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**Effect of the Application of Different Rates of NPK  
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in Ejigbo Local Government Area,  
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## EFFECT OF THE APPLICATION OF DIFFERENT RATES OF NPK FERTILIZER FOR OPTIMUM VEGETATIVE GROWTH AND YIELD OF WATERMELON (*Citrullus lanatus* L.) IN EJIGBO LOCAL GOVERNMENT AREA, OSUN STATE

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**ABSTRACT:** The importance of applying inorganic fertilizers to boost the good growth of watermelon cannot be over emphasized. However, awareness of the negative environmental impact of the excessive use make it important to determine the right rate that could be applied to achieve optimum growth and yield of watermelon in a sustainable manner. An experiment was therefore conducted at the Teaching and Research Farm, Osun State University Ejigbo to investigate the effect of different rates of NPK fertilizer on the growth and yield of watermelon. The experimental field was laid in a randomized complete block design (RCBD) with three replications. Application of NPK 20-10-10 fertilizer commenced at 2 weeks after sowing at the rates of 100kg/ha, 150kg/ha, 200kg/ha and control (No fertilizer application) on each block respectively. Cultural practices were carried out to control weeds and pests. Data were collected on vegetative parameters (vein length, number of nodes, leaf number, leaf length, leaf breadth and leaf area index), and yield components; fruit weight (kg), fruit length (cm) and fruit width (cm). Data collected were subjected to analysis of variance (ANOVA) and the significant means were separated using Least Mean Square using the GLM procedure of SAS (Version 9.4). The results showed highly significant differences in all the vegetative growth parameters, fruit length (44.04cm) and fruit breadth (263.93cm) but significant variation for fruit weight (2.21kg). The plants treated with 200 kg / ha of fertilizer gave the highest fruit weight and fruit breadth (2.05kg and 54.47cm respectively) as well as number of nodes (9.67), vine length (104.13cm), number of leaf (25.07) and leaf area index (233.79). 100kg/ha of NPK gave the highest value for fruit length (29.13cm). The application of NPK fertilizer at the rate of 200kg/ha is therefore recommended for optimum vegetative growth and yield of watermelon in Ejigbo Local Government area of Osun State.

**Keywords:** Sustainable, Watermelon, Fertilizer rate, NPK 20-10-10, Fruits yield, Vegetative growth

### 1. INTRODUCTION

Watermelon is an herbaceous creeper from the botanical family Curcubitaceae, or gourd family. It thrives in the tropical region and has been grown for thousands of years in the Middle East (Syria, Egypt, Jordan, Tunisia, Lebanon, etc.) and Southeast Asia (Erukainure *et al.*, 2010). It is widely consumed worldwide because it is very rich in nutrients such as phytonutrients and antioxidants lycopene (Reetu and Tomar, 2017).

Being in the tropics, watermelon is also grown in Nigeria, but in few locations. This restriction in areas of production is mainly due to the climatic conditions and geographical locations of these areas that favour production (Ukwuaba *et al.*, 2019). In spite of the increasing relevance of watermelon in Nigeria, yield across the country is rather low (Enujeke, 2013). The low yield of watermelon can be attributed to reasons, such as poor cultivation practices, lack of access to improved varieties, improper use of fertilizers, erratic rainfall etc. (Dube *et al.*, 2020; Nweke and Nsoanya, 2015; Kahan,

2013). Deficiency or insufficient soil nutrients for proper plant nutrition show up in poor growth and yield quality with the resultant effect of reduction in farmers' income (Aluko *et al.*, 2014).

