EFFECT OF DIFFERENT SPACINGS ON THE GROWTH AND YIELD OF WATERMELON (*Citrullus lanatus* L) IN RAINFOREST ZONE OF NIGERIA.

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ABSTRACT
This study examined the effect of different spacing's (50cm x 50cm, 1m x 1m, 1.5m x 1.5m and 2m x 2m 2.5m x 2.5m) on the growth and yield of watermelon (Citrullus lanatus L) under the soil of Anwai in Delta State. Nigeria. Growth Parameters measured at different growth stages (2, 4, 6, 8 and 10 weeks after planting) include the main vine length (cm), number of lateral branches, number of leaves on the main vine, number of fruits per plant, fruit weight (kg) and Fruit yield. The result showed that there were significant differences among treatments for number of fruits per plant, fruit weight and fruit yield. At a spacing of 2.5m x 2.5m, the highest mean values of 24.00cm, 3684.00g and 25.00kg for fruit length, fruit weight, and fruit yield were recorded. The result of this study showed that there were significant differences among different spacing and 2.5m x 2.5m spacing performed better than others. Thus, a spacing of 2.5mx 2.5m can be recommended to the farmers who are interested in growing watermelon.
Keywords: seed rate, fruit yield, sowing, spacing, varieties

INTRODUCTION
Water melon (*Citrullus lanatus* L) belong to the family *cucurbitaceae*, kingdom *plantae*, order *cucurbitates*, Genus: *citrullus* and species: Lanatus. It is one of the most widely cultivated crop in the world with global production reaching about 89.9 million.. The plant is believed to have originated from Kalahari and Sahara desert in Africa and there have been regarded as a point of diversification to other part of the world. (Jarret *et al*., 2009)

Water melon is an important food for human consumption. It provide large amount of mineral vitamin and antioxidant. Water melon contain about 127 to 129kg (30 k Cal) of energy, 7.55g carbohydrate, 63g sugar, 0.4g dietary fiber, 0.15g fat and 0.61g protein per 100g and also contain about 6.2g sugar and 91.45% water by weight. Water melons are rich in water and also help in preventing dehydration potassium help in lowering high blood pressure. The mineral are said to be good at preventing condition like stroke and heart disease. (Adekunle*et al.*, 2003).

The yield of water melon worldwide ranges from about 25 t/ha, varying from 5-60 t/ha depending on the cultivar and cultural practice. But production of water melon is restricted to some areas in Nigeria and this restriction is mainly due to climatic condition and geographical location of these areas favoring the production (Dantata 2014). The low yield of water melon in Nigeria may be attributed to a number of reasons like cultural practice, poor knowledge about spacing, lack or unavailability of improved varieties, improper fertilizer application, seed rate, water requirement and time of sowing (Dantata 2014). The major constraints of water melon production in Delta State are basically poor Agricultural practices and lack of appropriate information on cultivation of water melon which include knowledge of appropriate spacing for maximum fruit yield in this area. Therefore, this study is aimed at examining the effect of different spacing on the growth and yield of water melon (*Citrullus lanatus*).

MATERIALS AND METHODOLOGY
The experiment was conducted at the Teaching and Research Farm of Delta State University Asaba Campus, Asaba, Nigeria. Asaba is located at latitude $06^0$14'N and longitude $06^0$49'E of the Equator. The annual rainfall was between 1500mm-1849.3mm with distribution as bimodal with peak in July and September and a period of precipitation in August. Asaba has a mean temperature of 37.3^{o}C with mean relative humidity of 77.2% (NIMET, 2013).

Experimental Design and plot layout
The experiment was laid out on a Randomized Complete Block Design (RCBD)**.** The length and width of the experimental field was14m by 10m given a total land area of 144m^2 with different spacing of (50cm x 50cm, 1m x 1m, 1.5m x 1.5m and 2m x 2m 2.5m x 2.5m) the treatment was replicated three times at five different spacing. This gave total number of 15 plots in the experimental area .Agronomic practices that was carried out include clearing, tilling of the soil, complete slashing, packing of debris. Tilling of the soil is mainly done to expose larva stage of predators that hibernate in the soil which is a cultural method of controlling insect pest.

