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Full Length Research Paper

An assessment of some growth and yield indices of six varieties of watermelon (*Citrulus Lanatus* Thumb) in Asaba area of Delta State, Nigeria

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ABSTRACT

Field experiments were conducted in 2011 and 2012 cropping seasons in the Teaching and Research Farm of Delta State University, Asaba Campus, Nigeria to assess some growth and yield indices of six varieties of watermelon (Sugar baby, Charleston gray, Crimson sweet, Green gold, Jubilee, and Ice box) in Asaba area of Delta State, Nigeria. The experiments were carried out in a Randomized Complete Block Design (RCBD) with three replicates. Four parameters were assessed to achieve the objectives of the study - vine length, number of leaves/plant, number of branches /plant, and weight of fruits at 75 days after sowing. The results of the two-year evaluation indicated that Sugar baby variety was superior at 4, 6, and 8 weeks in the parameters tested with mean vine length of 63.4 cm, 133.1 cm, and 181.1 cm, respectively; mean number of leaves/plant of 30.5, 33.5 and 40.4 respectively; mean number of branches/plant of 5.0, 6.0, and 7.0, respectively; and mean weight of fruits of 1315.43 tha^{-1} at 75 days after sowing in 2011 and 2012. Based on the findings of this study, it was recommended that farmers in the study area grow Sugar baby variety for increased growth and yield of watermelon.

Keywords: Growth and yield indices, varieties of watermelon, Asaba, Nigeria.

INTRODUCTION

Watermelon (*Citrullus lanatus Thumb*) is a member of the cucurbitaceae family. It is believed to have originated from the Kalahari and Sahara deserts in Africa (Jarret, et al., 1996). In Nigeria, its cultivation which was originally confined to the drier savannah regions of the North, is now gradually gaining ground in the southern parts of the country. It is a crop with huge economic importance to man. The fresh fruit is relished by many people across the world because it is known not only to be low in calories but highly nutritious, sweet and thirst-quenching (Mangila *et al*., 2007). It is commonly used to make a variety of salads, most notably fruit salad (Wikipedia.com., 2010). It is a popular cash crop grown by farmers during summer due to its high returns in investment, especially those residing near the urban areas. Watermelon contains Vitamin C and A in form of the disease fighting beta-carotene. Potassium is also available in it, which is believed to help in the control of blood pressure and possibly prevent stroke (IITA, 2013). The numerous uses of watermelon in Nigeria notwithstanding, yield across the country is not encouraging not necessarily because of declining soil fertility only, but mainly due to failure to identify high yielding varieties best adapted or most suitable to each agro – ecological zone. Iken and Anusa (2004) reported that because of the differences in yield potential of different ecological zones, testing of new crop varieties across the country became an established practice in plant breeding. The report further argued that though high yielding crop varieties can only express their full genetic resources, the yield advantages and special traits of hybrids appear to be sufficiently large enough to attract the attention of farmers. This according to the report starts with the right choice of site through timely and appropriate establishment, nutrition; disease and pest control to proper harvesting procedure and produce disposal and/or storage. Varietal differences affect or determine the growth and yield of crops. Majanbu *et al.,* (1996) and Sajjan *et al.,* (2002) reported that growth characters of crops such as plant height, vine length, leaf

area, number of leaves or branches, and fruit production were influenced by genetic factors of the different varieties. Ibrahim *et al.,* (2000) reported that the differences in growth indices of crops is normally attributed to their genetic constitution. Akinfoesoye *et al,* (1997); Odeleye and Odeleye (2001) indicated that growth characters, yield and its component differed among crop varieties and therefore suggested that breeders must select most promising combiners in their breeding programmes. Ray and Sinclair (1997) attributed differences between the growth characters of crop genotypes to photosynthetic activity of leaves i.e. internal factors and/or to the differences in high distribution on leaf surface of the crop canopy, leaf arrangement, differences in chlorophyll content, activity of photosynthetic enzymes and differences in stomatal conductance values. Costa and Campos (1990); Gardner *et al.,* (1990) and Zaki *et al.,* (1999) attributed yield differences in crop cultivars to stomatal conductance value and to differences between genotypes in partitioning of photosynthetic materials towards economic yield. Clark *et al.,* (1997) reported that the genotypes differences in yield and its components may be due to variations in genetic structure, mineral concentration and potentials to transport photosynthetic materials within plants.

At present, no variety of watermelon has been identified as best adapted or most suitable for Asaba area of Delta State, Nigeria. The objective of this study, therefore, was to assess the growth and yield indices of six different varieties of watermelon with a view to identifying the best adapted or most suitable variety for the study area.

