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USE OF FISH POND EFFLUENT AS SOIL AMENDMENT FOR THE PRODUCTION OF *TELFAIRIA OCCIDENTALIS* (FLUTED PUMPKIN) IN ABRAKA, DELTA STATE, NIGERIA

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ABSTRACT

The study was conducted to evaluate the possible uses of fish pond effluent (FPE) as soil amendment in the production of fluted pumpkin in Abraka, Delta State. Land area measuring 26 x 15 m and plotted into 2.8 x 2.8 m were used for the study. The experiment was laid out in a randomized complete block design replicated four times. The FPE was applied at 0, 50, 100, 150, 200, 250 and 300 l/ha two weeks after sowing. Data were collected on number of leaves, leaf area and yield indices, also soil chemical properties were also analysed after harvest. The data were statistically anslysed with ANOVA and Duncan Multiple Range Test at 5% level of probability was used to separate treatments means. Results of the study showed increase in the growth and yield indices evaluated with various level of treatment. Treatments rates at 250 and 300 l/ha were not significantly different except in number of leaves and fruit weight. Post-harvested soil chemical properties were influenced at highest rate of treatment. The FPE at the rate of 250 and 300 l/ha had better efficacy in all the growth and yield indices investigated and should be recommended in the study area for the production of fluted pumpkin

Keywords: *Abraka, fish pond effluent, soil fertility, fluted pumpkin, organic fertilizer*

INTRODUCTION

Despite the increasing demand for fluted pumpkin in Nigeria, farmers are experiencing yield reduction due to poor soil fertility and the need to increase the productivity to compensate for the increasing demand is imperative. The soil fertility challenges required sustainable management of soil resources to raise the fertility to a level that will support vegetable production. Soils are often susceptible to continuous degradation once it is used for cultivation, however inorganic fertilizers that are used to ameliorate the effects of the poor yield is facing a lot of criticism on health and environmental ground. Comparatively, organic fertilizer (Fish pond effluent) had been successfully used to produce *Amaranthus* (Ojobor and Tobih, 2015) but no information on the use of fish pond effluent on *Telfairia occidentalis*. The organic fertilizer can sustain continuous vegetable production because its nutrients are released gradually and also have the potential to improve soil organic matter of the soil (Iren *et al.,* 2016). Quality soil is paramount for sustainable and continuous vegetable production.

Telfairia occidentalis also called fluted pumpkin is a popular vegetable crop mostly consumed in Southern Nigeria. The origin could be trace to the eastern part of country (Edu *et al.,* 2015). It is a leaf and seed vegetable with high nutritional and industrial values and contains 29% protein, 18% fat, and 20% minerals and vitamins (Tindall, 1986). It acts as blood purifiers and therefore can be use for health maintenance (Aletor *et al.,* 2002 and Ndor & Dauda, 2013). Nkang *et al.* (2003), further noted that the crop is cultivated across West Africa while Nigeria, Ghana and Sierra Leone are the major producers. The vegetable contains essential nutrients like potassium, magnesium, sodium, phosphorus and iron, β-carotene (Ogbadoyi *et al.*, 2011). Despite these qualities, the vegetable is scared and expensive in the market and this necessitated the distribution of its seeds to farmers by Federal Ministry of Agriculture in Imo, Abia, Cross Rivers and Delta States, to encourage the local farmers but no meaningful progress was made to alleviate the problem of poor soil fertility. Hence, there need to raise the fertility to the level that can support the growth and yield of *Telfairia occidentalis* with fish pond effluent.

Management of fish pond effluent is a major challenge facing the fish farmers in Nigeria and studies have shown that the fish pond effluent contain high organic matter content, nitrogen, phosphorus, potassium and micro nutrients (Jamu and Piedrahita, 2001; Boyd *et al.,* 2002). The effluent can be used as liquid organic fertilizer to fertilize the vegetable (Lin and Yi, 2003; Prein, 2002). The inorganic forms of nutrients in the effluent are readily available to plant while the organic forms are available through microbial decomposition (Muendo *et al.,* 2014). Advantage can be taken of the nutrient in the effluent by converting it into liquid organic fertilizer for Telfairia production. This study therefore, evaluated the response of *Telfairia occidentalis* to the use of fish pond effluent as possible source of soil amendment in Abraka, Delta State.

