CONSERVATION TILLAGE FARMING IN THE WIMMERA WITH CHLORSULFURON[1]

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Summary. Conservation tillage experiments based on the use of chlorsulfuron at 15 to 45 g ha^{-1} were installed during 1982 and cropped with wheat *(Triticum aestivum)* the following year on the alkaline grey self-mulching clay soils of the Wimmera.

Chlorsulfuron at 22.5 to 45 g ha^{-1} provided good to excellent fallow and following in-crop weed control. Fallows ranged from 8.5 to 12 months before the following wheat crops were sown. The final weed efficacy assessments late in the life of the crops indicated the good to excellent control of Annual Ryegrass *(Lolium rigidum)*, Deadnettle *(Lamium amplexicaule)*, Wireweed *(Polygonum aviculare)*, Prickly Lettuce *(Lactuca serriola)*, Hoary Cress *(Cardaria draba)*, Common Sowthistle *(Sonchus oleraceus)* and Indian Hedge Mustard *(Sisymbrium orientale)* was still being achieved 12 to 18.5 months after chlorsulfuron was applied to the fallow at rates down to 22.5 g ha^{-1}.

INTRODUCTION

Seventy-five percent of wheat grown in the Wimmera area of Victoria is sown into land fallowed for nine to ten months. According to Ridge (1983) increased wheat yields following long fallow are associated with:

1. conservation of moisture
2. mineralisation of nitrogen
3. reduction of disease
4. reduction of in-crop weed seeds

As a standard practice farmers have used a number of cultivations, normally six to ten, to control weeds during the fallow period (Cook, 1982; Ridge, 1983). It is now widely recognized that these cultivations have a number of detrimental effects on soil, including:

1. destroying soil structure
2. development of a hard pan
3. leaving soil prone to wind and water erosion
4. drying of the soil surface layer

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The costs of these cultivations (fuel, repairs and maintenance of machinery, labour, depreciation and interest charges) are considerable (Campion and Tichon, 1981; Retzlaff, 1980; Swinnerton, 1983). Most machinery and labour costs have escalated rapidly over the past few years. On the other hand, herbicide prices have, as a whole, experienced only modest rises in recent years; some have actually fallen in price.

Herbicides, both soil active residual types such as atrazine and diuron, and the foliar absorbed types like glyphosate, paraquat and diquat have been used in fallowing experiments (Wells, 1977; Ridge, 1983) to replace or reduce tillage in conservation fallow systems. These herbicides have their limitations; none of them are the "ideal" herbicide for fallow use. Limitations include poor efficacy on some problem weeds, require frequent application throughout the fallow, herbicide residue remaining after the fallow is injurious to the wheat crop, or not cost competitive with cultivation for weed control.

MATERIALS AND METHODS

Three experiments were initiated in 1982 and sited in the Wimmera district of Victoria on grey self-mulching clay soils. Trial, treatment and agronomic details for these trials are detailed in Table 1. All trials evaluated chlorsulfuron treatments of 15, 22.5, 30 and 45g ha^{-1} in comparison with glyphosate at 360g ha^{-1} and a mechanical cultivation treatment. The herbicide treatments were applied using a precision truck sprayer operating at a pressure of 280 kPa and application volume of 75 L ha^{-1}.

Mechanically cultivated treatments were maintained weed free by a series of cultivations utilizing a variety of tillage implements - details are given in Table 1. All herbicide treatments were cultivated towards the end of the fallow to prepare a suitable seedbed for the following wheat crop - details are presented in Table 1. Trifluralin at 1.0 L ha^{-1} was applied to the glyphosate and mechanical cultivation treatments as a pre-plant incorporated treatment in trial number PS/H8/82. Dicamba at 80 g ha^{-1} plus MCPA amine at 340 g ha^{-1} was applied in-crop to the glyphosate and mechanical cultivation treatments in trial number PS/H3/82 for broadleaf weed control. No in-crop herbicide applications were possible in trial number PS/H14/82 as the site was too waterlogged to allow a spray operation.

Assessments of weed control for each trial were made at periodic intervals during the fallow, and in the following wheat crop. The crops were assessed for phytotoxic symptoms and grain yields were measured at harvest.

Weed efficacy assessments are expressed as weed biomass reduction on a 0 to 10 scale, where:

- 0 = plot with highest level of infestation in the replicate in terms of weed biomass, and
- 5 = 50% reduction in weed biomass compared to the plot that scores "0" in the same replicate, and
- 10 = complete kill.

Table 1. Trial, treatment and agronomic details.

