Natural Resources Eyre Peninsula **NREP NLP2 REGENERATIVE AGRICULTURE PROGRAM – SOIL CARBON LANDHOLDER DEMONSTRATIONS.**

LOCK/MURDINGA/TOOLIGIE FARMING GROUP SOIL MODIFICATION DEMONSTRATION.

This project is supported by Eyre Peninsula Natural Resources Management Board, through funding from the Australian Government's National Landcare Program. Acknowledging the landholder co-operator, Wayne Hodge for his time in implementing this demonstration on his property.

Australian Government | National Landcare Program

Government of South Australia
Eyre Peninsula Natural Resources Management Board

MURDINGA Site

Location. Kamrock Road, Murdinga

Cooperator – Everglen (Hodge Farms)

BOM weather station 18046; Lock

Rainfall (mean); 390mm annual, 293mm April-October

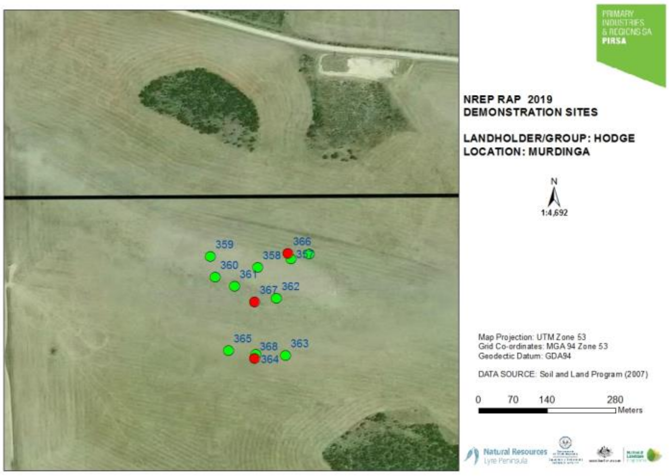


Figure 1. **Location of site within paddock approx. 2.6 KM west of Tod Highway along Kamrock Road.**

Site Selection

The target soil for this demonstration is duplex sandy soils. Surface water repellence, infertile bleached A2 layers, and subsurface layers with high soil strength (Penetrometer resistance >2000 kpa) limit the development of crop roots in this soil type in the district. Additionally high levels of carbonate and boron in subsoil layers can provide significant chemical constraints to root development. The aim of this trial is as a proof of concept to demonstrate the capacity for modified tillage equipment to improve crop growth and soil organic carbon levels on sandy soils in the Murdinga district.

After discussion with a number of Lock/Murdinga/Tooligie Farmer Group members Wayne Hodge's Kamrock Road site (Figure 1) was proposed as having the best access and most uniform topography for establishment of a demonstration site. The landform can be described as broadly undulating dune swale.

Soil sampling for site characterisation, preseason nutrition and water repellence was conducted in early April 201 using a hydraulic drill rig to a depth of 100 cm at 9 locations (3 each on the dune, mid slope and swale). Sample numbers refer to GPS reference points where characterisation cores (green dots) or penetrometer resistance measurements (red dots) were taken (Figure 1).

This sampling identified a sandy surface soil (A1 horizon) to 10 cm, on highly bleached layer (A2) overlying a sodic clay layer from around 30 cm below the soil surface. Carbonate levels also increase from around 45 cm (Figure 2). Limestone was encountered within 80 cm of the soil surface on the flat (sample points 363 – 365). Soil cores were subsampled by profile layers, with changes in texture and depth to carbonate identified. Composite samples were sent for comprehensive laboratory analysis (Appendix 1)

Figure 2. **Soil core taken from the site.**

Soil analysis identified very low organic carbon levels (even for the soil texture) with low cation exchange capacity indicating poor inherent fertility in the surface soil layers. P levels were adequate with elevated levels below 15 cm indicating some fertiliser leaching. Whilst K and S levels were in the range expected for the soil type Zn and Cu marginal were below desirable levels.

PENETROMETER READINGS

A time of soil characterisation the soil profile was very dry in surface layers and in order to measure penetration resistance three locations were wet up to field capacity. High soil strength (penetrometer resistance in the range 2750 and 3250 kpa) was found at 10-25 cm depth with B horizon clays presenting resistance from 400 mm (Figures 3 and 4).

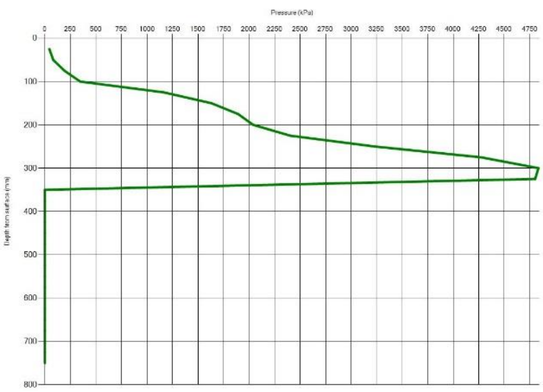


Figure 3. **Penetrometer resistance (51 – mid slope)**

Figure 4. **Penetrometer resistance (57 – flat)**

A number of treatments were identified as possible options for addressing the constraints identified by the soil characterisation (Table 1)

Table 1. Identified soil constraints and possible treatment options.

