Phytology

The comparative assessment of different fertilizer application on the growth and development of *Solanum aethiopicum* (Linn)

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Received 8 Jan 2022; Accepted 21 Feb 2022; Published 9 Mar 2022

Abstract

A study on the comparative effects of different fertilizers on the growth and development of *Solanum aethiopicum* was carried out at the teaching and research farm of Ebonyi state university, presco campus. Randomized Complete Block Design was used for the study. The soil samples were treated with N:P:K 15:15:15, poultry excreta, cow dung and no fertilizer (control), the seeds were sown by spraying. Growth parameter such as plant height, leaf area and plant girth were monitored and data collected for 8 weeks. The study revealed that in week one, NPK gave the highest plant height, leaf area and stem girth 23.61±347, 26.86±3.18 and 2.27±0.18 respectively while the control samples had the least all parameters tested. In week two, there was a slight increase in the parameter tested for all treatments but week three and four gave a significant increase, with NPK giving a plant height of 42.05±3.66 (week 3) and 52.61±4.07 (week 4), leaf area 31.78±5.81 (week 3) and 32.63±8.18 (week 4), and stem girth 2.24±0.22 (week 3) and 2.24±0.33 (week 4). Week five showed a slight difference from the values obtained in week four in all treatments. For week six, NPK gave the highest plant height 69.96±5.59; the control gave the highest leaf area 32.42±23.26 while the stem girth had almost the same value for all treatments. The control gave a value of 50.47±7.52 for plant height in week 7 but dropped to 48.60±13.52 in week eight. The leaf area and stem girth showed very slight difference in week 7 and 8. This study revealed that *Solanum aethiopicum* growth parameters, such as plant height, leaf area and plant girth obtained from NPK fertilizer was also significantly higher than that of cow dung, poultry excreta and control values. Thus NPK 15:15:15 should be used in the cultivation of *Solanum aethiopicum* for fast growth and development.

Keywords: cow dung, poultry excreta, N: P: K, growth, development, *Solanum aethiopicum*, plant height, leaf area, stem girth

1. Introduction

Solanum aethiopicum is among the indigenous underutilized vegetables consumed by the resource poor women in the southeast Nigeria to meet daily vegetable requirements to supply minerals, vitamins and protein for women because of their inability to purchase highly nutritious food items such as egg, meat and milk [1]. However, Production and consumption of the vegetables have been limited, primarily, due to insufficient information on the agronomic requirements, nutritional and health benefits, cooking techniques and market opportunities [2]. The vegetable is believed to be nutritive and serve as cheap sources of minerals and vitamins. Helping women improve the productivity of more nutritious, high-value products such as vegetables will not only increases family income but also promote ground-level nutrition by increasing the amount of healthy food available for home consumption. This crop diversification provides variety for primarily rice-based diets, which inherently lack the availability of primary, secondary and micronutrients necessary for human health.

Vegetable production in Africa is as old as peasant farming though its cultivation is still at the household level with very few farmers producing on a commercial level. This could be due to the fact that energy-given crops such as cereals, roots and tubers and body-building crops like legumes are giving much attention. Cereals and tubers form the bulk of food consumed in the tropics but they are deficient in minerals and vitamins compared to the body requirement to guarantee good health living. Vegetables supply an important amount of vitamins and minerals required by the body. In Nigeria, vegetables are usually cultivated in the rainy season when they grow luxuriantly giving high yields with a resultant cheap market price.

The commonly grown and consumed vegetables in Nigeria include: *Solanum spp*., *Amaranthus spp.*, *Hibiscus spp.* and *Curcubita spp*. *Solanum aethiopicum* is non-tuberous leafy specie possibly indigenous to Nigeria and known as a good source of vitamins and minerals [3].

This vegetable (*Solanum aethiopicum*) has been given different local names by various authors. It is called “Osun' or “Igbagba” in the western part of Nigeria [4, 5], “Gboma” in some part of west Africa, “Anara” in the South eastern part of Nigeria. *Solanum aethiopicum* is an important member of the family *Solanaceae* alongside with other cultivated specie like potato, tomato and pepper. It is grown commonly for its leaves and fruits. It could be cultivated sole or intercropped in patches with staple food crops such as cassava and yam. It has perennial tendency and sprouts at the onset of rains the following year after withering of the top growth in the dry season. All being equal, this vegetable exhibits its full potential luxuriant growth when grown in a soil that supplies all required nutrients in adequate quantity. Most soils used for its cultivation do not supply the crops nutrients requirements. This necessitates the

need for fertilizer application, both organic and inorganic [3].

