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Original Research Paper

Evaluation of the Responses of *Solanum melongena* to Different Soil Types and Levels of NPK Fertilizer

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Hitherto, production of *Solanum melongena* Lin. (garden egg) on large scale has been very unpopular despite its high level of consumption in Western Nigeria based on the premise that it cannot thrive well, single superphosphate fertilizer (SSP) and urea are very scarce or difficult to procure and that there has been no information on the response of this crop to different levels of NPK fertilizer with regard to its yield. Thus, this study was carried out to assess the growth and yield of this garden egg under different soil types and NPK fertilizer levels. Matured fruits, four soil types (river sand, sandy/clayey/loamy soils), polythene pots and NPK fertilizer were procured, seeds of the garden egg were extracted, dried at room temperature, planted (to raise its seedlings for transplanting) and pre experimental soil analysis was done. It was a 4x4 factorial experiment in completely randomized design comprising 16 treatment combinations replicated 3 times (making 48 treatment combinations). Seedlings were transplanted 2 weeks after sowing and fertilizer application commenced 2 weeks after transplanting (at 0, 111, 222 and 333 Kg/ha) and all cultural operations (watering, weeding, insect control) were ensured. Apparent growth parameters (plant height, number of leaves, collar girth, number of branches) and yield indices (number of fruits and fruit weight) were evaluated. Analysis of variance indicated significant differences among the growth and yield parameters with a3b3 (garden plants planted in loamy soil at 333Kg NPK/ha) emerging as the best treatment combination (11.91t/ha). This was followed by a_1b_3 (garden egg plants planted in sandy soil at 333Kg NPK/ha) which had 4.69t/ha and the least was the control (aobo: garden egg plants planted in river sand at 0Kg NPK/ha) which yielded 0.17t/ha. Thus, garden egg can be productively cultivated in this area with NPK fertilizer and in soil types ranging from sand, clay to loam.

Keywords: Garden egg, Soil types, Fertilizer, Growth and yield.

INTRODUCTION

Garden Egg (Solanum melongena Lin*.)*

Garden egg has been one of the essential vegetable crops cultivated in Nigeria and in the West African subcontinent. It was said to have originated from Indian but presently it is grown in the sub-tropical, tropical and warm temperate regions in the world as a vegetable (Tindall, 1992) In countries like India, Japan and China, it has long been regarded as an important vegetable and its importance had increased as a protected crop in Northern Europe.

Solanum melongena L. exhibits a wide range of fruit shapes among the available cultivars ranging from oral or egg-shaped to long club shaped and these cultivars have various colors such as white, yellow, green, purple pigmentation to almost black (this very variety that was employed in this study was oral shaped). Most of the cultivars that are very important commercially were selected from old – long established types from India and China. The local and exotic varieties are cultivated in West Africa, but the local ones are more prevalent (Norman, 1992). Eggplant (the matured fruits) could be eaten raw or cooked and in some parts of Western Nigeria, the fruits are cooked with bell pepper *Capsicum annuum* and *C.* frutescens (hot pepper), crushed/pounded/ground together (with the aid of small mortar and pestle), palm oil and salt are added, it is then eaten with cooked yam, cocoyam or plantain.

It has been said that garden egg probably originated from India where it has been in cultivation for ages. In another development, Norman (1992) also reported that the center of

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origin of garden egg was in the indo- Burma region and this plant has been known in China for the last 1,500 years. The plant can grow up to 120cm, it is erect, leaves are simple and has properly formed branches. Its yield is influenced by soil type, fertilizer application, anthesis, pest and disease infection.

Some of the different varieties include *Solanum melongena* Var. *esculentum* (common eggplant, including white varieties with many cultivars), *Solanum melongena* Var. *depressum* (dwarf eggplant) and *Solanum melongena* V*ar. serpentium* (snake eggplant). Economic benefits include medicinal uses as carminative and sedatives and for treating colic and blood pressure problems, the materials used are gotten from its fruits and roots (Grubben and Denton, 2004). It also serves as a good source of vitamin C and potassium e.g. white garden egg is often recommended for diabetic patients, for food and as antidote to poisonous mushrooms (Duke and Ayensu, 1985).

Nature of Soils in the Tropics

The zonal part of the world lying (approximately) between the tropic of cancer (Lat. 23.5^0 North of the Equator) and the tropic of Capricorn (Lat. 23.5^0 South of the equator) is referred to as 'tropics' and agriculture is prevalent in this area (Juo *et al*., 2003). Though tropical soils are lower in soil organic matter than that of temperate soils due to the rate of breakdown which is faster in the tropics and this soil organic matter has been described as a vital component of soil exchange complex (Nye, 1961) and without it the soil will be extremely low in nutrient status.

About 36% of the world's land surface area is tropical (Juo. *et. al*., 2003) and the soil is highly leached. The acidic nature of the soil is brought about by the high Iron (Fe) and Aluminium (Al) oxides and in most cases phosphorous deficient (Juo *et. al*., 2003). Farm yard manure was used in past to remedy the ugly situation of poor/low fertility status but limited to very small (negligible) area of land and continuous demand by large scale farmers could not be met due to unavailability/insufficient quantities of animal wastes, transportation and labour costs (Yayock *et al*., 1988). Owing to these constraints, the use of inorganic/chemical fertilizer was embraced (on its advent).