Water melon seed was obtained from International Institute of Agriculture Ibadan. The seeds were sown by direct seedling at a depth of 1.5cm per hole, with this different spacing (50cmx50cm, 1m x 1m 1.5m x 1.5m 2m x 2m,and2.5m x 2.5m). Thinning was practiced when the seedling has three true leaves. The seedlings will be thinned by keeping out one vigorous and heal their plant per hole. Weeding was done manually using hoe and pesticide was applied at 2nd 3rd 4th week after planting to protect the plant against insects such as melon fly and aphid white flies.

Data Collection

Three plants from each plot where tagged from which growth and yield parameters would be recorded the data will be recorded for the main vine length (cm) number of lateral branches, number of leaves on the main vine number of fruits per plant, fruit weight and fruit yield.

Vine length (cm): Two plants from each plot were tagged from which growth of the main vine will be recorded. The main vine from the 4th 6th8thand 10th week after sowing main vine length (cm) measured from the soil surface to the end tip of the plant using ruler and a lope.

Number of leaves on the main vine: Number of leaves on the main vine from two plants of each plot was counted at 4th 6th8thand 10th weeks after sowing.

Number of lateral branches: Number of lateral branches was counted from the two plants of each plot at 4th6th8thand 10th weeks after sowing.

Fruit length (cm): Three fruit per plants selected in each plot were measured using meter rule.

Fruit Weight (kg): Each fruit per plot were weighed using a weighing balance.

Fruit Yield (s): Three fruit per plant were weighed using a weighing balance.

Data Analysis: Data collected were subjected to analysis of variance (ANOVA), and means were separated using LSD at 5% level of probability(SAS, 2010).

RESULTS AND DISCUSION

Effect of Different Level of Spacing on Vine Length of Watermelon at Different Sampling Periods

The effect of different levels of spacing on vine length at 4th 6th and 8th and 10th weeks after sowing is shown in Table1. The result shown in Table 1 at 4th week after sowing showed that there was no significant difference on effect of spacing. This is due to the fact that there was no competition for nutrient, water and light at the 4th week after sowing. At 6 weeks there were no significant difference among treatments; however the highest vine length (1.35cm, 2.40cm, 2.85cm and3.65cm) was recorded in 2.5m x 2.5m treatment at 5% level of probability. At 8th weeks after sowing, there were no significant differences among treatments but the treatment 2.5m x 2.5m was significantly different in vine length (2.85cm) at 5% level of probability. At 10 weeks after sowing the results showed that there were no significant differences among treatments. Also the results shown in Table1 showed that among the treatments, the vine length was significantly different at 10th week after sowing due to the effect of different level of spacing.

The results showed that as spacing increase, watermelon main vine length also increased due to low competition with water nutrient and light between crops.

Table 1: Effect of Different Level of Spacing on Vine Length of Watermelonat Different Sampling Periods

	WEEKS AFTER PLANTING			
Spacing	4	6	8	10
50cm x 50cm	1.1	1.30	1.65	2.40
1m x 1m	1.20	1.55	1.85	2.75
1.5m x1.5m	1.30	1.60	2.40	3.25
2m x 2m	1.25	2.30	2.75	3.55
2.5m x 2.5m	1.35	2.40	2.85	3.65
LSD (0.05)	0.27	0.34	0.23	0.23

Effect of Different Level of Spacing on Number of Branches of Water Melon at Different Sampling Periods

The effect of different level of spacing on number of branches of water melon is presented in Table 2. At 4 weeks after sowing the result showed that there were no significant differences among treatments. At 6, 8 and 10 weeks after sowing the results showed that there were no significant differences among treatments; however the treatment 2.5m x 2.5m consistently produced the highest means number of branches at 5% level of probability. The result showed that as spacing increased and watermelon number of lateral branches increased, due to low competition with water nutrient and light between crops. Also, the vine length, diameter, number of leaves and number of branches increased linearly with increased in spacing.

