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Response of *Amaranthus hybridus L* to Sugarcane Bagasse-Based *Fertilizer*: A Growth and Yield Analysis

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ABSTRACT

The increasing demand for sustainable agricultural practices has led to the exploration of innovative fertilisers. This study investigated the response of Amaranthus hybridus enriched with sugarcane bagasse-based fertiliser, focusing on growth and yield analysis in Odi, Bayelsa State. The study adopted a randomised complete block design (RCBD), with three replications. Data were obtained from plant height, number of leaves, stem girth, leaf width, leaf length and weight of the plant on ten (10) plants that were randomly sampled. The results obtained 49 days after planting (DAP) showed significant differences (p<0.05) in plant height (80.07 cm), leaf length (33.94 cm), leaf width (12.43 cm), stem girth (7.20 cm) and mean number of leaves (38.80), respectively, in treatment A (Organic). Similarly, plants in treatment A also recorded more weight than other treatments, with a mean weight of 5.5 kg. Based on the findings, sugarcane bagasse-based organic fertiliser is recommended for maximum growth and returns of A. hybridus in the study area. Farmers are therefore encouraged to adopt sugarcane bagasse-based fertiliser as a sustainable alternative to synthetic fertilisers.

Key words: Sustainable, Food, Security, Sugarcane Bagasse.

INTRODUCTION

The farmers' reliance on inorganic fertilisers poses significant challenges due to limited availability, high cost, a technical knowledge gap, limited access to farm credit, and high production costs (Mofunanya *et al.*, 2014). The adverse effects of inorganic fertilisers have promoted a search for more environmentally friendly alternatives. Organic fertilisers, such as sugarcane bagasse-based fertilisers, have emerged as a promising solution, offering a more efficient and sustainable way to enhance soil fertility.

Amaranthus, collectively known as amaranth, is a short-lived annual plant. It is an important vegetable in the human diet, providing nutrients such as vitamins, minerals, sugar, water, protein, and fibre needed for healthy growth and sustenance (Bailey, 1992). *A. hybridus L.* is an herbaceous plant that is common in waste places, cultivated fields and barnyards. In Nigeria, *A. hybridus* leaves, combined with condiments, are used to prepare soup and sauce for rice and yam (Oke, 1983; Mepha *et al.*, 2007). *A. hybridus* has been shown to contain large amounts of Squalene – a compound that has both health and industrial benefits (Rao and Newmark, 1998; Smith, 2000).

The current high demand for vegetables in the cities and towns has stimulated the growth of market gardening along perennial rivers and streams in major towns and cities of Nigeria. However, yield increases depend on many factors, including water availability and distribution, spacing, and nutrient supply, which is a major determinant of field addition or subtraction (Tindall, 1992). Apart from the use of green manure, farmyard manure, inorganic fertilisers, crop residues, and biofertilizers, organic manure remains one of the most effective tools for improving fertility status, tilth, and soil productivity. Comparatively, organic manure outweighs inorganic fertilisers in providing a wide range of essential nutrients and organic matter needed by plants, since nutrients are held in organic form. Therefore, it is imperative to supplement nutrients in the soil to boost plant growth and yield (Akanbi *et al.*, 2003; Adeoye *et al.*, 2015). Some problems encountered by amaranth growers include declining soil fertility and the amount of manure required for optimum crop productivity (Lucas and Ojeifor, 1985; Adeyemi *et al.*, 1987), inadequate supply of chemical fertiliser, and a lack of capital to buy it (Olufolaji *et al.*, 1999). However, to increase the availability of high-quality amaranth throughout the year and reduce

its price, organic manure is needed, since the South-South region of Nigeria has abundant rainfall to encourage its decomposition. Hence, the aim of this study is to determine the response of *A. hybridus* to sugarcane bagasse-based fertiliser: A growth and yield analysis in Odi, Bayelsa State.

MATERIALS AND METHODS

Experimental site: A field experiment was conducted in the Bioresources Development Centre, Odi, Bayelsa State, Nigeria, during the early planting season of 2022, between February and March. It has geographical coordinates of 50 34'0" North, 50 43'0" East, and is located in the ecological zone of southern Nigeria.

Experimental design: The experimental design was a completely randomised block design with three (3) replications. The experimental site underwent thorough preparation, including clearing, levelling, shielding, packing, and burning of trash before seedbed preparation. The plot was marked and measured to precise dimensions, 10m length and 50 cm width. Planting holes were dibbled with a sharp-pointed stick at 50 cm within row, and the seedlings were firmly transplanted two (2) weeks after sowing in the nursery. At the time of transplanting, the seedlings had reached the height of approximately 3-4 cm. Sampling, preparation and analysis: Surface soil samples were collected from the field and air- dried for 7 days. The samples were then sieved through a 2 mm mesh to remove debris and stones. The soil was analysed, and the results obtained as shown in Table 1.

