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Evaluation of Growth Performances of Maize Grown on Dumpsite Soils

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ABSTRACT

Maize is one of the most important staple cereals with a wide geographical spread in terms of production and utilization amongst cereals in Nigeria. This study was carried out at the Department of Plant Science and Biotechnology Botanical Garden, in Rivers State University (RSU), Port Harcourt, Nigeria with the aim to evaluate growth performances of maize grown on dumpsite soils. Soil samples were collected from three different locations; Njemanze Dumpsite, Mile One Flyover Dumpsite, Chinda by Iwofe Dumpsite and RSU Botanical Garden (control soil). Hybrid maize seeds were subjected to viability and germination test. Viable seeds of maize were sown into polybags containing the different soils and arranged in a Completely Randomized Design (CRD). Data collected were subjected to ONE WAY ANOVA analysis. Results showed there were significant differences in plant height with Chinda by Iwofe having taller plants (68.1 cm) than, RSU (Control) (51.9 cm), Mile One Flyover (43.4 cm) and Njemanze (37.8 cm). Number of leaves was also significant with that of Chinda by Iwofe higher (9), RSU (Control) (8) and Mile One Flyover (8) had same leaf number and Njemanze (7) had lowest number of leaves. There were no significant differences in days to tasseling and days to cobbing in the different locations. Growth was positive in all soil treatments; Chinda by Iwofe had high values while Njemanze had the least. There is every indication that dumpsite soils enhances growth of maize showing a variation in the different soil types due to the peculiarity of each dump site waste.

Keywords: Maize, dumpsite soil, growth performance, tasselling, cobbing, plant height.

Introduction

Maize (*Zea mays* L.), a member of the family Poaceae is a major food crop consumed by a large number of human population. Maize belonging to the cereal family is one of the cereals that are widely distributed in terms of production and utilization. Maize is seen as an essential crop as it serves as food for both animal and human consumption (Badu-Apraku and Fakorede, 2017; Badu-Apraku *et al*., 2021). Maize is native to South America but extensively cultivated in various other countries. It is widely grown in temperate and tropic regions with well drained and fertile soil (Kumar and Jhariya, 2013). It is considered as one of the main cereal/staple food crop as it is an important feed and industrial resource (Ribaut *et al*., 2009; Cai *et al*., 2020).

In Nigeria, maize is one of the grain crops cultivated in addition to rice, cowpea, soybean, sorghum, millet and maize (Adekunle and Nabinta, 2000).

Food and Agricultural Organization data indicated increase in maize production in Nigeria, in part because of the plant's ability to strive in different ecological zone within the country (Adiaha, 2018). Maize crop is consumed as staple food in Nigeria, accounting for about 43% calorie in the diet of an average Nigerian. Kumar and Jhariya (2013) reported that maize is to be used as local 'cash crop', indicating that 30% of land has been devoted to maize cultivation pointing to the importance of maize in the country's economy. The large hectares of land devoted to maize production indicate the potentials of maize in fighting global food shortages.

Nigeria as one of the exporter of maize and the largest African producer of maize, contributes to increase in the production of maize to feed the fast-growing human population (Kumar and Jhariya, 2013). Maize is also fast becoming an industrial crop in Sub-Saharan African countries (Olaniyan, 2015).

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The grains of maize can be eaten after boiling, roasted or ground into powder and used in making pap, corn flour, tuwo (Abdulrahaman and Kolawale, 2006). Some industries also use maize as raw material for the production of bioethanol (Skoufogiann *et al*., 2019), linoleum, paints, varnishes, and soaps (Nawaz *et al*., 2018), thereby making maize an important crop to cultivate.

Materials and Methods

Soil Sample Collection

Soil samples were collected from Njemanze, Mileone flyover and Chinda Dumpsite respectively. The control soil was collected from the Botanical Garden of Rivers State University.

Viability Test

The maize seeds were subjected to viability test using the Whatman filter paper method as described by Al-Turki and Baskin (2017). Five filter papers (90 mm) were placed inside five petri dishes (90 mm), ten (10) seeds were sown in each petri dish making a total of 50 seeds and distilled water was sprinkled to soak the filter paper. The number of radicle was counted for 3-7 days.

