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Research Article

Effect of Poultry Manure and Irrigation Depth on the Growth of Fluted Pumpkin (*Telfairia occidentalis* Hook. F) During the Dry Season in the Niger Delta Region of Nigeria

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Abstract: Farmers in the Niger Delta region of Nigeria only practice rainfed agriculture, partly because of the misconception that the area has abundant rainfall even though the region has distinct wet and dry seasons. This, coupled with the low soil fertility always results in crops being produced at the subsistence level. This experiment was therefore conducted during the dry season to investigate the growth response of fluted pumpkin (*Telfairia occidentalis* Hook. F) to different combinations of poultry manure and depths of irrigation in a loamy sand soil. It was a randomized complete block design experiment involving three levels each of poultry manure and irrigation with three replications. The treatments comprised random combinations of 10, 20 and 30 t/ha poultry manure with 3, 4 and 5 mm depths of irrigation, including control treatment that had neither manure nor irrigation. Results indicated that the application of poultry manure and irrigation produced significantly higher values of all the growth parameters than the control. Although the combination of 30 t/ha manure and 4 mm depth of irrigation produced the maximum leaf area, the best result in terms of vine length, number of leaves, vine fresh weight and total shoot yield was obtained by combining 30 t/ha manure with 3 mm irrigation depth. This study therefore recommends the application of 30 t/ha poultry manure and 3 mm depth of irrigation for the cultivation of fluted pumpkin during the dry season in the Niger Delta region of Nigeria.

Keywords: Fluted pumpkin, growth parameters, poultry manure, rainfed agriculture, soil fertility

INTRODUCTION

The Niger Delta region of Nigeria accounts for 100% of the crude oil production in the country. The region, however, has very little in terms of socio-economic development to show for its huge contribution to the national economy. The main occupation of the people is agriculture but this sector has been totally neglected because of the discovery and exploration of oil. The result is that the youths, whose energy would have been channeled to the once-viable agricultural sector, are now engaged in anti-government activities, sometimes with extreme violence, demanding for a more equitable distribution of the oil wealth. One viable option to the problem of youth restiveness in this region is the creation of jobs through the revitalization of the agricultural sector. This can only be achieved if the twin-problems of soil infertility and total dependence on rainfed agriculture are solved.

According to Opuwaribo *et al*. (1990), soils in this region are inherently low in fertility, fragile and often highly weathered with characteristic low-activity clays and low cation exchange capacity. Thus, farmers have traditionally maintained soil fertility by bush fallowing. Wahua (2002) asserts that fallowing is the major means of soil fertility maintenance in traditional African farming systems. He posits further that the fallow system protects the fragile soils and eliminates dangerous weeds and pests. However, increasing population pressure, coupled with other socio-economic activities has drastically reduced the land available for cultivation.

This has not only made shifting cultivation impracticable but also reduced the length of traditional bush fallowing for maintaining soil fertility. This view was also expressed by Ayoola and Makinde (2007). Farmers have therefore resorted to the use of inorganic or chemical fertilizers as an alternative in order to restore soil fertility. Apart from the fact that these fertilizers are scarce and expensive, their use has impacted negatively on the soil and, hence, the crop because of increase in soil acidity, nutrient leaching and degradation of the soil's organic matter and physical conditions (Nottidge *et al*., 2005). For Okra, Aduayi (1980) found that continuous use of inorganic fertilizers reduced the yield and micronutrient content of the crop.

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Current concepts of sustainable agriculture therefore advocate the use of organic materials from wastes to maintain agricultural productivity. Benefits derivable from organic fertilizers in soils include the improvement of physical properties, decreased susceptibility to erosion, encouragement of microbial activities and the provision of potentially available nutrients (Hesse, 1984).

One other factor militating against effective and sustainable crop production in the Niger Delta region is the total dependence on rainfed agriculture, as there is no culture of irrigation. This region is characterized by distinct wet and dry seasons and, so, farmers produce crops at the subsistence level only during the wet season. Fubara-Manuel (2005) however observed that even during some months of the rainy season, especially in May and June, crops can still suffer from moisture stress due to insufficient soil moisture within the root zone.

The enhancement of the soil quality and the transition from rainfed to irrigated agriculture are imperative for effective crop production. Although substantial amount of poultry manure is generated, most farmers are yet to be enlightened on the use and hence benefits of this organic manure in crop production. This study therefore seeks to determine the combination of poultry manure and irrigation depth most suitable for the cultivation of fluted pumpkin during the dry season.

