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Yield evaluation of water melon (*Citrullus lanatus L.*) on Alfisols using organic fertilizer as nutrients source in Makurdi, Nigeria

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Abstract

There is a general misconception among small holder farmers in the Southern Guinea Savanna that water melon do not necessarily required fertilizer input for growth and yield. As a consequence, there has been decline in yield of the crop. In order to demonstrate the importance of fertilizer to the crop, a field experiment was conducted in 2018 and 2019 under rain fed conditions. The experiment had six levels of organic fertilizer; (0, 200, 400, 600, 800 and 1000) kg/ha. The experiment was in three replications and laid out in Randomised Complete Block Design. Soil samples of the experiment location were analysed for nutrient composition before sowing and after harvest. Growth and yield data collected were treated using ANOVA (P≤0.05). The concentration of organic matter, nitrogen, available phosphorus and exchangeable cations in the soil were relatively increased upon addition of organic fertilizer. Also, vine length and fruits per plant of water melon was significantly influenced by fertilizer application; fruit yield was low in non fertilizer treatments. Therefore, yield of water melon in the study area can be optimized using organic fertilizer as soil amendment.

Keywords: Organic fertilizer, soil nutrients, organic matter, water melon.

Introduction

Water melon is valuable horticultural crop and its origin is traced to Northern Africa[1]. The production and consumption of water melon is by far more than any other species in the cucurbitaceae family[2]. Water melon fruit is round with varying colours; dark pale red or white depending on variety the average fruit weight of water melon ranges between 5-10kg depending on the variety. The cultivation of the crop in Nigeria has been on the rise due to increasing awareness of its economic importance to farmers. A fruit of water melon may cost as much as two hundred naira (N200.00) and with an average yield of 2.0 tones per hectare or 30,000 fruits per hectare a farmer is likely to rake as much as N6,000.00 gross income per hectare. Obviously there is a high return as per investment on the crop in Nigeria[3].

Given the health and nutritional benefit of water melon, understandably, farmer's holders are giving much attention to the cultivation of the crop. Over the years crop productivity has been optimized using chemical farm inputs and other conventional agronomic practices[4-5]. With growing concern over the limitations of some of these chemical inputs on the soil environment and human health, other environmentally friendly agricultural inputs are been advocated. Industrial organic products and compost manure have been used to improve soil properties and nutrients supply for plants intake and hence higher yield[6].

However, in Makurdi as in most parts of the Southern Guinea Savanna, there is erroneous opinion among small farm holders that certain arable crops do not necessarily requires fertilizer inputs for optimal production[3]. The consequence of this misconception has been a general decline in production of most crops. This trial was conducted to assess the effect of industrial manufactured compost on nutrients concentration in the soil and the growth and fruits yield of watermelon.

Materials and methods

Location of experiment: Studies were conducted in 2018 and 2019 farming seasons at the University of Agriculture, Makurdi, within the Southern Guinea Savanna Agro- Ecological Zone of Nigeria. The mean annual rainfall and temperature of Makurdi is 1250 mm and 32^0C respectively.

Treatments and Design: There were six treatments, namely; Control, 200, 400, 600, 800 and 1000kg/ha of organic fertilizer. These treatments were in three replications in Randomized Complete Block Design. The spacing of 0.75mx0.5mx1 was adopted and this gave 26,666 numbers of plants in a hectare.

Data collection and analysis: Laboratory analysis was conducted to assess the concentration of organic matter, pH and concentration of plant nutrient elements in the soil of the study area before and after the experiment.

The plant data collected were; length of vine (cm) at 3 weeks intervals after planting, yield and weight (kg) of fruits at harvest. The crop parameters were subjected statistical analysis were analyzed using analysis of variance and the means were separated using Fisher's least significant difference[7].

Results and discussion

Soil Properties: The result of soil analysis indicates that soil pH were 6.40 and 6.60 in 2018 and 2019 respectively (Table-1). The concentration of organic matter in the soil was below critical concentration value[8]. Similarly, the result of analysis showed that the soil had low total nitrogen, available phosphorus (P) potassium (K), calcium (Ca), magnesium (Mg), and sodium (Na) and the cation exchange capacity (CEC). This could be attributed to climatic factors and soil mismanagement which is characteristic of most soil in the tropics[9]. Therefore, soil amendment was necessary for optimal yield of crop in the study area.

Post harvest Soil Properties: The soil of the study area was influenced by fertilizer as presented in Table-2 and 3. The application of fertilizer affected pH of soil in both seasons. Application of 1000kg/ha of fertilizer resulted in soil pH value of 6.78 which was highest in 2018. Similarly, in 2019 the highest pH (6.80) was obtained at1000kg/ha of fertilizer. The concentration of OM and nutrient elements (N, P, K, Ca, Mg, and Na) cmolkg^{-1}, increased with increasing levels of organic fertilizer. The CEC of the soil followed similar pattern with nutrient elements in soil. i.e. 1000kg/ha > 800kg/ha > 600kg/ha > 400kg/ha > 200kg/ha in that order. It is thus safe to conclude that organic fertilizer can serve as a liming material as well as plant nutrients source. Similar findings have indicated that organic fertilizer in varying forms is a rich agricultural input that replenishes soil nutrients[10,11].

