CURRENT STATUS OF BIOLOGICAL CONTROL OF ALLIGATOR WEED IN NEW ZEALAND

B.A. PHILIP, C.J. WINKS, P.W. JOYNT¹ and
O.R.W. SUTHERLAND

*Entomology Division, DSIR, Private Bag, Auckland and
¹Hobson District Plants Authority, Private Bag, Dargaville.*

SUMMARY

Of the insect species introduced into New Zealand between 1981 and 1984 to control alligator weed (*Alternanthera philoxeroides*) only *Agasicles hygrophila* (Coleoptera: Chrysomelidae) has successfully established. It has spread rapidly throughout Northland and is reducing the weed problem in aquatic habitats. No recoveries were made following the 1984 releases of *Vogtia malloi* (Lepidoptera: Pyralidae). A further importation was made in 1987 and field releases were made in the spring and summer of 1987/88. If this species becomes established it may exert pressure on the weed in non-aquatic habitats and complement *A. hygrophila*.

INTRODUCTION

Alligator weed (Amaranthaceae), a native of South America, grows as a terrestrial plant on the banks of waterways and adjacent land as an aquatic plant rooted in shallow water and forming thick mats extending up to 20 metres from the water's edge. The hollow stems contain nodes every 5-10 cm, each of which is capable of producing a new plant.

Since its introduction into New Zealand early this century, alligator weed has spread throughout much of Northland. In April 1987 a survey of all Noxious Plant Authorities north of a line from Gisborne to Taumaranui showed that the weed is present from South Auckland to the Bay of Islands (Fig. 1). An isolated infestation at Orongo, near Thames (Roberts *et al* 1984) has been eradicated (P. Kennedy pers. comm.).

In Northland, alligator weed has become a serious pest of waterways and agricultural and horticultural land. The weed mats impede water flow in rivers, streams and drains and make access to ponds and dams difficult for stock. This leads to tramping, pugging and deterioration of bank edges which allows other weeds such as willow weed and rush to colonise. During floods, large mats of alligator weed wash downstream, block drains and culverts and flatten fence lines. On low-lying horticultural land its sprawling, smothering habit causes considerable problems and cultivation assists its spread. In pasture, it is readily eaten by stock, but recent tests by the Northern Wairoa Veterinary Service link it to a photosensitivity reaction of stock, especially lambs and calves (C. McKay pers. comm.).

Mechanical clearance of alligator weed hastens its spread because fragments with nodes readily regrow and efficacy of herbicides is reduced because nodes impede their translocation. For these reasons the plant was considered a good candidate for biological control. Three South American species of insect were imported and released between 1981 and 1984: two chrysomelid beetles, *Disonycha argentinensis* and *Agasicles hygrophila* and a pyralid moth, *Vogtia malloi* (Roberts *et al* 1984). Only *A. hygrophila* successfully established. This paper describes the progress of *A. hygrophila* in the field since 1984, and the further importation and releases of *V. malloi*.

Proc. 41st N.Z. Weed and Pest Control Conf.

*VOGTIA MALLOI***Importation and release**

The larvae of *V. malloi* feed and pupate inside the hollow stems of alligator weed. Each larva can destroy up to nine stems in the course of its development (Maddox 1970). The insect is multivoltine and at 22°C completes a generation in approximately 6.5 weeks. *V. malloi* has been reported to be successful in situations too dry for *A. hygrophila* (Julien *et al* 1979).

No recoveries were made following field releases of *V. malloi* from two 1984 importations. A contributing factor could have been infection by pathogenic microsporidia, detected in the second colony.

Rearing

In March 1987 220 *V. malloi* larvae and pupae were imported from near Sydney, Australia. In order to establish a disease-free colony, the insects were line-bred from original pairs of moths. A proportion of each generation was tested for disease, and lines with infection discarded.

From 106 adults which emerged from the imported insects, 37 pairs laid viable eggs. Two of the 74 adults (2.7%) were found to have low levels of microsporidian infection. Their offspring were destroyed, while those of the remaining 35 pairs were reared separately in gauze sleeves in quarantine at 25°C and 70% RH. The larvae were supplied with field-collected alligator weed.

Up to ten first generation individuals in each of 26 lines were screened for disease. Eighteen out of 202 insects contained microsporidia, with infected individuals coming from 13 (50%) of the lines tested. This high proportion of diseased offspring from adults in which no infection was detected indicated that the microsporidia were being introduced on the field-collected weed, rather than being transmitted from one generation to the next. Line-rearing ceased but in all subsequent generations, adults were mated in individual pairs and pathogen-tested after oviposition. Only offspring from adults in which no infection was found were used for colony maintenance. Insects for release would be one generation away from 'clean' adults and should contain only a small proportion of diseased individuals carrying only low levels of infection.

On 23 April 1987, permission was granted to release the colony from quarantine. All further rearing was carried out in a temperature controlled glasshouse unit at approximately 22°C. Adults were mated in pairs in glass vials. Eggs and neonate larvae (300-600) from 'clean' adults were placed in 50 x 56 x 56 cm gauze cages on alligator weed held upright in saturated potting mix. Fresh weed was added as necessary. Emerging adults were collected daily and mated.

Between 1 May 1987 and 25 March 1988, six generations were reared. The yield of adults per cage varied (range 0-108), with a mean of 36. The percentage of diseased adults found per generation dropped from 8.9% (first quarantine generation) to 1.7-3.7% in the following three generations, possibly because of decreasing numbers of microsporidian spores on the alligator weed during the winter months (P.J. Wigley, pers. comm.).

