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EFFECT OF NITROGEN AND PHOSPHORUS ON THE FRUIT AND SEED CHARACTERISTICS OF EGUSI MELON IN SOUTHERN GUINEA SAVANNA, NIGERIA

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ABSTRACT

The experiment to study the effect of nitrogen and phosphorus and fruit position on the mother plant on the fruit and seed characteristics of egusi melon was conducted at the Teaching and Research Farm of Federal University of Technology, Minna during the 2011, 2012 and 2013 cropping seasons. It was factorial experiment made up of two factors, Nitrogen (0, 40, 60 and 80 kg ha-1) and Phosphorus (0, 10, 20 and 30 kg ha-1) fitted into Randomized Complete Block Design (RCBD) with three replications. Data were collected on fruit weight, length and circumference, number of seeds per fruit, 100-seed weight and seed length. The data were subjected to analysis of variance and significant means were separated using LSD. The effects of nitrogen, phosphorus, and fruit position on the mother plant on all the parameters. The interaction effects of nitrogen, phosphorus and fruit position on the mother plant were significant on seed yield.

KEYWORDS: Nitrogen, Phosphorus, Nigeria

INTRODUCTION

Egusi melon (*Citrullus lanatus* Thumb.) is an herbaceous annual vegetable crop with a trailing hairy, ridged vine which bears tendrils and lobed leaves on petioles. It belongs to the cucurbitaceae family (Ogbonna and Obi, 2009). Egusi is highly drought resistance, and productivity is enhanced during dry, sunny periods and reduces with excessive rainfall and high humidity (Olaniyi, 2008). Tropical soils are generally low in total nitrogen and phosphorus due to high temperature and low rainfall leading to sparse vegetation and high rate of mineralization, leaching and erosion (Okafor, 2010). The soil total nitrogen has long been identified as a factor that is important to soil fertility in both managed and natural ecosystems (Gaetano, 2007). After nitrogen, phosphorus is the most limiting plant nutrient in most agricultural soils (Smithson and Sanchez, 2000). Deficiency of nitrogen in soil where egusi melon is grown resulted to poor growth, thin vine and bristle leaves (Dass, 1999) while that of phosphorus will drastically reduce the yield due to its synergy with nitrogen (Uchida, 2007). Adequate supply of nitrogen is essential for vigorous vegetative growth, seed formation and optimum yield of melon (Olaniyi, 2008). Nitrogen and phosphorus exhibit synergy in functions in crop growth and development so cannot be used as replacement for one another (Uchida, 2007). Huseini *et al*. (2013) studied the effects of nitrogen and phosphorus fertilization on fruits and seed yields of musk melon and reported that lateral branches, male and female flowers formation, fruit length, fruit and seed yields became significantly superior to other levels when increased from 80 to 90 kg N/ha and 20 to 35 kg P/ha. Thus, the aim of this experiment was to study the characteristics of fruits and seeds of egusi melon as influenced by application of nitrogen and phosphorus.

MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farm of the Federal University of Technology, Minna, Niger State, (Latitude 9^0 33`35`` N and longitude $6^0$ 27`11`` E) in the southern guinea savanna agro ecological zone of Nigeria. The total annual rainfall in the area ranges from 1284 mm – 1383 mm with an average of 1332.5 mm. The experiment was carried out in the field that had a previous history of maize cultivation in 2011, groundnut production in 2012 and soybean production in 2013. The seed of egusi melon was sourced from the Teaching and Research Farm, Federal University of Technology, Minna, Niger State. It was a factorial experiment made up of four levels of nitrogen (0, 40, 60 and 80 kg/ha) and four levels of phosphorus (0, 10, 20 and 30 kg/ha) fitted into Randomized Complete Block Design with three replications. The land was ploughed and harrowed and then divided into plots measuring 10 m x 8 m each containing 30 heaps. As soon as rains started, planting was done at a spacing of 2 m x 2 m with three seeds sown per hole, which were later thinned to one seedling per hill after two weeks. There were six rows in each plot and data were collected from four middle rows. Contact herbicide was applied to reduce weeds before land

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preparation. Further removal of the weeds was done by hoe weeding as at when 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 $^{-1}$in the form of muriate of potash was done to the whole plots by spot application, 5cm away from the plant and about 5 cm deep and covered. Phosphorus was applied to the plots in which it is required in the form of single superphosphate also at planting, it was also be applied in the same method of application as K. One- third of N (in form of urea) was applied at planting while the remaining two- thirds was applied at six weeks after sowing (6WAS). The parameter measured includes fruit weight, length and circumference, number of seeds per fruit, 100-seed weight and seed length. The data were subjected to analysis of variance and significant means were separated using LSD.