Planting material and organic manure preparation: *A. hybridus* seeds were obtained from the Advanced Bioresources Developmental Laboratory. The seeds were raised in a nursery and watered for two (2) weeks. Transplanting was done under cool morning weather after 14 days at a spacing of 50cm within rows. Organic and inorganic fertilisers were introduced to the field at twenty-one (21) days before transplanting, fourteen (14) days after transplanting and thirty-five (35) days after transplanting and watered daily. The organic manure used for this research was prepared using sugarcane bagasse, poultry droppings and well-decomposed plant residues at a ratio of 3:2.5:1, respectively. The sugarcane bagasse was dried and carbonised. The manure was further subjected to analysis, and the results are shown in Table 2.th and morphological data collection: Random sampling of ten (10) plants from each of the three treatments (replicates) – Treatment A (Organic), Treatment B (Inorganic) and Treatment C (Control) was done for data collection on plant height (cm), number of leaves, leave length (cm), leave width (cm) and stem girth (cm). The data obtained in this study were further subjected to statistical analysis using Analysis of Variance (ANOVA). Significant means were separated using Fisher's Least Significant Difference (LSD) at the 5% probability level. Data were collected weekly for six (6) weeks after transplanting.

RESULTS AND DISCUSSION

Characteristics of Soil and Organic (Sugarcane bagasse-based) fertiliser soil properties, as presented in Table 1, indicate a need for organic amendments to enhance its fertility. The properties of the organic fertiliser used in this study, as shown in Table 2, reveal a nutrient-rich composition that can support plant growth.

Effect of Sugarcane Bagasse-based Fertilisers on the Growth and Morphology of Amaranthus

The study reveals that sugarcane bagasse-based fertiliser significantly influences plant height. Notably, Treatment A exhibited the tallest plants, measuring 80.1cm at 49 DAP. In comparison, Treatments B and C recorded plant heights of 58.0cm and 48.8cm, respectively. These findings underscore the potential of organic fertilisers in enhancing crop growth and productivity. Sugarcane bagasse-based fertiliser significantly impacted leaf development, particularly at 42 and 49 DAP. Notably, the mean number of leaves per plant was 25.4 and 38.8, respectively (Table 4). Furthermore, significant treatment effects were evident, with Treatment A differing markedly from the others in leaf number (Table 4). At 49 DAP, Treatment A exhibited the maximum mean leaf length of 33.9cm, while Treatment C recorded the shortest leaf length of 27.2cm (Table 5). Notably, significant differences in leaf length were observed between Treatment A and other treatments at multiple evaluation points (28, 35, 42, and 49DAP), highlighting the impact of treatment on leaf development. The widest mean leaf width at 49 DAP was 12.4 cm and was measured from plants in Treatment A. The narrowest mean leaf width (9.5 cm) was recorded from plants grown in Treatment C (Table 6). The study also revealed that Treatment A had the highest stem girth at 49 DAP. Statistical analysis indicated no

significant difference in stem girth between Treatments B and C; however, Treatment A showed a significant difference in stem girth formation compared with both B and C (Table 7). Similarly, the highest weight (5.5 kg) was recorded in the application of organic fertiliser (sugarcane bagasse-based), followed by the inorganic fertiliser with 3.6 kg, as shown in Table 8.

Table 1: Characteristics of the Experimental Soil

S/N	PARAMETER (S)	VALUE
1.	Total dissolved solid, TDS (mg/kg)	22
2.	pH	6.20
3.	Conductivity (µs/cm)	40
4.	Chloride (mg/kg)	6.0
5.	Salinity (mg/kg)	9.9
6.	Phosphate (mg/kg)	0.20
7.	Nitrate (mg/kg)	0.7
8.	Temperature (0C)	26.7
9.	Magnesium, Mg (g/kg)	0.679
10.	Calcium, Ca (g/kg)	0.429
11.	Iron, Fe (g/kg)	5.521
12.	Manganese, Mn (g/kg)	0.113

Table 2: Analysis of the Organic Fertilizer (Sugarcane bagasse-based)

S/N	PARAMETER (S)	VALUE
1.	Total dissolved solid, TDS (mg/kg)	331.6
2.	pH	8.93
3.	Conductivity (µs/cm)	603
4.	Chloride (mg/kg)	85
5.	Salinity (mg/kg)	140.2
6.	Phosphate (mg/kg)	1.11
7.	Nitrate (mg/kg)	2.6
8.	Temperature (0C)	26.9
9.	Magnesium, Mg (g/kg)	1.113
10.	Calcium, Ca (g/kg)	4.901
11.	Iron, Fe (g/kg)	3.058
12.	Manganese, Mn (g/kg)	0.158

