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Residual Fertilizer Value of OBD-plus Compost for Maize (*Zea mays*) Production

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Authors' contributions

All authors collaborated in this investigation. Authors OOAO and VOA-M conceptualized and designed the experiment, as well as supervised the investigation. Author OEAO carried out the field work and wrote the first draft. All authors read and contributed to the manuscripts.

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ABSTRACT

Ability of a fertilizer to contribute to crop performance beyond a cropping season is a positive consideration in soil fertility management. Thus, the residual fertilizer effects of OBD-plus (new commercial compost from market organic wastes and animal manure with composting accelerated with a specific microorganism) were investigated, using maize (*Zea mays*) as the test crop.
The field experiment replicated three times was conducted at the experimental site of the Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria. Experimental design was randomized complete block design with 5, 10 and 15 t/ha OBD-plus compost, mineral fertilizer (300 kg/ha NPK 15-15-15) and Control (no soil additive) as treatments. The different levels of compost were applied two weeks before planting while the mineral fertilizer was applied 2 weeks after planting. The treatment means were analyzed using Analysis of Variance (ANOVA) and the means were compared using standard error of means (SEM).
The results of this investigation on grain yield revealed that residual fertilizer effects of fertilizer treatments were in order of 10 t/ha OBD (35.02 kg/ha) >5 t/ha OBD (20.62 kg/ha)> NPK 15-15-15 (25.24 kg/ha)>Control (14.40 kg / ha).>15 t / ha OBD (11.20 kg/ha).Thus the result of this finding

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suggests that OBD-Plus at the rate of 10 t/ha could support maize production beyond a cropping season (i.e have residual effects) and this could save maize farmers' money.

Keywords: OBD- plus; city waste; compost; Zea mays.

1. INTRODUCTION

Soil nutrient depletion and likely soil degradation have been considered serious threats to productivity of crops in Sub Saharan Africa. These challenges have been identified as major causes of decreased crop yields and per capita food production [1]. Compost as organic fertilizers could be the solution to poor soil fertility in organic farming system or situations where mineral fertilizers are not readily available.

Organic fertilizers are considered to be better than the mineral ones because intensive use of mineral fertilizers has been reported to be associated with reduced crop yield; due to soil acidification and nutrient imbalance [2-5]. Another major limitation to the usage of chemical fertilizers in crop production is the ease of leaching, volatilization, and contribution to soil physical degradation [6]. Also, these mineral fertilizers are not usually available to the peasant farmers in most developing countries, as well as negative effects on climate [7-10]. Hence there is a lot of emphasis on organic fertilizers like composts, manure and similar ones, in supplementing soil nutrients [11,12].

The advantages of composts range from slow release of nutrients, long-term benefits to the soil and the environment in general and the ease of farmers generating their compost by themselves [13-16]. Also crops planted with organic production systems are devoid of synthetic chemicals which could be hazardous to human and environmental health. This helps to guarantee the safety of the producers as well as improving quality of the produce. Although appropriate timing of compost application has been reported to influence crops' responses [17], however, there is a need to ensure the ability of a compost to supply nutrients beyond a growing season. This could greatly reduce net expenditure of the farmers on crop production.

Effective composting of organic wastes is seen as a way of managing the environment in a sound and safe manner [18]. Composts can be produced from municipal and organic agricultural wastes. The OBD-plus organic fertilizer (compost) is anew commercial product from organic market wastes, animal manure and a compost degrading bacterial. The composting period of the OBD-plus is much reduced compared to the conventional compost, due to the effectiveness of the bio-degrader inclusion in the composting process. Compost could improve productivity of crops of which maize (*Zea mays*) is one. Maize is the third most important cereal in the world and the most important in sub-Saharan Africa [19]. Therefore, the residual ability of OBD-plus organic fertilizer was investigated for maize production in this research.

