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Unveiling the Dynamic Impact of Organic and Inorganic Fertilizers and their Combination on Growth and Yield of Gboma Eggplant (*Solanum macrocarpon* L.)

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Abstract

Gboma eggplant is a food security crop with numerous health benefits that improve human health and provide good nutrition. Therefore, soil amendment is necessary to enhance its production and maximize yield. A field experiment was carried out at the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana to investigate the growth and yield response of the gboma eggplant to different soil amendments. The experimental design used was a Randomized Complete Block Design with three replications. Landrace fruits were collected and seeds were extracted at the Offinso municipal. The seeds were nursed and transplanted onto a field at 50 × 50 cm spacing. The treatments imposed were NPK 15:15:15 133.5 kg/ha, 5 t/ha Poultry manure, 10 t/ha Poultry manure, NPK 15:15:15 66.75 kg/ha + 2.5 t/ha Poultry manure, NPK 15:15:15 66.75 kg/ha + 5 t/ha Poultry manure, NPK 15:15:15 133.5 kg/ha + 5 t/ha Poultry manure and NPK 15:15:15 133.5 kg/ha + 2.5 t/ha Poultry manure. All cultural practices were done timely. Data taken included plant height, number of leaves per plant, number of branches, leaf area, chlorophyll content, plant girth, growth rate, dry weight, days to 50% flowering, leaf yield, and fruit yield. The experiment results showed that the application of NPK, poultry manure and their combined application significantly affected all parameters except growth rate. The yield of leaves and fruits was significantly affected ($P < 0.05$) by the treatments and was greatest was in the NPK 15:15:15 133.5 kg/ha + 2.5 t/ha Poultry treatment.

Keywords

Soil amendment, Gboma eggplant, Leaf yield, Fruit yield

Introduction

Gboma (*Solanum macrocarpon*) is a very significant crop with 32 million tons of global production, the gboma eggplant is ranked the third most important Solanaceae crop [1]. It is common across warmer and drier regions of Africa where it serves as a fruit and leafy vegetable [2,3]. Gboma eggplant is abundant in protein, fiber, calcium, iron, potassium, magnesium, phosphorus, and salt [4,5]. The protein in Gboma leaves and fruit is of good quality, it provides many households with economical but nutritious food [6]. Boiling the leaves will release the juice, which can be used to treat asthma, whooping cough, and jaundice [7].

Gboma eggplant belongs to the Solanaceae family with chromosome 2n = 24, 36 [8]. The fruit is a depressed, globose berry that is 2-6 cm in diameter and 3-10 cm high. When young, the fruit is green, ivory, or purplish white with dark stripes; when it is ripe, the fruit turns yellow to brownish [9]. Gboma eggplant takes up a lot of nutrients and occupies a lot of space in the ground, fertilizer application is therefore essential [10].

Inorganic fertilizers are widely used by farmers due to their ability to supply essential nutrients much faster than organic types [11]. In recent years, organic fertilizers, once a traditional method of preserving soil fertility, have received increased attention. The well-to-do farmers are the only people who can afford the inorganic fertilizer after prices have doubled. To maintain soil fertility and increase productivity, the use of organic fertilizer to replenish soil fertility is therefore vital [12,13]. A report by Crespi, et al. [14] examining recent fertilizer price changes reiterates that one of the agricultural inputs that has attracted a lot of attention is

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fertilizer. They explained that fertilizer prices are two to four times higher than the prices recorded in September 2020.

Organic fertilizers, in addition to providing essential macro and micronutrient elements to plants, improve soil physicochemical conditions, increase soil productivity, increase soil organic carbon content, soil flora and fauna, soil crumb structure, and soil nutrient status to achieve sustainable high yields. In addition, organic fertilizer also improves physical fertility indicators such as soil aggregation, porosity, and water retention [15].

An important soil characteristic known as organic matter content is continuously being lost in agricultural soil. Because manure application can enhance the physical and chemical characteristics of soil, it is one of the most economical practices for soil and water conservation [16]. Organic fertilizers are frequently supplemented with inorganic fertilizers due to insufficient availability and competing uses, making it difficult to maintain the levels of productivity required to feed Africa's rapidly growing population. Improving soil productivity in Africa will thus necessitate an increase in the use of inorganic or "mineral" fertilizers [17]. It is however, important to note that the combination of organic and inorganic fertilizers may produce higher yields than either organic or inorganic fertilizers alone because inorganic fertilizers release nutrients quickly and meet the plant's needs at the appropriate time, whereas organic manure slowly releases nutrients and recaptures the growth rate in later stages [18].

