

Original Research Article

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## Response of Fish Pond Effluent on Soil Chemical Properties and Growth of Cucumber (*Cucumis sativus*) in Igbariam South Eastern, Nigeria

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### ABSTRACT

The response of fish pond effluent on soil chemical properties and growth of cucumber (*Cucumis sativus*) in Igbariam South Eastern, Nigeria was studied during 2018 farming season at the Teaching and Research Farm of the Department of Soil Science, Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra State, Nigeria. The field experiment which was laid out in a Randomized Complete Block Design (RCBD), comprised three treatments and three replications as follows: T1 – Control (No treatment); T2 – Fish Pond Effluent (40,000 litres/hectare) and T3 – Fish Pond Effluent (20,000 litres/hectare) + 200kg / ha fertilizer (NPK 20: 10:10). Results obtained revealed that, the treatments were significantly ( $P=0.05$ ) different on some chemical properties of soil and Growth Parameters of Cucumber. The highest values of the Soil Chemical Properties (Available Phosphorus -6.6 mg/kg; Total Nitrogen -0.8g/kg; Organic Carbon – 5.8g/kg; Organic Matter – 10.1g/kg) were recorded at the plot where Fish Pond Effluent was applied at the rate of 20,000 litres/ hectare with 200kg/ha of fertilizer (NPK 20: 10:10). Fish Pond Effluent had no significant effect on the pH of the soil as the pH of the treated plots was almost at par with the Control. While the highest values of Number of leaves (37.9), Vine length (39.47cm) and Number of Branches (2.80) were also recorded at the plot where fish pond effluent was applied at the rate of 20,000L/ha with 200kg/ha of NPK fertilizer (20:10:10) at 7 WAP.

#### Keywords

Fish Pond Effluent;  
Soil Chemical  
Properties, Growth  
Parameters, Soil  
Fertility, Cucumber,  
NPK fertilizer

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### Introduction

Cucumber (*Cucumis sativus*) is an edible fruit of the Cucumber plant which is eaten fresh in salad and other foods and some of them have high content of vitamins A and C (Peet, 2001). Regular consumption of Cucumber fruit has various medicinal effects such as promotion of healthy growth of hair, softening of skin texture, curing of skin

infection like Eczema and facilitation of weight loss. Dr A. Shrivastava *et al.*, (2013); Kashif *et al.*, (2008) reported that, Cucumber can also be helpful for both high and low blood pressure due to high content of potassium (50-80mg/100g). Paul *et al.*, (2012) also reported that aqueous extract of Cucumber can have good effectiveness on wound healing.

According to Tindall (1986) and Alter (2000), Cucumber is a tender warm season vegetable crop that produces well when given proper care and protection. Cucumber plant grows well on fertile soil and requires nutrient from seedling stage to maturity. In view of this, Cucumber requires fertilizer application either in the form of inorganic or organic for increasing the yield per unit area and improving the fertility of the soil.

Many researchers have opined that, the use of inorganic fertilizers increased the growth and yield of Cucumber (Agba and Enya, 2005; Lawal, 2000; Grubben, 1997). According to Eifediyi and Remison (2009), the Cucumber vegetative characters such as vine length, number of leaves, number of branches and leaf area responded significantly to applied inorganic fertilizers up to 400kg/ha which resulted to the development of the crop and its photosynthetic apparatus.

However, due to the excessive degradations of soils in the South Eastern Nigeria by high rainfall regime; high cost and scarcity of inorganic fertilizers as well as the global desire for organically produced foodstuff (Adeniyani *et al.*, 2011), there tends to be a shift by researchers to development of fertilizer management technologies that utilized organic fertilizers or combination of both organic and inorganic fertilizers (Granstedt, 1992; Iren *et al.*, 2015; Nweke and Nsoanya, 2013; Nsoanya and Nweke, 2015).

Food and Agriculture Organization of the United Nation (FAO) (2014) reported that, combination of fish farming and crop cultivation was well developed in China and the nutrient rich residues that settled in fish ponds can be utilized for soil fertility improvement. Results obtained by Udoh *et al.*, (2016) revealed that, pond waste water positively supported the growth of garden

eggs at equal level as did Pig manure and gave higher yields than Poultry Litter and NPK 15: 15: 15 when applied at rates that supplied N at the rate of 150 – 300 kg ha<sup>-1</sup>.

Ojobor and Tobih (2015) also reported that, fish Pond effluent increased the dry matter yield and soil chemical properties such as Available phosphorus, water soluble Potassium, Calcium and Magnesium and this increase was attributed to the high nutrient content of Fish Pond Effluent.

