# No.42. STUDIES ON SKELETON WEED (CHONDRILLA JUNCEA L.) IN THE NEW SOUTH WALES WHEATBELT

by

R.M. Moore * & J.A. Robertson *

## 1. INTRODUCTION

The importance of skeleton weed (Chondrilla juncea L.) as a weed in cereal crops has gained renewed publicity since its spread into the mallee wheatlands of Victoria and South Australia. It would seem desirable, therefore, that results of investigations on this weed on the red brown earths of New South Wales should be summarized and made available to those concerned with its control in other States.

Early work by A.B. Cashmore of the Division of Plant Industry, C.S.I.R.O., showed that skeleton weed could regenerate from roots severed more than three feet below the soil surface. Under such circumstances even the most powerful soil sterilant needed to be applied at an extremely high rate to achieve any degree of control.

Because the then newly discovered herbicides 2,4-D and M.C.P.A. seemed systematic in their effects, a research programme based on these compounds was begun by the Division of Plant Industry, C.S.I.R.O., at Camberra and Cowra soon after the conclusion of World War II.

The initial results with these compounds were promising enough to encourage a belief that sufficient downward movement of compounds of the growth-regulator type might be obtained if they were applied at the right physiological growth stage and at the right concentration. Subsequently more than one thousand plots were established involving a large range of compounds, concentrations, carriers, surface active agents, and times of application.

In addition to experiments with herbicides on uncropped land, other experiments were conducted in growing cereal crops. Finally, field studies were made of the competition between pasture species and skeleton weed.

* C.S.I.R.O. Division of Plant Industry.

## 2. EXPERIMENTAL METHODS AND RESULTS

### (a) Chemical control on uncropped land

A range of concentrations of salts and esters of 2,4-D, M.C.P.A., and 2,4,5-T was applied to skeleton weed in a number of growth stages and at different seasons of the year. None of the treatments which included rates of application from $\frac{3}{4}$ to 24 lb. per acre of active ingredient effectively reduced the population of skeleton weed rosettes twelve months after application. 2,4-D was generally slightly superior to M.C.P.A. and both of these were more effective than 2,4,5-T or 4 C.P.A. There was little difference among the 2,4-D formulations; esters however tended to be better then salts when weather conditions were very hot, very cold, very wet, or very dry.

Reference to Figure 1 shows that the best results were obtained from applications in the spring rosette stage of growth. Treatments were least effective at flowering. The same figure shows that there is a seasonal fluctuation in skeleton weed density and that sprayed populations vary in a similar manner to untreated ones, but generally at a lower density level.

Figure 2 shows the effects of different concentrations of sodium 2,4-D; the higher the concentration the greater the reduction in weed density. The amine salts gave similar results.

Attempts to raise the level of control by increasing the rates of application failed; esters applied at rates above 3 lb. per acre acid equivalent generally killed the leaves rapidly, and this was followed by an equally rapid regeneration. Salts above 6 lb. per acre acid equivalent similarly killed leaves rapidly, but delayed regeneration until broken down in the soil.

The results of the long series of experiments indicated that phenoxyacetic acid compounds by themselves offered little prospect for other than a relatively minor degree of skeleton weed control.

### (b) Control of skeleton weed in wheat

A field of wheat at Walla Walla, New South Wales, heavily infested with skeleton weed was sprayed in the spring of 1951 (18.ix.51) with a range of concentrations of sodium 2,4-D. The wheat was 7-15 inches tall and the skeleton weed was in the rosette stage. The treatments applied were as follows:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Control | Water 100 gals/acre. | | | | | | | | |
| 2. | Sodium, 2,4-D | 2 | oz/acre | acid | equivalent | in | 50 | gals. | water | |
| 3. | do. | 4 | " | " | " | " | " | " | " | |
| 4. | " | 8 | " | " | " | " | " | " | " | |
| 5. | " | 12 | " | " | " | " | " | " | " | |
| 6. | " | 16 | " | " | " | " | " | " | " | |
| 7. | " | 24 | " | " | " | " | " | " | " | |
| 8. | " | 32 | " | " | " | " | " | " | " | |

The wheat was harvested in January, 1952 and the results are shown in Table 1. (See following page).