According to Glaser, et al. [19], the application of organic matter, such as manures, can only temporarily replenish soil organic matter losses. However, when used alone, organic manures might have a low nutrient content and thus be unable to satisfy the needs of the gboma eggplant. However, there has not been much research on the use of organic and inorganic fertilizers in the cultivation of the gboma eggplant. The study was conducted to determine the effects of NPK fertilizer, poultry manure and their combination on the growth and yield of gboma eggplant in the Ashanti region of Ghana.

Materials and Methods

The study was conducted at the Plantation section of the Crop and Soil Sciences Department, KNUST. The field is located on the latitude 06° 41' North and longitude 01° 33' West. The trial was conducted between February and May 2023. The location experiences a bimodal rainfall and is found within the semi-deciduous forest zone with an average rainfall of 1450 mm. April through July is the major season, and September through November is the minor season. The maximum and minimum temperatures were 32 and 20 °C, respectively with relative humidity ranging between 75 and 79% (KNUST Meteorological Center, 2023). The results of soil analysis before the application of the treatment indicated pH 6.84, organic matter 1.9%, total N 0.11, available P 6.7 and exchangeable K 0.3. Poultry manure analysis results were as follows: Total nutrients in percentage are, N 2.62, P 2.20, K 2.23, C:N ratio of 18.86 and pH 6.86. A randomized complete block design was used in the experiment, and treatments were replicated three times. The treatments were; Control (No fertilizer application), NPK 15:15:15 133.5 kg/ha, 5 t/ha Poultry manure, 10 t/ha Poultry manure, NPK 15:15:15 66.75 kg/ha + 2.5 t/ha Poultry manure, NPK 15:15:15 66.75 kg/ha + 5 t/ha Poultry manure, NPK 15:15:15 133.5 kg/ha + 5 t/ha Poultry manure and NPK 15:15:15 133.5 kg/ha + 2.5 t/ha Poultry manure.

Gboma eggplant ripe fruits from a popular landrace were obtained from Offinso Municipality, and cut into two and soaked in water for twenty-four hours. Seeds were extracted afterward and air-dried for three days. Seeds were drilled onbeds which were covered with palm fronds and watered. The palm fronds were removed one week after the visible signs of seedling emergence. The experimental plot was slashed, ploughed, and harrowed to a fine tilth. The plot was divided into three blocks each measuring 23.5 m by 3.0 m, and then eight treatment plots, each measuring 3.0 m × 2.5 m. An alley of 0.5 m was left between the plots and 1 m between blocks. The seedlings were transplanted five weeks after nursing at one seedling per hill at a spacing of 50 cm by 50 cm and a depth of about 6 cm. All cultural practices were carried out when appropriate. Application of Sunpyriofos with active ingredient chlorpyrifos-ethyl 40% EC was made at 20 DAT to control caterpillars, leaf miners and grasshoppers at a rate of 40 ml in 15 L of water with a knapsack sprayer. Poultry manure was applied two weeks before transplanting of the seedlings depending on the treatments. The inorganic fertilizer was applied two weeks after transplanting of seedlings by using the side placement method.

Data collection and analysis

Data collection began four weeks after transplanting from five tagged plants which were randomly selected from each plot. The data collected were collected at 4, 6, and 8 weeks after transplanting of plants (WAT). Fruit and stem girth were measured using vernier callipers, chlorophyll content was measured using Opti-Science chlorophyll meter at 21 days after transplanting. Leaf area was measured non-destructively using a centimetre rule. Length and width were measured and multiplied by the correction factor of 0.70 [20]. Plant height was measured with a meter rule from the ground up to the terminal point. Fruit and leaves were harvested from the two middle rows at 8 WAT and weighed using the top pan weighing balance. Number of leaves, branches and fruit per plot was counted. The plants were monitored to establish the number of days after transplanting it took for the appearance of 50% flowering. Dry matter accumulated between 2-time intervals was used to determine the crop growth rate for each plot. All data was analysed using the Analysis of variance technique with GenStat version 12.1 edition. The Least Significant Difference (LSD) was used to determine statistical differences at a 5% level of probability.

Results and Discussion

Plant height and number of leaves per plant

The effect of different rates of the treatments on plant height and number of leaves are shown in Table 1. At 4 WAT, plant height was significantly affected ($P < 0.5$) by the treatments. The treatments did not result in significant

Table 1: Effects of NPK and poultry manure rates and their combinations on the plant height and the number of leaves of gboma eggplant.

