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EFFECTS OF FERTILIZER TYPES ON THE PERFORMANCE OF SWEET POTATO (*Ipomoea batatas* L.) UNDER URBAN AND CONVENTIONAL FARMING CONDITIONS IN OGBOMOSO.

***[1]Ibikunle O. Grace; [1]Babajide, P. Akintoye; [1] Oyebisi K. Rauf; [1]Adetona, A. Florence**
[1]Department of Crop Production and Soil Science, Ladoke Akintola University of Technology, PMB 4000, Ogbomoso, Nigeria
*Corresponding author: ibikunlegraceolubunmi04@gmail.com

ABSTRACT

Sweet potato (*Ipomoea batatas* (L.) is a creeping annual crop plant commonly cultivated for its edible tuber. It is a versatile crop well known for its dietary, medicinal, industrial and socio-cultural values. However, Intensification of land use particularly for buildings, construction and other infrastructure advancement in the urban centers had been reported to enhance unavailability of suitable hectarages of lands and rapid depletion of soil nutrients. As a result of these unpleasant conditions, devising organic means of maximizing, managing the available soil resources in the urban areas for dependable crop production is crucial. This experiment was conducted at the Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso, Oyo state. Soil samples were collected at 0–30cm soil depth.

The composite sample was taken and air dried, crushed and sieved through 2 mm and 0.5 mm sieves. Sweet potato vines measuring 25cm were planted concurrently both on the field and designated cement sacks containing 30kg soil each. Six-fertilizer treatments tested were; T0= Control, T1= Tithonia compost, T2= Composted Household wastes, T3= Rabbit droppings, T4= Poultry manure, T5= Cow dung applied at 4tons/ha. For the field experiment, one plot per treatment was used with treatments laid out in Randomized Complete Block Design (RCBD), replicated thrice.

Two pots per treatment was used for the pot experiment. The treatments were arranged in Complete Randomized Design (CRD), replicated three (3) times. Application of different fertilizers significantly enhanced growth, and yield of sweet potato, compared to the control in both field and pot experiment.

Therefore, the study recommends that application of any of the organic source fertilizers such as Tithonia, Rabbit droppings, household wastes, poultry manure and cow dung improves the growth and yield of sweet potato in the study area

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Keyword: *Tithonia* compost, composted household wastes, Rabbit Droppings, Poultry manure and Cow dung, *Ipomoea batatas* L

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam) is a perennial herbaceous vine cultivated as an annual crop. Sweet potato (*Ipomoea batatas* L.) produces high root yields per unit area and time (Uwah*et al.,* 2013; Duan*et al.,* 2018). Nevertheless, sweet potato crops take up large amounts of nutrients from the soil (Echer*et al.,* 2009). Sweet Potato ranks third after rice and wheat in terms of consumption in the world, and first among root and tuber crops, followed by cassava, sweet potato and yams in production (Vollmer *et al.,* 2017). Sweet Potato can be compared only with rice, wheat, and maize for its contribution towards securing food and nutrition and avoiding poverty and hunger, especially in developing countries, where food is extremely on demand to feed a higher population living with inherent social and political conflict (Shetty, 2009). High nutrition (carbohydrates, protein, dietary fibre, vitamins, minerals, amino acids, *etc*.), easy digestibility, bulk quantity production, *etc*. have made sweet potato the most popular vegetable in the world (Fernández-López *et al.,* 2020, Setiawati,2020). The potential of sweet potato to guarantee food security is under-estimated as its uses is often limited to a substitute food in African countries (Muktar*et al*; 2010).

There are varieties of natural fertilizers, such as animal manures (cow dung and goat manure), compost (plant residues, and food wastes), oil cakes and biological wastes, rock phosphate (sedimentary rock), chicken litter and bone meal as preferred to chemical or inorganic fertilizers (Khan *et al.,* 2022; Le Pera *et al.,* 2022; Madhu *et al.,* 2022; Wakawa *et al.,* 2022). Organic manure is made from plant or animal sources which contain elements that improve soil fertility. The manure is the feces sourced as a by-product from raising animals, while compost is an organic matter that has undergone a natural decomposition process. In many parts of the world, sweet potato farmers prefer using chicken manure as a fertilizer. Being a heavy feeder of nutrients, sweet potato requires high amount of Nitrogen, Phosphorus, and Potassium, and chemical fertilizers as the main source of nutrients used for potato cropping (Koch *et al.,* 2020, Smith 2020).

