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Effect of Dietary Supplementation with Varying Levels of *Raphia hookeri* on the Reproductive Indices of Male African Catfish (*Clarias gariepinus*) Broodstocks

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ABSTRACT

The increasing demand for sustainable agricultural practices has led to the exploration of innovative fertilisers. This study was carried out to investigate 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 reliance of farmers on inorganic fertilizers possess significance challenges due to limited availability, high cost, technical knowledge gap, limited access to farm credit, and high production costs of agricultural products (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 means of enhancing soil fertility. Amaranthus, collectively known as amaranth, is a short-lived annual plant. It is an important vegetable in the human diet as a source of nutrients such as vitamins, minerals, sugar, water, protein and fibre needed for healthy body 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 a large amount 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 are dependent on many factors ranging from water availability and

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distribution, spacing, as well as nutrient supply, which is the 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 in improving the fertility status, tilth and soil productivity.

Comparatively, organic manure outweighs inorganic fertilisers in terms of having a wide range of essential nutrients and organic matter needed by plants, since nutrients are held in organic form. It is therefore imperative to supplement nutrients in the soil to boost plant growth and yield (Akanbi *et al*., 2003; Adeoye *et al*., 2015). Some of the problems encountered by amaranth growers include decreasing soil fertility and the quantity of manure required for optimum crop productivity (Lucas and Ojeifor, 1985; Adeyemi *et al*., 1987), inadequate supply of chemical fertiliser, and lack of capital to buy them (Olufolaji *et al*., 1999). However, to increase the availability of high-quality amaranth throughout the year at reduction in its price, there is a need to use organic manure since there is an abundance of rain in the South-South region of Nigeria 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 at the Bioresources Development Centre, Odi, Bayelsa State, Nigeria, during the early planting season of 2022, between February and March. Odi have its 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 the preparation of the seed bed. 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 the rows, and the seedlings were firmly transplanted two (2) weeks after sowing in the nursery. At the time of transplanting, the seedlings had reached a height of approximately 3-4 cm.

Soil 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 result obtained as shown in Table 1.

Planting material and organic manure preparation

A. hybridus seeds were gotten 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 the row. Organic and inorganic fertilisers were introduced to the field 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 result shown in Table 2.

Growth 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). The significant means were separated using Fisher's Least

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Significant Difference (FLSD) at the 5% probability level. The data were obtained weekly for six (6) weeks after transplanting.

RESULTS AND DISCUSSION

Characteristics of Soil and Organic (Sugarcane bagasse-based) Fertiliser

The 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.

Table 1: Characteristics of the Experimental Soil

S/N	PARAMETER (S)	VALUE
1.	Total dissolved solids, 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 Fertiliser (Sugarcane bagasse-based)

S/N	PARAMETER (S)	VALUE
1.	Total dissolved solids, 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

The 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 others in terms of 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.

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 Plants	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's 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 Plants	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's Least Significant Difference (FLSD).

T*able 5: Summary of Growth Analysis of Mean Leaf 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 Plants	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's 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 Plants	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's Least Significant Difference (FLSD)

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).
Our study also revealed that Treatment A had the highest stem girth at 49 DAP. Statistical analysis indicated no significant difference in stem girth between Treatment B and C. However, Treatment A demonstrated a significant difference in stem girth formation compared to 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 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 Plants	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's 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 = Leaf length
LW = Leaf width
SG = Stem girth
WPS = Weight of plant sampled

DISCUSSION

Fertiliser is one of the most vital inputs contributing to crop production because it increases productivity and improves yield quantity and quality (Olaniyi *et al.*, 2010). The generally low ambient soil nutrient content made the soil suitable for the study of responses to fertiliser. Application of organic fertiliser generally resulted in growth which compared favourably with NPK fertiliser. Plant height is the major determinant of the plant's ability to compete for light. It determines the growth attained during the growing season. It increased with the amount of micro and macronutrients supplied to the soil by the organic and inorganic fertilisers (Ndubuaku *et al.*, 2015). Hence, the findings as shown in Table 3 agree with the report of Adeyemi *et al.* (1987), who observed that adequacy of organic manure increases plant height of Amaranthus.

The effect of organic fertiliser on the number of leaves indicates that the decomposition and availability of the organic fertiliser to the plants boost the number of leaves produced per plant. Tindall (1975) reported that Amaranthus require soils with high organic content, and such soils favour the production of leaf number. Stem girth determines the dimensional attainment of a plant during the growing period. It increases with the nutrients the soil gets. The treatment with the highest stem girth was the treatment with organic fertiliser at 49 DAP, which is in accordance with Ajari *et al.* (2003), who reported a similar thing in okra. The different treatments influenced the leaf length of the plant. The largest mean leaf lengths were

recorded from plants grown in treatment A (organic fertiliser), which implies that organic manure favours the production of *A. hybridus* in the study area.

On the other hand, a significant difference was also observed in treatment A in leaf width. However, significant variation in leaf width was found in treatment A due to the application of organic fertiliser. The application of the organic fertiliser similarly had a greater influence on the weight (kg) of the plant when harvested, as recorded in Table 8 above.

CONCLUSION

A. hybridus performs 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 not affordable 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. Waste produce from sugarcane is organic in nature, and if augmented, it will improve the soil chemical, physical and biological properties as well as improve crop yield and quality, and also enhance nutrient availability to plants.

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