Trial of compost containing zeolite in Canola

Introduction

The field trial of composted soil conditioner containing 10% (w/w) zeolite (CompostZ) was designed and supervised by BioCarbon Soil at a property called Hyland, on the Warral Birthmere Road, Warral, near Tamworth, NSW. The zeolite was provided by Castle Mountain Zeolites and was co-composted with garden organics and paunch as detailed in the companion report "Trial of zeolite in commercial composting". The purpose of the field trial was to measure the agronomic effect of using Compost Z and other compost treatments in the production of Canola, a common winter crop in the area. This report presents results for one year only (2023).

For the owner of Hyland, the primary objective of using compost was to improve soil health while producing a profitable cash crop. It was recognised that improving soil health occurs over several years and is influenced by many management practices. However, in a commercial operation, inputs must remain affordable and production profitable each year. This can be achieved by reducing other inputs whilst maintaining or increasing yield.

The compost supplied for the trial was well matured having completed 14 weeks of controlled composting and stored for at least a further 8 weeks before spreading. The manure was added to the compost using a self-motivated windrow turner (2 passes) after composting (14 weeks) but before further maturation in windrows (8 weeks storage).

Trial Methodology

The trial occurred on an 18-hectare paddock that had previously grown lucerne and native grasses. In 2022 the grasses were terminated with a glyphosate-based herbicide with barley direct drilled into residue and resulting in 3 tonne/ha barley at harvest. Compost and lime were spread on the soil surface in first week of March 2023 but not soil incorporated (not ploughed in). Sowing by direct drill occurred in the last week of April 2023. The grain was harvested on 30 October 2023. The paddock was not irrigated.

Soil was sampled by BioCarbon Soil and tested by Environment Analysis Laboratory (EAL) before compost application (3 March 2023) and immediately before harvesting (30 October 2023).

The trial consisted of three treatments 100 m wide and the full length of the paddock (approximately 3 ha each) at an application rate of 2.5 tonne (4 cubic metres) per hectare with the remaining area (approximately 9 ha) acting as the control. The treatments were:

1. Compost only (Compost)
2. Compost containing 10% zeolite (Compost Z)
3. Compost containing 25% (w/w) cow manure blended after composting (Compost M)
4. No Compost (Control)

Lime was spread at 2 tonnes/ha. Other inputs applied in the two weeks before sowing were:

1. 100kg/ha UreaSS
2. 50kg/ha MAP

Fertiliser application rates were 50%-75% of what has previously been used to grow Canola at Hyland. No additional fertiliser was used after sowing. Intervix was used at early vegetative stage (before row closure) for grass control and a fungicide used at late flowering stage. An area of 1 ha was harvested from each

treatment before completing harvest on the remainder of the paddock, with the quantity of grain measured by a chaser bin with load cell.

Rainfall

After record rainfall of 215mm in March 2023, monthly rainfall figures for April to October 2023 were well below average:

- 29mm in April, including 13mm immediately after sowing
- 0.2mm in May
- 52mm in June, being the only month of average rainfall
- 26.8mm in July
- 12.8mm in August
- 1.8 mm in September
- 34.4mm in October

A total of 157mm fell between April and October 2023.

Plate 1: Canola Crop 3 months after sowing (2 August 2023)

Results

All the treatments increased yield compared to the control. The control yield of 1,866 kg/ha is close to reported average dryland yields in NSW of 1,890 kg/ha. This was a high yield given that rainfall for July-September 2023 was 60% of mean rainfall. Higher yield was achieved from Compost Z and Compost M treatments. Compost Z contain significantly higher (3-5 times) the levels of N available in the first year as ammonia and nitrate.

Analysis of Canola seed showed increased oil content in all treatments compared to the control.

Treatment	Oil %	Oil % @ 6% moist	Year 1 quality benefit ($/ha)	Protein in meal @ 10% moist	Glucosinolates in oil free meal @ 10% moist
Control	43.3	43.2	NA	41.9	10
Compost	46.8	46.6	62.82	36.7	10
Compost Z	45.8	45.7	47.41	38.1	9
Compost M	46.5	46.3	63.23	37.4	6

Increase in yield compared with control was most pronounced with Compost M.

