**POTENTIALS OF TWO BREWERY WASTE-BASED COMPOSTS ON SOIL FERTILITY FOR AMARANTH (*Amaranthus* *caudatus)* AND JACKBEAN**

**(*Canavalia ensiformis)* INTERCROP**

O. O. AdeOluwa\*, E. Y. Thomas, A. Bello and B. Joshua

Department of Agronomy, University of Ibadan, Ibadan, Nigeria.

Corresponding author: [adeoluwaoo@yahoo.com](mailto:adeoluwaoo@yahoo.com)

**ABSTRACT**

The need for an increased production of vegetables to meet the human dietary necessitated a research in the use of different organic resources, for improving the soil fertility as well as improved yield and quality of amaranth. Thus, this report investigated the potential of two brewery waste based composts on soil fertility for amaranth (*Amaranthus* *caudatus)* and Jackbean (*Canavalia ensiformis)* intercrop. Six treatmentsL Compost IBBW1 (Ibadan brewery waste-based compost Grade A), Compost IBBW2 (Ibadan brewery waste-based compost Grade B), Compost IBBW1+ Jackbean (JB), Compost IBBW2+ Jackbean (JB), Jackbean and control (no fertilizer) were used. The compost was applied at the rate of 100 kgN/ha. The experiment was laid in a randomized complete block design (RCBD) of with four replications. The results revealed that the treatments had a significant effect on the total yield (fresh weight and dry weight in t/ha) of amaranths as well as some post soil chemical properties. Compost IBBW2 produced a significantly highest total fresh weight and dry weight of 31.3 and 2.64 t/ha respectively, which was better than control of 16.5 and 2.03 t/ha but not different from IBBW1. The control was significantly better than treatment combination with Jackbean. Based on the results from this experiment, both grades of the brewery waste-based compost increased the yield and improved the soil fertility. Thus, both grades A and B of the brewery wastes-based are recommended as organic fertilizers for crop production.

**Key words**: Amaranth, Ibadan brewery waste based compost, soil fertility, Jackbean.

**Introduction**

Poor soil fertility has emerged as one of the greatest constraint to increasing agricultural productivity, hence threatening food security (Mugwe *et al.,* 2009). Application of compost is one of the steps usually taken in addressing soil fertility management in organic crop production. However, different composts could behave differently with different soils and crops. This could be due to their composition in term of nutrient status, age and processing (Pietro *et al*., 2013)

Adoption of improved and sustainable farming system in order to guarantee improvements in crop productivity (Landers, 2007) is alternative to soil fertility improvement. Among these farming systems include the use of integrated soil fertility management practices (ISFM) which have intercropping vegetables, cereals with legumes as one of its main components (Mucheru-Muna *et al.,* 2010). This farming system is popular among farmers due to the ability of legume to reduce the risk against total crop failure, conserve soil and improve soil fertility. Furthermore, intercrop can give higher yield than sole crop yields, greater yield stability, and more efficient use of nutrients. Despite the beneficial effects, intercropping of legumes with cereals and vegetables could accelerate soil nutrient depletion, particularly for phosphorous. This is could be due to soil nutrient mining through the harvested crops (Mucheru-Muna *et al.,* 2010). However, augmenting soils with organic fertilizers like composts in an organic crop production system could mitigate this loss.

Amaranthus is a fast growing and highly nutritional among the annual leaf vegetables in the tropics. However, one of the major limitations to the cultivation of amaranths is that it requires more nitrogen which is one of the limiting nutrients in the tropical soil. Thus, this report investigated the potentials of two brewery waste based composts on soil fertility for amaranthus (*Amaranthus* *caudatus)* and Jackbean (*Canavalia ensiformis)* intercrop.

**MATERIALS AND METHODS**

The research work was carried at the Organic Vegetable Garden, Teaching and Research Farm of the Department of Agronomy, Faculty of Agriculture and Forestry, University of Ibadan, Nigeria at latitude 70 24' N and longitude 300 54' E between May and June 2014. The experiment was laid in a randomized complete block design (RCBD) of six treatments with four replications. The dimension of each bed was 1.8m × 1.2m, the treatments used is as follows; control (no fertilizer), Compost IBBW1 (brewery waste-based compost Grade A), Compost IBBW2 (brewery waste-based compost Grade B), Compost IBBW1+ Jackbean (JB), Compost IBBW2+ Jackbean (JB), Jackbean and the compost treatment was applied at the rate of 100kgN/ha Jackbean (*Canavalia ensiformis*) seeds and the compost were obtained from organic section of Teaching and Research Farm University Ibadan department of Agronomy University of Ibadan while the Amaranth (*Amanranthus caudatus*) seeds were obtained from Eagle seeds Orogun, Ibadan.

