Effect of improving soil organic matter with compost, on wheat production

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Background

The Farm Compost Demonstration project is the largest compost trial in Australia. It was established by the Southern Metropolitan Regional Council (SMRC), supported by the State Government, as a means of generating interest in the use of compost in commercial farming.

Today, most agricultural businesses in Western Australia are using synthetic fertilisers to feed nutrients into their crops. Compost, however, can be thought of as a source of nutrients and it also offers the potential of long term solutions for sustainable soil management which fertilisers alone are unable to achieve.

20 broad-acre farms were to be selected in 2004 to participate over a two year period as part of a program to develop the market for compost made from household waste.

As a result, this project will contribute strongly to the creation of demand for the use of MSW (municipal solid waste) derived compost and create a greater degree of confidence for the development of future waste composting plants in WA.

Twenty farms were chosen from a group of farmers that expressed an interest in being involved in the project. They were chosen primarily on several basic issues including, distance from Perth, crops grown, soil type, paddock accessibility and their ability to spread compost (either through contractors or their own equipment). Most properties were within 100-150km of Perth although two farms were ~200km from Perth in the Williams-Darkan region.

This report is focussed on the results from seven of these farms which grew wheat during the winter of 2004.

Materials and Methods

On each property selected, 1ha plots (100m x 100m) were established and comprehensive tests were conducted to assess nutrient levels, heavy metal and pesticide residue levels in the soil.

SMRC compost was broadcast at two nominal rates – 10t/ha and 20t/ha (wet weight); the actual rates of compost were determined by using either load cells, if contractors were equipped with them, or measuring the bulk density of the compost and then applying the appropriate calculated volume to the treated areas. Final rates of compost applied did vary between properties, see **Table 1**.

Table 1: Compost rates, wheat varieties and soil management by property.

Location	Site #	Soil Type	Wheat Variety	Compost Rate – T1 t/ha	Compost Rate – T2 t/ha	Stubble Retained	Cultivation
Brookton	BE05	Gravelly sand	Brookton	13	26	Yes	Yes
Brookton	BE08	Grey sand	Calingiri	10	20	Yes	No
New Norcia	BN03	Brown sandy loam	Calingiri	9.9	19.9	No	No
Northam	BE03	Sand to red gravely ssand	Calingiri	10	20	No	Yes
Northam	BE10	Red sandy loam	Calingiri	10	20	No	No
Wongan Hills	BN04	Grey sandy loam	Carnamah	8.5	17	No	No
York	BE07	Grey-brown sand	Carnamah	10.4	20.9	Yes	Yes

A minimum of 30m was left between the treated plots and this was used as the control area along with the remainder of the paddock.

Each farm was monitored for soil and crop performance which included:

a) Soil analysis – initial nutrient, heavy metal & pesticide residue levels, mid-crop including soil moisture, pH, nitrate, ammonium, EC.
b) Plant tissue analysis - mid-crop
c) Plant growth – dry weight, tiller count
d) Crop yield
e) Grain quality

Sites for broad-acre were pegged and initial soil tests were conducted prior to application of compost.

Crops were sown within the farmers seeding program in autumn 2004 and all treatments had the farmers' normal fertilizer rates.

The mid-crop measurements were taken at 56 days after sowing, dry weights and tiller counts were measured at flowering and yields were determined with a harvest by hand just prior to the farmers' own machine harvest.

All soil analysis was conducted on 15 sites in each treatment which were logged by GPS and used as ongoing sample points.

Dry weight and tiller counts were conducted on 10 sites, yields on 5 sites per treatment. Where crop material was harvested each site consisted of a quadrat of 0.32m2.

Grain quality was assessed by CBH Avon District laboratory using their standard methodology.

