Original Research Article

Response of Watermelon (*Citrullus lanatus* (L.) to Organic and Inorganic Fertilization in Makurdi, Southern Guinea Savannah, Nigeria

ABSTRACT

The field experiment was conducted at the Teaching and Research Farm of Joseph Sarwuan Tarka University, Makurdi, in the 2019 cropping season under rain-fed conditions. The site falls within the Latitude 7°4'1N and Longitude 8°3'7E at an elevation of about 97 m above sea level in the Southern Guinea Savanna Agro-ecological Zone of Nigeria. The experiment was aimed at studying the effects of oOrganic and iInorganic Ffertilizers on the growth and yield of wWatermelon (Citrullus lanatus L.). Five treatments, namely and they were T1 (Control 0 kg/ha), T2 (150 kg/ha cCompost), T3 (200 kg/ha cCompost), T4 (250 kg/ha cCompost) and T5 (300 kg/ha NPK 20:10:10) laid out in rRandomized cComplete bBlock dDesign with three replications. The study revealed the the use of compost manure at 250 kg/ha and 30 0 kg/ha of NPK fertilizer in the cultivation of watermelon in Makurdi. However, NPK fertilizer is expensive and is generally beyond the reach of smallholder farmers. Therefore, the use of compost manure at 250 kg/ha is advocated, bearing in mind its beneficial effects on soil, ground-water and the environment.

Keywords: Watermelon, organic, inorganic, growth and yield

1. INTRODUCTION

Watermelon (*Citrullus lanatus* (L.), a member of the *Cucurbitaceae* family, is widely cultivated and the most consumed cucurbit in the world (Huh *et al.,* 2008). In Nigeria, watermelon is mostly cultivated in the Northern part of the country because of its warm loving nature, which makes it production seasonal in other parts of the country (Charles, 2005). The crop is a very important fruit that contains nutrients and phytochemicals that have been reported to be of high benefit to human health (Ijah *et al.,* 2015). The fruit is said to be a good source of vVitamins B, C, and E as well as minerals such as pPhosphorus, mMagnesium, cCalcium and iron (Romdhane *et al.,* 2017). Watermelon is mostly cultivated for its vegetative and fruit parts (Eifediyi *et al.,* 2017) and accounts for 6.8% of the world's vegetable production (Goreta *et al.,* 2005). The world's production is estimated at 2.079 million tons at an average yield of 21.97 tons/ha with Brazil as the major producing country (Nowaki *et al.,* 2017). The crop is said to have its optimum production when planted on well-drained fertile sandy or sandy loamy soils (Audi *et al.,* 2013) and, on soils with high organic matter content (Lawal, 2000), especially in this part of the country (the north central region), where soil is said to have low fertility (Abdel *et al.,* 2005). In order to meet the high demands of watermelon, it is important to boost the nutrient status of the soil, and one of the ways of increasing the nutrient status is by boosting the soil nutrient content either with the use of organic materials such as poultry manure, animal waste, and compost or with inorganic fertilizers (Dauda *et al.,* 2005). The nutrient requirement for the whole production period of the crop is in the ratio of N: P_2O_5: K_2O of 3.28: 1: 4.33 (Audi, et al., 2013). The amount of N, P_2O_5 and, K_2O as suggested by researchers, needed by the crop depends on the growth stage, as the seedling stage requires 0.0003, 0.0008, and 0.0022 g/plant, while the fruiting stage requires 0.44, 0.127, and 0.624 g/plant per day, respectively (Audi *et al.,* 2013).

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The major constraint to crop production in Nigeria, especially in the North Central region is the low organic matter content in the soil, which is a result of constant bush burning and subsequent erosion (Eifediyi *et al.,* 2017). The farmers in this particular area, mostly peasant farmers, have resorted to the continual usage of inorganic fertilizers and this act causes soil acidity, thereby reducing fruit and vegetative proliferation (John *et al.,* 2004). Harnessing the energy from biological waste is important for crop production; when these wastes are recycled and used as manure for agriculture, it reduces the pollution of streams and rivers (Balasubrabramaniyan and Palaniappan, 2003).

Research has shown that mineral fertilizers alone cannot increase the production of the crop optimally, and there is a need for mineral fertilizers to be augmented with organic manure (Roe, 1998). Generally, high nitrogen fertilizer and high temperature promote the production of male flowers of the fruit and reduce the production of the female flowers, thereby resulting in less fruit set (Chedha, 2006). Soil amendments using both organic and inorganic fertilizers have been reported to improve of soil conditions and enhance plant growth by replenishing of soil nitrogen (Audi *et al.,* 2013). The combined effect of mineral fertilizers and organic matter at 40kg P_2O_5/ha, 60kg N/ha, and 2.7kg K_2O/ha increased millet grain yield by 87% and cowpea grain yield by 200% in a continuous cropping system (Moutonnet, 2000).

