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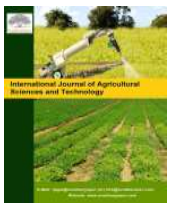

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Fish Pond Effect and Inorganic Fertilizers on the Development of Okra (*Abelmoschus esculentus* L.) Anyigba, Kogi State, Nigeria

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Abstract

A field experiment conducted at Prince Abubakar Audu University Teaching and Research farm aimed to evaluate Fish Pond Effect and Inorganic fertilizers on the development of okra (*Abelmoschus esculentus* L.) Anyigba, Kogi State. Nigeria. The experiment was carried out using a Randomized Complete Block Design (RCBD). Treatments consisted of 10 t/ha, 20 t/ha, 30 t/ha of fish pond effluent, 100 kg/ha, 250 kg/ha, 350 kg/ha of NPK 10:10:10 fertilizer and combination of fish pond effluent (10 t/ha) and 100 kg/ha of NPK 10:10:10. Parameter measured were plant height (cm), number of leaves, stem girth (cm), fruit length (cm), fruit weight (g) and number of fruits per plant. Results obtained showed that Fish pond effluent had significant influence at 5% level of probability ($p \geq 0.05$) on the growth and yield of okra than NPK 10:10:10 fertilizer. It was observed that 30 t/ha of fish pond effluent gave the highest values for growth and yield parameters. Plant height (37.87 cm), number of leaves (14.17), stem girth (3.00 cm), fruit length (11.04 cm), fruit weight (3671 g), while combination of fish pond effluent (10 t/ha) and 100kg/ha of NPK 10:10:10 gave the highest on number of fruits per plant (6.83). The lowest values were observed in the control plot. The result obtained from this experiment clearly shows that fish pond effluent gave significant difference ($p \geq 0.05$) at 5% level of probability on the growth and yield of okra than NPK 10:10:10 and their combinations.

Keywords: *Fish pond effluent, Inorganic, NHA-4-E, Yield*

1. Introduction

Okra (*Abelmoschus esculentus L. Moench*) commonly known as "Lady's finger", belong to the family *Malvaceae*, it is an annual vegetable cultivated mostly in tropical, and subtropical regions in the world (Maganha *et al.,* 2010). The cultivated okra is of old world origin and is believed to have originated in Africa and Asia as a polyphyletic species (Gardner, 2004). The leading lady's finger production countries are India, Sudan, Egypt and Nigeria (Varmudy, 2011). Okra is a highly nutritious vegetable. Vegetable cultivation is one of the major enterprises in horticulture which is becoming more popular due to the greater appreciation of their food values such as vitamins and minerals (Nweke *et al.,* 2013). In many parts of the world, especially in arid and semi-arid areas, the increasing demand for water has led to the generation of wastewater for agriculture (Amin, 2011). Today, wastewater has become a major concern because it is an

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important part of our environment, mainly used for irrigation of agricultural land, reducing soil salinity, and increasing soil moisture (Agbaire, 2015). Today, a large amount of water in our immediate environment is used for various industrial purposes and after the water is fully used, it is discharged directly into the soil or surface water so that soil and groundwater (Temilola *et al.*, 2014). However, most wastewater usually has high nutritive content that might improve plant growth and productivity (Roy *et al*., 2014). Soil irrigated with wastewater proved to contain 4.1% organic matter by weight, but these particles contain 47.8% of total soil carbon and 41.7% nitrogen, thus becoming a source of energy and nutrition for microorganisms, indicating the necessary care (Tripathi, 2011). Wastewater has been described as both "a resource and a problem" as; the challenge is to maximize the potential of the resource and reduce the associated problems (Namara *et al.*, 2010).Therefore this study was carried out to evaluate the Fish Pond Effect and Inorganic fertilizers on the development of okra (*Abelmoschus esculentus* L.) Anyigba.

2. Materials and Methods

2.1. Experimental Site

The experiment was carried out at Prince Abubakar Audu University Student Research and Demonstration Farm, Anyigba, which is in the Southern Guinea Savannah agro-ecological zone in Nigeria latitude $7^0$29 N and longitude $7^0$11 E Kogi State. The total land area that was used for the experiment is 284.625 m^2 (34.5 m x 8.25) each experiment sub plot was (3 m x 2.25 m).The plot was separated from each other by the border row of 0.5 m.The spacing that was adopted is 25 cm x 75 cm intra and inter row spacing.

2.2. Treatment and Experimental Design

The trial was conducted using a Randomized Complete Block Design (RCBD). Treatment consisted of 10 t/ha, 20 t/ha, 30 t/ha of fish pond effluent, 100 kg/ha, 250 kg/ha, 350 kg/ha of NPK10:10:10 fertilizer, and the combination of 10 t/ha (fish pond effluent) and 100 kg/ha of NKP 10:10:10. The variety of okra used was NHA-4-E (V35) from Farm West Agric Business, Kano, Nigeria. The okra seed was manually planted on a mechanically ploughed and harrowed flat land using two (2) seeds per hole. Organic manure (fish pond effluent) and inorganic fertilizer (NPK) was applied using broadcasting method of application after planting. The okra seeds was planted two (2) seeds per hold but later thinned to one (1) plant per stand after germination with spacing of 75 cm × 25 cm. Weed control was manually carried out using hoe at every two weeks interval.