MATERIALS AND METHODS

Description of study site: The experiment was conducted at the Teaching and Research farm of the Rivers State University of Science and Technology, Port Harcourt, in the Niger Delta region of Nigeria during the dry season between the months of November, 2010 and February, 2011. Port Harcourt is characterized by a humid tropical climate with an annual rainfall of 2000-2484 mm. Mean air temperature varies between 24 and 30°C. The soil type is ultisol (USDA classification) and its texture is loamy sand.

Experimental design: The experiment was laid out in a randomized complete block design with three replications. Treatments consisted of three rates of Poultry Organic Manure (POM) applications of 10, 20 and 30 t/ha and three depths of irrigation, 3, 4 and 5 mm. There was also a control with neither POM nor irrigation. Thus, there were a total of ten treatment combinations. There were 10 plots in a block, each plot measuring 3×5 m. Shallow drains were constructed between plots to prevent treatment from flowing from one plot to another either by surface runoff or interflow.

Soil sample collection and analysis: Corporate soil samples were randomly collected prior to treatment with soil auger at 0-25 cm depth. Soil samples were similarly collected thirteen Weeks after Planting (13 WAP). The samples were analyzed in the laboratory for pH, electrical conductivity, organic matter and total nitrogen. Other parameters analyzed were available Phosphorus, exchangeable cations (Ca, Mg, K and Na), base saturation and particle size. The methods of analysis used were those outlined by Jackson (1962), Walkley and Black (1934), Bremner (1965), Bray and Kurtz (1945) and Day (1965).

Land preparation, treatment and planting: The land was first tilled and poultry manure that was cured for 3 weeks under shade was then measured, spread uniformly on the plots and, with the aid of hoes, incorporated into the soil 7 days before planting. Three seeds were planted per stand but later thinned to 2 plants per stand 2 weeks after planting. The seeds were planted with the plumine facing vertically upward and spaced 1×1.5 m, thus giving a plant population of 24,000 plants/ha. Weeding was done manually. The first weeding was done 3 weeks after planting in all the plots. Subsequent weedings were done at 3 weeks interval in order to keep the plots weed-free throughout the study period. Irrigation water was applied uniformly to each plot immediately after planting by measured application using watering cans with roses similar to overhead irrigation at an interval of 4 days.

Data collection and analysis: The middle six plants of each plot were selected for data collection and analysis, thirteen Weeks after Planting (13 WAP). The parameters measured were vine length, number of leaves, leaf area, vine fresh weight and total shoot yield. The leaf area was estimated by using the following 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

The Analysis of Variance (ANOVA) was used to compare the variability in the selected parameters, while the Duncan's Multiple Range Test (DMRT) was utilized to compare the treatment means as outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Results:

Composition of the poultry manure and soil: The chemical composition of the poultry manure is presented in Table 1. The manure used was slightly acidic with high organic matter and carbon contents.

Table 1: Chemical composition of the poultry manure

pH (H_2O)	6.9800
EC (dS/m)	0.9800
Organic matter (%)	52.3800
Organic carbon	30.2500
Nitrogen (%)	3.0100
Available P (%)	0.3900
Ca (%)	0.9200
Mg (%)	0.0600
K (%)	0.1300
Cu (%)	0.0002
Zn (%)	0.0220
Fe (%)	0.0950
Mn (%)	0.0030

Table 2: Initial physical and chemical composition of the soil (0-25 cm depth)

pH (H_2O)	5.22
EC (dS/m)	0.45
Organic matter (%)	2.53
Total nitrogen (%)	0.06
Available P (mg/k)	8.98
Ca (cmol/kg)	7.46
Mg (cmol/kg)	2.09
Na (cmol/kg)	0.07
K (cmol/kg)	0.13
Base saturation (%)	74.33
Sand (%)	81.61
Silt (%)	6.92
Clay (%)	11.47
Moisture content (% by volume)	11.89
Available water (%)	26.72

Table 3: Physical and chemical properties of the soil (0-25 cm depth) after the experiment