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2. MATERIALS AND METHODS

The field experiment was conducted at the Teaching and Research Farm of the Federal University of Agriculture, Makurdi, during the 2019 cropping season under rain-fed conditions. The site falls within the Latitude 7°4'1N and Longitude 8°3'7E at an elevation of about 97m above sea level in the Southern Guinea Savanna Agro Ecological Zone of Nigeria. The soil around the area is a s~~S~~andy loamy with a slightly acidic ~~with a~~ pH of 6.54 (Table 1). Experimental ridges were constructed manually using hoe and the field was demarcated into plots measuring 20 m^2. Before planting, the top soil (0-15cm) samples were collected at different points with a soil auge~~a~~r for physicochemical characterization following routine procedures. The experimental was a Randomized Complete Block Design (RCBD) that was replicated three times. The experiment consists of five treatments, control inclusive, namely T1 (150 kg/ha c~~C~~ompost), T2 (200 kg/ha c~~C~~ompost), T3 (250 kg/ha c~~C~~ompost), T4 (300 kg/ha NPK 20:10:10), and T5 (c~~C~~ontrol) laid out in a r~~R~~andomized complete block design (RCBD) replicated three times. Three seeds were sown per hole and were later thinned to two seeds per stand at 3 WAS. The g~~G~~rowth parameters recorded were vine length and the number of leaves per plant at 4, 8, and 12 weeks after planting (WAP), while the number of fruits, fruit weight, and fruit yield were collected after harvest. All data were subjected to Analysis of Variance (ANOVA) using the GENSTAT statistical package (2015), and the means were separated using Fishers Least Significant Difference (F-SLD) at the 5% level of probability.

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3. RESULTS AND DISCUSSION

The pre-planting soil data (Table 1) indicated that the soil was slightly acidic before planting. Table 2 shows the effects of organic and i~~I~~norganic fertilizers on the soil properties. After various applications, the results showed that the lowest pH (6.41) was obtained from the c~~C~~ontrol treatment, and the highest soil pH was obtained from the application of 250 kg/ha of c~~C~~ompost. The s~~S~~oil o~~O~~rganic m~~M~~atter increased after planting across all treatments, with the application of 250 kg/ha compost providing the highest s~~S~~oil o~~O~~rganic m~~M~~atter content and the least soil organic matter content from the untreated treatment. Total Nitrogen in the soil increased with the application of fertilizers; the highest nitrogen concentration was obtained with the application of 250 kg/ha c~~C~~ompost, giving a value of 0.25%, and the lowest recorded was with the application of 300 kg/ha NPK 20:10:10, giving a value of 0.22%. Application of 250 kg/ha compost gave the highest phosphorus concentration with a value of 1.94 mg/kg and application of 300 kg/ha NPK 20:10:10 gave the lowest concentration (1.75 mg/kg). The highest exchangeable cations (K, Ca, Mg, Na) were recorded from the application of 250 kg/ha compost, while the lowest values were recorded from the application of 300 kg/ha NPK 20:10:10 and control plots (Table 2). The low organic matter content of the experimental soil is characteristic of soils in the southern Guinea savannah of Nigeria, due to constant bush burning and high temperatures leading to a high rate of organic matter decomposition (Eifediyi *et al.* 2017). Akinrinade and Obigbesan (2000) reported an organic matter content of 3 % as best for watermelon production in this area; thus, the low organic matter content invariably results in soil fragility in this environment. The above requires organic soil amendment in this area. Ahamefule *et al.* (2015) reported that organic matter improves soil microbial activities and soil-water holding capacity, among other roles. The significant improvement observed in the chemical properties, particularly in the organic matter and total nitrogen of the organically amended soil, against the decline in NPK-amended and control soils with time is indicative of structural enhancement following soil organic amendment.

Table 1: Soil Properties (0-15 cm) of the experimental site before Planting in Makurdi

Soil Parameters	Values
Sand (%)	73.90
Silt (%)	10.91
Clay (%)	15.19
Textural Class	Sandy Loam
pH (H_20)	6.54
Organic matter (%)	1.68
Total Nitrogen (%)	0.24
Phosphorus (mg/kg)	2.75
Potassium (cmol/kg)	0.26
Calcium (cmol/kg)	0.29
Magnesium (cmol/kg	2.53
Sodium (cmol/kg)	3.02
Exchangeable Acidity (cmol/kg)	1.12
Cation Exchange Capacity (CEC)	7.22

Table 2: Effects of organic and inorganic fertilizers on the soil properties after treatments during the 2019 cropping season in Makurdi

Treatment	pH (H_20)	OM (%)	N (%)	P (mg/kg)	K (cmol/kg)	Ca (cmol/kg)	Mg (cmol/kg)	Na (cmol/kg)	EA (cmol/kg)	ECEC (cmol/kg)
T1	6.67	2.01	0.23	1.86	0.25	3.75	2.51	0.25	1.02	7.78
T2	6.69	2.04	0.25	1.92	0.27	3.77	2.53	0.27	1.10	7.94
T3	6.71	2.10	0.25	1.94	0.27	3.78	2.55	0.30	1.12	8.02

