Maximising De-compaction and Minimising Water Repellence in Sandy Soil at Binnu- 2015GE96 Trial report 2015

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Introduction

Crops on WA sandy soils are often restricted to below yield potential by subsoil compaction, acidity and water repellence. Subsoil compaction is caused by heavy agricultural equipment greater than one tonne. Machinery size is increase to improve efficiency forcing compaction deeper. Soil strengths greater than 2.5mPA are being found at 400-600mm that severely restrict plant root growth. In a drying environment, where more moisture equals more grain and profit, plant root access to deeper moisture and nutrients is vital.

Department of Agriculture and Food Western Australia's GRDC funded project DAW00243 "Minimising the effect of soil compaction on crop yield" is evaluating new methods of ripping to remove deep compaction and extend the lifetime of the investment in a controlled traffic system. The ripper has a shallow leading tine and following deeper tine system for de-compacting deeper than 300mm (450-600mm depending on conditions). The ripper also has the capacity to add topsoil and ameliorants to the subsoil using topsoil slotting plates attached behind the tines and a hydraulic cage roller for better firming, levelling and clod crushing.

Aim

Identify profitable long term management of subsoil compaction for deep sandy soil at Binnu

Trial details

Property	Binnu
Soil type	yellow pale sand (dune) and loamy yellow sand (swale)
Crop	Mace
Paddock rotation	2014: canola
Treatments	De-compaction: control, ripped to 300mm, ripped to 550mm, ripped to 550mm with topsoil slotting plates Soil amelioration: 5 t/ha lime, 10t/ha organic pellets top-dressed prior to seeding
Replicates	3
Sowing date	11th May
Seeding rate	70 kg/ha
Fertiliser (kg/ha)	65kg/ha MAP:MOP 70:30 Blend – Deep Banded, post emergent 115kg UREA:AMSOL:MOP 56:28:16
Rainfall total	385.4mm (See table 1 monthly distribution)

Table 1: Monthly rainfall total for 2015 (mm)

Date	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Monthly	3.5	11	115	42	18	90	64	37	3.5			

Table 2: Soil test results the week prior to seeding

Depth	NH4 mg/Kg	N03 mg/Kg	P Colwell mg/Kg	K Colwell mg/Kg	S mg/Kg	OC %	EC dS/m	pH Level (CaCl2)	Al CaCl2 mg/Kg	PBI	MED
DUNE											
0-10	0.5	3.5	19	12	4.7	0.39	0.022	5.8	0.31	11.5	1.5
10-20	0.5	1.0	23	7	2.0	0.25	0.008	4.7	2.70	11.3	0.5
20-30	0.5	0.5	6	14	4.5	0.15	0.009	4.5	5.86	12.9	0
30-40	0.5	0.1	4	7	6.2	0.07	0.013	4.3	6.23	11.1	0
30-40	0.5	0.1	2	7	8.7	0.02	0.014	4.2	6.33	13.6	0
40-50	0.5	0.1	1	15	7.8	0.02	0.010	4.3	5.40	17.3	0
50-60	0.5	0.1	1	13	7.4	0.04	0.012	4.9	0.82	15.5	0
70-80	0.5	0.1	1	7	7.3	0.02	0.010	4.9	0.45	16.0	0
80-90	0.5	0.1	1	7	7.2	0.02	0.005	5.0	0.32	15.1	0
90-100	0.5	0.1	1	13	8.5	0.06	0.024	5.9	0.10	15.0	0
SWALE											
0-10	0.53	3.0	17	38	1.9	0.50	0.016	6.1	0.01	7.9	2
10-20	0.05	2.0	20	23	1.7	0.41	0.012	5.3	0.50	8.7	1.5
20-30	0.05	0.5	18	9	2.5	0.17	0.008	4.7	1.19	9.0	0
30-40	0.53	2.0	12	9	2.5	0.12	0.008	4.5	1.73	7.7	0
30-40	0.05	0.5	7	23	4.8	0.10	0.009	4.6	1.05	11.9	0
40-50	0.05	1.0	3	20	5.7	0.11	0.008	4.7	0.71	12.4	0
50-60	0.05	1.5	2	10	6.3	0.07	0.009	5.1	0.33	13.0	0
70-80	0.05	0.5	1	20	7.3	0.05	0.008	5.3	0.01	13.5	0
80-90	0.05	0.5	1	21	7.2	0.06	0.009	5.7	0.01	16.1	0
90-100	0.05	0.5	6	23	6.8	0.04	0.008	5.7	0.01	16.5	0

Results

Yield was significantly increased by ripping to 550mm at both sites (Figure 1 and 2). Deeper ripping and topsoil slotting added about 1.0 and 1.4t/ha at the dune and swale site respectively.

