RESEARCH ARTICLE

RESPONSE OF GBOMA EGGPLANT TO NITROGEN FERTILIZATION IN MINNA SOUTHERN GUINEA SAVANNA OF NIGERIA

Afolabi, S.G.^{a*}, Davidson, J. O.^a, Ibrahim, H.M.^b, Tijani, A. T.^a, Adeboye, M.K.A.^a.

^a Department of Soil Science and Land Management, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Nigeria.

^b Department of Crop Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Nigeria.

*Corresponding Author Email: afolabi.gbolahan@futminna.edu.ng, ooreoluwa14@gmail.com

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ABSTRACT

Gboma eggplant is ranked as third most important crop from *solanaceae* family with a world production of 32 million tonnes. A pot experiment was carried out in the Horticultural Nursery of the Federal University of Technology Minna, Nigeria to evaluate the response of Gboma eggplant to nitrogen fertilization in Minna. The treatments consisted of five levels of nitrogen application 0 kg N ha⁻¹, 100 kg N ha⁻¹, 200 kg N ha⁻¹, 300 kg N ha⁻¹ and 400 kg N ha⁻¹. The experimental design was a completely randomized design (CRD) replicated four times. Data collected were plant height, number of leaf, number of branches, days to flowering, number of fruits, shoot biomass, fruit weight and agronomic efficiency was determined. The Data collected were subjected to Analysis of Variance (ANOVA). Treatment means were compared using Duncan Multiple Range Test. Results showed that the texture of the soil was sandy loam and the soil was slightly acidic with low organic carbon and nitrogen content. The results showed that plant height, number of leaves and fruit weight of Gboma eggplant were significantly influenced by the application of 200 kg N ha⁻¹. Application of 200 kg N ha⁻¹ improves the growth and yield parameter of Gboma eggplant in the study area.

KEYWORDS

Gboma eggplant, nitrogen, fertilization, and Minna.

1. INTRODUCTION

Gboma eggplant (*Solanum macrocarpon*), is one of the regularly consumed vegetables in Nigeria, it is used as condiment, rich in protein, fibre, calcium, iron, potassium, magnesium, phosphorus and sodium (Agoreyo *et al.*, 2012; Nyadanu and Lowor, 2014). Adeyeye and Adanlawo (2011) noted that the quality of protein in Gboma leaf and fruit possesses great quality and therefore, represents cheap but quality nutrition for many families Gboma eggplant is called Dauta in Hausa; afufa or añara in Igbo; and igbagba in Yoruba and highly valued components of the Nigerian foods and native medicines; they are regularly consumed almost on daily basis by both rural and urban families. It is suggested that for good health and general wellbeing, a minimum daily intake of 400 g of fruits and vegetables is required (Nishida *et al.*, 2004). *Solanum macrocarpon* is among the native underutilized vegetables consumed by the underprivileged women in the southwest Nigeria to meet daily vegetable need to provide minerals, vitamins and protein for women because of their inability to acquire highly nutritious food items such as egg, meat and milk. The most primitive domestic relatives of eggplant had round and green fruit. The domestication practice has changed the quality of fruit: size, shape and taste (Agoreyo *et al.*, 2012; Nyadanu and Lowor, 2014).

The root of Gboma eggplant is used against bronchitis, itching, body aches, and asthma and to cure wounds while its seeds are used to treat toothache. The juice from the vegetables is used in the treatment of gout, rheumatism and angina. It is also used as childbirth anaesthesia, to treat inflammatory

tumours, cancerous tissues and in the treatment of Parkinson's disease (Obboh *et al.*, 2005). It has native medicinal uses, which ranges from weight reduction to treatment of several conditions including asthma, skin infections and constipation. Various parts of the plant are used in decoction for curing disorders such as diabetes, leprosy, gonorrhea, cholera, bronchitis, dysuria, dysentery, asthenia and hemorrhoids (Gill, 1992). In addition, it prevents heart diseases and control blood pressure (Grubben and Denton, 2004; Okon *et al.*, 2010). It is also used in traditional medication for treatment of various ailments, ranging from asthma, skin infections, rheumatic disease, gastro oesophageal reflux diseases, to constipation and diabetes (Nwodo *et al.*, 2011). The fruits are said to represent blessings and fruitfulness and are offered as tokens of goodwill during visits, marriages and other social events in Nigeria and Ghana (Schippers, 2000). Moreover, its leaves and flowers can be poisonous if it consumed in large quantities due to their solanine (Rotino *et al.*, 2014). The fruit is a popular and generally grown vegetable crop in the tropic and subtropics regions of the world mainly for its unripe fruits and leaves as vegetables (Manoko and Van der Weerden, 2004). It is important to improve the production of the crop per unit area so as to fulfil the requirements of dietary needs with the use of fertilizer application (Adeyemo and Ojo, 1991).

