The Evaluation of Biocontrol Agents with Particular Reference Two Hispine Beetles Established on Lantana camara in Australi

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ABSTRACT

The evaluation of agents introduced for biological control of weeds is discussed. Several possible approaches are outlined, and a technique used in the evaluation of two hispine beetles is considered in detail. These beetles, *Octotoma scabripennis* and *Uroplata girardi* were introduced into Australia for control of a woody perennial plant *Lantana camara*.

INTRODUCTION

Post liberation evaluation of biological control agents has been attracting more attention during recent years. Good evaluation of established biological control agents is essential to demonstrate the effectiveness of a program and we believe that it can be most valuable in the development of sound strategies for selecting other control agents.

In this paper we will discuss certain evaluation techniques which we have developed for insects introduced for control of *Lantana camara*. Particular reference will be made to evaluation of two hispine beetles.

PROBLEMS OF QUANTITATIVE EVALUATION

Evaluation techniques will vary with each insect-plant relationship and there can be no one approach which will be adequate for every situation.

Evaluation can take two pathways. The insect may be evaluated directly by detailed examination of that unit of the plant where its activity is concentrated, or it may be evaluated indirectly by determining what effect the direct action is having on the plant stand in total. Indirect evaluation is difficult but in the case of a woody perennial, it may be the more important of the two approaches. To pursue this aspect requires a thorough knowledge of the biology and ecology of the plant but in this area our information is often incomplete and confused.

Frick (1974) suggested that a statistical record of plant cover and the status of the target weed should be known prior to liberation of natural enemies. Pre-liberation sites should be chosen carefully to ensure there will be minimum interference from grazing animals, cultivation practices, and any activity of man himself. A number of sites should be selected and these should cover the range of geographic and climatic conditions colonized by the weed. Adequate pre-liberation studies followed by long-term post-liberation monitoring of both plant and control agent will provide a valid basis for the evaluation of an introduced organism. Wapshere (1970) was able to compare stands of *Chondrilla juncea* in Australia with stands in Europe on the basis of choosing eco-climatic homologous areas. From his ecological studies within the native range of the weed, he was able to predict the effectiveness of organisms prior to their introduction and have these estimates of effectiveness checked during post-liberation studies (Cullen *et al.*, 1973, Cullen 1974, Wapshere, 1973).

However, as with lantana, the ecology and biology of a plant in its native range cannot always be matched with that in the country it has invaded. Lantana is a far more aggressive weed in Australia than in its native range and it is extremely difficult to predict the effectiveness of an agent prior to introduction. It is clear that a complex of organisms will be required to control lantana throughout its wide geographic range and in its several taxa in Australia. In this situation post-liberation evaluation studies will be of particular value in selection of additonal control agents and it behooves the researcher to evaluate every organism which has established and has the capacity to attain damaging populations.

Evaluation of *Octotoma scabripennis* and *Uroplata girardi*

General considerations: Lantana, like most weed species, has a set of problems which dictate the best approach for evaluating established introduced organisms. In Australia, lantana is a serious pest of tropical and sub-tropical coastal regions and in areas most favourable for its growth, it exists as a pure stand. Branches from neighbouring plants

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intertwine and make it difficult to distinguish one plant from another. Movement through a stand without damage to the plants is impossible and observations must be confined to the undisturbed edge of a thicket. Studies have shown that this approach is valid, as there is no significant difference in hispine activity throughout the plant stand (Forno, unpublished data).

Lantana responds to favourable light intensity, temperature and soil type, and plant vigour can vary greatly between stands of lantana of the same taxa. Even within a single stand the variation is such that there is no easily identifiable pattern of growth.

These plant growth characters pose problems when attempting to correlate changes in plant growth with insect damage. Under such circumstances, critical examination of the distribution of insect activity over the plant and throughout the lantana thicket must be made prior to a decision on a suitable sampling unit.

Current programme: In 1974 a programme was commenced to study the field biology of two hispines and to evaluate their effects on lantana.

The two hispine beetles, *Uroplata girardi* Pic and *Octotoma scabripennis* Guérin, introduced into Australia in 1966, readily became established and bred to attain high populations in certain regions along the eastern Australia coast between lat. 16°S and lat. 28°S.

Both hispine species deposit their eggs on the young leaves near the branch tip and larval activity continues throughout the period of leaf maturity. The adults and larvae cause severe damage to the leaf tissue and greatly reduce the photosynthetic area of the leaf. It would seem reasonable to suggest that should this attack be prolonged and of sufficient intensity, these beetles could suppress the growth of lantana. However, qualitative description is not sufficient to conclude what effect they are having on the plant stand and the current programme is aimed at quantifying the impact of these species throughout the range of lantana in Australia.

Both direct and indirect evaluation studies of the two hispine species are in progress. For direct quantitative assessment, the five uppermost nodes of any branch have been chosen as the sampling unit. Within this unit hispine activity can be measured in terms of loss of photosynthetic tissue and their activity can be correlated with leaf size.

To establish that a control agent is causing a known degree of damage to a defined unit of a perennial plant means very little unless this direct effect can be evaluated in terms of changes to the whole plant stand. Hence, concurrently with the direct assessment of insect damage, measurements to detect changes in the plant stand should be made.

In the hispine-lantana relationship a number of changes may occur following prolonged damage to branch tips and loss of photosynthetic tissue: ground temperature may increase in favour seed germination of plant species other than lantana, light intensity beneath the lantana canopy may increase to favour seedling growth, the energy reserves of lantana may be wholly or partially depleted and any reduction in the competitive ability of lantana may lead to changes in the plant community in favour of other plant species.

One approach for the indirect evaluation of the effects of the two hispine species is to monitor light penetration through the lantana canopy, and to monitor the appearance and growth of other plant species. Variation in light penetration, other than that attributed to seasonal effects, must be correlated with changes in the plant community, and on a more precise scale, with changes in insect activity.

The current programme has achieved a direct evaluation of the two hispine species: hispine activity, be it adult or larval, can be expressed in terms of damage to the leaf tissue and hispine behaviour can be correlated with leaf area. Whilst monitoring of light penetration and documentation of changes in the plant community have commenced, it is too early to draw any conclusions on the overall effect of the hispines on the lantana stand. However, there is sufficient qualitative data to suggest that favourable plant competition can occur following hispine attack and indirect evaluation of the hispines is essential for the completeness of this programme.

A number of important points become evident from an evaluation study of this type. Firstly, direct evaluation of leaf feeders on a woody perennial is possible once populations have started to increase. Secondly, indirect evaluation may not reveal any visible change in the plant stand until some time after populations have attained high levels—this aspect of evaluation may need to be continued for a long period before a change in the plant community becomes evident. Thirdly, there is a need for an interdisciplinary team of researchers in any biological control programme, particularly where the target weed is one with as many 'unknowns' as lantana.

We are confident that our lantana program will give an improved knowledge of the biology and ecology of the plant and of the intimate relationships between insects and plant. It is hoped that this study will contribute towards the difficult task of evaluation of potential biological control agents. Feed-back of the results of evaluation studies can only improve the rationality whereby organisms are selected as good prospects for biological control.

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