GROWTH AND YIELD RESPONSE TO PLANT DENSITY OF WATER LEAF (*TALINUM TRIANGULARE JACQ.)* IN RIVERS STATE, NIGERIA

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ABSTRACT
The effects of different planting spaces (15cm x 15cm, 20cm x 20cm, 25cm x 25cm and 30cm x 30cm) on the growth and yield of *Talinum triangulare* (Water leaf) were investigated in two cropping seasons from 2012 to 2013 (rainy and dry seasons) at University of Port Harcourt Teaching and Research farm, Port Harcourt, Rivers State. A completely randomized block design was used in the experiment and the results were statistically assessed by analyses of variance. The results showed that the planting space of 15cm x 15cm recorded the highest plant height of 33.50cm in rainy season and 32.11cm in dry season. On yield per hectare, the spacing with 15cm x 15cm gave the significant yield of 14.47Kg and 10.01Kg in rainy and dry season respectively at seven (7) weeks harvesting after planting. This result showed that the planting space of 15cm x 15cm could be used to produce a higher yield of water leaf for consumption. Further research work on the use of different soil amendment materials to enhance productivity of the crop is hereby recommended.

Keywords: Plant density, water leaf, growth, yield.

INTRODUCTION
Water leaf (*Talinum triangulare)* is a vegetable which plays an important part in the diet of people in the tropics. It is a non-conventional vegetable crop which belongs to the family *Portulacaceae*. It originated at the banks of the Amazon River, from where it was introduced to West Africa, including Nigeria, Asia (Indonesia and India) and Malaysia. It is well adapted to the local hot and humid weather conditions and does well in areas of low soil fertility (Cardoso, 1997). Waterleaf is a small fibrous herb growing to a height of 30-60cm with an erect or semi-prostrate growth habit (Rice *et al*., 1987). The stems are succulent, with either white or purple colour. They may be flat or triangular in cross section. Water leaf as a vegetable has some inherent characteristics which makes it attractive to small-holder farmers and consumers. This is because it is a short duration crop which is due for harvest between 35-45 days after planting (Rice *et al*., 1986). It is highly nutritious with soft leaves which make it a reasonable substitute for spinach (*Spinacea oleracea)* (Rice *et al*; 1987 and Saikia, 1998).

This vegetable crop is tasteful and much cherished in Southern part of Nigeria especially in Akwa Ibom and Cross River state. It is gradually been used in other parts of Nigeria as food delicacy. It is used as a "softener" when cooking fibrous vegetables such as Afang (*Gnelum africanum*), Atama (*Heinsia crinala*), and fluted pumpkin (*Telferia occidentalis*). Ibeawuchi e*t al.* (2007) noted that the leaves and young shoots are used to thicken sauce and it is consumed in large quantities in the Southern part of Nigeria. Nutritionally, waterleaf has been proven to be high in crude-protein (22.1%), ash (33.98%), and crude fiber (11.12%). It also has some medicinal values in humans and acts as green forage for rabbit feed management (Ekpenyong,

1986; Aduku and Olukosi, 1990). In addition, waterleaf production provides a complementary source of income to small-scale farming households (Udoh, 2005).

The increasing rate of urbanization and population has resulted to low productivity coupled with high demand which outweighs supply. Adequate production is yet to be achieved due to decline in available land space for large scale production. Therefore in order to utilize the available land area wisely, this study was to determine the best planting space that will improve and increase the productivity of the crop so as to meet its high demand by the increasing population.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the University of Port Harcourt Teaching and Research Farm. The University lies on latitude $4^0$31' to 5^0N and longitude $6^0$41' to 7^0E, with an average temperature of 27^0C, relative humidity of 78% and average rainfall that ranges from 2500 – 4000mm (Nwankwo *et. al.,* 2010). The mean monthly rainfall and temperature of the area are presented in Table 1. The experimental area has acidic sandy loam to soil classified as – typical paleudult.The dry season is short, lasting from December through February; the wet rainy season begins from March and continues through November. Maximum rainfall occurs during the months of June to October with mean annual rainfall of 2233mm. The mean monthly temperature ranges between 28^0C and 33^0C, while the monthly minimum is between 20^0C and 23^0C. The highest temperature figures recorded are in the months of December to March.

