Commercial development of Roundup for long-term control of soursob (*Oxalis pes-caprae* L.)

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Introduction

Soursob is an introduced bulbous perennial weed infesting large areas of the cereal belt of southern Australia. It can reduce crop yields by 20%–50%, decrease pasture production and cause kidney damage in sheep due to its oxalic acid content. Vegetative reproduction by bulbs has facilitated its spread by cultivation.

Until recently, commonly adopted control measures were not consistently effective. Two or more cultivations during May and June at the bulb exhaustion stage of growth were proposed in 1965, but this technique was unsuccessful because of the different stages of soursob maturity within the population and the dependence of cultivation on seasonal conditions. Another method relied on the application of diuron in the cereal crop, but this gave variable levels of control whilst the narrow margin of safety to the crop also limited the success of the technique.

The development of Roundup for the control of soursob

Roundup controls many annual and perennial weeds. Its properties of foliar uptake and translocation towards the roots and underground stems indicated its potential for long-term control of soursob. In 1976, Jannett Mahoney from the Wheat Research Institute at Horsham embarked on a series of investigations into the efficacy of Roundup for this purpose. A concurrent study of the influence of seasonal conditions on soursob growth and development was conducted and the results reported in this journal.*

In the initial trials three rates of Roundup (1.5, 3.0 and 6.0 L ha^{-1}) were applied at four different times before sowing a cereal crop. There were no differences in control between the rates of Roundup used, but better control was achieved when Roundup was applied later in the season. These results and the observation that soursob reductions at the later timings were carried over into the following year prompted an investigation into the effect of using Roundup to initiate a fallow in the autumn prior to cropping.

Trials in 1977–78 and 1979 showed that Roundup at 1.5 L ha^{-1} applied to mature soursob from late July to early September provided at least 84% plant reduction in the year after treatment (Figure 1). This timing coincides with bulb formation, when translocation moves Roundup into the lower parts of the plant where it effectively controls the formation or viability of new bulbs.

Economic benefits of soursob control

In 1978 paddock trials were established by Monsanto Australia Ltd at Indoota in the mid-north of South Australia, where soursob populations of 3000 m^{-2} are not uncommon in heavily infested paddocks. Before 1978 the owners of Indoota controlled soursob by six or seven cultivations prior to sowing the heavy red-brown soil. Continuous cropping of barley with a paddock put into pasture about one year in six also helped to control the weed.

Proof of the effectiveness of Roundup for control of soursob induced the owners of Indoota to adopt a chemical fallow approach to soursob control in the pasture phase of their cropping rotation. The yield benefits of weed control and of moisture conservation were obvious one and two years after treatment (Table 1). In addition to increased cereal yields, chemical fallow and control of soursob helped save time during seedbed preparation and allowed the adoption of a new cropping rotation and a conservation tillage approach to crop establishment.

A farm financial analysis for Indoota was conducted by agricultural economists from the South Australian Department of Agriculture in 1982. This analysis calculated the change in net farm income over the 3 years since the adoption of chemical fallow, conservation tillage and the new crop rotation. To quantify the effect of this new technology the authors compared the pre-1978 or old rotation with the new rotation on a gross margins basis (Table 2). In summarizing their analysis they stated that

> . . . good management and prudent adoption of a new rotation and new technology including conservation tillage is enabling the owners of

