



Effect of Proximate Space and Sources of Manure on the Yield of Egg Plant (Garden Egg) (*Solanum melongena*) in Ishiagu, Ebonyi State, Nigeria

by

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Abstract

*Proximate space and four sources of manure were studied to show the yield of eggplant (*Solanum melongena*) in Ishiagu, Ebonyi State of Nigeria in the 2017 cropping season. NPK fertilizers (15:15:15), swine, goat and poultry droppings were used as the inorganic and organic treatments with plot a size of 2m x 2m and a spatial distance between the plots being 0.5m. Each block was separated from the other by 1m with the experimental size being 10m x 12m (120m²) laid out in a Randomized Complete Block Design (RCBD) comprising 5 treatments that were replicated 3 times to a total of 15 plots. A total weight of 0.6kg was applied for all organic manure while 20kg was for the fertilizer. A seedling was planted per hole at a depth of 2cm and a planting distance of 50cm x 50cm for both intra-row and inter-row. Results from the ANOVA for each stage of the 5 harvests are that statistically significant variations in yield were recorded for organic manure comparatively across the treatments and replicates. The use and application of organic manure are encouraged with increased economic returns and less input following the problems associated with the use of inorganic manure.*

Key words: eggplant, manure sources, proximate space, ANOVA, Ishiagu

1. Introduction

Eggplant (*Solanum melongena*) is an annual plant that is well branched and erect with its varieties grouped according to the similarities of use, appearance, morphology and environmental sensitivity. It is a vegetable (both fruit and leafy) that is grown mainly for its fruits that are utilized in various ways around the world. According to Edgew and Rovbo (1989), the local eggplant known as 'Anara' in Igbo, 'Igba' in Yoruba and 'Guata' in Hausa

is widely grown in Nigeria in commercial quantities. In southern Nigeria, the oval or zebra coloured or striped varieties are common particularly in the east especially Ngwa, Umuahia and Enugu and popularly called the 'Ngwa large' because of its origin and size.

Eggplant develops best under conditions of high temperature, abundant light and water. Below 20°C and 40°C growth and fruit sets are reduced while the plant dies when temperature drops below 10°C and above 20°C. The adaptation of cultivars to specific environments is demonstrated when they are cultivated outside the area to which they were selected. Tropical cultivars grown in temperate climate often display slow vegetative growth, late flowering and fruit sets but their growth potential is rapid and therefore vegetative development is weaker than when grown elsewhere. Also, cultivars bred in winter in green houses in Europe often perform poorly under open field conditions in summer. According to Greenisil (1965), it is now widely grown both in the tropics and the sub-tropical zones of the world. In the tropics, it grows to a height of 60-120cm and may bear many fruits which are oval in shape.

As a green plant, eggplant (garden egg) supplies essential mineral elements and vitamins such as riboflavin required for good health. It contains only little fat and protein. It acts as a roughage whose leaves can be eaten fresh or cooked and recommended to patients with blood shortages. Eggplant contains the following nutrients; water (90g), protein (1g), carbohydrates (7g), calcium (14g), fats (0.2g), fibre (1.3g), ascorbic acid (9mg), phosphorus (26mg), iron (1.3mg), niacin (5mg), thiamine (0.07mg) and harotens (3.4mg).

As Nigeria is shifting to a form of business through agriculture, crops which hitherto were regarded as minor crops that were planted only by women are increasingly being accorded proper recognition in the nation's farming systems. It has become clear that some of these crops could yield higher revenue to farmers than the recognised roots, tubers and grains (Unanma, 1992). This increasing awareness has been shifted to eggplant as a major employer of labour and revenue earner for most rural families with cultivation world-wide in two main production regions as Asia and the Mediterranean. Also it is estimated that that 800 million people are engaged in urban agriculture world wide of which 200 million are considered to be market producers employing 150 million people full time (RUAF Foundation, 2007; Enete and Achike, 2008).

Soil fertility maintenance is essential in achieving and maintaining high crop yields over a period of time. In this regard, fertilizer application (inorganic manure) has usually been the major means of supplying plant nutrients due to the convenience and increased yield impact of its use. In the same vein, several organic materials have been reported as suitable soil amendment for increasing crop production (Obi and Ebo, 1995). The application of these materials as fertilizer provides growth regulating substances, increases yield and improves the physical, chemical, structural and microbial properties of the soil (Kang et al, 2002). Synthetic fertilizers are commonly used for growing all crops with application rates depending on the soil fertility rates usually measured by a soil test according to the particular crop. Nutrients in the soil can be thrown out of balance with concentration of fertilizers while stability of the system is reduced by the use of nitrogen containing fertilizers which causes soil acidification. On the other hand, Asiegbu and Uzo (1984) reviewed the use of organic manure and noted that when properly applied it benefits fruiting eggplant and generally enhances size, height and number of branches and leaves. Compost and farmyard manure in several trials gave the most effective method of improving and maintaining the soil fertility while pig and poultry which inject concentrate

feeds produce relatively higher phosphorus content and other valuable soil nutrients than goat and cattle which consume only forage grasses (Aduayi and Ekong, 1981).