In Nigeria, the soils of the southern Guinea zone are inherently low in soil fertility, especially of nitrogen and organic matter with resultant low crop yields [6]. Reijntties *et al.* [7] and Adepetu [8] remarked, that the downward trend in food production should prompt farmers to amend the soil with different materials in order to enhance growth yield of crops.

Application of fertilizers to soil is an effective means of improving soil fertility. The use of organic fertilizer in soil have gained wide acceptance in improving soil fertility and it has significantly increased the yield of crops and vegetables such as *Zea mays* and *Solanum aethiopicum;* however, its scarcity and removal of government subsidy makes its use unprofitable for crops and vegetable productions [9].

Application of organic fertilizers is also an important means of maintaining soil fertility status and it is also environmental friendly, because nutrients contained in organic manures are released slowly and are stored for a longer time in the soil, thereby ensuring a long residual effect [10].Poultry farmers and cattle farmers, generate a lot of poultry excreta and cow dung as waste on their farms, these wastes could be turned to wealth by using it as organic fertilizer for vegetable production for healthy living as well as additional income generation to the farmers, also N: P: K can be used to aid growth and development of vegetable when organic fertilizer is out of reach and also as a good source of nitrogen which is needed by the plant but mostly low in organic fertilizer. The aim of this study was to compare the effects of different fertilizer application on the growth and development of *Solanum aethiopicum.*

2. Materials and Method

Study Area

The study area falls within Ebonyi state university Abakaliki, which is geographically located between latitude $6^0$15'N and $6^0$2^0'N and longitude $8^0$5'E and $8^0$10'E, which lies in the south eastern belt of Nigeria. The region has luxuriant vegetation of tropical which is densely populated with grasses and trees of different sizes in the area. It is a humid tropical region, which experiences eight months of rainy season and four months of dry season. Harmattan is felt between December and January. The mean annual temperature stands at 28^0C and the mean annual rainfall of 2500mm. The soil type is loamy clay and clayey loam.

Seed Collection

Solanum aethiopicum seeds were used in this experiment or study were sourced from a local market in Abakaliki (Abakpa Market).

Growth Parameters

- Height of the plant.
- Leaf area.
- Stem girth.
- Fresh and dry weight of the plant.

They were all measured using meter rule, measuring tape and electronic weighing balance. The plant height was taken from the soil surface to the apical tip of the plant. The tape was placed on a meter rule where the values were taken and recorded.

Procedure

A portion of land was cleared in Presco campus, Ebonyi State University Abakaliki, and was ploughed and harrowed manually; the experimental layout was a randomized complete block design (RCBD). Four blocks were made, each fertilizer (cow dung, NPK, poultry dung) were mixed on one ridge each and left for two days to enable the fertilizer mixed with the soil properly. The control is left without any amendment. The seeds, which were sourced from a local market, are sown by spraying, on top of the four blocks. The seedlings emerge after six days of sowing. The *S. aethiopicum* experimental plot was irrigated with the help of a watering can belonging to the department of applied biology in Ebonyi state university. The irrigation was done immediately after sowing the seeds as *S. aethiopicum* needed sufficient water to germinate and this was continued all through the period of cultivation, except when there was sufficient rainfall. Weeding was carried out manually from time to time on the experimental plot throughout the period of the research. After 30 days of seedlings emergence, the seedlings were thinned to twenty seedlings per block, and readings commence after 2 days of thinning. The following parameters were taken into cognizance;

- Height of the plant
- Girth of the plant
- Leaf area
- Ten plants were masked on each block and measured weekly. The reading where taken seven times consecutively.

Date of Planting and Harvesting of *Solanum aethiopicum* Plant

Sowing	Harvesting
24/7/2015	21/9/2015

Data Analysis

The data obtained in this study was analyzed using Analysis of Variance (ANOVA).

3. Results

Table 1: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 1

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	6.028 ±2.99	15.42± 2.76	1.18± 0.29
NPK	23.61±347	26.86±3.18	2.27±0.18
Poultry Excreta	10.96±2.15	21.02±1.64	1.63±0.17
Cow dung	12.36±2.86	22.07±2.99	1.72±0.19
Total	13.30±2.86	21.34±2.64	1.70±.0.47

From the table above, it was observed that the height, leaf area and girth of all the manure applied showed significant increase in week 1, when compared to the control (height 6.28±2.99, leaf area 15.42±2.76 and girth 1.18±0.29), with the NPK having the highest values (23.61±3.47, 26.86±3.18 and 2.27±0.18).