High yield of good quality fruits can be achieved through the supply of nutrients, particularly nitrogen, to enhance the fertility level of the soil (Nweke and Nsoanya, 2015; Adeyeye *et al.*, 2016). Watermelon feeds heavily on nitrogen and it is therefore recommended that fertilizer containing high nitrogen should be applied before sowing (Kacha *et al.*, 2017). Getting N in enough quantity aids high photosynthetic activity, vigorous vegetative growth and dark green colour of the leaves (John *et al.*, 2004). Among many other sources of N, inorganic fertilizers remain the best source. Farmers continuously strive to meet the demands of the ever-growing population by using fertilizers to replace the nutrient lost in the soil (Adetutu *et al.*, 2018; Adediran *et al.*, 2015). However, the use of inorganic fertilizers by many subsistence farmers in Nigeria is still relatively low due to socio-economic setbacks such as limited availability or high costs of fertilizers and other inputs such as poor facilities (storage, water systems) and poor distribution mechanisms (Poudel *et al.*, 2017). Despite its low consumption, production is still heavily dependent on the introduction of artificial fertilizers into the agricultural system by farmers. However, the improper use of inorganic fertilizers gave rise to some challenges, mainly affecting soil fertility and thereby leading to delays and reduction in fruit setting, delay ripening, heavy vegetative growth and eventual reduction in yield year after year. Another side effect of the excessive use of chemical fertilizer is the harmful effect on the environment, causing water pollution and making more agricultural crops to be harmful to health (Mahmoud *et al.*, 2009; Wakui, 2009).

The awareness of the negative environmental impact of the extensive use of inorganic fertilizers and the importance of their application to the good growth of watermelon, makes it necessary to determine the quantity that could be applied in a sustainable manner. However, there is rather scanty information about the fertilizer rate that will give optimum yield of important fruits vegetable like watermelon.

In order to ensure the optimal use of inorganic NPK fertilizer in a sustainable manner for the good growth of watermelon, there is the need to ascertain the optimal quantity of fertilizer required and the best method of its application. This experiment was therefore conducted to investigate the effect of different rates of NPK fertilizer on the growth performance and yield of watermelon and to determine the best rate of NPK fertilizer that gives high yield and growth of watermelon.

## 2. MATERIALS AND METHODS

### 2.1 Description of Experimental Site and Materials

The field experiment was conducted at the teaching and research farm of the College of Agriculture, Osun State University, (Latitude 7°, 52'28.37"N and Longitude 4°, 18'13.76"E) Ejigbo campus from June to September, 2020. The climate is typically rain forest type with two peaks of rain (bimodal rainfall) which is between 1,158mm-1,250mm per annum. The temperature regime is high all the year round with mean of 28°C-33°C, relative humidity of about 85%, except during dry season and sunshine of 5.1%.

### 2.2 Land Preparation and Plant Establishment

The experimental site was cleared off its vegetation manually. It was later ploughed twice and harrowed once by the use of tractor, mapped out at 18 m x 18 m and divided into 4 treatment plots of 4.5m x 4.5m respectively with 1.5m border line in between each block apart and 1.5 m apart to differentiate the replicates. Treatments used were different rates of NPK which are 100kg, 150kg, 200kg and control.

### 2.3. Experimental Design and Application of Treatments

The experiment was laid out in a randomized complete block design (RCBD) design with three replications. There were four treatment plots of 4.5m x 4.5m each with 1.5m border line in between each block and 1.5 m apart to differentiate the replicates. The treatments are 100kg/ha, 150kg/ha, 200kg/ha of NPK 20-10-10 and control (no fertilizer application). Watermelon seeds (Kaolack) collected from Agric farm, Osogbo were sown on the plots at two seeds per hole at a depth of 2cm with a planting distance of 1m x 1.5m. The seedlings were later thinned to one plant per stand after two weeks when the treatments commenced. Weeds were controlled manually and by applying Paraforce. Pests and disease were controlled when noticed by spraying Cypermethrin at the rate of 40 ml to 20 liter of water starting from two weeks after planting, this was repeated at 35 and 50 days after planting.

### 2.4. Soil Analysis

Soil samples were taken at a depth of 0-15cm using random sampling techniques, mixed to form a composite, air dried and sieved using 2mm sieve and analysed at the soil Laboratory, Department of Agronomy, Osun State University, Ejigbo Campus.

The physical and chemical properties of the soil were determined using the following methods:

1. Determination of Nitrogen was by khedjahl method of using automated kjeltec distillation apparatus. (Bremner, 1982).
2. Test for exchangeable bases was carried out using flame photometer.
3. Available phosphorus was done using UV/Visible spectrophotometer at a specified wavelength (Kuo, 1996).
4. Organic carbon and matter was done by titration method of sample against ferrous sulphate using appropriate indicator.
5. Particle size and pH was determined by hygrometer and pH meter.

