Testing new options for the management of soil water repellence and subsoil compaction in a dry environment

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Location: Tom Powell, Binnu

Key Messages:
- The aim of this trial is to compare new options for the management of water repellent soils with subsoil compaction in low rainfall areas of the Wheatbelt.
- The yield in the control was very low to start with. The addition of clay/compost on the surface and incorporation by offset disc (treatment 2) had little impact on yield (only 0.1-0.2 t/ha; Tab 2)
- Deep ripping alone (treatment 3) increased yield by more than 1 t/ha.
- Adding the inclusion plates to the ripper (treatment 4, 5 and 6), increased the yields by an additional 0.4 to 0.6 t/ha over deep ripping alone.
- The combination of clay/compost with deep ripping and inclusion plates increased the yields by an extra 0.15 to 0.2 t/ha compared to deep ripping + inclusion plates alone. However, no significant difference was found between the deep inclusion of clay/compost (treatment 6) and the inclusion of surface clay/compost with the inclusion plates (treatment 5).

Trial Description

Table 1: Average Mace yields and grain quality from the different treatments

Treatment	Plants /m²	Yield t/ha	Protein %	Weight kg/hl	Screenings %
1. Control	20	0.95	11.63	80.68	6.22
2. Clay/compost spreading + offset	48	1.15	12.00	81.11	5.32
3. Deep Ripping 600mm (DR)	53	2.00	10.93	81.69	4.37
4. DR + Inclusion plates	61	2.42	10.98	81.37	4.07
5. Clay/compost spreading + DR + Inclusion plates	59	2.56	11.00	81.71	3.85
6. DR + inclusion plates+ deep incorporation of clay/compost	59	2.64	10.98	82.00	3.58

The trial was design was made for the comparison of different methods of incorporating subsoil clay and compost mixture for the management of soil water repellence (Table 1), in combination of deep ripping (with or without inclusion plates) for the reduction of subsoil compaction.
The clay/compost mixture was applied at an approximate rate of 72 t/ha (62 t/ha clay; 10 t/ha compost), either spread and incorporated with offset discs or deep ripper with inclusion plates or directly placed into subsoil behind ripper tines with inclusion plates (using a modified NuFab deep ripper).
The compost was made from general vegetative waist and produced by C-wise. The typical chemical analysis of the compost is shown in Table 2.

Table 1: Chemical analysis of the OSC compost produced by C-wise

Element	%
Nitrogen (N)	1.2
Phosphorus (P)	0.3
Potassium (K)	0.4
Magnesium (Mg)	0.2
Sodium (Na)	0.4
Organic carbon (C)	30

We also tested a new method for the incorporation of clay/compost in the soil (treatment 6, Table 1): a Nufab deep ripper was modified in order to allow for the deep incorporation of a clay/compost mixture through a pipe just behind the inclusion plates, so that the material was buried at approximately 500mm, completely by-passing the soil surface. The idea behind this approach was that during the late stage of plant growth the clay/compost mixture would allow for more water and nutrient access to roots, while the "untouched" water repellent surface would help harvest water into the furrow and behave as a mulch, reducing water loss through evaporation.

