SESSION 8a.

THE SELECTIVE CONTROL OF ANNUAL WEEDS IN CEREAL CROPS

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It is now more than 50 years ago that, following the treatment of fruit trees with copper sulphate, weeds growing under the trees were found to be killed. Bonnet and other workers soon discovered that by spraying a cereal crop with dilute solutions of copper sulphate and other chemicals it was possible to kill many annual weeds without causing permanent injury to the crop. The principle of selective herbicides was born.

In subsequent years other substances used included iron sulphate, kainite, calcium cyanamide and sulphuric acid. Of these sulphuric acid was probably the most effective but had the disadvantages of being corrosive and also dangerous to handle. The next major advance was made in 1932 when a patent was filed in France for the use as a selective herbicide of D.N.O.C. - sodium dinitro-orthocresylate. Although still used quite extensively in Europe for the control of certain broad leaved weeds in cereals, it has not found favour in Australia mainly because of the cost and the volume of application.

The advent of growth regulating herbicides is fresh in our memories, their development having taken place since World War II. Their significance to agriculture is indicated by a statement of Professor Crofts, University of California, that they offer more aid to the farmer than any material introduced since artificial fertilizers.

In Australia large scale chemical weed control in crops has been influenced mainly by three considerations, a suitable selective herbicide, the cost of the chemical and the practicability of application. It was soon found that the growth regulating herbicides met the first need in the case of a number of annual weeds and that the cost of the chemical required was within practical limits. Initially the volume of solution presented a problem in the case of large scale farming but this was overcome by the construction of efficient low volume equivalent for use with orthodox boom units and also with aircraft.

During recent years development in this field have been so rapid that workers have had difficulty in keeping published material up to date. It is not intended, therefore, to review information available from Australian literature but

to present the position as it applies at present in Western Australia. Since the initial trials in 1950 some detailed investigations with the growth regulating herbicides have been undertaken. It is estimated that approximately 400,000 acres of cereal crop is sprayed for weed control each year, and besides the experiments, observations have been made on the results of this work. About one fifth of the spraying is carried out with aircraft. The main crop weeds with which we are concerned are wild turnip (Brassica tournefortii) wild radish (Raphanus raphanistrum) double gee or spiny emex (Emex australis) and Cape weed (Cryptostemma calendulaceum). It is proposed to consider each of these.

WILD TURNIP (Brassica tournefortii) - This is the most widespread weed of cereal crops and fortunately is one of the most susceptible. With our original trials satisfactory control was obtained with four ounces acid equivalent per acre of the sodium salt of both M.C.P.A. and 2,4-D, in fact under favourable conditions two ounces was sufficient. As was to be expected, the amine and ester of 2k4-D have proved equally effective. In order to provide a margin of safety for adverse conditions the recommendation is four ounces of acid equivalent per acre of any formulation. With undersown clovers M.C.P.A. is favoured. Aircraft application of amine and ester at that rate in 1-2 gallons of water per acre has given consistently good results.

WILD RADISH (Raphanus raphanistrum) Conclusions from the early investigations were that under favourable conditions four ounces of acid equivalent per acre of the sodium salt of 2,4-D or M.C.P.A. would give a degree of control sufficient to prevent the weed from interfering unduly with the crop, but eight ounces was required to give virtually complete control, even when the various factors influencing the treatment were regarded as being satisfactory. Recommendations were made accordingly but farmers tended to use the lower rate generally. During the past two seasons the amine of 2,4-D has been used for a large proportion of wild radish spraying including most of the aerial treatment.

In a number of cases, particularly with aircraft application the control has not been satisfactory, in fact at times has been very disappointing. On occasions even though the wild radish plants showed the typical effects shortly after spraying, varying proportions survived the treatment and reached maturity. With a view to clarifying the position an experiment was undertaken in 1953 to compare the sodium salt of M.C.P.A. and the amine, ethyl ester and butoxyethanol ester of 2,4-D applied at the rates of four and six ounces of acid equivalent in five gallons of water per acre. At the time of

spraying (7 August) the growth of the crop was even, the wheat being about eight inches high and stooling. There was a moderate to fairly heavy infestation of wild radish at the rosette stage with foliage 6-8 inches in length. The soil was of a sandy nature and the weather was fine.

The four ounces of acid equivalent per acre of M.C.P.A. and 2,4-D amine affected a proportion of the wild radish plants but did not give a satisfactory degree of control. The six ounce rate of both gave practical control although some plants recovered and set seed. There was no visual difference between the two types of ester but the results with four ounces of acid equivalent per acre were better than with six ounces of amine and M.C.P.A. The six ounce rate of the esters gave complete control of the radish.

