Bentonite Clay and Tillage to Improve Soil and Yield

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Key Messages

- Crop germination was poor on the mouldboard plots and compaction is still a big issue on these plots.
- Bentonite clay has shown no effect on organic carbon %.

Aim

To determine if the inclusion of Bentonite clay improves crop yields on non-wetting sandy soils and their ability to store more carbon.

Background

Bentonite clay, also known as smectite, can be found near Watheroo and is used by home gardeners to increase water and nutrient holding capacity in sandy soils. This trial examines if 6 t/ha of Bentonite clay can improve water and nutrient holding capacity of agricultural soil sufficiently to increase crop yield. The 'A' grade Bentonite sourced from Watheroo costs $130 per tonne and has 82% clay content.

Three methods of incorporating the Bentonite (mouldboard plough, deep ripping and tandem discs) were also compared.

Mouldboard ploughing involves a one-off inversion of the topsoil. The plough in this trial was able to invert the top 30cm of soil. Mouldboard ploughing can help in the control of weeds, burying water repellent topsoil, incorporating lime at depth as well as having a deep ripping effect. Cost of the operation is approximately $100-150/ha (Davies et al, 2012). The deep ripping cost was $60/ha and the tandem disc operation was $30/ha.

Trial Details

Property	Manji Spring, Miling
Plot size & replication	50m x 20m not replicated
Soil type	Yellow sand
Soil pH ($CaCl_2$)	0-10cm: 6 10-30cm: 4.7
EC (dS/m)	0-10cm: 0.04
Sowing date	30/04/2014
Seeding rate	3 kg/ha Benito canola
Paddock rotation	2011: wheat, 2012: wheat, 2013: barley
Fertiliser	30/04/2014: 75 kg/ha Mallee Extra, 25 kg/ha Muriate of Potash, 50 L/ha Flexi N 28/06/2014: 80 kg/ha NS51 25/07/2014: 40 L/ha Flexi N
Herbicides & Insecticides	30/04/2014: 3 L/ha Atrazine, 1 L/ha Propyzamide, 25/05/2014: 2 L/ha Atrazine, 200 mL/ha Talstar 11/06/2014: 500 mL/ha Select, 240 mL/ha Targa, 100 mL/ha Alpha Cypermethrin
Growing Season Rainfall	225mm

Results

This is a large scale farm demonstration which is not replicated and results should be treated with caution. The soil type improves down the paddock from the Bentonite to the non-Bentonite plots which was reflected in increasing yields down the paddock rather than treatment results. This was evident in no significant differences between all treatments on yield in 2013 and 2014. The mouldboard plots had severe compaction issues and several wheel tracks where there was very poor emergence which has impacted the plot yield.

Table 1: Yield and quality of Benito canola on the no Bentonite treatment sown at Miling, 2014.

Tillage type	Treatment	Yield (t/ha)	Protein (%)	Oil (%)
Mouldboard	No Bentonite	0.94	22.4	42.4
None	No Bentonite	0.79	22.1	41.6
None	No Bentonite	1.24	22	42.8
Mouldboard	No Bentonite	1.47	21.9	44.5
Deep rip	No Bentonite	1.94	19.9	45.7
None	No Bentonite	1.61	19.8	45.8
Disc	No Bentonite	1.19	22	43.5

Table 2: Yield and quality of Benito canola on the Bentonite treatment sown at Miling, 2014.

Tillage Type	Treatment	Yield (t/ha)	Protein (%)	Oil (%)
Mouldboard	Bentonite	0.52	21.9	42.5
None	Bentonite	0.63	22.7	41.9
None	Bentonite	0.85	22.2	42.6
Mouldboard	Bentonite	0.87	21.8	44.2
Deep rip	Bentonite	1.22	22	43.7
None	Bentonite	1.45	18.9	46.2
Disc	Bentonite	1.86	20.2	46.6
None	Bentonite	1.93	22.1	43.8

Table 3: Average soil organic carbon as a percentage of soil two years after treatment at Miling, December 2014. Incorporation occurred in 2012.

Cultivation Type	Ameliorant	Soil organic carbon % (0-60cm)
Mouldboard	Bentonite	0.19
Control	Bentonite	0.24
Deep Ripped	Bentonite	0.23
Tandem Disc	Bentonite	0.29
Mouldboard	No Bentonite	0.23
Control	No Bentonite	0.32
Deep Ripped	No Bentonite	0.47
Tandem Disc	No Bentonite	0.27

Comments

In the first year of the trial there was no change in yield or grain quality after the incorporation of Bentonite clay. However, it's important to note that there is an improvement in soil type in the non-Bentonite plots. With this in mind the results from 2014 should also be treated with caution. The soil organic carbon percentage is greater on the plots that were untreated with Bentonite (Table 3) but again we feel that this is more a reflection of paddock variation than treatment effect.

The trial has made the farmer realise that mouldboard ploughing is not practical for their farm unless they can strip down their seeding rig as it is currently too heavy (approximately 70 tonne loaded) and left 18cm deep ruts on the mouldboard plots where the liquid cart followed. There was no plant establishment on these ruts. Another comment was on the narrow window of opportunity there is to implement mouldboard ploughing without the detrimental effects such as wind erosion and compaction. With these factors in mind the farmer has decided that in their particular system deep ripping is the most effective tool they currently have at their disposal. The grower also observed that if the Bentonite has been mixed better in the 20 to 30cm layer that it may have shown a better result.

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References

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