However, continuous dependence on chemical fertilizers causes nutritional imbalance and adverse effects on the physio-chemical and biological properties of the soil. Due to the usage of ammonium fertilizers and the leaching of cations from the root zone (Muthoni, 2016, Scott 2021).

Urban Farming was implemented in cities around the world, urban agriculture could produce 10% of the global output of legumes, roots and vegetables (Clinton *et al.,* 2018). Urban Farming may not produce enough food to replace traditional farming; however, it can be a major contributor to the food security of urban areas both systemically, and in Emergency Readiness (Darcel *et al.,* 2019). Urban Agriculture(UA) remains a relatively small, yet important percentage of the larger food distribution system in cities: Urban agriculture projects are intended to replace traditional food retail or would claim to lead to food self-sufficiency for individuals or for cities" (Santo *et al*, 2016). Urban Agriculture (UA) contribute to urban food security in different regions, based on a low threshold of urban land required to grow the daily vegetable intake for the urban poor (Badami and Ramankutty, 2015

Experimental Site

The experiment was carried out at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State. The climate of Ogbomoso is mostly influenced by the North East trade wind and south monsoon wind. The temperature of the area ranges from 28- 33°C. Ogbomoso falls in the Southern Guinea savannah agro-ecological zone of Nigeria 8° 10' 15" N and 4° 16' 12'E. The humidity of the area is high (74%) all year round except in January when the dry wind from the north flows in. Annual rainfall is over 1000mm (Babajide *et al.,* 2012).

Soil sampling and Analysis

After land preparation, pre planting collection of soil sample was carried out randomly using soil auger at a depth of 0-30cm. Soil samples (0 – 15 cm depth) were taken randomly with soil auger before planting. Composite soil sample was air – dried, crushed using ceramic mortar and pestle to pass through 2 mm and 0.5 mm sieves to remove unwanted materials like stones, plants remains and debris. Particle size was determined by hydrometer method (Gee an Or, 2002). Soil acidity levels were evaluated with a 1:2 (soil: water) ratio after 15 minutes equilibrium period using a glass electrode in pH buffer 4, 7 and 9 (Mclean, 1982). The random sampling were bulked into a composite sample and taken to the laboratory for analysis of the soil physical and chemical properties.

Treatments

There were six (6) treatments laid out as randomized complete block design (RCBD) replicated three (3) times which were T_0 (control), T1 (Tithonia application), T2 (Composted Household waste), T3 (Rabbit droppings), T4 (Poultry manure), T5 (Cow dung). One plot per treatment was used for field experiment while two pots per treatment was used for pot experiment. The treatments were arranged in complete randomized design (CRD) and replicated three times.

Data collection and Analysis

Data were collected on the following parameters after four weeks of planting (4WAP); vine length, number of leaves per plant and number of branches per plant, fresh shoot weight and dry shoot weight and tuber yields. All data collected were subjected to analysis of variance (ANOVA) procedure in SAS and significant means were separated using Duncan's multiple range test (DMRT) at $p \leq 0.05$ (SAS, 2019).

Results and Discussion

Soil physical and chemical properties of sample used.