	Plant height (cm) at			Number of leaves at		
Treatment	**4 WAT**	**6 WAT**	**8 WAT**	**4 WAT**	**6 WAT**	**8 WAT**
Control (No fertilizer)	13.90^{a}	34.18^{a}	55.33^{a}	26.7^{a}	55.4^{a}	66.13^{a}
NPK 15-15-15 133.5 kg/ha	19.69^{ab}	46.50^{b}	64.00^{ab}	33.2^{a}	64.07^{ab}	80.00^{ab}
5 t/ha Poultry manure	22.77^{ab}	44.33^{b}	60.47^{ab}	30.8^{a}	60.07^{ab}	70.6^{a}
10 t/ha Poultry manure	24.23^{b}	45.67^{b}	69.43^{b}	37.7^{a}	77.47^{cd}	92.13^{b}
NPK 15-15-15 66.75 kg/ha + 2.5 t/ha PM	15.43^{ab}	42.40^{ab}	66.47^{ab}	33.7^{a}	60.6^{ab}	74.00^{a}
NPK 15-15-15 66.75 kg/ha + 5 t/ha PM	20.73^{ab}	49.30^{b}	71.00^{b}	37.7^{a}	66.47^{abc}	78.33^{ab}
NPK 15-15-15 133.5 kg/ha + 5 t/ha PM	22.8^{ab}	47.13^{b}	69.20^{b}	38.9^{a}	68.07^{bc}	76.6^{a}
NPK 15-15-15 133.5 kg/ha + 2.5 t/ha PM	23.67^{b}	50.07^{b}	69.07^{b}	35.9^{a}	86.27^{d}	91.47^{b}
p-value	0.01	< 0.001	0.011	0.26	< 0.001	< 0.001
CV (%)	15.9	6.8	7	17.4	6.2	6.2

*Means followed by same letters are not significantly different at 5% probability.

Table 2: Effects of NPK and poultry manure rates and combined application on the number of branches and stem girth of gboma eggplant.

	Number of branches at			Stem girth (cm) at		
Treatment	**4 WAT**	**6 WAT**	**8 WAT**	**4WAT**	**6WAT**	**8WAT**
Control (No fertilizer)	2.47^{a}	3.60^{a}	4.47^{a}	0.95^{a}	1.29^{a}	2.11^{a}
NPK 15-15-15 133.5 kg/ha	6.07^{b}	6.67^{b}	8.47^{b}	1.39^{bc}	1.41^{ab}	2.25^{ab}
5 t/ha Poultry manure	5.73^{b}	6.13^{b}	7.4^{b}	1.13^{ab}	1.44^{ab}	2.10^{a}
10 t/ha Poultry manure	5.87^{b}	6.33^{b}	8.47^{b}	1.63^{c}	1.87^{c}	2.30^{ab}
NPK 15-15-15 66.75 kg/ha + 2.5 t/ha PM	5.67^{b}	6.27^{b}	7.87^{b}	0.94^{a}	1.39^{ab}	2.24^{ab}
NPK 15-15-15 66.75 kg/ha + 5 t/ha PM	5.53^{b}	6.53^{b}	8.0^{b}	1.11^{ab}	1.65^{bc}	2.23^{ab}
NPK 15-15-15 133.5 kg/ha + 5 t/ha PM	6.00^{b}	6.87^{b}	8.27^{b}	1.09^{ab}	1.79^{c}	2.57^{b}
NPK 15-15-15 133.5 kg/ha + 2.5 t/ha PM	6.27^{b}	7.00^{b}	8.27^{b}	1.41^{bc}	1.82^{c}	2.51^{ab}
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01
CV (%)	10.1	9.8	8.6	11.6	7.6	6.3

*Means followed by same letters are not significantly different at 5% probability.