Table 2: Effect of Different Level of Spacing on Number of Branches of Water Melon at Different Sampling Period

	WEEKS AFTER SOWING			
SPACING	**4**	**6**	**8**	**10**
50cm x 50cm	3.00	3.50	4.00	5.00
1m x 1m	3.00	3.50	4.00	5.00
1.5m x1.5m	3.00	4.00	5.00	5.50
2m x 2m	3.50	4.50	5.00	6.00
2.5m x 2.5m	3.50	4.50	5.00	6.50
LSD (0.05)	1.15	1.63	0.11	1.15

Effect of Different Level of Spacing on Number of Leaves of Watermelon
At Different Sampling Periods

The effect of different level of spacing on water melon number of leave is presented in Table 3. The result at 4 weeks after sowing showed that there were no significant differences among treatments. At 6 weeks after sowing the result showed that there were no significant differences among treatment; however the highest means number of leave (29.00) was recorded in 2.5m x 2.5m treatment at 5% level of probability. At 8 and 10 weeks after sowing the results showed that there were no significant differences among treatments. The result showed a progressive increment in plants number of leaves from 4 to 10 weeks after sowing across treatments. At 10th week after sowing numbers of leaves was relatively more with 2.5m x 2.5m. The results showed that spacing has no significant effect on numbers of leaves and as spacing increased watermelon leaves also increased due to low competition with water nutrient and light between crops promoting better growth of watermelon.

Table 3: Effect of Different Level of Spacing on Number of Leaves of Watermelon at Different Sampling Periods

	WEEKS AFTER SOWING			
Spacing	**4**	**6**	**8**	**10**
50cm x 50cm	6.50	14.50 `	21.50	28.50
1mx1m	7.50	17.00	26.50	34.50
1.5mx1.5m	7.00	23.50	32.50	36.50
2mx2m	8.50	27.50	33.50	37.00
2.5mx2.5m	9.00	29.00	36.00	39.50
LSD (0.05)	1.41	2.15	2.29	1.63

Effect of Different Level of Spacing on Fruit Length (cm), Fruit Weight(s), Yield (kg) of Watermelon at Different Sampling Periods.

The effect of different level of spacing on fruit length is presented in Table 4. The result showed that there was no significant difference between treatments. Fruit length was relatively more with 2.5m x 2.5m (24.00cm) followed by lm x 2m (21.3cm), l.5m x 1.5(18.0cm), lm x lm(12.1cm) and the lowest 50cm x 50cm (8.67cm). The result showed that increase in spacing also leads to increase in fruit length.

The result obtained on effect of different level of spacing on fruit weight showed no significant difference (P>0.05) between treatments but there was a gradual increment in fruit weight across treatments. Weight of fruit was relatively more with 2.5m x 2.5(3684g), 2m x 2m (3167g), l.5m x 1.5m (2689.7g), lm x lm (2373g) and the lowest 50cm x 50cm (1925g). The result showed that by increasing spacing the fruit weight also start increasing gradually. Total yield increased as plant spacing increased from 50cm x 50cm to 2.5m x 2.5m. Thus it indicated that 2.5m x 2.5m is the best spacing for getting higher yield as compared to any other spacing.

Table 4: Effect of Different Level of Spacing on Fruit Length (cm), Fruit Weight (g), Yield (kg) and yield/ha (kg/ha) of Watermelon at Different Sampling Periods.

Spacing	Fruit Length(cm)	Fruit Weight(g)	Fruit Yield(kg)	Yield(kg/ha)
1mx50cm	8.66	1925.00	11.000	763.88
1m x 1m	12.100	2373.00	16.000	1111.11
1.5m x 1.5m	18.000	2689.67	18.000	1250.00
2m x 2m	21.300	3167.00	20.667	1435.21
2.5m x 2.5m	24.000	3684.00	25.000	1666.67
LSD(0.05)	0.8764	6.2352	0.4861	6.7352