MATERIALS AND METHODS

Description of experimental site

Field experiments were carried out at the Research and Teaching Farms of Anwai Campus of the Delta State University. The experimental site is located within latitude 06°14'N and longitude 06°49'E of the equator. The experiment was conducted during the 2011/2012 cropping seasons in a typical humid environment that is characterized by a bimodal rainfall pattern with peaks in July and September and an interrupted dry spell in August otherwise called (Harmattan). The annual mean rainfall is about 1,650 mm, the mean annual temperature is 37.3°C and a mean relative humidity of 73.2% (NIMET, 2011). By nature of its geomorphological settings, the study area falls within the classification of Ancient metamorphic crystalline basement complex formation which are more acid than base (Egbuchua, 2007). They are essentially gneisses and pegmatites that gave rise to coarse-textured soils that are deficient in dark ferromagnessium minerals (Egbuchua, 2007).The topography is undulating with pockets of hills and land use is typically based on rain - fed agriculture with root, tuber, spices, pulses and vegetables prominently cultivated. The vegetation is of rainforest origin but has been drastically reduced to derived savanna due to continuous use of the land.

Field studies

A land measuring 388.85 m^2 (38.5 m x 10.1m) was selected for the study and prepared by using a tractor to plough and harrow the land. It was marked out according to the experimental layout. Eighteen plots of 6.0m x 2.7m each were made and composite samples collected from the plots at 0-15 cm depth in order to assess the initial physio-chemical properties of the soil.

Laboratory studies

The composite soil samples collected from the individual plots were air-dried in a room temperature of 27°C for three days, crushed and sieved using 2mm aperture. The parameters evaluated include the particle size distribution by hydrometer method (Gee and Bauder, 1986). The pH was determined using Pye Unican model MK2 pH meter in a 1:2:5 soil/water suspension ratio. Organic carbon was determined by Walkley-Black wet oxidation method (Nelson and Sommers, 1982). Total nitrogen was determined by micro-Kjeldahl distillation technique as described by Breminer and Mulvaney (1982). Available phosphorus was determined by Bray No. 1 method (IITA, 1979). Exchangeable potassium was determined by flame photometer, while cation exchange capacity (CEC) was determined by Amnonium acetate saturation method (Roades, 1982).

Experimental Design

The experiment was carried out in a Randomized Complete Block Design (RCBD) with three replicates. Six varieties of watermelon were sown- Sugar baby, Charleston gray, Crimson sweet, Green gold, Jubilee, and Ice box. Poultry manure was uniformly incorporated at the rate of 30 tha^{-1} into the soil 2 weeks before planting.

Seed collection and planting

The six watermelon varieties were collected from Agro – Allied Company, Ibadan, and sown on the plots at 2 seeds per stand at a depth of 2.5 cm, using a spacing of

90 cm x 75 cm, with 1 m Alley pathways.

Weeding

Regular weeding was done around the base, along and ahead of the vines using hoe.

Data Collection

Fourteen middle stands were used as sample population. Data collected were vine length, number of leaves/plant, number of branches/plant, and fruit weight at maturity. Vine length was measured with tape from the base to the growing tip of the plant. Number of leaves/plant and number of branches/plant were determined by direct counting. Fruit weight was measured using a weighing scale, after harvesting at 75 days from planting.

Statistical Analysis

Data collected was subjected to analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) according to Wahua (1999).

RESULTS

Initial Soil Properties

The data on the initial physico-chemical properties of the soils used for the study is presented in Table 1. The particle size fracture showed that the soils were sandyloam in texture and low in fertility as reflected by the low content of organic matter (15.5 gkg^{-1}), and total nitrogen (0.87 gkg^{-1}). Soil pH was strongly acid with a mean value of 5.3. The available phosphorus (P) and water soluble, potassium (K) with mean values of 5.35 $mgkg^{-1}$ and 0.17 $cmolkg^{-1}$ were seemingly low based on the ratings of FMANR, (1996) for the ecological zone. The low fertility status of the soils is a true reflection of most ultisols of humid environment that are strongly weathered of low activity clay mineralogy and high acidity due to intense precipitation with its associated erosion and leaching in the environment.

