# GLYPHOSATE FOR CONTROL OF SOURSOB IN WINTER CEREAL SYSTEMS IN SOUTHERN AUSTRALIA

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*Summary*. Glyphosate was evaluated at 0.54 kg ha$^{-1}$ for long term control of soursob *(Oxalis pes-caprae)*, a serious weed of winter cereals in southern Australia. Control was maximised by application in August to September and is attributable to the growth stage at that time. Cereal yield benefits were attributable to soursob control.

## INTRODUCTION

Soursob is a winter active, bulbous perennial weed infesting an estimated 500 000 ha of arable land in South Australia and 26 000 ha in Victoria (McKenzie 1973). Soursob is a serious competitor with crops, and sowing of winter crops is often delayed by additional cultivations aimed at reducing the weed. In pasture it competes with desirable species and its oxalic acid content may lead to chronic kidney damage in sheep.

The vegetative life cycle of soursob is shown diagramatically in Figure 1, the numbers referring to growth stages and used in Tables 1 and 2. Control measures, including cultivation at bulb exhaustion, long fallowing and use of in-crop herbicides, have been reviewed by Catt (1972). Recently Mahoney (1978) showed that bulb dormancy does not extend beyond the year of formation.

Results of initial trials with glyphosate (unpublished data) indicated an optimum rate of 0.54 kg ha$^{-1}$ for maximum reduction of the bulb population. Consideration of the growth cycle of soursob in relation to the recognised translocation behaviour of glyphosate suggested that seasonal timing of application would be the factor of greatest importance in achieving long term control. This was investigated in a research project from 1978 to 1980.

## MATERIALS AND METHODS

*Effect of glyphosate rate and timing on soursob control*. Trials were established on soursob dominated pastures at five sites in South Australia between June and September 1979 to compare treatment with glyphosate at 0.54 kg ha$^{-1}$ with untreated controls. Application was by hand held boom with 8001 flat fan nozzles. Water volumes varied from 100 to 130 L ha$^{-1}$ and pressures from 180 to 245 kPa. Plot size varied from 40 to 90 m$^2$ with three replications. Soursob plant density was recorded in June to July, 1979 and again in June to July, 1980. Growth stage was recorded at treatment time.

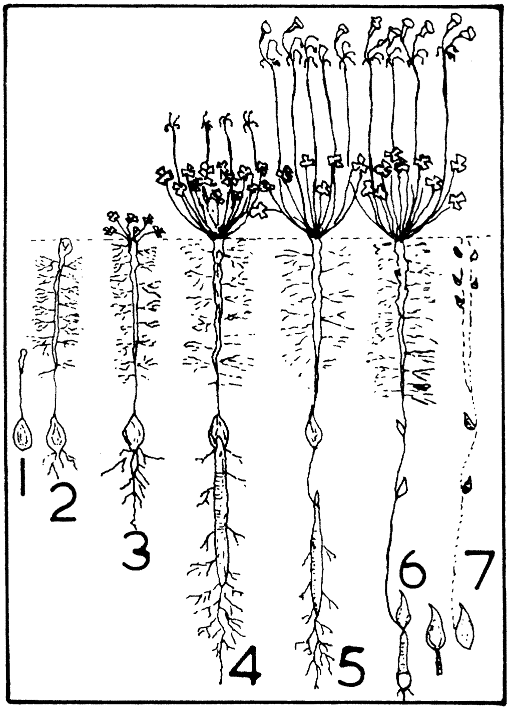


Figure 1. Vegetative life cycle of soursob (adapted from Bulletin No. 406, S.A. Department of Agriculture).

*Effect of soursob control on cereal yield.* Nine large scale trials were established in 1978 and 1979 with glyphosate applied at 0.54 kg ha$^{-1}$ in July to September to soursob dominated pastures in South Australia and Victoria. Application was by field scale boom equipment in water volumes of 85 to 110 L ha$^{-1}$ at pressures of 200 to 280 kPa. Trials varied in plot size (0.10 to 0.24 ha) and replication (3 to 4) but all compared treated with untreated areas. Cereal crops were sown in the year following treatment with sowing time varying from May to August. Plots were harvested with either small plot (43 to 72 m$^2$ per plot harvested) or farmer equipment (240 to 570 m$^2$ per plot harvested). Soursob plant density was recorded in June to July of the year following treatment.

## RESULTS

Application of glyphosate at 0.54 kg ha$^{-1}$ in August and early September maximised soursob reduction by timing application to growth stages 5 and 6 (Table 1 ).

In nine field scale trials, application of glyphosate at 0.54 kg ha$^{-1}$ over the period mid-July to mid-September resulted the following year in soursob plant density reductions of 70 to 90% and cereal grain yield increases averaging 60% (Table 2.). Early sowing disadvantaged crops in untreated plots (e.g. Mundoora) where extra cultivations and a later sowing would have normally occurred.

