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The Influence of Poultry Manure Application and Plant Density on the Growth and Yield of *Egusi* Melon (*Colocynthis citrullus*) on the Nsukka Plains of South Eastern Nigeria

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ABSTRACT

A two year study, 1995 and 1996, was undertaken to assess the effects of poultry manure, plant density and their interaction on the yield and yield components of "egusi" melon (Colocynthis citrullus) under Nsukka ecological condtions of south - eastern Nigeria. It was observed that fruit production ha^{-1}, average fruit weight, 1000 - seed weight and seed yield ha^{-1} increased with increase poultry manure application giving seed yield increase of 51% and 41% for 5 and 10t ha^{-1} rates respectively over the 0 t ha^{-1} rate. It was also observed that higher plant density gave higher fruit and seed yields compared with low plant density. Seed yield was increased by 31% and 39% in the 10,000 and 40,000 plants ha^{-1} densities compared with the 4444 plants ha^{-1} in 1995 and similarly by 41% and 60% in 1996. High plant density and increasd poultry manure application also enhanced plant development as was measured by days to 50% flowering, lenght of stem and number of branches plant at 30 days after planting. Poultry manure x plant density (MxD) interaction was significant in fruit and seed production and this showed a trend of increased fruit and seed yield as poultry manure use was increased with increased plant density rates.

Key words: "Egusi" melon, poultry manure, plant density.

INTRODUCTION

The "egusi" melon (*Colocynthis citrullus*) is a member of the cucurbitaceae family. It is a native of Africa where it has been in cultivation for many centuries (Cobley, 1957). The "Egusi" melon seed like soyabean (*Glycine max*) is rich in oil (53.1%) and protein (33.8%) (Okigbo, 1975). In Nigeria, the seeds are prepared into different types of condiments used especialy in soup making. The seed after shelling, can be fermented to prepare "Ogiri" (Igbo) which is a highly proteinous condiment for making soup. The peeled seeds are also ground and used in thickening and enriching soup and stew. The seed oil is commonly extracted and used for cooking.

In spite of the enormous uses and nutritional qualities of this crop, there is a dearth of information on its agronomy. To achieve increased production of this crop, necessary cultural practices have to be evolved and adopted. Plant density is one of the factors that influence yield and yield components. Evidence is replete in literatures, that increased plant density increased yield per unit area of land for a number of crops (Squire, 1990, Ofori and Stern,1987). There is also the need to evaluate the effect of poultry manure on this crop to evolve optimum rates for use by the local 'egusi' farmers under Nsukka ecological conditions. Continual depletion of soil fertility through erosion and leaching underscores the need to investigate means of sustaining the soil. Poultry manure is known to supply many plant nutrients to the soil as well as improving the soil structural conditions. Ogunremi (1978) has shown that fruit and seed yield ha^{-1} of egusi melon were significantly increased by applying nitrogen (N) up to 48 kg N ha^{-1} beyond which yield dropped significantly. Therefore, the objectives of this study are:

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1. to determine the optimum plant density for optimum seed yield of egusi melon.
2. to determine the optimum rate of poultry manure appliction for optimum seed yield, and
3. to asses the plant density x poultry manure interaction.

Materials and Methods

The experiments were carried out on April 2, 1995 and April 2, 1996 in the Department of Crop science experimental farm, University of Nigeria, Nsukka (06E 52" N, 07E24' E and altitude 447m). The 'egusi' melon cultivar used was purchased from a local 'egusi' farmer from Nsukka, Enugu State, Nigeria.

Poultry manure was of the deep litter system and was in dry condition at purchase. The land was ploughed and harrowed and later prepared manually into beds.

1995 Experiments

The experiment consisted of three levels of poultry manure (0,5 and 10 t ha $^{-1}$) and three plant densities of 40,000, 10,000 and 4444 plants ha^{-1} at their respective spacings of 0.5m x 0.5m, 1.0m x 1.0m and 1.5m x 1.5m. These were laid out as a 3x3 factorial experiment in randomised complete block design (RCBD) of four blocks. Each block was divided into nine plots each measuring 6m x 3m and each plot was separated from the adjourning plot by a space of one metre. The seeds were hand sown at the rate of one seed per hole on the flat.