2.3. Fertilizer Application

Both organic (fish pond effluent) and inorganic (NPK) fertilizers was applied in split doses and this was done at two weeks after sowing (2WAS) and six weeks after sowing (6WAS).

2.4. Data Collection

Below are the parameters measured:

Plant Height (cm): The height of the plant was measure from the ground level to the top using a meter rule.

Number of Leaves: The average number of leaves produce by each plant.

Plant Stem Girth (cm): The Girth of the plant was measured using a vernier caliper round the plant's stem close to the ground level.

Number of Fruits: The number of fruits produced per plant.

Weight of Harvested Fruits (g): A weighing balance was use to weigh the harvested fruits per plot.

Fruit Length (cm): The fruit's length was measure using a meter rule.

2.5. Statistical Analysis

Data collected was subjected to analysis of variance (ANOVA) using GENSTAT Discovery Software and means found to be statistically significant was separated using Fisher's Least Significant Difference (F-LSD).

3. Results and Discussion

3.1. Plant Height

Fish pond effect and NPK 10:10:10 fertilizer on plant height of okra is presented in Table 1. There was significant difference (p>0.05) in plant height at 4^{th} and 6^{th} week after sowing. The tallest plant (37.87 cm) was observed in plot

Table 1: Fish Pond Effect and NPK Fertilizer (10:10:10) on the Plant Height (cm), Number of Leaves and Stem Girth (cm) of Okra (*Abelmoschus esculentus L.*) at Anyigba, 2022 Growing Season

Treatments	Plant Height (cm)			Number of Leaves (cm)			Plant Stem Girth (cm)		
	2 WAS	4 WAS	6 WAS	2 WAS	4 WAS	6 WAS	2 WAS	4 WAS	6 WAS
NPK 10:10:10									
Control	4.28	11.12^{c}	20.55^{e}	4.57	7.87^{e}	9.48^{f}	0.41	0.90^{d}	1.88^{d}
100 kg/ha NPK	4.28	11.46^{c}	21.45^{e}	4.67	8.25^{d}	10.22^{e}	0.40	0.93^{d}	1.93^{d}
250 kg/ha NPK	4.31	14.62^{b}	25.55^{d}	4.77	9.08^{c}	10.63^{d}	0.41	1.18^{c}	2.25^{c}
350 kg/ha NPK	4.34	15.04^{b}	28.14^{c}	4.83	9.25^{c}	12.68^{c}	0.42	1.34^{b}	2.38^{b}
F.P Effect									
10 t/ha	4.27	15.21^{b}	27.85^{c}	4.50	9.14^{c}	12.47^{c}	0.42	1.37^{b}	2.40^{b}
20 t/ha	4.26	18.28^{a}	34.40^{b}	4.70	11.52^{b}	13.28^{b}	0.41	1.57^{a}	2.92^{a}
30 t/ha	4.41	19.40^{a}	37.87^{a}	5.03	12.55^{a}	14.17^{a}	0.42	1.58^{a}	3.00^{a}
10 t/ha FPE + 250 kg NPK	4.63	18.10^{a}	35.28^{b}	4.90	11.76^{b}	13.45^{b}	0.41	1.55^{a}	2.94^{a}
LOS	-	*	*	-	*	*	-	*	*
LSD	n.s	1.43	1.57	n.s	0.24	0.27	n.s	0.06	0.12

Note: Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability. FPE-Fish Pond Effluent, WAS-Weeks After Sowing LOS-Level Of Significance, LSD-Least Significant Difference, n.s-Not Significant. * significant.

treated with 30 t/ha of fish pond effluent. Highest plant height observed in plot treated with 350kg/ha of NPK 10: 10: 10 is 28.14 cm. The shortest plant (20.55 cm) is observed in the control plot.

3.2. Number of Leaves

Table 1 also shows the fish pond effect and NPK 10:10:10 on the number of leaves of okra. Significant difference at 5% level of probability was observed in the number of leaves at 4th and 6th weeks after sowing. 30 t/ha of fish pond effluent produced the highest number of leaves (14.17), while the control had the lowest number of leaves across the weeks with significant difference; 4th week after sowing (7.87) and 6th weeks after sowing (9.48)

3.3. Stem Girth

Okra (*Abelmoschus esculentus L.*) response to fish pond effect and NPK 10:10:10 on stem girth is shown in Table 1. At 4 and 6 weeks after sowing, there was significant difference at 5% level of probability in the stem girth. At 4 and 6 weeks after sowing, the widest stem girth (1.58 cm and 3.00 cm) was obtained where 30 t/ha of fish pond effluent was applied while the control gave the thinnest girth (0.90 cm and 1.88 cm) within the weeks of the experiment.