Table 1. Effect of glyphosate at 0.54 kg $ha^{-1}$ and timing of application on soursob population in 1980 at five sites in South Australia after treatment in 1979.

| Site | Application date in 1979 | Growth stage (as shown in Fig.1) | Plant Density: Initial in June to July 1979 ($no.m^{-2}$) | Plant Density: Reduction[1] in June to July 1980 (%) | (S.D.[2]) |
|---|---|---|---|---|---|
| Mallala | June 6 | 3 to 4 | 1242 | 47 | |
| | July 12 | 5 | | 72 | |
| | August 24 | 5 to 6 | | 87 | |
| | September 13 | 6 | | 92 | |
| Maitland | June 27 | 4 | 1020 | 65 | 7.8 |
| | August 17 | 5 to 6 | | 96 | 2.4 |
| | September 21 | 6+ | | 85 | 18.0 |
| Riverton | July 4 | 4 | 2050 | 72 | 2.2 |
| | August 17 | 5 to 6 | | 83 | 4.6 |
| | September 20 | 6+ | | 70 | 4.6 |
| Mundoora | July 7 | 4 | 1070 | 62 | 3.9 |
| | August 17 | 5 to 6 | | 92 | 6.1 |
| | September 21 | 6+ | | 78 | 3.0 |
| Port Lincoln | July 11 | 4 to 5 | 1990 | 72 | 8.5 |
| | August 23 | 5 to 6 | | 77 | 5.9 |

[1] Relative to the density in the untreated control plots.
[2] Standard Deviation.

## DISCUSSION

Maximum soursob control occurred after treatment at growth stages 5 and 6 which corresponded to tuber contraction and bulb filling - probably the period of maximum translocation from the foliage to the bulbs. Treatment in June to July corresponded to growth stages varying from commencement of tuberisation (3) to tuber contraction (5) and resulted in variable control which was often less than 70%. Bulb exhaustion occurs between stages 4 and 5 and presumably treatment before this stage restricts basipetal translocation of glyphosate and allows regrowth from the rhizome.

Depending on cultural practices (e.g. grazing) and local seasonal variations, foliage senescence and bulb separation may begin from about mid-September. Thus treatment after the onset of senescence (stage 6+) may lead to a slightly reduced result (e.g. Table 1, late September applications).

Soursob plants remaining in plots treated in August and September were small and many originated from shallow small bulbils, whereas many of the plants in the earlier treated plots were larger and originated from deeper larger bulbs. Since soursob control has been expressed as plant number reduction, this assessment may tend to understate the real level of reduction in weed competition.

Table 2. Effect of glyphosate on soursob density and grain yields one year after treatment of soursob dominated pastures.

| Site | Application Date | Growth Stage (as shown in Figure 1.) | Sowing Date | Crop | Glyphosate rate ($kg\ ha^{-1}$) | Reduction in soursob (%) | Grain yield ($kg\ ha^{-1}$) | |
|---|---|---|---|---|---|---|---|---|
| Mallala, S.A. | August 24, 1979 | 5 to 6 | May 13, 1980 | Wheat cv. Aldirk | 0<br>0.54 | 0<br>87 | 400<br>1 180 | N.A.[1] |
| Kadina, S.A. | August 23 1979 | 5 to 6 | May 14, 1980 | Wheat cv. Festiguay | 0<br>0.54 | 0<br>96 | 1 485<br>1 940 | N.A. |
| Mundoora, S.A. | July 27, 1979 | 4 to 5 | May, 15 1980 | Wheat cv. Oxley | 0<br>0.54 | 0<br>72 | 0<br>2 820 | ** |
| Warracknabeal Vic. | August 29, 1979 | 5 to 6 | May 25, 1980 | Wheat cv. Egret | 0<br>0.54 | 0<br>86 | 2 105<br>2 882 | N.A. |
| Blyth, S.A. | August 21, 1979 | 5 to 6 | May 27, 1980 | Wheat cv. Festiguay | 0<br>0.54 | 0<br>88 | 970<br>1 390 | N.A. |
| Nullawill, Vic. | July 25, 1979 | 4 to 5 | May 29, 1980 | Wheat cv. Kewell | 0<br>0.54 | 0<br>88 | 2 357<br>2 557 | N.A. |
| Riverton, S.A. | July 13, 1979 | 4 | June 14, 1980 | Wheat cv. Lance | 0<br>0.54 | 0<br>70 | 2 589<br>4 560 | ** |
| Kadina, S.A. | September 13, 1978 | 6 | June 30, 1979 | Barley cv. Clipper | 0<br>0.54 | 0<br>83 | 814<br>879 | N.A. |
| Maitland, S.A. | July 19, 1979 | 5 | August 7, 1980 | Barley cv. Weeah | 0<br>0.54 | 0<br>88 | 1 886<br>1 927 | N.S. |

[1]** = significant difference at P=0.01; N.S. = not significant; N.A. = not analysed.

Application of glyphosate at 0.54 kg $ha^{-1}$ in August to early September provides near complete kill not only of soursob but of most associated annual pasture species present, resulting in a nearly vegetation free situation over the ensuing spring period. Moisture conservation due to this chemical fallow effect may have contributed to the observed yield responses.

## LITERATURE CITED

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