In essence, organic manure which is a valuable product has not been extensively explored following some near space demands since no part of the earth's surface exhibits the same characteristics in time. The various spatial differences in soil physico-chemical properties, aeration, moisture and temperature occasioned by proximity are part of the effects that crops react to in their various stages of development and yield. It is worthy of note that commercial fertilizers are necessary to furnish limiting elements in the most economical feeding zones and to maintain proper ratio of the nutrient for the particular variety being grown. Recently it was discovered that the high cost of inorganic manure (fertilizers) is a major constraint to rural farmers who cannot afford their increasing costs. Regrettably, inadequate knowledge of the use of organic manure and space are problems confronting eggplant (garden egg) farmers. It is against this backdrop that the high cost of inputs especially inorganic manure (fertilizers) can be cushioned through a careful study of the relative application of organic manure in Ishiagu, Ebonyi State Nigeria. In addition, Thompson (1966) noted that the plant can be adapted to a wide range of soils, but fertile sandy loam soil rich in organic matter is preferred.

2. Objectives of the Study

The objectives are;

- i) to examine the yield of egg plant (garden egg) using four sources of manure
- ii) to quantify statistical variations in yield across the various treatments in the area.

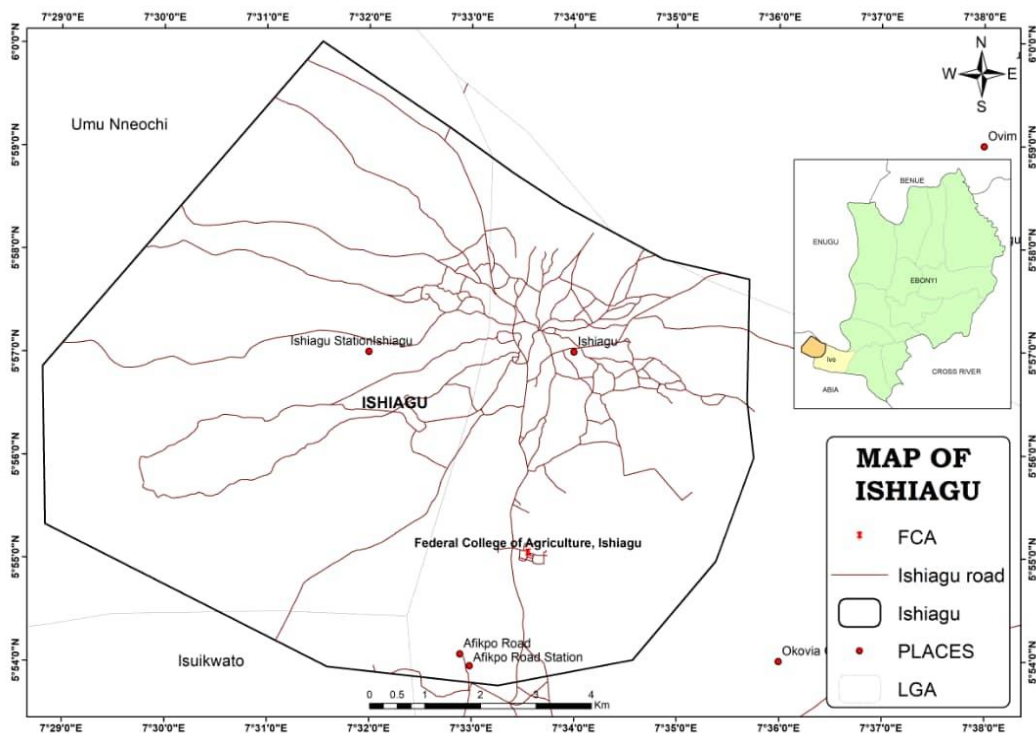
3. Hypothesis

Ho: There is no statistically significant variation in the yield of egg plant (garden egg) across the treatments and replicates.