Length of vine: The length of vine per plant was influenced by fertilizer as seen in Table-4. The plot with zero fertilizer application had shorter vine length compare to plants that received varying quantities of fertilizer application. Application of fertilizer at 1000kg recorded the highest vine length 139.6 and 157.7cm at 12 WAP in 2018 and 2019 respectively. Zero fertilizer treatment gave crop with lowest vine length at 12WAP in both seasons (92.4 and 134.9cm). However, there was no statistical difference between these two levels of organic fertilizer. This phenomenon was attributed to nutrients supply from organic fertilizer added to the soil. The nutrients release into the soil by the manure was utilized by the crop and hence optimizing it growth. A similar finding was reported in south western Nigeria indicating that application of fertilizer positively correlated with growth parameters of tomato[12,13].

Table-1: Soil Properties before land preparation.

Soil parameter	2018	2019
Sand (%)	75.64	79.3
Silt (%)	13.36	11.1
Clay (%)	10	9.6
Textural class	Sandy loam	Sandy loam
pH	6.4	6.6
OM (%)	1.12	1.2
N (%)	0.22	0.23
P (mg/kg)	1.21	1.54
K (cmol kg^{-1})	0.32	0.3
Ca (cmol/kg^{-1})	2.4	3.46
Mg (cmol kg^{-1})	2.16	2.58
Na (cmol kg^{-1})	0.15	0.17
CEC (cmol kg^{-1})	5.03	6.51

Table-2: Properties of Soil at Harvest, 2018.

Treatment (Kg/ha) Organic fertilizer	pH	OM (%)	N (%)	P (mg/Kg)	Exchangeable Cation (Cmol/kg)				
					K	Ca	Mg	Na	CEC
Control	6.37	1.1	0.2	0.98	0.2	2.1	2.01	0.15	4.46
200	6.42	2.38	0.23	2.86	0.34	2.63	2.19	0.21	5.37
400	6.55	3.15	0.27	3.73	0.53	2.5	2.47	0.25	5.75
600	6.55	3.36	0.39	4.15	0.6	3.63	3.11	0.3	7.64
800	6.78	3.38	0.57	6.05	0.61	3.71	3.93	0.41	8.66
1000	6.78	4.01	0.6	7.04	0.64	3.79	3.99	0.43	8.85

Fruit yield: The plot with zero fertilizer application had fewer numbers of fruits per plant. Also, zero fertilizer application resulted in low yield of fruits per plant. The application of fertilizer at 1000kg resulted in the highest number of fruits per plant 96.0 and 125kg/ha in 2018 and 2019 respectively. This was followed by organic fertilizer at 800kg/ha which produced 88.8 and116.6kg/ha in 2018 and 2019 respectively. However, there was no statistical difference between these two levels of organic fertilizer. Weight of fruits per plant responded to fertilizer application in a similar manner to vine length and numbers of fruits yield per plant i.e. 1000kg/ha > 800kg/ha > 600kg/ha > 400kg/ha > 200kg/ha in that order.

Table-3: Soil Properties at Harvest, 2019.

Treatment (Kg/ha) Organic fertilizer	pH	OM (%)	N (%)	P (mg/kg)	Exchangeable Cation (Cmol/kg)				
					K	Ca	Mg	Na	CEC
Control	6.5	1.16	0.2	0.78	0.2	2	0.8	0.2	3.16
200	6.6	2.39	0.3	2.87	0.3	2.63	2.1	0.2	5.29
400	6.7	3.25	0.3	3.78	0.6	2.51	2.6	0.3	5.93
600	6.7	3.38	0.4	4.17	0.7	3.65	3.5	0.3	8.11
800	6.8	3.38	0.6	6.35	0.7	3.79	4	0.4	8.82
1000	6.8	4.41	0.6	7.64	0.7	3.81	4.1	0.4	9.04

Table-4: Vine Length (cm) of Water melon in 2018 and 2019.

Treatment Kg/ha Organic fertilizer	3WAP		6WAP		9WAP		12WAP	
	2018	2019	2018	2019	2018	2019	2018	2019
Control	12	13.1	31.5a	28.1a	86.1a	128.4a	92.4a	134.9a
200	14	19.6	36.9a	33.5ab	94.7b	130.9ab	96.7a	135.0a
400	14	10.2	37.7ab	35.6b	109.6c	139.1abc	111.1b	143.9ab
600	12	10.1	43.6bc	39.4b	113.5c	141.0bc	115.0b	146.1b
800	14	11.2	44.9c	39.9b	128.8d	145.1cd	131.8c	149.0bc
1000	13	15.1	48.3c	40.1b	136.9d	155.2d	139.6c	157.7c
LSD (0.05)	NS	NS	5.8	7.13	9.1	13.83	8.9	10.85

Mean with the same alphabet are statistically same (P≤0.05).

Table-5: Fruits and weight (kg) per plant in 2018 and 2019.

Treatment Kg/ha Organic fertilizer	Number of fruits per plant		Weight (Kg) of fruits per plant	
	2018	2019	2018	2019
Control	7	12	38.3a	48.3a
200	7	13	41.7a	51.5a
400	12	13	45.6a	58.9a
600	12	18	67.0b	83.7b
800	18	18	88.8c	116.6c
1000	18	20	96.0c	125.0c
LSD (0.05)	NS	NS	11.13	8.78

Mean with the same alphabet are statistically same (P≤0.05).

It was observed that though higher yield were obtained with application of 1000kg fertilizer as compared to fruits yield obtained from application of organic fertilizer at 800kg/ha, there were no statistical difference at these levels of fertilizer application in the two seasons. Several studies have indicated that organic fertilizers in numerous forms supplies soil nutrients essential for plant growth and yield[15,16].

Conclusion

In conclusion, this study has demonstrated that organic fertilizer can be used as a soil amendment to increase nutrients supplying power of the soil and ultimately optimized yield of water melon in Makurdi.

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