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Growth and Seed Yield Response of *Egusi* Melon to Nitrogen and Phosphorus Fertilizers Application

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ABSTRACT

There is little known about how agronomic practices affect seed yield of *egusi* melon. Field studies were conducted at the Teaching and Research farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria, to determine the individual and combined levels of nitrogen (N) and phosphorus (P) fertilizers required for optimum growth and seed yield of *egusi* melon. An *egusi* melon cultivar, black edged seed *bara* was subjected to 4 levels of N (0, 40, 60 and 80 kg N ha^{-1}) and 4 levels of P (0, 8.8, 13.2 and 17.2 kg P ha^{-1}) in order to investigates the main and interactive effects of N and P. The factorial combinations of the two factors (N and P) gave 16 treatment combinations. The treatments were laid out in a randomized complete block design, replicated three times. *Egusi* melon growth parameters and seed yield attributes were assessed and analyzed using analysis of variance. The various levels of individual and combined N and P fertilizers significantly ($P \leq 0.05$) influenced the growth and seed yield of *egusi* melon. Sole application of 80 kg N and P ha^{-1} resulted in the highest growth parameters which was significantly higher than that obtained without N and P but not significantly different from that recorded at 60 kg N and 13.2 kg P ha^{-1}, respectively. Sole application of 60 kg N and 13.2 kg P ha^{-1} fertilizer rates and their combination produced optimum seed yield of *egusi* melon.

Key words: *Citrullus lanatus*, nitrogen, phosphorus, growth, seed yield, yield components

Introduction

Egusi melon (*Citrullus lanatus* (thunb.) Mansf) is one of the popular seed vegetables grown in Nigeria, especially in South Western and Eastern parts of the country. *Egusi* melon seeds are popular condiments in Nigerian local soups. Melon seed is a good source of oil, protein, minerals, vitamins, and energy in form of carbohydrates. The seed contained 4.6g carbohydrates, 0.6g proteins, 0.6g crude fibre, 33mg vitamin C, 17g Ca, 16mg P and 230 mg K per 100g edible seeds (Gorski, S.F., 1985).

The nutrient requirements of crops depend upon soil texture; types of previous vegetation cover, cropping intensity and soil moisture (Denton, L. and V. Swarup, 1990). Nitrogen and phosphorus elements perform different functions in crops growth and development and none of them can be substituted to act for one another in its special function in the crop, therefore, there is need for fertilizer application in order to obtain optimum yield from cultivated crop (Adepetu, J.A., 1986).

Nitrogen (N) is one of the nutrients of major importance in the growth of melon. Lack of nitrogen causes the plant to be stunted and becomes yellow in appearance. Adequate supply of nitrogen is essential for vigorous vegetative growth, seed formation and optimum yield of melon. As N rates applied to the plants are increased, plant growth, yield and fruit- set are increased. At high rate of N, it has been found that yields again declined for melon in the Savanna zone of Southwestern Nigeria (Olaniyi, J.O., 2006; Ogunremi, E.A.,

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1978). Nitrogen fertilizer has been reported to increase the early yield of melon with observation showing that plants that receive low N level are smaller and show N deficiency symptoms. Maximum fruit set can be delayed up to 11 days if N is limiting. The application of 34, 68 or 100kg N/ ha increases flower production, fruit set and the solute acid content of the fruit (Gorski, S.F., 1985). Ogunremi (1978), in his investigation on the effects of N on melon showed that application of N increased number of leaves and leaf size (leaf area) which resulted in increased number of fruits and total yield in the Southern savanna zone of South western Nigeria.

Phosphorus is required for all life, being a structural constituent of nucleic acid, as well as being involved in metabolic energy transfer through Adenosine triphosphate (Ozanne, P.G., 1980). Phosphorus does not exist as abundantly in the soil as nitrogen and potassium. Similarly, the plants requirement of P is not as large as N and yet, it is very essential for plant growth and development; and breakdown of sugar and the transfer of energy (Mitchel, Rel., B.E. Caldwel, 1980). In view of this important role in physiological processes, its deficiency would be disastrous leading to immediate and severe disruptions of metabolism and plant development (Epstein, E., 1972). Characteristics symptoms of P deficiency in melon are changes in leaf colour from a dark green colour to a much duller green, and slender stems (Gorski, S.F., 1985). Unlike N, once P is removed from the soil, it can only be replenished from external sources (Sanyal, S.K. and S.K. De Datta, 1991). The need for continued P additions in many tropical soils is as a result of slow conversion of P to plant unavailable forms, or P fixation (Smithson, P.C. and P.A. Sanchez, 2000).