Thus, this paper aims at investigating the response of this variety of eggplant (*Solanum melongena Var. esculentum)* to different levels of NPK fertilizer in terms of its growth and yield in different growth media (soil types) so as to be able to give appropriate recommendation to the people in the area of study and to allay their fears about poor yield sequel to unavailability of SSP and Urea in the area.

MATERIALS AND METHODS

The study was carried out at the Department of Plant Science & Biotechnology, Faculty of Science, Adekunle Ajasin University, Akungba – Akoko, Ondo State, Western Nigeria (Latitude 7.20^0N, Longitude 5.44^0 E, altitude 432m above sea level). Garden egg (fully matured) fruits, N P K 15: 15: 15: and polythene pots were procured from a nearby town (Ikare – Akoko) and the different soil types used were got from the University premises and thereafter taken for identification/analysis.

The seeds of this variety of garden egg were meticulously extracted and dried at room temperature. The seeds were first sown in three (3) polythene pots initially filled with 2.6kg of top soil and watered for a week prior to sowing in order to make the soil conducive for germination. The seeds were sown by broadcasting, covered with soil (1.0- 1.5cm depth), watered carefully and covered with little mulch in June. It was a 4x4 factorial experiment in completely randomized design (CRD) consisting of two factors: A (soil types – river sand, sandy soil, clayey soil and loamy soil) and B (fertilizer levels – NPK 15: 15: 15 at 0kg/ ha, 111/ha, 222Kg/ha and 333Kg/ha) replicated 3 times (making a total of 48 treatment combinations). The experimental plot lay –out is found in Table 1 below.

The seedlings were transplanted 4 weeks after seed sowing (planting), watering of seedlings was done prior to transplanting to soften the soil for easy lifting and avoid damage to the roots. Depth of planting was 2cm into polythene pots filled with 5kg of the respective growth medium (soil type). During transplanting one healthy seedling was planted per pot and all necessary tending operations (watering, weeding, insect control) were carried out. The morphological growth parameters assessed include plant height, collar girth, number of leaves, and number of branches while the yield parameters evaluated were number of fruits and fruit weight.

Some of the tending operations were carried out when necessary (e.g. watering was done when there was no rain for more than 2 days) and application of insecticide to all the treatments (cypeforce) was done to prevent insect attack at flowering stage while weeding was regularly carried out (every three weeks) to prevent competition with the crop plant (garden egg) for nutrients, sunlight and water. The plant height was measured by using a tape rule (calibrated in centimeter from the base of the plant at soil level to the terminal bud of the main stem, collar girth was got by means of vernier caliper 2cm from the surface, the number of leaves, number branches, number flowers and number fruits were got by physical counting and weight of fruits by sensitive weighing balance in the laboratory per treatment combination.

With regard to soil analysis, samples of the four (4) soil types (river sand, sandy soil, clayey soil and loamy soil) were bulked, air dried and ground to enable it to pass through a 2mm sieve for routine analysis. The physicochemical parameters considered include pH, organic matter, total nitrogen, phosphorus, potassium, calcium, sodium, exchangeable acidity and effective cation exchange capacity.

Thus, the pH (1:1) in water was measured means of the pH meter, conductivity (Vs/cm3) by conductivity meter, percentage organic matter (carbon) was determined by potassium dichromate method (Walkey and Black, 1974), total nitrogen by Kjdeldal method (Jackson. 1962), available phosphorus by Bray and Kurtz (1945) method, the exchangeable cations (bases): Sodium (Na) and Potassium (K) were determined by the use of flame photometer, Ca and Mg were estimated with the aid of atomic absorption spectrophotometer (AAS). Effective cation exchange capacity (ECEC = exchangeable bases/cations + exchangeable acidity) was determined by the summation method after the extraction of exchangeable acidity (EA) with the aid of 1N KCL (Kamprath, 1984).

RESULTS AND DISCUSSION

Soil Sample Analysis

The pre – planting soil analysis (Table 2) indicated that the pH range (5.22-6.40) in loamy and clayey soils could still pave way for reasonable crop performance (those of sandy soil and river sand were above 7.0) but the organic matter (0.15- 1.25%), total nitrogen (0.16- 0.25 %), available phosphorus (1.56- 3.89 ppm) and other essential nutrients were low and below the critical range (Adeoye and Agboola, 1985).

Table 1: Experimental plot – layout

Fertilizer level	Soil Types			
	a_0	a_1	a_2	a_3
b_0	a_0 b_0	a_1 b_0	a_2 b_0	a_3 b_0
b_1	a_0 b_1	a_1 b_1	a_2 b_1	a_3 b_1
b_2	a_0 b_2	a_1 b_2	a_2 b_2	a_2 b_3
b_3	a_0 b_3	a_1 b_3	a_2 b_3	a_3 b_3

Note: Each of the 16 treatment combinations was replicated 3 times, making a total of 48 treatment combinations;a_0, a_1, a_2 and a_3 were river sand, sandy soil, clay, loam respectively (growth media); b_0, b_1, b_2, and b_3 were the fertilizer levels at 0, 111, 222 and 333kg/ha respectively, while the dose/quantity per plant (in big polythene pot/bag filled with 5kg of each soil type) based on the levels were 0g, 4g and 8g, and 12g respectively, 1ha = 100 m x 100 m, spacing for *S. melongena* = 0.6m x 0.6m, No. of plants ha^{-1} = 27778.