Results

On July 19th 2017, plants counts (plant/m^2) were taken for the assessment of early plant establishment (Table 1). All treatments (2 to 6) outperformed control plots in terms of plant numbers but the best establishments were obtained in all treatments with the inclusion plates (treatments 4, 5 and 6).
In September 2017 soil profiles from each treatment were excavated and root numbers were counted using a 5x5cm grid (90cm wide and 70cm deep). The results in Fig 1 clearly show the effect of deep ripping in improving root growth to depth, particularly important for soil water access to roots during dry seasons such as the one experienced in 2017. Moreover, the results show that adding inclusion plates to the deep ripping significantly increase the number of roots between the ripping lines when compared to the standard deep ripping.
The yields of Mace wheat (harvested on 14/11/17) reflected the results of root growth (Fig 2). The shallow incorporation of the clay/compost mixture by the off-set disc only increased the yield of wheat by 0.3 t/ha in comparison to the control. On the other hand, deep ripping alone increased the yields by more than 1 t/ha when compared to the control, which suggested that subsoil compaction was the main soil constraint.
The addition of inclusion plates to the ripping furthermore increased yields (significantly at $p<0.05$) by 0.4 t/ha (treatment 4) and by 0.6 t/ha (treatments 5 and 6) when combined with the clay/compost mixture.
With regards to grain quality (Table 2), the control and the off-set disc treatments (treatments 1 and 2) recorded the highest protein content (>11.5%). Nevertheless, all the treatments had more than 10.5% of protein.
Moreover, the off-set disc treatment and in particular the control recorder much higher screening % when compared to the treatments with deep ripping (treatments 3 to 6). This result indicated that the wheat from the control and the off-set treatments hayed-off due to limited access to soil moisture at depth, as suggested by the results of the root counts.
In general, no significant differences were found between including surface clay/compost mixture with the inclusion plates (treatment 5) and the deep incorporation with the modified ripper (treatment 6). This suggests that good outcomes can be obtained with existing machinery. Nevertheless, further research is needed to better understand the effect of deep inclusion of clay and compost in the long term.