	Control	Treated plots
pH (H_2O)	4.950	5.130
EC (dS/m)	0.124	0.144
Organic matter (%)	1.780	1.630
Total nitrogen (%)	0.040	0.040
Available P (mg/kg)	8.930	25.240
Ca (cmol/kg)	5.780	5.400
Mg (cmol/kg)	1.820	1.910
Na (cmol/kg)	0.060	0.060
K (cmol/kg)	0.140	0.130
Base saturation (%)	70.830	68.790
Sand (%)	81.610	81.780
Silt (%)	6.920	7.060
Clay (%)	11.470	11.160
Moisture content (% by volume)	11.750	19.750
Available water (%)	25.570	91.150

Table 2 shows the physical and chemical properties of the soil (0-25 cm depth) before the experiment. This table indicates that the soil was loamy sand in texture with low moisture content and hence low available water. The soil was also acidic, low in organic matter, total nitrogen, available Phosphorus (P), sodium (Na) and potassium (k). The effect of poultry manure and irrigation on the same soil is also shown in Table 3. The pH increased from 4.95 in the control that had no treatment to 5.13 in the treated plots. There was similar increase in EC, available P and Mg. The moisture content also increased significantly from 11.75% in the control to 19.75% in the treated plots. There was however a decrease in organic matter, Ca and base saturation.

Growth parameters: Table 4 shows the influence of poultry manure and irrigation on the growth parameters of fluted pumpkin at the end of thirteen weeks after planting. Plots that were irrigated and amended with poultry manure produced crops whose growth parameters were significantly higher than those from the control plots. For the treated plots, the minimum vine length of 192 cm was obtained from the combination of 10 t/ha manure and 3 mm depth of irrigation, while the combination of 30 t/ha manure and 3 mm irrigation depth gave the maximum vine length of 225 cm. This trend was also observed for number of leaves and total shoot yield. For leaf area, the combination of 10 t/ha manure and 3 mm irrigation depth gave the minimum area of 78.81 cm^2 which was not significantly different from those obtained from the combinations of 10 t/ha manure with 4 mm irrigation depth and 10 t/ha manure with 5 mm depth of irrigation. There was also no significant difference in leaf area obtained from the combinations of 20 t/ha manure with 3, 4 and 5 mm irrigation depths. The maximum leaf area of 104.90 cm^2 was obtained from the combination of 30 t/ha manures with 4 mm irrigation depth although this was not significantly different from the 103.41 and 104.51 cm^2 obtained from the combinations of 30 t/ha manure with 3 and 5 mm depths of irrigation respectively. Table 5 presents the summary of ANOVA used to compare the means of the selected growth parameters. It shows that the means of all the parameters are significant at the 1% level.

Discussion: The addition of poultry manure usually increases soil pH as indicated between the control and treated plots (Table 3). This is supported by Dikinya and Mufwanzala (2010) who found a significant increase in pH in all treated soil types with increase in chicken manure application. Ano and Agwu (2006) also observed increase in soil pH after the addition of organic manure. However, Ouda and Mahadeen (2008) found that soil pH was not significantly affected by different doses of inorganic and organic fertilizers.

The EC also increased from 0.124 dS/m in the control to 0.144 dS/m in the treated plots. It is difficult to offer tangible explanation for this increase because normally, plant uptake and the leaching effect of the irrigation water, which is potable, would have

Table 4: Effect of poultry manure and irrigation on growth parameters of fluted pumpkin

Treatment		Growth Parameters				
Poultry manure (t/ha)	Irrigation depth (mm)	Vine length (cm)	Number of leaves	Leaf area (cm^2)	Vine fresh weight (t/ha)	Total shoot yield (t/ha)
0	0	98a	20.33a	29.69a	0.79a	0.79a
	3	192a	39.00b	78.81b	2.55b	1.53b
10	4	200cd	42.33bc	80.41b	2.00c	1.80b
	5	197bd	40.33c	80.70b	2.42d	2.43c
	4	201bcd	61.67d	89.76	2.41d	2.36c
20	4	207cd	50.67e	90.33c	2.19e	1.94d
	5	202bcd	48.67e	90.32c	2.35f	2.16cd
	3	225e	87.67f	103.41d	3.93g	3.78e
30	4	215c	66.00g	104.90d	3.76h	3.62e
	5	208cd	63.33d	104.59d	3.82i	2.99f

Means with different letters in a column are significantly different by DMRT

Table 5: Summary of the Analysis of Variance (ANOVA)