3.4. Fruit Length, Fruit Weight, Numbers of Fruit per Plant

Table 2 shows the fish pond effect and NKP 10: 10: 10 on fruit length, fruit weight and number of fruits per plant. At 5% level of probability, there was significant influence for the yield parameters. 30t/ha of fish pond effluent gave the longest fruit length of 11.04 cm followed by the combination of 10 t/ha fish pond effluent (FPE) + 250 kg NPK 10:10:10 that gave 11.02 cm fruit length while the control treatment gave the shortest fruit length (7.30 cm). Plot treated with 30 t/ha of fish pond effect produced the heaviest fruit weight (3671.00 g) per plot followed by plot treated with the combination of 5 t/ha FPE + 250kg NPK 10: 10: 10 which gave 3667.67 g. The control plot produced the lowest values for fruit weight (1246.07 g). The plot with combination of 10 t/ha FPE + 250 kg NPK 10: 10: 10 gave the highest number of fruits per plant (6.83) while the lowest (2.20) was observed in the control plot.

Table 2: Fish Pond Effect and NPK Fertilizer (10:10:10) on the Fruit Diameter, Fruit Length, Fruit Weight and Numbers of Fruit Per Plant of Okra (*Abelmoschus Esculentus L*) At Anyigba, 2021 Growing Season

Treatment	Fruit Length (cm)	Fruit Weight (g)	Numbers of Fruit per Plant
NPK 10:10:10			
Control	7.30^{e}	1246.07^{d}	2.20^{e}
100 kg/ha NPK	8.42^{d}	1411.33^{d}	3.33^{d}
250 kg/ha NPK	9.20^{c}	2113.33^{e}	4.80^{c}
350 kg/ha NPK	9.42^{c}	2978.00^{b}	5.60^{b}
Fish Pond Effect			
10 t/ha	10.08^{b}	3021.33^{b}	5.57^{b}
20 t/ha	11.02^{a}	3653.67^{a}	6.80^{a}
30 t/ha	11.04^{a}	3671.00^{a}	6.82^{a}
10 t/ha FPE + 250 kg NPK	11.02^{a}	3667.67^{a}	6.83^{a}
LOS	*	*	*
LSD	0.53	375.52	0.41

Note: Means having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level of probability. LOS – Level Of Significance, LSD- Least Significant Difference, * significant.

3.5. Fish Pond Effect and NPK Fertilizer (10:10:10) on the Fruit Diameter, Fruit Length, Fruit Weight and Numbers of Fruit Per Plant of Okra

The growth of okra increased tremendously when 30 t/ha of Pond waste is used at a high level of NPK 10:10:10 (Davarinrjad *et al.*, 2004). Application of organic matter in soil is an effective way to maintain soil organic matter, increase soil fertility and provide essential nutrients to plants. Fish waste is rich in nitrogen, potassium, phosphorus and minerals (Ghaly *et al*., 2013). While Nadafi *et al.* (2005) also reported increased growth rate and improved quality of garden purslane, sweet basil, and radish and cucumber crops with fish pond water application. Also, higher yield of fresh bean pod and fresh Kale leaf increases via fish pond water application as a source of fertilizer (Wood *et al.,* 2001) Organic manure is a good fertilizer that contains NPK and other nutrients. It can also add organic matter to the soil, improve soil structure, aeration, retain soil moisture, and water infiltration. Nutrients in plants are released more slowly and remain in the soil for a long time, thus for a longer-lasting effect, root growth, and higher yields. Nutrients contained in manures are released more slowly and are stored for a longer time in the soil thus ensuring longer residual effects; improve root development and higher crop yields (Abou-Magel *et al.,* 2006).

Fruit length, fruit weight and fruit quantity per plant show the effectiveness of fish pond 30 t/ha, which shows the highest result, in producing NPK fertilizer 350 kg/ha. It was also found that fish pond water has nutritional value, which is an obvious factor that leads to increased fertility. Delaide *et al.* (2016) reported that the supplementation of fish water with mineral fertilizer increased the fresh weight of lettuce by nearly 40%. Similar finding was also reported by Khandaker *et al.* (2017), who stated that application of fish pond waste can increase the stomatal conductivity on Red *Chilli Kulai.* Similarly, Wood *et al.* (2001) showed that irrigating with fish pond waste results in greater yield of a crop.

4. Conclusion

Observations obtained from the result showed that fish pond waste, the difference is significant (p>0.05) at the 5% probability level for the growth and production of okra than NPK 10:10:10 fertilizer. It was observed that 30 t/ha application rate of fish pond effluent gave the highest response in plant height, number of leaves and stem girth for growth parameters; fruit diameter, fruit length, fruit weight while combination of fish pond effluent (10 t/ha) and 100 kg/

ha of NPK 10:10:10 gave the highest on numbers of fruit per plant for yield parameters while the lowest responses was observed in the control treatment for the growth and yield parameters. Likewise 350 kg/ha NPK 10:10:10 fertilizer gave responsive growth on okra. Therefore, 30 t/ha of fish pond effluent should be used on okra for optimum growth by farmers in Anyigba.

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