Two weedings were carried out throughout the duration of the crop in the field. The first was done manually with hoe three weeks after planting and the second was done by hand pulling at the fifth week after planting since hoe weeding at that stage would damage the vines that had extensively established.

Harvesting was done when the vines had all senesced. The fruits were gathered according to the treatments, cut open with matchet, heaped together and then covered with dry grasses to enhance fermentation of the mesocorp tissue for easy extraction of the seeds. After fermentation, the seeds were extracted and were washed with copious water. The cleaned seeds were collected and sun-dried and weighed.

1996 Experiment

The 1996 experiment unlike the 1995 experiment was on effect of plant density only and a rate of poultry manure at 5t ha^{-1} was used on the three plant density treatments. The remnant of the seed lot for the 1995 experiment still gave 95% germination and was used in the 1996 planting. The experiment was laid out in a RCBD of four blocks, each divided into three plots.

Data collected in both 1995 and 1996 experiments were days to 50% seedling emergence, days to 50% flowering, length of stem and number or branches per plant at 30 days after planting (DAP), number of fruits ha^{-1}, fruit yield ha^{-1} (kg), average fruit weight (kg), 1000 - seed weight (g) and seed yield ha^{-1} (kg).

Weather Data

Concomitant obervations included; the rainfall, relative humidity and temperature data at Nsukka during the 1995 and 1996 planting seasons which were collected from the Faculty of agriculture meteorological station (N0. 0607.52^{n}) some 400 metres from the experimental site.

Statistical Analysis

The analyses were done according to the procedures outlined by Steel and Torrie (1980) and Obi (1995) for factorial experiments. Separation of treatment means for statistical significance was by the F-LSD procedures, (Obi, 1986).

RESULTS

Weather Information

Considering the periods of these experiments, April to July, 1995 and 1996, higher amount of rainfall was recorded in 1995 than in 1996 (Table 1). The rain, however, was better distributed in the months of April and May 1996,

Table 1: Summary of total rainfall (mm) raindays, morning (0600hr) and evening (1800hr) relative humidities (%) and the daily minimum (min) and maximum(max) temperatures for the two years, 1995 and 1996.

Weather Record 1995	Jan.	Feb.	Mar	April	May	June	July.	Aug.	Sep.	Oct	Nov	Dec.
Rainfall (mm)	0.0	0.3	121.7	128.6	172.8	324.5	255.7	414.0	225.8	143.0	88.1	0.0
Raindays	0.0	1.0	4.0	7.0	11.0	15.0	18.0	24.0	19.0	14.0	2.0	0.0
Relative Humidity												
0600 Hr.	62.5	62.5	79.5	80.0	79.5	81.0	80.5	80.5	80.5	80.5	78.0	65.5
1800 Hr.	51.0	50.0	65.5	69.0	73.0	78.0	76.0	76.0	75.5	73.0	65.5	52.0
Temperatures(Ec)												
Min.	13.5	18.0	22.0	22.0	21.0	20.5	20.5	20.0	20.5	20.5	17.0	16.5
Max.	31.0	33.0	31.0	31.0	29.0	28.5	26.5	26.0	29.0	30.0	31.0	31.5
1996 Rainfall (mm)	34.5	14.2	86.7	104.3	135.1	140.5	137.8	219.6	226.4	96.9	17.0	0.0
Raindays	1.0	5.0	4.0	8.0	14.0	13.0	15.0	22.0	22.0	16.0	1.0	0.0
Relative Humidity												
0600 Hr	78.0	74.5	74.5	74.5	74.0	74.5	75.0	77.5	80.5	80.5	77.5	80.5
1800 Hr	57.0	61.5	66.0	67.0	70.0	72.0	72.0	75.0	73.5	74.0	65.0	55.5
Temperature(Ec)												
Min.	19.0	21.5	22.5	22.5	21.0	21.0	19.5	20.5	20.5	20.0	17.0	17.0
Max.	31.5	32.5	31.5	31.0	30.5	29.0	28.0	26.0	28.0	29.0	30.5	29.0

Table 2: Mean effects of poultry manure and plant density and their interaction on the growth and development attributes of the crop.