The results show that spraying with 2,4-D increased wheat yields by $2\frac{1}{4}$ to $4\frac{3}{4}$ bushels/acre. On the untreated plots harvesting was difficult because of fouling of the header by skeleton weed stems. Spraying with even 2 oz. of 2,4-D/acre reduced the height of skeleton weed sufficiently to prevent interference during harvesting. The apparently anomalous effect of the 4 oz/acre treatment on the height and yield of wheat is either due to chance or is a direct stimulation. A similar effect was obtained in an experiment on hoary cress (Cardaria draba) control but a subsequent attempt to reproduce the result in weed-free wheat failed.

Subsequent counts of skeleton weed showed that none of the treatments had permanent effects on rosette density. The low wheat yields even with 2,4-D treatment can be explained by the results obtained subsequently by Myers and Lipsett (1958). These investigators found that competition between skeleton weed and wheat was largely for nitrogen. This competition could be alleviated by supplying nitrogen directly as a fertilizer or by fallow spraying the weed prior to sowing the wheat. Since nitrogen appeared to be a principal factor in competition between the weed and cereals, and since effective control on a monocultural system appeared impracticable, experiments were initiated to investigate possible control by other systems involving competition at higher fertility levels.

(c) Competition between skeleton weed and pasture species

The following treatments were applied at Cowra, New South Wales, in April 1952 to an old wheat field heavily infested with skeleton weed:

1. Control
2. Wimmera ryegrass - 12 lb/acre
3. Subterranean clover - Clare variety - 6 lb/acre
4. Wimmera ryegrass 6 lb/acre + subterranean clover 3 lb/acre.

Superphosphate was applied to all plote at 8 cwts per acre at the beginning of the experiment and no further applications were made for five years. (See Table 2 - following page)

TABLE 1

Effects at Harvest Time of a series of concentrations of sodium 2,4-D on skeleton weed and wheat. Means of four replications.

| 2,4-D Treatment | Mean height of wheat in cms. | Mean height of skeleton weed in cms. | Percentage reductions of skeleton weed from original densities | Mean yield of wheat bus/acre |
|---|---|---|---|---|
| Nil | 77.2 | 69.4 | 6 | 10.0 |
| 2 oz/ac. | 79.7 | 59.7 | 18 | 12.3 |
| 4 " | 81.1 | 52.2 | 28 | 14.9 |
| 8 " | 77.3 | 39.3 | 30 | 12.3 |
| 12 " | 77.4 | 40.1 | 33 | 12.8 |
| 16 " | 77.6 | 35.6 | 39 | 13.9 |
| 24 " | 78.1 | 30.7 | 62 | 14.7 |
| 32 " | 80.7 | 30.3 | 80 | 14.4 |
| Minimum difference for significance 5% level | N.S. | 6.6 | Not calculated | 1.7 |

TABLE 2

Effect of competition from pasture species on skeleton weed densities. Means of six replications.

| Treatments | Change in skeleton weed densities relative to untreated control | | | | Dry wt. of skeleton weed relative to control August 1956 |
|---|---|---|---|---|---|
| | October 1953 | September 1954 | August 1955 | August 1956 | |
| Wimmera ryegrass | +11% | - 6% | -16% | -19% | - 3% |
| Subterranean clover | -48% | -64% | -61% | -63% | -80% |
| Ryegrass and clover | -15% | -53% | -51% | -41% | -43% |

The effectiveness of clover as a competitor with skeleton weed is evident from the above table. An interesting feature is the rapidity with which clover reduces the skeleton weed population to an equilibrium density. The figures in the last column of the Table suggest that, in addition to reducing the rosette population, clover also reduces the growth of individuals.