Table 2: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 2

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	9.69±4.00	18.76±3.32	1.54±0.33
NPK	29.81±4.58	28.99±1.89	2.13±0.32
Poultry Excreta	16.56±3.37	22.96±2.41	1.77±0.23
Cow dung	17.10±2.48	24.61±3.58	1.76±0.25
Total	18.29±3.60	23.83±2.80	1.80±0.28

It was observed that the height, leaf area and girth of all the manure applied shows a significant increase in week 2, when compared to the control (height 9.69±4.00, leaf area 18.76±3.32 and girth 1.54±0.33), with the NPK, having the highest values (29.81±4.58, 28.99±1.89 and 2.13±0.32).

Table 3: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 3

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	16.72±4.95	22.28±4.73	1.65±0.24
NPK	42.05±3.66	31.78±5.81	2.24±0.22
Poultry Excreta	26.26±4.88	25.08±2.86	1.79±0.19
Cow dung	26.43±2.85	27.34±4.54	2.00±0.36
Total	27.86±4.08	26.60±4.48	1.92±0.25

It was observed that the height, leaf area and girth of all the manure applied shows a significant increase in week 3, when compared to the control (height 16.72±4.95, leaf area 22.28±4.73 and girth 1.65±0.24), with the NPK, having the highest values (42.05±3.66, 31.78±5.81and 2.24±0.22).

Table 4: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 4

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	26.63±3.93	23.32±7.52	1.9±0.53
NPK	52.61±4.07	32.63±8.18	2.24±0.33
Poultry Excreta	34.81±4.63	26.04±4.03	2.03±0.22
Cow dung	37.48±4.40	27.19±7.44	2.12±0.49
Total	37.88±4.25	27.29±6.79	2.07±0.39

The table shows, that the height, leaf area and girth of all the manure applied shows a significant increase in week 4, when compared to the control (height 26.63±3.93, leaf area 23.32±7.52 and girth 1.9±0.53), with the NPK, having the highest values (52.61±4.07, 32.63±8.18 and 2.24±0.33).

Table 5: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 5

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	35.48±3.82	25.25±8.51	2.21±0.55
NPK	56.36±15.17	29.46±4.69	2.40±0.20
Poultry Excreta	41.57±5.82	25.55±4.39	1.94±0.39
Cow dung	45.04±8.25	29.91±7.77	2.22±0.45
Total	44.61±8.26	27.54±6.34	2.19±0.39

The table shows, that the height, leaf area and girth of all the manure applied shows a significant increase in week 5, when compared to the control (height 35.48±3.82, leaf area 25.25±8.51 and girth 2.21±0.55), with the NPK, having the highest values (56.36±15.17, 29.46±4.69 and 2.40±0.20).

Table 6: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 6

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	42.46±3.93	32.42±23.26	2.36±0.52
NPK	69.96±5.59	27.87±5.55	2.73±0.23
Poultry Excreta	48.53±10.68	25.29±4.64	2.25±0.34
Cow dung	52.39±10.86	29.30±6.88	2.45±0.47
Total	53.33±7.76	28.72±10.8	2.44±0.39

The result, shows that there was a significant increase in all the manure height when compared to the control (42.46±3.93), but the leaf area has no significant ($P<0.05$) increase, when compared to the control (32.42±23.26). There is also a significant ($P<0.05$) increase in the girth of NPK and cow dung when compared to the control the fowl dung has no significant control.

Table 7: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 7

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	50.47±7.52	26.63±7.97	2.28±0.43
NPK	76.28±7.98	26.10±3.11	2.83±0.22
Poultry Excreta	57.21±6.40	24.57±4.73	2.25±0.13
Cow dung	64.35±10.98	28.51±9.05	2.58±0.46
Total	62.07±32.88	26.45±6.22	2.49±0.26

Here, the height, leaf area and girth of all the manure applied shows a significant increase in week 7, when compared to the control (height 50.47±7.52, leaf area 26.63±7.97 and girth 2.28±0.43), with the NPK, having the highest values (76.28±7.98, 26.10±3.11and 2.83±0.22).