As a result of the trials described along with field observations it is possible to make some recommendations which should give better and more consistent results.

1. Time of spraying - This is best correlated with the growth stage of both the crop and the weeds. Wheat is least likely to be affected when stooling and 6-8 inches in height. At this growth stage little further emergence of wild radish is likely and the plants, while small, are more susceptible to 2,4-D. Undoubtedly much spraying of wild radish is carried out too late to be most effective.

2. Conditions - Fine, warm, weather without a strong wind is desirable. Strong winds and low relative humidity are especially unsuitable with aircraft application. Rain a few hours after treatment, particularly when using the ester, is unlikely to be detrimental but spraying should not be carried out when rain is imminent. Annual weeds are most vulnerable when making active growth and some poor results have followed spraying when wild radish has been checked by a dry period, especially when associated with low temperatures. In such cases although the plants show formative effects many of them subsequently recover.

3. Type and amount of chemical - The ester of 2,4-D is favoured for the treatment of wild radish in wheat. For general purposes, providing conditions are favourable, four ounces of acid equivalent per acre is recommended.

When complete control is desired or application is being made by aircraft, six ounces should be applied. If M.C.P.A. or the amine or sodium salt of 2,4-D is used a minimum of six ounces of acid equivalent per acre is recommended.

4. Accuracy of treatment - It should not be necessary to mention this aspect but a number of poor results have been traced to incorrectly calebrated spraying units, poorly controlled speeds of traction and carelessness in preparing the solution.

DOUBLE GEE (Emex australis) - The habit of the plant and the fact that it is an annual gave reason to believe that it would be susceptible to moderate rates of application of the growth regulating herbicides. Unfortunately the double gee belied its appearance and results have not been encouraging.

Farmers have claimed varying degrees of success with different formulations and some of our trials have caused a marked suppression of growth and given partial control. After many detailed investigations extending over several years, however, we are unable to recommend a treatment that is likely to give consistent results and destroy a high proportion of the plants. Even with the most effective treatments many seeds mature to supplement the reserve remaining in the soil.

As with a number of other weeds, somewhat better results have been obtained under crop than under pasture conditions. The spraying of double gees in a crop, particularly when other susceptible weeds are present, could be an economical undertaking in areas where this weed is vigorous and strongly competitive. Although a high proportion of kill cannot be expected, six ounces of acid equivalent per acre of ester has caused suppression of growth for a period and could result in considerable advantage to the crop if applied when the weeds are small. Double gees have been affected to a greater extent by the ester than by similar quantities of the amine or sodium salt.

The volume of solution applied does not appear to be an important factor as was suggested at one stage. Reducing the volume from eight gallons to four gallons applied with a low-volume boom caused no improvement and similar results followed the application of the same quantity of active chemical in two gallons per acre by means of an aircraft. Treatments appear to be more effective in the northern portions of the wheat belt, possibly associated with more rapid growth in the early part of the season. This apparent advantage is offset by the fact that, in those districts double gee tends to germinate over a longer period.

CAPEWEED (Cryptostemma calendulaceum) - Trials and field observations have shown that capeweed is relatively difficult to control with growth regulating herbicides. Young seedlings are killed by eight ounces of acid equivalent of 2,4-D amine

per acre but soon become more resistant. When the crop is 6-8 inches in height and stooling, that is at the "safe stage" for spraying, the capeweed plants which have emerged since the sowing are usually severely checked by 10-12 ounces acid equivalent of the amine per acre. The smaller plants succumb but the larger ones tend to recover, subsequently flowering and seeding. This rate of application at the critical time, however, has helped considerably in the case of heavily infested crops. Some farmers prefer to check rather than destroy the plants in order to prevent undue competition with the crop but, at the same time, allow the capeweed to recover and provide dry feed in the summer.

Trials were undertaken to assess the value of pre-emergence spraying of cereals with a view to controlling capeweed surviving cultivation at the time of sowing. Low volume application was made at rates of 4, 8 and 16 ounces acid equivalent of amine per acre immediately after the sowing of the crop. Large plants, although showing marked 2,4-D reaction continued to grow quite strongly, even with the highest rate of application. At the same time there was an effect on the emergence of both wheat and oats. This was quite apparent at the 8 ounce level and severe at 16 ounces.

We must conclude that pre-emergence treatment for capeweed in cereal crops is not practicable. Post emergence spraying is only likely to give a high degree of control when the capeweed plants are still small and when rates of ten ounces of acid equivalent or more are used per acre.