Liebe Group Soil Biology Trial

Nadine Hollamby, Project Coordinator, Liebe Group

Aim

To investigate the potential of organic matter inputs to increase yield and improve soil health.

Background

This long term trial was established in 2003 to investigate how soil biology and carbon affect crop yield and soil health.

The trial site was selected as it had no significant chemical or physical soil constraints, therefore capacity to increase grain production through improved moisture conservation and enhanced soil biota can be demonstrated.

The trial aims to understand how agronomic factors such as yield and grain quality are effected by organic matter (OM) breakdown and cycling. Although the application of 20 t/ha of organic matter is not practical in a commercial farming enterprise, this treatment is designed to demonstrate the potential upper level of organic carbon for sandy soils in our environment. The plots have now received a total of 80 t/ha of organic matter across four separate applications (2003, 2006, 2010 and 2012) of chaff. Future modelling will determine whether the soil is nearing its upper soil organic carbon capacity.

Trial Details

Property	Long Term Research Site, west of Buntine
Plot size & replication	10.5m x 80m x 3 replicates
Soil type	Deep yellow Sand
Soil pH	Topsoil: 6, Subsoil 4.6
EC	0.1 dS/m
Sowing date	7/6/12
Seeding rate	3 kg/ha Telfer
Fertiliser	7/6/12: 40 kg/ha TSP 19/7/12: 40 L/ha Flexi-N
Paddock rotation	2009 lupin, 2010 wheat, 2011 wheat
Herbicides	17/5/12: 1 L/ha Spray Seed 7/6/12: 1.2 L/ha Roundup Attack, 1 kg/ha Atrazine, 2.5 L/ha Trifluralin 29/6/12: 1.1 kg/ha Atrazine 18/7/12: 500 mL/ha Clethodim 15/10/12: 1.7 L/ha Roundup Attack
Insecticide	29/6/2012: 100 mL/ha Dimetholoate, 100 mL/ha Cypermethrin
Growing Season Rainfall	162.5mm

2012 Treatment List

1. Control (minimum till with knife points and full stubble retention)
2. Tilled soil using offset discs
3. Organic matter (chaff is applied once every 3 years last applied 2012 at rate of 20 t/ha; tilled with offset discs)
4. Organic matter run down (plots where chaff was previously applied in 2003 & 2006 but not since)
5. Burnt (stubble burnt annually in March; minimum till)

Table 1: Trial history.

Year	Crop type	Yield range	Treatment notes
2003	Lupin	None recorded	Set up phase: 20 t/ha barley chaff applied, lupin crop brown manured
2004	Wheat (cv. Wyalkatchem)	2.9-3.5 t/ha	Brown manuring and addition of 20 t/ha organic

			matter increased yield by 18-22%
2005	Wheat (cv. Wyalkatchem)	2-2.8 t/ha	Burnt plots yielded 25% higher than control.
2006	Lupins	None recorded	Set up phase: 20t/ha canola chaff applied, brown manure
2007	Wheat – sprayed out	None recorded	
2008	Wheat (cv. Wyalkatchem)	2.4-3.4 t/ha	Addition of organic matter increased yield by 23% compared to control.
2009	Lupins	1.5 t/ha	Set up phase
2010	Wheat (cv. Magenta)	2.5-1.9 t/ha	20 t/ha chaff applied. No significant yield difference between treatments.
2011	Wheat (cv.Wyalkatchem)	3-3.8 t/ha	No significant difference in yield
2012	Canola (cv. Tefler)	0.7-0.9 t/ha	20 t/ha chaff applied

Results

In 2012, the addition of organic matter resulted in a small yield increase of 0.2 t/ha over the tilled treatment (appropriate comparison) which was similarly tilled but did not have any organic matter added (Table 2). A significantly lower oil content was also observed (Table 2) for this treatment.

Table 2: Yield and oil content for canola comparing different tillage and stubble retention methods west of Buntine, 2012.

