

COMMERCIAL USE OF CONSERVATION TILLAGE IN AUSTRALIA

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Summary. Conservation Tillage practices in Australia cover a broad range of managerial techniques based on herbicide use to reduce or replace cultivation for weed control in fallows and prior to sowing. Such techniques reflect individual managerial, agronomic, and rotational needs and have evolved from initial direct drilling and no-till fallow techniques. While basic herbicide and agronomic strategies exist for most cropping areas, further development of application technology and herbicide use, in particular, offer more potential. A healthy extension system is important to maintain the growth in Conservation Tillage usage.

INTRODUCTION

Conservation Tillage encompasses farming practices that conserve resources, particularly soil and water, by reducing or removing cultivation for weed control in fallow or prior to sowing. Such techniques generally replace cultivation with herbicides for weed control.

Conservation Tillage in Australia is as diverse as the soils and cropping rotations of the continent and a review of the current situation needs to be sufficiently broad to cover the major issues.

WHERE HAVE WE COME FROM?

Reductions in tillage by Australian farmers commenced in the 1950's as rotations widened from fallow based to include improved pastures (French, 1963).

Herbicide use occurred initially for problem weed control; eg. 2,4-D application to Skeleton Weed (*Chondrilla juncea*) in pasture and fallow (Tindale, 1954; Wells, 1971); and with the adoption of pre-emergent herbicides, eg. trifluralin and triallate, throughout the 1970's to reduce the dependence on cultivation for in-crop weed control. Farmer desire to reduce cultivation and the advent of broadspectrum herbicides has led to the direct reduction or replacement of cultivation more commonly associated with Conservation Tillage.

The two major components in the development of Conservation Tillage techniques have been (i) the generation of weed control strategies with the herbicides, and (ii) the development of an agronomic "package". Such development has occurred on a co-operative basis between the chemical industry and government agencies often on a project team basis; initially based around paraquat and diquat, and later glyphosate.

Development was based initially on the direct drill technique in southern and Western Australia and more recently on the fallow management techniques in northern New South Wales and Queensland. Separate to weed control other components of the new techniques have included in-crop weed management particularly for Annual Ryegrass (*Lolium rigidum*) and Wild Oats (*Avena fatua*), sowing equipment and crop establishment, application technology, and the long term effects of herbicide usage. Stubble retention practices in the northern areas (Marston and Doyle, 1978) have increased the emphasis on sowing equipment.

Conservation Tillage development initially concentrated on the total replacement of pre-sowing cultivation with herbicides, unquestionably a quantum leap in farming practice. The direct drill approach usually requires only one herbicide application. On the other hand repeated knockdown herbicide applications or risky residual herbicide use is the case in the northern fallow areas. Farmer adoption has generally reflected this difference. The fallow spray approach in northern areas of spraying emerged weeds in prepared fallows (Fellowes et. al., 1979) has been widely adopted however.

The availability of suitable herbicides has enabled farmers to reduce cultivation at their own "pace" while still utilizing their investment in tillage equipment. Following initial experimentation most farmers realize managerial related benefits and modify techniques to suit their individual farm requirements.

Extensive commercial market development supported by varying levels of public sector extension has resulted in rapid farmer adoption of Conservation Tillage techniques in recent years. As shown in Figure 1 this growth has been affected by seasonal conditions, eg. "wet" 1981 and 1983 compared to 1982 drought, however the strong growth trend is very evident.