MATERIAL AND METHODS

Description of study area

The study was conducted on farmer's Farm in Ajanomi-Abraka between August and November, 2015 and 2016 cropping year. The site is about 10 kilometers from Delta State University, Abraka Campus with latitude 5^0 46'N and longitude 6^0 5'E. The soil belong soil order ultisol according to USDA classification (Egbuchua, 2007). The site was cultivated to cassava and maize left for one year before it was for this study. The weeds and grasses are *Ageratum conyzoides, Pennisetum purpureum*, *Amaranthus spinosus*, and *Centrosema pubescens*

Land preparation and experimental design

Land measuring 26 x 15m was used for the study. It was cleared and tilled manually and demarcated into plots of 2.8 x 2.8 m. The experiment was laid out in a randomized complete block design with four replications. The fish pond effluent (FPE) used as treatments was obtained from concrete pond used for cat fish production after harvest was applied at six rates: 50, 100, 150, 200, 250 and 300 litres/ha which is equivalent to 2, 4, 6, 8, 10 and 12 cl/plot, respectively. Two seeds of *Telfairia occidentalis* were sown per hole and were thinned to one stand two weeks after sowing. The seeds were sowed with the plumine vertically facing up at a spacing of 70 x 70 cm (Oroka, 2015). Weeding was done manually as at when due.

The treatments were applied with Knapsack Sprayer and this was done two weeks after sowing. The soil pH of the fish pond effluent was 8.2 and N = 3.2 g/kg, P = 1.0 g/kg, K = 0.7 g/kg, Ca = 0.4 g/kg, Mg = 0.5 g/kg and Na 0.4 g/kg.

Data collection

Four plants in middle row and column in each plot was used for data collection and parameters considered were: Number of leaves was taken by counting all the leaves that are visible. Leaf area (cm^2) was determined with the aid of equation proposed by Akoroda (1993): LA = 0.9467 + 0.2475 LW + 0.9724 LWN. Where: LA = leaf area, L = length of the central leaflet, N = number of leaflets in a leaf, W = maximum width of the central leaflet. Fresh market yield was obtained by weighing harvested leaves with table scale. Fruit weight was obtained by weighing the fruits extracted from the pod. Number of fruits were obtained by counting all the fruits in each pod while dry matter yield was obtained by oven drying the harvested shoot at 65^{o}C.

Soil sampling and laboratory analysis

Soil samples were randomly taken before FPE application at 0-30 cm depth and at harvest of the second year. Soil pH, organic matter, total nitrogen, available phosphorus, exchangeable cations (Ca, Mg, K and Na), base saturation and particle size distribution were analyzed at the Department of Agronomy Laboratory, University of Ibadan. Particle size distribution: was measured by Bouyouscos (1957) method. Soil pH was in 1:2 soil water ratios. Organic carbon was by Walkley-Black (1934) method. Total nitrogen by Kjeldhal Digestion method (Anderson and Ingram, 1993). Exchangeable bases were extracted with 1N ammonium acetate solution (Jackson, 1964) and K and Na were read with flame photometer while Mg and Ca were measured with Atomic Absorption Spectrophotometer (AAS). The available P was read colormetrically after extracting with Bray-1 extracting solution.

Data analysis

Analysis of variance was used to analysed data collected and differences in mean were separated with Duncan's Multiple Range Test (DMRT) at 5% level of probability.

RESULTS

Soil properties before sowing

Table 1 showed the nutrient content of the experimental soil before fish pond effluent (FPE) application. The soil pH was acidic while soil organic carbon and total nitrogen were low. Available phosphorus was low and ECEC was also low while the textural class was loamy sand.]]