Parameter	Source of variation	Degree of freedom	S.S.	M.S.	F-value
Vine length	Replication	2	0.008	0.004	91.750**
	Treatment	9	3.303	0.367	
	Error	18	0.070	0.004	
	Total	29	3.381		
Number of leaves	Replication	2	1.800	0.900	470.979**
	Treatment	9	9312.667	1034.741	
	Error	18	39.533	2.197	
	Total	29	9354.000		
Leaf area	Replication	2	0.045	0.023	1246.883**
	Treatment	9	12995.013	1443.890	
	Error	18	20.844	1.158	
	Total	29	13015.902		
Vine fresh weight	Replication	2	0.002	0.001	2846.000**
	Treatment	9	25.611	2.846	
	Error	18	0.021	0.001	
	Total	29	25.634		
Total shoot yield	Replication	2	0.073	0.037	71.056**
	Treatment	9	23.026	2.558	
	Error	18	0.656	0.036	
	Total	29	23.755		

**: Significant at 1% level

led to a reduction of EC. The increase can therefore be attributed to the poultry manure which has a higher EC level than that in the soil prior to treatment. However, the decrease in EC in the soil after the treatment when compared to that before the experiment was due to plant uptake and leaching by the irrigation water. In a related study with Spent Mushroom Substrate (SMS), Maher (1994) observed that the addition of the organic manure at a rate of 25 metric tons/ha drastically increased EC but after a certain amount of harvest, EC was reduced due to leaching and plant uptake.

Although the addition of poultry manure enhanced the status of organic matter in the soil, Table 3 indicates that there was a reduction from 1.78% in the control to 1.63% in the treated plots. This reduction is certainly due to plant uptake. The table further shows that available P increased from 8.93 mg/kg in the control to 25.24 mg/kg in the treated plots, while Mg increased from 1.82 to 1.91 cmol/kg in the control and treated plots, respectively. These increases are also attributable to the organic manure. Similar observations were made by Adesodun *et al*. (2005). Plant uptake was however responsible for the reduction in Ca and K. This assertion is supported by Ewulo *et al*. (2008) who observed, in a study on tomato, that improved soil nutrient content led to increased uptake of N, P, K, Ca and Mg by the crop.

The increase in moisture content and, hence, available water in the treated plots is mainly due to irrigation. However, the enhancement of soil moisture status by organic manure cannot be neglected. Aluko and Oyedele (2005) attributed the improved soil moisture associated with poultry manure to the mulching effect of the organic matter, improved moisture retention and water acceptance as a result of improved soil structure and macro porosity. Khaleel *et al*. (1981) also observed that the enhancement of soil water retention capacity due to animal manure is attributable to structural improvement resulting in increase in total porosity and the fraction of porosity involved in soil water storage.

The application of poultry manure and irrigation provided the nutrients and soil moisture needed for effective growth of the crop. This is evidenced by the significant difference in growth parameters between the control and the treated plots as indicated in Table 4. Although the influence of the treatments on the parameters does not show a general trend, a few patterns can be identified. For vine length, the application of 10 t/ha manure and 3 mm irrigation depth produced a vine length that was shorter compared to that of 4 mm irrigation, which in turn was higher than the 5 mm depth. This trend is similar to the combinations of the 3 irrigation depths with the 20 t/ha manure. In other words, increase in irrigation depth increased the vine length up to a point and then decreased. This pattern is also true for irrigation with 10 and 30 t/ha manure for number of leaves and leaf area respectively. These observations are in agreement with the findings of Talukder (1985) who reported, in the case of sweet corn, that yield increased up to a certain level of irrigation and then decreased. Chowdhury and Islam (1993) and Zhirkov (1995) also observed the same pattern with maize. In the case of 30 t/ha manure, combinations with increasing depth of irrigation produced a continuous reduction in vine length, number of leaves and total shoot yield. This implies that the highest water-use efficiency occurred with the application of 3 mm depth of irrigation. It can also be implied that this depth of application maintained the moisture level at the readily available zone. On the whole, the combination of 30 t/ha poultry manure and 3 mm depth of irrigation produced the best growth parameters in terms of vine length, number of leaves, vine fresh weight and total shoot yield, while 30 t/ha manure combined with 4 mm irrigation depth gave the maximum leaf area.

CONCLUSION

This study indicates that no meaningful crop production can take place during the dry season in the study area without irrigation and the enhancement of the soil quality through the application of fertilizers. Use of poultry manure as an organic fertilizer should be encouraged. Applications of poultry manure less than 30 t/ha with varying depths of irrigation were not sufficient to ensure optimum growth of fluted pumpkin.

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