NON-CHEMICAL WEED CONTROL IN VICTORIAN DRYLAND CROPS - THE DREAM AND THE REALITY

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Summary. Many people appear to believe that herbicides should not be used and that, in the future, biological control will be able to solve most weed problems. The following aspects of weed control are discussed: prevention, use of rotations, crop competition, changing the soil environment, biological control, cultivation, mowing and cutting pastures for hay, stubble burning and use of "natural" herbicides. It is concluded that integrated control using as many of these practices as possible and the responsible use of herbicides will be necessary for many years to come.

INTRODUCTION

There was a five fold increase in the quantity of herbicide used in Victoria between 1975 and 1985. This reflects the general acceptance that herbicides are an essential component of dryland farming, particularly in the development of cropping systems involving reduced tillage, stubble retention and new crops. However, there appears to be an increasing belief amongst conservationists and others in the community that herbicides are harmful and should not be used, and that biological control will solve all weed problems. Some farmers are asking whether it is possible to eliminate the need for herbicides or, at least, reduce the reliance on them. This paper discusses some of the options available.

METHODS OF WEED CONTROL

1. Prevention

Ideally, the best approach to weed control is to prevent the occurrence of a specific weed problem. This can be achieved by:

(a) Use of clean seed.

(b) Use of clean vehicles and equipment, cf. silverleaf nightshade, *Solanum elaeagnifolium*, berries on vehicles, caltrop, *Tribulus terrestris*, burrs on tyres, great brome, *Bromus diandrus*, seeds in harvesters.

(c) Prevent or reduce the formation of weed seeds and vegetative propagules.

(d) Eradicate small infestations before they spread.

(e) Encourage growth of dense, well managed crops on soils maintained at a high level of soil fertility (however, some weeds such as great brome and wild oats, *Avena fatua*, are also competitive when the soil fertility is high).

2. Rotations

The main advantages of crop rotations are that they can provide a disease break for subsequent crops and they enable soil nitrogen levels to be managed.

By rotating crops and using selective herbicides it is possible to reduce the population of, say grass weeds in broadleaf crops or broadleaf weeds in cereal crops. Some crops also compete better with weeds than others, e.g. rapeseed is more competitive that chickpeas. Inclusion of lucerne in a rotation is useful in the suppression of a perennial weed such as skeleton weed, *Chondrilla juncea*. However, as a general rule, rotation of crops without the use of herbicides will do little to assist in the control of perennial weeds.

3. Crop competition

Experience suggests that well managed crops with a high leaf index are more competitive that poorly managed crops with a low leaf area index. Some crops such as chickpeas are more open and hence, generally more predisposed to weed competition that others. However, if we were to rely solely on plant competition to suppress weeds there is a problem because plant breeders evaluate and select breeding material grown in trials where a high level of weed control is achieved by the use of herbicides. New varieties are usually shorter, less leafy and consequently less competitive with weeds than the older varieties. For example, the semi-dwarf wheats are markedly different to the tall leafy types originally introduces from Europe. One approach could be to increase the seeding rate of the crop although this results in a far lower level of weed control than the use of herbicides.

4. Changing the soil environment

Some weeds such as toad rush, *Juncus bufonius*, are common only under waterlogged conditions. Consequently, if the land is drained then toad rush should no longer present a problem. This is an example of changing the soil environment to favour the crop instead of the weeds. Another example would be to increase the soil pH to favour the growth of a crop and suppress a weed such as sorrel, *Rumex acetosella*, which grows best on acidic soils.

5. Biological control

The most publicised forms of biological control are those which aim to control weeds by the use of specific insects, fungi, nematodes or bacteria. Publicity surrounding this activity has resulted in high expectations of success within the general community. There are three main types of biological control relevant to dryland cropping areas:

(a) Grazing by sheep is the main method of biological control on dryland farms in Victoria. Sheep are used extensively to suppress weeds occurring on fallows and, to some extent, to reduce the seed production of weeds in pastures prior to cropping.