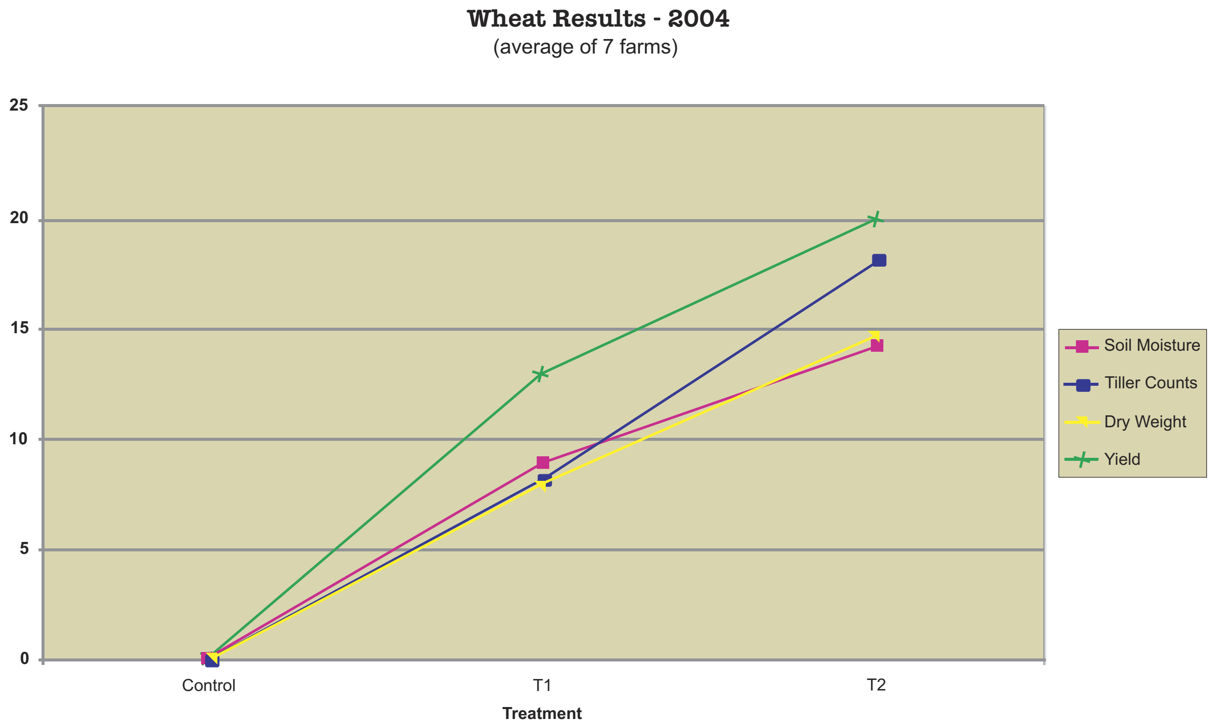
There were no adverse effects of crop germination observed at any of the farm sites (see photograph below).

Recently germinated wheat Muresk College - 2004

Results

Wheat yield, shown in figure 1, has improved by an average of 20% in the 20 tonne treatment and 13% in the 10 tonne treatment. On an individual farm level yield increases were up to 39% above the cotntrol at the higher rate of compost addition. For most properties wheat yield improvements appeared to level off between 10 and 20t of compost.

Figure 1: Effect of compost application on wheat yields, by property



Average results (of the seven properties) for wheat production, in figure 2 below, show consistent almost linear improvements in yield, soil moisture, plant dry weight and tiller numbers with the application of compost.

Average soil moisture increased above the control blocks by 8.9% in the 10t rate and 14.2% in the 20t rate.

pH also increased from an average of 5.5 in the control block to 5.9 in the 10t treatment and 6.1 in the 20t treatment.

The indicators of crop growth showed improvement in dry weight (8% in 10t; 14.7% in 20t) and tillering (8.2% in 10t; 18.1% in 20t).

Figure 2: Effect of compost application on wheat production and soil moisture.