	Poultry Manure	Plant Densities (Plants ha^{-1})			
	Rates (Kg ha^{-1}	4,444	10,000	40,000	Mean
Days to 50%	0	10.50	9.00	10.00	9.83
Seedling	5	10.75	8.75	10.00	9.83
Emergence	10	11.00	10.25	10.00	10.42
	Mean	10.00	9.33	10.75	10.03
F-LSD(P = 0.05) for comparing plant density means = 0.83					
Days to 50%	0	38.75	36.25	36.75	37.25
Flowering	5	40.00	36.50	37.25	37.92
	10	40.25	35.50	37.25	37.67
	Mean	39.67	36.08	37.08	37.61
F- LSD(P = 0.05) for comparing plant density means =1.85					
Length of	0	91.31	119.24	139.75	116.77
Stem(cm) at	5	139.13	168.43	176.56	161.37
30 DAP	10	116.00	163.69	173.90	151.20
	Mean	115.48	150.45	163.40	143.11
F-LSD(P=0.05) for comparing plant density means = 24.06					
F-LSD(P=0.05) for comparing poultry manure rate means = 24.06					
F-LSD(P=0.05) for comparing M X D interaction means =41.67					
Number of	0	3.75	4.50	4.00	4.08
branches/	5	5.75	6.00	4.50	5.42
plant at 30	10	4.00	6.50	5.75	5.42
DAP		4.50	5.67	4.75	4.97
F-LSD(P=0.05) for comparing plant density means = 0.82					
F-LSD(P=0.05) for comparing poultry manure rate means = 0.82					

but at the later months of June and July distribution was better in 1995. The atmosphere was also more humid in 1995 them in 1996, and temperature variation between the years was minimal.

1995 Experiments

Growth and Development Parameters

Poultry manure had no statistically significant effects on days to 50% seedling emergence while the effects of planting density was not consistent (Table 2). Number of days to 50% flowering was not significantly affected by poultry manure application. Planting at low density significantly increased number of days to 50% flowering. The poultry manure x plant density interaction had no significant effect on this attribute. It was also observed that the application of 5 t ha^{-1} rate of poultry manure significantly increased stem length compare with when manure was not applied. Further increase in the application of poultry manure to 10 t ha^{-1} had no further significant effect. Increased plant density resulted to significant increase in stem length, hence planting at 40,000 plants ha^{-1} resulted in the production of stem length that was higher than what was obtained from 10,000 plants ha^{-1}. The lowest value was obtained from 4,444 plants ha^{-1} treatment. A significant poultry manure x plant density interaction indicated increasing stem length as poultry manure

application and plant density were increased; however longest stem length was obtained when planting was done at 40,000 plants ha^{-1} with 5t ha^{-1} rate of poultry manure. The result also showed that the application of 5t and 10t ha^{-1} rates of poultry manure gave the same number of branches per plant, the values of which were significantly higher than the value obtained where no poultry manure was applied. Similarly planting at the highest density of 40,000 plants ha^{-1} and the lowest of 4,444 plants ha^{-1} produced the same number of branches per plant which were significantly lower than what was produced when planted at 10,000 plants ha^{-1}.

manure gave the highest number of fruits ha^{-1} and was significantly higher than the values obtained when 0 or 10 t ha^{-1} rates was applied. Number of fruits ha^{-1} increased significantly with increased plant density hence highest value was obtained from the highest plant density of 40,000 plants ha^{-1} while the least was obtained from the 4,444 plants ha^{-1} density. Significant poultry manure x plant density interaction effect showed that the application of 5t ha^{-1} rate of manure produced the highest number of fruits at the higher plant density levels, while at the lower planty density, increased application of manure resulted to lower number of fruits ha^{-1}. The

Table 3: Mean effects of poultry manure and plant density and their interaction on the yield attributes of the crop.