DISCUSSION

The effect of different levels of spacing on vine length at 4th 6th and 8th and 10th weeks after sowing is shown in Table1. The result shown in Table 1 at 4th 6th, 8th and 10th week after sowing showed that there was no significant difference on effect of spacing. This is due to the fact that there was no competition for nutrient, water and light. At 4th 6th, 8th and 10th the highest vine length (1.35cm, 2.40cm, 2.85cm and3.65cm) were recorded in 2.5m x 2.5m treatment at 5% level of probability. The results showed that as spacing increase, watermelon main vine length also increase due to low competition with water nutrient and light between crops. These results are in agreement with the finding of Efediyi *et al,* (2009) who reported that the spacing has positive effect on plant height. These result get support from the work done by Ban *et al.* (2011) who observed that in row-plant spacing has a significant effect on the growth and yield of watermelon. These results are supported by the work done by Sabo *et al*. (2013) who reported an increase in watermelon vine length with an increase in spacing. The effect of different level of spacing on water melon number of leave is presented in Table 3. The result at 4 weeks after sowing showed that there were no significant differences among treatments. At 6 weeks after sowing the result showed that there were no significant differences among treatment; however the highest means number of leave (29.00) was recorded in 2.5m x 2.5m treatment at 5% level of probability. At 8 and 10 weeks after sowing the results showed that there were no significant differences among treatments. The result showed a progressive increment in plants number of leaves from 4 to 10 weeks after sowing across treatments. At 10th week after sowing numbers of leaves was relatively more with 2.5m x 2.5m. The results showed that spacing has no significant effect on numbers of leaves and as spacing increased watermelon leaves also increased due to low competition with water nutrient and light between crops promoting better growth of watermelon.

These results get supported from the work done by Sabo *et al.* (2013) who reported that there is no significant difference in all the level of spacing (2.5m x 2.5m, 2m x 2m, l.5m x 1.5) used in promoting numbers of leaves of watermelon.

These results are in agreement with the finding of Efediyi *et al,* (2009) who reported that the spacing has positive effect on number of leave. These result get support from the work done by Ban *et al.* (2011) who observed that in row-plant spacing has a significant effect on the growth and yield of watermelon. These results are supported by the work done by Sabo *et al*. (2013) who reported an increase in watermelon number of leave with an increase in spacing.

The effect of different level of spacing on number of branches of water melon is presented in Table2. At 4, 6, 8 and 10 weeks after sowing the result showed that there were no significant differences among treatments. The effect of different level of spacing on fruit length is presented in Table 4. The result showed that there was no significant difference between treatments. Fruit length was relatively more with 2.5m x 2.5m (24.00cm) followed by 2m x 2m (21.3cm), l.5m x 1.5(18.0cm), lm x lm(12.1cm) and the lowest 50cm x 50cm (8.67cm). The result showed that increased in spacing also leads to increase in fruit length. These results are supported by Goreta *et al.* (2013) who reported that with increased spacing average fruit weight of watermelon and fruit size distribution shifted to large categories. The result obtained on effect different level of spacing on fruit weight showed no significant difference (P>0.05) between treatments but there was a gradual increment in fruit weight across treatments. Weight of fruit was relatively more with 2.5m x 2.5(3684g), 2m x 2m (3167g), l.5m x 1.5m (2689.7g), lm x lm (2373g) and the lowest 50cm x 50cm (1925g).

The result showed that by increasing spacing the fruit weight also start increasing gradually these result are in agreement with the finding of Doneta *et al*., (2011) who reported that with increased spacing average fruit weight of watermelon and fruit size distribution shifted to larger categories.

Total yield increased as plant spacing increased from 50cm x 50cm to 2.5m x 2.5m and also the yield per hectare also increases from 50cmx50cm to 2.5m x 2.5m. Thus it indicated that 2.5m x 2.5m is the best spacing for getting higher yield as compared to any other spacing. Similar result was also recorded by Hamide *et al.,* (2013) who reported that spacing effect was observed on yield.

CONCLUSION

The experiment was conducted to evaluate the effect of different levels plant spacing on the growth and yield of watermelon (*Citrullus lanatus*L.) in Agronomy Research Farm, Delta State University, Asaba Campus. The treatment comprised of five different plant spacing (50cm x 50cm, 1m x 1m, 1.5m x 1.5m, 2m x 2m and 2.5m x 2.5m). Each treatment was replicated three times and the parameters measured were: Vine length, number of leaves, number of branches, fruit length, fruit weight and fruit yield. The result showed that spacing at 2.5m x 2.5m significantly increased the vine length, number of leaves, number of branches, fruit length, fruit weight and fruit yield. Spacing at 2.5m x 2.5m was the adequate measurement for maximizing fruit length, weight fruit and fruit yield. Plant spacing at 50cm x 50cmconsequently gave the least values in all the yield parameters. It is recommended that watermelon producer should use the spacing 2.5m x 2.5m in raising the crop for maximum production, in the study area.

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