2. MATERIALS AND METHODS

The experiment was conducted in the rainy season of year 2011, at the experimental site of the Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria, Lat. 7°22' 39.32'' N, Long. 3°50' 19.64''E and Lat. 7°22'39.86''N, Long. 3°50'18.74''E at 183 m above the sea level. Experimental design was randomized completely block design in three replicates. Planting was done twice; one main and the other residual (without further treatments application). The treatments applied were 5, 10 and 15 t / ha OBD-plus organic fertilizer, while mineral fertilizer (300 kg / ha NPK 15-15-15) and Control (no soil additive) were used as control treatments. OBD-plus is a commercial organic fertilizer from Gateway Organic Fertilizer Company, Abeokuta, Ogun State, Nigeria which composting was achieved in three weeks by the addition of a microbial-degrader. Conventional composting takes up to two or more months. The proximate analysis of the OBD-plus compost used for this study is shown in Table 1.

Each plot size was 11.25 m^2 and the spacing of 75 cm x 25 cm with one plant per stand was adopted giving a plant population of 60 stands per plot. While the OBD organic fertilizer treatments were applied two weeks before sowing, the inorganic was applied 2 weeks after sowing. The growth parameters of the maize plants were observed at 4, 6 and 8 weeks after sowing (WAS) while the cobs were harvested at 12 WAS, dried and shelled.

Experimental soil was low in N (1.21 g / kg), P (8 mg / kg) and K (0.2 cmol / kg) [20], while the textural class was loamy sand. Total N was determined using the micro Kjeldahl procedure described by [21]. Available P was extracted using Bray 1 method [22] P concentration determined with spectrophotometer. Exchangeable K was extracted with 1 N ammonium acetate [23], and read using flame photometer. Particle size distribution analysis was carried out by hydrometer method, using sodium hexa meta-phosphate as the dispersing agent [24].

The average rainfall amount of the experimental location for the three months (May-July, 2011) of the main planting was 271.9 mm, while that of the residual fertilizer planting (August-October, 2011) was 173.0 mm. The average daily maximum temperature within the period of the main and residual planting was 30.5 and 32.6 ˚C respectively. The treatment means were analyzed using Analysis of Variance (ANOVA) and the means were compared using standard error of means (SEM) ($P< 0.05$). The statistical package used was SAS version 9.2 [25].

3. RESULTS

At the main planting (Fig. 1), the NPK (15-15-15) resulted in a significantly ($P<0.05$) higher grain yield (2.54 t/ha) than the various levels of OBD-plus and Control treatments. While the maize grain yield from the various levels of OBD-plus were significantly lower than that of the Control treatment. However, at the second planting (residual fertilizer effects), 10 t / ha OBD (35.02 kg / ha) performed significantly better than NPK (15-15-15) (25.24 kg / ha) which was also significantly better than the Control (14.40 kg / ha) in terms of the grain yield of maize (Fig. 2). The result also showed that the maize grain yield increased significantly with 5 t/ha OBD producing 20.62 kg/ha, 10 t / ha OBD having 35.02 kg/ha) and 15 t / ha OBD resulting into 11.20 kg/ha maize grain.

4. DISCUSSION

The focus of this research was to investigate the residual effects of OBD-plus organic fertilizer (compost) on the yield of maize. At the main planting, the maize grain yield from the various levels of OBD-plus being lower than that of the mineral fertilizer and even the Control treatment at the main planting is not in line with the report of [26] where organic fertilizer improved the yield of maize and also compared favourably with NPK 15:15:15. It is also not in consonance with the finding of [27] where farm yard manure improved the yield of maize. This result therefore suggests that the compost might not have been properly cured and consequentially had negative effects on the mineralization of nutrients for crop use. This is in line with the report of [28] where lower crop yield was obtained from plot treated with semi cured compost compared with the fully cured one.

Table 1. Proximate Analysis of the OBD-plus compost used for this study

Parameter	pH (H_20)	N	P	K	Org. C	Ca	C/N ratio	Moisture
OBD %	6.5	1.23	1.58	0.23	15.03	7.06	12.22	20.16