Treatment	Yield (t/ha)	Oil %
Control	0.71 *a*	43.3 *a*
Burnt	0.78 *ab*	44.3 *a*
Tilled soil	0.78 *ab*	42.8 *a*
Organic matter run down	0.87 *ab*	42.2 *a*
Organic matter	0.97 *b*	39.7 *b*
LSD	*0.25*	*2.1*

Note: Results followed by the same letter do not significantly differ from each other. P=0.05

Ammonium, nitrate, phosphorus and potassium levels were significantly lower in the tilled plots compared to treatments where organic matter was added (Table 3) suggesting the addition of organic matter provided a significant nutrient resource. In treatments where organic matter has been added but is being allowed to 'run down', there has been a significant depletion of potassium. No difference in available soil nutrients was measurable between burnt and un-burnt/control treatments (Table 3).

Soil organic carbon is highest for the treatments where large additions of organic matter have been made but appear to be declining for the 'run down' treatments rapidly (Table 3). There was no difference between burnt and un-burnt treatments in soil organic carbon reflecting previous studies where long term changes in total organic carbon were hard to measure (Table 3).

Table 3: Soil analysis for 0-10cm of soil sampled May 2012, before seeding.

Treatment	Amm. (mg/kg)	Nitrate (mg/kg)	Phos (mg/kg)	Potassium (mg/kg)	Organic carbon (%)	pH (cacl)
Control	1.67 *ab*	22.7 *ab*	30 *a*	74 *a*	0.77 *a*	6.2
Burnt	1.67 *ab*	24.3 *ab*	32 *a*	96 *a*	0.78 *a*	6.3
Tilled soil	1.33 *a*	18.7 *a*	27 *a*	94 *a*	0.91 *ab*	6.3
Organic matter run down	2.00 *ab*	28 *b*	49 *b*	135 *b*	1.15 *bc*	6.2
Organic matter	2.67 *b*	30 *b*	58 *b*	280 *c*	1.41 *c*	6.4
LSD	*1.06*	*8.17*	*11.5*	*27*	*0.34*	*NS*

Note: results followed by the same letter do not significantly differ from each other.

Potassium was again very high in plots where organic matter was added (280 mg/kg) as has been the case since soil results were first collected in 2005 (Figure 1). When the organic matter stopped being applied in 2010 the potassium levels began to drop. Soil organic carbon content in the topsoil has been steadily increasing since 2005 in plots where organic matter is regularly added; they are now approximately twice

that of the control (Figure 2). Unlike potassium, when organic matter stopped being added in 2010, soil organic carbon has not declined, rather it has remained at a stable level of around 1%.

