Organic amendments vs inorganic fertiliser in a cropping enterprise - three years on

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Key messages

- There is an opportunity to use locally available amendments in place of inorganic fertiliser.
- High rates of surface-applied chicken litter tend to have a better yield response than either surface-applied compost or inorganic N fertiliser.
- After three years there does not appear to be an advantage using 20 t/ha of amendment compared to 10 t/ha.
- Stability of these organic products may provide a long term benefit to the system that could mean less fertiliser is required in crop under an organic amendment regime.

Introduction

This project aims to demonstrate the effectiveness of two types of surface applied organic amendments – compost and chicken manure. It is hoped the applications will increase the organic carbon content of the soil and reduce the reliance on the application of inorganic nitrogen applications, as well as increasing crop yields. Both the compost and chicken manure are readily available in Gippsland so it is an opportunity to evaluate the fertility and yield benefits of these amendments on cropping soils. However, the question is: do we see a yield increase?

What has been happening?

There are two identical trials within the Gippsland branch, at Bairnsdale and Giffard. In both trials the compost and chicken manure has been surface applied at four application rates each and then compared to a normal fertiliser with no amendment and an untreated control (Table 1). The lower rates of amendment (2.5 t/ha and 5 t/ha) was applied annually, with the higher rates as a one-off application. Table 1 outlines the treatment details.

Table 1. The ten treatments being compared at Bairnsdale and Giffard sites

1	An annual pre-sowing surface application of chicken litter at 2.5 t/ha
2	An annual pre-sowing surface application of chicken litter at 5 t/ha
3	A one-off pre-sowing surface application of chicken litter at 1 t/ha
4	A one-off pre-sowing surface application of chicken litter at 20 t/ha
5	An annual pre-sowing surface application of compost at 2.5 t/ha
6	An annual pre-sowing surface application of compost at 5 t/ha
7	A one-off pre-sowing surface application of compost at 10 t/ha
8	A one-off pre-sowing surface application of compost at 20 t/ha
9	No organic amendment applied, with inorganic nitrogen applied in crop
10	No organic amendment applied and no nitrogen applied in crop (control)

A locally available chicken litter was chosen, with a 'man-made' compost waste product being sourced from Gippsland Water to match the nutrient analysis of the chicken manure. A basic summary of a 20 t/ha chicken manure rate is given below.

Table 2. Nutrient analysis of a 20 t/ha rate of chicken litter, showing a surprisingly low nitrogen content and high phosphorus and potassium

Nutrient	Amount in 20 t/ha chicken litter	
Nitrate (NO_3^-)	14.2	kg/ha
Ammonium (NH_4^+)	97.3	kg/ha
Phosphorus (P)	159.0	kg/ha
Sulphur (S)	85.0	kg/ha
Potassium (K)	410.1	kg/ha
Calcium (Ca)	100.1	kg/ha
Magnesium (Mg)	114.9	kg/ha

What have we seen over the three years?

2012

In 2012, heavy rain in early winter delayed any field work (not through lack of trying!), and eventually spring barley was sown at both sites. Due to the very late sowing at the Giffard site, yields were compromised, although the crop did yield (surprisingly), any effect of amendments was not seen in the first year.

The Bairnsdale site had a kinder season and a good response was seen in the Westminster barley crop (see table 3). The chicken litter treatments yielded significantly higher than their corresponding compost rates. The reasons for this are unclear, as nutrient wise they were very similar. The thinking is that perhaps the content of shavings/rice hulls in the chicken litter may have made for slower release of nutrients compared to the pure compost.

Table 3. Westminster barley yields at Bairnsdale in 2012, the first year of treatments.

Treatment	Yield (t/ha)	
10 t/ha Chicken litter	2.94	a
5 t/ha Chicken litter	2.90	a
20 t/ha Chicken litter	2.85	a
2.5 t/ha Chicken litter	2.59	ab
2.5 t/ha Compost	2.55	ab
10 t/ha Compost	2.28	bc
20 t/ha Compost	2.27	bc
5 t/ha Compost	2.20	bc
Normal fertiliser (no amend)	2.05	c
Control (no amend or fert)	2.04	c
***p*-value**	**<0.001**	
LSD (*p*=0.05)	**0.40**	