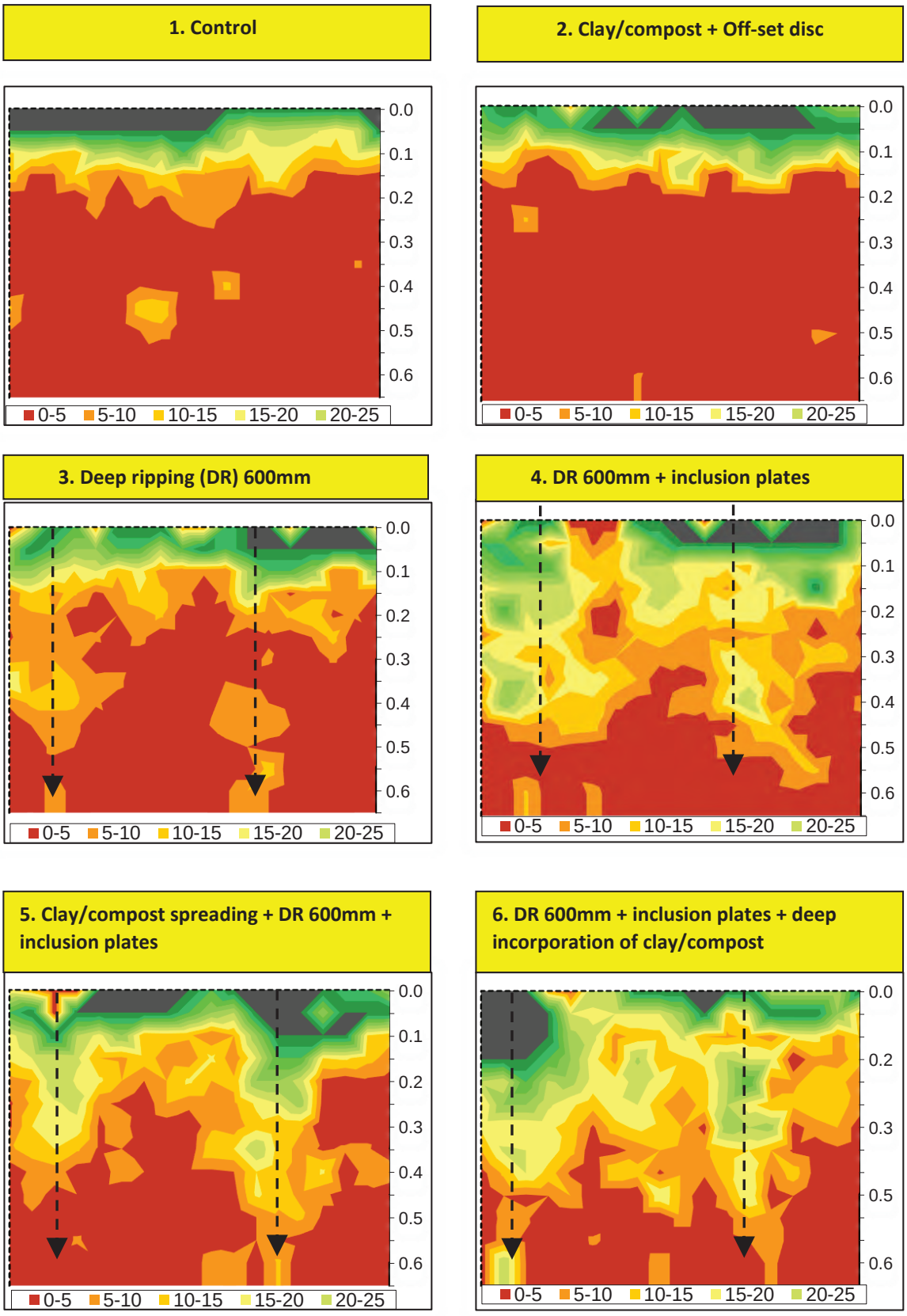

Fig 1. Graphical representation of root density obtained by counting the roots from exposed soil profiles using a 5x5cm grid. Dashed black arrows represent the approximate locations of the ripping lines

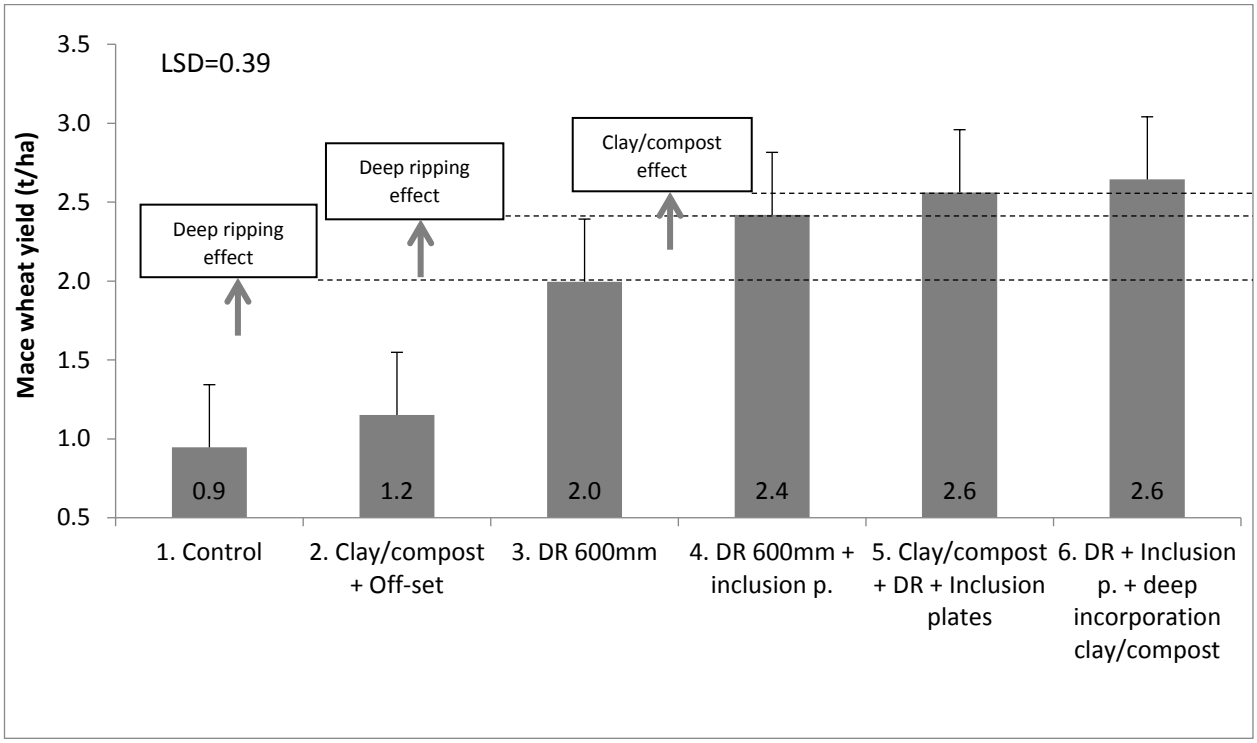

Fig 2. Yields of Mace wheat from the different treatments at the Binnu trial

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