

BIOLOGICAL CONTROL OF WEEDS: FROM ART TO SCIENCE¹

by

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Biological control is the use of an insect, pathogen or other living organism to control a pest. It is an old method of controlling weeds but its development has been slow because projects tend to have been done empirically with little attention given to putting the method on a scientific basis. Never-the-less, the method has evolved and six constraints to its use that have been overcome or face us today are discussed.

The first constraint was the failure to recognize the potential of biological control for solving weed problems. It took from 1795, when prickly pear was controlled biologically in India as the result of serendipity to its international use in Australia in the 1920's for the method to receive general recognition.

The immediate problem that arose following the conscious use of biological control was how to demonstrate that the insect to be introduced against the weed would not also damage desirable plants. The initial approach was to show that the insect starved when confined to various economic plants, or in other words to determine what it would not eat. The present approach is with a centrifugal-phylogenetic selection of test plants to determine the host range limits of the insect. Also, to an increasing extent the basis or reasons for host specificity are being investigated. These tests have meant that the hazards of biological control are largely eliminated but they have added a cost restraint as testing represents about 2 scientist years for each insect.

The Australians introduced 51 insects against prickly pear of which 5 were effective. Today, because of the host-testing procedures this project would be prohibitively expensive. The obvious solution is to eliminate the ineffective species before starting the host-plant tests. One method is to create infestations of the weed in its country of

origin and observe which agents contribute most to its decline. Problems with this approach are that parasites and competitors often obscure the result and it is not always possible to work in the climatic analogue of the release site with the consequence that the result may not be pertinent. An alternative method is to score fecundity, length of season over which an agent or a combination of agents will attack the host, and other characteristics, so that the one with the highest score can be selected. The problem is that many of the criteria and scores employed are still subjective. Thus, preferably both approaches are used together.

Initially biological control of weeds was regarded as only appropriate for use against introduced weeds that had become monopolistic over large areas of range or other relatively undisturbed areas. These are still prime targets but the method will also work against native weeds and against weeds of arable crops. Biological control is directed against individual weed species and is appropriate when there is some benefit from the control of a single species in a plant community. In contrast, the object with either chemical or mechanical weed control is normally to control all plants except for the crop species. Both effects have their place depending on the situation but traditionally biological control has only been resorted to for economically serious weeds that are difficult to control by other means. However, rationally the weed control method selected should be the one with the most favourable cost-benefit ratio that minimizes undesirable side effects. Prospective cost-benefit ratios are unfortunately not calculated before starting a biological control project and until they are, the method will not take its proper place beside chemical and mechanical control.

A fifth constraint to the scientific advancement of biological control is the lack of detailed assessment of the effect of the agent. Without proper assessment there can be no feed-back for the improvement of future attempts. Normally failures are more instructive than successes but unfortunately almost all the attention is given to successes.

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Biological control will not have made the transition all the way to a science until it is possible to accurately predict the impact of agents or combination of agents on the weed. This will probably involve computer simulations to reveal the vulnerable points in the life cycle of the weed. Indeed, the lack of attention given to the ecology and population dynamics of the weed before selecting an agent is the major deficiency in the present application of biological control. The technology is available although its application will require a team

rather than the traditional individual approach. With accurate biological control could be safely used against weeds such as big sage and mesquite for which a certain minimum threshold population is desirable.

The present status of biological control is that it is a safe and useful method of controlling individual species of noxious weeds but it is slower and more expensive than necessary because of the empirical element still involved.