Table 1. Physio-chemical properties of the soil of the experimental field

Parameters	Soil
<b>Chemical Properties</b>	
pH (H <sub>2</sub> O)	6.30
Organic carbon (%)	0.49
Total N (%)	0.039
Available P (mg/kg)	1.07
Na <sup>+</sup> (Cmol/kg)	0.18
K <sup>+</sup> (Cmol/kg)	1.22
Ca <sup>2+</sup> (Cmol/kg)	1.86
Mg <sup>2+</sup> (Cmol/kg)	0.09
Bulk density (cm <sup>3</sup> )	1.2
<b>Physical Properties of Soil</b>	
% Sand	79.1
% Silt	15.5
% Clay	5.4
Textural class	Sandy loam

**Key:** % = Percentage, H<sub>2</sub>O = Water, Org. C = Organic carbon, gkg<sup>-1</sup> = gram per kilogram, N = Nitrogen, P = Phosphorus, mgkg<sup>-1</sup> = Milligram per kilogram, cmol kg<sup>-1</sup> = Centimole per kilogram, Ca = Calcium, Mg = Magnesium, K = Potassium, Na = Sodium.

## 2.5. Data Collection and Analysis

In each plot, data was collected on five randomly selected plants. Parameters were taken using the International Plant Genetic Resources Institute (IPGRI) (2003) guide, they include:

**Vine length:** Vine length was measured with tape from the base to the growing tip of the plant.

**Number of branches:** Number of branches from each rootstock was recorded by counting only flowering or fruit bearing branches.

**Number of leaves:** Number of leaves was determined by direct counting.

**Leaf Length:** The most broaden leaf length was measured using ruler

**Leaf Breadth:** The most broaden leaf length was measured using ruler.

**Leaf Area Index:** Multiplication of length and breadth

**Fruit weight:** This was measured by using a weighing scale, after harvesting at 75 days from planting.

**Fruit length (cm):** Fruit length was measured at fruit harvest maturity using ruler.

**Fruit width (cm):** Fruit diameter was measured at fruit harvest maturity using ruler.

Analysis of variance (ANOVA) was carried out on all agronomic parameters and Least Mean Square was calculated for significant values of treatment mean sum of square using the GLM procedure of SAS (Version 9.4).

## 3. RESULTS AND DISCUSSION

### 3.1. Variation in Morphological Characteristics of Watermelon

Analysis of variation for the treatments mean sum of squares application on watermelon is given in Table 2. The result showed highly significant mean square for all treatments except fruit weight that gave significant variation with 2.21. Number of nodes gave highly significant variation with (8.64). Similarly, significant variation was observed for vine length (986.66cm), number of leaf (104.19), leaf length (57.09cm), leaf breadth (7.62cm), leaf area index (9957.03), fruit length (44.04cm), and fruit breadth (263.93cm). The coefficient of variation ranged from 4.78% (vine length) to 15.18% (fruit weight).

### 3.2. Morphological Performance of the Watermelon (*Citrullus lanatus*. L.)

Morphological performance of watermelon under four levels of NPK 20:10:10 fertilizer is given in Table 3. The result revealed significant differences among the treatments for all parameter taken. Fertilizer 200kg/ha NPK gave the highest value for number of nodes, vein length, number of leaf, leaf area index and yield weight with 9.67, 104.13cm, 25.07, 233.79 and 2.05kg respectively. However, control showed the lowest value for the same parameters with 7.95, 80.74cm, 19.00, 180.77, and 1.20kg respectively. Application of 100kg /ha NPK showed the highest value for leaf length (23.90cm) whereas control gave the least value for the same parameters (19.83cm). In addition, 100 Kg/ha of NPK gave the highest value for fruit length (29.13cm) and fruit breadth (54.47) while control showed the lowest with 25.80 and 45.02.

Table 2. Analysis of Variance of characters of different rate of NPK fertilizers on Watermelon (*Citrullus lanatus* L.)