differences (P > 0.05 in the number of leaves at 4WAT Application of 10 t/ha Poultry manure and NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure recorded the greatest plant height, whose effects were significantly higher than that of the control treatment only. Plant height was significantly different at 6 WAT; NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure treatment effect was greater than the control treatment only. All other treatment differences were not significant. At 6 WAT, the number of leaves per plant in the treatment NPK 15-15-15 was 133.5 kg/ha + 2.5 t/ha Poultry manure combined application recorded the greatest number of leaves per plant, which was significantly higher than all other treatments except that of the 10 t/ha Poultry manure treatment. At 8 WAT, the height of the gboma eggplant was significantly affected with the treatment, NPK 15-15-15 66.75 kg/ha + 5 t/ha Poultry manure treatment effect was significantly higher than that of the control treatment only. The control treatment effect was similar to those of NPK only, 5 t/ha Poultry manure, 10 t/ha Poultry manure and NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure treatments (Table 1). The result collaborated with the observation that vegetable crops preferred chicken manure in combination with inorganic fertilizers containing nitrogen, such as NPK and Urea [21], as poultry manure alone is thought to break down slowly and may not fulfill vegetable growth [22]. At 8 WAT, the 10 t/ha Poultry manure treatment effect was the greatest, but this was higher than those of the control, 5 t/ha Poultry, NPK 66.75 kg/ha + 2.5 t/ha Poultry manure, and NPK 15-15-15 133.5 kg/ha + 5 t/ha Poultry manure treatments only. The performance of the poultry manure at this stage agreed with Jahn, et al. [23] who found that poultry manure has vital nutrient elements that support optimum photosynthetic actions and ends up in proper root and vegetative growth.

Number of branches and stem girth

The treatments applied had a significant effect (P < 0.05) on the number of branches as shown in Table 2. On all sampling days, all the treatment effects were statistically similar except the control. According to Patterson, et al. [24], poultry manure is known for releasing nutrients slowly and continuously over time. Similarly, certain NPK fertilizers are designed to deliver nutrients in a regulated or slow-release manner. A

steady supply of nutrients from both sources throughout 4 to 8 WAT could have resulted in consistent and equal impacts on branch development. Nitrogen fertilizer of up to 150 kg ha^{-1} was also proven to increase the number of sweet pepper branches [25]. Treatment differences were significant ($P < 0.05$) on all sampling days. 10 t/ha Poultry manure recorded the greatest girth of gboma eggplant in 4 WAT and 6 WAT, but this was greater than those other treatments, except those of NPK only and NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure treatments at 4 WAT, and the control, NPK only, 5 t/ha Poultry manure and NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry manure at 6 WAT, respectively. This agreed with Kehinde-Fadare, et al. [26] who observed that cucumber stem girth increased significantly when poultry manure was applied. At 8 WAT the treatment NPK 15-15-15 133.5 kg/ha + 5 t/ha Poultry manure recorded the largest girth, which was greater than those of the control and 5 t/ha Poultry manure treatments. Plants transport materials through their stems, so healthy stems for plants are required to aid in the flow of substances to the root and shoot, store nutrients, support blossoms and leaves, and produce fresh tissues [27].

Leaf area

The results of the leaf area are presented in Table 3. NPK, poultry manure and their combination had a significant effect ($P < 0.05$) on leaf area. NPK 15-15-15 133.5 kg/ha + 5 t/ha Poultry manure recorded the greatest leaf area; this was followed by that of NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure treatment at 4 WAT. The control treatment recorded the least leaf area. The result agreed with Akanbi, et al. [28] who indicated that the leaf area of *Telfairia occidentalis* increased upon application of a good proportion of NPK and was found to be better than plants from treatments that received only 100% NPK.

At 6 WAT, the control treatment effect was significantly lower than only NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure treatment. All other treatment differences were not significant. Poultry manure recorded the highest mean leaf area of 303.1 cm^2. The results could be the effect of the precise nutrients and organic matter supplied by the poultry manure in combination with the NPK fertilizer. Poultry manure contains a high concentration of organic matter as well as vital elements such as nitrogen, phosphorus, and potassium [29]. These nutrients are essential for plant growth and development, and their availability has a large influence on leaf area.

At 8 WAT, NPK 15-15-15 133.5 kg/ha + 5 t/ha Poultry manure recorded the greatest leaf area, which was significantly greater than the control, NPK only, 5 t/ha Poultry manure and NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry manure treatments. NPK fertilizer is added to poultry manure give necessary macronutrients [11,30]. According to Mellendof [31], crop yield may become high when a large leaf is produced to intercept light at the reproductive stage of their growth. The leaf area of a plant is typically used to estimate plant nutrition, plant-soil water interactions, plant protection measures, plant rivalry, respiration, light reflection, and heat exchange [32]. Its leaf area must be estimated to understand water and nutrient usage, photosynthesis, light interception, crop development, and plant yield. The leaf has been defined as the plant's major organ since it participates in photosynthetic activities and serves as a sink for plant nutrients [33].