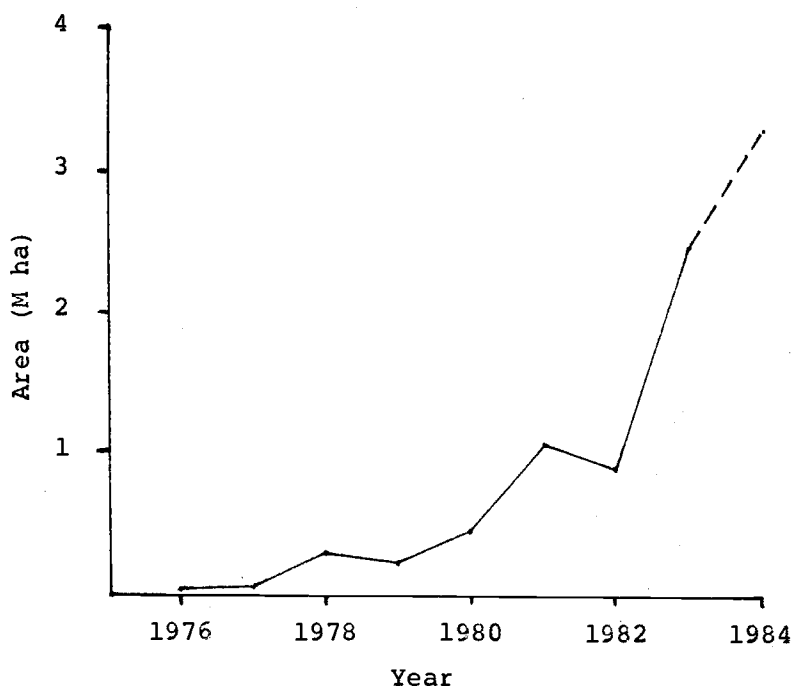


Figure 1. Area of Wheat and Barley sown in Australia 1976-1983 (projected 1984) using Conservation Tillage techniques.

Source : Industry estimates and Monsanto Market Research.

Extension of the range of herbicides to include in-crop weed control has also been of prime importance with the development of diclofop methyl in the late 1970's and more recently the increased versatility afforded by chlorsulfuron.

THE CURRENT SITUATION

In 1983 approximately one third of wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*) farmers used some form of Conservation Tillage on approximately one sixth (2.45 M ha) of the sown area, based on herbicide use prior to sowing (Monsanto Market Research). Projected areas for 1984 depend on seasonal conditions and vary from 2.8 to 3.9 million hectares. Considerable areas of winter cereal are also sown in the lower rainfall areas of southern and Western Australia using no herbicide or cultivation prior to sowing, relying on post-emergent applications of herbicides in the crop (G.A. Pearce, personal communication, 1982; P. Parker, personal communication, 1984).

Market research between 1981 and 1983 indicates that the major perceived advantages of Conservation Tillage are related to (i) benefits to the soil by reducing cultivation, and (ii) savings in managerial or physical inputs (eg. time, labour, fuel). Regional influences such as extra grazing (south) or soil moisture conservation (north) are also evident.

Farmer reservations relate mainly to the use of herbicides and perceived long term effects in the environment, and the direct cost of herbicides.

Increased managerial flexibility is very obvious following adoption allowing not only more efficient farming operations but often fundamental changes to the farm programme, eg. favourably altering rotations (Ronan and Edwards, 1983). Where some tangible benefit is available, eg. a yield benefit for summer crops (Holland and Felton, 1983) or control of Sorghum (*Sorghum bicolor*) stubble regrowth with glyphosate (Monro, 1984), the farmer is motivated even further to adopt such techniques.

The influence of seasonal conditions is very obvious with many farmers initially using herbicides to solve a weed control problem before sowing in "wet" seasons. Favourable farmer experience from such use generally leads to wider adoption of Conservation Tillage practices in subsequent seasons.

While the basic herbicide and agronomic recommendations now exist for the major cropping areas, the following aspects warrant further attention at the practical level.

1. Application technology.

A detailed market survey in 1983 of glyphosate use in Conservation Tillage indicated that lower water volume techniques were being widely used with half the volume of herbicide applied in less than 50 L ha⁻¹ (Table 1). Nationally, 80% of farmers applied the herbicide themselves with regional differences in water volume very evident.

Table 1. Water volumes used for application of glyphosate (as Roundup herbicide) in Conservation Tillage throughout Australia in 1983.

Water volume (L ha ⁻¹)	Percentage herbicide applied						
	Nationally		By farmer respondents in				
	by volume	by farmers	Qld.	N.S.W.	Vic.	S.A.	W.A.
1 to 50	51	37	32	36	18	24	72
51 to 80	16	19	37	19	20	24	15
81 to 120	19	28	17	34	48	37	4
> 120	2	4	6	4	8	9	2
Other ¹	12	12	8	7	6	6	7

¹ Responded as "Recommended Rate" or "Don't Know".