Table 2: Result from Pre–Planting Soil Analysis of the Four Soil Types

Parameters	Loamy Soil	Clay Soil	Sandy Soil	River Soil
PH	6.40	5.22	7.75	7.33
Conductivity	17.90	76.70	54.00	29.70
O.M. (%)	1.25	0.45	0.65	0.15
T.N. (%)	0.25	0.19	0.16	0.16
Available P (ppm)	3.89	2.37	1.56	1.56
Ca (cMol / kg)	4.44	3.69	2.20	1.54
Mg (cMol / kg)	1.80	1.09	0.89	0.72
K (cMol / kg)	1.60	5.70	2.50	2.30
Na (cMol / kg)	1.12	0.80	0.96	0.80
E.A. (cMol / kg)	2.56	7.28	5.55	5.52
ECEC (cMol / kg)	11.52	18.56	12.10	10.88

Note: O.M = Organic matter (%), T.N.= Total Nitrogen (%), E.A. = Exchangeable Acidity (cMol/kg),
ECEC = Effective Cation Exchange Capacity (cMol/ kg), Ca, Mg, K and Na (cMol/kg of oven dry soil.

In order to achieve high yield, the soil nutrient status should be beefed up/improved. Thus, the NPK fertilizer applied significantly affected/influenced the growth and yield parameters (Tables 3, 4 & 5).

Germination Rate / Percentage and Growth Parameters

Seedlings' emergence (germination) commenced on the 4th day after planting (4DAP) and the seedlings were two (2) weeks old when they were transplanted. Out of the 60 seeds sown (in loamy/top soil only), a total number of 51 seeds germinated (85% germination percentage). The highest mean plant height (from Weeks 2, 4, 6, 8, 10, 12, 14 and 22 after transplanting) of 48.68cm was recorded in a_3 b_3 (Seedlings in loamy soil with 333kg / ha of NPK 15:15:15, followed by a_2 b_3 (Seedlings in clayed soil with N.P.K fertilizer rate of 333kg / ha) which had a mean height of 40. 92cm. The least mean value (7.5cm) was observed in the a_0b_2 (seedling in river sand at 222kg/ha NPK).

The Analysis of variance (ANOVA) indicated significant differences among the treatment combinations (TC) at 5% probability ($P \leq 0.05$) level (SPSS version 20.1 was used). The trend was not different in the other two growth parameters considered (number of leaves and collar girth). Pertaining to the number of branches, a_0 b_0 and a_0 b_2 had very low mean values. It was a_3 b_3 that had the highest mean value while the lowest mean value was recorded in a_0 b_2 and significant differences from ANOVA were observed (at $P < 0.05$).

This was probably not unconnected with the fact that a_3 b_3 was the treatment combination (TC) with highest nutrient status in terms of the organic matter content. N, P, K, and other mineral nutrients which affected the growth of the plant (*S. melongena*) positively (Addac – Kagya and Norma, 1977; Nandekar and Sawarkar, 1990; Naik *et. al*., 1996, Olaniyi and Ojetayo, 2010; Kareem *et al*., 2014). The reason why a_0b_2 treatment combination that had the least mean values in all the apparent growth parameters demands for further investigation, One could have probably expected TC a_0b_0 (river sand without NPK fertilizer application) to have had the least values due to its extremely low nutrient status (Tables 3- 6).

Yield Indices

Fruiting commenced at the 10th week after planting (10 WAP) in treatment combination (TC) a_3b_3 (garden egg plants transplanted into polythene pots with 5kg loamy soil at 335kg NPK/ha) and it was this TC a3b3 that had the highest cumulative (total) number of fruits harvested (10th – 22nd WAP) which was 405 $plant^{-1}$ and 11,295,045/ha (approx.). The next TC to a3b3 was a2b3 (garden egg plants transplanted into polythene pots with 5kg clayey soil at 335kg NPK/ha) which had 397 $plant^{-1}$ and 11,027,778/ha (approx.).

The least value was observed in TC aobo (garden egg plants transplanted into polythene pots with 5kg river sand at 0kg NPK/ha) which was the control. Analysis of variance (ANOVA) indicated significant differences among the 16 TC at $P \leq 0.05$ (Table 7), SPSS version 21.0 was employed. This trend agrees with the reports earlier made by Afari (1999), Nandekar and Sawarkar (1990), Naik *et. al*., (1996) and Kareem (2014b and 2015b) in respect of positive correlation between increase in crop yield with increasing rate of either organic or inorganic fertilizers. It is pertinent to mention here that even after the 22nd week, this crop plant still continued to grow and harvesting still continued.

Table 3: Extract from statistical analysis on plant height showing the treatment combinations, means, standard error and DMRT