Gboma eggplant is a heavy feeder and occupies the ground for a long period of time, so fertilizer application is a necessity (McCullum, 1980). Its production in Nigeria is inhibited by the low level of soil fertility, combined with poor prevailing climatic conditions and this result in low yield of the

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plant. Fertilization has been a constituent of enhanced cultural practices for most crops since over 95 percent of most arable lands of Nigeria are under regular cultivation. Constraints and the problem of soil nutrients of low to medium level of available nutrients have caused yield below potential levels (Adepetu, 1986). The best way of preventing soil from becoming poor is to put back into it what plant has taken out and this can only be achieved by the use of inorganic fertilizer (Roberts and Andrew, 1989). In good soil fertility management programme, proper timing and good fertilization are necessary to maintain high levels of crop production (i.e. yield), (Harper, 1983).

The objective of the study is to determine the effect of nitrogen fertilization on the growth and yield performance of Gboma eggplant and its agronomic efficiency.

2. MATERIALS AND METHOD

2.1 Experimental site

Experiment was conducted at Horticultural Nursery, Federal University of Technology, Minna, in the Southern Guinea Savanna of Nigeria which lies at latitude 09° 31' 214" N and longitude 06° 27' 604" E, Minna Niger State. The study site is situated 222 m above sea level, climate of Minna is sub humid with mean annual rainfall of about 1284 mm and a distinct dry season of about 5 months duration occurring from November to March. The mean maximum temperature remains high throughout the year, about 33.5°C particularly in March and June.

The physiographic characteristics of Minna area consist of gently undulating high plains developed on basement complex rocks made up of granites, migmatites, gneisses and schists. Inselbergs of "Older Granites" and low hills of schists rise conspicuously above the plains. Beneath the plains, bedrock is deeply weathered and constitutes the major soil parent material (saprolites) (Ojanuga, 2006).

2.2 Treatment and experimental design

The pots were filled with 10 kg of soil. The treatments consisted of five rates of nitrogen application 0 kg N ha⁻¹, 100 kg N ha⁻¹, 200 kg N ha⁻¹, 300 kg N ha⁻¹ and 400 kg N ha⁻¹. The experimental design was a completely randomized design (CRD) replicated four times.

2.3 Soil sampling and analysis

The soil samples were collected from the Teaching and Research Farm in Federal University of Technology Minna, before the commencement of the experiment. The sampling was collected at the depth of 0-15cm using spade. The samples were bulked together to form a composite sample which was air-dried and analysed for particle size and some chemical properties.

The soil particle size distribution was determined by the hydrometer method. Soil pH was determined in a ratio of 1:2.5 soil to water with a pH meter, while the soil organic carbon was determined using the Walkley and black wet oxidation method, total nitrogen by the micro-Kjeldahl method. Exchangeable basis was extracted with neutral 1 N NH₄ OAC extraction. Na and K in the extract were determined using flame photometry while the Ca and Mg were determined by Na-EDTA titration. Exchangeable acidity was extracted and determined by titrimetric method and phosphorus was extracted using Bray P-1 method and the concentration was determined calorimetrically using atomic absorption spectrophotometer.

2.4 Agronomic practices

The Gboma eggplant was sourced from National Horticultural Research Institute (NIHORT) in Ibadan, Oyo State. It was first raised in a nursery bed which was later transplanted three weeks after sowing to the experimental pots. Three stands were transplanted per pot and then later thinned to one seedling per pot. The fertilizer was applied in split dose. The first dose was applied at 2 weeks after transplanting (WAT) and the second dose was applied at 7 WAT to required pots. The water was applied on a daily basis, and weeding was carried out when necessary by hand pulling.

The height of the Gboma eggplant was measured from the base of the soil to the plant tip using meter rule at 2, 4, 6, 8, 10 and 12 WAT. The number of leaves was determined by counting and recording the number of leaves at 2, 4, 6, 8, 10 and 12 WAT. The number of branches was determined by counting and recording the number of leaves at 2, 4, 6, 8, 10 and 12 WAT. Days to flowering was observed by visual assessment of the Gboma eggplant. The numbers of days were calculated from the days of sowing to

the days when the flower first appeared. The Gboma eggplant was cut above the soil in the pots, dried and weighed using weighing balance and recorded as shoot biomass. The number of fruit was determined by counting the number of fruit on each pot and was recorded as number of fruit per pot. The yield were harvested at maturity and weighed and the weight was recorded as fruit yield.