Table 1: Physical and chemical Analysis of the soil sample used

Soil characteristics	Values
pH (H_2O)	6.10
Organic Carbon (gkg^{-1})	3.26
Total N (gkg^{-1})	0.09
Available P ($mgkg^{-1}$)	4.94
Fe ($mgkg^{-1}$)	11.40
Cu ($mgkg^{-1}$)	2.98
Zn ($mgkg^{-1}$)	2.74
Exchangeable K ($cmolkg^{-1}$)	0.09
Exchangeable Na ($cmolkg^{-1}$)	0.28
Exchangeable Ca ($cmolkg^{-1}$)	3.16
Exchangeable Mg ($cmolkg^{-1}$)	3.58
Sand (gkg^{-1})	860.20
Silt (gkg^{-1})	70.30
Clay (gkg^{-1})	69.50
Textural class	Sandy loam

Table1 above shows the soil physical and chemical properties used. The soil is slightly acidic with pH 6.10 and grossly low in essential nutrients particularly N (0.09 g kg^{-1}), P (4.94 mg kg^{-1}) and K (0.09 Cmol kg^{-1}) and the textural class is Sandy loam.

Effect of fertilizer types on Vine length under urban and conventional farming condition

Table 2: Effect of fertilizer types on Vine length under urban and conventional farming

Treatment	VL4	VL8	VL12	VL14
T0	69.8c(37.7e)	141cd(55.1e)	153.9cd(62.8e)	161.6cd(65.4f)
T1	79.9b(49.4d)	149.3bcd(67.7e)	169.4bc(76.1c)	177.2bc(75.3d)
T2	78.5b(38.6e)	131.8d(62.0d)	143d(70.0d)	151.4d(70.5e)
T3	81.3b(65.1c)	152.9bc(81.3c)	155.8cd(92.8b)	165.3cd(88.8c)
T4	81b(70.4b)	106b(88.5b)	177b(92.8b)	183.3b(99.8b)
T5	86.1a(81.6a)	183.4a(98.5a)	197.1a(104.7a)	205.9a(113.1a)

Means followed by the same letter are not significantly different at 5% probability level, using Duncan Multiple Range Test (DMRT). T0 (control), T1 (*Tithonia*), T2 (Household waste), T3 (Rabbit Droppings), T4 (Poultry manure), T5 (Cow dung). VL: Vine length. Values without parenthesis are for field experiment while values in parenthesis belong to the sack experiment

Table 2 shows the effect of fertilizer types on vine length under urban and conventional farming condition**.** Applications of organic fertilizer enhanced the vine length of sweet potatoes under sack conditions. At 4 weeks, T5 that received cow dung has the highest value (81.6 cm) and is significantly higher than other treatments with the least value (37.7 cm) from the control. At 8 weeks, T5 that received cow dung has the highest value (98.9 cm) and is significantly different from other treatments with the least value (55.1 cm) from the control. At 12 weeks, T5 that received cow dung has the highest value (104.7 cm) and is significantly different from other treatment with the least value (62.8 cm) from the control. At 14 weeks, T5 that received cow dung has the highest value (113.1 cm) and is significantly different from other treatment with the least value (65.4 cm) from the control.

Field conditions

At 4 weeks, T5 that received cow dung has the highest value (86.1 cm) which is significantly different from other treatment with the least value (69.8 cm) from the control. At 8 weeks, T5 that received cow dung has the highest value (183.4 cm) which is significantly different from other treatment with the least value (106.0 cm) from T4 that received poultry manure. At 12 weeks, T5 that received cow dung has the highest value (197.1 cm) which is significantly different from other treatment with the least value (143.0 cm) from T2.

Effect of fertilizer types on number of branches under urban and conventional farming condition

Table 3: Effect of fertilizer types on number of branches under urban and conventional farming condition

Treatment	NB4	NB8	NB12	NB14
T0	3.0c(3.0c)	6.0d(4.0c)	6.0e(5.0d)	6.0e(5.0d)
T1	3.0c(3.6b)	7.0b(5.3b)	8.0c(6.0c)	8.0c(6.0bc)
T2	5.0a(4.7a)	9.0a(7.6a)	10.0a(9.3a)	10.0a(8.3a)
T3	4.0b(4.0b)	6.0bcd(5.3b)	8.0c(6.0c)	8.0c(5.6bcd)
T4	4.0b(4.0b)	6.0cd(5.6b)	7.0d(6.0C	7.0d(5.3cd)
T5	5.0a(4.0b)	7.0bc(5.8b)	8.0b(7.0b)	9.0b(6.3b)

Means followed by the same letter are not significantly different at 5% probability level, using Duncan Multiple Range Test (DMRT). T0 (control), T1 (Tithonia), T2 (Household waste), T3 (Rabbit Droppings), T4 (Poultry manure), T5 (Cow dung). NB: Number of Branches.