Although little literatures are available on the use of fertilizer on melon, it is evidence that melon plants benefited from combined application of nutrient elements. In the studies conducted in the guinea savanna zone of Southwestern Nigeria (Olaniyi, J.O., 2000) 350kg N P K ha^{-1} was recommended for optimum seed yield of melon. NIHORT, (1983). also recommended 400kg N P K 15-15-15 for melon, based on data and fertilizer use experiences of similar tropical countries. Adeyemi (1991), reported that N P K (15-15-15) fertilizer was most effective at the rate of 500kg ha^{-1} for melon where soil is low to medium fertility.

There is minimal information on the agronomic practices that affect growth and seed yield of *egusi* melon. This study was therefore set up to determine the appropriate individual and combined levels of N and P fertilizers for optimum growth and seed yield of *egusi* melon.

Materials and methods

Field trials were carried out in 2003 and 2004 at the Ladoke Akintola University of Technology, Ogbomoso ($4^0$10'E and $8^0$10'N) in south west Nigeria, in order to investigate the main and interactive effects of N and P. Annual rainfall of this area is over 1,000/mm and air temperature range between 21^0 C and 33^0 C (Olaniyi, J.O., 2000). The treatments consisted of 4 levels of N (0, 40, 60 and 80 kg N ha^{-1}) and 4 levels of P (0, 8.8, 13.2 and 17.6 kg P ha^{-1}). The factorial combinations of the two factors that is N and P, gave 16 treatment combinations. An *egusi* melon cultivar Black-edged b*ara* which showed outstanding performance in the previous studies (Olaniyi, J.O., 2000) was used. The treatments were laid out in a randomized complete block design, replicated three times. The levels of N and P and their combinations are as follows:

0kg N and 0kg P ha^{-1} (control)
40kg N and 0 kg P ha^{-1}
60kg N and 0 kg P ha^{-1}
80kg N and 0 kg P ha^{-1}
0kg N and 8.8 kg P ha^{-1}
0kg N and 13.2 kg P ha^{-1}
0kg N and 17.6 kg P ha^{-1}
40 kg N and 8.8 kg P ha^{-1}
40kg N and 13.2 kg P ha^{-1}
40kg N and 17.6 kg P ha^{-1}
60 kg N and 8.8 kg P ha^{-1}
60kg N and 13.2 kg P ha^{-1}
60kg N and 17.6 kg P ha^{-1}
80 kg N and 8.8 kg P ha^{-1}
80kg N and 13.2 kg P ha^{-1}
80kg N and 17.6 kg P ha^{-1}

Each plot was 12m x 6m with 5 rows of melon plants grown at 1m x 1m spacing. At planting, three seeds were sown in each hole, and the seedling later thinned down to one plant per stand 2 WAS to give a population of 10,000 plants per hectare. The various fertilizer treatments were applied three weeks after sowing. Basal application of 30kg P + 30 kg K ha^{-1} to N treatments; 56 kg N + 30 kg K ha^{-1} to P treatments and 30 kg K ha^{-1} to the various N and P combinations treatments, applied at sowing.

Weeds were controlled by hoeing at 3 and 6 WAS. Insect pests and diseases were controlled by application of Ambush and Benlate at a rate of 500 g.ha^{-1} a.i., at 4 and 7 WAS, against fruit flies and anthracnose, respectively. Data were collected by destructive sampling method by randomly taking six plants per plot for measurement of vine length, number of vines, number of leaves and dry matter yield determination at 10 WAS. Days to 50% flowering, number of male and female flowers, number and weight of fruits, fruit diameter, and number of seeds per fruits, number and weight of seed per plant and per hectare were used to determine yield. The data collected were averaged across the two years since they are similar and analyzed statistically using SAS-GLM procedure (SAS, 1989) for analysis of variance (ANOVA). Differences among treatments means were compared using the least significant difference (LSD) at 0.05 probability level.