TC	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12	Week 14	Week 22	Total	Means
a_0b_0	5.33±0.17^{c}	6.17±0.33^{b}	7.33±0.44^{fgh}	8.17±0.66^{fgh}	8.17±0.67^{fgh}	9.83±0.67^{def}	10.67±0.29^{g}	17.83±1.59^{f}	56.21±3.32	8.03±0.46
a_1b_0	5.00±0.17^{c}	6.40±0.44^{b}	13.47±1.55^{d}	17.50±1.76^{de}	17.50±1.76^{d}	25.33±2.80^{c}	36.40±5.80^{cd}	65.833±10.58^{ef}	121.6±14.28	17.37±2.04
a_2b_0	5.97±0.38^{c}	6.80±0.60^{b}	12.60±1.40^{de}	16.07±2.12^{de}	16.01±2.12^{de}	23.17±2.17^{c}	30.43±1.01^{d}	53.90±5.87d^{ef}	111.05±9.8	15.86±1.4
a_3b_0	5.90±0.46^{c}	6.47±0.29^{b}	11.00±1.61^{defg}	13.67±2.40^{defg}	13.67±2.40d^{efg}	21.67±4.42^{cd}	29.47±10.62^{de}	62.83±17.35^{cdef}	101.85±22.2	14.55±3.17
a_0b_1	5.30±0.80^{c}	6.07±0.54^{b}	7.67±0.88^{efgh}	8.53±1.9^{fgh}	8.53±1.19^{fgh}	16.23±5.00^{cdef}	13.85±1.65^{efg}	39.17±7.66b^{cde}	66.18±18.91	9.45±2.36
a_1b_1	5.37±0.56^{c}	6.23±0.90^{b}	11.30±2.59^{defg}	13.67±3.17^{def}	13.67±3.17^{defg}	20.33±4.13^{cde}	28.00±3.55^{de}	52.67±6.17b^{cd}	151.24±24.24	18.91±3.03
a_2b_1	5.67±0.46^{c}	6.40±0.06^{b}	12.23±1.30^{def}	15.53±1.49^{def}	15.53±1.50^{def}	25.83±4.04^{c}	33.03±9.30^{cd}	60.67±17.62^{bcd}	174.86±25.77	21.86±3.22
a_3b_1	5.10±0.31^{c}	5.50±0.29^{b}	10.07±0.18^{defgh}	13.00±0.29^{defgh}	13.00±0.29^{defgh}	19.67±0.44^{cdef}	29.87±1.30^{de}	62.67±5.55^{bcd}	158.88±8.85	19.86±1.08
a_0b_2	6.20±0.38^{bc}	6.53±0.24^{b}	6.90±0.46^{gh}	7.03±0.26^{gh}	7.03±0.26^{gh}	8.00±0.29^{f}	7.90±0.35^{g}	10.60±0.31^{abcd}	60.19±2.55	7.52±0.32
a_1b_2	4.77±1.12^{c}	4.93±1.03^{b}	5.53±1.07^{h}	5.90±1.23^{h}	5.90±1.23^{h}	8.90±2.12^{ef}	13.57±4.79^{efg}	30.50±13.61^{abcd}	80±26.20	10±3.28
a_2b_2	6.10±0.40^{bc}	6.33±0.38^{b}	9.37±0.82^{defgh}	13.33±0.60^{defg}	13.33±0.60^{defg}	24.3±0.93	36.13±1.03^{cd}	49.40±9.34^{abc}	154.29±14.1	19.79±1.76
a_3b_2	4.70±0.57^{c}	4.80±0.42^{b}	6.97±1.83^{gh}	9.40±3.36^{efgh}	9.40±3.36e^{fgh}	16.40±5.16^{cdef}	26.33±6.71^{def}	45.33±2.03^{abc}	123.33±23.44	15.42±2.93
a_0b_3	9.33±1.57^{a}	13.67±1.59^{a}	22.33±1.59^{c}	26.50±2.00^{c}	26.50±2.00^{c}	36.50±1.04^{b}	46.83±2.95^{bc}	61.00±7.00^{abc}	242.66±19.74	30.33±2.47
a_1b_3	8.80±1.50^{a}	14.67±3.49^{a}	35.50±1.61^{b}	44.17±3.83a^{b}	44.17±3.83^{ab}	50.40±6.52^{a}	53.23±3.62^{ab}	69.50±13.94^{abc}	320.44±38.34	40.06±4.79
a_2b_3	8.60±1.56ab	16.17±3.09^{a}	35.33±2.68^{c}	41.47±3.15^{b}	41.47±3.15^{b}	50.67±4.17^{a}	57.43±2.91^{ab}	76.23±2.83^{abc}	327.37±23.54	40.92±2.94
a_3b_3	9.47±0.52^{a}	17.67±0.88^{a}	42.83±2.09^{a}	50.33±3.18^{a}	50.33±3.18^{a}	61.23±5.61^{a}	66.50±5.85^{a}	91.07±7.06^{a}	389.43±28.13	48.68±3.52

Note: TC=treatment combination, a_0= river sand, $a_1$sandy soil, a_2=clay soil, a_3=loamy soil, b_0= 0Kg ha $^{-1}$, b_1=111Kg ha $^{-1}$, b_2=222kg ha^{-1}, b_3=333Kg ha $^{-1}$ of NPK fertilizer. The means in the horizontal column with the same alphabet(s) are not significantly different at $P \leq 0.05$ while the means in the horizontal column with the different alphabet(s) are not significantly different at $P \leq 0.05$.

Table 4: Extract from statistical analysis on collar girth showing the treatment combinations, mean, standard error and DMRT