Constraint	Possible treatments	Possible Machinery Options
Water Repellence	• Clay addition • Soil mixing • Wetting agents	• Spader, • Modified one way disc ('Plozza') plough • Ripping with inclusion plates • Clay spreading or delving
Infertile A horizons	Incorporation of topsoil, organic material or nutrition into bleached layers	• Spader, • Modified one way disc ('Plozza') plough • Ripping with inclusion plates
High soil strength above clay layer	Deep ripping	• Deep ripper • Delving.

Soil modification treatments (Table 1) were implemented on 15th May using the landholder's machinery (Table 1). The landholder has modified a one way disc plough for deep mixing (working depth of approximately 300 m) (Figure 5) and retrofitted homemade topsoil inclusion plates to the tynes of a deep ripper with a capacity to rip to around 450 mm (Figure 6).

Figure 5. **Modified one way disc plough for deep soil mixing.**

Figure 6. **Homemade topsoil inclusion plates fitted to deep ripping tynes.**

Plots run north/south and are 18 wide by around x 250 m long per trial layout below (Figure 7);

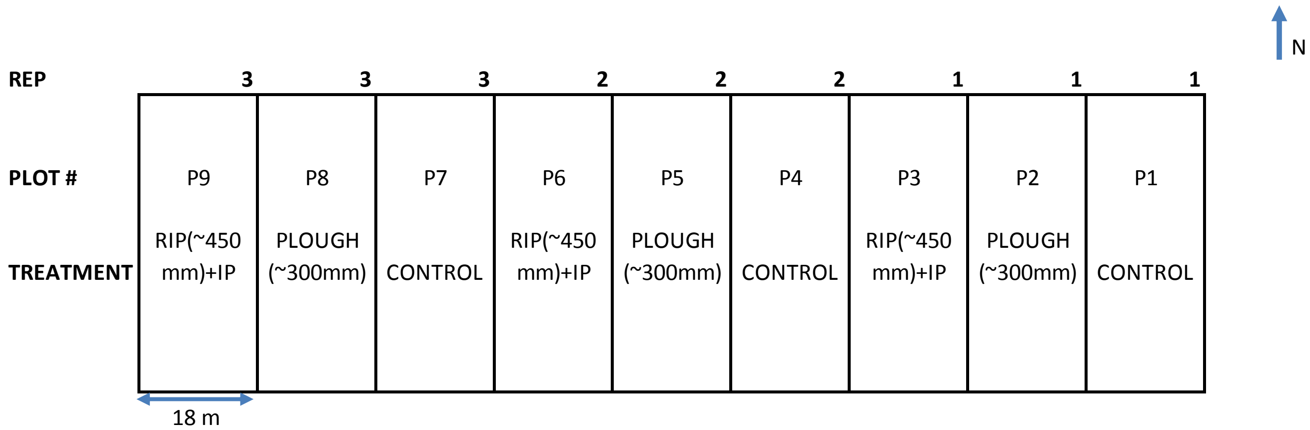
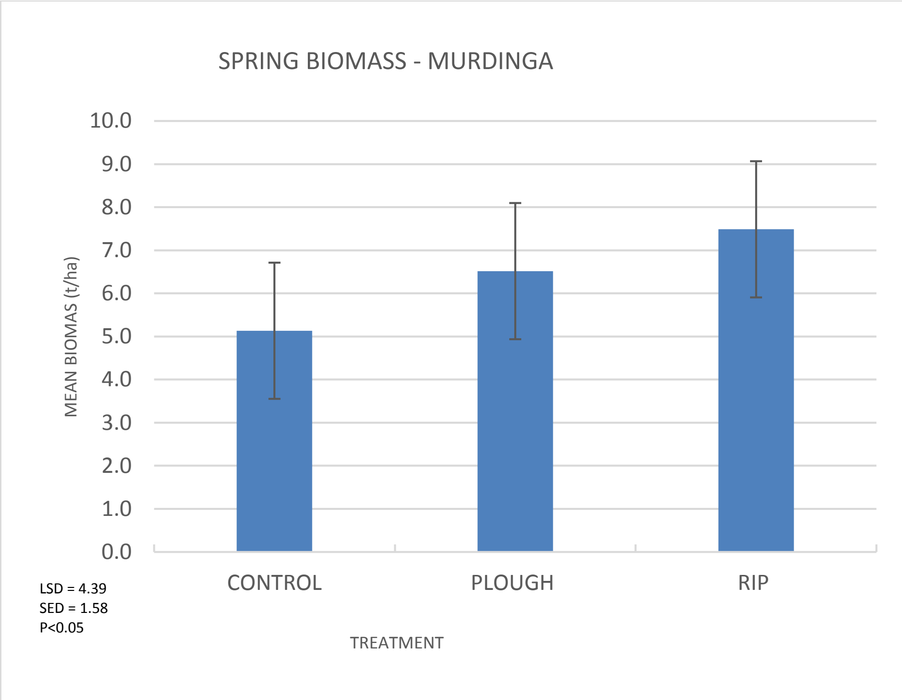