Values without parenthesis are for field experiment while v alues in parenthesis belong to the sack experiment

Table 3 reveals the effect effect of fertilizer types on number of branches under urban and conventional farming condition. Applications of organic fertilizer enhanced the number of branches of sweet potatoes under sack conditions. At 4 weeks, T2 that received household waste compost has the highest value (5.0) and is significantly different from other treatment with the least value (3.0) from the control. At 8 weeks, T2 that received household waste compost has the highest value (8.0) and is significantly different from other treatment with the least value (4.0) from the control. At 12 weeks, T2 that received household waste compost has the highest value (10.0) and is significantly different from other treatment with the least value (5.0) from the control. At 14 weeks, T2 that received household waste compost has the highest value (9.0) and is significantly different from other treatment with the least value (5.0) from the control.

Field conditions

At 4 weeks, T2 that received household waste has the highest number of branches with the value (5.0) and is significantly different from other treatment with the least value (3.0) from control, Table 4.3. At 8 weeks, T2 that received household waste has the highest value (9.0) and is significantly different from other treatment with the least value (6.0) from control. At 12 weeks, T2 that received household waste has the highest value (10.0) and is significantly different from other treatment with the least value (6.0) from control. At 14 weeks, T2 that received household waste has the highest value (10.0) and is significantly different from other treatment with the least value (6.0) from control

Effect of fertilizer types on number of leaves under urban and conventional farming condition

Table 4: Effect of fertilizer types on number of leaves under urban and conventional farming condition

Treatment	NL4	NL8	NL12	NL14
T0	73e(64.0d)	139.6d(55.0e)	163d(62.0e)	187.3c(65.0f)
T1	80.3bc(69.0c)	262.3b(67.0d)	298.3b(76.0c)	326b(75.0d)
T2	75de(37.0e)	147d(62.0d)	178.6d(70.0d)	209.6c(70.0e)
T3	82.3b(73.0b)	232.6c(98.0c)	267c(89.0b)	326.6b(88.0c)
T4	78cd(76.0a)	143.3d(88.0b)	174d(92.0b)	204.3c(79.0b)
T5	89.6a(79.0a)	290a(98.0a)	323.6a(104.0a)	359a(113.0a)

Means followed by the same letter are not significantly different at 5% probability level, using Duncan Multiple Range Test (DMRT). T0 (control), T1 (Tithonia), T2 (Household waste), T3 (Rabbit Droppings), T4 (Poultry manure), T5 (Cow dung). NL: Number of Leaves. Values without parenthesis are for field experiment while v alues in parenthesis belong to the sack experiments.

Table 4 shows the effect of fertilizer types on number of leaves under urban and conventional farming condition. Applications of organic fertilizer enhanced the number of leaves of sweet potatoes under sack conditions. At 4 weeks, T5 that received cow dung has the highest value (79.0) and is not significantly different from T4 that received poultry manure but significantly different from other treatment with the least value (37.0) from T2 that received household waste. At 8 weeks, T5 that received cow dung has the highest value (98.0) and is significantly different from other treatment with the least value (55.0) from the control. At 12 weeks, T5 that received cow dung has the highest value (104.0) and is significantly different from other treatment with the least value (62.0) from the control. At 14 weeks, T5 that received cow dung has the highest value (113.0) and is significantly different from other treatment with the least value (65.0) from the control. The order of increase was T5 > T……>T

Field conditions

At 4 weeks, T5 that received cow dung has the highest value (89.6) and is significantly different from other treatment with the least value (73.0) from the control. At 8 weeks, T5 that received cow dung has the highest number of leaves with the value (290.0) and is significantly different from other treatment with the least value (140.0) from the control. At 12 weeks, T5 that received cow dung has the highest value (324.0) and is significantly different from other treatment with the least value (163.0) from the control. At 14 weeks, T5 that received cow dung has the highest value (359.0) and is significantly different from other treatment with the least value (187.3) from the control.