Treatment and Experimental Design

The experiment was a randomized complete block design with four replications. Treatments (spacing) used in the experiment was 15cm x 15cm, 20cm x 20cm, 25cm x 25cm and 30cm x 30cm which was one treatment with four levels or replicates.A plot of 25m x 25m (0.0625ha) was used with 16 beds of 5m x 5m (sub plots). The planting material used was by stem cuttings (vegetative propagation) which were obtained from Aluu Town. The stems were cut to length of 15cm and planted to a depth of 5cm per hole. The experiment was conducted in two cropping seasons in 2012 to 2013; each season has duration of 3 months. They were planted in the months of June – August 2012 for rainy season and November 2011 – January 2013 for dry season planting. The area was weeded manually by hand pulling and later with the use of hoe. This was done 3 times (3, 6 and 9 weeks) after planting.

Growth and Yield Measurement

The plant height was measured using meter rule from the soil level to the tip of the plant at 2, 4, 6, 8 weeks after planting. The number of branches was taken by visual counting within the same period while the leaf area was calculated according to Asif, 1977; Olasantan, 1999; Akanbi *et al;* 2010 with the formula $y = 115 x - 1050$, where y is the leaf area (cm^2); x is the length of mid-rib (cm/plant) with a constant of 0.025. Girth at 5cm was taken with the aid of an electronic venire caliper at 5cm above the soil level.On yield, the fresh leaf weight was determined by weighing after harvesting using the weighing balance.

RESULTS AND DISCUSSION

The effects of various levels of treatments on plant height, number of leaves, number of branches, leaf area, and girth at 5cm above the soil level are presented in Table 2 for rainy and dry season cropping. The fresh weight yield results in both cropping seasons are represented in

Table 3. These effects were statistically assessed by analyses of variance techniques for a completely randomized block design.

On Growth Parameter

Plant height of *Talinum triangulare* was significantly ($P<0.05$) influenced by the treatment levels in both rainy and dry season cropping periods. The plot planted at 15 x 15cm recorded the highest plant height of 33.50cm in rainy season. The tall plants produced by this spacing may be attributed to the closer spacing which intercepts light. Light is known to have an effect on photosynthesis, stem and root elongation, chlorophyll development and flowering; hence the plants grew taller due to the effects of intra and inter rows shading (Kochhar, 1981). This was also the case in the dry season period where the 15 x 15cm spacing gave taller plant height of 32.15cm because of shade effect and increased soil surface cover which reduced water evaporation from the soil surface (Agusiobi, 1976). The plots with wider spacing 30 x 30cm and 25 x 25cm recorded more number of leaves, branches and leaf areas in both cropping seasons. This is due to wide spaces available for more branching and more number of leaves. A higher Leaf area of 5.41 and 5.40 for rainy season and 4.25 and 4.39 for dry season was also recorded in wider spacing of 30 x 30cm and 25 x 25cm respectively. Though they all did not exhibit any significant ($P<0.05$) difference. This may be attributed to available space for expansion and exposure to sunlight for photosynthesis. The rate of leaf expansion and mature leaf area increased with leaf number (Biemond, 1995). In plants, a decrease in leaf photosynthetic potential results in decreased leaf growth and expansion. Increase in leaf area and plant growth may also be attributed to large feeding area and adequate nitrogen build up by the vegetative portions of the plant producing larger green leaves and its presence in large amounts in relation to other elements which causes excessive vegetative growth and succulence (Ware and McCollum, 1980). Leaf area measurement is often used in growth analysis and is important in current estimates of potential photosynthesis of a crop canopy (Francis *et al*, 1969). Watson (1956) reported that leaf area index (LAI) and duration are strongly related to dry matter production.