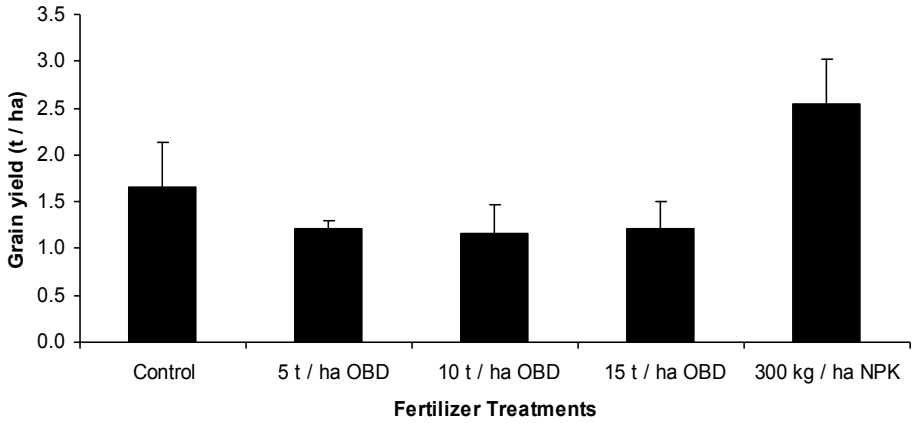

Fig. 1. Effects of the treatments on the grain yield of maize at 12 weeks after sowing in the main planting

Legend: Bar is Standard error of means

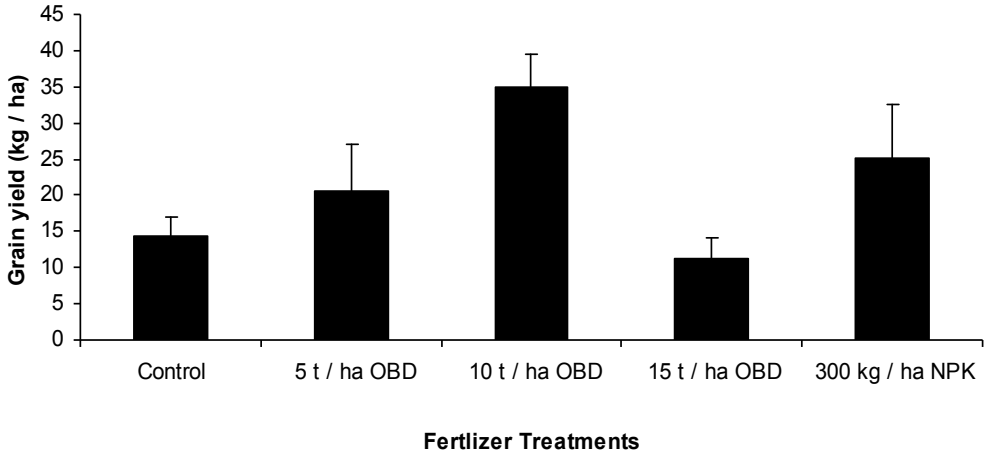

Fig. 2. Effects of the treatments on the grain yield of maize at 12 weeks after sowing in the residual planting

Legend: Bar is Standard error of means

Although the result of the residual fertilizer trial showed that maize yield was generally low across all the treatments, however, the 10 t/ha OBD-Plus resulted into best grain yield of 35.02 kg / ha. This poor performance seems to be due to drought experienced during the early growth and the silking stages of the maize plant, rather than the fertilizer treatments. This is reflected in the rainfall amount (173 mm) for the period of the residual planting relative to that of the period of the main planting (271.9 mm). The nutrient uptake of the maize plants must have been low during the moisture stress periods [29]. The residual fertilizer treatments from 10 t/ha OBD-plus treatment having better yield compare to other treatments in this investigation could be as a result of better nutrient mineralization with time of application. This is in line with the report of several authors [13,14,30,31] that organic fertilizers are characterized with slow release of nutrients, which leads to reduction in soil nutrient loss. However, the residual effectiveness of OBD-Plus organic fertilizer dropped after 10 t/ha of application. The 10 t/ha of OBD-plus performed better in residual fertilizer quality compared to other OBD-Plus fertilizers used in this study.

5. CONCLUSIONS

The result of this finding suggests that OBD-Plus compost at the rate of 10 t/ha could support maize production beyond a cropping season (i.e having good residual effects) and this could save maize farmers some fund. However, detailed research still needs to be carried out on responses of maize to the OBD-Plus Organic fertilizer in different soils and nutrient specific application rates of the fertilizer for optimum yield of maize.

DISCLAIMER

This manuscript was presented in the conference (only abstract).
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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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