Crop growth rate, chlorophyll content and days to 50% flowering

The results of the effect of NPK and poultry manure and their combination on the growth rate, and chlorophyll content are presented in Table 4. Application of NPK, poultry manure and their combined application did not significantly ($P > 0.05$) affect growth rate at 4-6 WAT and 6-8 WAT. The balanced supply of vital nutrients provided by NPK fertilizers, including nitrogen (N), phosphorus (P), and potassium (K), is critical for optimal plant growth. However, depending on factors such as soil conditions, plant type, and growth stage, the impact of these nutrients on growth rate can vary. Lynch, et al. [34] emphasized the importance of nutrient balance and implied that excessive fertilizer application may not necessarily improve growth rate, especially if the needed nutrients are already present in sufficient levels. Chlorophyll content was significantly affected ($P < 0.05$) by the treatments. The

Table 3: Effect of NPK and poultry manure rates and combined application on the leaf area of gboma eggplant.

Treatment	Leaf area (cm^2) at		
	4 WAT	6 WAT	8 WAT
Control (No fertilizer)	96.30^{a}	169.5^{a}	195.9^{a}
NPK 15-15-15 133.5 kg/ha	149.0^{abc}	245.4^{abc}	265.7^{ab}
5 t/ha Poultry manure	131.7^{ab}	188.8^{ab}	238.6^{ab}
10 t/ha Poultry manure	176.2^{bcd}	216.7^{abc}	292.6^{abc}
NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry manure	136.9^{ab}	222.6^{abc}	270.6^{ab}
NPK 15-15-15 66.75 kg/ha + 5 t/ha Poultry manure	145.7^{abc}	271.0^{abc}	307.3^{bc}
NPK 15-15-15 133.5 kg/ha + 5 t/ha Poultry manure	235.0^{d}	303.1^{abc}	378.1^{c}
NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure	210.6^{abc}	284.4^{bc}	322.0^{bc}
p-value	< 0.001	0.005	0.001
CV (%)	15.1	15.2	12.7

*Means followed by same letters are not significantly different at 5% probability.

Table 4: Effect of NPK, poultry manure and their combined application on the growth rate, chlorophyll content and days to 50% flowering (anthesis) of gboma eggplant.

Treatment	Growth rate (g/m²/day)		Chlorophyll content (CCI)	Days to anthesis
	4-6 WAT	6-8 WAT		
Control (No fertilizer Application)	1.33[a]	0.86[a]	37.73[a]	53.33[c]
NPK 15-15-15 133.5 kg/ha	1.27[a]	2.90[a]	49.66[bc]	39.67[ab]
5 t/ha Poultry manure	1.12[a]	2.98[a]	43.94[ab]	42.67[b]
10 t/ha Poultry manure	1.87[a]	2.75[a]	55.10[cd]	37.67[ab]
NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry manure	1.29[a]	3.22[a]	42.12[ab]	42.00[b]
NPK 15-15-15 66.75 kg/ha + 5 t/ha Poultry manure	1.42[a]	1.43[a]	48.84[bc]	41.00[ab]
NPK 15-15-15 133.5 kg/ha + 5 t/ha Poultry manure	1.50[a]	3.69[a]	51.94[bc]	38.33[ab]
NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure	1.82[a]	3.47[a]	62.83[d]	36.00[a]
p-value	0.24	0.46	< 0.001	< 0.001
CV (%)	25.7	23.5	7.6	4.8

*Means followed by same letters are not significantly different at 5% probability.

Table 5: Effect of NPK, poultry manure and their combined application on number of fruits, fruit girth, leaf yield and fruit yield.

Treatment	Number of fruits	Fruit girth (cm)	Leaf yield t/ha	Fruit yield t/ha
Control (No fertilizer Application)	8.00[a]	3.47[a]	4.40[a]	1.40[a]
NPK 15-15-15 133.5 kg/ha	18.33[abc]	5.71[c]	7.73[bc]	3.07[ab]
5 t/ha Poultry manure	24.33[cd]	4.93b[c]	6.80[ab]	3.91[abc]
10 t/ha Poultry manure	31.33[d]	5.75[c]	9.60[bc]	5.12[bc]
NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry manure	11.00[ab]	4.43[b]	8.27[bc]	2.27[a]
NPK 15-15-15 66.75 kg/ha + 5 t/ha Poultry manure	20.33[bcd]	4.91b[c]	7.07[abc]	3.73[abc]
NPK 15-15-15 133.5 kg/ha + 5 t/ha Poultry manure	19.67[abcd]	5.75[c]	8.27[bc]	3.87[abc]
NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure	30.67[d]	5.76[c]	9.87[c]	6.27[c]
p-value	< 0.001	< 0.001	< 0.001	< 0.001
CV (%)	20.8	6.3	12.9	24.9