Germination Percentage

The maize seeds (10) were sown in perforated plastic plates containing the different soil samples in 3 replicates each. The number of germinated plants was counted for two weeks and the germination percentage determined in accordance with the outlined method of Abdel-Haleem (2015).

$$\text{Germination percentage (\%)} = \frac{\text{Number of germinated plants}}{\text{Total number of seeds planted}} \times 100$$

Sowing of Seeds

The seeds of hybrid maize were sown into polythene bags (55 x 49 x 49 cm) containing 20kg of sandy-loam soil at the rate of four seeds per bag which were later thinned to two plants per bag.

Experimental Design and Layout

The maize seeds planted in the polythene bags were each replicated five times and arranged in a Completely Randomized Design in the open field giving a sample size of 40 plants.

Data Collection

Data collection began from ten days after planting and every four days. Thereafter data collected were as follows:

Plant height: this was determined by measuring with a calibrated tape from ground level to the apex (last node).

Number of leaves per plant was determined by counting all fully formed leaves on each plant.

Number of days to tasseling was calculated from the date of planting to date of first appearance of tassel.

Number of days to cobbing was calculateded from the date of planting to date of first appearance of cobs.

Cultural Practices: watering, weeding and earthing of the plants were carried out when necessary.

Statistical Analyses

Data collected from this work is presented as mean ± S.E.M. One way analysis of the variance (ANOVA) and Turkey Post Hoc test was used for the establishment of significant difference ($p< 0.05$) of growth parameters of the maize.

Results

The germination percentage of maize grown in soils collected from three different dumpsites as well as the control is shown in Table 1. Chinda by Iwofe Dumpsite and Njemanze Dumpsite had high percentage germination (97%) each, Mile One Flyover Dumpsite had (93%), and Rivers State University (Control) soil had (90%) germination.

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Table 1: Germination Percentage of Maize Grown in Dumpsite and Control Soil Samples

Location	Rivers State University botanical garden (Control)	Njemanze dumpsite	Mile One flyover dumpsite	Chinda by Iwofe dumpsite
Germination Percentage (%)	90	97	93	97

The average height of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig 1. There were significant differences in the height of the plants with the plants in soil from Chinda by Iwofe Dumpsite taller (68.1 cm),than the maize plants in the soils from Rivers State University (Control) (51.9 cm), Mile One Flyover Dumpsite (43.4 cm) and the Njemanze Dumpsite (37.8 cm).

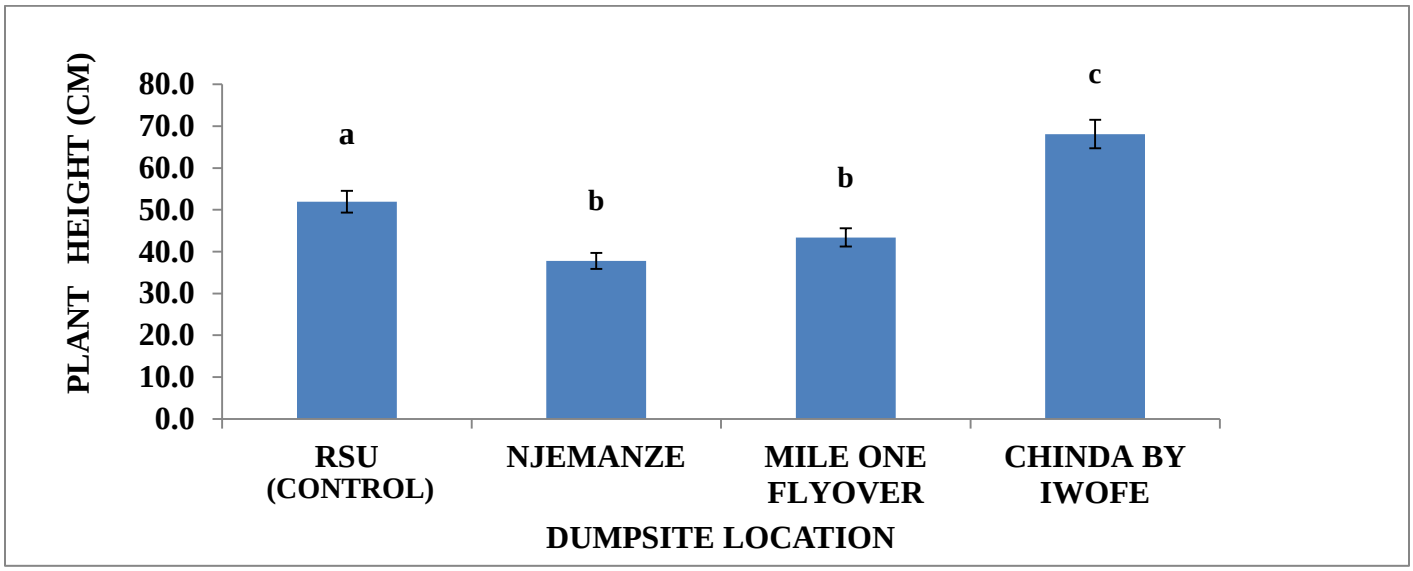

Fig. 1: Plant height of maize grown in dumpsite and control soils in Port Harcourt

