

EFFECTS OF NITROGEN AND PHOSPHORUS FERTILIZERS ON THE GROWTH AND FRUIT YIELD OF WATERMELON (*Citrullus lanatus* LINN.) IN SOUTHERN GUINEA SAVANNA, NIGERIA

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ABSTRACT

The effects of nitrogen (N) and phosphorus (P) fertilizers on the performance water melon (*Citrullus lanatus* Linn.) were determined during the 2018 cropping seasons at the Teaching and Research Farm of the Federal University of Technology, Minna, and Gwagwalada (Kutunku), Federal Capital Territory, Abuja. The experiment was a 4 x 4 factorial laid out in Randomized Complete Block Design (RCBD). Four levels of N and P fertilizer at 0, 30, 60, and 90 kg/ha and 0, 10, 20, and 30 kg/ha were combined into a total of 16 treatments combinations. The variety used was sugar baby early maturing (70 to 75 days after planting). The different levels of fertilizer were applied at three weeks after planting. Soil characterization was also done on the study areas. Data were collected on growth and yield parameters. The results show that vine length and number of lateral branches were significantly influenced by N and P application in the study area. More numbers of marketable fruits were obtained from plots treated with higher N and P as compared with those treated with lower N and P from both sites. At higher N and P application, the seed yield in Federal University of Technology, Minna farm and Gwagwalada (Kutunku) were all better than the control. Application of 90 kg N/ha and 30 kg/ha P gave the highest yield of seed of 0.9 and 0.8 tons at Federal University of Technology, Minna farm and Gwagwalada (Kutunku) respectively. Application of fertilizers had significant elongation of vine, produces more lateral branches, significantly higher marketable fruits and increased seed yield and general performance of watermelon. The significant edge in performance of Gwagwalada over Minna in growth parameter could be attributed to the rainfall distribution in 2018 cropping season

Keywords: Nitrogen, Phosphorus, Watermelon, Seed, Growth and Fruit

INTRODUCTION

Watermelon (*C. lanatus* Linn) is a member of the family Cucurbitaceae (Bukar, 2017). Tropical soils are beset with the problems of acidity, low nutrient contents, nutrients imbalance and soil erosion. In order to obtain high yield of watermelon, it is necessary to augment the nutrient status of the soil to meet the crop's need. 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 (Demir, 2013). Watermelon is a heavy feeder on nitrogen and therefore requires application of N to boost its production. Continuous dependence on chemical fertilizers may be accompanied by a

decline in soil organic matter content, increased soil acidity, degradation of soil physical properties and increased rate of erosion due to instability of soil aggregates (Adeogun, 2012). The global consumption of the crop is greater than that of any other cucurbit but as important as this crop is, few people are aware of its market potentials (Asharaf, 2013). The use of mineral fertilizer by farmers is limited because of scarcity, high costs and basic disadvantages in apparent inability to substantially redress the physical fragility and chemical deterioration of the soil (Ojeniyi, 2011). Research has shown that organic based fertilizers are less leached into ground water than the chemical fertilizer. Organo-mineral fertilizer appears to be reliable organic source of nitrogen needed for growing watermelon. Organo-mineral fertilizer is a low-input technology of improving the nutrient status of tropical soils for sustainable crop production. High plant density is recommended in watermelon seed production because more fruit per area is achieved at a denser spacing (Nerson, 2009). The goal of this present study was to determine the effects of inorganic fertilizer such as Nitrogen and Phosphorus on the yield of watermelon.

MATERIAL AND METHODS

Two location trials were conducted at the Federal University of Technology GidanKwano Campus Minna, Niger State, and Gwagwalada (Old Kutunku), Federal Capital Territory Abuja. The areas fall into southern Guinea Savanna agro ecological zone of Nigeria. The area has a distinct rainy and dry season with a rainfall pattern which usually establishes between mid-May to early June, and peaks in the month of July/August

The effects of four levels of nitrogen varied at (0, 30, 60 and 90 kg/ha) and four levels of phosphorus also varied at (0, 10, 20 and 30 kg/ha) were tested. The study was therefore a 4 x 4 factorial experiment, which translated to 16 treatment combinations with three replications. Randomized Complete Block Design was used for the experiment in both sites. Seeds of watermelon were sown on flat

bed of 2 m x 2 m. Each plot measured 8 m x 6 m and contained 20 heaps in both experimental sites.