TC	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12	Week 22	Total	Mean
a_ob_o	0.17+0.00^{c}	0.21±0.01^{defg}	0.24+0.0l^{efg}	0.26+0.02^{de}	0.42±0.02^{ef}	0.46+0.02^{fg}	0.67±0.1l^{d}	2.67±0.19	0.38±0.03
a,b_0	0.17±0.00^{c}	0.36+0.06^{c}	0.41±0.06^{cde}	0.53+0.10^{bc}	0.72±0.55^{cd}	0.81±0.07^{cd}	1.10±0.15^{bc}	4.10±00.99	0.59±0.14
a_2b_0	0.16+0.00^{c}	0.32±0.03^{cde}	0.43±0.05^{cd}	0.42±0.04^{cde}	0.59±0.06^{de}	0.67±0.05^{def}	0.92±0.03^{bc}	3.51±0.26	0.50±0.37
a_3b_0	0.17±0.00^{c}	0.32+0.03^{cde}	0.38±0.06^{cdef}	0.44+0.08^{cde}	0.63±0.07^{d}	0.83+0.11^{cd}	0.97±0.33^{bc}	3.74±0.68	0.53±0.10
a_ob_1	0.17+0.00^{c}	0.19±0.02^{efg}	0.25±0.03^{defg}	0.23+0.03^{de}	0.42+0.01^{ef}	0.49±0.03^{ef}f^{g}	0.67±0.08^{cd}	2.42±0.20	0.35±0.03
a_1b_1	0.16±0.01^{c}	0.26±0.05^{cdef}	0.35±0.09^{cdef}	0.44+0.11^{cde}	0.63±0.07^{d}	0.72+0.03^{de}	0.91±0.02^{bcd}	3.47±0.38	0.50±0.05
a_2b_1	0.17±0.00^{c}	0.32±0.24^{cde}	0.46±0.00^{b}	0.51±0.06^{bcd}	0.69±0.04^{d}	0.79+0.14^{cd}	0.96+0.17^{bcd}	3.90±0.65	0.56±0.09
a_3b_1	0.12±0.05^{c}	0.34±0.03^{cd}	0.38+0.0l^{cdef}	0.46±0.02^{cde}	0.68±0.02^{d}	0.64±0.06^{def}	0.89±0.07^{bcd}	3.51±0.26	0.50±0.04
a_ob_2	0.16±0.00^{bc}	0.13±0.01^{fg}	0.16+0.15^{g}	0.19+0.01^{f}	0.29+0.06^{f}	0.31+0.05^{g}	0.37±0.07^{d}	1.61±0.35	0.23±0.05
a_1b_2	0.15±0.01^{c}	0.09+0.05^{g}	0.11+0.06^{g}	0.16+0.03^{f}	0.35+0.10^{f}	0.46+0.14^{fg}	0.69+0.14^{cd}	2.46±0.53	0.35±0.08
a_2b_2	0.16+0.0l^{bc}	0.22±0.04^{defg}	0.40±0.06^{cdef}	0.49±0.05^{cd}	0.71+0.01^{cd}	0.81±0.04^{cd}	0.92±0.46^{bc}	3.71±0.67	0.53±0.10
a_3b_2	0.15+0.00^{c}	0.16±0.08^{fg}	0.22+0.12^{fg}	0.31±0.13^{def}	0.60+0.10^{de}	0.73+0.03^{d}	0.85±0.03^{bc}	3.02±0.49	0.43±0.07
a_0b_3	0.20+0.00^{a}	0.61±0.04^{b}	0.66±0.04^{b}	0.70±0.05^{b}	0.89±0.07^{c}	1.02+0.06^{c}	1.34±0.09^{bc}	5.24±0.36	0.75±0.05
a_1b_3	0.20±0.01^{a}	0.76+0.07^{a}	0.92±0.05^{a}	0.96±0.03^{a}	1.10+0.05	1.23±0.09^{b}	1.42±0.06^{b}	6.59±0.36	0.94±0.05
a_2b_3	0.20±0.00^{ab}	0.82±0.03^{a}	0.99±0.00^{a}	1.04±0.00^{a}	1.27±0.01^{b}	1.39±0.02^{ab}	1.54±0.09^{b}	7.25±0.15	1.04±0.02
a_3b_3	0-.20±0.00^{a}	0.84±0.03^{a}	1.06±0.07^{a}	1.11+0.05^{a}	1.50±0.10^{a}	1.58+0.09^{a}	1.93+0.17^{a}	8.22±0.51	1.17±0.07

Note: TC= treatment combination, a_0= river sand, $a_1$sandy soil, a_2=clay soil, a_3=loamy soil, b_0= 0Kg ha $^{-1}$, b_1=111Kg ha $^{-1}$, b_2=222kg ha^{-1}, b_3=333Kg ha $^{-1}$ of NPK fertilizer. The means in the horizontal column with the same alphabet(s) are not significantly different at $P \leq 0.05$ while the means in the horizontal column with the different alphabet(s) are not significantly different at $P \leq 0.05$

Table 5: Extract from statistical analysis on number of leaves showing the treatment combinations, mean, standard error and DMR