Results and discussion

Growth Parameters

The mean primary vine length, number of vines and leaves, and dry matter yield per plant of melon are presented in Table 1. N rate, P rate, and N by P interactions significantly improved melon growth. The growth parameters increased as the applied N rates increased from 0 up to 80kg N ha^{-1}. Similarly, the mean primary vine length, number of vines and leaves and dry matter yield increased as the applied P rates increased, but with no significant difference between 13.2kg and 17.6kg P ha^{-1}. All the growth parameters measured were influenced by the combined N and P fertilizers application with the highest mean values recorded at 80 kg N and 13.2 kg P ha^{-1}.

Table 1: Effect of N and P fertilizers application on the growth parameters of *Egusi* melon.

N & P level (kg ha^{-1})	Primary vine length (cm)	Number of vines	Number of leaves	Dry matter yield (g)
Control	220.5	22.5	260.2	77.6
N_{40}	285.6	38.4	370.0	115.3
N_{60}	341.0	50.1	455.0	126.5
N_{80}	405.5	65.5	691.5	165.5
Mean	313.2	44.1	444.2	121.2
$P_{8.8}$	260.5	36.0	325.5	96.7
$P_{13.2}$	271.5	40.9	365.0	99.5
$P_{17.6}$	325.3	44.7	388.6	123.7
Mean	285.8	40.5	359.7	106.6
N_{40} $P_{8.8}$	198.5	27.0	236.0	81.5
N_{40} $P_{13.2}$	219.0	29.5	286.8	87.0
N_{40} $P_{17.6}$	245.2	34.0	302.5	99.7
N_{60} $P_{8.8}$	259.6	39.4	337.0	99.8
N_{60} $P_{13.2}$	265.5	42.5	360.1	109.0
N_{60} $P_{17.6}$	278.0	45.8	372.0	120.5
N_{80} $P_{8.8}$	287.1	46.7	387.6	128.6
N_{80} $P_{13.2}$	289.0	49.0	401.2	126.0
N_{80} $P_{17.6}$	288.9	48.5	395.5	125.5
Mean	258.97	40.3	342.1	108.6
LSD (5%)				
Nitrogen (N)	24.56	1.56	9.00	4.26
Phosphorus (P)	24.56	1.56	9.00	4.26
NXP	54.50	9.15	10.51	68.41

Flower Production

The mean numbers of days to 50% flower production were significantly affected ($P \leq 0.05$) by the N and P fertilizers application (Table 2). As the level of N increased the number of days to 50% flower production decreased, but without any significant difference between 60kg N and 80kg N ha^{-1}. Similar trend was observed when P fertilizer was applied with the shortest number of days to 50% flowering recorded at 17.6kg P ha^{-1}. The combined application of 60kg N and 13.2kg P ha^{-1} fertilizers gave an earlier days to 50% flowering closely followed by 60kg N and 8.8kg P ha^{-1}.

The mean number of male and female flowers production increased significantly ($P \leq 0.05$) as the rates of N fertilizer increased from 0 up to 60kg N ha^{-1}, then declined slightly thereafter. Likewise, the application of P fertilizer significantly ($P \leq 0.05$) increased the mean number of male and female flowers with the maximum production at 17.6kg P ha^{-1}, but there was no significant difference between 13.2kg P and 17.6kg P ha^{-1}. Overall, the highest numbers of male and female flowers were recorded with the combined application of 60kg N and 13.2kg P ha^{-1}, while the least values were obtained at 40 kg N and 8.8 kg P ha^{-1}.

Table 2: Effect of N and P fertilizers application on the flower production of *Egusi* melon.