4. Study Area

The research was conducted at the students' research farm of the Federal College of Agriculture, Ishiagu during the 2017 cropping season. The college experimental site is located at 5^o29'N of the equator and 7^o33'E of the Greenwich Meridian of the derived savannah of south-eastern Nigeria with mean annual rainfall of 1350mm; an average humidity of 88% in the wet season and a mean annual temperature of 28.5^oC with a gently sloping topography.

5. Materials and Methods



The variety of eggplant, the Ngwa large was sourced from the Federal College of Agriculture Ishiagu farm while the manure sources used included the inorganic fertilizers (N.P.K: 15:15:15), swine, goat and poultry droppings. The plot size was 2mx2m with a spatial distance between each plot as 0.5m. The plots were separated from each other by a space of 0.5m while each block was separated from each other by a space of 1m. The experimental size was 10mx12m (120m²) laid out in a Randomized Complete Block Design (RCBD) comprising five treatments which were replicated three times giving a total of fifteen plots.

For the organic manure (swine, goat and poultry) weights ranged the same for each treatment except for the control and NPK (15:15:15). This is shown thus:

T₁ – Goat droppings

T₂ – Swine Droppings

T₃ – Poultry Droppings

T₄ – NPK (15:15:15)

T₅ – Control (No treatment)

1ha = 10,000m²

∴ 1m² = 6/10000 x 1000

Therefore; 0.6kg was applied for all treatments except the NPK and control hence for fertilizer = 10,000m² = 200kg (NPK)

∴ 1m² = 200/10000 x 1/1 x 1000g

= 20kg

During transplanting, the seedlings were uprooted with a ball of soil from the nursery where they were raised with one seedling planted per hole at a depth of 2cm at a

planting distance of 50cm x 50cm in both intra-row and inter-row. Each plot had a total plant population of sixteen stands with a total plant population of two hundred and forty stands (240). The organic manure treatments (goat, swine and poultry droppings) were applied on all plots with the same organic manure weights of 0.6kg with uniform spread, placing and incorporation into the soil while the NPK was applied two weeks after transplanting. Other agronomic practices like weeding and pest control were done regularly to avoid distortion in yield and reading. The main parameters that were observed and recorded included; mean number of fresh fruits per stand and mean weight of fresh fruits. Data collected were analysed with mean scores of fruits from their weights after each harvest. The various scores of weights following the treatments were analysed with the Analysis of Variance to justify any statistically significant variation in the effects of the various treatments on the yield of the plant. The ANOVA is given by:

$$\frac{\Sigma\Sigma \times ij}{ij} - eq.1$$

$$\frac{\Sigma\Sigma \times^2 ij}{ij} - eq.2$$

$$TSS = \frac{\Sigma\Sigma \times^2 jk}{jk} - \frac{(\Sigma\Sigma \times jk)^2}{jk N} - eq.3$$

$$CSS = \Sigma \frac{(\Sigma \times jk)^2}{jk n} - \frac{(\Sigma\Sigma \times jk)^2}{jk N} - eq.4$$

$$ESS = TSS - CSS$$

where; TSS = Total Sum of squares

CSS = Column Sum of Squares (between)

ESS = Error Sum of Squares (within)

6. Results and Discussion

From the mean weight analysis T₃ (Poultry droppings) recorded the highest from the total number of fresh fruits harvested (35 gms) followed by T₂ (Swine droppings) which recorded 30gms. Goat droppings T₁ recorded 26.67gms while the NPK 15:15:15 and control showed 8.33gms and 6gms respectively for the first harvest (table 1).

Table 1: Mean weight of fresh fruits for various harvests

Harvest (\bar{x})	T ₁	T ₂	T ₃	T ₄	T ₅
First	26.67	30	35	8.33	6
Second	70	81.67	56.67	20	10
Third	103.33	113.33	78.33	31.67	10
Fourth	68.33	93.33	73.33	30	10
Fifth	16.67	36.67	15	11.67	3.33

Source: Author's field work, 2017

For the mean weight of fruits at second harvest, T₂ (swine droppings) recorded the highest with 81.67gms while T₁ (goat droppings) followed with 70gms. T₃ (poultry droppings) gave a mean weight of 56.67gms. Fertilizer and the control were 20gms and 10gms respectively (table 1). At the third harvest the mean weight of fruits for the treatments were T₂ (swine droppings) 113.33gms; T₁ (goat droppings) 103.33gms and T₃ (Poultry droppings) 78.33gms while the NPK 15:15:15 and control recorded 31.67gms and 10gms respectively (table 1).