Poultry Manure Rates (Kg/ha)		Plant Densities (Plants ha^{-1})			
		4,444	10,000	40,000	Mean
Number of fruits ha^{-1}	0	37639	40833	58472	45648
	5	37500	46806	73750	52685
	10	30277	43194	69167	47546
	Mean	35139	43611	67130	48626
F-LSD(P=0.05) for comparing plant density means = 5081					
" " " " " poultry manure rate means = 5081					
" " " " " M x D interaction means = 8801					
Fruits yield ha^{-1} (kg)	0	33272.22	38130.00	44315.28	38572.50
	5	45166.67	44647.64	54888.89	48234.39
	10	35123.75	48780.56	56512.50	46805.60
	Mean	37854.21	43852.73	51905.56	44537.50
F-LSD(P=0.05) for comparing plant density means =2023.67					
" " " " " Poultry manure rate means =2023.67					
" " " " " M x D interaction means =3505.09					
Average fruit weight (kg)	0	0.88	0.93	0.76	0.85
	5	1.21	0.93	0.74	0.96
	10	1.15	1.13	0.82	1.03
	Mean	1.08	1.00	0.77	0.95
F-LSD(P=0.05) for comparing plant density means = 0.101					
" " " " poultry manure rate means = 0.101					
" " " " M x D interaction means = 0.0175					
1000-seed weight(g)	0	111.03	111.38	113.18	111.86
	5	121.20	117.38	117.43	118.67
	10	109.90	124.03	120.23	118.05
	Mean	114.04	117.59	116.94	116.19
F-LSD(P=0.05) for comparing poultry manure rate means=5.39					
" " " " M x D interaction means = 9.34					
Seed yield ha^{-1} (kg)	0	335.38	451.14	447.92	412.15
	5	571.11	609.96	696.77	625.95
	10	407.87	655.09	677.92	580.29
	Mean	438.12	572.06	608.20	539.46
F-LSD(P=0.05) for comparing plant density means = 91.34					
" " " " poultry manure rate means = 91.34					
" " " " M x D interaction means = 158.21					

Yield and Yield Parameters

Application of 5t ha^{-1} rate of poultry

highest number of fruits ha^{-1} was produced when 5 t ha^{-1} manure rate was used on 40,000 plants

ha^{-1}. Further increase of manure application to 10t ha^{-1} decreased number of fruits ha^{-1} in all plant denstiy levels.

Fruit yield ha^{-1} was significantly increased with increasing poultry manure rates. Increased plant density also increased fruit yield of 4,444 plants ha^{-1} highest average fruit weight was produced from 5t ha^{-1} manure rate which was also the highest value obtained among all the combinations.

Application of 5t ha^{-1} of poultry manure significantly increased 1,000 - seed weight

Table 4: Effect of plant density on the attributes of egusi melon growth, development and yield in 1996. Growth, development and yield measurements.

Plant density (plant ha^{-1})	Days to 50% seedling emergence	Days to 50% flowering	Length of stem(cm) at 30 DAP	Number of branches/ plant at 30 DAP	Number of fruits ha^{-1}	Fruit yield ha^{-1} (kg)	Average fruit weight (kg)	1000 seed weight (g)	Seed yield ha^{-1} (kg)
4,444	7.50	37.25	94.58	4.33	21944	21083.33	0.97	112.22	409.93
10,000	8.00	38.50	80.92	4.67	29444	29388.89	0.96	109.99	577.64
40,000	7.75	36.50	61.50	3.67	40,000	31986.11	0.81	109.99	654.64
F-LSD (P=0.05)	-	-	14.02	-	-	-	-	-	-

ha^{-1}. There was significant interaction effect of poultry manure and plant density on fruit yield ha^{-1} (kg) and this showed a trend of increased fruit yield wih increased plant density and poultry manure rates, hence the highest fruit yield was recorded when planting was made at 40,000 plants ha^{-1} with 10 t ha^{-1} rate of poultry manure while the lowest fruit yield was obtained from the lowest plant population with zero rate of poultry manure.

Weight per fruit increased with increasing manure rates although statistical significance was not established for the value obtained with 5 t compared with 10 t per hectare of poultry manure. Similarly weight per fruit increased with decreasing planting density while the values for 10,000 and 4,444 plants per hectare did not differ statistically. The significant poultry manure x plant density interaction observed showed a trend of consistent increase in average fruit weight with increased poultry manure rate at the higher plant density levels of 40,000 and 10,000 plants ha^{-1} while at the lowest plant population compared with where no manure was applied. However, application of 10 t ha^{-1} manure did not produce any further increase in seed weight over where 5 t ha^{-1} rate was applied. The poultry manure x plant density interaction showed that the combination of 10 t ha^{-1} rate poultry manure and 10,000 plants ha^{-1} gave the highest 1000 - seed weight followed by the value obtained from the combination of 5 t ha^{-1} manure rate and 4,444 plants ha^{-1}. The least value was obtained when planting was made at 4,444 plants ha^{-1} with 10 t ha^{-1} manure rate.