However, the effect of fish pond effluent on growth of Cucumber and Soil Chemical Properties of Igbariam has not been widely studied, hence this research.

The objective of this study was to investigate the Response of Fish Pond Effluent as Organic Fertilizer on Growth of Cucumber (*Cucumis sativus*) and some Soil Chemical Properties in Igbariam, South Eastern Nigeria.

## **Materials and Methods**

### **Location and characteristics of the experimental site**

The experiment was conducted during 2018 farming season at the Teaching and Research Farm of the Department of Soil Science, Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campu, Anambra State Nigeria. Igbariam falls within the derived savanna zone of Nigeria and is located at Latitude 06° 14<sup>1</sup>N and longitude 06°45<sup>1</sup>E (Anambra State Ministry of Science and Technology Meteorological Station, Igbariam). The pattern of rainfall is bimodal between April and October. The total annual rainfall is between 1500mm and 2000mm; while the average temperature ranges between 21°C and 30°C. The Relative Humidity (RH) of the area is moderately high and the highest RH of 80%

and lowest RH of 58% were recorded during the wet and dry seasons respectively. The soil of the study area is loamy sand.

### **Land preparation, experimental design and treatment allocation**

The experimental field was cleared and tilled with the help of hoe. Thereafter, it was marked out into plots. The area of the experimental site was 10m x 14m = 140m<sup>2</sup>.

The experiment was laid out in a Randomized Complete Block Design (RCBD) which comprised three treatments and three replications, giving a total of 9 plots. The size of each plot was 2m x 2m = 4m<sup>2</sup> with a distance of 1m between the plots and 2m between the blocks. Treatment material -fish pond effluent was applied to plots in accordance with the allocated rates one week before planting to allow for decomposition and mineralization of nutrients. The treatments were made up of three levels: T<sub>1</sub> – Control (No treatment), T<sub>2</sub> – Fish Pond Effluent – 40, 000 litres/ha; T<sub>3</sub> – Fish Pond effluent 20,000 litres/ha + 200kg / ha NPK fertilizer (20: 10:10).

Planting of two Cucumber seeds (Poinsett) per hole was carried out one week after the application of fish pond effluent at the spacing of 50cm x 60cm. The seedlings were later thinned to one plant per hole, while empty stands were supplied. Weed control was done manually using hoe at two weeks interval till harvest to reduce competition between the Cucumber plants and weeds for the available nutrients, water and light.

### **Data collection**

Composite soil samples were initially collected randomly from different locations of the experimental site using a soil auger at a depth of 0 – 20cm for pre-planting analyses of

physico-chemical properties of the soil of the study area (Table 1).

Soil samples were also collected at the end of the experiment from each plot for determining some soil chemical properties (namely; pH, Organic Matter, Total Nitrogen and Available Phosphorus) of Igbariam. Soil pH was determined with Digital pH meter; Organic Matter was determined according to Walkley and Black (1934) Wet Oxidation method. Total Nitrogen was determined by Kjeldahl digestion method of Black *et al.*, (1965); while Available Phosphorus was determined by the method of Bray and Kurtz (1945).

Data collection on Growth Parameters of Cucumber plants was carried out at the 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> weeks after planting (WAP). Five Cucumber plants were randomly selected from each plot and tagged for the measurement of the following growth parameters: (Number of leaves, Vine length, Leaf Area and Number of Branches in order to access the effect of Fish Pond Effluent when applied singly as well as its combination with NPK fertilizer 20;10;10.

The Data generated were subjected to Analysis of variance (ANOVA) test according to Steel and Torrie (1980). While Treatment means were compared using the Least Significant Difference (LSD) at 0.05% level of probability.

## **Results and Discussion**

### **Effect on soil chemical properties**

The results of the study on some soil chemical properties presented on Table 2 showed that, fish Pond Effluent when applied singly as well as its combination with NPK fertilizer (20:10:10) increased some soil chemical properties (namely; Available Phosphorus, Total Nitrogen, Organic Carbon and Organic

Matter) when compared with the Control. Fish Pond Effluent had no significant influence on the pH as the pH of the treated plots was almost at par with the Control. The results on Total Nitrogen, Available phosphorus, organic carbon and organic Matter indicated significant ( $P = 0.05$ ) difference among the treatments. The highest values of the Soil Chemical Properties ( $P = 6.6$  mg/kg;  $N=0.8$ g/kg,  $OC = 5.8$ g/kg and  $OM = 10.1$ g/kg) were recorded at the plot where Fish Pond Effluent was applied at 20,000L/ha with 200kg/ha of fertilizer (NPK 20:10:10). The plot where Fish Pond Effluent was applied alone at 40,000L/ha recorded the following values of Soil Chemical Properties (Available Phosphorus( $P$ )-5.73mg/kg; Total Nitrogen( $N$ )-0.7g/kg; Organic Carbon( $OC$ )-4.4g/kg and Organic Matter( $OM$ ) – 7.6g/kg) while the Control recorded the least values ( $P$ -4.7mg/kg,  $N = 0.56$ g/kg;  $OC = 3.4$ g/kg and  $OM = 5.9$ %g/kg).