2013

A huge 262 mm of rain fell in June in Bairnsdale, which is 200 mm above the average for June. This saw the Bairnsdale canola crop suffer from waterlogging and the impact was evident at harvest with disappointing yields across the trial area and into the farmer's paddock. Luckily, in 2013, the Giffard site delivered the goods after suffering a similar fate to Bairnsdale in 2012. Results from the canola (cv. Garnet) at Giffard are presented in Table 4. It is interesting to note that at Giffard in 2013, there was no significant yield advantage from applying 20 t/ha compared to 10 t/ha of chicken litter or even 5 t/ha. Applying 20 t/ha of chicken litter was a significantly better treatment than farmer practice fertiliser which was 100 kg/ha of urea at stem elongation. Similar to 2012, the chicken litter performed better across the board than comparable rates of compost except for the 2.5 t/ha rate.

Table 4. Canola yields at Giffard in 2013, the second year of treatments

Treatment	Yield (t/ha)	
Chicken litter 20 t/ha	3.42	a
Chicken litter 10 t/ha	3.25	ab
Chicken litter 5 t/ha	3.02	abc
Control (no amend or fert)	2.92	bcd
Chicken litter 2.5 t/ha	2.76	cde
No amend. + no N fert	2.63	c-f
Compost 20 t/ha	2.51	def
Compost 2.5 t/ha	2.51	def
Compost 10 t/ha	2.42	ef
Compost 5 t/ha	2.29	f
***p*-value**	**<0.001**	
LSD (*p*=0.05)	**0.42**	

2014

Both sites results suggest that in this third year, the compost amendment has caught up to the chicken litter in regards to yield. This has been supported by other field trials done around the state, with the suggestion that perhaps the compost, if high in N, can cause nutrients to be tied up in the short term, and may need to be supplemented by nutrients to get through this lag.

It is interesting to note that in the third year, the control, which had no amendment or in crop fertiliser didn't perform any worse at both sites that the high or low rates of amendment. This creates a bigger question - is in-crop N always necessary? Do the high rates of amendment cause an increase in baseline soil fertility that results in less dependence in inorganic fertiliser over time?

Table 5. Wheat yields at Giffard in 2014, the third year of treatments.

Treatment	Yield (t/ha)	
Compost 20 t/ha	4.54	a
Chicken litter 20 t/ha	4.49	a
Chicken litter 10 t/ha	4.38	ab
Compost 10 t/ha	4.30	ab
Control (no amend or fert)	4.28	abc
Chicken litter 5 t/ha	4.23	abc
Compost 5 t/ha	4.22	abc
Chicken litter 2.5 t/ha	4.21	abc
Normal fert	4.07	bc
Compost 2.5 t/ha	3.93	c
Mean	4.26	
LSD(p=0.05)	0.36	

Means followed by the same letter do not significantly differ (p=0.05).

Table 6. Wheat yields at Bairnsdale in 2014, the third year of treatments.

Treatment	Yield (t/ha)	
Compost 20 t/ha	4.83	-
Control (no amend or fert)	4.65	-
Compost 5 t/ha	4.64	-
Compost 2.5 t/ha	4.61	-
Chicken litter 20 t/ha	4.61	-
Chicken litter 2.5 t/ha	4.58	-
Compost 10 t/ha	4.51	-
Normal fert	4.47	-
Chicken litter 10 t/ha	4.43	-
Chicken litter 5 t/ha	4.14	-
Mean	**4.55**	
LSD(p=0.05)	**0.76**	

Results from this trial were not significant (p=0.05).

Soil fertility

The complete analysis of the soil carbon will be done in 2015. Soil carbon is expected to increase slowly under the chicken litter and compost treatments. The timing of soil sampling is being investigated at the moment by other agencies.

What does this mean for my cropping enterprise?

Finding alternatives to bagged fertiliser using locally sourced manures and composts sounds logical, especially as input costs get higher and the growing seasons more volatile, but what if they can actually improve paddock performance? So far results are showing you can get yield increases from using an amendment like chicken litter over artificial nutrients, but the fact that two years on there are still significant results from surface applied

amendments is pretty exciting. Organic amendments are proving to be fairly stable out in the paddock. They present a great opportunity to manage risk as we have seen applications prior to sowing significantly increase yields, even without in-crop fertiliser. This is especially valuable for areas that receive a lot of winter rainfall and struggle with top dressing throughout the season.

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Figure 1. Compost spreading at the Giffard site.