(d) The effect of pasture leys on wheat yields

The pastures were ploughed in December 1956 and each of the four major plots of the experiment were split into four sub-plots. The following herbicide treatments were superimposed on the pasture species plots:

1. No treatment
2. Fallow sprayed six weeks prior to sowing wheat with $\frac{3}{4}$ lb. 2,4,-D/acre.
3. Sprayed in spring in the growing wheat crop with $\frac{3}{4}$ lb. 2,4-D/acre.
4. Sprayed in both fallow and crop with $\frac{3}{4}$ lb. 2,4-D/acre on each occasion.

Bencubbin wheat was sown in July 1957 with 90 lbs. superphosphate/acre. The spray treatments were applied as scheduled but the crop failed because of severe drought. The experiment was repeated in 1958. The fallow sprays were applied on 27th March, and Bander wheat with 60 lbs. superphosphate/acre was sown on 7th May. The spring sprays were applied on 8th September and the wheat crop was harvested between 15th and 19th December.

TABLE 3

Yields of wheat on different pasture leys subjected to different herbicidal spray treatments for skeleton weed control. Means of six replications in bushels per acre.

| Treatments | Control - no pasture | Wimmera ryegrass | Subterranean Clover | Ryegrass & Clover | Means-Spray Treatments |
|---|---|---|---|---|---|
| Control - No spray | 38 | 46 | 46 | 40 | 42.5 |
| Fallow sprayed | 36 | 46 | 44 | 36 | 41.0 |
| Spring sprayed | 41 | 47 | 47 | 42 | 44.3 |
| Fallow and spring sprayed | 38 | 43 | 49 | 36 | 41.5 |
| Means-Pasture Treatments | 38.3 | 45.5 | 46.5 | 38.5 | |

Spraying in the spring gave small increases in wheat yields, but fallow spraying tended to reduce yields on the plots formerly under the ryegrass-clover mixture. Ryegrass was more prevalent on the latter - presumably because of its higher soil nitrogen status - than on the ryegrass alone plots. Autumn spraying promoted the growth of this species, which was not completely eliminated by pre-sowing cultivation. Apart from this effect, pastures gave yields higher by 6-7 bushels per acre than no pasture. This does not fully express the difference in yield potential between a crop-fallow and a pasture ley crop system on skeleton weed infested land. The control plots in this experiment had been uncropped for five years before what was virtually a two-year fallow prior to cropping. The high soil nitrogen levels in the pasture ley plots resulted in lodging of the wheat crop as well as an invasion by Wimmera ryegrass. The densities of ryegrass at the beginning of the 1957-58 fallow were 1.2, 5.7, 2.1, and 52.9 plants per square link on the control, ryegrass, clover and ryegrass-clover plots respectively. In these experiments the effects of grazing as a control measure could not be as fully exploited as under normal farming conditions.

It may be concluded that an appreciable reduction in skeleton weed can be obtained by a subterranean clover ley of 2-3 years duration. Leys of longer duration probably increase the hazards of lodging in subsequent crops.

Evidence from farmers who have used the short clover ley as an aid to skeleton weed control suggests that competition from the clover, enhanced by selective grazing of the weed by sheep, combined with the effects of cultivation in the cropping phase, reduce skeleton weed to levels at which chemical treatments may not be necessary.

## 3. REFERENCES

Myers, L.F. and Lipsett, J. (1958).- Competition between skeleton weed (Chondrilla juncea L.) and cereals in relation to nitrogen supply. Aust. J. Agric. Res. 9: 1-12.

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Weed Control Conference
1960.

FIGURE 1. - Effects of Sodium 2,4-D applied at $1\frac{1}{2}$ lb. acid equivalent per acre on skeleton weed densities when applied at different growth stages. Means of five replications.