In table 4, T₂ (swine droppings) recorded the highest with 93.33gms; T₃ (poultry droppings) 73.33gms and T₁ (goat droppings) 68.33gms. The NPK 15:15:15 fertilizer and control recorded 30gms and 10gms respectively all for the fourth harvest. In the fifth harvest the mean weights of fruits for the various treatments recorded were in this order; T₂ (swine droppings) 36.67gms; T₁ (goat droppings) 16.67 and T₃ (poultry droppings) 15gms. The NPK and control recorded 11.67gms and 3.33gms (see table 1).

In addition, the various weights for yield were subjected to ANOVA to justify statistically significant variations across the various treatments. In table 2, the test statistic gave a value of 6.19 with the critical value at 4 and 10 degrees of freedom being 3.48, at 0.05 level of significance. Ho: was rejected showing a statistically significant variation in the yield of the plant across the treatments. This conclusion was supported by the mean weights of fresh fruits at first harvest with the organic manure showing better performance.

Table 2: ANOVA result for yield of first harvest

Square of variations	Sum of squares	D	F	Mean sum of squares	F
Between columns (CSS)	2 0 8 3 . 0 6 4			5 2 0 . 7 7	6.19
Within columns (ESS)	- 8 9 0 . 7 1		0	- 8 4	
T o t a l	1 2 4 2 . 4 1		4		

For the second harvest, Ho: was not rejected at 0.05 level of significance since f-value of 1.8563 was less than the critical value of 3.48. There was therefore no statistically significant variation in yield across the treatments. Statistically the yield across the treatments is the same (table 3).

Table 3: ANOVA result for yield of second harvest

Square of variations	Sum of squares	D	F	Mean sum of squares	F
Between columns (CSS)	2 4 2 7 6 . 6 5 4			6 0 6 9 . 1 6	1 . 9 0 7 5
Within columns (ESS)	3 1 8 1 6 . 6 8 1 0		0	3 1 8 1 . 6 7	
T o t a l	1 5 6 0 9 3 . 3 3 1		4		

Table 4 result is that there was no statistically significant variation in the yield of the plant across the treatments. Ho: was not rejected as f-tabulated 3.48 is greater than f-calculated 1.9075 at 0.05 level of significance. In essence the yield of the plants for the third harvest across the treatments and replicates is statistically the same.

Table 4: ANOVA result for yield of third harvest

Square of variations	Sum of squares	D	F	Mean sum of squares	F
Between columns (CSS)	2 4 2 7 6 . 6 5 4			6 0 6 9 . 1 6	1.9075
Within columns (ESS)	3 1 8 1 6 . 6 8 1 0		0	3 1 8 1 . 6 7	
T o t a l	5 6 0 9 3 . 3 3 1 4				

In table 5 (fourth harvest), no statistically significant variation in the yield of fruits from the various treatments was established since; f-calculated value of 2.63267 is less than the tabulated value of 3.48 hence accepting the null hypothesis at 95% confidence level.

Table 5: ANOVA result for yield of fourth harvest

Square of variations	Sum of squares	D	F	Mean sum of squares	F
Between columns (CSS)	1 3 8 9 9 . 9 9	4		3 4 7 4 . 9 9	2.63257
Within columns (ESS)	1 3 2 0 0 . 0 1	1	0	1 3 2 0 . 0 0 1	
T o t a l	2 7 1 0 0 1 4				

In table 6, result gave a statistically significant variation in yield with organic manure droppings, goat droppings and poultry droppings showing better performance. In essence, swine droppings had the highest yield among the three while the control and inorganic manure (NPK 15:15:15) had the least yields. The null hypothesis was rejected as f-calculated was greater than the critical value at 95% confidence level.

Table 6: ANOVA result for Yield of fifth harvest

Square of variations	Sum of squares	D	F	Mean sum of squares	F
Between columns (CSS)	2 4 9 9 . 9 8	4		6 2 4 . 9 9 5	6.356
Within columns (ESS)	9 8 3 . 3 6	1	0	9 8 . 3 3 6	
T o t a l	3 4 8 3 . 3 4 1 4				

7. Conclusion and Recommendations

From the general results, organic manure showed better performance in the yield of garden eggs across the replicates and treatments in Ishiagu. The huge spending on inorganic manure/fertilizers does not equate with the economic returns that accrue from this venture when the organic manure with less amount has better performance. This is common in Ishiagu where peculiarities in climatic and soil conditions have shown good yield.

In other areas with similar climatic and edaphic factors, garden egg production should thrive under the application of various grades of organic manure considering the ideal space standards especially between and within rows since variations occur from one space to the other as a result of prevailing environmental changes. In the area of pests, an agronomic surveillance is recommended to ward off losses from such areas including human pests.

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