Southern Incentives Southern Soils

Stirlings to Coast Farmers
Nil Disturbance systems for managing non-wetting soils

PROJECT PROFILE

PROJECT MANAGERS: Stirlings to Coast Farmers Inc. (SCF)
FARMERS: Brad Wood and Family, Beau Valley Farms
LOCATION: Kendenup, WA
AVERAGE ANNUAL RAINFALL: 582 mm
LANDSCAPE: Forest gravels

NUTS & BOLTS

- A long term, broadscale research site has been established in Kendenup to test the hypothesis that by not disturbing the soil, old root pathways are preserved and act as a conduit ('bio pores') for water entry in non-wetting soils resulting in improved soil condition, crop establishment, and crop yields.
- The Wood family of Kendenup and SCF, are comparing disc, tyne and maximum disturbance seeding techniques on a site that has been managed as a nil disturbance system (disc seeding and nil grazing) for 18 years.
- The research has been through one and a half years of study with plant counts identifying that that the nil disturbance farming treatment is favourable in dry start cropping seasons.

***Soil health** is a key focus for natural resource management groups and grower groups across the South Coast, with water repellent and non-wetting soils being an issue across a range of soil types, including the forest gravels of Kendenup.*

Soil water repellence is caused by an accumulation of waxy organic matter in the soil surface. When these waxy, hydrophobic compounds become fused onto the surface of soil particles they create a water repellent skin around soil particles, rendering them hydrophobic (DPIRD, 2018 and Roper and Davies, 2015). Non-wetting soils impact on the environment and production, with issues such as poor, delayed, patchy and staggered emergence of crops, pastures and weeds, poor groundcover, poor weed control, increased risk of soil erosion due to increased run-off on sloping sites and nutrient deficiencies with nutrients not available to the dry repellent soils. Drier autumns, less cultivation, dry sowing and some seeding methods make the expression of water repellence worse (Roper and Davies, 2015).

Management options for soil water repellence are categorised into three types and include;

- Mitigation: improved furrow seeding methods, delaying sowing, higher seeding rates, banding soil wetters in the furrow at seeding or blanket use of soil wetters.
- Amelioration: claying, disc ploughing, soil inversion, rotary spading,
- Avoidance: perennial fodder shrubs, pastures or trees in highly water repellent soils (DPIRD, 2018).

Currently, industry is unsure of the best systems for mitigating non-wetting forest gravels in the high rainfall zone. The Wood family at Kendenup have one paddock that has been continuously cropped for the last 18 seasons using a nil disturbance system (described as disc seeding with nil grazing). Brad Wood has observed a reduction in the non-wetting nature of the soils in this paddock over time. He has achieved better plant establishment which he assumes is increasing crop yield, particularly in dry sowing conditions.

In 2016, Stirlings to Coast Farmers Incorporated (SCF) and the Wood family worked to develop and implement a collaborative, long term research project assessing the ability of nil disturbance systems (NDS) to overcome water repellence in non-wetting gravels and other soil health issues over time. Specifically, the project aims to answer the following longer-term research questions:

1. Is it the NDS, applied over 18 years, that has improved the soil health of the paddock?
2. If so, can the changes in the non-wetting properties of the soils in this paddock be measured by applying NDS treatments versus reversion (tillage) treatments?
3. How long will reversion of the soil condition take with conventional seeding systems causing soil disturbance?

RESEARCH DESIGN

- Site and farmer host selection is critical to the long-term nature of the research established in Kendenup.
- The Wood family are controlled traffic farmers (CTF) and this trial design allows them to maintain their tramlines without compromising the trial results.
- Soil testing, including non-wetting Molarity of Ethanol Droplet (MED) test, were carried out.
- Trial design was four replicates of:
  - Control treatment of nil disturbance (using Daybreak single disc seeder),
  - Tyne seeding (conventional one pass seeding), and
  - Maximum disturbance (the farmer scarified the soil to a depth of 15cm

immediately before seeding. The trial plots were then sown using the tyne seeder). By including the maximum disturbance treatment, we aim to accelerate any potential soil damage and changes in the non-wetting characteristics.

- Buffer plots to allow inputs, such as fertilizer and herbicides, to be applied to the plots without wheel damage occurring in the treatment plots themselves.
- Plots were 10m wide and 250m long.
- 2016 Season: canola planted on May 13th, 2016.
- 2017 Season: field peas planted on 1st June 2017.
- Crop maintenance was as per whole of paddock management by the Wood family.
- SCF measured plant establishment (plants/ m2) and yield (kg/ ha) measured using a weigh trailer and converted to paddock yields.