*****Values are Mean± S.E.M (n=5). Means with different superscript (a-c) are significantly different (Turkey HSD, $p<0.05$).

The average number of leaves per plant of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig. 2. There were significant differences in the number of leaves of the plants with the plants in the soil from Chinda by Iwofe Dumpsite higher (9) than the others, Rivers State University (Control) (8) and Mile One Flyover Dumpsite (8) had same number of leaves, and the Njemanze Dumpsite (7) had lowest number of leaves.

The average days to tasseling of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig. 3. There were no significant differences in the days to tasseling of the plants with the maize plants in the soils from Rivers State University (Control) and Mile One Flyover Dumpsite with the shortest days to tasseling (50 days), the plants in the soil from Chinda by Iwofe Dumpsite following (51days), and the Njemanze Dumpsite had longest days (55 days) to tasseling.

The average days to cobbing of the maize plants established in soils collected from three different dumpsites as well as the control is shown in Fig. 4.

There were no significant differences in the days to cobbing of the plants with the plants in the soil from Rivers State University (Control) having shortest days to cobbing (56 days), Mile One Flyover Dumpsite (58 days) and Chinda by Iwofe Dumpsite (58 days) cobbed within same period, and the Njemanze Dumpsite had longest days to cobbing (62 days).

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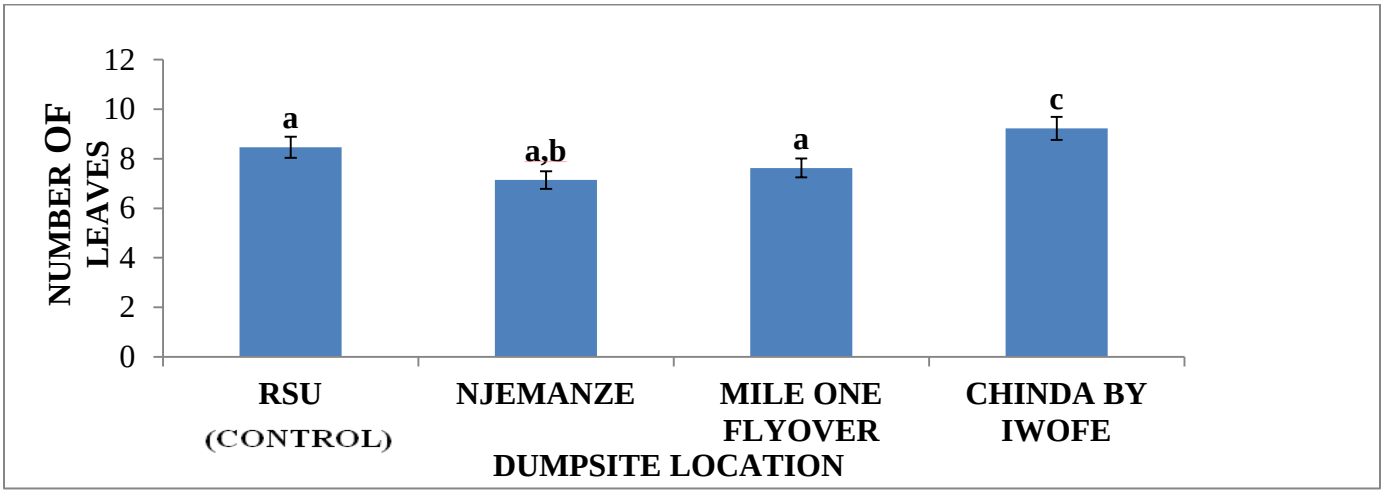

Fig. 2: Number of leaves per plant of maize grown in dumpsite and control soils in Port Harcourt
*****Values are Mean± S.E.M (n=5). Means with different superscript (a-c) are significantly different (Turkey HSD, p<0.05).

