UNDERSTANDING PRODUCTION BENEFITS OF CLAY INCORPORATION AND THE ROLE OF ORGANIC MATTER IN SANDY SOILS

David Davenport, Amanda Schapel, Dr.Rebecca Tonkin, Dr Melissa Fraser, Rural Solutions SA
Melissa.Fraser@sa.gov.au

PROJECT PROPONENT: ADVISORY BOARD OF AGRICULTURE
FUNDING BODY: CARING FOR OUR COUNTRY

Background:

Demonstration sites at Sherwood (Jaeschke) and Bordertown (Groocock) in 2012 and 2013 showed large increases in cereal dry matter and grain yield on plots where organic matter had been incorporated into clayed sands. In 2014, three new sites were established to add further understanding around what occurred and to increase the rigor of the results by increasing the number of trials and replicates within the trials.

These sites were located at: Pine Hill (Janette and Ted Ridgeway's), and two sites at Sherwood (Jaeschke Partners and Trevor and Trish Menz's).

Treatments varied across sites, but included the addition of clay (at previously unclayed sites), the addition of physically incorporated organic matter, and spaded treatments.

SITE 1: JANETTE AND TED RIDGEWAY - PINE HILL RD, PINE HILL (WOLSELEY)

Paddock history
The paddock was initially clayed 15 years prior to the current trial establishment using grey clay from crabholes at an unknown rate (considered to be heavier than current practice). The paddock was delved in 2008 but the amount of elevated clay was patchy, particularly on the rises where the trial is located. The paddock was planted to vetch in 2013 which was cut for hay. There was noticeably less hay cut on the rises with more ryegrass present.

Treatments:
(Plot size: 6 m wide by 25 m long)
3 replicates

- Control (previously clayed and delved)
- Spaded
- Spaded + organic material (OM) – vetch/rye grass hay at approximately 10t/ha

Paddock was sown down to Canola in 2014.

Results
Bulk density values (a measure of weight of soil per cubic cm) in the topsoil ranged from 1.50-1.61 g/cm3 with some values to 1.75 g/cm3 obtained in the 20-30 cm zone (bulk density greater than 1.6 g/cm3 is considered to impact on root development); however, results were highly variable.
This was also reflected in visual assessments of growth with some portions of the plots growing much better than others.
Emergence and yield data were also highly variable within treatments. Spading did appear to reduce emergence (possibly due to depth of seed placement), however, average yields of the spaded treatments were higher than the control (Table 1).

Table 1: Canola establishment and yield data at the Ridgeway site in 2014.

Treatment	Clay	Clay + spading	Clay + spading + OM
Emergence (plants/m)	10.4	8.7	8.6
Yield (t/ha)	1.37	1.54	1.55

NB/ These results should be treated with caution due to the high level of variability in the results

Conclusion

Site variability appeared to impact on the consistency of results. Visually there were large differences in growth within and between the plots. Further investigation is required to identify the factors behind this variability.

SITE 2: JAESCHKE PARTNERS – HUNDRED OF MAKIN RD, SHERWOOD

Paddock history

The trial site is located on a sandy rise (with clay deeper than 50 cm) in a paddock that has only been grazed within known history; veldt grass had been established at site sometime in the past. The site was clayed in March 2014 at approximately 300 t/ha (clay rate measured at 3 locations/plot demonstrated a large degree of variability).

Treatments

(Plot size: 6 m wide by 25 m long)*
3 replicates

- Control - nil
- Clayed
- Clayed + Spaded
- Clayed + Spaded + organic material (OM) – lucerne hay at approximately 10 t/ha

Paddock was sown down to wheat in 2014.

(*emergence and yield measurements were also taken adjacent to trial where landholder undertook clay spreading and shallow incorporation)

Results

Bulk density values in the topsoil ranged from 1.46-1.60 g/cm^3 with values increasing to 1.64 g/cm^3 in the 10-20 and 20-30 cm zones. Values lower than those observed at Site 1 are expected as this site had not previously been cropped.