Yield Parameter

There were differences between treatments at different harvest intervals and these were statistically significant at 15 x 15cm and 30 x 30cm. In both dry and rainy season cropping the fresh weight yield of *Talinum triangulare* at harvest was more in smaller spacing (15 x 15cm) than wider spacing of 25 x 25cm and 30 x 30cm owing to more plant populations in smaller spacing. Planting closely ensure optimum utilization of available spacing for vegetable crop growth. The lower yield recorded in plots treated with large spacing may be attributed to low plant population which will definitely bring about uneconomic use of land as weed may occupy the spaces which has no economic benefit. Rice *et al,* 1987 reported that a water leaf plant gave yield average of 1Kg per annum. Frequent harvesting of three weeks interval as recorded gave higher yields as presented in the Table 3. From the trial conducted, it was observed that planting space of 15 x 15cm was more advantageous in terms of growth and yield performance of *Talinum triangulare* in both rainy and dry seasons. On yield 15 x 15cm spacing produced more fresh weight yield of 11.05 Kg/ha, 14.47 Kg/ha and 15.21 Kg /ha for rainy season cropping and 7.95 Kg /ha, 10.01 Kg /ha and 12.1 Kg /ha for dry season cropping. A harvesting interval of three weeks was adopted.

On growth of *Talinum triangulare*, the spacing of 15 x 15 cm gave the highest plant height of 33.5cm compared to other wider spacing. Therefore, 15 x 15cm is more suitable for sustainable water leaf production as they produce more yields and make use of available land resources.

CONCLUSION

From the study, it was observed that *Talinum triangulare* with 15 x 15cm spacing to have shown highest yield and growth. It is therefore recommended for sustainable production of water leaf (*Talinum triangulare*) in Port Harcourt environment. Further research work is recommended on the use of some soil amendment materials to determine the best treatment that can enhance the crop productivity.

Table 1: Mean Monthly Rainfall and Temperature at Port Harcourt

Rainfall (mm)	Jan	Feb	Mar	Apr.	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
Rainfall (mm)	25	60	126	200	211	279	283	210	409	269	128	33	2233
Temperature (^{0}C)													
Mean maximum	32.8	34.8	33.9	32.9	31.6	30.2	30.0	29.0	29.4	29.6	31.0	31.5	-
Mean minimum	19.7	19.7	23.8	23.9	23.1	22.7	22.3	22.3	22.4	22.4	22.6	20.9	-
Mean mean	26.3	28.9	28.9	28.4	27.4	26.5	26.2	25.7	25.9	260.0	26.8	26.2	-

Table 2: Effects on Growth Performance

	Rainy Season					Dry Season				
Treatment level (cm)	Plant height (cm)	No. of leaves	No. of branches	Leaf area	Girth at 5cm	Plant height (cm)	No. of leaves	No. of branches	Leaf area	Girth at 5cm
15 x 15	33.50a	64.50b	9.41c	4.80b	0.75a	32.15a	61.0c	8.95c	3.25b	0.63a
20 x 20	32.95ab	69.80ab	11.62b	5.21a	0.71a	30.83ab	65.5ab	10.43b	4.34a	0.60ab
25 x 25	29.90b	71.05a	14.22a	5.40a	0.65b	28.25b	66.3ab	13.91a	4.39a	0.58ab
30 x 30	28.80b	71.81a	13.01a	5.41a	0.64b	27.35b	68.15a	11.30b	4.25a	0.56b

Means with different superscription vary significantly at P<0.05

Table 3: Effects on Fresh Weight Yield/ha (Kg) in both seasons

	Rainy Season			Dry Season		
Treatment levels (cm)	4 Wks	7 Wks	10 Wks	4 Wks	7 Wks	10 Wks
15 x 15	11.05a	14.47a	15.21a	7.95a	10.01a	12.1a
20 x 20	11.03a	13.90b	14.10b	6.05b	8.67b	10.34b
25 x 25	10.7ab	13.00b	13.65b	5.85b	6.81bc	8.62c
30 x 30	10.01ab	12.43bc	12.88c	4.50c	5.62bc	7.34c

Means with different superscription vary significantly at P<0.05

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