	Trial number		
	PS/H3/82	PS/H8/82	PS/H14/82
Location	Byrneville, Victoria	Warracknabeal, Victoria	Wallup East, via Horsham, Victoria
Soil pH	8.5	8.0	9.0
Herbicides applied	May 27, 1982	July 2, 1982	Sept. 26, 1982
Plot size	0.12 ha	0.686 ha	1.08 ha
Replications	4	2	2
Cultivation dates for Mechanical Cultivation treatments	late Oct. 1982-S early Autumn 1983-S mid Autumn 1983-S late Autumn 1983-S May 1983-H	March 1983-S April 1983-S May 1983-S May 1983-H	Sept. 27, 1982-S Dec. 9, 1982-S March 7, 1983-S April 13, 1983-S April 28, 1983-FS+L May 13, 1983-FS June 1, 1983-H
Stubble burnt	Not burnt	Feb. 1983	Not burnt
Cultivation date(s) for herbicide treatments	May 1983-S	May 1983-S	Feb. 2, 1983-S March 7, 1983-H
Wheat sown	early June, 1983	late May, 1983	June 6, 1983
Wheat variety	Olympic	Millewa	Oxley
Wheat harvested	Dec. 20, 1983	Jan. 6, 1984	Jan. 6, 1984

S = scarified FS = field span L = leveller H = harrowed

RESULTS

Rainfall in the Wimmera area of Victoria during 1982 was the lowest on record and weed growth was correspondingly poor. An early seasonal break in 1983, followed by above average rainfall, resulted in excellent crop growth and vigorous in-crop weed pressure.

In all three trials, assessments of weed efficacy throughout the fallow, and into the wheat crop, revealed that chlorsulfuron at 15 to 45 g ha^{-1} was always superior to glyphosate at 340 g ha^{-1} and the mechanical cultivation treatment. At no stage in any trial was there a sign of phytotoxicity to the wheat crop following the fallow. Tables 2, 3 and 4 present the last in-crop weed efficacy assessments made; they clearly show the long term weed control achieved with all rates of chlorsulfuron.

At Byrneville (Trial No. PS/H3/82) chlorsulfuron at 22.5 g ha^{-1} and above provided very good to excellent control of Deadnettle, Wireweed, Prickly Lettuce, and Common Sowthistle in-crop, 18.5 months after the fallow application (Table 2).

Table 2. In-crop weed control 18.5 months post-application and grain yield at harvest - Trial No. PS/H3/82

Treatment	Rate (g ha^{-1})	Weed biomass reduction				Grain Yield (kg ha^{-1})
		Deadnettle	Wireweed	Prickly Lettuce	Common Sowthistle	
Chlorsulfuron	15	7.5 a	8 a	8 a	6 c	2213
Chlorsulfuron	22.5	8.5 a	9 a	9 a	8 b	2307
Chlorsulfuron	30	9 a	8 a	8.5a	9 b	2307
Chlorsulfuron	45	9 a	10 a	9 a	10 a	2560
Glyphosate[(a)]	360	4 b	5 b	0 b	0 d	2280
Mechanical Cultivation[(a)]		0 c	0 c	0 b	0 d	2080
		*	*	*	*	N.S.

(a) Sprayed in-crop with 80 g ha^{-1} dicamba + 340 g ha^{-1} MCPA amine

At Warracknabeal (Trial No. PS/H8/82) results in-crop, 14.5 months after the fallow application (Table 3.) indicate that chlorsulfuron provided good control of Annual Ryegrass and Hoary Cress at 22.5 g ha^{-1} and above, good control of Wireweed at 15 g ha^{-1} and above, and excellent control of Deadnettle and Indian Hedge Mustard at 15 g ha^{-1} and above.

At Wallup East (Trial No. PS/H14/82) results in-crop, 12 months after the fallow application (Table 4.) indicate that chlorsulfuron provided good control of Annual Ryegrass at 15 g ha^{-1} and above, good control of Hoary Cress at 22.5 g ha^{-1} and above, and very good to excellent control of Wireweed, Deadnettle and Prickly Lettuce at 15 g ha^{-1} and above. Chlorsulfuron did not provide appreciable control of Barley grass *(Hordeum leporinum)* at rates up to 45 g ha^{-1}.

Table 3. In-crop weed control 14.5 months post-application and grain yield at harvest - Trial No. PS/H8/82

Treatment	Rate (g ha^{-1})	Weed biomass reduction: Annual Rye-grass	Dead-nettle	Wireweed	Hoary Cress	Indian Hedge Mustard	Grain Yield (kg ha^{-1})
Chlorsulfuron	15	6.5	9 a	7.8	6 b	9.5 a	3346
Chlorsulfuron	22.5	7	9 a	8	7 a	9.5 a	3021
Chlorsulfuron	30	7.5	9 a	7.8	7.8 a	10 a	3420
Chlorsulfuron	45	7.8	9.3 a	8.3	8 a	10 a	3523
Glyphosate[(a)]	360	6.5	6.5 b	6	7 a	0 b	2955
Mechanical Cultivation[(a)]		6.3	7.5 b	7.5	0 c	0 b	3113
		N.S.	*	N.S.	*	*	N.S.