Contact and systemic herbicide (Glyphosate) was applied to reduce weeds before land preparation. Further removal of weeds was done by hoe weeding as at and due and subsequent weeding was by hand pulling to prevent disturbances to flower that could result in abortion

At planting, basal application of 30 kg K/ha in form of Muriate of potash was done to the whole plots by spot application, 5cm away from the plant and about 5cm deep and covered. Phosphorus was applied to the plots in which it is required in form of single superphosphate also at planting. One third of N in form of urea was applied at planting while the remaining two third was applied at six weeks after sowing. Vine length, number of lateral branches were collected at maturity while numbers of marketable fruits and seed yield/plot were determined at 70 days after planting. Data collected on all the parameters were all subjected to Analysis of Variance (ANOVA) using SAS as statistical tools or platforms and treatment were separated where significant using the Duncan Multiple Range Test. DMRT at 5% level of probability.

RESULTS

The soil was sandy loam with a slightly acidic soil reaction. The organic carbon and total nitrogen were both low. The available phosphorus and exchangeable bases were moderate in the soils from both sites Table 1. The total annual rainfall in the areas was 1875 mm and 1950 mm. The areas has daily mean temperature of 37.5°C and 38.2°C respectively. [Meteorological station of FUT Minna (MET), 2018]. The experiments were carried out in the field that had a previous history of maize, groundnut and soybean cultivation.

Table 2 shows the effects of application of both N and P on vine length of watermelon in Futminna and also in Gwagwalada (Old Kutunku) in 2018. At Futminna, Vine length increased with increasing N and P levels. N fertilizer rates at 90 kg N/ha recorded the

longest vine length (3.94 m) while the shortest vine was recorded at control (1.66 m), Application of P at 30 kg /ha resulted in significantly longer vine than at lower levels, the difference between the values obtained at 10 and 20 kg P/ha was not significant at FUTminna The result at Gwagwalada shows that N fertilizer rates at 90kg/ha produced highest number of vine (4.99 m) while the shortest vine was recorded at control (1.75 m). In phosphorus application, P fertilizer rate at 30kg/ha produced the highest number of vine (4.90 m), while the shortest vine was recorded at control (1.74 m) with significant difference between them. In both sites, no significant interaction was recorded.

The effects of nitrogen and phosphorus on number of lateral branches in Futminna and Gwagwalada are shown in Table 3. Application of N and P to watermelon has significant effects on the production of lateral branches. There was steady increase in the number of lateral branches as N and P levels were increased. The highest and lowest number of lateral branches were produced at 90 kg N/ha and 0 kg N/ha, and 30 kg P/ha and 0 kg P/ha in both sites respectively. The differences between the application rates of 30 and 60 kg N/ha, and 10 and 20 kg P/ha on number of lateral branches produced in both sites were not significant during the study year. The effects of interaction between Nitrogen and phosphorus were not significant in both sites during the 2018 cropping season. The effects of N and P application on days to 50% flowering was significant. Application of nitrogen and phosphorus significantly delayed flower formation. The longest delay (46.01 and 49.93) was at the application of 90 kg N/ha in both sites. Although, P application has no significant effect on the days to 50% flowering in Futminna while the effects of phosphorus application on days to 50% flowering was only significant at the control application with shortest (41.71) at Gwagwalada. The application of phosphorus at the rates of 10, 20 and 30 kg P/ha were not significant in

Gwagwalada site. N by P interaction was not significant during the 2018 cropping season both sites (Table 4).

The effects of application of nitrogen and phosphorus fertilizer on the number of fruits are presented in Table 5. N and P fertilizer application had significant effect on the number of marketable fruits harvested. The highest number of marketable fruits in Futminna site at N application was obtained at 90 kg/ha N (3.86) while the lowest was recorded at control (2.51) and they differed significantly. The highest number of marketable fruits in the same year at P application rate was obtained at 30 kg/ha P (3.77) while the lowest was recorded at control (2.45) and they differed significantly. In Gwagwalada, the highest number of marketable fruits at N application was recorded at 90 kg/ha N (3.82) while the lowest was recorded at the control (2.71) The highest number of marketable fruits in old Kutunku, Gwagwalada at P application rate was obtained at 30 kg/ha P (3.55) while the lowest was recorded at control (2.65) and they differed significantly