TC	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12	Week 22	Total	Mean
Aobo	4.67±0.67^{c}	5.33±0.33^{b}	6.33±0.58^{c}	6.33±0.67^{f}	6.67±0.33^{d}	8.00±0.00^{c}	7.00±1.00^{c}	44.334±3.58	6.334±0.51
a_1b_0	6.67±0.33^{c}	9.33±1.33^{b}	15.33±3.38^{c}	19.33±5.36^{def}	24.00±5.69^{cd}	3,7.674±11.92^{c}	107.00±48.81^{bc}	219.334±76.82	31.334±10.97
$a_2$bo	5.67±0.88^{c}	7.00±0.58^{b}	12.00±1.53^{c}	15.33±0.88^{def}	25.67±8.74^{cd}	35.00±18.50^{c}	26.004±9.61^{c}	126.67±40.72	18.104±5.82
a_3b_0	5.67±0.88^{c} .	5.33±0.67^{b}	11.00±3.61^{c}	15.00±4.93^{def}	19.67±7.05^{cd}	27.33±15.84^{c}	89.674=68.73^{bc}	173.674±91.7	24.814±13.101
a_0 b_1	4.67±0.33^{c}	5.67±0.33^{b}	6.004±.00^{c}	7.00±0.58^{ef}	8.67±0.33^{d}	11.67.4±1.20^{c}	24.00±7.51^{c}	67.684±10.28	9.674±1.47
a_1b_1	4.00±1.00^{c}	5.33±0.88^{b}	12.33±2.96^{c}	12.674±5.36^{ef}	17.67±3.71^{cd}	24.33±4.26^{c}	45.00±11.27^{bc}	121.334±29.44	17.334±4.21
a_2b_1	4.00±0.58^{c}	5.50±0.50^{b}	15.67±i'.20^{c}	21.3 3±3.28^{def}	31.00±=6.43^{cd}	33.67±13.97°	75.674±2.73^{bc}	186.844±68.69	26.694±9.81
a_3b_1	5.33±0.88^{c}	6.33±0.33^{b}	10.00±1.52^{c}	14.67±2.9^{ef}	17.00±3,46^{cd}	17.67±4.26^{c}	56.33±26.26^{bc}	127.334±39.62	18.194±5.66
a_0b_2	4.00±0.58^{c}	5.00±0.00^{b}	5.00±0. 58^{c}	6.00±0.58^{f}	5.67±0.67^{d}	5.674±0.33^{c}	5.67±0.33^{c}	37.014±3.08	5.294±0.44
a_3b_2	3.00±0.0.58^{c}	4.33±0.33^{b}	4.67.±0 88^{c}	6.67±1.33^{f}	8.67±2.84^{d}	12.334±4.70°	21.674±9.77^{c}	61.634±20.43	8.764±2.92
aob_2	4.33±0.88^{c}	4.00±1.00^{b}	16.00±3.06°	33.00±2.89^{d}	46.67±4.18^{c}	32.334±14.81^{c}	50.33±fc4.67^{bc}	186.664±31.49	26.674±4.50
a_3b_2	3.00±0.00^{c}	5.33±1.33^{b}	11.00±6.11^{c}	23.33±14.52^{def}	40.33±:11.31^{cd}	41.674±9.94^{c}	50.33±10.68^{bc}	174.994±43.91	25.00±6.27
aob_3	18.33±1.86^{ab}	12.67±3.92^{b}	21,00±3.51^{c}	25.33±3.38^{de}	39.00±9.53^{cd}	50.334±13.45^{c}	96.674±28.81^{bc}	263.33±64.46	37.62±9.21
a)b_3	20.67±4.18^{a}	47.33±7.51^{a}	66.00±6.00^{b}	78.00±10.60^{c}	93.00±:14.84^{b}	108.004±19.50^{b}	123.004±37.86^{bc}	536.4±90.49	76.57±12.93
a_2b_3	15.67±1.45^{b}	41.67±5.78^{a}	112.67±33.17^{a}	96.33±2.60^{a}	115.67±5.36^{b}	133.334±12.25^{b}	158.004±19.01^{b}	653.344±79.62	93.33±11.37
a_3b_3	19.00±1.73^{ab}	48.67±0.33^{a}	104.33±7.88^{a}	141.00±5.20^{a}	185.00±31.76^{a}	203.004±41.07^{a}	3 47.674±103.28^{a}	1048.674±191.25	149.81±27.32

Note: TC=treatment combination, a_0= river sand, $a_1$sandy soil, a_2=clay soil, a_3=loamy soil, b_0= 0Kg ha $^{-1}$, b_1=112Kg ha $^{-1}$, b_2=224kg ha^{-1}, b_3=336Kg ha $^{-1}$ of NPK fertilizer. The means in the horizontal column with the same alphabet(s) are not significantly different at P ≤ 0.05 while the means in the horizontal column with the different alphabet(s) are not significantly different at P ≤ 0.05

Table 6: Extract from statistical analysis on number of branches showing the treatment combinations, mean, standard error and DMRT