Soil chemical properties at harvest

Effects of FPE on soil chemical properties at harvest are shown in Table 1. Soil pH, organic carbon, total nitrogen, available P and exchangeable bases in control plot decreased in values but increased with application of 250 and 300 l/ha of FPE.

Number of leaves and Leaf area

Number of leaves gradually increased as FPE rates increases (Table 2). There were significant differences in both years except at 3 weeks after sowing (WAS) in first year. At 7th and 11th WAS, all the FPE treatments were significantly different. Highest number of leaves was recorded in plots treated with 250 l/ha in first year and 150 l/ha in second year at 3 WAS. However, 300 l/ha had the highest number of leaves at 11 WAS in both years.

Table 3 shows the effects of FPE on leaf area and at 3 WAS, 250 l/ha had the highest leaf area in first year while 200 l/ha had the highest at second year. At 7 and 11 WAS, the rate of FPE at 300 l/ha had the highest leaf area in both years.

Yield indices

Table 5 shows the yield indices and there were significant differences except the treatments were not significantly different in second year with regard to dry matter yield and fruit weight in both years. The FPE at 300 l/ha had the highest fresh market yield, dry matter yield and fruit weight while 250 l/ha had the highest number of fruits in both years.

DISCUSSION

The initial physic-chemical properties of the experimental site showed that the soil was low in N, P, K and organic carbon. The values were below the critical level established by FMARD (2012) for crop production in the ecological zone. The result showed that the contents of the three important element cannot support crop production and this need soil amendment typically fish pond effluent. Nutrient elements are important for growth and leaves formation.

The fish pond effluent increased soil pH as shown in the result and ability of the organic fertilizer to increase soil pH could be due to the presence of some basic cations. According to Ojobor and Tobih (2015), fish pond effluent contains exchangeable Ca, Mg and K which when release can increase soil pH. This could be responsible for the increase soil pH in treated plots. The fish pond effluent also increased organic carbon, total N, available P and exchangeable bases. Therefore, it could be used to amend the soil as it improved the chemical properties. In support of this, Ojobor and Tobih (2015), reported that fish pond effluent can increased both micro and macronutrient of soil.

The number of leaves, leaf area and yield indices increased significantly with application of fish pond effluent over the control. This could be attributed to the nutrient contents in the fish pond effluent used as treatments. The higher number of leaves in treated plots could be related to high N, P and exchangeable cations (K, Ca, Mg and Na) release by the treatments that maintained optimum condition in soil for the pumpkin to grow (Iren *et al.,* 2016). The research revealed that there is gradual increased in the number of leaves, leaf area and yield indices of fluted pumpkin with increasing application of the fish pond effluent. The increased nutrients released may encourage higher vegetative growth rate (Ndor, and Dauda, 2013). The lower number of leaves, leaf area and yield indices in control plots justified the potential of the fish pond effluent in improving vegetable yield. The increment suggested that availability of soil nutrients to the crop is a major factor of photosynthesis (Oroka, 2015). The higher growth rate and yield indices recorded with application of fish pond effluent also suggested that fluted pumpkin can produce optimally when nutrients are available, that is, the fertility of the soil is optimum. Fish pond effluent contains nutrients (Ojobor and Tobih, 2015) that are needed for photosynthesis and dry matter production and also improve in soil properties.

CONCLUSION

The study evaluated effects of soil amended with fish pond effluent on fluted pumpkin production at Abraka for two years. The fish pond effluent significantly increased fluted pumpkin growth and yield. There was no significant difference between treatment rate of 250 and 300 l/ha except in number of fruits. The effluent could be use as soil amendment as it improves the chemical properties and increase growth and yield of fluted pumpkin. It could be recommended at the rate of 250 l/ha.