2.5 Calculation and data analysis

Agronomic Efficiency (AE) was calculated using the formula:

$$AE = \frac{\text{Yield of Gboma eggplant of treated pots} - \text{yield of Gboma eggplant of untreated pots}}{\text{Nutrient applied}}$$

The Data collected were subjected to Analysis of Variance (ANOVA). Treatment means were compared with Duncan Multiple Range Test (DMRT) at 5% level of probability, using statistical analysis system.

3. RESULTS AND DISCUSSION

The results of the physical and chemical properties of the soil used for the experiment prior sowing are shown in Table 1. The textural class of the soil was sandy loam, soil reaction was slightly acidic with pH 6.3 considered as suitable for normal plant growth. Most nutrients in soil are available for plant uptake at pH 5.5- 6.5 (Brady and Weil, 2002). Organic carbon, nitrogen content and available phosphorus were low, medium in calcium (Esu, 1991).

The effect of nitrogen on the plant height of Gboma eggplant at different growth stages shown in Table 2. At 4 WAT, pots treated with 300 kg N ha⁻¹ were significantly taller ($p < 0.05$) than control. At 8 and 10 WAT, 200 kg N ha⁻¹ significantly taller ($p < 0.05$) than 0 and 100 kg N ha⁻¹ but similar to 300 and 400 kg N ha⁻¹ at 10 WAT. 200 kg N ha⁻¹ had the highest number of leaves which was significantly different ($p < 0.05$) from 400 kg N ha⁻¹. At 8 and 10 WAT, 100 kg N ha⁻¹ was significantly different ($p < 0.05$) from 400 kg N ha⁻¹ and 0 kg N ha⁻¹ (Table 3). The effect of nitrogen on the number of branches of Gboma eggplant at different growth stages was shown in Table 4. At 4 and 6 WAT, pots treated with 200 kg N ha⁻¹ had more branches which was significantly different ($p < 0.05$) from 400 kg N ha⁻¹ but similar to other treatments. More branches was observed from 100 kg N ha⁻¹ at 10 WAT which was significantly different ($p < 0.05$) from 0, 300 and 400 kg N ha⁻¹ but similar 200 kg N ha⁻¹ but only 0 kg N ha⁻¹ recorded the lowest branches at 12 WAT.

No significant different was observed in plant height at 2 and 4 WAT, number of leaves of Gboma eggplant at 2 and 6 WAT and number of branches at 2 WAT.

200 kg N ha⁻¹ recorded the shortest days to flower while the 200 and 400 kg N ha⁻¹ took the longest days to flower which was significant different from other treatments. No significant different was observed in number of fruit per pot (Table 5).

Table 1: Some physical and chemical properties of soil prior to sowing.

Parameter	Value
Sand (g kg ⁻¹)	788
Silt (g kg ⁻¹)	80
Clay (g kg ⁻¹)	132
Textural class	Sandy loam
pH (H ₂ O)	6.3
Organic carbon (g kg ⁻¹)	3.30
Available phosphorus (mg kg ⁻¹)	9
Total nitrogen (g kg ⁻¹)	0.058
Exchangeable bases (cmol kg ⁻¹)	
Ca ²⁺	4.12
Mg ²⁺	2.40
K ⁺	0.34
Na ⁺	0.23
Exchangeable Acidity (cmol kg ⁻¹)	0.12

Table 2: Effects of nitrogen fertilization on plant height of Gboma eggplant

Plant height (cm)						
Treatments	2 WAT	4 WAT	6 WAT	8 WAT	10WAT	12 WAT
0 kg N ha ⁻¹	3.25a	6.25b	10.13a	15.86b	21.50b	22.38b
100 kg N ha ⁻¹	3.25a	6.20b	11.25a	16.37b	20.38b	26.13ab
200 kg N ha ⁻¹	3.75a	6.75ab	11.25a	22.63a	27.13a	29.00a
300 kg N ha ⁻¹	3.63a	7.25a	12.50a	19.63ab	24.15ab	24.75ab
400 kg N ha ⁻¹	4.13a	7.00ab	13.63a	17.38b	23.13ab	23.50ab
SE±	0.18	0.15	0.51	0.83	0.85	0.88

Means with the same letter(s) in a column are not significantly different at 5 % level of probability

WAT: Weeks after transplanting.