Effect of fertilizer types on yield of sweet potato under urban and conventional farming condition

Table 5: *Effect of fertilizer types under urban and conventional farming condition on yield parameters.*

Treatment	Tuber Weight (kg)	Fresh Shoot Weight (kg)	Dry Shoot Weight (kg)
T0	120.7c(260.9d)	88.1bc(89.8d)	33.33d(33.9c)
T1	735.3ab(615.2a)	194.5b(196.8d)	53.9bc(54.6b)
T2	861.8a(544.7a)	108.3c(108.9c)	44.8c(35.2c)
T3	722.9ab(465.5bc)	161.9bc(168.8bc)	55b(55.9b)
T4	587.4bc(425.0bc)	155.7bc(172.5bc)	45c(45.6b)
T5	487.8c(389.4c)	263a(265.2a)	73.8a(79.9a)

Table 5 shows the effect of fertilizer types on yield of sweet potato under urban and conventional farming condition. Applications of organic fertilizer enhanced the yield of sweet potatoes under sack conditions. T1 that received Tithonia has the highest value of sweet potato tuber (615.2 kg) and is not significantly different from T2 that received household waste but significantly different from other treatments with the least value (389.4 kg) from T5 that received cow dung. T5 that received cow dung has the highest value (265.2kg) of fresh shoot weight and is significantly different from other treatment with the least value (108.9kg) from T2 that received household waste. T5 that received cow dung has the highest value (79.9kg) of dry shoot weight and is significantly different from other treatment with the least value (33.9kg) from the control.

Field Conditions

T2 that received household waste has the highest value (861.8 kg) of tuber weight and is not significantly different from T1 that received Tithonia and T3 that received rabbit droppings but significantly different from other treatment with the least value (420.7 kg) from the control. T5 that received cow dung has the highest value (263.0 kg) of fresh shoot weight and is significantly different from other treatment with the least value (108.3) from T2 that received household waste. T5 that received cow dung has the highest value (73.8 kg) of dry shoot weight and is significantly different from other treatment with the least value (33.3 kg) from the control.

Discussion

In the pre-cropping soil analyses, it showed that the soil was slightly acidic and was grossly low in essential nutrients, total nitrogen (N) with a value of 0.09g/kg, available phosphorus (4.94g/kg), and exchangeable potassium (0.09cmol/kg). It showed that the experimental plot was inadequate in nutrients and therefore there will be need to apply fertilizer to meet the nutrient needed for optimum growth and yield of sweet potato. These results are in agreement with the other earlier researchers (Babajide *et al,* 2008).

The observation in this work showed that cow dung tested, significantly influenced the length of primary vines of sweet potato both under the field and sack conditions. Also, the values of the number of leaves obtained from most of treatments were not significantly different from one another. Control had the least value across all the parameters measured. The values obtained on the number of branches were not significantly different from each other under field and sack conditions. The study's finding that fresh biomass and tuber weight significantly increases with the addition of all the organics tested, especially *Tithonia* compost and household waste.
This work therefore shows that agricultural practices can be done even on improvised soils in urban areas where there is little or no lands for cultivation.

Conclusion and Recommendation

All treatments applied significantly improved the growth and yield irrespective of farming conditions. Composted household wastes significantly improved the growth and yield of sweet potato treatment tested. However, the values obtain from *Tithonia* and Rabbit droppings were not significantly different from household waste on the field experiment while in the sack experiment, household waste was significantly different from all others. This study recommend that application of organic source fertilizers such as *Tithonia* and Rabbit droppings, household waste improves growth and yield of sweet potatoes

References

Badami, M. G and Ramankutty, N. (2015). Urban agriculture and food security: A critique based on an assessment of urban land constraints. *Global Food Security*.4:8-15.