### **Effect on growth parameters**

The results of the study on Growth Parameters of Cucumber presented on Tables 3, 4, 5 and 6 showed that, fish pond effluent had great effect on the Number of leaves, Vine length, Number of branches and leaf area of cucumber plant at different stages of development when compared with the Control. Results presented on Table 3 revealed that, the treatments had significant effect on Number of leaves. The number of leaves increased from the 5<sup>th</sup> to 7<sup>th</sup> weeks after planting (WAP) in all the treatments when compared with the control. The highest number of leaves (37.93) was recorded at 7<sup>th</sup> WAP in the plot where fish pond effluent was applied at 20,000 L/ha with 200kg /ha of NPK fertilizer (20:10:10), while the plot where fish pond Effluent was applied alone recorded 33.73 which was better than the value (20.93) recorded in control. Results on Table 4 revealed that, fish pond Effluent significantly

influenced the Vine length of Cucumber at the 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> WAP. The highest vine length (39.47cm) was recorded at the plot that received fish pond effluent at 20,000L/ha combined with 200kg/ha fertilizer (NPK 20:10:10). The plot that received fish pond effluent alone at 40,000L/ha recorded 33.6cm while the Control was 26.87cm. The results presented on Table 5 showed that, Fish Pond Effluent when applied singly as well as its combination with fertilizer (NPK 20:10:10) increased the number of branches at all the developmental stages when compared with the Control and were therefore significantly ( $P = 0.05$ ) different.

The highest Number of branches (2.80) was recorded at the plot where fish pond effluent was applied at 20,000 litres / hectare + 200kg/ha fertilizer (NPK 20:10:10) at 7 weeks after planting (WAP).

The results on Table 6 indicated that, Fish Pond Effluent increased the Leaf Area of Cucumber when compared with the Control at all the developmental stages and there was significant difference among the treatments. The highest leaf area (48.60cm<sup>2</sup>) was recorded at the plot that received Fish Pond Effluent at the rate of 20,000L/ha combined with 200kg/ha of NPK Fertilizer 20:10:10,

The results of the study showed that, soil chemical properties and growth parameters of cucumber were enhanced as a result of application of fish pond effluent singly as well as its combination with inorganic fertilizer (NPK 20: 10: 10).

This enhancement could be attributed to the high content of nutrients released into Fish Pond Effluent. Formulated feeds and large amounts of green/ animal manures introduced / applied to fish ponds, led to accumulation of organic matter at the bottom of the ponds and other vital nutrients like Nitrogen and

phosphorus which have significantly improved the soil fertility level of the studied area and growth of cucumber.

Results obtained on analysis of soil chemical properties of the studied area, indicated that application of Fish Pond Effluent at the rate of 40,000 litres/hectare increased the Total Nitrogen, Available Phosphorus, Organic Carbon and Organic Matter when compared with the Control. Combination of 20,000litres/ha of fish pond effluent with 200kg/ha of NPK (20:10:10) fertilizer further increased the values of Total Nitrogen; Available Phosphorus, Organic Carbon and Organic Matter as a result of the nutrients supplied from both the pond effluent and

added NPK fertilizer. These results were supported by the results obtained by Ojobor and Tobih (2015), Dominic and Otobong (2016). The increased values noted in the growth components of Cucumber (namely: Number of leaves, vine length, Number of branches and leaf Area in the studied area with the application of fish pond Effluent singly and its combination with NPK Fertilizer (20:10:10) could be attributed also to the increased rate of mineral nutrition and photosynthetic processes occasioned by high content of Nutrients (Nitrogen, Phosphorus, organic carbon and organic matter) in the fish pond effluent and the nutrients added from NPK fertilizer.