Figure 7. **Trial layout**

The site was sown to Spartacus Barely on 16th May 2019 at 250 mm row spacing. 75 kg ha^{-1} 24:16 plus trace elements followed up with nitrogen applications at the end of June and end of July (~ 40 kg N in total). Post emergent broadleaf herbicides were applied on 28th June and fungicide was applied on August 15.

Assessments of crop establishment were undertaken in early June 2019 with the crop at 3-4 leaf stage. There was no significant difference in mean plant numbers between the treatments and the control (Figure 8). Spring biomass cuts were taken in mid-August, although there was a high degree of variation in plant biomass across the site there was not a significant difference in mean biomass between the treatments (Figures 8 and 9).



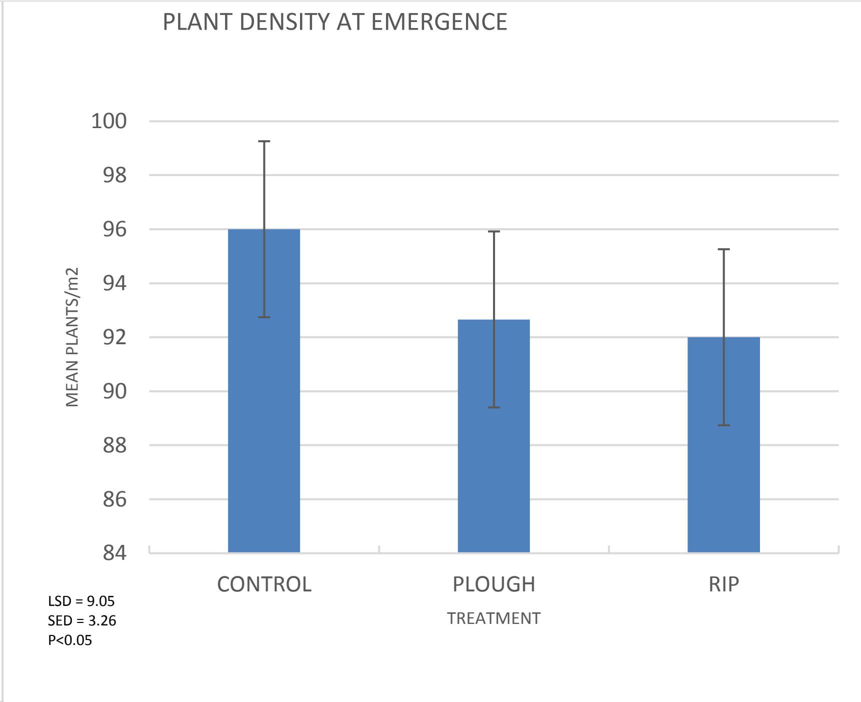


Figure 8. **Plant density at emergence in June.**

Figure 9. **Biomass (t/ha) in mid-August**

The site will be continue to be monitored over the coming years to measure any gains in crop yield and soil organic carbon resulting from the treatments.

Appendix 1. Laboratory soil results

Depth	pH 1:5(water)	pH CaCl2	Org. C	NO3	NH4	Col. P	Col K	KCl Sulfur (S)	Exc Ca	Exc Mg	Exc K	Exc Na	ECEC	Ca	Mg	K	Na	EC1:5	Boron	Iron (Fe)	Mn	Cu	Zn
	pH units	units	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol/kg	%	%	%	%	dS/m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
0-10	6.65	5.92	0.39	1.8	2.3	23	34	4.5	260	30	30	12.8	1.68	77.3	14.8	4.6	3.3	0.042	0.16	28	1.7	0.12	0.67
10-35	8.09	7.39	0.2	1.6	<1	15	29	<2.5	231	26	23	<8	1.46	79	14.7	4	2.2	0.044	<0.1	10	<0.3	0.08	0.52
35-60	8.55	7.64	0.2	1.7	1.2	7	320	4.9	1030	538	383	189	11.4	45.2	38.9	8.6	7.2	0.129	3.5	11	<0.3	0.18	0.36