RESULTS AND DISCUSSION

Results

The effects of nitrogen and phosphorus on fruit weight, number of seeds in a fruit are presented in Table 1. Fruit weight was significantly affected by nitrogen while P had no significant effect in 2011. The difference in fruit weight at 0 and 40 kg N /ha was not significant Nitrogen and phosphorus had significant effect in 2012 and 2013 on fruit weight. As N and P levels were increased, fruit weight also significantly increased. Although, the differences at 0, 10 and 20 kg /ha were not significant in 2013. The interaction effects of nitrogen and phosphorus on fruit weight was not significant in the three cropping seasons.

Table 1: Effects of Nitrogen and Phosphorus fertilizers on Fruit Weight and Numbers of Seeds per fruit in 2011, 2012 and 2013 Cropping Seasons

Treatment	Fruit weight (g)			Number of seeds in a fruit		
	2011	2012	2013	2011	2012	2013
Nitrogen(N) (kg/ha)						
0	830^{c}	1260^{d}	1300^{d}	76^{d}	84^{a}	87^{c}
40	840^{c}	1320^{c}	1420^{c}	95^{c}	85^{a}	89^{c}
60	980^{b}	1460^{b}	1540^{b}	111^{b}	88^{a}	94^{b}
80	1050^{a}	1560^{a}	1690^{a}	149^{a}	88^{a}	101^{a}
SE±	11	10	20	14.0	4.0	4.0
Phosphorus (P) (kg/ha)						
0	910^{a}	1350^{d}	1450^{c}	98^{a}	84^{a}	89^{b}
10	920^{a}	1380^{c}	1470^{b}	99^{a}	89^{a}	90^{b}
20	940^{a}	1400^{b}	1490^{b}	100^{a}	88^{a}	92^{b}
30	940^{a}	1450^{a}	1540^{a}	111^{a}	88^{a}	98^{a}
SE±	0.1	10	20	14.0	4.0	4.0
Interaction						
N x P	NS	NS	NS	NS	NS	NS

Means followed by same letter under each column within a treatment group are not significantly different from one another at 5% level of probability, NS – Not significant

FP – Fruit position

Application of nitrogen significantly increased the number of seed in a fruit from about 76 at 0 N kg/ha to about 149 at 80 kg/ha in 2011 and from about 87 to about 101 in 2013 (Table 1). The number of seeds in a fruit was not significantly affected by P in 2011 and 2012. In 2013 however, P at 30 kg/ha resulted in significant increase in number of seeds compared to the values obtained at 0, 10 and 20 kg P /ha which were statistically similar. The effect of interaction of nitrogen and phosphorus on number of seeds in a fruit was not significant in all the cropping seasons.

The effects of application of nitrogen and phosphorus fertilizers on fruit length, fruit circumference and number of fruit per plot are presented in Table 2. Nitrogen significantly affected the fruit length in 2011. The difference between the application of N at 0 and 40 kg/ha was not significant in 2011. In 2012, melon fruit length was significantly affected by the application of N, P and fruit position. The differences in N levels at 0 and 40 kg N/ha, and P at 10, 20 and 30 kg P/ha were not significant. In 2013, fruit length was significantly affected by N. The effect of application of phosphorus fertilizer on fruit length was not significant in 2013.. Nitrogen at 60 and 80 kg N/ha

and P at 10, 20 and 30 kg P/ha did not produce significantly different fruit length from one another. The interaction effects of N and P and N on fruit length was not significant.

Fruit circumference was significantly affected by nitrogen in 2011 while phosphorus application was not significant. In 2012 and 2013, the effects of the application of N and P on fruit circumference were significant. Fruit circumference increased as N and P levels increased even though the difference between 20 and 30 kg P was not significant. The interaction effect of N and P on fruit circumference was not significant in all the cropping seasons.

