**Effect of accelerated compost on soil physical and chemical properties of an Alfisol**

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**Abstract**

Accelerated compost (AC) is a newly developed commercial compost from market organic wastes and animal manure with composting accelerated within twenty one (21) days using a specific microorganism. However, information on effect of AC on soil properties is scarce. Therefore a field experiment was conducted in Ibadan to assess the effect of an AC on the properties of an Alfisol using maize (*Zea mays* L.) as a test crop. The experiment was laid out in a randomized complete block design with three replications. The treatments were AC at the rates of 60, 90, 120, 150 and 180 kgN/ha; while NPK 15-15-15 mineral fertilizer and conventional compost (CC) at 60 kgN/ha and an absolute control (no soil additive) were used as checks. Data collected on post cropping soil physical and chemical properties were subjected to analysis of variance (ANOVA) with the means separated using Duncan Multiple Range Test (DMRT). The study revealed that the AC improved the physical (bulk density, total porosity and volumetric moisture content) and chemical (pH, organic carbon, N and P) properties of the soil with the 60 kgN/ha as the optimum rate.

Key words*: Accelerated compost, Alfisol,* microorganism, *soil properties*

**Introduction**

The regular addition of organic fertilizer to the soil increases soil organic matter, decreases soil bulk density and enhances the soil structure and water holding capacity (Agele *et al.*, 2005; Adeleye *et al*., 2010; Adeyemo and Agele, 2010). The use of compost as soil amendment has been reported to improve crop yields and quality (Achieng *et al.,* 2010; Adeleye and Ayeni, 2010; Ibrahim and Fadni, 2013); this is in addition to documented positive impacts on post soil chemical properties (Kayode *et al*. 2013, Ibrahim and Fadni, 2013; Šimon and Czakó, 2014).

Relative to the conventional composting where the decomposition of organic materials could take six weeks to several months (Cooperband, 2002), the same process could be fast tracked by the introduction of artificial catalytic microorganism agents like *Trichodirma sp* and *Penicellum sp*. making such compost (otherwise known as accelerated compost) to mature within twenty one days (Rotor, 2008). This technology has the tendency to address the problem of lack of organic fertilizer in developing countries thereby enhancing the rate of adoption of organic agriculture. However, there is a paucity of information on the effects of accelerated compost on the soil properties. Therefore the objective of this study was to assess the effect of an accelerated compost (AC) on the properties of an Alfisol.

Materials and methods

This trial took place at the experimental site of the Federal College of Agriculture, Moor Plantation, Ibadan (7o 22’ 27.95’’ N and 3o 50’ 20.62’’ E), Nigeria. The site is a well-drained greyish brown Alfisol in the derived savannah agro-ecological zone. The pre cropping physical and chemical analysis of the site carried out showed low N (0.9 g/kg), P (4 mg/kg), organic carbon (9.1 g/kg) and medium K (0.4 cmol/kg) which justified the need for fertilizer application.. The textural class was loamy sand according to the USDA textural triangle. The bulk density was 1.65 and 1.79 g/cm3 at 0-15 and 15-30 cm soil depth respectively. The total porosity was 37.74 and 32.45 % at 0-15 and 15-30 cm soil depth respectively. While the volumetric moisture content was 0.167 and 0.21 cm3/cm3 at 0-15 and 15-30 cm soil depth respectively.

The experiment was laid out in a randomized complete block design, replicated three times. The treatments were accelerated compost (AC) at the rates of 60, 90, 120, 150 and 180 kgN/ha; NPK 15-15-15 mineral fertilizer and conventional compost (CC), both at the rate of 60 kgN/ha as well as the absolute control (no soil additive) were used as checks. AC is a newly developed commercial compost from market organic wastes and animal manure with composting accelerated within twenty one (21) days using a specific microorganism. The brand of CC used was Alesinloye compost. The depth of treatment application was 10 - 15 cm. Each plot size was 3.3 m x 3.3 m planted to *TZEE1 14 X TZEE1 57 X TZEE1 12* (extra early maturing Hybrid) variety of maize at a spacing of 75 cm x 25 cm. The maize plants were thinned to one plant per stand giving a plant population of 53, 333 plants/ha. The compost treatments were applied one week before sowing while the mineral fertilizer was applied at two weeks after sowing (WAS). The soil samples were collected from 0 -15 and 15 - 30 cm depth. The post cropping soil physical and chemical analyses were carried out after the second cropping. Data were subjected to analysis of variance (ANOVA) and means separated using Duncan Multiple Range Test (DMRT).