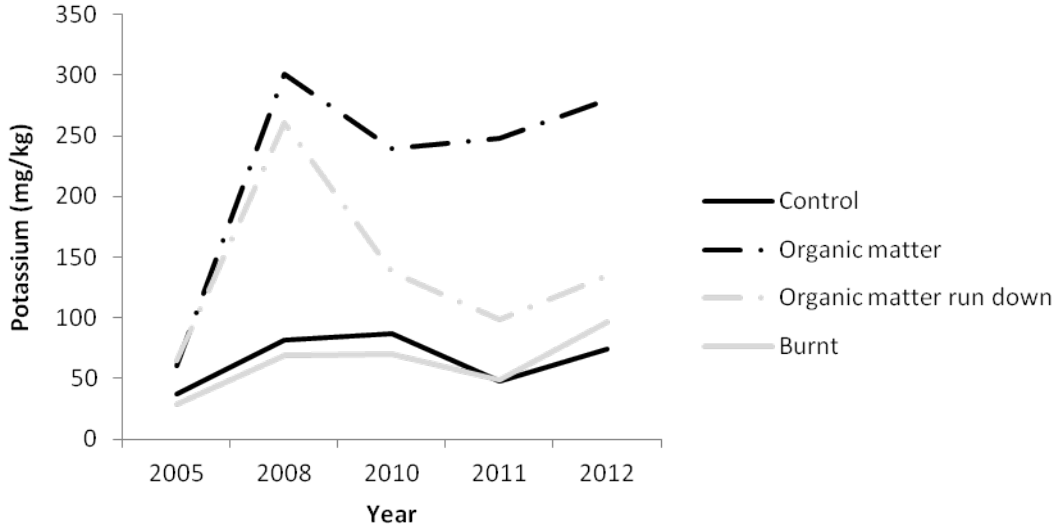

Figure 1: Potassium (mg/kg) in top soil (0-10cm) for plots with organic matter added or stubble burnt compared to control which was normal farm practice of minumum tillage and full stubble retention for years which soil information has been collected.

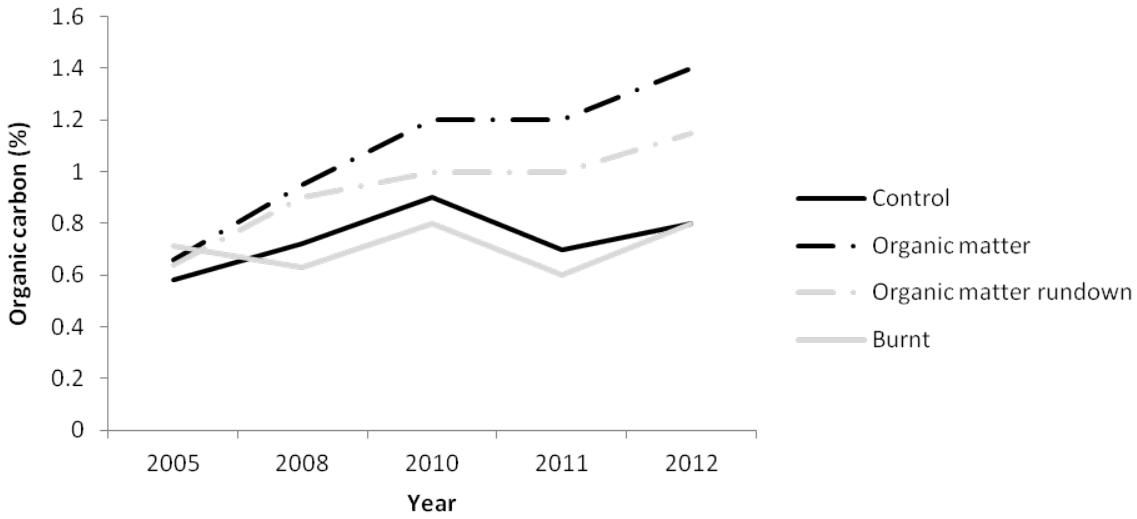

Figure 2: Organic carbon (%) in top soil (0-10cm) for plots with organic matter added or stubble burnt compared to control which was normal farm practice of minumum tillage and full stubble retention for years which soil information has been collected. Bulk density of soil has not being taken into account in this graph.

Comments

Applying chaff to the soil, although not practical on a farm scale has continued to supply large quantities of nutrients to the soil and increased canola yield slightly. Rainfall is still the main factor limiting yield. Organic matter run down plots have had no additional chaff added since 2006, yet still have more potassium, phosphorous and organic matter than control plots. This suggests that positive effects resulting from the addition of organic matter are continuing to be observed in the medium term (3-5 years).

Key findings over last 9 years

- Average yield increase of 0.3 t/ha or 12% where chaff was added. (Although in some seasons addition of chaff resulted in no yield benefit or a yield decline.)
- Microbial population has doubled where chaff was added.

- 650 kg/ha more nitrogen where chaff was added.
- Soil now holds 8 t/ha more organic carbon where chaff was added.

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Contact
Nadine Hollamby, Liebe Group
nadine@liebegroup.org.au
(08) 9661 0570