# Liebe Group Soil Biology Trial

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## Aim

To investigate the potential of organic matter inputs to increase soil water storage, 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. After three separate applications (2003, 2006, 2010) of organic matter, totalling 60 t/ha, we assume the soil is near soil organic carbon capacity.

**Trial Details**

| | |
|---|---|
| **Property** | Long Term Research Site, Buntine |
| **Plot size & replication** | 10.5m x 80m x 3 replicates |
| **Soil type** | Deep yellow sand |
| **Sowing date** | 1/06/11 |
| **Seeding rate** | 50 kg/ha Wyalkatchem |
| **Fertiliser** | 1/6/11: 60kg/ha K-Till Extra, 20 L/ha Flexi-N<br>26/7/11: 50L/ha Flexi-N |
| **Paddock rotation** | 2010 wheat, 2009 lupins, 2008 wheat |
| **Herbicides** | 19/3/11: 0.6 L/ha PowerMAX, 0.4 L/ha Ester 680, 100 ml/ha Garlon<br>31/5/11: 2.5 L/ha BoxerGold, 1.5 L/ha PowerMAX<br>4/7/11: 1 L/ha Jaguar<br>26/7/11: 0.5 L/ha Precept |
| **Growing Season Rainfall** | 293mm |

## 2011 Treatment List

1. Control (minimum till with knife points and full stubble retention).
2. Tilled soil using offset disks.
3. Organic matter (Organic matter is applied once every 3 years, last applied 2010 at rate of 20 t/ha).
4. Organic matter run down (plots where organic matter was previously applied in 2003 & 2006 but not in 2010).
5. Burnt (plots last burnt in March 2011).

## 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: 20 t/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 | Lupin | 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) | 3.3-4.2 t/ha | Addition of organic matter |

**Results**

**Table 1:** Yield and quality for wheat comparing different tillage and stubble retention methods West of Buntine.

| Treatment | Yield (t/ha) | Protein % | Screenings % |
|---|---|---|---|
| Control | 3.3 | 11.20 | 1.07 |
| Tilled soil | 3.4 | 10.23 | 1.15 |
| Burnt | 3.8 | 10.73 | 1.40 |
| Organic matter run down | 4.0 | 10.80 | 1.19 |
| Organic matter | 4.2 | 12.00 | 3.02 |
| *LSD* | *NS* | *NS* | *NS* |

**Table 2:** Soil analysis for 0-10cm of soil sampled May 2011, before seeding.

| Treatment | Amm. (mg/kg) | Nitrate N (mg/kg) | Phos. (mg/kg) | Potassium (mg/kg) | Organic carbon (%) |
|---|---|---|---|---|---|
| Control | 3 | 19 ab | 30ab | 48 a | 0.7 abc |
| Tilled soil | 4 | 23 ab | 24a | 55 a | 0.5 a |
| Burnt | 3 | 16 a | 26a | 49 a | 0.6 ab |
| Organic matter run down | 5.3 | 39bc | 48.7 bc | 99 a | 1.0 bc |
| Organic matter | 7 | 47 c | 55.7 c | 248 b | 1.2 c |
| *LSD* | *NS* | *21.6* | *19.43* | *79.9* | *0.47* |

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

The treatment's had no statistical effect on yield or grain quality this season (Table 1). Although there is a trend towards higher yields with more organic matter, this is not statistically significantly different to other treatments due to large variation of yields between replicates. Different treatments did show large differences in soil nutrients (Table 2). Organic carbon plots had higher levels of nitrate N, phosphorus and potassium. In the case of potassium, the organic matter plots had 5 times the amount of plant available potassium than the control. Organic matter was significantly lower where plots were tilled or burnt than where organic matter had been added.

Addition of organic matter increased carbon stock in the top 0-10cm of soil but has not changed the soil deeper in the profile (Figure 1). In the top 0-10cm 16 t/ha of carbon was present where organic matter was added and only 10 t/ha of carbon present where plots were burnt or tilled. In the sub soil the amount of carbon is less with 6-8 t/ha in the 10-20cm level and 6-4 t/ha in the 20-30cm level. Treatment did not change subsoil carbon stock. Carbon stock is the amount of carbon in the soil, it takes into account the soils bulk density and is measured in tonnes per hectare. It is therefore a physical amount which is easier to comprehend than the organic carbon percentage of weight which is often reported.

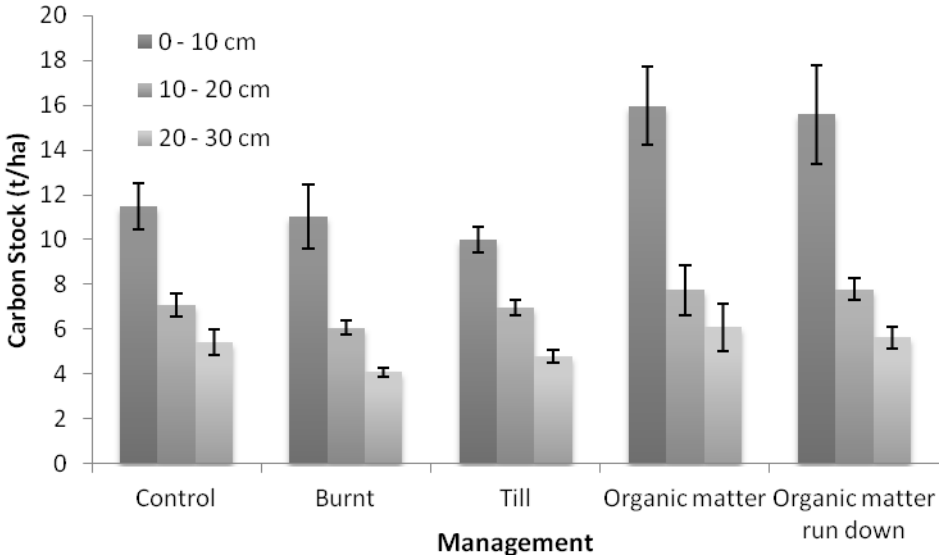


**Figure 1:** Carbon stock for different stubble management treatments at three soil depths on 2nd May 2011.

**Comments**

The addition of chaff to the organic matter plots acted as a significant source of potassium and phosphorus. These nutrients were also significantly higher than other plots in 2010, where potassium was 240 mg/kg and phosphorus was 61 mg/kg where organic matter was added.
The increased level of nutrients did not translate into higher yields in the organic matter plots. Organic matter in soil exists with relatively standard ratios of major nutrients. While the addition of organic matter has increased carbon stocks, this has also resulted in an increased amount of nitrogen, phosphorus, potassium and sulphur contained within the soil organic matter. These nutrients are used by the soil microbes for their own structures, and while they are recycled on a constant basis the microbial community is much better at utilising them than growing plants.

This trial will be discussed in more detail at the Liebe Groups Trials Review Day, 13th of February, 2012, at the Buntine Hall.

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