*Means followed by same letters are not significantly different at 5% probability.

treatment NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure recorded the greatest value of chlorophyll content, which was greater than all other treatment effects, except the 10 t/ha Poultry manure. Chlorophyll captures energy and converts CO_2 and water into sugars for vegetative development. The increase in chlorophyll content could be explained by a sufficient and timely supply of nutrients for vigorous photosynthetic activity. Plants that received nitrogen fertilizers on time increased their photosynthetic rate, resulting in rapid vegetative development and dark green leaves, according to John, et al. [35].

There was a significant difference ($P < 0.05$) among the treatments in terms of the number of days to fifty percent flowering. The treatment NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure recorded a faster day to 50% flowering than all other treatments but this was different from the control, 5 t/ha Poultry manure, NPK 66.75 kg + 2.5 t/ha Poultry manure treatments. The present finding also is in disagreement with Agyeman, et al. [36] who noted that there was no significant effect of NPK fertilizer on a number of days to 50% flowering in tomatoes.

Number of fruits, Fruit girth, Leaf yield and Fruit yield

The results of NPK, poultry manure and their combination on the number of fruits per plot, fruit girth, leaf yield and fruit yield of gboma eggplant are presented in Table 5. The number of fruits per plot, fruit girth, leaf yield and fruit yield were significantly affected ($P < 0.05$) by the treatment application. The greatest number of fruits were recorded in the 10 t/ha Poultry manure, but this was significantly higher than the control, NPK only, all the NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry treatments. This finding is in line with Ewulo, et al. [37] who researched into the effects of poultry manure (PM), NPK 15-15-15 fertilizer, and NPK 15-15-15 fertilizer combined with poultry manure on tomato growth and yield. They reported that all poultry manure rates, NPK 15-15-15 fertilizer alone, and NPK 15-15-15 fertilizer combined with poultry manure greatly improved the number of fruits, and fruit weight. A study by Ewulo, et al. [37] mentioned that poultry manure and NPK fertilizer are capable of increasing the number of fruits.

The greatest fruit girth value was recorded in NPK 15-15-15 133.5 kg/ha + 2.5 t/ha Poultry manure, but this was significantly higher than those of control, and NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry manure treatments only. All other treatment differences were not significant ($P > 0.05$). Similar observations were made by Agaba, et al. [38] who found that the mean diameter of tomato fruits was higher in plots that received some form of fertilizer treatment than the diameter of fruits from the control plot.

Leaf yield was significantly affected by the treatments applied. NPK 15-15-15 133.5 kg/ha + 2.5 t/ha obtained the highest leaf yield, but this was significantly higher than the control and 5 t/ha Poultry manure treatment effect only. All other treatment differences were not significant ($P > 0.05$). The significant differences in leaf yield across treatments suggest that the availability and balance of critical nutrients, such as nitrogen, phosphorus, and potassium, provided by the NPK 15-15-15 fertilizer played an important impact in increasing leaf output in gboma eggplant. According to Jahn, et al. [23], poultry manure composition consists of crucial nutrients needed by plants in root and vegetative growth. It also underlines the significance of correct fertilization procedures in increasing yields and increasing crop output.

Fruit yield was significantly affected by the treatments. The greatest yield was recorded by the treatment with NPK 15-15-15 133.5 kg/ha + 2.5 t/ha and followed by 10 t/ha Poultry manure treatments which were significantly 7 higher than the control, NPK only, NPK 15-15-15 66.75 kg/ha + 2.5 t/ha Poultry manure treatments only. This present finding can be attributed to the reason that the crop best utilizes nutrients when two sources, organic and inorganic are applied together. Extensive studies on numerous crops revealed that utilizing a combination of organic and inorganic fertilizers resulted in the highest yields [39-41].

Conclusion

The result from the study showed that plant height, number of leaves, stem girth, chlorophyll content and days to 50% flowering all increased significantly with the application of the poultry manure, NPK and their combinations. In general yield and yield component of gboma eggplant were significantly increased by the treatments. NPK 15-15-15 133.5 kg/ha + 2.5 t/ha poultry manure combination recorded the highest leaf and fruit yield. It is therefore recommended that NPK and poultry manure can be applied in NPK 15-15-15 133.5 kg/ha+ 2.5 t/ha poultry manure combination to increase the growth and yield of gboma eggplant.

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