Table 2: Effects of Nitrogen and Phosphorus fertilizers on Fruit characteristics in 2011, 2012 and 2013 Cropping Seasons

Treatment	Fruit length (cm)			Fruit circumference			Number of fruits per plot		
	2011	2012	2013	2011	2012	2013	2011	2012	2013
Nitrogen(N)(kg/ha)									
0	10.31^{c}	10.22^{c}	11.03^{b}	26.77^{c}	28.59^{d}	29.55^{b}	10^{a}	10^{a}	10^{a}
40	10.32^{c}	10.31^{c}	11.09^{b}	27.90^{b}	29.18^{c}	30.11^{b}	10^{a}	10^{a}	10^{a}
60	11.09^{b}	10.66^{b}	11.21^{a}	29.00^{a}	29.78^{b}	33.41^{a}	10^{b}	10^{a}	10^{a}
80	11.80^{a}	10.92^{a}	11.96^{a}	29.51^{a}	31.24^{a}	34.22^{a}	10^{a}	10^{a}	10^{a}
SE±	0.2	0.2	0.2	0.3	0.2	1.0	0.8	0.8	0.8
Phosph(P)(kg/ha)									
0	10.67^{a}	9.66^{b}	10.11^{a}	27.8^{a}	29.10^{c}	29.22^{c}	10^{a}	10^{a}	10^{a}
10	10.92^{a}	10.21^{a}	10.25^{a}	28.10^{a}	29.55^{b}	31.11^{b}	10^{a}	10^{a}	10^{a}
20	10.94^{a}	10.41^{a}	10.41^{a}	28.49^{a}	30.17^{a}	33.22^{a}	10^{a}	10^{a}	10^{a}
30	10.98^{a}	10.46^{a}	10.44^{a}	28.60^{a}	30.33^{a}	34.11^{a}	10^{a}	10^{a}	10^{a}
SE±	0.2	0.2	0.2	0.3	0.2	1.0	0.8	0.8	0.8
Interaction N x P	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means 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, FP – Fruit position

The effects of nitrogen and phosphorus on seed length, 100-seed weight and seed yields in a fruit in the three cropping seasons were significant (Table 3). Seeds were longer when 80 kg N and 30 kg P/ha were applied than at the application of 60 kg N and 20 kg P/ha in 2011. Also, there were no significant interactions of N and P on seed length during the three cropping seasons. The weight of 100 seed was significantly affected by N and P only in 2011. Seeds were significantly heavier at 80 kg N/ha than at lower levels. Seed weight values were similar at 20 and 30 kg P/ha but were significantly greater than at 0 and 10 kg P /ha. In both, 2012 and 2013 application of N and P had no significant effect on 100- seed weight (Table 3). The interactions effects of N and P on 100 seed weight were not significant during the three cropping seasons. The effects of N and P and their interactions were significant on seed yield in the three cropping seasons as shown in Table 4. As N and P rates increased, there were significant increases in seed yield. Seed yield generally increased with increase in P, though no significant difference in values at 10 and 20 kg P /ha combined with 40 and 60 kg N/ha in 2011. Similarly, the difference between the yield at P 0/10 and at P 20/30 kg/ha was not significant at 0 kg and 60 kg N/ha respectively in 2012. Such non- significant differences were also recorded in 2013. However worthy of note that all through the cropping seasons, highest yield was recorded at the combination of 80 kg N and 30 kg P/ha.

Table 3: Effects of Nitrogen and Phosphorus fertilizers on Seed Length, 100 Seed Weight and Seed Yield (kg) Per Hectare in 2011, 2012 and 2013 Cropping Seasons

	Seed length (g)			100 seed weight (g)			Seed yield (kg/ha)		
Treatment	2011	2012	2013	2011	2012	2013	2011	2012	2013
Nitrogen(N)(kg/ha)									
0	0.83^{d}	0.88^{b}	0.77^{b}	7.22^{d}	8.77^{a}	8.77.^{a}	347.8^{d}	347.6^{d}	364.6^{d}
40	0.94^{c}	0.96^{b}	0.81^{b}	7.48^{c}	8.67^{a}	8.75^{a}	464.4^{c}	466.8^{c}	470.4^{c}
60	1.05^{b}	1.10^{a}	1.10^{a}	8.07^{b}	8.74^{a}	8.76^{a}	611.6^{b}	611.6^{b}	568.8^{b}
80	1.12^{a}	1.10^{a}	1.11^{a}	8.68^{a}	8.96^{a}	9.05^{a}	807.4^{a}	807.8^{a}	722.0^{a}
SE±	0.1	0.1	0.1	0.1	0.4	0.4	20	20	20
Phosph (P)(kg/ha)									
0	0.96^{b}	0.89^{b}	0.88^{b}	7.68^{c}	8.79^{a}	8.80^{a}	506.2^{d}	506.^{2d}	479.4^{d}
10	0.98^{b}	0.99^{b}	0.89^{b}	7.80^{b}	8.74^{a}	8.82^{a}	543.6^{c}	543.6^{c}	513.6^{c}
20	1.00^{b}	1.22^{a}	0.91^{a}	7.95^{a}	8.69^{a}	8.82^{a}	573.4^{b}	573.4^{b}	550.6^{b}
30	1.03^{a}	1.25^{a}	1.00^{a}	8.01^{a}	8.93^{a}	8.85^{a}	608.4^{a}	608.4^{a}	582.2^{a}
SE±	0.1	0.1	0.1	0.1	0.4	0.4	20	20	20
N x P	NS	NS	NS	NS	NS	NS	*	*	*