Jackbean was sown with a spacing of 40 X 40 cm apart with a seeds per hole and amaranth was introduced in between the rows two weeks after planting Jackbean using the drilling method and was thinned to average of about 373 plants per bed which is proportionate to the average plant population per hectare. Amaranth was harvested fresh at four weeks after sowing (WAS) to determine the fresh weight shoot and total weight, sample were later oven dried at 70oC to determine the dry weight. Soil samples were collected (0-15 cm) before and after the experiment from the plot to determine the pre and post planting nutrient status of the soil. All the parameters measured were subjected to analysis of variance (ANOVA) and means were separated using Least Significance Difference (LSD) at p<0.05.

**RESULTS**

Chemical properties of soil before and after treatment application are shown on Table 1. The initial soil was slightly alkaline (7.3). The total nitrogen in the soil was below the lower limit of critical range for N (1.5 – 2.0g/kg) with the value of 0.6 g/kg. The organic carbon content of the soil (17.4 g/kg) was below the critical range of soil organic matter (20 – 30g/kg). The available phosphorus was on the high side at 25mg/kg. The exchangeable potassium was medium (0.2cmol/kg). This revealed that the soil was suitable for experimental trials and application of compost should give a measurable response. The post harvest soil revealed soil pH remained the same for IBBW2 (7.0), while IBBW1 increased from (6.8) to (7.2) and Control with no fertilizer additive became slightly acidic (6.6). The organic matter content of the soil decreased in Control (1.44), this is below the critical range of organic Carbon (20-30 g/kg). However, there was an increase in the organic matter content of the soils treated with compost IBBW1 (27.48 g/kg) and IBBW2 (35.34 g/kg) which is above the critical range of organic matter of the tropical soils. The nitrogen content of all the soil was low compared to the initial pre-planting level of 0.64 g/kg. However, there was a little increase compared to control. Available phosphorus increased in all the treatments and the calcium level increased in all treatments except control and IBBW2 (0.6 cmol/kg) showed an increased in potassium level.

**Effects of fertilizer Treatments on fresh and dry weight yield of Amaranth (t/ha)**

Effects of fertilizer treatments on fresh and dry yield of amaranth are shown in Table 2. The IBBW2 compost produced a significantly higher fresh whole weight (31.3) at 4 weeks after sowing when the plant was harvested, which was not different IBBW1 (28.2) but both were significantly (p≤0.05) better than the control (16.5). Control treatment (no fertilizer) was significantly better than the IBBW1+Jackbean (9.7), IBBW2+Jackbean (9.9) and Jackbean alone (11.3). However, there were no significant difference in the dry weight IBBW1 (2.21), IBBW2 (2.64) and control (2.03), but significantly better than IBBW1+Jackbean (1.21), IBBW2+Jackbean (1.34) and Jackbean alone (1.64).

**Table 1 Comparative chemical properties of experimental soil before and after planting**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatments | pH | OC | N | Av. P | Ca | K | Na | Mn | Fe | Cu |
|  |  | g/kg | | mg/kg | cmol/kg | | | mg/kg | | |
| **Pre- planting soil analysis** | | | | | | | | | | |
| Initial | 7.3 | 17 | 0.6 | 25 | 3.7 | 0.2 | 0.6 | 687 | 77 | 11 |
| **Post soil analysis** | | | | | | | | | | |
| Control | 6.6 | 1.4 | 0.11 | 41 | 3.1 | 0.3 | 0.8 | 668 | 69 | 5 |
| IBBW1 Compost | 7.2 | 27.5 | 0.14 | 52 | 5.0 | 0.2 | 0.6 | 675 | 101 | 6 |
| IBBW2 Compost | 7.0 | 35.3 | 0.16 | 43 | 4.4 | 0.6 | 0.5 | 624 | 78 | 11 |
| Mean | 6.9 | 21.4 | 0.1 | 45 | 4.2 | 0.4 | 0.6 | 655 | 82.6 | 10 |

**Table 2: Comparative effects of organic amendments on the yields of amaranths (t/ha) after 4 weeks of sowing**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatments | Fresh shoot weight | Fresh whole weight | Dry shoot weight | Dry whole weight |
| CONTROL | 10 | 16.5 | 1.5 | 2.03 |
| IBBW1+JACKBEAN | 7.4 | 9.7 | 0.31 | 1.21 |
| IBBW2+JACKBEAN | 7.5 | 9.9 | 0.64 | 1.34 |
| IBBW1 | 18.4 | 28.2 | 1.21 | 2.21 |
| IBBW2 | 23.1 | 31.3 | 1.44 | 2.64 |
| JACKBEAN | 7.3 | 11.3 | 1.34 | 1.64 |
| LSD (≤0.05) | 12.2 | 8.7 | 1.2 | 1.8 |