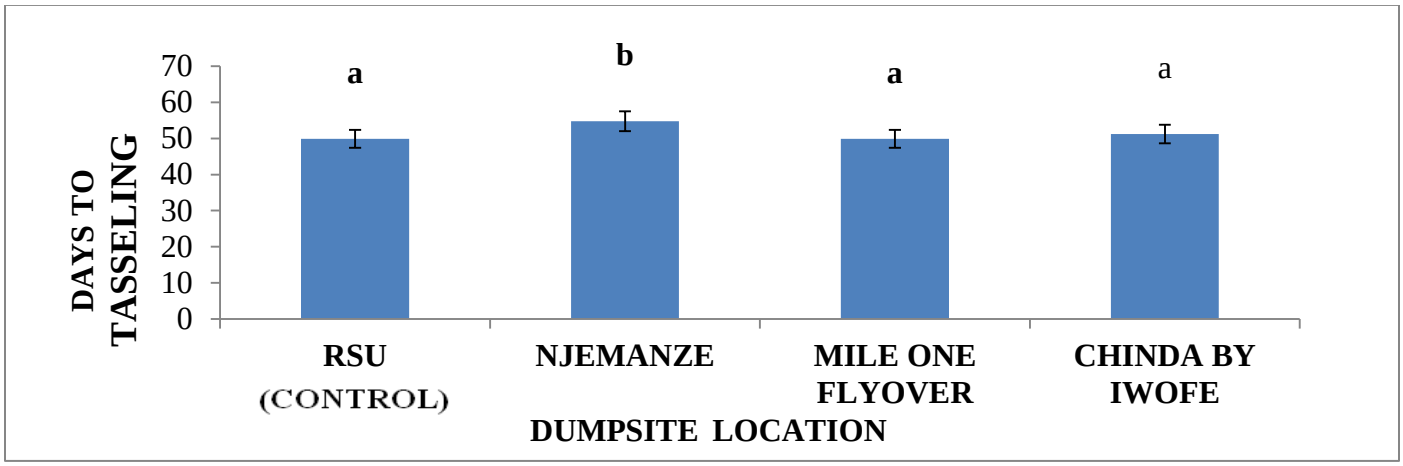

Fig. 3: Days of tasseling of maize grown in soils collected from three different dumpsites in Port Harcourt
*****Values are Mean± S.E.M (n=5). Means with different superscript (a-b) are significantly different (Turkey HSD, p<0.05).

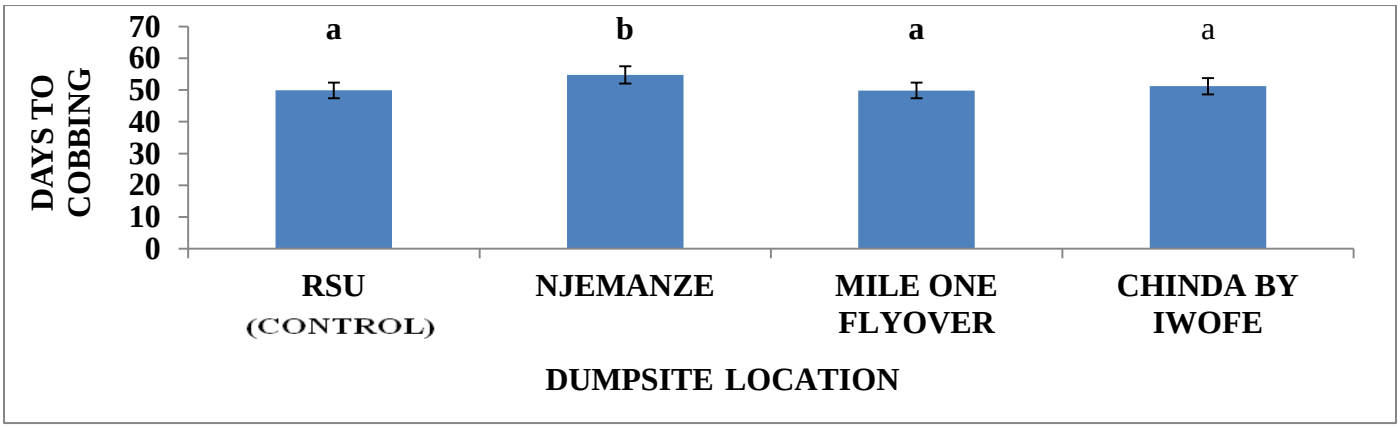

Fig. 4: Days to cobbing of maize grown in dumpsite and control soils in Port Harcourt
*****Values are Mean± S.E.M (n=5). Means with different superscript (a-b) are significantly different (Turkey HSD, p<0.05)

