Effect of Cowdung and Poultry Compost on the Physical and Chemical Properties of an Alfisol Soil in a Forest Ecology

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Application of compost to agricultural fields is a widely used method of increasing soil organic matter and fertility. Cowdung and poultry droppings were separately collected and composted for three months. The composts were applied singly and in-combination to a typical alfisol soil when maize was the test crop with a view to determining the effect of these compost applications on soil properties. This was a field experiment carried out in early and late cropping season of 2014. The experiment consisted of seven treatments; namely, 100% cowdung compost (CD), 100% poultry compost (PT), 50% CD + 50% PT, each at 3 and 6 t ha-1 and zero compost application served as control. The experiment was a randomized complete block design and each treatment plots (3.0 m x 2.5 m) was replicated three times to give a total of 21 plots. We concluded that application of animal composts to an alfisol soil enhanced soil properties, particularly the soil organic matter, a major key in crop husbandry.

Introduction

The impact of climate change are reducing capacity of natural resources such as biodiversity, soil and water to sustain the growing population of the world's food demand. Therefore, food security and climate change are interlinked threats that needs to be tackled at the same time. Increasing resource efficiency in agriculture and building resilience to climate risks are the important (1, 2). Drought-tolerant maize [3] and organic farming [4] are some of the mitigating mechanisms adopted biologically in climate changing scenario, globally. This study assessed the effects of cowdung and poultry compost on the physical and chemical properties of soil when a drought-tolerant maize variety was cultivated in a forest agro-ecology.

Materials and Method

Cowdung and poultry droppings were collected from the Beef and Poultry Unit of the Teaching and Research Farm, OAU, Ile-Ife. The two animal wastes were separately and aerobically composted for three months. Fresh cowdung and poultry droppings were separately heaped under a shed. The heaps were manually stirred once in two weeks with a strong wood to enhance the rate of curing. Water was occasionally added to facilitate aeration and decomposition rate. The temperature of the compost at fully-cured stage was recorded (32 °C) with a hand-held thermometer.

Experimental Layout and Agronomic Practices

The field experiment was carried out at the Teaching and Research Farm, Obafemi Awolowo University (OAU), Ile-Ife, Nigeria (Lat. 7.55' N and Long. 4.55 E) during the early cropping seasons (April – July) and late (September – December) maize cropping season of year 2014. Viable seeds of maize variety DT-SR-WC2 were obtained from the Institute of Agricultural Research and Training, Ibadan. The experimental plot was cleared twice. The experiment was laid out in a randomized complete block design with seven treatments: 100% cowdung (CD), 100% poultry manure (PM), 50% CD + 50% PM and each at the rate of three and six tonnes per hectare and zero manure application to serve as control. Each treatment plots (3.0 m x 2.5 m) was replicated three times to give a total of 21 plots in the experimental site. Composts were applied at 2 weeks after sowing. The maize seedlings were later thinned to two stands per hole at two weeks after sowing (WAS). Collection of data on growth parameter of maize commenced at 2 WAS and continued fortnightly till maturity. At full maturity, maize ears were harvested per plot, manually shelled and grains were weighed. The treatment plots used in the early season were cleared again for maize cultivation in the late season without new treatments addition.

Analysis of Soil and Compost Samples

Composite surface soil samples (0-15 cm) were taken for each plot before and after the sowing. Samples of the composts were also taken. The samples were air-dried for analysis. Organic carbon was determined by Walkley-Black method [5] and total soil nitrogen was determined by Macro-kjeldahl method [6]. Available P was determined by Bray-1 method [7]. Exchangeable acidity was determined by titration method [8]. Soil pH was determined in a 1:1 soil to water suspension using the Dwyer model WPH1 waterproof pH tester. Data obtained were subjected to analysis of variance and their treatment means were separated using Bonferroni Multiple Comparison Tests at $p > 0.05$.

Results/ Discussion

The sandy loam soil texture of the study area may be attributed to the parent material from which the soil was formed and the climate of the area. Enujeke et al. [9] earlier reported that high sand content of a soil could be attributed to high content of quartz in the parent material. The pre-cropping soil was slightly alkaline with pH 7.86. Other results included: 2.12 g N kg-1, 22.51 g OC kg-1, 1.63 mg P kg-1 and cations exchangeable capacity 21.01 cmol kg-1. The chemical compositions of poultry compost were: total N 15.1 g kg-1, total P 4500 mg kg-1, organic carbon 148.67 g kg-1 and C/N ratio 9.85; while cowdung compost contained total N 11.6 g kg-1, total P 3500 mg kg-1, organic carbon 145.88 g kg-1, and C/N ratio 12.58. Cowdung compost reduced by 23.2% for total N, 22.2% for total P and 1.9% for organic carbon when compared with poultry compost. The properties of the soil reduced after the first cropping harvest (N 1.35-1.72 g kg-1, P 0.82-2.00 mg kg-1 and OC 14.84-19.61 g kg-1 wet season) but increased after the repeat experiment (N 0.40- 0.52 g kg-1 P 2.39-7.95 mg kg-1 and OC 25.70-30.41 g kg-1). The slow-decomposition rate of compost could be attributed to this. Adesodun et al. [10, 11] had found that application of poultry manure to soil increased soil N and P and aggregate stability.

Conclusions

We concluded that application of animal composts to an alfisol soil enhanced soil properties, particularly the soil organic matter, a major key in crop husbandry.

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