T4	6.60	1.98	0.22	1.71	0.20	3.70	2.50	0.18	1.12	7.70
T5	6.41	1.59	0.21	1.64	0.21	3.73	2.50	0.17	1.02	7.63

T1 = (150kg/ha compost),
T2 = (200kg/ha compost),
T3 = (250kg/ha compost),
T4 = (300kg/ha NPK 20:10:10)
T5 = (control)

Table 3 shows the effect of organic and inorganic fertilizers on the number of leaves of watermelon. The highest number of leaves was obtained from plots treated with 250 kg/ha compost at 4 WAP, 300 kg/ha NPK 20:10:10 at 8 and 12 WAP. The difference was statistically significant across the various treatments; however, the number of leaves produced from the application of 250 kg/ha compost and 300 kg/ha NPK was at par, and no significant difference was observed. Generally, untreated plots (control) had the lowest number of water-melon after time of evaluation. The reason why the 250 kg/ha compost-treated plot outclassed the other rates may have been due to the comparatively faster decomposition rate and higher nutrient status. However, the number of leaves of watermelon in the study was similar to the findings of Aniekwe and Nwokwu, (2014); Eifediyi *et al.* (2017) but was fewer than that reported by Enujeke *et al.* (2013) using different rates of organic manure in Asaba, Nigeria.

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Table 3: Effects of organic and inorganic fertilizers on the Number of Watermelon Leaves in Makurdi

	Number of Leaves		
Treatments	**4 WAP**	**8 WAP**	**12 WAP**
T1 = (150kg/ha compost),	12	18	19
T2 = (200kg/ha compost),	13	19	21
T3 = (250kg/ha compost),	14	19	22
T4 = (300kg/ha NPK 20:10:10)	13	20	22
T5 = (control)	11	15	14
F-LSD(*P*=0.05)	1.78	0.51	0.50

WAP- Weeks after planting

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Table 4 shows effects of organic and inorganic fertilizers on plant length, which indicated that the longest primary lengths were obtained from plots treated with 300 kg/ha NPK 20:10:10 at 4, 8, and 12 WAP, and the difference was significant. The findings collaborate with those of Eifediyi *et al.* (2017) but are shorter in the response of watermelon to organic and inorganic fertilizers in Illorin, north central Nigeria. The earlier reason adduced for the observation in the growth parameters may also have been responsible for that in the yield parameters; this is because the yield components followed a similar trend with the growth parameters.

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Table 4: Effects of organic and inorganic fertilizers on the Plant Length of watermelon in Makurdi

	Vine Length (cm)		
Treatments	**4 WAP**	**8 WAP**	**12 WAP**
T1 = (150kg/ha compost),	19.14	27.15	34.04
T2 = (200kg/ha compost),	19.61	28.07	36.67

T3 = (250kg/ha compost),	22.06	30.08	44.11
T4 = (300kg/ha NPK 20:10:10)	30.48	39.07	46.89
T5 = (control)	17.21	25.07	30.15
F-LSD(*P*=0.05)	0.58	0.14	1.10

WAP- Weeks after planting
NS- Not Significant

Table 5 shows the effect of organic and inorganic fertilizers on yield parameters of watermelon, which indicated that the highest number of fruits, highest fruit weight, and highest fruit yield ~~was~~ were attributed to the plots treated with the 300 kg/ha NPK 20:10:10 fertilizer, while the least were attributed to plots treated with control fertilizer (no application). The number of fruits increases with an increase ~~d~~ in the rates of compost. The number of fruits per plant obtained in this study is lower than that reported by Eifediyi *et al.* (2017), who used organic and inorganic fertilizers in Illorin, north-central Nigeria. The yield (weight of fruits and yield (t/ha)) experienced in this experiment was also lower than that reported in a similar work by Enujeke, (2013) using different rates of poultry manure on watermelon and Eifediyi *et al.* (2017), who reported a yield range of 334-402 t/ha, 306-390 t/ha, and 38.25-59.20 t/ha for NPK, poultry manure, and control treatments, respectively.

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Table 5: Effects of organic and inorganic fertilizers on the yield parameters of Watermelon in Makurdi

Treatments	**Number of Fruits**	**Fruit weight (kg/ha)**	**Fruit Yield (t/ha)**
T1 = (150kg/ha compost),	8.0	2.28	17.47
T2 = (200kg/ha compost),	9.0	1.97	16.01
T3 = (250kg/ha compost),	10.0	2.28	17.65
T4 = (300kg/ha NPK 20:10:10)	11.0	2.74	31.04
T5 = (control)	8.0	1.64	13.79
F-LSD(*P*=0.05)	0.45	1.04	0.48

4. CONCLUSION

It can be concluded from this study that the use of compost manure at 250 kg/ha and 300 kg/ha of NPK fertilizer is appropriate for the cultivation of watermelon in Makurdi. However, NPK fertilizer is expensive and is generally beyond the reach of smallholder farmers. Therefore, the use of 250 kg/ha compost manure is advocated, bearing in mind its beneficial effects on the soil.

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