Plant emergence between clayed and unclayed treatments was relatively consistent, suggesting that non-wetting was not a major issue on this site this year. Crop growth on the clayed site was visually better than unclayed with further increases in clay + spading with clay + organic matter + spading the best treatment; this was confirmed by dry matter assessments (Table 2).

Collection of yield data was impacted by a severe hailstorm just prior to harvest that flattened the crop. Material was collected by hand (3 x 1 m^2/plot) and threshed out. Unfortunately, the reliability of the data has consequently been affected. The dry finish may also have adversely impacted on the

grain yield of the high dry matter sites as the recorded grain yields are not consistent with the mid-season dry matter values.

Table 2. Wheat establishment and yield data at the Jaeschke site in 2014

Treatment	Nil	Clay surface	Clay 10cm incorporation (farmer practice)	Clay + spading	Clay + spading + OM
Emergence (plants/m)	30	31	41	42	32
Dry Matter (t/ha)	0.68	0.96	n/a	1.85	3.28
Yield (t/ha)	0.53	1.10	1.35	2.61	2.51

Clay – surface **Control** **Control** **Clay+OM+Spading**

Photos 1 and 2: taken at the Jaeschke site on 17 October 2014 clearly showing the effect of clay + organic matter + spading on crop performance.

Conclusion

The addition of clay has increased yields on this site particularly when incorporated to 30 cm by spading. The addition of organic matter has provided an additional benefit to dry matter production (photos 1 and 2) but hail damage and possibly the dry finish have made yield impacts less certain.

SITE 3: TREVOR MENZ – EMU FLAT ROAD, SHERWOOD

Paddock history

The trial is located on a low sandy rise with clay greater than 50cm depth that had been clayed with a low rate of clay (80 t/ha) over a decade ago. The paddock has been used as a ram paddock and only been grazed within known history; the pasture consisted of a mix of ryegrass, silvergrass and broad leafed weeds.

Additional clay was applied in March 2014 at approximately 300 t/ha (clay rate was measured at three locations in the plots, but there was a high degree of variability). Incorporation of the clay also resulted in some movement of clay onto “nil” treatments.

Treatments (plot size: 4.5 m wide by 25 m long)

- Control (clayed >10 years ago)
- Spaded (clayed >10 years ago)
- Clayed (clayed >10 years ago + additional clay)
- Clayed + Spaded (clayed >10 years ago + additional clay)
- Clayed + Spaded + organic material (OM) – as above + lucerne hay at approx. 10 t/ha

Number of replicates: 3 Crop 2014: Mac wheat, with 70 kg/ha DAP

Results

Plant emergence between clayed and unclayed treatments was relatively consistent, suggesting that non-wetting was not a major issue at this site this year. Visually, crop growth was better on the clay with organic matter spaded plots compared to the other treatments throughout the season, which was confirmed mid-season by the dry matter assessments (Table 3).

Yield data was quite variable between plots of the same treatment. Also, clayed treatments visually appeared to suffer from the dry finish more than unclayed. Despite this, the organic matter treatments have delivered a large yield increase compared to the other treatments.

Table 3. Wheat establishment and yield data at the Menz site in 2014

Treatment	Control	Spaded	Clay	Clay + spading	Clay + spading + OM
Emergence (plants/m)	31	29	32	43	34
Dry Matter (t/ha)	2.76	2.85	2.64	3.01	4.59
Yield (t/ha)	1.75	1.46	1.71	1.68	2.53

Conclusion

Spading alone and the addition of more clay did not appear to increase growth in this year. This would suggest that non-wetting and soil compaction were not major constraints affecting this site. The incorporation of organic matter combined with clay did, however, provide large increases to both dry matter and yield. The incorporation of organic matter provides a large nutrient benefit, particularly nitrogen, phosphorus and potassium. However, nutrients applied by the landholder should have been adequate to meet the yields delivered. Clay addition would have provided more than enough potassium.

This trial was delivered by David Davenport with assistance from Amanda Schapel, Dr Melissa Fraser and Dr Rebecca Tonkin from Rural Solutions South Australia, PIRSA. Many thanks go to the participating landholders for assisting with the trials.