TC	Week 8	Week 10	Week 12	Week 14	Week 22	Total	Mean
a_0b_0	0.00±0.00^{c}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{f}	1.00±0.00^{d}	1.0040.00	0.20±0.00
a_1b_0	0.33±0.33^{c}	0.33±0.33^{b}	1.00±1.00^{de}	0.6740.67^{f}	12.67±3.93^{bc}	15.00±.6,26	3.00±1.25
$a_2$bo	0.00±0.00^{c}	0.00±0.00^{b}	1.33±1.33^{de}	1.33±1.33^{ef}	11.33±3.18^{bc}	13.99±5.84	2.8041.17
a_3b_0	0.00±0.00^{c}	0.00±.00^{b}	0.00±0.00°	0.00±0.00^{f}	9.33±4.48^{bc}	9.33±4.48	1.87±0.90
a_0b_0	0.00±0.00^{c}	0.00±0.00^{b}	0.00±0.00°	0.00±0.00^{f}	5.33±1.86^{cd}	5.33±1.86	1.0740.37
a_1b_1	0.00±0.00^{c}	0.0040.00^{b}	0.67±0.67°	0.00±0.00^{f}	8.33±1.45^{bcd}	9.00±2.12	1.8040.42
a_2b_1	0.00±0.00^{c}	0.33±0.33^{b}	0.67±0.67°	0.00±0.00^{f}	9.00±2.65^{bcd}	10.0±43.65	2.00±0.73
a_3b_1	0.00±0.00^{c}	0.0040.00^{b}	0.00±0.00^{e}	0.00±0.00^{f}	9.00±3.06^{bcd}	9.00±3.06	1.8040.61
a_ob_2	0.00±0.00^{c}	0.0040.00^{b}	0.00±0.00°	0.00±0.00^{f} '	1.00±0.00^{d}	1.00±0.00	0.20±0.00
a_1b_2	0.00±0.00^{c}	0.0040.00^{b}	0.00±0.00°	0.00±0.00^{f}	5.67±2.60^{cd}	5.67±2.60	1.1340.52
a_2b_2	1.33±0.67^{c}	1.33±0.67^{b}	3.33±0.33^{d}	3.33±1.33^{f}	10.00±1.53^{bc}	19.32±4.53	3.86±091.
a_3b_2	0.00±0.00^{c}	0.67±0.67^{b}	1.67±0.88^{de}	2.67±0.33^{c}	9.67±0.67^{bc}	14.68±2.55	2.9440.51
a_ob_3	1.0041.00^{c}	1.33±0.67^{b}	2.67±0.67^{de}	0.67±0.67^{de}	10.00±1.53^{bc}	15.67±4.54	3.13±0.91
a_1b_3	4.67±3.33^{b}	6.00±0.00^{a}	7.33±0.88°	7.00±0.00^{c}	15.33±f.20^{b}	40.33±5.41	8.0741.08
a_2b_3	7.00±l.00^{a}	8.00±1.00^{a}	I0.67±1.45^{b}	9.00±0.57^{b}	15.33±0.88^{b}	50.00±4.90	10.0040.98
a_3b_3	7.33±3.33^{a}	7.3343.67^{a}	14.33±l.45^{a}	10.67±0.33^{a}	25.33±4.37^{b}	64.99±13.15	.12.9942.63

Note:TC= treatment combination, a_0= river sand, $a_1$sandy soil, a_2=clay soil, a_3=loamy soil, b_0= 0Kg ha $^{-1}$, b_1=111Kg ha $^{-1}$, b_2=222kg ha^{-1}, b_3=333Kg ha $^{-1}$ of NPK fertilizer. .The means in the horizontal column with the same alphabet(s) are not significantly different at P ≤ 0.05 while the means in the horizontal column with the different alphabet(s) are not significantly different at P ≤ 0.05

Table 7: Extract from statistical analysis on number of fruits showing the treatment combinations, mean, standard error and DMRT

TC	Week 10	Week 12	Week 14	Week 16	Week 18	Week 22	Total	Mean
a_0b_0	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.33±0.33^{c}	0.00±0.00^{b}	0.00±0.00^{e}	0.33±0.33	0.06±0.06
a_1b_o	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.0Q^{C}	1.00±0.58^{bc}	2.00±l.15^{ab}	17.87±11.82^{e}	20.87±13.55	3.48±2.26
a_2b_o	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.67±0.67^{c}	0.33±0.33^{b}	0.00±0.00e	1±1	0.17±0.17
a_3b_0	0.00±0:00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	1.33±0.88^{bc}	'0.33±0.33^{b}	31.27±l7.87^{de}	32.93±19.08	5.49±3.18
a_0b_1	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{c}.	0.00±0.00^{b}	80.40±40.20^{bcde}	80.40±40.2	13.4±6.7
a_1b_1	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.33±0.33^{c}	0.67±0.67^{b}	71.47±11.82^{cde}	72.47±12.82	12.08±2.14
a_2b_1	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	1.00±0.58^{bc}	2.00±2.00^{ab}	13.40±7.74^{e}	16.4±1 0.32	2.73±1.72
a_3b_1	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{c}	0.33±0.33^{b}	165.27±29. 92^{b}	165.6±29.62	27.6±4.94
a_ob_2	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{c}	0.00±0.00^{b}	26.80±7.74^{e}	26.80±4.47.	7.74±1.29
a_0b_2	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{c}	0.00±0.00^{b}	31.33±8.97^{de}	31.33±8.97	5.22±1.50
a_1b_2	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	2.00±0.58^{bc}	2.00±0.58^{ab}	0.00±0.00^{c}	4.00±0.67	1.16±0.19
a_3b_2	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	2.00±l.15^{bc}	1.67±0.88^{ab}	89.20±49.79^{bcde}	92.87±51.82	15.48±8.64
a_0b_3	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.67±0.67^{c}	3.33±0.88^{ab}	120.60±50.73^{bcd}	124.6±52.28	20.77±8.71
a_1b_3	,0.00±0.00^{b}	1.33±0.33^{a}	1.67±0.33^{b}	2.00±0.58^{bc}	4.67±3.71^{ab}	40.20±7.74^{bc}	49.87±12.69	8.31±2.12
a_2b_3	0.00±0.00-^{b}	1.67±0.33^{a}	2.33±0.8S^{ab}	4.67±1.76^{b}	5.00±3.06^{ab}	383.27±56.18^{cdc}	396.94±62.21	66.16± 10.37
a_3b_3	1.00±0.58^{a}	1.67±0.88^{a}	2.67±0.33^{a}	8.67±3.67^{a}	7.33±4.10^{a}	383.27±56.18^{a}	404.61±65.74	67.44±10.96

Note: TC=treatment combination, a_0= river sand, $a_1$sandy soil, a_2=clay soil, a_3=loamy soil, b_0= 0Kg ha $^{-1}$, b_1=111Kg ha $^{-1}$, b_2=222kg ha^{-1}, b_3=333Kg ha $^{-1}$ of NPK fertilizer. The means in the horizontal column with the same alphabet(s) are not significantly different at $P \leq 0.05$, while the means in the horizontal column with the different alphabet(s) are not significantly different at $P \leq 0.05$