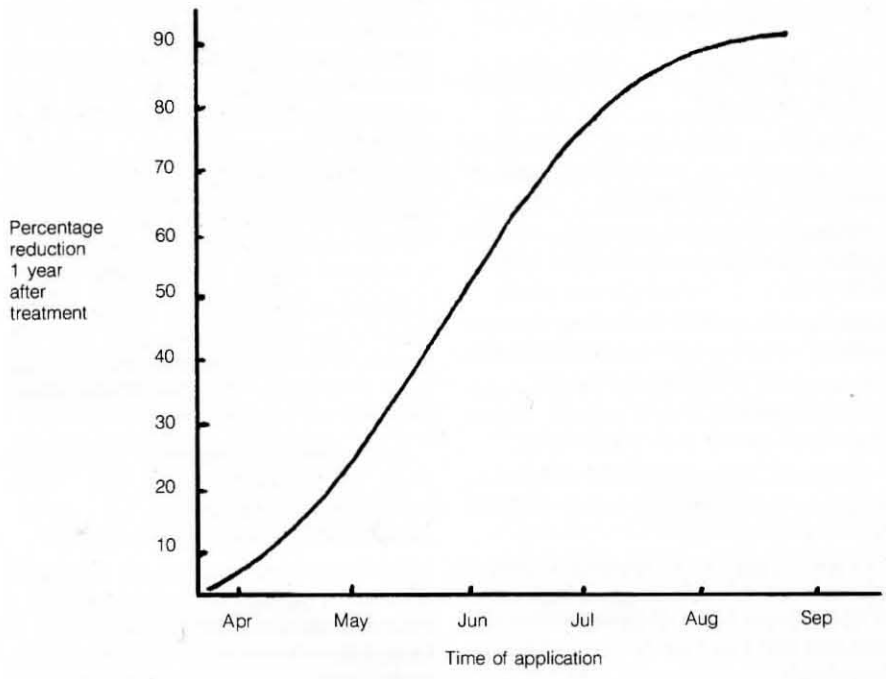

Figure 1 Effect of Roundup at 1.5 L ha^{-1} at different times of the year.

* *Australian Weeds* Volume 1, number 4. June 1982 pp. 9–11.

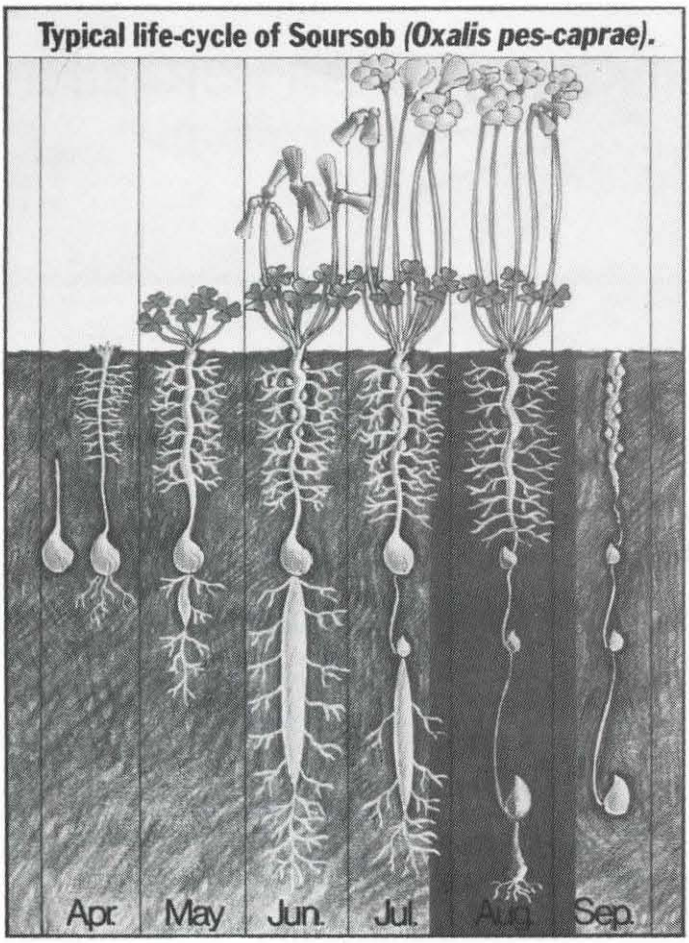

Figure 1 Using Roundup reduces soursob prior to sowing allowing more effective crop establishment.

Figure 2 Reductions of soursob in the crop (right) compared to untreated (left).

Figure 4 Field trial at Mundoora, South Australia. The area treated with Roundup herbicide in the previous year is very obvious with virtually no soursobs visible in the crop.

Figure 3 Soursob growing in the crop.

Indoota to improve their crop yields, to expand their farming operations and to realise increased farm profit.

Reinfestation of soursob after treatment with Roundup

Table 1 shows that the increased cereal yields and hence the economic benefits that accrue from control of soursob extend into the second year after treatment and possibly longer. To determine the extent of soursob control over time, four Monsanto Australia Ltd field trial sites established in 1978–79 were monitored to determine the rate of soursob reinfestation after fallow treatment with Roundup.

Figure 2 shows that reinfestation was almost complete 3 years after treatment on undisturbed small plot sites regardless of the initial population or location of the trial. However, control of soursob was maintained over 3 years on the site cropped continuously in the seasons after Roundup treatment. This long-term control was reflected in increased crop yields on the treated plots over the entire period.