Table 6 shows effects of nitrogen and phosphorus on seed yield. As N and P rates increased, there were significant increase in seed yield. The highest in all the two sites were N at the levels of 90 kg/ha and P at 30 kg/ ha. At Futminna site, the highest seed yield was recorded at 90 kg/ha N (867.4) while the lowest was recorded at the control (587.8). The highest seed yield at P application rate was obtained at 30 kg/ha P (795.4) while the lowest was recorded at control (602.2) and they differ significantly in all the levels of application. At Gwagwalada, the highest seed yield was recorded at 90 kg/ha N (887.4) while the lowest was recorded at the control (597.8). The highest seed yield in 2018 at P application rate was obtained at 30 kg/ha P (808.4) while the lowest was recorded at control (506.2) and they also differ significantly in all the levels from 0 kg/ha through 30 kg P/h. The application of N and P fertilizer at the combination of 90 kg N

and 30 kg P/ ha gave the highest yield. The interaction of N and P on yield was not significant in both FUT minna and Gwagwalada sites during the 2018 cropping season.

Table 1: Physical and Chemical Properties of Soil at the Experimental Sites During the 2018

Parameters	Values	
	Futminna	Gwagwalada (Oldkutunku)
Particle size analysis (gkg ⁻¹)		
Sand	752	755
Silt	111	110
Clay	137	135
Textural Classification	Sandy loam	Sandy loam
pH (0.01M CaCl ₂)	6.95	7.43
Total N (%)	0.31	0.3
Organic Carbon (gkg ⁻¹)	0.39	0.4
Available P (mg kg ⁻¹)	8	7.5
Exchangeable Cations (mol.kg ⁻¹)		
K	0.8	0.81
Mg	2.9	2.9
Ca	4.1	4.15
Na	0.41	0.42
CEC	278	280

Source: Department of Soil and Land Management, Federal University of Technology Minna

Table 2: Effects of Nitrogen and Phosphorus Fertilizers on Main Vine Length of watermelon

Treatments	Main vine length at 12 weeks after sowing	
	Futminna (GK Campus)	Gwagwalada (Kutunku)
Nitrogen(Kg)		
0	1.66 ^d	1.75 ^d
30	2.72 ^c	2.88 ^c
60	3.33 ^b	3.88 ^b
90	3.94 ^a	4.99 ^a
SE ±	0.58	1.05
Phosphorus(Kg)		
0	1.63 ^c	1.74 ^d
10	2.74 ^b	2.83 ^c
20	3.36 ^b	3.87 ^b
30	3.99 ^a	4.90 ^a
SE ±	0.58	1.05
Interaction		
N x P	NS	NS

Mean followed by same letter in a column within a treatment group are not significantly different from one another at 5% level of probability

Table 3: Effects of Nitrogen and Phosphorus Fertilizers on Number of Lateral Branches

Treatments	Number of Lateral Branches at 8 weeks after sowing	
	Futminna (GK Campus)	Gwagwalada (Kutunku)
Nitrogen(Kg)		
0	8 ^c	9 ^c
30	11 ^b	11 ^b
60	12 ^b	12 ^b
90	14 ^a	14 ^a
SE $\pm$	1.4	1.4
Phosphorus(Kg)		
0	9 ^c	9 ^c
10	11 ^b	12 ^b
20	12 ^b	13 ^b
30	14 ^a	15 ^a
SE $\pm$	1.4	1.4
Interaction		
N x P	NS	NS

Mean followed by same letter in a column within a treatment group are not significantly different from one another at 5% level of probability.

NS – Not Significant

Table 4 : Effects of Nitrogen and Phosphorus Fertilizers on the Days to 50% Flowering

Treatments		
	Futminna (GK Campus)	Gwagwalada (Kutunku)
Nitrogen(Kg)		
0	42.00 ^b	44.51 ^c
30	43.04 ^b	46.75 ^b
60	44.00 ^b	49.91 ^a
90	46.01 ^a	49.93 ^a
SE $\pm$	2.00	2.05
Phosphorus(Kg)		
0	40.71 ^a	41.71 ^b
10	41.63 ^a	46.93 ^a
20	41.21 ^a	47.41 ^a
30	42.00 ^a	47.46 ^a
SE $\pm$	2.00	2.05
Interaction		
N x P	NS	NS

Mean followed by same letter in a column within a treatment group are not significantly different from one another at 5% level of probability

