CONSERVATION TILLAGE ON THE DARLING DOWNS, QUEENSLAND

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Summary. Six trials were set up as pilot studies after the 1978 wheat crop and a further trial after the 1979 harvest, to assess the feasibility of growing wheat on a field scale by replacing mechanical weed control with herbicides during the summer fallow. The trials range in size from 4 to 10 ha.

Important points that have emerged are:
- herbicides can be substituted for tillage
- the cost will vary according to the season and individual managerial ability
- management of straw and general field operations including wheel tracks demands an understanding of what is required
- crops can be satisfactorily established under no tillage
- crop yields are similar to or better than under conventional tillage.

INTRODUCTION

Conservation tillage practices are gaining increasing acceptance for crop production on the Darling Downs in Queensland, predominantly for erosion and run off control. Simultaneously, energy and economic considerations are stimulating interest in herbicide substitution for tillage.

Co-operative work between the Queensland Department of Primary Industries and Monsanto Australia Limited was initiated in late 1978 to investigate management aspects of conservation cropping including zero tillage of wheat and barley. Since 1968 zero tillage and other conservation cropping systems with wheat have been studied on a small plot basis at Hermitage Research Station, Warwick. However, little attention was paid to the practical aspects that might limit adoption of reduced and zero tillage practices by producers. The practical management aspects including weed control, straw management and planting were investigated in this study.

MATERIALS AND METHODS

Six sites were selected on the basis of environmental considerations, soil type, and producer interests. Each location represented a major wheat growing soil with expected differences in weed flora, herbicide effect, fallow and seeding management problems. The soil type was a self mulching black earth at Anchorfield, Jimbour and Jondaryan, a calcareous gilgai self mulching grey clay at Jandowae, a grey clay at Mt. Carmel and a solonised brown soil at Enarra. In the second year, another trial was started on a heavy self mulching grey clay at Hodgsonvale.

Herbicides were applied with a four wheel drive vehicle in a spray vol-

ume of 50 L ha^{-1} at a pressure of 280 kPa and a ground speed of 18 km hr^{-1}. Stainless steel 8002 nozzles were used, except over the wheel tracks where 8003 nozzles were used to compensate for dust reducing the effectiveness of glyphosate[1].

Weed control was effected during the summer fallow by herbicides applied according to the weed species present. Three to six sprays, with an average of five, were applied during the summer fallow. The herbicides used were glyphosate, dicamba, 2,4-D amine and ester, and MCPA. The most frequent control method for mixed infestations of annual grasses and broadleaf weeds was glyphosate at 0.36 kg ha^{-1}. For improved control of harder to kill broadleaf weeds, glyphosate at 0.36 kg ha^{-1} plus dicamba at 0.1 kg ha^{-1} was applied as a tank mix.

The treatments for weed control were full mechanical tillage, complete herbicide substitution for tillage, and early and late blade plough treatments followed by or preceded by herbicide treatments respectively. The late blade treatment was abandoned in the second year due to soil management problems. The effect of these unreplicated treatments on crop yield at the various locations was measured.

A 3.25 m wide prototype planter was constructed because conventional stubble mulch planters were found to be unsuitable. It consisted of 45 cm diameter mouldboard coulters preceding edge on tines fitted with spear points, with an over centre type press wheel following each tine. Fifty-six centimetre coulters replaced the 45 cm ones in the second year. Where possible, fertilizer applications followed those of traditional farming practices. Up to 30 kg ha^{-1} N was applied with the seed.

RESULTS

The yield results and cost of zero tillage for year one and two are shown in Tables 1 and 2 respectively.

Table 1. The effect of summer fallow weed control method on the yield of the subsequent wheat crop in year one (1978-79), and the cost of zero tillage treatment.