Means 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, FP – Fruit position

Table 4: Interaction Effect of Nitrogen and Phosphorus Fertilizer Levels on Seed Yield Per Ha in 2011, 2012 and 2013 Cropping Seasons

Seed yield (kg /ha)				
Nitrogen(kg/ha)	P (Kg/ha)			
	0	10	20	30
		2011 cropping		
0	336.70^{m}	347.50^{l}	368.20^{k}	379.64^{j}
40	390.24^{i}	406.53^{h}	410.53^{h}	424.40^{g}
60	430.90^{g}	441.35^{f}	446.00^{f}	460.60^{e}
80	540.80^{d}	558.40^{c}	628.00^{b}	702.80^{a}
SE±		**10.1**		
		2012 cropping		
0	311.62^{n}	307.22^{n}	378.73^{m}	394.37^{l}
40	420.33^{k}	445.26^{j}	470.73^{i}	522.04^{h}
60	565.021^{g}	607.40^{f}	630.00^{e}	644.31^{e}
80	727.80^{d}	777.43^{c}	815.00^{b}	872.100^{a}
SE±		**20**		
		2013 cropping		
0	325.53^{i}	312.34^{l}	403.28^{h}	417.35^{h}
40	435.00g^{h}	468.26^{fg}	482.93^{efg}	495.64^{ef}
60	530.75^{de}	554.86^{d}	564.4^{d}	625.60^{c}
80	628.80^{c}	719.34^{b}	752.22^{ab}	790.22^{a}
SE±		**20.1**		

Means followed by same letter (s) within a set of trial in a year are not significantly different from one another at 5% levels of probability

DISCUSSION

Significantly, larger and longer fruits were obtained as a result of fertilizer application. Plants treated with higher N and P produced fruits were significantly longer compared to lower applications. Olaniyi and Ajao, (2010) recorded significant increase in fruit length by the application of 15-15 -15 NKP fertilizer in 'egusi' melon. Fruit circumference increased as N and P levels increased even though the difference between 20 and 30 kg P was not

significant. Fruits harvested from plots with higher N and P application rates had larger circumference compared to lower rates. At higher N and P application, the number of seeds in fruit increased compared with those with lower fertilizer application. Generally, seeds from plots with higher fertilizer doses significantly outnumbered those from plots with lower fertilizer doses across the study periods. This can be attributed to the significant role of higher fertilizer application, which is available to stimulate development at seed filling stage. This is similar to the reports of Haggai (2004), Olowe and Busari (2010) and Noorka *et al*. (2011) on effect of nitrogen on Sesame seed. The enhanced 100-seed weight at increasing N and P application rates recorded in 2011 agrees with the reports of Olaniyi and Fagbayide (2007) and Law-Ogbomo (2009). Ayodele *et al.* (2006) also reported significant seed weight increase when P was applied at 10/20 kg/ha, but, this study revealed that maximum 100-seed weight was recorded when P was applied at 20/30 kg/ha. Likewise, Abdul *et al*. (2006) reported significant increase in 100- seed weight of pea by the use of NPK. In a related work, Ogbonna (2009) recorded enhanced 100-seed weight when NPK rates was increased from 150 – 200 kg/ha in 'egusi' melon. Ogutu *et al*. (2012) also recorded a significant increase in 100-seed weight in bean by the addition of N fertilizer.

CONCLUSION

Higher application of nitrogen and phosphorus fertilizer resulted in longer and larger fruits with high number of seeds

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