RESPONSE OF MAIZE TO MODE OF APPLICATION OF RECYCLED WASTE MATERIALS IN TWO SOIL TYPES

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ABSTRACT

Composting is an effective approach for recycling of the organic wastes for agriculture uses. The recovery of the organic fraction of municipal solid waste for the peri- urban agriculture could contribute to the improvement of environmental sanitation and increase agricultural productivity in the Sub-Saharan Africa through improvement in soil physical and chemical properties. The organic fraction of the municipal solid waste compost, however, is low in nitrogen (N) and has to be enriched to meet crop requirement for growth and development. Municipal solid waste compost (MSWC) has the ability of supplying both the required macro and micro plant nutrients but in low quantities and usually not early enough for quick utilization. Enriching the organic fertilizer source with inorganic N fertilizers addresses the deficiency of late and low supply of nutrients.

Plot experiments were conducted to assess the growth and yield of maize with MSWC only (CO) and Nitrogen-enriched MSWC (CO+ AS). These treatments were compared with performance of inorganic N fertilizer materials such as ammonium sulphate (AS), NPK, NPK +AS. Each treatment was designed to supply 150kgN/ha and was applied either on the surface or buried, and used to grow maize in Cambisol or Ferric Lixisol. Maize growth was significantly (P = 0.05) affected by the application of CO+AS. The plants of CO and CO+AS treatments were comparable in height and leaf area with inorganic N fertilizer. Fertilizer of maize gave significantly (P= 0.05) higher grain yields. In the Cambisol, the CO and the CO +AS treatment gave an average grain yield of 1.27 and 1.74 t/hs respectively, while the inorganic N fertilizers gave 1.10, 1.24 and 1.67t/ha for AS, NPK, and NPK +AS treatments respectively. The unfertilized control treatment recorded 0.73t/ha. No significant difference was observed between surface or buried application treatments. Although lower grain yields were observed for similar treatments under the Ferric Lixisol, CO+AS once again recorded higher grain yields that the inorganic N fertilizer treatments. The grain yields of the CO and CO + AS treatment were 0.95 and 1.17t/ha respectively, while that of the inorganic N fertilizers were 1.00,1.02,1.08t/ha for AS, NPK and NPK+AS respectively. The unfertilized

control recorded 0.58 t/ha. These results show the potential of the use of CO and especially CO+AS, as a sustainable alternative to inorganic N fertilizer for maize grain production.

The application of the N fertilizer materials had a positive effect on most of the yield components such as leaf area, plant height and leaf chlorophyll content. A positive relationship was observed between total DM and grain yield with the following values r = 0.83for surface, and r = 0.92 for buried for Cambisol. Similar positive relationship was observed between total DM and grain yield in the Ferric Lixisol, with the following values r = 0.83 for surface, and r = 0.93 for buried applications.

Generally, maize plants grown on Cambisol accumulated greater amounts of N than similar treatments in the Ferric Lixisol. Maize plants treated with CO and CO + AS accumulated 67 % and 39% respectively more N than similar treatment in the Ferric Lixisol, while AS treated plants accumulated 17%, NPK accumulated 49% greater N when grown in Cambisol than Ferric Lixsol. A positive relationship between N uptake and grain yield of r = 0.92 and r =0.95 was observed for Cambisol and Ferric Lixisol respectively. These results show that grain yield of maize was limited by N, and the CO and CO + AS treatments were effective in supplying N for maize growth and grain yield. The % N recovery was generally higher in the Cambisol than the Ferric Lixisol. The highest N recovery (%) was observed in CO +AS treatment recording 82.3% and 57.3% for the Cambisol and Ferric Lixisol respectively. The highest N recovery among the inorganic N fertilizers was observed in NPK+AS recording 58.3 and 55.7%, for the Cambisol and Ferric Lixisol respectively while the lowest was observed in AS, recording 36 and 31 % for Cambisol and Ferric Lixisol respectively. The N recovery (%) in the CO was 59.7 and 30.7% for Cambisol and Ferric Lixisol respectively.

In the Cambisol, all the treatment decreased the soil pH, although marginal decreases were observed for the control, NPK and CO, when applied to the surface. Only the CO treatment increased the soil pH when buried. Similarly for the Ferric Lixisol, the residual soil pH decreased for all the N fertilizer treatments, except the CO treatment. Marginal decrease in soil Ph was observed for the control and CO+AS while significant decreases was observed for the inorganic N fertilizer materials. The residual soil nitrate was higher in Cambisol than Ferric Lixisol. Similarly, while the residual soil nitrate for CO and CO+AS was 3.7 and 4.3 fold higher than that of the control, that for AS was only 0.6 fold higher than the control for Ferric Lixisol when applied on the surface. This suggests that most of the soil nitrate might have leached beyond the reach of the plant, and is a potential source of nitrate pollution.

Therefore, the use of CO and CO + AS is a sustainable way of improving soil health as significant amount of nitrates is still in the soil and can be used by the subsequent plant.

The control and AS treatment decreased the soil total carbon, while CO significantly increase to 3.3% and 8% for surface and buried respectively in the Cambisol. Similarly, in the Ferric Lixisol all treatments decreased the total soil C content except for CO. In the Ferric Lixisol, the soil residual P for CO and CO+AS treatments were 45% and 65% respectively higher than that of the control, while that of the NPK +AS was 85% higher. On the other hand, soil residual P for CO or CO+AS were 75% and 80% respectively higher, while NPK was 105% higher than the control in the Cambisol. Thus, the residual soil P through the application of the CO or CO +AS at this rate was lower than that of the inorganic fertilizer, and therefore has no potential of accumulating P in the soil. Agronomic utilization of N-enriched MSWC can help reduce the amount of MSW used in land filling each year and, by recycling valuable nutrients, MSWC production and use has an important role to play in the improvement of our environment.

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