Conclusion

Soursob is a problem weed in some agricultural areas of Victoria, Western Australia and particularly in South Australia and many people have studied aspects of the ecology, morphology and physiology of the plant to establish suitable control measures. An economically viable technique for long-term control of soursob has now been developed.

Roundup applied at 1.5 l ha^{-1} pre-fallowing was used commercially in 1980 for the first time. Since then, 100 000 ha of soursob infested agricultural country has been treated in South Australia alone. Cereal yield increases of nil to 100% have been demonstrated relative to standard cultivation, with the wide range of yield responses resulting from the varying efficiency of standard cultivation and the competitiveness of soursob depending on planting date and growing conditions.

At Indoota in South Australia and in many other places the long-term control of soursob resulting from a single pre-fallow application of Roundup has given farmers the flexibility to adopt new cropping technology such as new rotations, conservation tillage and, hence, expanded farming operations and increased farm profit.

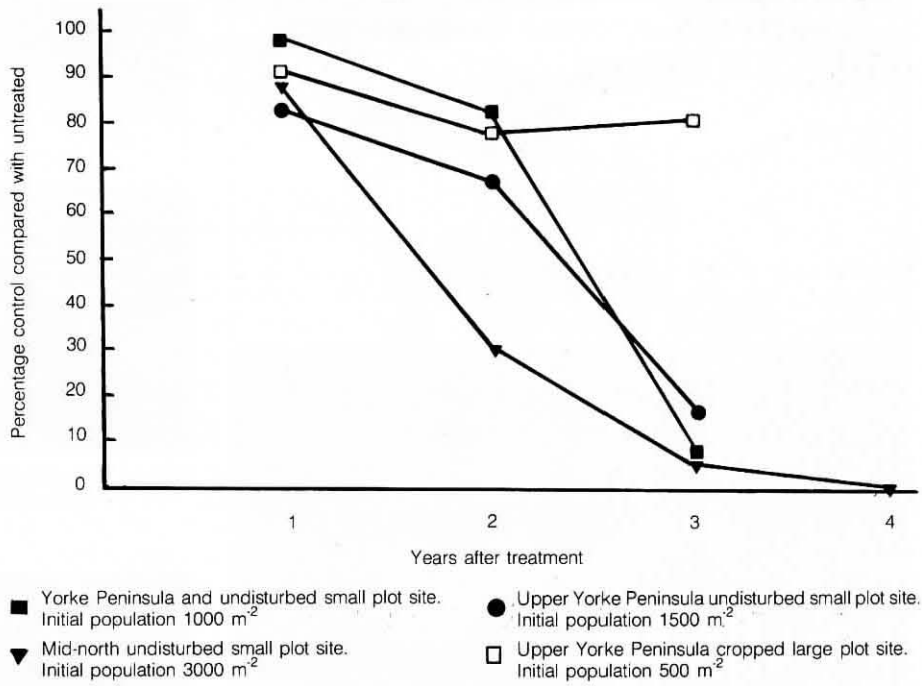

Figure 2 Reinfestation of soursob after treatment with Roundup at 1.5 L ha^{-1} in August.

Table 1 Effect of Roundup at 1.5 L ha^{-1} and fallow treatment on cereal yield at Indoota, South Australia

Treatment	Yield (kg ha^{-1}) 1980	1981
Untreated	1589	1946
Untreated and fallowed	4012	2627
Roundup at 1.5 L ha^{-1} in August 1979	4560	3002
Roundup at 1.5 L ha^{-1} in August 1979 and fallowed	4440	2919

Table 2 Economic comparison of old and new rotations at Indoota, South Australia

Year	Enterprise	Gross margin* ($ ha^{-1})	Enterprise	Gross margin* ($ ha^{-1})
1	barley	87	pasture/ fallow (sheep)	63 (½ sheep gross margin)
2	barley	87	wheat	312
3	barley	87	barley	156
4	barley	87	legume	224 (average gross margin for peas, lupins and faba beans)
5	barley	87	barley	156
6	pasture (sheep)	127	pasture (sheep)	127
Total		$562		$1038
Average per year		$94		$173
Difference between margins				$79 per hectare per year

* Details of how each gross margin has been calculated are available from the authors.