**Table.1** Physical and chemical properties of soil of the experimental site before treatment

<b>Soil Properties</b>	<b>Values</b>
<b>Physical characteristics</b>	
<b>Particle size (g/kg)</b>	
<b>Fine sand</b>	<b>43</b>
<b>Course sand</b>	<b>40</b>
<b>Silt</b>	<b>5</b>
<b>Clay</b>	<b>12</b>
<b>Textural class</b>	<b>LS</b>
<b>Chemical characteristics</b>	
<b>pH (H<sub>2</sub>O)</b>	<b>5.8</b>
<b>pH (Kcl)</b>	<b>4.7</b>
<b>Available phosphorus (mg/kg)</b>	<b>7.60</b>
<b>Total nitrogen (g/kg)</b>	<b>0.70</b>
<b>Organic carbon (g/kg)</b>	<b>5.55</b>
<b>Organic Matter (g/kg)</b>	<b>9.57</b>
<b>Exchangeable bases (cmol/kg)</b>	
<b>Ca<sup>2+</sup></b>	<b>8.40</b>
<b>Mg<sup>2+</sup></b>	<b>2.00</b>
<b>K<sup>+</sup></b>	<b>0.08</b>
<b>Na<sup>+</sup></b>	<b>0.03</b>
<b>CEC (cmol/kg)</b>	<b>14.00</b>
<b>Base Saturation (%)</b>	<b>75.07</b>
<b>Exchangeable Acidity (cmol/kg)</b>	
<b>Al<sup>3+</sup></b>	<b>-</b>
<b>H<sup>+</sup></b>	<b>1.40</b>

**Table.2** Effect of fish pond effluent on soil chemical properties of Igbariam

Treatment	pH		P (mg/kg)	N (g/kg)	OC (g/kg)	OM (g/kg)
	H2O	Kcl				
Control (No treatment)	5.8	4.43	4.79	0.56	3.4	5.9
F P E (40,000 L/ha)	5.9	5.57	5.73	0.7	4.4	7.6
FPE +F (20,000L/ha+200kg/ha)	5.97	4.83	6.66	0.8	5.8	10.1
LSD 0.05	NS	NS	0.09	0.04	0.11	0.72

**Table.3** Effect of fish pond effluent on number of leaves of cucumber

Treatment	WAP		
	5	6	7
Control (No treatment)	11.4	14.2	20.9
FPE (40,000L/ha)	15.5	19.0	33.7
FPE +F(20,0000L/ha+200kg/ha)	23.8	28.9	37.9
LSD 0.05	3.99	6.35	10.22

WAP – Weeks After Planting; FPE – Fish Pond Effluent F – Fertilizer (NPK 20:10:10); LSD – Least Significant Difference.

**Table.4** Effect of Fish Pond Effluent on Vine Length of Cucumber (cm)

Treatment	WAP		
	5	6	7
Control (No treatment)	11.8	18.93	26.87
FPE (40,000L/ha)	15.3	21.93	33.6
FPE +F(20,0000L/ha+200kg/ha)	26.7	31.27	39.47
LSD 0.05	2.80	2.25	7.25

WAP – Weeks after planting; FPE – Fish Pond Effluent, F – Fertilizer (NPK 20:10:10); LSD – Least Significant Difference; NS – Not Significant

**Table.5** Effect of fish pond effluent on number of branches of cucumber

Treatment	5	WAP 6	7
Control (No treatment)	1.42	1.47	<b>2.00</b>
FPE (40,000L/ha)	1.77	2.07	<b>2.40</b>
FPE +F(20,0000L/ha+200kg/ha)	2.00	2.27	<b>2.80</b>
<b>LSD 0.05</b>	<b>0.35</b>	<b>0.61</b>	<b>0.28</b>

WAP – Weeks After Planting; FPE – Fish Pond Effluent; F- Fertilizer (NPK 20:10:10); LSD – Least Significant Difference; NS – Not Significant.

**Table.6** Effect of fish pond effluent on leaf area of cucumber (cm<sup>2</sup>)

Treatment	5	WAP 6	7
Control (No treatment)	23.28	25.89	<b>28.49</b>
FPE (40,000L/ha)	41.34	44.09	<b>48,40</b>
FPE +F(20,0000L/ha+200kg/ha)	42.81	45.72	<b>48.60</b>
<b>LSD 0.05</b>	<b>8.57</b>	<b>8.35</b>	<b>8,14</b>

WAP – Weeks After Planting; FPE – Fish Pond Effluent; F – Fertilizer (NPK 20: 10:10); LSD – Least Significant Difference; NS – Not Significant.

The results obtained in these growth parameters agreed with the works of Egharevba and Ogbe (2002); Ojobor and Tobih (2016).

In conclusion, the results of the study indicated that fish pond effluent increased both the soil chemical properties and growth parameters of Cucumber and as such, it is recommended to be utilized as Organic Fertilizer to improve Soil Fertility level and growth of Cucumber in the studied area.. Combination of fish pond effluent at the rate of 20,000litres/ha with 200kg/ha of NPK (20;10:10) fertilizer gave the highest results in all the parameters accessed except the leaf Area where the results obtained were at par with that of fish pond effluent singly applied.

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