

Application of immature industrial compost to soil and its affect on soil properties and barley growth

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Introduction

Application of composted industrial residues to land has the potential to replace inorganic fertilisers and unstable organic wastes. Organic wastes have a high potential for agricultural use as they offer a supply of a wide range of nutrients and can also contribute to soil organic matter content. Chemical changes reported for re-use of composts include; increased soil pH and cation exchange capacity (CEC), plant available potassium and plant available calcium and magnesium. Levels of calcium, magnesium and sodium are often higher in municipal composts than in peat based growth media. Application of compost has been shown to increase levels of calcium, magnesium and sodium in the soil.

Negative plant growth effects, normally associated with a decrease in yield and inhibition of seed germination and plant growth, have been reported from use of low quality immature compost. Such composts exhibit an excess of heavy metals and salt, and a low degree of stability. Depending on the feedstock, certain composts may contain high concentrations of trace elements that may be detrimental to plants and the environment.

The aim of this study was to investigate the potential use of a composted industrial bio-waste as a soil additive and its effects on soil chemical parameters and barley (*Hordeum vulgare*) growth and performance

Materials and Methods

The experiment was run in a controlled greenhouse environment to determine the effects of four application rates (0 t/ha, 25 t/ha, 50 t/ha, and 100t/ha) of a compost on soil properties and barley growth. Compost properties can be summarised as, total N 6.8 g/kg, total P 16500 mg/kg, organic matter 86.4%, pH 7.4. Surface soil (0-10cm) was collected, air-dried and ground to pass through a 5.6 mm aperture sieve. Sixteen (4 treatments, 4 replicates) 2 litre polypropylene pots were filled with a mixture of soil and equivalent rates of compost. The experiment was conducted as a completely randomised design and percentage germination as well as average shoot height was recorded on a weekly basis for 16 weeks. Soil samples were taken at the cessation of a 16-week growing period and properties of the soil were determined by the following methods: pH and EC were measured in an aqueous extract (1:5), organic matter content by modification of the Walkley and Black method and organic carbon was determined using the rapid dichromate oxidation technique, exchangeable cations were determined using the Ammonium Acetate extraction method, total nitrogen content by the Kjeldahl method, and cation exchange capacity (CEC) by the sodium saturation method. The significance of differences was determined by ANOVA. The experimental data was subjected to analysis of variance (ANOVA), a probability level of $p < 0.05$ being considered to be statistically significant.

Results and Discussion

Maximum emergence (100%) was achieved in treatments that had not received compost (0 t/ha) and those which had received 25 t/ha. Percent seedling emergence was lower (89%) in treatments that had received 50 t/ha and 100 t/ha. Growth of the barley was conditioned by the phyto-toxic potential of compost, which, after addition to the soil, temporarily inhibited barley seedling emergence.

Compost addition appreciably increased soil organic matter and nutrient content. Cation content of the soil was also significantly increased.

Table 1. Properties of soil as affected by compost application

	pH	EC mS/cm	OM %	OC %	N %
0 t/ha	6.7a	0.35a	5.57a	1.76a	0.18a
25 t/ha	6.9ac	0.56b	6.30ac	2.15ab	0.22b
50 t/ha	7.1bc	0.56b	7.20bc	2.39bc	0.22b
100 t/ha	7.2b	0.63b	8.14d	2.72c	0.31c

Table 2. Exchangeable Cations and Cation Exchange Capacity in soil as affected by compost application

	meq/100g				
	Ca	Mg	K	Na	CEC
0 t/ha	6.83a	0.99a	0.23a	0.11a	15.2a
25 t/ha	7.66ab	1.08ab	0.26a	0.31b	15.6a
50 t/ha	8.19b	1.18b	0.37b	0.52c	17.4b
100 t/ha	11.15c	1.39c	0.42b	0.85d	23.3c

Means (n=5) followed by the same letter in the same column do not differ significantly ($p < 0.05$).

Conclusion

Application of compost at all rates raised levels of organic matter, organic carbon and nitrogen in the soil. However, high application rates of compost adversely affected barley seed germination and initial growth.

Soil pH and EC were significantly increased at high application rates. This trend was repeated for exchangeable cations and CEC.

Prior to future land application of compost greater maturation of the compost is recommended to ensure lowering of excessive salts.

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