Whole-farm management of water repellence in the West Midlands – productivity & economic benefits

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Purpose:	To assess the whole farm implementation of water repellence management strategies.
Location:	**'**Rubicon' Goonderoo Rd, Badgingarra
Soil Types:	Pale deep sand; Sandy gravel
Rotation:	2010 Barley; 2011 Lupin; 2012 Barley
Growing Season Rainfall (April- October 2012):	338 mm (BRS)

BACKGROUND SUMMARY

A number of options exist for managing water repellent sandplain soils. The range of options include better sowing methods that are relatively cheap to implement and can be used over the whole cropping program and long-term though more costly amelioration methods such as clay spreading, mouldboard ploughing and rotary spading. In this report we assess the results of an on-farm soil amelioration demo but also assess the net whole farm benefit from using a winged point paired-row seeder over the cropping program plus adoption of 450 ha of mouldboard ploughing.

METHODOLOGY

Soil amelioration trial

Machinery used 2012: Gregoire-Besson 9-furrow mouldboard plough; Morris Contour Drill with paired-row sowing points

Repetitions: Large scale demonstration – 2 replicated control strips only (see Trial Layout)

Crop type, seeding rate and date 2012: Hindmarsh barley, 70 kg/ha, 16th June.

Fertiliser rates 2012: 100 kg/ha MacroPro at seeding; 2x post-seeding of 75kg/ha NS61

Treatment rates and dates: 2010 – mouldboard ploughed 5 ha
2012 – mouldboard ploughed a further 30 ha in the trial area
2012 – clay strips 150 t clay-rich subsoil/ha

Whole farm

Winged paired-row seeding: Morris Contour independent-opener seed drill used for sowing 2230 ha of crop

Mouldboard ploughing: Gregoire-Besson 9-furrow mouldboard plough used on a total of 450 ha then sown to either wheat or barley in 2012.

TRIAL LAYOUT

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Clayed 2012 ~150t subsoil/ha
Untreated Control 1
Mouldboard 2010
Clayed 2012 on Mouldboard 2010
Mouldboard 2010
Untreated Control 2
Clayed 2012 + Mouldboard 2012
Mouldboard 2012

RESULTS and DISCUSSION

Andrew has undertaken several on-farm trials including a seeder comparison and two mouldboard ploughing trials. In 2011 Andrew's Morris 9000 knife-point seeder was compared with a Morris Contour independent opener seed drill with a paired row double-shoot winged opener so that seed is placed near the walls of a 4-inch wide furrow. Wheat establishment was doubled using the paired-row seeder in more severely water repellent patches. The overall bulk-harvest yield benefit was 190 kg/ha. While this yield increase for a different seeder is encouraging in a similar comparison at Jeff Fordhams property the bulk harvest yield improvement was over 500 kg/ha indicating the benefits can in fact be much larger. In 2012 Andrew purchased a Morris Contour Drill and used it over his entire cropping program which included 658 ha of wheat, 677 ha barley, 416 ha 'TT' canola, 247 ha 'RR' canola , 195 ha lupin and 32 ha oats.

In 2010 Andrew established two large scale on-farm mouldboard plough trials (Table 1) on repellent soil with ploughing resulting in yield increases >1.0 t/ha for wheat and barley and between 0.5-1.0 t/ha for lupins (Table 1). The measured yield increases were partly a result of overcoming the water repellence by soil inversion and improving crop establishment. For example, at site 1 barley establishment was improved by ~50% (40 more plants/m^2) in 2010, lupin establishment increased by 300% (33 more plants/m^2) in 2011 and barley establishment by 75% (75 more plants/m^2) in 2012. However additional productivity benefits are likely a result of soil loosening (deep ripping effect), improved nutrient access and enhanced crop root growth in the 10-40 cm layer could all contribute to the measured yield improvement.

Table 2. Yield increases in two on-farm mouldboard plough (MBP) trials at Badgingarra on highly water repellent sandplain soils. Ploughing was done in 2010. Note that for site 2 the whole paddock was ploughed in 2012 so no comparative results are available.