Table 3: Effects of nitrogen fertilization on number of leaves of Gboma eggplant

Number of leaves						
Treatments	2 WAT	4 WAT	6 WAT	8 WAT	10WAT	12 WAT
0 kg N ha ⁻¹	5a	7ab	9a	14ab	26b	29b
100 kg N ha ⁻¹	5a	7ab	10a	17a	31a	33a
200 kg N ha ⁻¹	5a	8a	11a	15ab	31a	34a
300 kg N ha ⁻¹	4a	7ab	8a	12b	29ab	31ab
400 kg N ha ⁻¹	5a	6b	8a	12b	19c	21c
SE±	0.21	0.13	0.53	0.72	1.12	1.08

Means with the same letter(s) in a column are not significantly different at 5 % level of probability

WAT: Weeks after transplanting.

Table 4: Effects of nitrogen fertilization on number of branches of Gboma eggplant

Number of branches						
Treatments	2 WAT	4 WAT	6 WAT	8 WAT	10WAT	12 WAT
0 kg N ha ⁻¹	5a	7ab	7ab	8ab	8c	9b
100 kg N ha ⁻¹	5a	7ab	7ab	8ab	14a	16a
200 kg N ha ⁻¹	5a	8a	8a	9a	13ab	15a
300 kg N ha ⁻¹	4a	7ab	7ab	7b	10bc	12a
400 kg N ha ⁻¹	5a	6b	6b	8ab	10bc	13a
SE±	0.21	0.13	0.18	0.17	0.61	0.74

Means with the same letter(s) in a column are not significantly different at 5 % level of probability

WAT: Weeks after transplanting.

Table 5: Effects of nitrogen fertilization on days to flowering and yield of Gboma eggplant

Treatments	Days to flowering	Number of fruits/pot	Fruits yield (g)
0 kg N ha ⁻¹	79bc	4a	26.80b
100 kg N ha ⁻¹	77bc	4a	29.68b
200 kg N ha ⁻¹	75c	8a	83.90a
300 kg N ha ⁻¹	87a	6a	82.12a
400 kg N ha ⁻¹	84ab	5a	58.00ab
SE±	1.35	0.6	7.34

Means with the same letter(s) in a column are not significantly different at 5 % level of probability

The heaviest yield was recorded when 200 kg N ha⁻¹ was applied which was significantly different from 0 and 100 kg N ha⁻¹ but similar to 300 and 400 kg N ha⁻¹.

Effect of nitrogen on shoot biomass was shown in Figure 1. Treatments 300 kg N ha⁻¹ recorded the heavier wet shoot biomass weight and the lowest was observed in 0 and 100 kg N ha⁻¹ meanwhile The same trends was observed in dry shoot biomass. The 200 kg N ha⁻¹ efficiently utilized the nutrients supply and 10 % higher than 300 kg N ha⁻¹ and 36 % higher than 400 kg N ha⁻¹ (Figure 2)

Figure 1: The effects of nitrogen fertilization on shoot biomass of Gboma eggplant **Figure 2:** The agronomic efficiency as affected by nitrogen fertilization

The application of nitrogen fertilizer significantly increase the growth and yield of Gboma eggplant, similar results were reported by Hashimoto and Yamamoto, 1970; Hashimoto, 1971. They identified nitrogen as an element identified to be of critical importance to high yield of gboma eggplant during vegetative development, flowering and seed set. Nitrogen plays a very important role in Gboma eggplant (*Solanum macrocarpon*) which is very essential for growth and development (Grubben and Denton, 2004; Okon *et al.*, 2010). Bobadi and Van Damme (2003) observed that nitrogen supplied at 200 kg N/ha gave best results and significantly produced the highest number of flowers per plant, fruits per plant and yield (32.24 ton/ha) over control plants in *Solanum melongena* L. Miceli and Miceli (2014) also reported increasing the level of nitrogen fertilization over 100 kg N/ha, plants had a higher fresh weight and yield in similar vegetable crops like Swiss chard (*Beta vulgaris* L. var. cicla L.). Similar results also reported by Ahmadi *et al.* (2010) which observed increased in the high of spinach with nitrogen application. Akanbi *et al.* (2003) reported that nitrogen fertilizer influence leaf number per plant, plant height, fruit number per plant, fruit mean weight and total yield per plant in similar vegetable crop like tomato. Ruiz and Romero (1998) studied tomato cultivars and found that cultivars have significant effect on yield and Bufalo cultivar and Nancy cultivar, respectively had a least and greatest yield with application of nitrogen fertilizer.

4. CONCLUSION

The application of 200 kg N ha⁻¹ improved the growth and yield parameter of Gboma eggplant and therefore it can be considered useful for the cultivation of Gboma eggplant in the study area. A field trial should be conducted to ascertain this finding.

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