Release and Assessment

From 26 August 1987 to 22 February 1988, 12 releases of *V. malloi* were made at 10 sites (Fig. 1). Releases consisted of approximately 5000 eggs/neonates or 1000-2000 older (2nd/3rd instar) larvae.

Eight of the 10 sites have been revisited since releases were made. No *V. malloi* or their feeding damage were found and at two of these Sites (1,5). A Site 5 cow had eaten all the alligator weed down to water level. At a third site (Site 10) *V. malloi* were found until the fourth visit, when flooding had submerged, washed away or damaged much of the weed.

At five sites where *V. malloi* were recovered, one or more field generations would have been completed. All surviving populations should have completed at least one generation before winter 1988, and most two or more.

Fig. 1: District Noxious Plants Authorities in which alligator weed is known to occur. Ten sites at which *Vogtia malloi* was released are shown.

AGASICLES HYGROPHILA

Progress since establishment

Both larvae and adults of *A. hygrophila* feed on the leaves of alligator weed, although pupation takes place inside the hollow stems. Local populations of the beetle can multiply rapidly and completely defoliate the weed. The beetle is restricted to alligator weed growing over water because of the susceptibility of its eggs to desiccation.

Roberts *et al* (1984) reported the release of *A. hygrophila* at 26 sites and concluded that the major factor influencing over-winter survival was the condition of the weed. Where frosts and flooding did not reduce the availability of alligator weed, *A. hygrophila* was capable of exerting considerable pressure on the weed.

Hobson District Noxious Plants Authority

Since 1984, *A. hygrophila* has spread rapidly. A detailed assessment of the insect in Hobson District Noxious Plants Authority (DNPA) was carried out between December 1986 and April 1987. This showed that in 4 years, the insect has spread from eight isolated release sites to all known aquatic alligator weed infestations in the county (Fig. 2) (Joynt 1987).

Beetle numbers in drains and rivers increased slowly during early summer, but by May many sites had large populations inflicting considerable damage to the weed. Either flash floods or drought during summer can reduce *A. hygrophila* populations considerably, but with the return of favourable conditions the beetles quickly re-establish. On dams beetle numbers increased more rapidly, probably because the weed was less affected by flooding or drying out.

Potential Benefit in Hobson DNPA

Drainage systems. To maintain water flow, the 237 km of water board drains are usually sprayed with herbicide twice yearly (at a cost of \$800/km) and mechanically cleared once yearly (\$400/km). *A. hygrophila* negated the need to spray and mechanically clear in two drains in the DNPA during the summer of 1986/87. However,

in one of these drains, the following summer, beetle numbers were very low, probably due to floods or very dry conditions. If the action of *A. hygrophila* could render a second spraying unnecessary in just 20% of drains, \$19,000 would be saved each year.

Rivers and streams. The action of *A. hygrophila* helped maintain water flow. During the survey, a planned clearance of 2 km of the Kaihu River at a cost of \$7,000 was not carried out, mainly due to the destruction of alligator weed mats by *A. hygrophila*. Less damage by weed mats washed away during floods could also be expected.

Dams and ponds. There are approximately 100 farm dams infested with alligator weed in Hobson DNPA. In dams with light infestations of weed, the beetle has prevented the formation of floating mats, thereby slowing down pugging of dam edges and preventing deterioration of water quality. Farm dams are normally mechanically cleared every 7 to 8 years at an average cost of approximately \$500 each. The action of *A. hygrophila* could extend this to 10-12 years, by which time other weeds would also require clearance.

Fig. 2: Map of Hobson District Noxious Plants Authority showing (A) sites at which *Agasicles hygrophila* were released in January 1983 and (B) sites at which the insect was found in April 1987.

CONCLUSIONS

A. hygrophila has spread rapidly throughout Northland; in Hobson DNPA it has spread to all known aquatic infestations of alligator weed. Its efficacy in controlling the weed at any given site in any one season depends on conditions experienced at that site, such as frosts, flooding, drying out, stock management, and herbicidal or mechanical clearance of the weed. It is already providing economic and environmental benefits.

If *V. malloi* survives the winter and establishes it will complement the action of *A. hygrophila* in reducing the level of alligator weed infestations.

ACKNOWLEDGEMENTS

This project was made possible by financial contributions from the Noxious Plants Council, the Auckland Regional Water Board and District Noxious Plant Authorities

throughout New Zealand. We thank Dr P.J. Wigley for his advice on *V. malloi* rearing management with respect to disease control and, together with Mr S. Dhana, for screening *V. malloi* for pathogens. Mr D. Helmore kindly prepared the figures.

REFERENCES

- Joynt, P.W., 1987. Biological control of alligator weed: The results and benefits of introducing *Agasicles hygrophila* in the Hobson County. Internal Report. Hobson District Noxious Plants Authority. 33pp.
- Julien, M.H., Broadbent, J.E. and Harley, K.L.S., 1979. The current status of biological control of *Alternanthera philoxeroides* in Australia. *Proc. 7th Asian-Pacific Weed Sci. Conf.*:231-235.
- Maddox, D.M., 1970. The bionomics of a stem borer, *Vogtia malloi* (Lepidoptera: Phycitidae) on alligator weed in Argentina. *Ann. Entomol. Soc. Am.* 63:1267-1273.
- Roberts, L.I.N., Winks, C.J., Sutherland, O.R.W. and Galbreath, R.A., 1984. Progress of biological control of alligator weed in New Zealand. *Proc. 37th N.Z. Weed and Pest Control Conf.*:50-54.