Such differences are ascribed to farm size, availability of good water supplies, and the variable extension of spray application technology. There are distinct managerial as well as technical benefits from using low water volumes in Conservation Tillage (Campbell et. al., 1984). The adoption of low water volume technology is expected to increase associated with Conservation Tillage.

2. Chemical technology and use.

Basic broad herbicide strategies for both pre-sowing and in-crop weed control are now established. At regional levels, herbicide mixtures have developed to suit individual requirements, eg. soil characteristics, weed spectrum and density. While this has broadened the arsenal of herbicide treatments available to the farmer, appropriate extension is necessary to ensure their correct positioning. Farmer experimentation continues to allow useful incorporated herbicides such as trifluralin and trillate to be used under Conservation Tillage conditions.

Separate to the major use of broadspectrum herbicides prior to sowing wheat and barley, alternative uses are now rapidly developing. The recent development of glyphosate for pasture topping (Blowes et. al., 1984) has re-established the value of this technique originally developed with paraquat. In northern Australia the response of Sorghum to Conservation Tillage has stimulated the use of glyphosate for both pre- and post-harvest management of the crop.

Australian farmers are showing a willingness to take the chemical technology available and develop new uses to suit their managerial needs, often ahead of the chemical industry and extension agencies.

Current development of new chemical technology in Australia is concentrating on further improving in-crop weed control. Beyond this, Conservation Tillage provides a new focus for herbicide development with commercial research targets changing, eg. fallow residual herbicide development. These changes alter product performance requirements, such as residual characteristics and absolute efficacy, from those normally associated with in-crop usage. Efficacy requirements become absolute rather than assisted by crop competition for example.

Agrochemical development is inherently stringent with respect to environmental and toxicological requirements, with new compound profiles reflecting increasingly stringent assessment. Increased requirements for new chemistry in terms of product performance and safety will effect the availability of new compounds and place more value on those that survive this rigorous evaluation process.

3. Information and communication.

The increasing diversity of Conservation Tillage has created a broad base of information for the farmer and his advisors to interpret. The current communication revolution offers tremendous potential in the dissemination of information, however the value of individual extension worker and farmer contact still needs to be recognized. Conservation Tillage techniques have been "hailed as the greatest technological advance in crop husbandry since the mechanisation of seedbed preparation and sowing in the late 18th century" (Hutchings, 1977). Communication of further developments and new technology will need continuing on-farm activity.

THE FUTURE?

The continued adoption of Conservation Tillage techniques by Australian farmers is assured, with the rate and magnitude dependent to a large degree on the extension input from both the public and private sector. Issues that may effect this process are summarized as follows :

1. Application technology.

Improvement in application equipment design, reliability, and accuracy is necessary to support the intensification of herbicide usage, and extension needs to parallel such development.

2. Agronomic technology.

Conservation Tillage techniques involve substantial alteration to the crop environment and consequent agronomy. The technical infrastructure of applied research needs to be maintained and strengthened where necessary to provide relatively quick answers to problems arising, eg. crop tolerance studies, soil dissipation of herbicides, weed ecology.

3. Extension.

As discussed, a framework of both public sector and chemical industry extension is paramount to enable successful transfer of new developments to the farming community. Specialized private sector extension by farm consultants is also expected to increase in association with Conservation Tillage.

4. Chemical technology.

Australia's cereal cropping areas are significant by world standards and as such provide a suitable environment for commercial development of new chemical technology. Australian farmers have demonstrated considerable managerial skill in the judicious use of the herbicide technology available to become the leaders in Conservation Tillage use for large scale cereal cropping. A favourable regulatory environment will ensure continued access to new chemical technology as it develops.

CONCLUSION

Conservation Tillage development and commercial usage in Australia has involved co-operative action by industry, government agencies, and the farming community to develop new farming techniques. The catalyst of appropriate herbicide technology and the fundamental need for more resource conservative farming techniques has stimulated this development. The use of Conservation Tillage techniques is rapidly growing providing new opportunities in the development of application, herbicide, and agronomic technology, plus an extension challenge in the dissemination of this information.

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