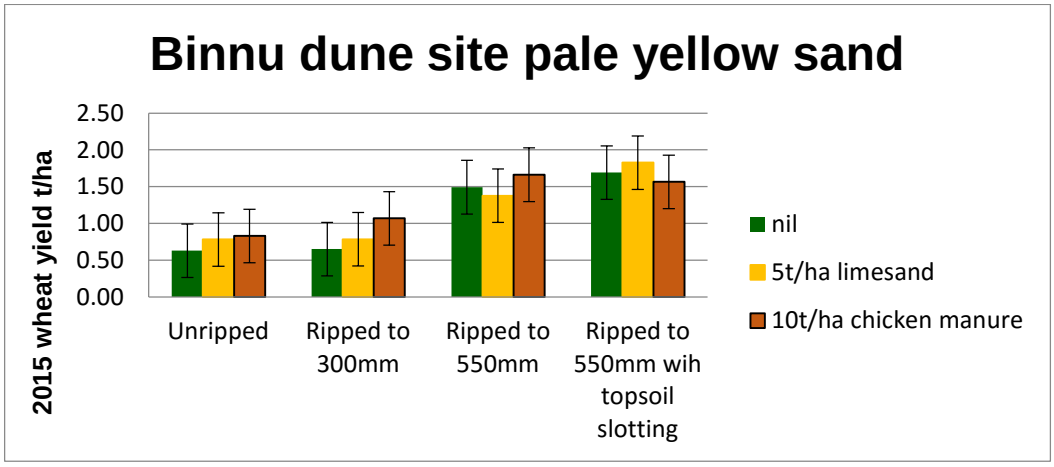

Figure 1: Wheat yield 2015 on the dune site a pale deep sand. LSD 5% 0.364

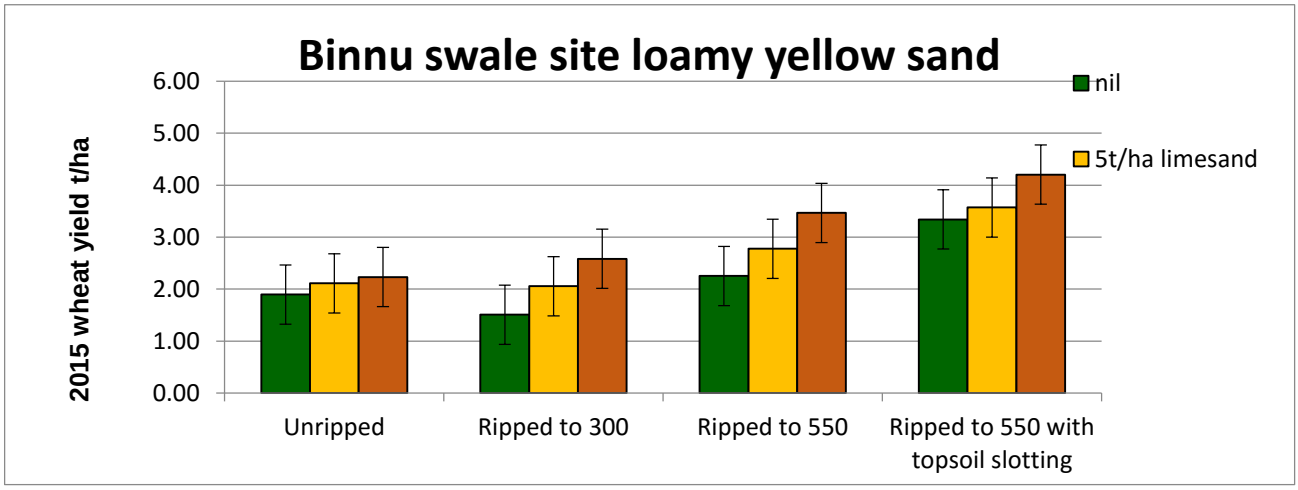

Figure 2: Wheat yield 2015 on the swale site a yellow loamy sand. LSD 5% 0.57

The number of heads increased with ripping as did the protein with no topdressing or lime (table 3). The best return on investment was gained from ripping to 550mm and ripping to 550mm with plates.