RESULTS OBSERVED TO DATE

Soil test results for the site are as shown in Table 1. Further, non-wetting soil tests (MED) measured the test score for site topsoils at an average < 2.5. This scores as a severely non-wetting soil and is typical of the forest gravels in the Southern region.

TABLE 1: Soil test results captured in the summer of 2016.

Soil Parameter	Beverley Rd Paddock	Beverley Rd Paddock
pH	5.2 / 6.0	5.3 / 6.2
EC	0.056 (ok)	0.140 (ok)
Organic C	3.06 (ok)	3.33 (ok)
Nitrogen – NO3 – N	53.7	54.8
NH4-N	3.4	4.0
P	90 (high)	81 (high)
PBI+ColP	120	153
K	84 (sufficient)	101 (sufficient)
S	15 (high)	20 (high)

TABLE 2: Plant counts for 2016 and 2017 crops.

	Plant Count (plants/ m2)		Yield (kg/ha)	
Seeding Type	**2016: Canola**	**2017: Field Peas**	**2016: Canola**	**2017: Field Peas**
Nil disturbance treatment	34	25	1959	*
Tyne seeder treatment	41	20	1956	*
Tillage to 15cm and tyne seeding	40	17	2034	*

** Report compiled prior to harvest season. Contact SCF directly for data.*

2016 - YEAR 1

A challenging year with soil water levels well above the field capacity of the forest gravel soil for 3 months of the growing season (Decile 9). Tillage treatments exacerbated the surface waterlogging with the disc sown treatment which was notably more trafficable.

Plant counts indicated a slightly better plant establishment in the tyne treatments (40 & 41 plants/m2) compared to the nil disturbance control (34 plants/m2) as per Table 2.

Yield results as per Table 2 indicated no significant differences between the treatment which was expected because:

1. Non-wetting in 2016 was not an issue, even in April, with Decile 10+ rainfall in the first half of the growing season.
2. Treatments have longer term effects and are not expected to impact on crop performance in the initial years of the study.
3. Canola is an indeterminate plant type that can compensate for lower plant densities. There were more than enough canola plants for its potential yield to be fulfilled, see Figure 1 for comparisons of plant densities in August 2016.

FIGURE 1: icture of the nil disturbance seeding systems trial in August 2016.

FIGURE 2: Photo of the field peas on the 20th August 2017.

2017 - YEAR 2

A dry start to the season (Decile 1 rainfall) was challenging with plant establishment occurring under marginal soil moisture conditions. The drying topsoil in the seedbed was exacerbated by the tyne treatments in comparison to the disc seeding.

There was improved plant establishment and biomass in the disc seeding treatments compared to tyne treatments in 2017 as shown in Table 2. The disc seeder treatments averaged 25 plants/m2 while the tyne seeder averaged 20 plants/m2 and less for the cultivated and tyne seeded treatments.

The dry start to the 2017 season allows for for non-wetting issues to be visually expressed, such as shown in Figure 2. Yield data was not available at the time of reporting.

CONCLUSION

The 2016 season was a Decile 10 rainfall year which meant that non-wetting soil issues were not expressed typically. In 2017 seeding conditions were much tougher (Decile 1 rainfall) and measured differences in plant establishment counts were observed, favouring the NDS. It remains to be seen if this will translate into a statistical yield difference at the site in field peas for that season.

This project has achieved the start–up of an objective systems study to give answers required by SCF members, South Coast NRM and industry regarding non-wetting soils management on forest gravels. With just a season and a half of results, there are already differences measured in the treatments and it is the expectation of SCF that yield differences after 3-5 years will occur with the site to be planted to cereal and legume crops in 2018 and 2019, respectively. This will however depend on the seasons encountered as more seasons like 2016 will likely see similar yields between seeding systems. Analysis of cropping systems is not a short-term research effort, it will take at least until the medium or long term to assess accurately.

REFERENCES

Department of Primary Industries and Regional Development (DPIRD) (2018) Water Repellence. Accessed at https://www.agric.wa.gov.au/climate-land-water/soils/managing-soils/water-repellence, on 17/6/2018.

Roper, M. and Davies, S. (2015) Ground Cover Supplement Issue 118 – Soil Constraints. Accessed at https://grdc.com.au/resources-and-publications/groundcover/ground-cover-supplements/ground-cover-issue-118-soil-constraints/new-initiative-investigates-non-wetting-solutions, on 17/6/2018.