Treatment	Bin 1 (kg)	Bin 2 (kg)	Total (kg)	Increase (kg/ha)	Canola price ($/kg)	Gross income ($/ha)	Year 1 yield benefit ($/ha)
Control	912	954	1866		0.65	1212.90	NA
Compost	935	960	1895	29	0.65	1231.75	18.85
Compost Z	999	946	1945	79	0.65	1264.25	51.35
Compost M	1075	1017	2092	226	0.65	1359.80	146.90

Analysis of soil showed improved nutrient levels in the soil compared to the control and pre-crop soil analysis. All results are in mg/kg. No post crop soil analysis is available for the Compost M treatment.

Treatment	Total C	Total N	C:N	Sol N	Total P	Colwel P	Total K	Exch K	Sulfur	CEC
Control	17000	1800	9.4	9.2	265	27	1808	179	11	11
Compost	17000	1700	10.0	10.7	313	53	2241	266	12	13
Compost Zeolite	19000	2100	9.0	30	400	57	2488	392	16	12
Pre-crop	15000	1400	10.7	14	396	29	2148	294	13	14

Treatment	Total Ca	Exch Ca	Sol Ca	CEC
Control	2515	1513	1733	11
Compost	3568	1633	1835	13
Compost Zeolite	3049	1483	1790	12
Pre-crop	2106	1885	1635	14

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Plate 2: Dry canola pods immediately prior to harvesting

Costs and Benefits in Year 1

The compost and compost blends were provided at the same fee of $70/tonne delivered, which equates to $175/ha at an application rate of 2.5 tonne/ha. Spreading was done with existing equipment by the property owner, however typical cost is no more than $15/ha. Therefore, the total cost of application was equivalent to $190/ha. This is affordable in the context of gross revenue of $1,300 per hectare. Due to the cost of Zeolite as an input, a fee of $85/tonne delivered for Compost Z would better reflect future pricing of the product.

While synthetic fertiliser use was reduced compared to standard practice, the same quantity was applied to all treatments so there is no cost difference between the treatments. This means that only the Compost M year one cash benefits were greater than costs (by $20.13/ha) based increased yield and oil content in the first year after application.

Benefits of compost application, including nutrient release, occur over several years. By looking at the changes in the soil analysis it is possible to partially quantify the change in stock of nutrients available for future years of production.

Results indicate that organic carbon and nitrogen stocks, in addition to most pools of primary nutrients, are building despite the demands of the 2023 Canola crop and relatively low level of synthetic fertiliser use. Most notably, the post crop Colwell P of 53 and 57 mg/kg is sufficient to grow Canola without additional P as synthetic fertiliser and is worth at least $50/ha future avoided use of synthetic fertiliser. Compost Z also maintained total P stocks and significantly increased total N and K and tripled the available N left in the soil post-crop. Co-application of compost with lime enhanced total, exchangeable and soluble calcium levels in the soil compared to the control.

Conclusion

This field trial adds to the evidence that compost use can be an affordable farm management practice for building soil health in dryland cropping systems over time. Application of Compost Z resulted in the greatest increase in organic carbon and nitrogen, which are indicators of soil health, in year one. Affordability is improved if compost blends can be supplied that contain higher levels of ammonia, nitrate, and other plant available (in year one) primary nutrients, particularly phosphorus, which are relatively costly to add using synthetic fertilisers due to the limitations on fertiliser use efficiency in soils with low soil organic matter. This can be achieved by blending compost with either zeolite and/or cow manure.

The significantly increased yield associated with the Compost M is only partially explained by the additional ammonia N supplied by the manure. Only 25% of the blended Compost M product was cow manure. Cow manure typically contains 2.5-3% nitrogen with <0.5% as ammonia N, part of which can be lost when surface applied. Total nitrogen in the compost is 1.5-2% with 0.1-0.2% ammonia and nitrate. Therefore, it appears that the additional benefit of this blend extends beyond what can be explained by additional ammonia N supply. Replication of the trial is required to confirm that these results are typical.