Table 3: Grain quality and economic analysis results 2015 Binnu dune and swale site. Bold and underlined is at least 95% probability difference, bolding alone is at least 90% probability difference from Nil rip or top dress. Yellow highlight for ROI>10.

	No top dressing				**5t/ha lime top-dressed**				**10t/ha organic pellets**			
	R300	R550	R550TS	nil	R300	R550	R550TS	nil	R300	R550	R550TS	nil
Dune												
Yield t/ha	0.65	**1.49**	**1.69**	0.63	0.78	**1.38**	**1.83**	0.78	1.07	**1.66**	**1.57**	0.83
Protein %	**11.9**	**11.5**	**14.7**	13.4	*10.6*	**9.2**	11.4	11.8	**10.5**	**9.4**	11.8	11.8
Scrns %	3.1	**3.9**	2.9	2.2	2.0	1.2	1.5	1.2	1.8	2.1	1.6	1.5
2-2.5mm %	**33**	**39**	**33**	26	26	26	28	23	24	**32**	28	22
grains/head	21	**45**	**46**	19	28	**44**	**48**	24	27	**31**	**28**	21
heads/m2	85	93	**107**	88	**74**	79	**102**	84	**104**	**138**	**140**	**103**
GRADE	H2	H2	H1	H1	APW1	ASW1	APW1	H2	APW2	ASW1	H2	H2
price $/t	**287**	**287**	**297**	**297**	**282**	**274**	**282**	**287**	**279**	**274**	**287**	**287**
ROI 1 Yr	-1	5	6	0	-1	0	1	-2	-1	-1	-1	-1
ROI 5yrs	0	26	31	0	0	4	8	-5	-1	-1	-1	-1
Swale												
Yield t/ha	1.51	2.25	**3.34**	1.90	2.05	**2.78**	**3.57**	2.11	**2.58**	**3.47**	**4.20**	2.23
Protein %	**8.6**	**8.3**	9.7	10.1	10.4	9.7	**10.9**	**11.0**	**9.0**	**8.3**	**9.3**	10.1
Scrns %	1.8	1.6	1.0	1.6	1.6	2.2	1.9	1.9	1.5	1.8	1.3	1.6
2-2.5mm %	20.5	**15.6**	20.9	22.1	24.4	26.1	**29.4**	25.8	18.8	**17.0**	22.2	22.5
grains/head	16.6	22.2	**28.4**	20.2	23.2	**30.4**	**36.2**	24.4	22.2	**26.6**	**29.6**	20.7
heads/m2	224.0	240.3	**269.3**	234.7	219.2	226.0	252.5	218.5	**272.0**	**298.6**	**343.5**	255.8
GRADE	ASW1	ASW1	ASW1	APW2	APW2	ASW1	APW1	APW1	ASW1	ASW1	ASW1	APW2
price $/t	**274**	**274**	**274**	**279**	**279**	**274**	**282**	**282**	**274**	**274**	**274**	**279**
ROI 1 Yr	-5	1	8	0	-1	0	2	-5	-1	-1	-1	-1
ROI 5yrs	-17	10	39	0	0	5	11	-17	-1	-1	0	-1

Comments

Ripping to 550mm increased yield in the pale deep sand and yellow loamy sand. The yield penalty of 300mm is likely due to the crop running out of water during the dry spring as the ripping did not remove the hard pan.

The water use efficiency (WUE) at the dune site was calculated as 5kg/mm better than nil (3kg/mm) with deeper ripping and topsoil slotting. The swale site had a WUE of 19kg/mm with topsoil slotted chicken manure, but was in a swale with a possible perched water table, therefore it was uncertain that the WUE was from rain alone.

Topsoil slotting, with soil inclusion plates attached to the rear of deep ripper tines, can increase yield from deep sandy soils more than by deeper ripping alone. Deeper ripping with topsoil slotting also helped lessen grain losses from dry and hot spring weather. If slotting maintains the de-compaction response longer it will provide very good returns on investment.

A full trial report will be available on the DAFWA website.

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