Table 3: Summary of Growth Analysis of Mean Plant Heights (cm) of the Amaranth at 49 Days After Planting (DAP)

Treatments	28(DAP)	35(DAP)	42(DAP)	49(DAP)
A (Organic)	10.27^{a}	21.89^{a}	50.67^{a}	80.07^{a}
B (Inorganic)	7.12^{b}	16.57^{b}	39.00^{b}	58.02^{b}
C (Control)	6.50^{b}	16.40^{b}	26.37^{c}	48.79^{b}
No. of Plant	30	30	30	30

Source: Field survey, 2022.
Values within a column having different alphabet superscripts are statistically significant ($p<0.05$) according to Fisher Least Significant Difference (FLSD)

Table 4: Summary of Growth Analysis of Mean Number of Leaves of the Amaranth Plant at 49 DAP

Treatments	28DAP	35DAP	42DAP	49DAP
A(Organic)	6.70	9.70	25.40^{a}	38.80^{a}
B(Inorganic)	6.80	9.60	17.70^{b}	28.80^{b}
C(Control)	5.60	9.30	14.50^{b}	24.20^{b}
No of Plant	30	30	30	30

Source: Field survey, 2022.
Values within a column having different alphabet superscripts are statistically significant ($p<0.05$) according to Fisher Least Significant Difference (FLSD).

Table 5: Summary of Growth Analysis of Mean Leave Length (cm) of the Amaranth at 49 DAP

Treatment	28DAP	35DAP	42DAP	49DAP
A(Organic)	7.06[a]	17.31[a]	27.47[a]	33.94[a]
B(Inorganic)	4.54[b]	12.70[b]	22.02[b]	31.89[ab]
C(Control)	3.93[b]	11.00[b]	17.16[b]	27.22[b]
No of Plant	30	30	30	30

Source: Field survey, 2022
Values within a column having different alphabet superscripts are statistically significant ($p<0.05$) according to Fisher Least Significant Difference (FLSD).

Table 6: Summary of Growth Analysis of Mean Leaf Width (cm) of the Amaranth at 49 DAP

Treatment	28DAP	35DAP	42DAP	49DAP
A(Organic)	3.30[a]	6.15[a]	10.63[a]	12.43[a]
B(Inorganic)	1.59[b]	5.21[b]	8.45[b]	10.75[ab]
C(Control)	1.47[b]	4.20[ab]	7.09[b]	9.56[b]
No of Plant	30	30	30	30

Source: Field survey, 2022
Values within a column having different alphabet superscripts are statistically significant ($p<0.05$) according to Fisher Least Significant Difference (FLSD)

Table 7: Summary of Growth Analysis of Mean Stem Girth (cm) of the Amaranth at 49 DAP

Treatment	28DAP	35DAP	42DAP	49DAP
A(Organic)	2.62[a]	3.05[a]	5.21[a]	7.20[a]
B(Inorganic)	1.84[b]	2.18[b]	3.85[b]	5.66[b]
C(Control)	1.76[b]	2.01[b]	3.06[b]	5.08[b]
No of Plant	30	30	30	30

Source: Field survey, 2022.
Values within a column having different alphabet superscripts are statistically significant ($p<0.05$) according to Fisher Least Significant Difference (FLSD)

Table 8: Mean Performance and Yield of Amaranth After Harvest at 49 DAP

Treatment	NL	PH (cm)	LL (cm)	LW (cm)	SG (cm)	WPS (kg)
Organic	38.80	80.07	33.94	12.43	7.20	5.5
Inorganic	28.80	58.02	31.89	10.75	5.66	3.6
Control	24.20	48.79	27.22	9.56	5.08	2.8

Source: Field survey, 2022
Values within a column: NL = Number of leaves; PH = Plant height; LL = Leave length; LW = Leave width; SG = Stem girth;
WPS = Weight of plant sampled

CONCLUSION

A. hybridus performed better when treated with organic fertiliser in the study area. Organic manure has proven to present a much more viable agricultural and economic future for local farmers. At a time when the cost of chemical fertiliser is skyrocketing and unaffordable for farmers, sugarcane bagasse, when incorporated with poultry droppings and decomposed plant residue, will become a good source of nutrients and a medium for raising sugarcane seedlings, leguminous inoculants, and other horticultural crops. Sugarcane waste is organic in nature, and when augmented, it will improve soil chemical, physical, and biological properties, increase crop yield and quality, and enhance nutrient availability to plants.

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