Table 8: Extract from statistical analysis on weight (g) of fruits showing the treatment combinations, means, standard error and DMRT

TC	Week 14	Week 16	Week 18	Week 22	Total	Mean
a_0b_0	6.37±6.37^{abc}	0.00±0.00^{c}	0.00±0.00^{a}	0.00±0.00^{e}	6.37±6.37	1.59±59
a_1b_0	12.80±6.55^{acb}	0.00±0.00^{c}	10.30±5.21^{a}	17.87±11.82^{e}	40.97±23.58	10.24±5.90
a_2b_0	3.90±3.90^{bc}	0.00±0.00^{c}	3.90±3.90^{a}	0.00±0.00^{e}	7.8±7.80	1.95±1.95
a_3b_0	9.83±4.92^{abc}	0.00±0.00^{c}	5.03±5.03^{a}	31.27±17.87^{de}	46.13±27.82	11.53±6.96
a_0b_1	0.00±0.00^{c}	0.00±0.00^{c}	0.00±0.00^{a}	80.40±40.20^{bcde}	80.40±40.20	20.1±10.05
a_1b_1	5.63±9.76^{abc}	0.00±0.00^{c}	0.00±0.00^{a}	71.47±11.82^{cde}	77.1±21.58	19.28±5.40
a_2b_1	12.00±11.25^{abc}	0.00±0.00^{c}	9.77±4.98^{a}	13.40±7.74^{e}	35.17±23.97	8.79±5.99
a_3b_1	0.00±0.00^{c}	0.00±0.00^{c}	0.00±0.00^{a}	165.27±29.29^{b}	165.27±29.29	41.32±7.32
a_0b_2	0.00±0.00^{c}	0.00±0.00^{c}	0.00±0.00^{a}	26.80±13.40^{e}	26.80±13.40	6.7±3.35
a_1b_2	0.00±0.00^{c}	0.00±0.00^{c}	0.00±0.00^{a}	31.33±8.97^{de}	31.33±8.97	7.83±2.24
a_2b_2	14.43±0.63^{ab}	11.20±5.61^{b}	11.47±5.83^{a}	0.00±0.00^{e}	37.10±12.07	9.28±3.02
a_3b_2	11.53±5.86^{abc}	0.00±0.00^{c}	4.47±4.47^{a}	89.20±49.79^{bcde}	105.2±60	26.3±15
a_0b_3	6.43±6.43^{abc}	6.40±6.40^{bc}	5.07±5.07^{a}	120.60±50.73^{bcd}	138.5±68.63	34.64±17.16
a_1b_3	18.13±0.44^{b}	20.53±1.29^{b}	11.73±5.93^{a}	40.27±7.74^{adc}	90.59±15.4	22.65±3.85
a_2b_3	18.60±0.20^{a}	18.07±0.70^{a}	6.13±6.13^{a}	125.07±19.47^{bc}	167.87±28.5	41.97±7. 13
a_3b_3	18.67±0.79^{a}	20.07±1.67^{a}	5.07±5.07^{a}	383.27±56.18^{a}	427.08±63.71	106.77±15.93

Note: TC=treatment combination, a_0= river sand, $a_1$sandy soil, a_2=clay soil, a_3=loamy soil, b_0= 0Kg ha $^{-1}$, b_1=111Kg ha $^{-1}$, b_2=222kg ha^{-1}, b_3=333Kg ha $^{-1}$ of NPK fertilizer The means in the horizontal column with the same alphabet(s) are not significantly different at $P \leq 0.05$ while the means in the horizontal column with the different alphabet(s) are not significantly different at $P \leq 0.05$.

There was no sign of senescence probably due to continued watering and the plant being shrubby (not herbaceous). Under regular supply of water and by carrying out other necessary tending/cultural operations (e. g. weeding, insect/pest control, application of manure, etc) this plant thrives perennially.

Pertaining to the weight of fruits, the trend was not different, it was TC a3b3 that had the highest total weight of fruits (427g /plant or 11.91ton/ha between 14 and 22 WAP followed by a2b3 (4.69 ton/ha), a3b1 (4.60 ton/ha) and a_ob_o was the least (0.17 ton/ha) among the 16 treatment combinations (TC). ANOVA indicated significant differences among the various TC at $P \leq 0.05$ (Table 8).

Results obtained on plant's fruit number/weight could be attributed to the nature of the growth medium of each of the treatment combinations (Tables 1 & 2) and fertilizer level, which determined the nutrient status of the growth medium and subsequently growth rate and yield (e. g. Tables 3, 5, 6 &7). But an exemption to this yardstick/standard is TC a0b3, the growth medium was river sand which had very low nutrient status (Table 2) though with high fertilizer level, but still had higher values (in fruit number/weight) more than TC such as a3b2, a2b3 and a2b2. Owing to the fact that the sizes of ripe/mature fruits within each treatment combination (TC) were more or less the same, thus, the weight of fruits per TC was directly proportional to the number of fruits harvested (Kareem, 2015).

CONCLUSION

This study revealed that *Solanum melongena* (garden egg) could be productively cultivated in the study area and its environs by employing growth media such as loamy, clayey or sandy soils, but preference should be given to loam at 333kg NPK ha^{-1} in order to obtain optimal yield. Although, 222kg NPK ha^{-1} can employed where the cost of procurement of the NPK fertilizer is too exorbitant.

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