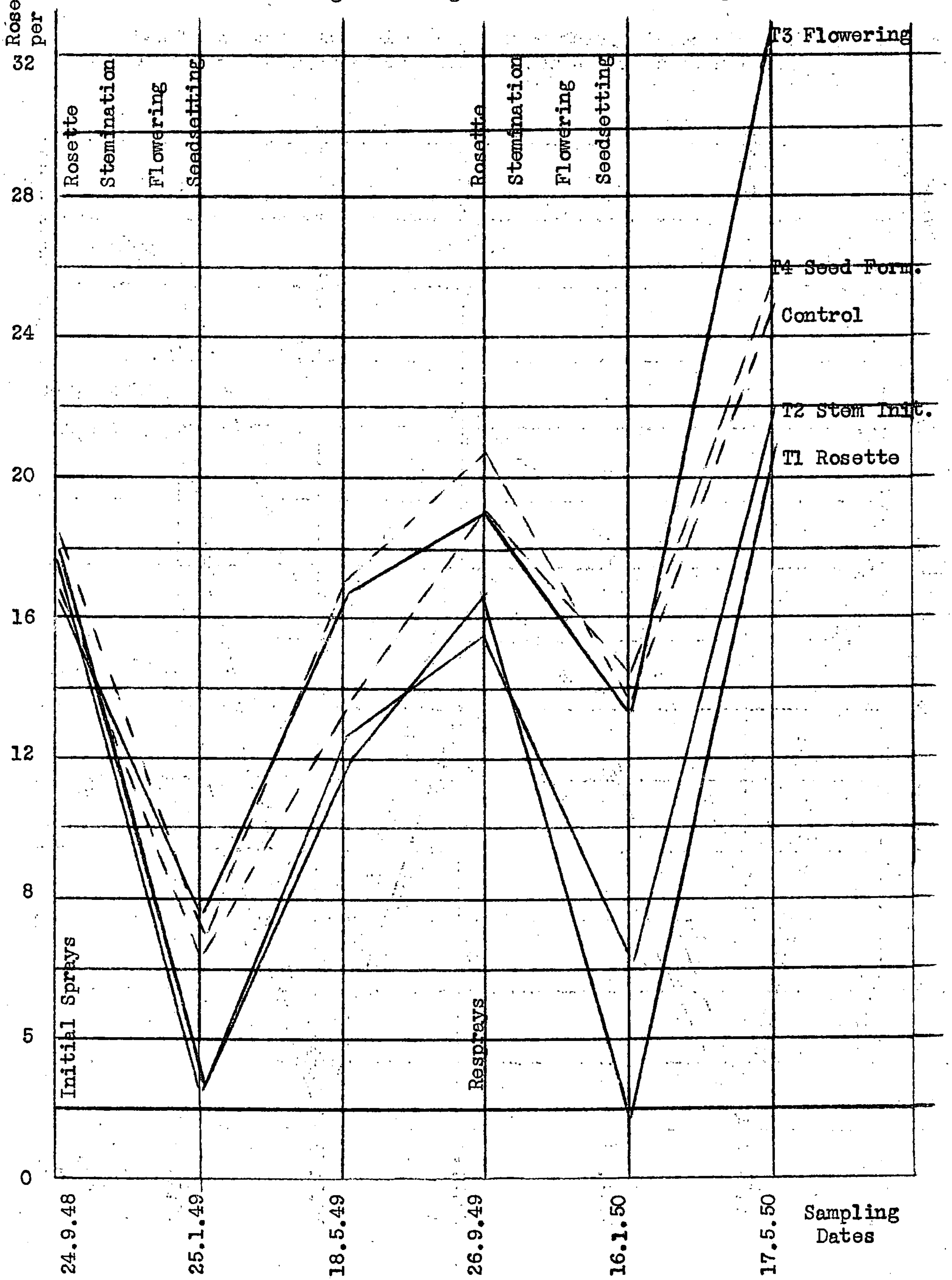

FIGURE 2. - Effects of different rates of application of Sodium 2,4-D applied to skeleton weed at the spring rosette growth stage.