Weed control in cereals: aerial spraying trials

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Recent trials have shown that aerial application of "extra low" volumes of hormone-like herbicides, with oil or water solvents, does not damage cereals if spraying is done at the right stage of growth.

by


SPRAYING cereal crops for weed control is now standard farming practice in Western Australia. Almost 500,000 acres of cereal crops, mainly wheat, are sprayed each year, and approximately three-quarters of this area is treated by aircraft.

The two main weeds concerned are wild radish (Raphanus raphanistrum) and wild turnip (Brassica tournefortii), with mustards (Sisymbrium spp.) and saffron thistle (Carthamus lanatus) involved to a lesser extent.

Although the 2,4-D (or hormone-like) herbicides used for spraying these weeds are probably the most selective that have been developed, crop plants are by no means immune to them. Species such as lupins, tomatoes and vines are highly susceptible and extreme care must be taken when using 2,4-D, even some distance away. Grasses, including the cereals, are relatively resistant but can be damaged if reasonable care is not exercised.

World-wide research has been undertaken to assess the tolerance of cereals to various formulations of 2,4-D, and in view of the importance of these chemicals to West Australian agriculture, a series of experiments has also been carried out in this State. The investigations have incorporated a number of variables including the type of cereal (wheat, oats or barley), variety, growth stage, type and rate of herbicide and volume of application.

Stage of Growth:

As a result of this work it has been known for some time that the effect of 2,4-D on cereals depends largely on the growth stage at which the chemical is applied. There is also some variation according to the type of cereal and the formulation used.

There are two periods of greater risk. The first is at the seedling stage and continues until the plants are stooling freely, while the second is at the "boot" stage when the head becomes apparent as a swelling in the leaf sheath.

The hazard remains during the flowering period but again decreases when the grain has reached the milk or soft dough stage.

This means that spraying should be carried out after the cereal is stooling freely but before the head has obviously commenced to form.

Toxicity on Cereals:

The nature of the effects on cereals usually varies according to the time they are caused.

Treatment during the early danger period can result in a number of malformations and growth disturbances. Wheat may produce club shaped ears with an irregular arrangement of spikelets. The glumes may become fused and the number of spikelets reduced, producing interrupted heads. Both leaves and heads often become twisted in a grotesque manner.

Late spraying is more inclined to reduce grain setting than cause conspicuous abnormalities. Oats is more likely to be
affected than wheat, with barley intermediate.

The grading of the most frequently used chemicals in decreasing order of risk is:—2,4-D ester, 2,4-D amine, M.C.P.A. But this grading must be interpreted in terms of toxicity to weeds, which follows roughly the same pattern at comparable rate levels, 2,4-D ester being the most effective.

AERIAL APPLICATION

Aerial application of herbicides has been developed to a greater extent in Western Australia than in any other state. About 350,000 acres are sprayed by aircraft each year.

Low Volume Technique:

When the method was first used the accepted volume of application was $1\frac{1}{2}$ to two gallons an acre. Tiger Moths, with a payload of about 300 lb., could spray a maximum of 20 acres with each fill.

Experimental work carried out by the aerial operators in co-operation with the Department of Agriculture has since resulted in good control of wild radish and wild turnip with half gallon of solution an acre, and some commercial spraying is being done with one quart an acre. With the one quart rate, oil, rather than water, has been used as the carrier.

This “extra-low” volume technique means that, at the half gallon rate, 60 acres can be sprayed with each fill of the tank, and there is a substantial saving in time and cost.

It has been claimed that the half gallon rate and, in particular, the quart of oil an acre, have produced more abnormal heads and a lower yield than conventional rates.

However, several years’ field observations have shown that, providing the equipment is well designed and the spraying operations are thorough, weed control with the lower volumes is equal to that obtained with $1\frac{1}{2}$ gallons of spray an acre. There has been no evidence of a greater proportion of abnormalities in the crops due to low volume spraying.

Aerial Spraying Trials:

To avoid the difficulties involved in making experimental spray applications with aircraft a special boom was constructed and fitted to a four-wheel drive vehicle, to simulate aerial spraying.
Malformed heads of wheat, resulting from spraying too early with 2,4-D. The safest stage for spraying cereals is after the plants are stooling freely, but before the “boot” stage.

Using this equipment a trial was carried out in 1959 at Wongan Hills Research Station. The following treatments were applied to Gabo, Bencubbin and Insignia Wheat:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Acid equivalent (ounces per acre)</th>
<th>Solvent</th>
<th>Volume (pints per acre)</th>
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<tbody>
<tr>
<td>2,4-D ester</td>
<td>6</td>
<td>Distillate</td>
<td>2</td>
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<tr>
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<td>12</td>
<td>Distillate</td>
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Some malformed heads developed, particularly in the higher rates of ester plots, but there was no obvious relationship to the volume of either water or distillate, and no significant difference in yields between the various treatments.

For more conclusive results, further trials were carried out at the Wongan Hills Research Station in 1960, in which the spray applications were actually made by aircraft. This was made possible by the ready co-operation of the Aerial Operators Association of Western Australia.

The treatments were:

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Plots 10 chains long by two chains wide were randomised in four blocks, and half
of each plot received a double treatment in an attempt to assess any effect of overlapping which might occur under normal aircraft operating conditions. When the spraying was carried out on August 11, the Gabo wheat was at the growth stage regarded as being most tolerant to 2,4-D, being from six to eight inches high and stooling freely. Very few weeds were present.

Conditions were favourable for aerial application, the day being fine with only a slight breeze. The extent of spray drift was constantly checked and the plot markers placed accordingly.

Experimental work with aircraft is far from simple, particularly in relation to spray drift and maintaining direction, as well as a uniform height of spraying. The applications were made by two Tiger Moth aircraft operated by very efficient pilots and careful observations were made to check on the accuracy of the spray applications.

The plots were examined several times during the season and at no stage were abnormalities detected, even on the sections receiving double rates.

Seed heads were well formed and there was no evidence of the discoloration which has occurred with some crops and has been attributed, at times, to "extra low" volume application, particularly with oil solvents.

Yields were estimated by harvesting a strip down the centre of each treatment. These confirmed the visual observations, the average yield being 39 bushels an acre, with no significant differences between treatments.

As the control plots were free of weeds these did not present a complicating factor in assessing the effects of the chemicals on the wheat.

Repeatability under different seasonal conditions is always important with this type of investigation. The results of the 1960 trials, with those of simulated aerial treatment experiment of 1959, indicate that the application of herbicides at "extra low" volumes by means of aircraft is a sound practical method, providing the known necessary precautions are taken.

These same precautions are also essential when using ground equipment, the main consideration being not to spray too early.

ACKNOWLEDGMENTS

These investigations were made possible by the co-operation of the Aerial Operators Association of Western Australia. Thanks are due to that Association, and the pilots who undertook the precision flying required by the experiment.
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