N & P level (kg ha^{-1})	Days to 50% flowering	Male flowers	Female flowersControl
Control	47.0	22.5	4.9
N_{40}	45.5	35.0	6.8
N_{60}	41.5	39.3	13.1
N_{80}	41.0	33.3	11.0
Mean	43.8	18.2	8.95
$P_{8.8}$	44.5	36.0	9.2
$P_{13.2}$	40.3	40.5	12.5
$P_{17.6}$	40.1	40.7	13.0
Mean	41.6	39.1	11.6
N_{40} $P_{8.8}$	44.5	39.0	9.9
N_{40} $P_{13.2}$	42.0	41.5	11.5
N_{40} $P_{17.6}$	42.7	39.7	13.8
N_{60} $P_{8.8}$	42.0	40.3	14.6
N_{60} $P_{13.2}$	41.4	42.6	16.5
N_{60} $P_{17.6}$	43.9	39.7	13.7
N_{80} $P_{8.8}$	45.8	35.0	13.4
N_{80} $P_{13.2}$	45.5	37.0	12.0
N_{80} $P_{17.6}$	45.5	35.5	11.5
Mean	43.7	38.9	12.98
LSD (5%)			
Nitrogen (N)	0.31	0.57	0.36
Phosphorus (P)	0.31	0.57	0.36
N x P	19.96	1.23	1.22

Yield components

The mean number of fruits weight, fruit diameter number of seeds, and seed yield per fruit significantly influenced by the N application with the highest values recorded with application of 60kg N ha^{-1} while the least values were obtained when no fertilizer was applied (Table 3). Similarly, these yield components significantly ($P \leq 0.05$) influenced by the applied P rates with the highest mean values obtained when 17.6 kg P ha^{-1} was applied, but with no significant difference between 13.2 kg and 17.6 kg P ha^{-1}. The yield components measured significantly ($P \leq 0.05$) increased as the combined N and P application rates increased from 0 up to 60 kg N and 13.2 kg P ha^{-1}, beyond which there was a decline.

Table 3: Effect of N and P fertilizers application on the yield and yield components of *Egusi* melon.

N & P level (kg ha^{-1})	Fruit Diameter (cm)	Number of fruits per plant	Fruit weight(g)	Number of seeds per fruit	Seed yield per fruit (g)	Seed yield per plant (g)	Total dry seed yield (tha^{-1})
N_0P_0	11.1	2.0	1.4	85.2	17.5	35.0	0.35
N_{40}	11.7	2.5	2.0	151.0	31.2	78.0	0.78
N_{60}	12.5	3.0	2.5	162.3	35.0	105.0	1.05
N_{80}	12.2	2.5	2.1	130.5	26.5	66.3	0.66
Mean	11.8	2.5	2.0	132.3	27.6	71.1	0.71
$P_{8.8}$	13.5	2.7	1.9	285.0	35.5	95.9	0.96
$P_{13.2}$	14.3	3.5	2.8	325.4	42.5	162.8	1.63
$P_{17.6}$	14.1	3.8	3.0	330.0	47.0	178.6	1.79
Mean	14.5	3.3	2.6	313.5	41.7	145.8	1.46
N_{40} $P_{8.8}$	12.0	2.8	2.3	195.2	24.7	69.2	0.69
N_{40} $P_{13.2}$	12.5	3.1	2.8	268.6	30.0	93.0	0.93
N_{40} $P_{17.6}$	13.6	3.5	3.4	281.5	34.8	121.8	1.22
N_{60} $P_{8.8}$	13.8	3.7	3.7	315.0	39.0	144.3	1.44
N_{60} $P_{13.2}$	14.1	4.8	4.2	355.5	46.5	204.0	2.04
N_{60} $P_{17.6}$	13.2	4.1	3.6	332.3	39.7	162.8	1.63
N_{80} $P_{8.8}$	12.7	3.8	3.2	315.7	37.0	140.6	1.41
N_{80} $P_{13.2}$	12.2	2.8	3.0	300.5	32.5	91.0	0.91
N_{80} $P_{17.6}$	12.0	2.5	2.9	245.0	30.1	75.3	0.75
Mean	12.9	3.5	6.5	289.9	34.9	122.4	1.20
LSD (5%)							
Nitrogen (N)	0.26	0.21	0.18	10.92	2.51	15.01	0.15
Phosphorus (P)	0.26	0.21	0.18	10.92	2.51	15.01	0.15
N x P	33.67	0.17	0.13	11.60	4.70	1.95	0.02

Seed yield

N rate, P rate and N by P interactions significantly ($P \leq 0.05$) affected melon seed yield (Table 3). Marketable melon seed yield increased with the increased rates of N fertilizer up to 60kg N ha^{-1}, then declined thereafter. The highest mean values were recorded for the seed yield per plant and total seed yield per hectare

at 60 kg N ha^{-1}. Likewise, the highest seed yield per plant and total seed yield were obtained when 17.6kg P ha^{-1} was applied. There was however no significant difference between the seed yield of melon obtained at 13.2kg P and 17.6kg P ha^{-1}. The influence of N and P fertilizers combination was significantly manifested on the marketable melon seed yield with the highest mean values, obtained when 60kg N and 13.2kg P ha^{-1} was applied. However, higher application of N and P fertilizers combination rates reduced the melon seed yield.