Seed yield was always significantly increased by the application of poultry manure, although there was no siginificant difference between the values obtained with the use of 5t and 10t ha^{-1} poultry manure. Similarly, increasing plant population increased seed yield although values obtained with planting at 40,000 and 10,000 plants ha^{-1} were statistically similar. The significant poultry manure x plant density interaction observed showed a sequence of increasing seed yield with the application of

poultry manure and increasing plant density. The highest seed yield, however, was obtained where 5t ha^{-1} rate of poultry manure was used at 40,000 plants ha^{-1}, and was followed by the combination of 10t ha^{-1} rate of manure and 10,000 plants ha^{-1}. The least value was obtained when planted at 4,444 plants ha^{-1} with no manure usage.

1996 Experiments

There were no significant differences in the effects of plants densities on all the attributes measured in 1996 except that of length of vine at 30 DAP (Table 4). Average vine length of plants were highest with low plant density, while the values did not differ significantly with 40,000 plants ha^{-1} compared with the population of 10,000 plants ha^{-1}. Although differences in fruit yield values did not attain statistical significance, the higher plant populations gave higher yield values of 39.4 - 52% for fruit yield ha^{-1} and 34 - 82% for fruit number, higher than what were obtained at the lowest plant population. Seed yield was similarly affected, hence the higher plant populations gave higher yield values of 41% - 59.7% than what was produced at the lowest plant population.

DISCUSSION

The lack of effect of poultry manure on seedling emergence showed that soil nutrient may not be a major factor affecting seed germination. Possibly such other soil factors as moisture, aeration and temperature may have more influence on seed germination. Fakorede (1983) reported that moisture availability was one of the most important factors affecting the germination of maize. Flowering in crops has also be shown to be influenced by climatic factors such as temperature and relative humidity (Shaw and Thom, 1951). The non-significant effect of poultry manure on this attribute may be attributed to the fact that these climatic factors had an overwhelming influence, thereby masking the effect of the applied manure.

The increased stem length and number of branches per plant observed in the crop as a result of increased application of poultry maure was made possible by nutrients being released by the poultry manure (Gupta *et al.*, 1983).

The high fruit and seed yield resulting from manure application also suggested the positive response of the crop to nutrients supplied by poultry manure. This seems to suggest that the soil was low in fertility which was in accordance to the report by Tisdale and Nelson, (1975), that crops respond more to nutrient application in a soil with very low nutrient status than soil with high reserve. It was also noted that 5t ha^{-1} rate of manure caused greater crop growth, fruit and seed yield than the 10t ha^{-1} rate, and this may be an indication that adequate quantities of nutrient elements were supplied by the 5t ha^{-1} rate. Ogunremi (1978) recorded a similar decrease in fruit and seed yield when nitrogen (N) was increased above 48kg ha^{-1}. The decline in yield observed at the 10t ha^{-1} rate of poultry manure may also be attributed to the accumulation of toxic materials such as copper. In fact Tisdale and Nelson (1975) have noted the accumulation of copper in the soil as one of the problems of excessive use of poultry manure.

The contribution of high plant density on early attainment of 50% flowering may be attributed to the moisture conserving posture of the high populated plot which was beneficial during that period of the year when moisture was a limiting factor. This also contributed to the production of longer stems and higher number of branches per plant at 30 days after planting.

The significant increase in fruit and seed yield which resulted from increased plant population was in conformity with the findings of Squire (1990), Ofori and Stern (1987) and Bolton (1971) in other crops. It was however noted that the increase in fruit production caused by increased plant density was in the expense of average fruit weight which decreased significantly with increased plant density.

The production of highest fruit and seed yields from the use of 5t ha^{-1} rate of poultry manure at 40,000 plants ha^{-1} implies that these levels of the treatments were adequate for optimum Egusi melon production in this area. On the other hand, average fruit weight was highest at the lowest plant density with 5t ha^{-1} rate of poultry manure. In Egusi melon production, seed yield rather than fruit size, is of major important, therefore the levels of these

treatments that supported high seed yield should be recommended.

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