SOV	Df	Nodes	V. lght	No. Lf	Lf. Lght	Lf. Bth	LAI	Fr. Wght	Fr. Lngt	Fr. brt
Block	2	1.13	44.46	5.85	1.87	0.64	438.52	0.03	0.16	12.78
Treatment	3	8.64**	986.56**	104.19**	57.09**	7.62**	9957.03**	2.21*	44.04**	263.95**
Error	54	0.74	19.32	1.83	3.87	1.46	647.27	0.05	10.90	26.61
CV (%)		9.82	4.78	6.03	8.85	6.42	11.95	15.18	12.32	10.33

**Key:** \* = significant at  $p \leq 0.05$ , \*\* = highly significant at  $p \leq 0.01$ , CV% = Coefficient of Variation, SOV = Sources of Variation, DF = Degree of Freedom, V. lght = Vine length, No. Lf = Number of leaf, Lf. Brgt = Leaf breadth, Lf. Lght = Leaf length, LAI = Leaf area index, Frtd wght. = fruit yield per kg, Frt length. = fruit length, Frt. Brt = Fruit breadth.

Table 3: Effect of levels of NPK 20-10-10 fertilizer on growth performance of watermelon

Treatments (NPK/ha)	Nodes	V. lght	No. Lf	Lf. Lght	Lf. Bth	LAI	Fr. wght	Fr. Lngt	Fr. brt
200	9.67 <sup>a</sup>	104.13 <sup>a</sup>	25.07 <sup>a</sup>	23.72 <sup>a</sup>	19.43 <sup>a</sup>	233.79 <sup>a</sup>	2.05 <sup>a</sup>	26.20 <sup>ab</sup>	54.47 <sup>a</sup>
150	9.07 <sup>a</sup>	92.53 <sup>b</sup>	21.93 <sup>c</sup>	21.41 <sup>b</sup>	18.65 <sup>ab</sup>	203.37 <sup>b</sup>	1.43 <sup>b</sup>	26.07 <sup>ab</sup>	52.06 <sup>a</sup>
100	8.40 <sup>b</sup>	100.13 <sup>a</sup>	23.80 <sup>b</sup>	23.90 <sup>a</sup>	19.33 <sup>a</sup>	233.66 <sup>a</sup>	1.29 <sup>bc</sup>	29.13 <sup>a</sup>	46.80 <sup>b</sup>
Control	7.93 <sup>b</sup>	80.74 <sup>c</sup>	19.00 <sup>d</sup>	19.83 <sup>c</sup>	17.89 <sup>b</sup>	180.77 <sup>c</sup>	1.20 <sup>c</sup>	25.80 <sup>b</sup>	45.02 <sup>b</sup>

**Key:** <sup>abcd</sup> = means on the same column with different letters are significantly different ( $P < 0.05$ ). V. lght = Vine length, No. Lf = Number of leaf, Lf. Brgt = Leaf breadth, Lf. Lght = Leaf length, LAI = Leaf area index, Frt. wght. = kg/fruit, Frt length. = fruit length, F. Brt = Fruit breadth.

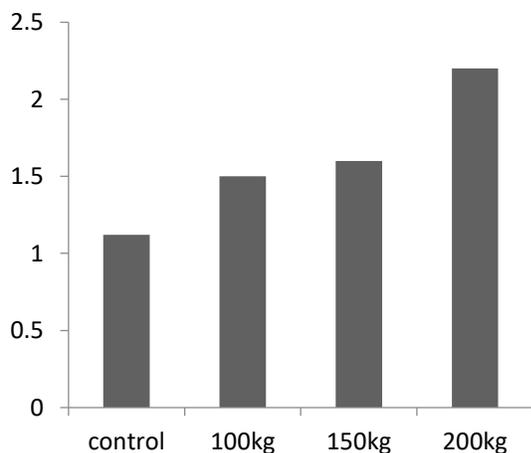


Figure 1: The graphical representation watermelon fruits per kilogram through response to different rate of NPK.