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Discussion

Germination percentages showed that the soils collected from the various locations favoured the growth of the maize seeds. Chinda by Iwofe Dumpsite and Njemanze Dumpsite had high percentage germination (97%), Mile One Flyover Dumpsite had 93%, and Rivers State University (Control) with the lowest (90%). This is in line with the findings of Simeon and Ambah (2013) and Ogbuehi *et al*. (2021), that maximum growth parameters; percentage emergence, plant height, number of leaves and leaf area were highly influenced by high doses of dumpsite soil. They attributed this fact to the claims that dumpsite soil contains more organic matter.

In this study, the height of the maize plants were significant with Chinda by Iwofe Dumpsite taller than the maize plants in the soils from Rivers State University (Control) and Mile One Flyover Dumpsite while the Njemanze Dumpsite had the smallest value for plant height. On the contrary, Odiyi *et al.* (2020) reported that there were reduction in the growth, leaf chlorophyll and yield of maize plant; stating that the highest mean height for the different treatments in the growth and morphology of maize grown in dumpsite soil were recorded as follows: treatments 50 ml was 33.54 cm, 100 ml was 31.34 cm and 150 ml was 27.44 cm respectively, while the control was 87.58 cm which is not in line with the present study as there were increase in plant height. This could be as a result of the dumpsite soils used which is rich in nutrient value and favourable for the growth of plant.

In this study, the number of leaves was significant in all soil samples. Chinda by Iwofe Dumpsite had more leaves, while Njemanze Dumpsite had the smallest number of leaves, Rivers State University (Control) and Mile One Flyover Dumpsite had same number of leaves. The result for the number of leaves in this study is similar to that reported by Shafique *et al.* (2020). The result of the number of leaves per plant as reported in their work bordering on the effect of heavy metal toxicity on maize seedlings growth traits was high. They further stated that because the leaves were more in each plant, higher photosynthetic compounds were indicated in the leaves and this helped to improve the accumulation of organic compounds in the maize plant.

The days to tasseling in this study were not significant in the maize plants cultivated in the dumpsite soils. Rivers State University (Control) and Mile One Flyover Dumpsite with the shortest days, tasseled within same period, after which Chinda by Iwofe Dumpsite followed, and the Njemanze Dumpsite had longest days to tasseling. This is in accordance with the statement of Ashfaque *et al*. (2016), that reduction in the growth and yield of crop is brought about by the presence of toxins in plants, these toxins present in plants, produces reactive oxygen species which alter growth, physiological processes and metabolism, ultimately leading to the death of the cells.

In this study, the days to cobbing of the maize plants were not significant. Rivers State University (Control) had shortest days to cobbing, Mile One Flyover Dumpsite and Chinda by Iwofe Dumpsite cobbed within same period, and the Njemanze Dumpsite had longest days to cobbing. This study contradicts the work of Asati *et al*. (2016) that dumpsite soils are detrimental to plants; causing reduction in the growth and yield of plants. They noted that the reduction in plant growth was as a result of the changes in the physiological and biochemical activities which alter growth.

In conclusion, the result of this study showed dumpsite soils used for crop production enhanced the growth of maize. The use of dumpsite soils had a significant effect on the performance of the growth parameters; plant height and number of leaves. Days to tasseling and days to cobbing were not significant. Growth rate was positive in the three different soil treatments including the control but there were variations with Chinda by Iwofe having high values while Njemanze had the least values. There is the need to use dumpsite soils for growth of maize provided the soils are free of poisonous substances.

References

Abdel-Haleem, A. H. E. (2015). Seed Germination Percentage and Early Seedling establishnment of five (*Vigna unguiculata* L. Walp) Genotypes Under Salt Stress. *European Journal of experimental Biology*, 5(2), 22-32.

Abdulrahaman, A. A. and Kolawole, O. M. (2006). Traditional preparations and uses of maize in Nigeria. *Ethnobotanical Leaflets*, 10, 219-227.

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Adekunle, O.A. and Nanbita, R.I. (2000) Indigenous Storage Structures for Cereals by Woman Farmers in Kaltungo Area of Gombe State. *Journal of Central European Agriculture*, 7, 435-438.