(b) In the case of classical biological control (introduced agents allowed to spread by natural means) and the use of inundative releases of insects, the main advantage is that the cost is normally not borne by the farmer. I suggest that the disadvantages include:

(i) The unrealistic expectations of the public

(ii) The limitation that the approach is usually feasible only where there is one major weed, and particularly on pasture, rangeland, or non-agricultural land

(iii) The difficulty in obtaining adequate specificity and level of control

(iv) The large costs involved in biological control programmes which have to be borne largely by the Government

(v) The long-term nature of the programmes

(vi) The variation from year to year in the level of control achieved, in contrast to the consistently high level of control required for economic crop production.

The few biological control programmes relevant to dryland cropping in Victoria are for the control of skeleton weed, Paterson's curse, *Echium plantagineum*, spiny emex, Emex spp., common heliotrope, *Heliotropium europaeum*, and *Rumex* spp. It should be borne in mind that there are over 90 weed species in the Victorian wheatbelt and, in the Wimmera region, an average of six weeds per field.

(c) The term mycoherbicide is used to describe the practice of spraying of fungi, usually endemic to the country, to selectively control weeds instead of spraying with a herbicide. The spray is usually applied early in the season to enable the development of a fungal epizootic which is earlier than normal. At least one application each year is required.

This technique is used successfully for the control of northern joint-vetch, *Aeschynomene virginica*, in rice and soybean crops in the U.S.A. In N.S.W. mycoherbicides are being investigated for the control of *Xanthium* spp. in rangeland and in irrigated crops. Another example is where crops are sprayed in the spring with fungal suspensions to reduce the viability of newly formed, immature grass seeds. At a recent workshop on mycoherbicides, Burdon and Groves (1) concluded that "the future use of mycoherbicides for weed control in Australia will be limited for economic reasons, to intensively farmed areas with high unit value crops such as cotton in the Namoi Valley, vegetables near Sydney, opium poppies in north-west Tasmania or for weed control in the home garden. The potential for use of mycoherbicides on extensively cropped cereal regions of Australia would appear to be minimal".

6. Cultivation

In Victoria, fallowing is commonly used to control weeds, store soil water and nutrients, and reduce the incidence of some diseases. Fallowing successfully controls barley grass, *Hordeum leporinum*, and any reduction in fallowing is followed by an increase in this weed.

Delaying the time of sowing to enable more cultivations prior to sowing is usually an effective method of controlling weeds such as barley grass which germinate mainly in early autumn. However, there is a yield penalty when sowing is delayed and the method is of little value on weeds such as great brome which germinate over a period of several months. In some circumstances weeds can be controlled by a shallow cultivation after sowing and before the crop has emerged. This time-critical operation has been used successfully to control weeds in chickpeas when no suitable herbicide was available.

Deep ploughing is effective in suppressing some weeds but in others such as wild radish, *Raphanus raphanistrum*, seed dormancy is induced and a long-term problem is created.

7. Mowing and cutting pastures for hay

The timely mowing of pastures or haymaking in spring reduces, to some extent, the formation of weed seeds before a crop is sown in the following year. Unfortunately, a significant reduction is rarely achieved because of the ability, particularly in wet years, of the mown plants to recover and produce seeds.

8. Stubble burning

Burning of stubbles kills some weed seeds and is a common practice to reduce sterile brome, *Bromus sterilis*, in England. In contrast, the trend towards retention of stubbles for soil and water conservation is likely to increase problems with some weeds, insects and diseases.

9. "Natural" herbicides

Whilst some people do not wish to use artificially synthesised herbicides it is possible that "natural" herbicides might be more acceptable in the same way as garlic is used supposedly as an insect deterrent by "organic' home gardeners. The recent report of the herbicide properties of an isolate from English couch, *Agropyron repens* could be an indication of future trends. At present, use of such compounds to control weeds is not a reality, nor are those elusive compounds which could be used to stimulate the germination of weed seeds or vegetative propagules so that they could be subsequently killed.

CONCLUSION

This paper has summarised some methods for controlling weeds without the use of herbicides. In some situations they may give adequate and economic control of weeds. However, with our present state of knowledge and the increasing cost/price pressures which generally necessitate a consistently high level of weed control, I conclude that integrated control using as many as these practices as possible and the responsible use of herbicides will be necessary for many years to come. The problem is the age old one of how to manage weed populations and not rely on magic wands, whatever form they may take.

REFERENCES

1. Burdon, C.K. and Groves, R.H. 1986. Proc. Workshop on Potential for Mycoherbicides in Australia, pp. 37-40.