MORE INFORMATION

For more information, including: further reading, references, potential future research following on from this work, or a copy of the full research report contact:

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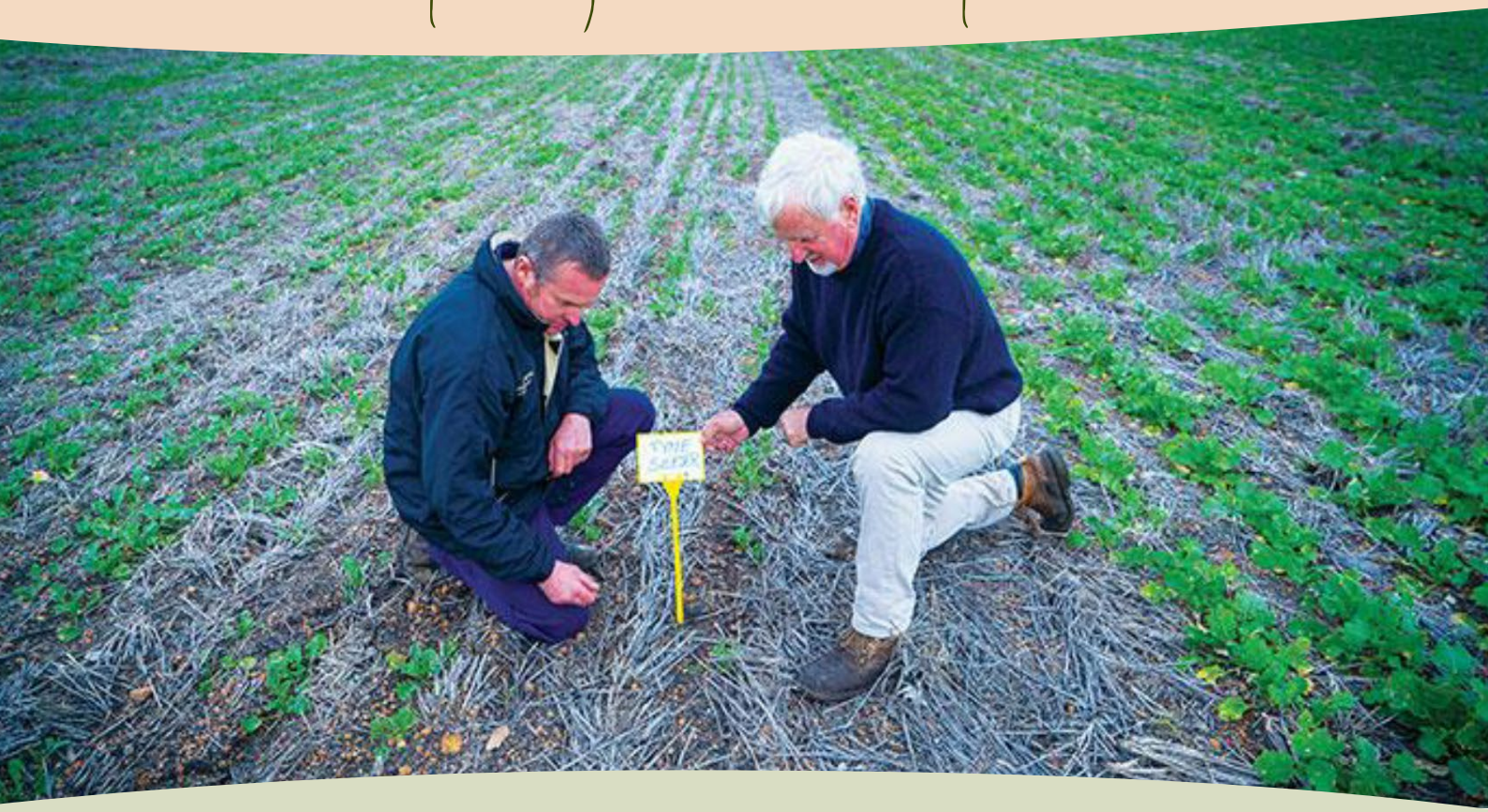
"There are already differences measured in the treatments and in subsequent years there are likely to be significant differences in yield and soil health"



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The Southern Incentives - Southern Soils program facilitates field trials in targeted locations across the south coast region to demonstrate sustainable practices in the key soil health areas of soil biology, soil acidity, soil erosion, water repellence and managing nutrient additions.

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