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Table 1: Initial physic-chemical properties before and after treatments application

	pH	Organic C	Total N	Avai. P	K	Ca	Mg	Na
	(H2O)	…………g/kg………..		mg/kg	……………cmol/kg………………			
Soil chemical properties before fish pond application								
	5.4	7.32	0.92	8.81	1.43	2.51	2.32	1.53
Soil chemical properties after fish pond application								
Rates								
0	5.3	6.12	0.76	6.7	1.23	2.30	2.40	1.21
50	5.5	8.10	1.01	9.5	1.43	2.54	2.52	1.54
100	5.6	8.32	1.11	9.3	1.54	2.66	2.63	1.65
150	5.6	9.22	1.26	10.2	1.76	2.50	2.70	1.80
200	5.7	9.43	1.25	11.3	1.85	2.77	2.76	1.82
250	5.8	10.56	1.31	11.8	1.88	2.87	2.98	1.86
300	5.8	10.59	1.32	12.6	1.76	2.88	2.98	1.74
Mean	5.6	8.92	1.15	10.2	1.64	2.65	2.71	1.66
SD	0.16	1.43	0.19	1.82	0.22	0.20	0.20	0.21

Table 2: Number of leaves of fluted pumpkin as affected by different levels of treatment

FPE rate	First year			Second year		
(t/ha)	Week 3	Week 7	Week 11	Week 3	Week 7	Week 11
0	12.7	21.5c	31.1d	10.2b	19.3d	28.3d
50	13.6	23.0bc	32.4cd	14.1a	24.6c	34.5c
100	13.4	24.4b	34.2c	15.0a	25.1c	35.1c
150	13.1	25.4ab	36.7b	15.8a	25.4c	35.0c
200	13.8	25.2ab	36.5b	15.2a	26.3bc	38.4b
250	14.5	26.6a	40.1a	15.1a	28.2ab	42.3a
300	14.4	26.4a	42.4a	15.7a	30.2a	44.1a
SD	**0.51**	**1.63**	**3.75**	**1.81**	**3.15**	**4.93**

Treatments within each column with same letters are not significantly different.

Table 3: Leaf area of fluted pumpkin (cm^2) as affected by different levels of treatment

FPE rate	First year			Second year		
(t/ha)	Week 3	Week 7	Week 11	Week 3	Week 7	Week 11
0	107.7c	194.5f	271.3g	92.3d	173.8f	255.3g
50	111.8bc	196.1f	280.4f	121.4c	205.6e	289.7f
100	118.3b	209.9e	301.4e	120.4c	224.6d	328.8e
150	128.4a	231.3d	334.1d	135.8b	242.4c	348.9d
200	127.8a	239.1c	350.4c	141.3a	253.5bc	366.7c
250	130.1a	248.8b	367.4b	140.1a	267.2ab	394.3b
300	132.4a	260.4a	388.3a	138.8ab	274.9a	411.1a
SD	9.0	24.1	41.3	16.4	33.3	51.5

Treatments within each column with same letters are not significantly different.

Table 4: Yield indices of fluted pumpkin as affected by different levels of treatment

FPE rate								
	Fresh market yield		Dry matter yield		Fruit weight		Number of fruits	
	(t/ha)----------------------------------		t/ha ------------------------------------					
	First year	Second year	First year	Second year	First year	Second year	First year	Second year
0	4.95b	5.48c	1.58c	1.42d	4.71f	4.20f	61b	55c
50	6.18a	6.22b	1.81b	1.83c	4.80c	4.92c	64a	67a
100	6.20a	6.24b	1.83b	1.83c	4.91e	4.90e	64a	63b
150	6.31a	6.30ab	1.83b	1.86c	5.22d	5.41d	65a	66a
200	6.86a	6.91a	1.99b	2.11b	6.11c	6.41c	64a	63b
250	6.78a	6.80a	1.98a	2.10b	6.34b	7.01b	66a	69a
300	6.95a	7.23a	2.10a	2.41a	7.58a	7.91a	64a	66a
SD	0.63	0.54	0.16	0.29	0.98	1.23	1.41	4.16

Treatments within each column with same letters are not significantly different.