Comparing the influence of organic matter and fertiliser inputs on soil organic carbon and grain production

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AIM

To identify on-farm management strategies to increase soil organic carbon (SOC) and quantify any associated risks and benefits in a grain production system.
In this trial the NSPNR wanted to determine whether:

i) Altering inputs to increase plant biomass would subsequently increase soil carbon and
ii) Amending soils with compost would increase soil carbon storage or provide agronomic benefits.

KEY MESSAGES

- In 2013 there was no evidence of changes in soil condition or organic carbon associated with the application of compost at up to 3 t/ha in 2012.
- Potential changes in soil organic carbon and other soil properties will be determined in February 2014.

BACKGROUND

This trial was initiated to support the implementation of on-ground trial activities by growers to investigate options for managing soil organic carbon over the short term as a part of DAFF's funding from the Australia's Farming Future Action on the Ground Program.

METHODS

Property	Wade Hinkley, Tincurrin
Plot size & replication	140m x 10m (control replicated x 4 strips)
Soil type	Grey deep sandy duplex (gravel below 25 cm); Grey Chromosol (4% clay in 0-20 cm, increasing to 8% in 20-30 cm layer)
Soil pH	4.8 in $CaCl_2$ (0-10 cm), 4.5 in $CaCl_2$ (10-20 cm), 4.7 in $CaCl_2$ (20-30 cm)
EC	0.09 dS/m (0-10 cm), 0.03 dS/m (10-30 cm)
Sowing date	NA
Seeding rate	Volunteer pasture in 2013
Fertiliser	100kg/ha Super & Potash 2:1
Soil amelioration	In 2012 lime sand was spread at 0.75t/ha prior to compost. Compost was combined with 0.2 t/ha of lime sand for ease of spreading. In total each treatment received 0.95 t/ha of lime sand + variable rate of compost prior to seeding.
Paddock rotation	Volunteer pasture (2013), Wheat (2012), Volunteer pasture – sub-clover base (2011), Wheat (2010), Pasture (2009)
Herbicides	NA
Growing Season Rainfall	**mm

Soil sampling was conducted in March 2013 to assess basal soil condition. Each treatment strip was sampled and soils bulked to assess soil quality parameters (Table 1). In 2014, compost and fertiliser treatments will be applied and their impacts assessed.

1. Nil fertiliser

2. Local farmer rate fertiliser (100 kg/ha Agras Extra)
3. High fertiliser rate (?)

RESULTS

Soil sampling (baseline)

March 2013 sampling

Baseline testing at the trial site indicates pH levels are below target levels in both the topsoil (0-10 cm) and subsoil (below 10 cm). With aluminium becoming soluble at a pH of 4.5 in calcium chloride this data suggests that continued liming is required at this site and that soil pH may constitute a constraint to plant growth (Table 1). This may constrain any potential benefit of other soil amendments.

Water repellence as measured using the molarity of ethanol (MED) droplet test (King 1984) was either not observed or low at this site (data not presented).

There was no effect of compost treatments imposed in 2012 on soil condition or nutrient status (Table 1). Potassium concentrations are low at this site.

Table 1: *Baseline soil condition for 01FAC13 sampled in March 2013*

Compost Trt	Depth (cm)	Ammonium (mg/kg)	Nitrate (mg/kg)	Phosphorous (mg/kg)	Potassium (mg/kg)	Sulphur (mg/kg)	Electrical conductivity (dS/m)	Soil pH ($CaCl_2$)
Nil	0-10	8	28	26	44	11.1	0.085	4.7
1 t/ha	0-10	9	29	26	38	16.9	0.096	5.0
2 t/ha	0-10	13	22	28	47	14.7	0.103	5.0
3 t/ha	0-10	7	25	21	49	13	0.072	4.6
Nil	10-20	4	8	17	31	5.4	0.032	4. 5
1 t/ha	10-20	4	8	20	46	4.8	0.033	4.8
2 t/ha	10-20	5	6	18	27	7.2	0.035	4.5
3 t/ha	10-20	4	7	12	30	7.4	0.032	4.4
Nil	20-30	3	6	12	38	5.4	0.025	4.6
1 t/ha	20-30	3	5	16	26	4.2	0.025	4.9
2 t/ha	20-30	4	4	13	26	5.3	0.025	4.9
3 t/ha	20-30	3	5	11	44	6.2	0.026	4.6

There were no measureable differences (p=0.05) observed in soil organic carbon for any of the compost treatments applied at this site in 2012 (Table 2).

A significant decrease (P<0.001) in SOC stocks was associated with increasing depth (Table 2) as would be expected.

The amount of carbon contained in the upper 30 cm of soil (bulk density adjusted) at this site was 28.4 t C ha in the nil plots and 27.3 t C ha in the compost plots, with no measureable difference with increasing rates of compost.

Table 2: *Soil organic carbon and nitrogen (%; Elementar) for 01FAC13 sampled in March 2013 on compost treatments applied in 2012.*

Compost Treatment	Depth (cm)	SOC (%)	SON (%)	C_N ratio	Soil organic carbon stocks (t C ha)
Nil	0-10	1.45	0.122	12	16
1 t/ha	0-10	1.42	0.12	12	16
2 t/ha	0-10	1.30	0.12	11	14
3 t/ha	0-10	1.15	0.10	12	13
Nil	10-20	0.54	0.05	10	7
1 t/ha	10-20	0.66	0.07	10	10
2 t/ha	10-20	0.54	0.05	11	8
3 t/ha	10-20	0.49	0.06	9	8
Nil	20-30	0.39	0.05	9	5
1 t/ha	20-30	0.34	0.04	10	5
2 t/ha	20-30	0.35	0.03	10	4
3 t/ha	20-30	0.39	0.04	9	5

The microbial biomass (mass of microorganisms) at this site in surface soil (0-10 cm) measured 75 kg/ha or 66 mg C/kg soil (low). Water holding capacity (0-10 cm) of this soil is approximately 26%.

Grain yield and quality (2013)

The site was under volunteer pasture in 2013 and will be sown to wheat in 2014 to establish any production outcomes associated with the application of compost and different rates of fertiliser.

Grain protein was significantly ($p < 0.05$) higher on the farmer practice and low fertiliser treatments (average

ECONOMICS

While no analysis has been done on the economics of these applied treatments, the application of compost at up to 3 t/ha implies a production cost that did not result in any measureable agronomic benefit.

COMMENTS

This trial will be continued in 2014 to assess changes in soil condition and future production.

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