A field study on the effects of spent mushroom compost incorporation on low organic matter tillage soil

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Introduction

When utilised as a soil conditioner, spent mushroom compost (SMC) has been proven beneficial in improving water-holding capacity, water infiltration, aeration, porosity, bulk density, aggregation and in the adequate provision of plant nutrients (Wang *et al.* 1984, amongst others). When applied to land, some of the organic matter, which is less susceptible to degradation, can remain on the surface of the soil, reducing the impact of rainfall on soil aggregates and consequently reducing crust development. This study explores the effects of SMC incorporation on low organic matter loam soil in Co. Kildare over a 3.5 year period and concerns with the effect of varying application rates of SMC and timing of incorporation on soil physical properties at yearly intervals.

Materials and Methods

The field trial was established in 2001 on a tillage farm (Mortarstown series), near Athy, Co. Kildare, which has an extensive history of soil structural problems, ascribed to intensive crop rotations, harvesting and ploughing over a 25-year period. Two trials were setup within one field, both of which had individual fully randomised factorial designs. The trials were established at different times so as to compare the merits of autumn/winter and spring SMC applications on soil properties. Area 1 was setup in November 2001 while area 2 was established in March 2002. Each area was split into 25 plots, which consisted of 5 application rates (0, 8, 16, 32 and 64 tha^{-1}) replicated 5 times that were amended with SMC in January/March 2002 and 2003. Each plot was 5 m by 10 m, with a 1m buffer zone surrounding it. A number of physical and chemical measurements were determined on a yearly basis. Yearly measurements included bulk density (Blake, 1965), particle density (Blake and Hartage, 1986), total porosity (Danielson and Sutherland, 1986), electrical conductivity (EC) and pH. Results were analysed using the general linear model for repeated measures on SPSS (SPSS, 2002).

Results and Discussion

The initial bulk density of the soil prior to SMC application was relatively high due to compaction caused by repeated cultivating and harvesting operations. Bulk densities were above 1.6 gcm^{-3} and can hinder root penetration (Brady and Weil, 1996). Soil bulk density reduced ($P<0.05$) over time and there were significant ($P<0.05$) time by application rate interactions effects for both experimental areas. Total porosity varied significantly ($P<0.05$) over time with significant interactions ($P<0.05$) between application rate and time. The effect of SMC application on total porosity was significant ($P<0.05$) in area 1 but not in area 2. This was probably due to the timing of SMC application. Soil pH and EC varied significantly over time ($P<0.05$) in both areas. The effect of SMC application on EC and pH was not significant in area 1 but were both significant ($P<0.05$) in area 2. SMC incorporation had a transient effect on pH, with soil pH returning to its initial value on a yearly basis (Fig. 1). Conversely, EC increased consistently over time, however there was no increase in values in response to application rates in area 1. Timing of SMC incorporation appears to influence soil pH and EC.

Conclusions

Taking into account the recommended phosphorous concentration of SMC, 8 tha^{-1} is the maximum quantity that can be applied in tillage soil (Maher and Magette, 1997), even at such a minute rate, pH and EC increased steadily over the 3-year period. So too did total porosity and a favourable decrease in bulk density was noted, particularly after the first year of incorporation.

References

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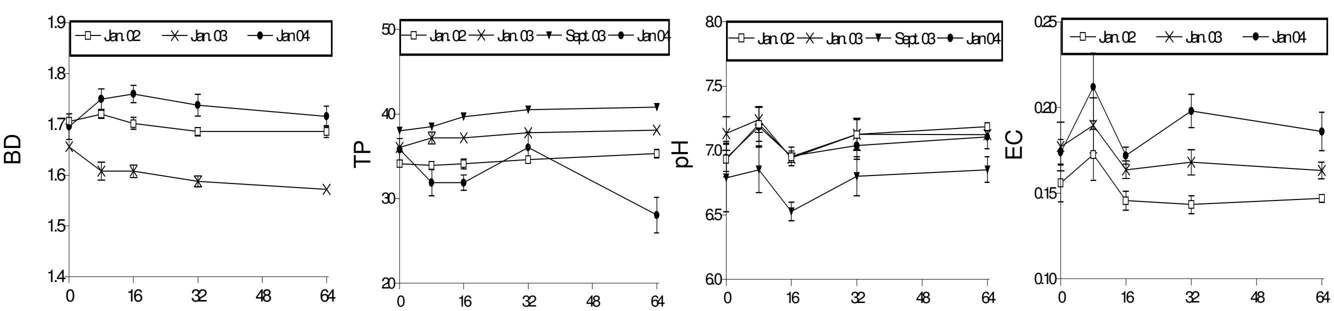

Figure 1 The effect of time and SMC application rates on bulk density (BD, g/cm^{-3}), total porosity (TP, %) electrical conductivity (EC, $mScm^{-1}$), and pH in area 1. Note different scales on y-axis.