(a) Trifluralin at 1.0 L ha^{-1} applied pre-plant incorporated

Table 4. In-crop weed control 12 months post-application and grain yield at harvest - Trial No. PS/H14/82

Treatment	Rate (g ha^{-1})	Weed biomass reduction: Annual Rye-grass	Barley grass	Hoary Cress	Wire-weed	Dead-nettle	Prickly Lettuce	Grain Yield (kg ha^{-1})
Chlorsulfuron	15	7 b	1 b	6 b	8 b	9 a	9 a	2013 cd
Chlorsulfuron	22.5	9 a	2 ab	7 b	9 a	9 a	8.5 a	2432 ab
Chlorsulfuron	30	7 b	2 ab	8 a	9 a	8.5 a	8.5 a	2353 bc
Chlorsulfuron	45	8.5 a	3 a	8.5 a	8.5ab	9.5 a	9 a	2735 a
Glyphosate	360	0 c	0 b	6 b	0 c	0 b	0 b	1909 d
Mechanical Cultivation		0 c	0 b	0 c	0 c	0 b	0 b	2415 ab
		*	*	*	*	*	*	*

DISCUSSION

Chlorsulfuron has been widely accepted across the Australian cereal belt as a broad spectrum selective herbicide that provides in-crop weed control for an extended period of time. Chlorsulfuron can be safely used pre-sowing incorporated by sowing (I.B.S.) in wheat and triticale *(X Triticosecale spp.)* and early post-emergence (E.P.E.) in wheat, triticale, barley *(Hordeum vulgare)*, oats *(Avena sativa)* and rye *(Secale cereale)*.

Chlorsulfuron is primarily broken down in the soil by hydrolysis. The rate of hydrolysis is increased by high soil moisture, low soil pH and high soil temperature. The half-life of chlorsulfuron therefore is shortest in hot acid soils high in moisture, and longest in cold alkaline soils low in moisture. Bearing this attribute in mind, it is readily apparent that chlorsulfuron lends itself to conservation tillage use on alkaline soils. The long term weed control evident from the three trials reported here bears testimony to the suitability of chlorsulfuron for fallow weed control in conservation tillage programmes.

While 1982 was the driest year on record in the Wimmera, and the hydrolysis of chlorsulfuron would therefore have been quite slow during this period, the early "break" to the season in 1983 and subsequent above average rainfall would have reversed the situation and then led to faster than normal chlorsulfuron hydrolysis. The duration of weed control obtained over the vastly different seasonal conditions experienced in 1982 and 1983, when evened out, can be considered to approximately equate to two "average" seasons. Taking the results of the three trials collectively, chlorsulfuron at 22.5 g ha^{-1} has provided the following levels of in-crop weed control 12 to 18.5 months after its application in fallow:

Deadnettle	-	85 to 90%
Wireweed	-	80 to 90%
Prickly Lettuce	-	85 to 90%
Common Sowthistle	-	80%
Annual Ryegrass	-	70 to 90%
Hoary Cress	-	70%
Indian Hedge Mustard	-	95%

The trial at Wallup East was the only one to show significant yield differences in the wheat crop following the fallow treatments. There is definite trend to higher yields with increasing rates of chlorsulfuron. At Byrneville and Warracknabeal there was also a trend to higher yields with the use of chlorsulfuron, but the differences were not statistically significant. Considering the seasonal conditions that prevailed during the period of the trials, it is not surprising that significant yield responses were not recorded in all three trials. Up until March 1983 conditions were extremely dry; there was little rainfall to conserve during the fallow. After that rainfall was abundant and the crop never wanted for moisture. Hence yield differences between treatments are unlikely to be due to moisture competition; more probably nutrient or soil physical conditions were involved.

Four further trials were installed during 1983. Two sites are again in the Wimmera on grey self-mulching clays of pH 7.0 and 8.0, while the other two sites are in the Mallee, one on a sandy clay loam of pH 8.5 and the other on a sandy loam of pH 8.7. It is intended to sow these sites to wheat in 1984 and monitor in-crop weed control and collect grain yield data. It is intended to report on this second season's fallow work at a later date once it has been cropped.

CONCLUSIONS

Chlorsulfuron can play an important part in conservation tillage farming in the alkaline soils of the Wimmera area of Victoria. Applied either early (May/June), at the more traditional fallow commencement time of July/August, or late (September), chlorsulfuron proved effective in controlling Annual Ryegrass and a range of broadleaf weeds, both in the fallow itself and into the following wheat crop.

Chlorsulfuron at 22.5 g ha^{-1} provided good to excellent in-crop weed control 12 to 18.5 months after its application in fallow. Specifically, control levels were - Deadnettle 85% +, Wireweed 80% + , Prickly Lettuce 85% +, Common Sowthistle 80%, Annual Ryegrass 70% + , Hoary Cress 70% and Indian Hedge Mustard 95%.

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