Clinton, N., Stuhlmacher, M., Miles, A., Uludere Aragon, N., Wagner, M., Georgescu, M and Gong, P. (2018). A Global Geospatial Ecosystem Services Estimate of Urban Agriculture. *Earth's Future*. 6(1): 40-60.

Duan W, Wang Q, Zhang H, Xie B, Li A, Hou F, Dong S, Wang B, Qin Z, Zhang L (2018) Differences between nitrogen-tolerant and nitrogen-susceptible sweet potato cultivars in photosynthate distribution and transport under different nitrogen conditions. *Field Crops Research*. 157 :89-97.

Echer FR, Dominato JC, Creste JE. (2009) Absorção de nutrientes e distribuição da massa fresca e seca entre órgãos de batata-doce. *Hortic Bras*. 27:176-82.

Fernández-López, J., Botella-Martínez, C., de Vera C, N.R., Sayas-Barberá, M. E., Viuda-Martos, M., Sánchez-Zapata, E., and J A, P.Á. (2020). Vegetable soups and creams: Raw materials, processing, health benefits, and innovation trends. *Plants*, 9(12), 1769.

Koch, M., Naumann, M., Pawelzik, E., Gransee, A., and Thiel, H. (2020). The importance of nutrient management for potato production Part I: Plant nutrition and yield. *Potato Research*, 63(1), 97–119

Le Pera, A., Sellaro, M., &Bencivenni, E. (2022). Composting food waste or digestate? Characteristics, statistical and life cycle assessment study based on an Italian composting plant. *Journal of Cleaner Production*, 350, 131-552.

Madhu, P., Sasireka, M., Samikannu, R., Vinoth, K., Kumar, A. U., Patil, P. P., Kaliappan, S., Gebrekidan, A. M., & Le, Q. V. (2022). Production and characterization of maximum liquid oil products through individual and copyrolysis of pressed neem oil cake and waste thermocol mixture. *Advances in Polymer Technology* 6: 1–11

Muktar, A.A.,Tanimu, B.,Arunah, U.L. And Babaji, B.A. 2010. Evaluation of the agronomic characters of sweet potato varieties grown at varying levels of organic and inorganic fertilizers. *World Journal of Agricultural Sciences*. 6 (4):370- 373.

Roullier, C., Lebot, V., and Kreike, C. M. (2018). Sweet potato diversity in New Guinea. *Journal of Agriculture and Food Research*, **66** (2), 415-422.

Schafleitner, R., Stein, A., and Weisser, W. W. (2010). Drought tolerance in sweet potato: A review. *Potato Research*, **53** (2), 117-138.

Scott, G. J., and Douches, D. S. (2021). Sweet potato root development in relation to soil physical properties. *Crop Science*, **61** (1), 22-34.

Setiawati, E., Suryanto, S., and Sulistyowati, H. (2020). Effect of potassium fertilizer on growth, yield, and quality of sweet potato (*Ipomoea batatas* L.) in a tropical Ultisol in Indonesia. *Journal of Plant Nutrition*, **43** (12), 3205-3217.

Sharfuddin, V., and Voican, S. (2011). Role of potassium in photosynthesis and respiration of higher plants. *Romanian Journal of Biology. Plant Biology*, **56** (2), 151-156.

Smith, J. L., (2020). Potassium fertilization and tuber yield of sweet potato in a low-potassium soil. *Communications in Soil Science and Plant Analysis*, **51** (1), 55-62.

Uwah D.F, Undie U.L, John N.M, Ukoha G.O (2013) Growth and yield response of improved sweet potato (Ipomoea batatas (L.) Lam) varieties to different rates of potassium fertilizer in Calabar. *J Agr Sci*. 5:61-9.

Vollmer, R., Villagaray, R., Cárdenas, J., Castro, M., Chávez, O., Anglin, N. L., and Ellis, D. (2017). A large-scale viability assessment of the potato cryobank at the International Potato Center (CIP). *Vitro Cellular and Developmental Biology-Plant*, 53(4), 309–317.