UTILIZATION OF ENDEMIC PLANT PATHOGENS FOR WEED CONTROL IN RANGELANDS

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Summary. Plant pathogens can be used to control weeds. There are two lines of approach; importation and release of exotic organisms, or the selection and distribution of endemic species. This latter bioherbicide approach is being applied successfully, mainly to weeds in crops in the U.S.A. Environmental parameters are more easily controlled in crops than in rangelands where the release of organisms needs to be timed to take advantage of naturally occurring conditions. In Australia, this concept which has received little attention to date, can no longer be ignored.

INTRODUCTION

Biological control of weeds with insects is now a well accepted technique of long standing (Haseler , 1981). The use of plant pathogens on the other hand is still viewed with concern by many (Freeman et. al., 1976). During the 1970's, there has been a dramatic increase in interest in this facet of plant pathology (Freeman and Charudattan, 1980).

Two approaches are available. The classical in which exotic organisms are introduced, e.g. control of skeleton weed (*Chondrilla juncea*) with the rust fungus (*Puccinia chondrillina*) (Cullen, 1978) or the use of endemic pathogens as bioherbicides (Freeman and Charudattan, 1980). The latter approach is discussed in the light of overseas experience, and in relation to environmental constraints which might be encountered in rangeland situations in Queensland. The use of bioherbicides might be indicated where:

a) suitable chemoherbicides are unavailable
b) the use of chemoherbicides is undesirable
c) the general public requires a choice of control methods
d) the use of the bioherbicide is the most economic technique available

CURRENT OVERSEAS WORK

The use of bioherbicides is now the subject of intensive study in U.S.A. with several major projects in progress (Charudattan and Walker, 1982). Apart from work on water hyacinth (*Eichhornia crassipes*), the other

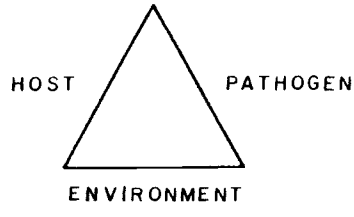
projects are aimed at weeds of crops. Weed control by specific bioherbicides would seem to offer obvious advantages over chemical herbicides. Templeton et. al. (1979) listed constraints to the use of bioherbicides such as host resistance, environment, spatial isolation of the host, narrow environmental requirements for infection, spore dormancy, and incubation period length. These were said to be especially important when using bioherbicides to control weeds in annual crops, and might be of less concern in a rangeland or aquatic situation where more time was available.

However the use of bioherbicides in crops would be enhanced by ones ability to control some environmental factors such as precipitation by irrigation, humidity as modified by crop density and conformity affecting microclimate & soil PH by fertilizers and so on.

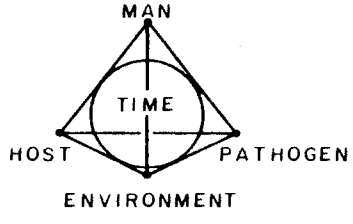
In a rangeland situation, apart from regulation of pasture height and density by grazing management, other environmental factors cannot be controlled.

FACTORS AFFECTING THE USE OF BIOHERBICIDES ON RANGELANDS

Three main factors are recognised as essential for disease outbreak to occur and are represented in a simple model.



Holcomb (1982) added 2 more dimensions, man and time.



These basic factors are listed thus:

Man - Our activity in the rangeland situation will be limited to selection and reproduction of inoculum, the timing and method by which it is dispersed , pasture management, and whether or not it is used along with another biocontrol agent such as insects.

Time - Timing of manipulative activities and natural phenomena, precipitation, winds etc. will all have an effect on the eventual outcome.

Host - Spatial distribution and geographic range will affect both the logistics and applicability of bioherbicide use. Host resistance as it affects pathogenicity of selected organisms and any ability to increase resistance genetically in the long term, may need to be considered.

Pathogen - Pathogens might be found on weeds where they are at noxious levels both within and outside the plant's original region of distribution. In these situations, the phytopathogens are usually ineffective, and the weeds remain at undesirable population levels (Hasan 1981). Selection processes should consider virulence, biology, genetic variability (existance of strains), whether it can be cultured stored and prepared for easy dispersal. Some organisms might require saturation release, while others might only require inoculative releases.

Environment - In rangelands, environment would seem the primary key to success or failure. As it cannot be controlled, organisms will need to be carefully matched to available environments, and dispersal of inoculum timed to take advantage of optimum environmental conditions.

Bioherbicides might operate in two separate sets of environmental conditions:

a) Induced

The most notable example is that of the secondary rots which accompany the feeding of *Cactoblastis cactorum* larvae in prickly pear (*Opuntia* sp.). Several fungi and bacteria were recognised as significantly aiding damage to prickly pear (Mann 1970). Such activity was induced by the caterpillars feeding internally.

More recently, an attempt has been made to enhance the damage caused to water hyacinth (*Eichhornia crassipes*) by the introduced weevil *Neochetina eichorniae* and caterpillar *Sameodes albiguttalis* by applying suspensions of various fungal spores, the feeding sites acting as infection courts. Laboratory trials so far, have produced encouraging results (G. Gailbraith personal communication 1984). The role of soil borne pathogens which attack the roots and base plants treated with herbicides is not understood and probably underestimated (Diatloff personal communication 1984).

b) Natural environment

Holcomb (1982) lists 6 factors - temperature and wind, moisture (precipitation and humidity), form and availability of nutrients, radiation, and the O_2, CO_2, and PH levels in the soil. These factors will directly affect interactions between the host and pathogen by their presence, absence, amount and duration.

Activity in much of northern Australia might be controlled by seasonal influences, e.g. wet season/dry season. Extremes between upper and lower limits of temperature, radiation and moisture will often be extreme, and could limit control by bioherbicides to specific niches,

such as shaded creek banks, seasonally inundated areas or water plants, where these extremes are tempered. The noogoora burr rust disease caused by *Puccinia xanthii* is now widespread within the regions of its principal host. When suitable temperatures and moisture levels persist, the organism exerts a controlling effect. In dry summers, useful damage is confined to smaller local areas where moisture levels are maintained by moist microclimates or scattered rainfall.

SOME PHYTOPATHOGENS FOR QUEENSLAND WEEDS

Perusal of the Host Index of Plant Diseases in Queensland reveals some 20 weeds of importance along with nearly twice that number of recorded phytopathogens. As well as host records, Hanlin, 1982, advocates the searching of abstracting journals, computerised records and herbarium records.

Of the phytopathogens and hosts listed in the index, initial consideration might be given to those which would give control when inoculative releases were made, e.g. *Sclerotium rolfsii* Sacc. on noogoora burr (*X. pungens*), and *Colletotrichium* species on bathurst burr (*X. spinosum*) applied during the wet season.

The recent appearance of dieback disease type symptoms in prickly acacia (*Acacia nilotica*) populations in northern Queensland, thought to be caused by a fungal root parasite as yet unidentified, has led to speculation about the use of such an organism as a control agent (Tomley, A.J. 1983 unpublished report).

CONCLUSION

Consideration should first be given to situations where bioherbicides might compete economically with present control methods, or where public opinion opposes the use of current weed control measures. Compilation of lists of weeds with endemic pathogens which could be useful is advocated.

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