Season	GSR (mm)	Site 1 – Pale Deep Sand			Site 2 – Pale Sandy Gravel		
		Crop	Grain yield (t/ha)		Crop	Grain yield (t/ha)	
			Control	MBP		Control	MBP
2010	300	Baudin barley	0.8	2.0	Calingiri wheat	1.0	2.2
2011	485	Mandelup lupin	0.8	1.8	Mandelup lupin	1.3	1.8
2012	337	Hindmarsh barley	1.4	2.7	Hindmarsh barley	n/a	n/a

In 2012 additional clay spreading strips were incorporated into the soil amelioration trial. Clay-rich subsoil was spread at a rate of ~150 t/ha, due to time constraints clay incorporation was minimal in 2012 and this probably limited crop response to claying (Fig. 1). On average the 2010 mouldboard ploughing increased barley grain yield by 1.33 t/ha over the untreated control, a 95% yield increase (Fig. 1) in the third season. The average 2012 mouldboard ploughing increased grain yield by 1.02 t/ha, a 73% increase (Fig. 1). It was encouraging to see that in this trial there has been no decline in crop response to the 2010 mouldboard ploughing. This trial will continue to be monitored to see if the clay and mouldboard treatments provide future benefits.

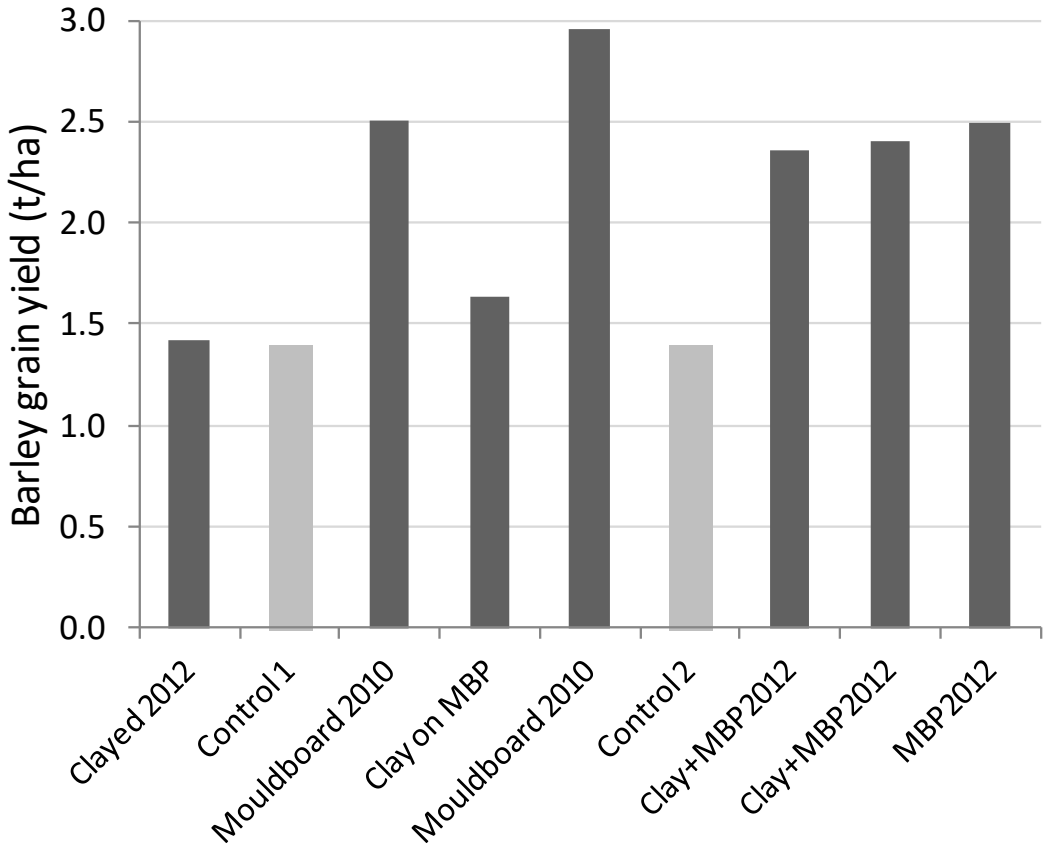

Figure 1. Barley grain yield (t/ha) in response to various combinations of clay spreading (150 t clay-rich subsoil/ha) and mouldboard ploughing (MBP) on a strongly repellent pale deep sand at Badgingarra.