Adiaha, M. S. (2018). Economic value of Maize (*Zea mays* L.) in Nigeria and its impacts on the global food production. *International Journal of Scientific World*, 6(1), 27-30.

Al-Turki, T. A. and Baskin, C. C. (2017). Determination of seed viability of eight wild Saudi Arabian species by germination and X-ray tests. *Saudi Journal of Biological Sciences*, *24*(4), 822-829.

Antar, M., Lyu, D., Nazari, M., Shah, A., Zhou, X. and Smith, D. L. (2021). Biomass for a sustainable bioeconomy: An overview of world biomass production and utilization. *Renewable and Sustainable Energy Reviews*, 139, 110691.

Asati, A., Pichhode, M. and Kumar, N. (2016). Effect of heavy metals on plant growth: An overview. *International Journal of Application or Innovation in Engineering and Management (IJAIEM)*, *5*, 79-101.

Ashfaque, F., Inam, A., Sahay, S. and Iqbal, S. (2016). Influence of heavy metal toxicity on plant growth, metabolism and its alleviation by phytoremediation-a promising technology. *International Journal of Agricultural Research*, 6, 1-9.

Badu-Apraku, B. and Fakorede, M. A. B. (2017). Maize in Sub-Saharan Africa: importance and production constraints. In Advances in genetic enhancement of early and extra-early maize for Sub-Saharan Africa. *Springer, Cham. pp*. 3-10.

Badu-Apraku, B., Bankole, F. A., Ajayo, B. S., Fakorede, M. A. B., Akinwale, R. O., Talabi, A. O. and Ortega-Beltran, A. (2021). Identification of early and extra-early maturing tropical maize inbred lines resistant to *Exserohilum turcicum* in sub-Saharan Africa. *Crop Protection*, 139, 105386.

Cai, F., Zhang, Y., Mi, N., Ming, H., Zhang, S., Zhang, H. and Zhao, X. (2020). Maize (*Zea mays* L.) physiological responses to drought and rewatering, and the associations with water stress degree. *Agricultural Water Management*, 241, 106379.

Kumar, D. and Jhariya, A. N. (2013). Nutritional, medicinal and economical importance of corn: A mini review. *Research Journal of Pharmaceutical Sciences*, 2(7), 1-6.

Nawaz, H., Muzaffar, S., Aslam, M. and Ahmad, S. (2018). Phytochemical composition: antioxidant potential and biological activities of corn. Corn production and human health in changing climate. *Intech Open*, London, 49-68.

Odiyi, B. O., Giwa, G. O., Abiya, S. E. and Babatunde, O. S. (2020). Effects of crude oil pollution on the morphology, growth and heavy metal content of maize (*Zea mays* Linn.). *Journal of Applied Sciences and Environmental Management*, 24(1), 119-125.

Ogbuehi, H. C., Onuh, M. O. and Christo, I. E. (2021). Effect of dumpsite organic manure soil on growth, nutrient content, and yield of *Curcuma longa* L. (turmeric) in Owerri, Imo State. *GSC Advanced Research and Reviews*, 8(1), 140-148.

Olaniyan, A. B. (2015). Maize: Panacea for hunger in Nigeria. *African Journal of Plant Science*, 9(3), 155-174.

Quan, Z., Li, S., Zhang, X., Zhu, F., Li, P., Sheng, R. and Fang, Y. (2020). Fertilizer nitrogen use efficiency and fates in maize cropping systems across China: Field 15N tracer studies. *Soil and Tillage Research*, *197*, 104498.

Ribaut, J. M., Betran, J., Monneveux, P. and Setter, T. (2009). Drought tolerance in maize. *Handbook of Maize: its Biology*. *pp*311-344.

Shafique, F., Ali, Q. and Malik, A. (2020). Effects of heavy metal toxicity on maze seedlings growth traits. *Biological and Clinical Sciences Research Journal*, 2020, 1-5.

Simeon, P. O. and Ambah, B. (2013). Effect of municipal solid waste on the growth of maize (*Zea mays* L.). *International Letters of Natural Sciences*, 2, 2281-3993.

Skoufogianni, E., Solomou, A., Charvalas, G. and Danalatos, N. (2019). Maize as Energy Crop. In Maize-Production and Use. *IntechOpen* 2019, 88969.

Citation: Agwor *et al*. (2024). Evaluation of growth performances of maize grown on dumpsite soils. *International Journal of Microbiology and Applied Sciences*. *3(2)*: 1 – 6.