Location	Grain yield relative to the zero tillage treatment yield				Grain yield zero tillage (kg ha^{-1})	Cost zero tillage ($ ha^{-1})
	Early blade plus herbicides	Late blade plus herbicides	Conventional tillage	Zero tillage		
Mt. Carmel	89.1	-	97.6	100	1782	30.13
Enarra	107.7	93.7	-	100	1011	30.63
Jimbour	99.1	-	88.9	100	2497	30.38
Anchorfield	83.9	-	92.6	100	2664	59.29
Jondaryan	-	-	-	100	3792	43.13
Jandowae	100.0	-	76.8	-	-	-

[1] Trade name Roundup

Table 2. The effect of summer fallow weed control method on the yield of the subsequent wheat crop in year two (1979-80), and the cost of zero tillage treatment.

Location	Grain yield relative to the zero tillage treatment yield			Grain yield zero tillage (kg ha^{-1})	Cost zero tillage ($ ha^{-1})
	Early blade plus herbicides	Conventional tillage	Zero tillage		
Mt. Carmel	Not harvested due to drought				36.25
Enarra	64.7	64.7	100	542	17.50
Jimbour	82.1	103.4	100	1841	25.65
Anchorfield	Not planted due to drought				41.28
Jondaryan[1]	-	100.2	100	2729	22.33
Jondaryan[2]	-	-	100	3364	27.20
Jandowae	100.4	96.8	100	1929	85.80
Hodgsonvale	95.9	97.7	100	2526	59.26

[1]barley [2]wheat

DISCUSSION

Herbicide costs varied in year one from $30.13 to $59.29 ha^{-1} with a mean of $38.71 ha^{-1}. However, the western plots, with lower weed densities and lower rainfall are all about $30 ha^{-1}. Costs were higher in the east where weed densities and rainfall were greater. In year two the average cost of zero tillage was $39.41. The cost differences between eastern and western areas tended to be as for year one, except for a greater range of cost within these two areas, indicating that seasonal variation will influence cost. Poor weed management decisions in any one year can increase costs in subsequent years.

Grain yields in both years from the zero tillage treatments were either equal to or better than those from conventional tillage. This contrasts with the findings of Davaud and Wickham (1980) and Doyle and Forrester (1980) under zero tillage and stubble mulching regimes respectively. With greater experience in weed management, planting techniques, field management and agronomics, it is thought that crop yields under zero tillage could be increased above the levels already achieved.

It is evident that management requirements with this system are much higher than with conventional farming practices. Not only is weed and herbicide management critical, but stubble must be correctly managed in terms of length and distribution. Long, poorly spread straw poses problems at planting and can enhance weed growth under certain circumstances. Care at harvest can minimize these problems. It is difficult to plant seed at the desired depth in the wheel tracks from the harvesting operation in the previous year or the tracks from any other vehicular traffic. Also, some degree of stunting of plants growing in wheel tracks has been observed with barley more than wheat. Further observations are required.

There is considerable information to be gained on the suitability of different crop varieties for zero and reduced tillage systems. A trial comparing four wheat varieties during 1980 indicated that there are varietal differences with respect to seedling vigour. Further evaluation is planned.

Stubble is a vital part of the system not only from erosion control and runoff viewpoints, but also for moisture accumulation (D.M. Freebairn, personal communication, 1981). The level of straw required for a reasonably efficient fallow on different soil types under different environmental conditions is not known. Trial results show that higher levels of straw give a higher yield.

There appears to be ample scope for improving the fallow efficiency and water use efficiency over that obtained under conventional fallow, particularly in western areas. In north-west New South Wales eight zero tillage sorghum trials over two years showed an average increase in yield of over 30% compared to conventional cropping (W.L. Felton, personal communication, 1981) indicating that zero tillage can contribute to this and in so doing could change the entire cropping system. Possibilities are that opportunity cropping in the eastern Darling Downs' areas and sorghum growing in the western areas could be made more reliable (Berndt and White 1976). Further, it could permit westward expansion of the wheat belt.

LITERATURE CITED

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