In 2012 Andrew ploughed a total of 450 ha over the farm which was sown to either wheat (180 ha) or barley (270 ha). While control areas were not left in each paddock the paddock yields achieved suggest substantial yield improvements, up to 1 t/ha in some cases. In good gravel soils wheat and barley yields ranged from 4.0-4.5 t/ha while in the poorer sand soils barley yields were 2.5-3.0 t/ha. Andrew commented that for some of these paddocks these were the best yields ever achieved.

FINANCIAL ANALYSIS - NET WHOLE FARM BENEFIT

Based on the results outlined above the net whole farm benefit (Table 2) for a total arable area of 3700 ha was calculated for both the winged boot + paired row seeder, which was used over the entire cropping program (2230 ha), and for the mouldboard ploughing (450 ha). Mouldboard ploughing was costed by the grower at approximately $150/ha including driver, tractor, plough, levelling and rolling costs.

For net whole farm benefit a conservative estimate of 100 kg/ha yield benefit is used for the paired-row seeder compared with a knife point seeder despite this being the lowest benefit recorded in the 2011 trials. A cereal yield benefit of 900 kg/ha is used for the mouldboard ploughing which is on the low side of the measured trial benefits (Table 1) on this farm. The economic benefit has been calculated using the actual crop makeup on the ploughed areas of barley (270 ha) and wheat (180 ha). Using these values it can be seen that the estimated net whole farm benefit was $19/ha for the winged boot + paired-row seeder and $15/ha for mouldboard ploughing in 2012 in the first year only (Table 2). This amounts to an overall additional profit of $77,700 for the new seeder used over the 2230 ha of cropping and $54,000 for the 450 ha of mouldboard ploughing in year 1 only.

Table 2. Net whole farm benefit (using 2012 grain prices) over a range of yield benefits from a paired-row seeder (compared with standard knife point seeder) and mouldboard ploughing on a 3700 ha Badgingarra property with common repellent soils.

Paired-row Seeder		Mouldboard Plough (Year 1 only)	
Yield Improvement (t/ha)	**$/ha improvement**	**Yield Improvement (t/ha)**	**$/ha improvement**
0.05	$7	0.05	-$16
0.10	**$19**	0.15	-$13
0.15	$31	0.30	-$7
0.20	$42	0.45	-$2
0.25	$54	0.60	$4
0.30	$65	0.75	$9
0.35	$77	**0.90**	**$15**
0.40	$88	1.05	$20
0.45	$100	1.20	$26
0.50	$111	1.35	$31

Paired-row seeding and mouldboard ploughing combined have had an estimated net benefit of $33/ha averaged over the 3700 arable hectares for Andrew in 2012. Many of the paddocks had been cropped continuously for 10 years so reduced and more effective herbicide use was a significant additional benefit. This analysis is for the first year only and the impressive long-term benefits in the moudlboard plough trials suggest that the ongoing

financial benefit of ploughing will be large. Andrew intends to continue mouldboard ploughing and using the paired row seeder which he partly purchased because it is good for seeding ploughed areas.

Andrew has undertaken claying in the past and found it does work but the cost is prohibitive and he has found that mouldboard ploughing gives a similar yield response but for only one-fifth of the cost of claying. It is not known how long the benefits of ploughing will last although significant yield increases have been measured 4 and 5 years after ploughing in some long-term trials.

CONCLUSION

Andrew's management of water repellence demonstrates that a strategy of affordable progressive amelioration and better sowing methods for the rest of the crop can be a successful and profitable approach for managing soil water repellence. On-farm testing of water repellence management options can help confirm which strategies are likely to be successful and profitable on particular soils and landscapes. The use of winged paired-row systems, winged points, banded-wetting agents, on-row seeding or broadcast spreading a proportion of the seed ahead of the bar can all potentially improve the effectiveness of sowing on water repellent soils and this is the subject of ongoing research.

PEER REVIEW: Craig Scanlan (DAFWA Northam)

ACKNOWLEDGEMENTS

We particularly thank Andrew and Gina Kenny, family and staff for trial establishment, support and allowing access to the site. Research funded by DAFWA & GRDC through the "Delivering agronomic strategies for water repellent soils in WA – DAW00204" project and by the West Midlands Group. Kari-Lee Falconer's involvement is supported by DAFWA through the "Bridging the Yield Gap" project.