#### 4. DISCUSSION

The variability of the vegetative parameter of the watermelon in response to the rate of inorganic fertilizer applied was significantly different. The result showed that the application of 200 kg / ha of NPK fertilizer gave the highest values for all the vegetative growth parameters (vine length, leaf number, number of nodes, leaf area index), though the values were not significantly different from that of 100 kg / ha, but significantly different from that of the control. The same trend was recorded for the yield parameters. This result agreed with the report by Sabo *et al.* (2013) and Agba and Enya (2005) who found that the application of 200 kg / ha NPK had the greatest effect on the vein length, and yield

component of watermelon. There is agreement with this finding and that of Gorota *et al.*, (2005) and Andrandra *et al.*, (2006) who noted watermelon production increased with the application of Nitrogen fertilizer. The least yield could be attributed to possible depletion of synthetic fertilizer from the soil whereas the higher yield results can be attributed to the role of nitrogen in creating plant fresh dry matter and energy rich compounds which regulates photosynthesis (Hochmith and Hochmith, 1994).

Poonam *et al.* (2014) showed that the fruit yield of watermelons increased significantly with all level applications of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O due to the water-soluble quality and conventional fertilizers compared to the generally recommended dose and control treatment. In addition, the fruit yields and creeping yields were inversely related and were also reported by Giskin and Nerson (2014). The application of 80 and 120 kg N/ha increased the fructose content by 23% and 28% compared to the zero application, while the total fruit yield was highest at 120 kg/ha N and lowest at zero application (Martin *et al.*, 2016). Martin *et al.* (2016) also showed that the sex ratio of watermelons increased significantly with increasing nitrogen content up to one point (more than 80 kg/ha of N) when a further increase led to a decrease. The results of Elmstrom *et al.* (2016) found that cucumbers grown in increasing amounts of nitrogen fertilizers lead to a significant decrease in their sex ratio, which means an increase in female flowers. This from Elmstrom *et al.* (2016) confirmed the results of Agba and Enya (2005), who recorded a higher cucumber yield when nitrogen was used at a rate of 180

kg N / ha compared to the control and those of Waseem *et al.* (2008) reported that a high dose of nitrogen fertilizer (100 kg N<sub>ha</sub><sup>-1</sup>) significantly maximized the length of the cucumber fruit and the length of the vine. A significant treatment effect on the fruit yield ton / ha showed that a higher watermelon yield in the Enugu area could be achieved by increasing the distances and the amount of fertilizer (Awere and Onyeachole, 2014). Their results are in agreement with the results of (Motsenbocker and Aracilria 2010; Andranda *et al.* 2016) who found that watermelon production increased with the use of nitrogen fertilizers. The lowest yield of the control could be attributed to a possible depletion of nitrogen from the soil. While the results with higher yields are due to the role of nitrogen in the production of fresh, dry matter and high-energy compounds that regulate photosynthesis (Hochmuth and Hochmuth 2014). The results of Edelstein and Nerson (2012) who recommended high plant density for more fruit production per unit area. The reason may be that a closely spaced design increases competition for water, nutrients, and light, resulting in insufficient vegetative growth and yield.

In addition, the application of 200 kg / ha NPK gave the highest number of nodes and leaf area index. This shows that the application will help in the formation of canopy. The use of 200 kg / ha NPK gave the highest yield weight. The result of this study showed that the growth and yield of watermelons can be improved by the application of fertilizer. These results are in agreement with the results (Gorota *et al.*, 2005, Andranda *et al.*, 2006) which found that watermelon production increased with the use of nitrogen fertilizers. The higher yield results to the role of nitrogen can be traced back to the production of dry matter fresh from plants and high-energy compounds that regulate photosynthesis (Hochmuth and Hochmuth, 1994). All measured growth and yield parameters were positively improved by the use of NPK.

## 5. CONCLUSION AND RECOMMENDATION

The following conclusions were drawn from this study;

1. The use of NPK fertilizer improved watermelon performance compared to unfertilized plants.
2. The fruit and growth parameters of the watermelon were optimal at 200 kg / ha, the weight and size of the fruits were higher at this rate than with other NPK values. Hence, this suggests that the NPK fertilizer amount of 200 kg / ha is the optimal NPK content for watermelons in the place where this experiment was carried out. When harnessed, these indigenous fruits can reduce hunger, alleviate poverty and improve food security.

3. A fertilizer content of 200 kg NPK / ha performed better than other fertilizer rates used. Therefore, farmers in the study area are recommended to use 200 kg NPK / ha for a more profitable production of watermelons.

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