LSD: Least Significant Difference

**Discussion**

Ibadan brewery waste-based grade B compost (IBBW2) had significant influence on the fresh and dry yield of amaranth and it performed better compared to other treatments. The best fresh mean yield of 31.4 t/ha obtained from this study is greater than the fresh yield of 30 t/ha reported by Grubben and Vanslotten (1978) but lower compared to the fresh yield of 34 t/ha reported by AdeOluwa *et al.,* (2009). The influence of the treatment on amaranths dry weight took the same trend and the variation observed can be due to amount of N content in the material applied and the season of planting. The low yield obtained from the intercrop and treatment combinations with jackbean could be due to the shading effects of jackbean on the amaranths which in turn inhibit the photosynthesis activities of amaranth. This is consonance with the findings of Chuang *et al.,* (2014) who reported mutual shading resulted in decrease in the uptake and transportation of CO2 in the photosynthesis which could reduce the growth and yield. Post harvest soil with IBBW2 treatment had better nutrient status compared to the control in terms of nitrogen, phosphorus, potassium and organic matter content and this is in accordance with findings of AdeOluwa and Cofie (2011) which revealed that organic fertilizer (human Urine) improved soil nutrient exchangeable cations and acidity. In an experiment conducted by (Hepperly *et al*., 2009), they concluded that compost treatments supported both high yields and increased soil carbon and nitrogen content. This revealed that sustainable crop productivity, crop health, or soil health over longer time periods is achievable on tropical soil with the use of organic inputs.

**CONCLUSION**

The result of this experiment revealed that both brewery waste-based compost grade A and grade B (IBBW1 and IBBW2) simultaneously gave good yield that was significantly better than control of no fertilizer additive. However, Compost IBBW2 gave better yield than Compost IBBW1. Legumes has potential to improve crop yield and soil health but this study shows that the intercrop of Jackbean and amaranths augmented with compost does not work due to shading effect of Jackbean. The post harvest soil analysis showed that IBBW2 is a good option to improve soil fertility under organic vegetable production.

**References**

AdeOluwa O. O., Adeoye G. O, Yusuff, S. A. (2009). Effect of organic nitrogen fortifiers on growth parameters of green Amaranths (*Amaranthus caudatus .L*). *Renewable Agriculture and food System 24 (4)*: 245 - 250.

AdeOluwa O.O. and Cofie O. (2011). Effects in amaranths (Amaranthus caudatus) production. Renewable Agriculture and Food Systems,Cambridge, UK. 24(4); 245–250

Chuang-Dao Jiang, Tao Li, Li-Na Liu, Yu-Jun Liu and Lei Shi., (2014). Effect of mutual shading on the regulation of photosynthesis in field grown Sorghum .Journal of photochemistry and photobiology B: Biology 137; 31-38.

Grubben, G. J. H. and Van Sloten, D. H., (1981). Genetic resources of amaranths: a global plan of action, including a provisional key to some edible species of the family Amaranthaceae by Laurie B. Feine-Dudley. *International Board for Plant Genetic Resources*, Rome, Italy pp. 57.

Hepperly P, Don Lotter, Ziegler Ulsh C, Seidel R. and Reider C. (2009). Compost, Manure and Synthetic Fertilizer Influences Crop Yields, Soil Properties, Nitrate Leaching and Crop Nutrient Content. *Journal of Compost Science & Utilization,* (2009), Vol. 17, No. 2, 117-126.

Landers, J. N., (2007). Tropical Crop–livestock Systemsin Conservation Agriculture: The Brazilian Experience. Integrated Crop Management. Vol. 5. FAO. Rome.

Mucheru-Muna, M., Pypers, P., Mugendi, D., Kung’u J., Mugwe, J., Merckx R., Vanlauwe, B. (2010). Staggered Maize–Legume Intercrop Arrangement Robustly Increases Crop Yields and Economic Returns in the Highlands of Central Kenya.Field Crops Research 115 (2010) 132–139.

Mugwe, J., Mugendi, D., Mucheru-Muna, M., Merckx, R., Chianu, J., Vanlauwe, B. (2009). Determinants of the Decision to Adopt Integrated Soil Fertility Management Practices by Smallholder Farmers in the Central Highlands of Kenya.Expl Agric. 45: 61–75.

Pietro Toscano, Teresa Casacchia, Diacano, M. and Montemurro, F. (2013). Composted Olive Mill By-products: Compost characterization and applicationon olive orchards. Journal of Agricultural Science and Technology. Vol. 15:627-638.