A RENEWED ATTEMPT AT THE BIOLOGICAL CONTROL OF *LANTANA CAMARA*

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Summary. The Queensland Department of Lands has renewed its program to find suitable biological control agents for lantana (*Lantana camara*). Two insect species (*Charidotis pygmaea* and *Pyramidobela* sp.) have recently been released and four others (*Cremastobombycia lantanella, Aerenicopsis championi, Aconophora compressa* and *Adfalconia* sp.) are being evaluated in quarantine at the Alan Fletcher Research Station. The pathogen *Prospodium tuberculatum* is being evaluated in the United Kingdom and further introductions of both insects and pathogens are planned.

INTRODUCTION

Lantana, *Lantana camara*, was the first weed to be subjected to classical biological control. Its natural enemies were collected in Mexico in 1902 by Koebele who shipped 23 insect species to Hawaii. Many died during the long sea voyage but eight species were established (9). Attempts to control it biologically have been made in 25 countries using 35 different insect species collected from the Americas. The number of species released in any one country have ranged from one in several countries to 22 in Australia (8).

The successful establishment of these insect species has been erratic and difficult to predict, probably more so than in any other biological control project. The reason for this is that the name *Lantana camara* is used for a wide complex of plants including weedy forms which may be separate species or varieties (2). *L. camara sensu lato* is a man made polyploid complex developed in Europe over three centuries by horticulturalists from material collected in the New World (11). The complex contains many colour forms differing in their general morphology, chemistry, toxicity and ecology. Introduced insects have distinct preferences for one or more varieties.

This varietal problem was not recognized in early biocontrol programs and Haseler in 1963 recognized only four lantana varieties naturalized in eastern Australia (7). Smith and Smith (10) however, in a later taxonomic study list 29 different taxa as being naturalized in this region. *L. camara sensu stricto* does not occur in Australia (10).

Previous attempts to obtain biological control of lantana have been largely unsuccessful and it remains a serious to very serious weed throughout tropical and sub tropical regions of the world. The Queensland Department of Lands has thus reactivated its overseas exploration program to find suitable control agents.

CURRENT STATUS IN AUSTRALIA

Australia's involvement with the biological control of lantana commenced in 1914 when the first group of four introduced insects were released. Since then a number of field exploration programs have been carried out with the most intense period of introduction and field releases occuring between 1965 and 1977 when 14 insect species were released.

Of the 22 insect species released onto lantana up until 1992, 14 have become established - 9 widely and 5 at localised sites (8). The combined result of all these introductions has ranged from partial to zero control. In the areas of partial control, the competitiveness of lantana has been markedly reduced. Lantana, however, still remains one of Australia's most serious weeds affecting almost 4 million hectares (1). In Queensland an estimated A$17 million is spent annually on its control (12) and because of this continuing problem, a renewed attempt has been made by the Queensland Department of Lands to find new control organisms and to reinvestigate insect species previously tried in other countries.

NEW RESEARCH PROGRAM

Insects. The exploration for candidate insect species has been centred on Mexico from where many lantana feeding insect species have been found in the past but for varying reasons have not been successfully utilized. Exploration has also been carried out in Brazil and Argentina looking particularly for insects that feed on both lantana and creeping lantana, *L. montevidensis*.

To date this has resulted in the introduction and release of two species and the introduction into quarantine for host specificity testing of another four. These are as follows:-

Pyramidobela sp. A small moth whose larvae feed on the undersides of lantana and creeping lantana leaves. The larva shelters within the protection of a silken tunnel emerging to feed on the surrounding leaf tissue. It was originally collected from Brazil where it is heavily parasitised. It was recently released in Queensland.

Charidotis pygmaea. A leaf feeding chrysomelid beetle was collected from lantana and creeping lantana in Brazil. It is well adapted to shady environments as well as to southern (cool) latitudes. Lantana in this type of environment in Australia is largely unattacked by previously introduced biological control agents and *C. pygmaea* could fill this niche. It has recently been released in Queensland.

Aerenicopsis championi. This stem boring cerambycid beetle was first identified as a potential control agent of lantana by Koebele in his exploration of Mexico in 1902. It was shipped to Hawaii by Koebele (9) and also by Krauss in 1955-56 when over 1000 beetles were shipped and released into the field (3) where it failed to become established. Mann (1954 unpublished report) thought it to be the best insect for lantana control that he had seen. Field collected larvae have now been shipped to Australia where host specificity testing will be carried out in quarantine.

Aconophora compressa. This stem sap sucking membracid bug is probably the same species found by Mann in Mexico in 1953 and identified as *A. marginata*. Mann regarded it as the most important insect found feeding on lantana stems causing considerable lengths to wither and die. A shipment of adults sent to Hawaii were not successfully reared (Mann 1954 unpublished report). Several shipments were sent to Australia in 1993 and these are now being successfully reared and host specificity testing has begun.

Adfalconia sp. A leaf sap sucking mirid bug capable of causing considerable damage to lantana was shipped to Australia in 1993. Cage rearing was unsuccessful even though adult bugs fed and oviposited. Neonate bugs failed to feed and died in the first instar. The failure of this

insect is probably due to lantana varietal differences even though three of the more common Queensland varieties, common pink, Helidon White and oblong red were used.

Cremastobombycia lantanella. This leaf mining gracillarid moth was found in Mexico and southern Texas, USA, with at least four species of *Lantana* as natural hosts (Palmer 1992 unpublished report). It was one of the species collected by Koebele in 1902 and subsequently released and established in Hawaii (9) where it is now one of the suite of insects responsible for a considerable reduction in the abundance of lantana particularly in drought prone areas (4). Preliminary host testing has been completed in Mexico and it has recently been shipped to Australia where cage rearing in quarantine has commenced.

Pathogens. A new direction in the biological control of lantana has been taken with the exploration in Brazil for suitable lantana pathogens. Four species were found, two at altitudes of 300 m in southern Brazil - the rust *Prospodium tuberculatum* and the hyphomycete *Mycovellosiella lantanae* and two in the humid tropical areas of northern and central Brazil - the rust *Puccinia lantanae* and a disease with symptoms similar to that of the web blight fungi, *Ceratobasidium* (12).

The host specificity testing of *P. tuberculatum* has commenced at the International Institute of Biological Control in the United Kingdom.

DISCUSSION

As *Lantana camara* sensu lato is a man made polyploid complex, with no true country of origin and which invades diverse ecosystems in Australia and other countries, the standard classical biological control procedure of exploring for natural enemies in its country of origin and in climatically similar habitats is largely irrelevant, as are the agent selection procedures recommended by Harris (6), Goeden (5) and Wapshere (13).

After nine decades and numerous intensive overseas explorations for new insect control agents, host specificity is the only issue likely to affect the release of any new introductions. Their affinity for any of the Australian lantana varieties will only be determined after their introduction into quarantine in Australia. The basis for the selection of any new agent should be its host range restriction to the genus Lantana.

The selection of pathogens for host specificity testing is influenced by lingering doubts by many plant pathologists as to their safety. The autoecious rust *Prospodium tuberculatum* was selected on the basis of its restriction to the genus *Lantana* and also after initial testing had shown its pathogenicity to the "common pink" lantana variety (Evans, 1988 unpublished report), the most abundant form of lantana in south eastern Queensland and New South Wales (2).

It is too early to predict the outcome of current investigations but it is obvious from cage studies that the different varieties of lantana in Australia will greatly influence the results. The failure of a control agent in Australia however does not mean that it should not be tried in other countries with different ecosystems and lantana varieties.

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