroides*

Location	Release dates	Number of sites	Number of adults
Georges River (freshwater)	Jan. 77	3	2250
Georges River (tidal) Chipping Norton experimental site	Jan. to Mar. 77	1	1290
Duck Creek	Jan. to Mar. 77	1	550
Williamtown	Jan. 77	1	300
Georges River (freshwater)	Sept. and Oct. 77	16	10100
Georges River (tidal)*	Oct. and Nov. 77	11	11400
Prospect Creek	Nov. 77	4	1200
Williamtown	Oct. 77	3	1200

*No releases were made at the Chipping Norton experimental site after March 1977.

survival and emergence of at least one generation was observed at all release sites except Williamtown. At this site the beetles were placed on alligator weed infesting a low-land drainage system. Adults were observed approximately one month after release but no further evidence of survival has been obtained.

During March 1977 normal seasonal flooding occurred on Georges River, Duck Creek and at Williamtown. The tidal areas of Georges River were less affected than elsewhere but in general the alligator weed mats were torn from banks, submerged, turned upside down or deposited on the banks. In spite of this damage to the weed, adults of *A. hygrophila* were quite numerous at Duck Creek and at least at one site in the fresh-water section of Georges River in November 1977.

At the Chipping Norton experimental site the beetle population increased and spread approximately 20 m from the release point. By June obvious changes in plant vigour were visible at the release point in comparison to areas of the weed not under attack. The onset of winter caused a decline in alligator weed growth and a decrease in insect activity. However adult beetles were observed throughout the winter and by November, when the alligator weed was rapidly increasing, all life-history stages of *A. hygrophila* were observed and apical leaves on more than 50% of stems in the release area had feeding damage.

During late September, October and November 1977, 23,900 beetles were liberated (Table 2) at 34 sites in Georges River basin and at Williamtown. No releases were made at the Chipping Norton experimental site or the Duck Creek site after March 1977. At these sites observations are in progress on the changes and effects of *A. hygrophila* populations that survived the winter. Results indicate that this beetle may be well suited to the control of alligator weed in the Georges River basin and Duck Creek areas.

During December 1977 *V. malloi* was liberated on Georges River, Duck Creek and at Williamtown. A programme is in progress to monitor establishment of *V. malloi* and to determine its role in effecting control of alligator weed.

Rearing and liberation of both *A. hygrophila* and *V. malloi* is continuing.

Salvinia and Canadian pondweed - Two insects, a weevil *Cyrtobagous singularis* Hulst. and lygaeid bugs of the genus *Lipostemmata* Berg are high on the list of potential control agents for study by the Biological Control Unit at Curitiba during 1978. There are no immediate plans to work on Canadian pondweed but if the fish, *Ctenopharyngodon idella* Val., were judged suitable for introduction into Australia it may have a significant impact on this submersed weed.

General Discussion - The Division of Entomology, C.S.I.R.O. has established a strong on-going program on biological control of aquatic weeds in Australia. The program is based on a research team located at the Brisbane Long Pocket Laboratories, and is supported by an exploratory unit located at Curitiba, Brazil. The work of the exploratory unit ranges extensively over the regions of South America where the target aquatic plants occur. Potential

control agents discovered by the unit will be carefully screened and selected species will be introduced to establish an effective complex.

Prognosis for reduction, and maintenance of the target aquatic weeds at acceptably low levels is good. Achievement of these aims will result in return of many of our streams and wetland areas to something approaching their original ecological state and will result in very considerable reduction in expenditure on weed control.

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