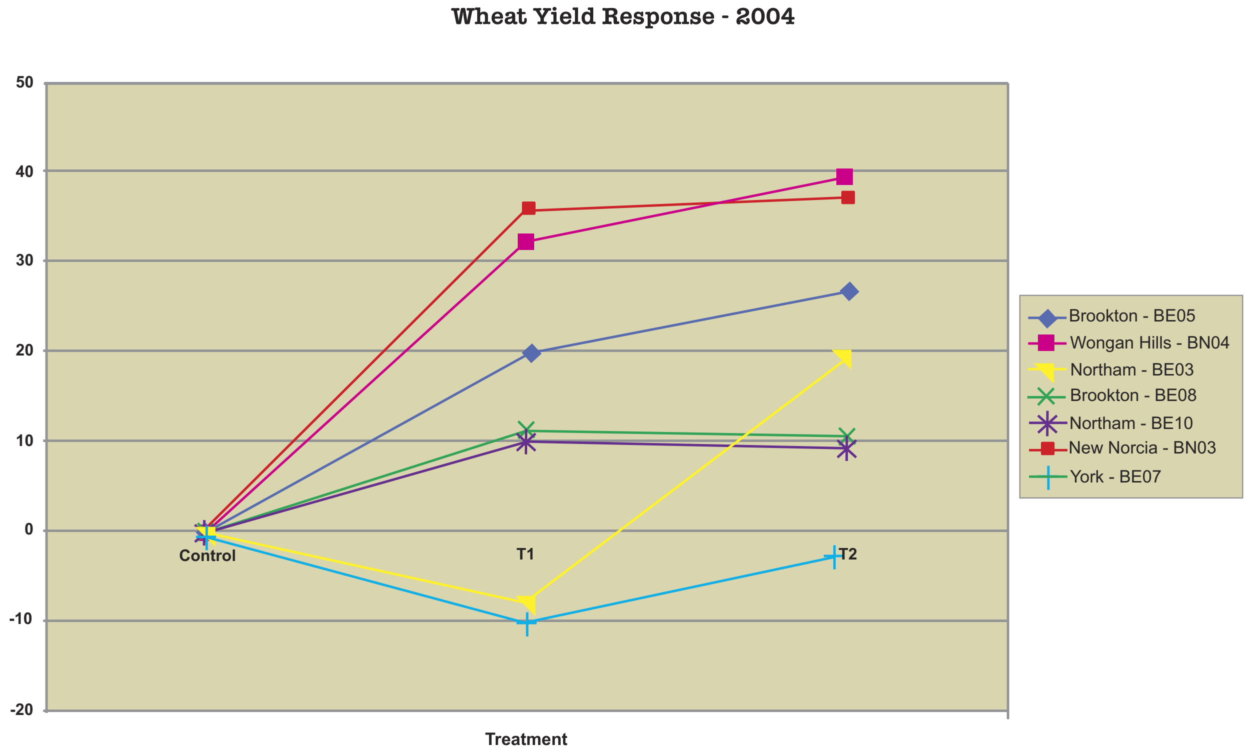


Table 2: Amount of nutrients applied in compost (T2), by farm (kg/ha).

Property	**Nitorgen**	**Phosphorus**	**Potassium**	**Organic Matter**
Brookton BE05	14.8	151.0	43.9	3,900
Brookton BE08	12.8	12.8	35.2	4,896
New Norcia BN03	183.9	25.1	83.6	3,353
Northam BE03	204	30	81	3,596
Northam BE10	204.4	21.9	73.0	4,442
Wongan Hills BN04	10.9	10.9	29.9	4,162
York BE07	13.4	13.4	36.8	5,116

Discussion

The addition of SMRC compost as an input into existing farm soil management systems was shown to increase soil fertility and moisture holding which lead, in most cases, to improved crop performance. It is difficult to isolate which of the components of the compost lead to these improvements because of the broad reaching benefits addition of this type of material to soil can have.

This project was established to demonstrate the practical benefits of using compost in existing farming systems and not as a definitive scientific trial, however all sampling and analysis of trials was conducted to comply with scientific principles.

Results show that compost applications consistently improved soil moisture and pH. This result was expected given the known impact of increasing soil organic matter.

The amount of nutrients added to the soil in compost has varied greatly (see Table 2) due to the fact that some properties received compost batches from early production runs that had relatively low nutrient levels.

Other than improving moisture and nutrient retention, compost is also a source of plant nutrients and organic matter which will boost the pool of nutrients to be gained by the crop.

Based on horticultural experience, not all nutrients in the compost are immediately available to the crop. Paulin (personal communication) suggests the Department of Agriculture trial work shows that approximately 40% of the phosphorus is available (similar availability to superphosphate) and results elsewhere show 20% of nitrogen is available in the first season. They also found potassium was at least as available as fertiliser sources and may improve the efficiency of potassium utilisation by 20 % during the life of the crops.

It is noteworthy that the Wongan Hills property had a relatively low level of nutrients in the compost but achieved the highest increase in yield. This suggests that the major impact of the use of compost in this situation has been via soil moisture improvements or other biological factors not measured.

With this in mind it would appear that the improvements in soil moisture was the major contributing factor for the improvements in crop growth, including dry weights and tiller numbers at flowering, and yield.

The addition of SMRC compost to agricultural soils is an effective way to boost a soils ability to retain nutrients and water, improve soil chemical characteristics and increase soil nutrient content. An increase in any one of these soil characteristics can lead to improvements in crop performance.

References:

David, SG Using SMRC Compost In Your Crop, Organic Farming Systems 2004

Paulin, B Department of Agriculture Western Australia; Personal communication 2005.

Project Manager:

Organic Farming Systems
PO Box 419, Cottesloe WA 6911
Tel 9384 3789; Fax 9384 3379

Website: www.organicfarming.com.au
Email: compost@organicfarming.com.au

Compost Manufacturer:

Southern Metropolitan Regional Council
www.smrc.com.au

Check the websites for results from other crops.

ORGANIC FARMING SYSTEMS

SOUTHERN METROPOLITAN REGIONAL COUNCIL

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