**Results**

The proximate composition of the composts (Table 1) showed that both the accelerated compost (AC) as well as the conventional compost (CC) contained plant nutrients and carbon appreciably. The AC treatments had significant effect on soil physical properties after the second cropping of maize (Table 2). The 120 kgN/ha AC had the least bulk density (BD) value (1.55 g/cm3) at 0-15 cm soil depth, which was not significantly different from other levels of AC, while the 60 kgN/ha NPK and the control gave the highest values of 1.68 and 1.67 g/cm3 respectively. At 15-30 soil depth, the 120 kgN/ha AC treated soil gave the lowest significant bulk density (BD) value of 1.58 g/cm3, followed by the 150 kgN/ha AC (1.60 g/cm3), 180 kgN/ha AC (1.65 g/cm3), 60 kgN/ha CC (1.63 g/cm3), 60 kgN/ha AC (1.68 g/cm3) while the 60 kgN/ha NPK gave the highest significant mean value of 1.69 g/cm3. All the AC rates; 60 - 180 kgN/ha and 60 kgN/ha CC therefore resulted into significantly higher values of total porosity of 40.38 - 41.57 % and 38.87 % respectively than the control (36.98 %) and NPK mineral fertilizer (36.60 %) at 0 - 15 cm soil depth. The result followed the same trend at 15 - 30 cm soil depth.

 In terms of the volumetric moisture content (VMC) at 0 -15 cm soil depth, the 60 kgN/ha CC treated soil gave the highest mean value of 0.081 cm3/cm3 which was not significantly different from all the AC levels except the 180 kgN/ha AC (0.058 cm3/cm3), while the 60 kgN/ha NPK and the control gave the lowest values of 0.048 and 0.044 cm3/cm3 respectively. At 15 - 30 cm soil depth, the 90 kgN/ha AC treated soil resulted into the highest mean value of VMC (0.110 cm3/cm3), followed by the 60 kgN/ha CC (0.095 cm3/cm3) and other levels of AC (0.084 - 0.077 cm3/cm3), while the 60 kgN/ha NPK gave the least value (0.074 cm3/cm3).

The results showed that the fertilizer treatments applied had significant (p<0.05) effect on the soil chemical properties after the second cropping (Table 3). The soil treated with 180 kgN/ha AC had the highest pH value of 6.5, which was not significantly different from other AC levels (except 60 kgN/ha;

**Table 1.** Proximate composition of the composts used for the study

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | pH (H2O) | Total Carbon | N | P  | K | Ca | Na | C:N ratio | Fe | Cu | Mn | Zn |
|  |  | --------------------- (g/kg) ---------------- |  | ------------- mg/kg ----------- |
| AC | 5.9 | 150 | 10.9 | 10 | 3 | 140 | 1 | 14 | 1321 | 61 | 405 | 146 |
| CC | 9.7 | 170 | 12 | 8 | 17 | 240 | 4 | 14 | 6053 | 11 | 393 | 1.5 |

AC; Accelerated compost, CC; Conventional compost

**Table 2**. Effects of the different levels of accelerated compost on some soil physical properties after the second cropping

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Bulk density (g/cm3) |  |  | Total porosity (%) |  | Volumetric moisture content (cm3/cm3) |
| Treatment | 0-15 soil depth | 15-30 soil depth |  |  | 0-15 soil depth | 15-30 soil depth |  | 0-15 soil depth | 15-30 soil depth |
| Control | 1.67a | 1.68b |  |  | 36.98c | 36.60f |  | 0.044d | 0.077c |
| 60 kg N /ha NPK | 1.68a | 1.69a |  |  | 36.60c | 36.23g |  | 0.048d | 0.074c |
| 60 kg N /ha CC | 1.62b | 1.63c |  |  | 38.87b | 38.49e |  | 0.081a | 0.095b |
| 60 kg N / ha AC | 1.58bc | 1.68b |  |  | 40.38ab | 36.60f |  | 0.069abc | 0.078c |
| 90 kg N / ha AC | 1.58bc | 1.67d |  |  | 40.38ab | 36.98d |  | 0.077ab | 0.110a |
| 120 kg N / ha AC | 1.55c | 1.58g |  |  | 41.51a | 40.38a |  | 0.064bc | 0.083bc |
| 150 kg N / ha AC | 1.56c | 1.60f |  |  | 41.13a | 39.62b |  | 0.069abc | 0.077c |
| 180 kg N / ha AC | 1.57c | 1.65e |  |  | 40.75a | 37.74c |  | 0.058cd | 0.084bc |

Means with same letter(s) in a column are not significantly different at 5% level of probability by Duncan Multiple Range Test (DMRT). NPK; NPK 15-15-15, AC; Accelerated compost, CC; conventional compost

**Table 3.** Effects of the different levels of accelerated compost on soil chemical properties after the second cropping

