

Have we found a new sustainable farming system?

David K. Malinda and Rick Darling

South Australian Research and Development Institute
PMB 2, Glen Osmond, South Australia 5064. E-mail Malinda.david@saugov.sa.gov.au

Abstract

"Tillage rotation" is a novel system used to rehabilitate compacted subsoil. The management of the hardpan through varying depth of tillage at seeding has improved the crop's ability to utilise soil moisture and nutrients, resulting in significant higher gross margin compared with no-till and conventional cultivation.

Key words

Tillage rotation, no-till, conventional cultivation, subsoil, water use efficiency, gross margin.

Introduction

Red-brown earths and similar heavy soils comprise a large area of cropping land in southern Australia. Severe degradation including compaction in these soils occurred during the 1930's to the 1940's when the land was intensively cropped to wheat following a long fallow cultivated for about 10 months (1). First attempts to biologically ameliorate these soils took place during the 1950's (2) followed by conservation farming systems such as no-till and stubble retention in the 1960's, and 1970's. Although these systems have shown promise (3, 4), repair of compacted subsoil has been slow and yield has not significantly improved, thus slowing adoption of the systems (5). In 1997 we initiated a trial to examine the subsoil parameters that limit sustainable production. In this paper we report the economic impact of rehabilitating compacted subsoil in red-brown earths.

Material and methods

A comprehensive trial design, measurements and analysis are reported in (6). Briefly, "Tillage rotation" (TR) is compared with (NT) and conventional cultivation (CC). The TR treatment uses narrow leading edge points with horizontal wings designed for deep tillage, but with normal seed depth placement in a direct drill operation to a depth of cut up to 150 mm, but varying from year to year to avoid a consistent uniform depth of working. NT uses narrow points for direct drilling. CC uses wide shares with two cultivations plus seeding. The three regimes are being tested in wheat-barley-wheat-wheat (WBWWW), wheat-pasture-pasture-wheat (WPaPaW), and wheat-grain legume-canola-wheat (WGICaW) rotations.

Results and discussion

Improved surface and subsoil conditions with TR (6) generally increased the use of water (Table 1) as a result of a significant increase in rooting depth (6). An economic appraisal of the results indicates that the newly developed TR system is more profitable for farmers than CC and NT (Table 2). Since water use efficiency is a useful indicator of management efficiency, and since the data has been consistent in the last four years, these results are of particular interest to farmers.

Table 1. Water use efficiency (% of potential calculated by the method of 7)

Year and crop	Rotation 1 (WBWWW)			Rotation 2 (WPeCaW)			Rotation 3 (WPasPasW)		
	TR	NT	CC	TR	NT	CC	TR	NT	CC

1997 Wheat	60	53	54	60	53	54	60	53	54
1998 Barley	87	92	91						
1998 Peas				60	61	55			
1998 Pasture									
1999 Wheat	87	81	74						
1999 Canola				50	37	46			
1999 Pasture									
2000 Wheat	65	59	54	103	94	98	107	98	96

Table 2. Summary of Gross Margin Results (\$/ha). Gross margin is defined as the difference between gross income (price x yield) of a particular enterprise such as wheat, and the variable costs for growing the crop.

Year and crop	Rotation 1 (WBWWW)			Rotation 2 (WPeCaW)			Rotation 3 (WPasPasW)		
	TR	NT	CC	TR	NT	CC	TR	NT	CC
1997 Wheat	307	258	252	307	258	252	307	258	252
1998 Barley	618	659	643						
1998 Peas				134	94	64			
1998 Pasture							15	15	15
1999 Wheat	509	454	418						
1999 Canola				351	188	327			
1999 Pasture							29	29	29
2000 Wheat	342	286	231	697	605	639	733	640	621

Average	444	414	386	372	286	320	271	236	229
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Conclusion

Economic benefits are being realised from managing the hardpan with the use of rotational working depths. This result was consistent across all rotations assessed in this trial. The consistency of this result provides a clear indication to farmers that this technology has relevance for their business. In the case of this trial, it has been observed that tillage machinery does not require upgrading in order for the hardpan management by tillage to be used. More notable is that rotational selection had the strongest impact on profitability, with the more intensive continuous cereal rotation providing the best average gross margin results.

Acknowledgments

GRDC, for its financial support to conduct the trial and attend the conference, Ashley Robinson, on whose land we conducted the trial, and Primary Sales Australia, for assistance with tillage tools, are all greatly acknowledged.

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