Table 8: Effect of N: P: K, Poultry Excreta and Cow Dung on Plant Height, Leaf Area Plant Girth for Week 8

Growth Parameters			
Fertilizer	**Height**	**Leaf Area**	**Girth**
Control	48.60±13.52	26.18±9.08	2.80±0.56
NPK	80.77±7.66	27.50±5.55	3.00±0.26
Poultry Excreta	58.34±16.95	25.97±9.30	2.74±0.57
Cow dung	67.48±13.13	29.16±8.52	2.81±0.65
Total	63.79±12.81	27.20±8.11	2.83±0.51

Here, the height, leaf area and girth of all the manure applied shows a significant increase in week 8, when compared to the control (height 48.60±13.52, leaf area 26.18±9.08 and girth 2.80±0.56), with the NPK, having the highest values (80.77±7.66, 27.50±5.55and 3.00±0.26).

4. Discussion

Both organic and inorganic fertilizers are important because they are required in large quantities by plants. In Nigeria and other West African countries where S*olanum aethiopicum* are grown as vegetable the maintenance of the soil organic matter content through the use of manure will be of primary importance to any soil management program. *Solanum aethiopicum* requires fertilizer application to ease the twin problem of scarcity and cost associated with the vegetable, the result from this study showed that fertilizer has a significant role to play in *Solanum aethiopicum* production.

This study indicated that NPK produced higher values for both edible and economic yield as against organic fertilizer which releases their nutrients slowly into the soil though not easily leached as the NPK. This result is in accordance with the finding of Adeyeye *et al*. [11] which states that NPK improves the vegetative growth parameters of plant, it also highlights the possibility of the use of NPK in the production of leafy vegetable. The study showed that (NPK 15:15:15) has the greatest yield among all the growth parameters, showing a significant increase above all the other treated blocks or ridges throughout the duration of the experiment, this result is in agreement with the findings of Olaniyi and Ojetayo [12] who reported that the application of NPK fertilizer gave vigorous development in plant vegetative parts due to the release considerable amount of nutrients for plant use, which is essential for the formation of plant essential molecules such as chlorophyll and protoplasm. This significant increase in all growth parameters may be attributed to the quick release of nutrient to the soil, which helps in the rapid growth and development of plant. The promising yield obtained with organic fertilizer (NPK) is a pointer to its potential use in vegetable production in Nigeria. The use of organic fertilizer (high and fast nutrient release) will therefore enhance vegetable production.

Second to NPK in terms of increase in all the growth parameters, is the cow dung which showed an increase in all the growth parameters throughout the period of the study. This result disagrees with the findings of Awodun [13] who reported that managing and putting cow dung into effective agricultural use is also often a problem because they are bulky, low grade fertilizers of variable composition and frequently, have high water content thus, not easy to transport far from point of source, and on farm management problems and associated offensive odors further complicate their use, but agrees with the findings of Schonberg *et al.*[14] who reported that these wastes could however be used to alleviate soil nutrients depletion problems, this increase in all the growth parameters seconding the NPK might be due to the mixing of the cow dung with lighter materials, such as straws or hays, in addition to the usual organic substances from vegetable matter or garden debris, prior its use as manure.

The fowl dung also showed an increase in the growth of the different parameters throughout the subsequent weeks there was a bit decline in all the growth parameters and a significant decrease was observed when compared to the NPK and cow dung. This study contradicts the findings of Warman [15] Duncan [16] which states that poultry manure is preferred amongst other animal wastes because of its high concentration of macro-nutrients. Among all the plants, the controls produce the lowest yield in all the growth parameters throughout the duration of the study.

There was a significant decrease in the plants without treatment (control), when compared to others treated with NPK, cow dung and fowl dung. This result is in agreement with the report of Donoron and Cassey [17] who reported that *Solanum aethiopicum* being a Vegetable required Nitrogen for cell division and enlargement, production of protoplasm and leaf size development, while the disturbance of these physiological processes as a result of inadequate nutrient supply will eventually lead to yield reduction [18].

5. Conclusion

This study indicates that applications of both organic and inorganic fertilizer are good and valuable method that needs to be encouraged. An application rate of 5% was capable of increasing yield more than 100% over the control. Preferably, NPK should be recommended to farmers because of its capacity of increasing crop yields within a short period of time, though its high cost and soil degradation effect makes it second to organic fertilizer. On the other hand, organic fertilizer should be used because they are environmental friendly though they are released into the soil slowly; they supply the soil nutrients which in turn make the soil fertile and ready for farming.

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