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatments | pH (H20) 1:1 | Org. C (g/kg) | Tot. N (g/kg) | P (mg/kg) | Ca | Mg | K | Na |
|  |  |  |  |  | (cmol/kg) |
| Control  | 6.3bc | 9.2e | 1.2bc | 10e | 0.3 | 0.4 | 0.2 | 0.7 |
| 60 kg N / ha NPK |  6.1d | 9.4e | 0.9d | 16e | 0.3 | 0.4 | 0.2 | 1.0 |
| 60 kg N / ha CC | 6.4ab | 10.0d | 1.0cd | 62ab | 0.3 | 0.4 | 0.2 | 0.6 |
| 60 kg N / ha AC | 6.3bc | 14.5a | 1.3ab | 37d | 0.3 | 0.3 | 0.2 | 0.9 |
| 90 kg N / ha AC | 6.4ab | 12.3b | 1.2bc | 38d | 0.3 | 0.5 | 0.2 | 0.8 |
| 120 kg N / ha AC | 6.4ab | 11.2c | 1.1cd | 49c | 0.3 | 0.4 | 0.2 | 1.2 |
| 150 kg N / ha AC | 6.4ab | 10.4d | 1.3b | 70a | 0.3 | 0.4 | 0.1 | 1.5 |
| 180 kg N / ha AC | 6.5a | 14.1a | 1.5a | 55bc | 0.4 | 0.5 | 0.2 | 1.0 |
|  |  |  |  |  | ns | ns | ns | ns |

Means with same letter(s) in a column are not significantly different at 5% level of probability by Duncan Multiple Range Test (DMRT). NPK; NPK 15-15-15, AC; Accelerated compost, CC; conventional compost, ns; not significant

AC; 6.3) and 60 kgN/ha CC, while the 60 kgN/ha NPK gave the lowest significant value of 6.1. The 60 kgN/ha AC gave the highest mean organic carbon (14.5 g/kg) which was not significantly different from the 180 kgN/ha AC (14.1 g/kg) but higher than others, followed by the 90 kgN/ha AC (12.3 g/kg), while the control gave the lowest value (9.2 g/kg) which was not significantly different from the 60 kgN/ha NPK (9.4 g/kg). In terms of total N, the 180 kgN/ha AC treated soil gave the highest mean value of 1.5 g/kg, which was not significantly different from 60 and 150 kgN/ha AC treatments (1.3 g/kg each), while the 60 kgN/ha NPK resulted in the lowest significant mean value of 0.9 g/kg. The 150 kgN/ha AC treated soil resulted into the highest value of available P (70 mg/kg) which was significantly higher than others except the 60 kgN/ha AC (62 mg/kg), followed by the 180 kgN/ha AC (55 mg/kg), 120 kgN/ha AC (49 mg/kg), 90 kgN/ha AC (38 mg/kg), 60 kgN/ha AC (37 mg/kg), while the 60 kgN/ha NPK and the control treatments gave the lowest significant mean values of 16 and 10 mg/kg P respectively. There was no significant difference among the treatment means in terms of the exchangeable bases.

**Discussion**

The AC treatments increased the soil pH, organic carbon, N and P relative to the control and NPK mineral fertilizer. The AC improved these soil properties relative to the initial soil status even when applied at 60 kgN/ha. This could be attributed to quick mineralization of the AC to release nutrients to the soil. The result confirmed the findings of Kayode *et al*. (2013) and Šimon and Czakó (2014) that organic fertilizers improved post cropping soil pH, organic carbon, available P and N. The result also showed that the AC at 60 kgN/ha decreased the bulk density and consequently increased the total porosity as well as the volumetric moisture content at 0 - 15 cm depth which is the rooting zone for most of the arable crops. Relative to the initial soil status at the two soil depths, the AC improved the bulk density and the total porosity comparable to that of conventional compost. This result is in support of the report of Adeyemo and Agele (2010) that farmyard manure improved the volumetric moisture content of an Alfisol in southwestern Nigeria. The improvement in the soil bulk density might be possibly due to increase in the proportion of macro-aggregates and soil organic matter (Agele *et a*l., 2005). The AC at 60 kgN/ha and at higher levels improving the bulk density and consequently the soil volumetric moisture content is in accordance with the report of Adeleye *et al*. (2010), that the addition of organic fertilizer improved the soil physical conditions mainly by improving the soil structure and decreasing soil bulk density.

**Conclusion**

The data from the study showed that the accelerated compost improved both the soil physical and chemical properties comparable to that of conventional compost at the same rate of 60 kgN/ha of application. Thus the short duration of composting for accelerated compost does not pose limitation to its ability to improve the soil properties at the optimum rate of 60 kgN/ha.

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