Nitrogen is highly needed for the good growth and yield of melon plants as earlier observed by Ogunremi (1978). The optimum rate of 60 kg N ha^{-1} obtained in this study is closely similar to what obtained by other Researchers (Anon, 1989; Usoroh, N.J., 1992). who reported 76kg N ha^{-1} for optimum yield of some vegetables in which egusi melon belongs. At National Horticultural Research Institute, Ibadan (NIHORT) fertilizer recommendation for melon has been 50kg N ha^{-1}, to boost vegetative growth. Anon (1986) suggested a side dressing of 100 kg ha^{-1} of sulphate of ammonia applied at flowering for enhanced reproductive growth.

The significant influenced of applied P rates on the dry matter yield and other growth parameters showed that the soils might be deficient or low in available P. This confirm the findings of Uyovbisere and Lombin (1990) that the widespread of P deficiency in the Nigerian savanna made it to be the most limiting nutrients for food crop production in this zone. The increase in dry matter production as the melon plants matures can be ascribed to the increase in the production of other growth parameters such as number of vines, vine length and number of leaves. This result is similar to that of Fagbayide (1997) who obtained increase in plant height and number of leaves of pepper, up to maturity. Dry matter yield and other growth parameters in melon increase as the rates of applied P increases up to the optimum at 13.2 kg P ha^{-1}, and thereafter declined. Mangal *et al*. (1985) also documented a significant influence in growth parameters of watermelon by P treatments.

The significant effects of applied P rates on the seed yield and yield components was in agreement with investigations of Singh and Naik (1989) and Fagbayide (1997). They reported that P application significantly increased yield and yield components of watermelon and peppers. Seed yield, and values for yield components significantly increased as P rates increased from 0 to 13.2kg P ha^{-1}, thereafter declined with further increase to 17.6kg P ha^{-1}. These results are in conformity with those obtained by Bhosale *et al.* (1978) regarding response of P fertilizer, where increasing the P rates increases the water melon yield up to a certain optimum fertilizer rate. The optimum P rates of 13.2kg P ha^{-1} obtained in this study is within the range of 8.8-17.6kg P ha^{-1} suggested by Enwezor *et al*. (1975) for tomato in the savanna soils of western Nigeria. This optimum rate is also very close to 11.9kg P ha^{-1} recommended by Anon (1989); and Usoroh (1992) for optimum yield of some vegetables to which egusi melon belongs.

The significant increase in the seed yield of melon from 0 kg N and 0 kg P ha^{-1} up to 60kg N and 13.2kg P ha^{-1}, application rate are in conformity with those obtained by Ibrahim *et al.* (1997) regarding response to combined application rates of N and P fertilizers where increased N and P fertilizer rates increased the fruit yield of watermelon to a certain optimum fertilizer rates. Son *et al.* (1986) reported increased in fruit yield of watermelon with a combination each of 40 kg ha^{-1} of N and P. Later on the yields were decreased with further increases in the fertilizer rates. Olaniyi [11] noted similar melon seed yield response to increased NPK fertilizer rates where *Egusi* melon yields were increased with an ever-increasing NPK rate and then leveled off after the optimum level was reached. Also, Rao *et al.* [26] observed a similar yield response with an increasing NPK rate then leveled off after the optimum level was reached. The reduction in the melon seed yield in this investigation after the optimum combined N+P fertilizer rates (60kg N + 13.2kg P ha^{-1}) might be due to over fertilization. The yield components also behaved in a similar manner that depicted their strong cumulative effect on grain yield.

Egusi melon responds positively to combined applications of N+P fertilizer rates with regard to growth and seed yield. Increasing N levels with increasing P levels increased seed yield up to the 60kg N + 13kg P ha^{-1} rate, which could be designated as the optimum. Thereafter, seed yield and yields components decreased due to over fertilizer application.

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