NS – Not Significant

Table 5: Effect of N and P Fertilizer on Marketable Fruits of Water Melons

Treatments	Marketable Fruit of Water Melon	
	Futminna (GK Campus)	Gwagwalada (Kutunku)
Nitrogen(Kg)		
0	2.51 ^d	2.71 ^c
30	3.61 ^c	3.42 ^b
60	3.76 ^b	3.76 ^a
90	3.86 ^a	3.82 ^a
SE $\pm$	0.09	0.19
Phosphorus(Kg)		
0	2.45 ^d	2.65 ^c
10	3.21 ^c	3.41 ^b
20	3.55 ^b	3.31 ^b
30	3.77 ^a	3.55 ^a
SE $\pm$	0.09	0.19
Interaction		
N x P	NS	NS

Mean followed by same letter in a column within a treatment group are not significantly different from one another at 5% level of probability

NS – Not Significant

Table 6: Effects of Nitrogen and Phosphorus Fertilizers on Seed Yield(kg/ha)

Treatments	Futminna (GK Campus)	Gwagwalada (Kutunku)
Nitrogen(Kg)		
0	587.8 ^d	597.8 ^d
30	720.4 ^c	730.4 ^c
60	741.6 ^b	761.6 ^b
90	867.4 ^a	887.4 ^a
SE $\pm$	5.0	8.0
Phosphorus (Kg)		
0	602.2 ^d	506.2 ^d
10	721.6 ^c	643.6 ^c
20	643.4 ^b	773.4 ^b
30	795.4 ^a	808.4 ^a
SE $\pm$	5.0	8.0
Interaction		
	NS	NS

Mean followed by same letter in a column within a treatment group are not significantly different from one another at 5% level of probability

NS – Not Significant

DISCUSSION

The study revealed that application of 90 kg N/ha and 30 kg P was superior to other treatments in respect to vine length and lateral branches of watermelon. This agrees with the study conducted on watermelon by Singh and Oseni (2010). The report by Opeyemi (2011) also showed that application of 90 kg N/ha resulted in the production of greater number of lateral branches in watermelon. The result is slightest different from the work of Olaniyi (2008) who reported 80 kg N/ha and 17.6 kg P/ha for longest vine length and highest marketable fruits on watermelon. Further contrary report was the work of Barua (2010) who also reported that watermelon vine length was greatest at 40 kg N beyond which there was drastic reduction in value. The significant increase in vine length with increase in N application could also be attributed to the ability of nitrogen to stimulate cell division and extension which in turn increased the length of internodes that translated into longer plants. Significant delay in flowering resulted from application of N and P fertilizers. The greatest delay was recorded at 90 kg N/ha and 30 kg P/ha in both sites. In the report of the work of Olaniyi, (2008) increasing N application from 0 up to 60 kg N/ha significantly reduced the delay in flower opening. Mehmood *et al.* (2012) also recorded significant increase in days to flowering in tomato as N fertilizer was increased from 0 to 200 kg/ha. This significant delay in flowering could be an indication that N application increases vigour of the plant, which ultimately increase vegetative period. Olaniyi, *et al.* (2010) cautioned that the use of excessive nitrogen may result in luxuriant plant growth which will in turn lead to delay flowering and poor yield. Delayed flowering could be to enable the plant have a robust and efficient utilization of nutrients at the vegetative stage, which will translate into

longer stems, more nodes flower and invariably higher fruits and seed yield as confirmed by this study. Seed is that which determines the optimum level of productivity and a starting point of crop production (Demir, 2013). The seed which has nutritional and health benefit is also term as golden (Opeyemi, 2011).

The current study revealed that the optimum seed yield of about 0.9 tons per ha all through the both sites recorded at the combination of 90 kg N and 30 kg P/ha was 2 tons less than what the combination of 60 kg N and 13.2 kg P/ha by Olaniyi (2008) had. This may probably due to the differences in the location of study. Benin, Steven, Peter and Kelvin (2013) obtained significant seed yield in watermelon when N and P were increased up to 75 kg/ha respectively. Similarly, results from the study conducted on watermelon by Huseiniet *al.*, (2013) indicated that it required up to 90 kg N and 35 kg PP/ha before significant differences in fruit and seed yields were recorded. Yakubuet *al.* (2017) who recorded significant seed yield on effect of N and P on egusi melon, agreed with this findings.

Generally, the result of this study revealed that watermelon seed yields increased with increasing N application.

CONCLUSION

It has been clearly established from the study that application of 90 kg N and 30 kg P gave higher marketable and seed yield of watermelon. Seeds and fruits of melon from lower application rate of nitrogen and phosphorus showed a declining performance as compared to higher rates. Hence application of nitrogen and phosphorus fertilizers resulted in enhanced agronomic characteristics of water melon which led to increased fruit and seed yield.

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