Vine length (cm) of six watermelon varieties at different weeks after sowing in 2011 and 2012

The vine length of six watermelon varieties from 4-8 weeks after sowing in 2011 and 2012 is shown in Table 2. Vine length of watermelon gradually increased from 4-8 weeks after sowing. There were significant differences in vine length of the varieties investigated. At 4 weeks after sowing in both years of evaluation, Sugar baby variety had the highest vine length with a mean value of 63.4 cm, while Ice box variety had the lowest vine length with a mean value of 43.2 cm. During the 6^{th} week of both years, Sugar baby variety also had the highest vine length with a mean value of 133.1 cm, while Ice box variety also had the lowest vine length with mean value of 76.2 cm. The trend did not change during the 8^{th} week. Sugar baby variety was also superior in vine length with mean value of 181.1 cm, while Ice box variety which had a mean value of 92.3 cm was lowest. The order of superiority in vine length of watermelon based on varieties investigated was Sugar baby > Charleston gray > Crimson sweet > Green gold > Jubilee > Ice box.

Number of leaves/plant of six watermelon varieties at different weeks after sowing in 2011 and 2012

The number of leaves of six varieties of watermelon at different weeks after sowing in 2011and 2012 cropping seasons is shown in Table 3. Number of leaves of watermelon gradually increased from 4-8 weeks after sowing. There were significant differences also in the number of leaves of the watermelon varieties tested. At 4 weeks after sowing in 2011 and 2012, Sugar baby variety had the highest number of leaves/plant with a mean value of 30.5, while Ice box variety with mean value of 17.6 had the lowest number of leaves/plant. During the 6^{th} week of both years of evaluation, Sugar baby variety also had the highest number of leaves/plant with a mean value of 33.5, while Ice box variety which had a mean value of 19.2 had the lowest number of leaves/plant. Similar trend was observed during the 8^{th} week where Sugar baby variety proved superior in number of leaves/plant with a mean value of 40.4, while Ice box variety which had a mean value of 23.2 had the lowest number of leaves/plant. Based on variety, the order of superiority in number of leaves/plant of watermelon was Sugar baby > Charleston gray > Crimson sweet > Green gold > Jubilee > Ice box.

Number of branches/plant of six watermelon varieties at different weeks after sowing in 2011 and 2012

The number of branches/plant of watermelon from 4-8 weeks after sowing in 2011 and 2012 is shown in Table 4. There were significant differences in the number of branches/plant of the varieties sown. At 4 weeks of both years of evaluation, Sugar baby variety had the highest number of branches/plant with a mean value of 5.0, while Ice box variety which had a mean value of 2.0 had the lowest number of branches/plant. During the 6^{th} week of both years, Sugar baby variety also had the highest number of branches/plant with a mean value of 6.0, while Ice box variety with a mean value of 3.0 had the lowest

Table 1.Initial phyisco-chemical properties of the soils used for the study

Parameters Measured	Values obtained
Particle size fractions (%)	
Sand	85.0
Silt	9.6
Clay	4.4
Textural class	Sandyloam
pH (H_2O)	5.3
Organic matter gkg^{-1}	15.5
Total Nitrogen (gkg^{-1})	0.87
Available P ($mgkg^{-1}$)	5.35
Exchangeable K ($Cmolkg^{-1}$)	0.17
CEC ($Cmolkg^{-1}$)	10.13

Table 2. Vine length (cm) of six watermelon varieties at different weeks after sowing in 2011 and 2012

	Weeks after sowing								
	4			6			8		
	Vine length (cm)								
Varieties of watermelon	2011	2012	Mean	2011	20012	Mean	2011	20012	Mean
Sugar baby	62.5$_a$	64.3$_a$	63.4$_a$	126.0$_a$	140.2$_a$	133.1$_a$	170.0$_a$	192.2$_a$	181.1$_a$
Charleston gray	58.2$_b$	60.4$_b$	59.3$_b$	108.4$_b$	122.6$_b$	115.5$_b$	148.2$_b$	166.4$_b$	157.3$_b$
Crimson sweet	54.4$_c$	54.8$_c$	54.6$_c$	98.6$_c$	116.2$_c$	107.4$_c$	122.3$_c$	142.1$_c$	132.2$_c$
Green gold	46.8$_d$	48.0$_d$	47.4$_d$	82.4$_d$	102.4$_d$	92.4$_d$	102.4$_d$	124.2$_d$	113.3$_d$
Jubilee	44.6$_e$	44.8$_e$	44.7$_e$	74.3$_e$	92.5$_e$	83.4$_e$	96.2$_e$	112.6$_e$	104.4$_e$
Ice box	42.4$_f$	44.0$_f$	43.2$_f$	72.0$_f$	80.4$_f$	76.2$_f$	82.2$_f$	102.4$_f$	92.3$_f$

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

number of branches/plant. The trend did not change during the 8th week. Sugar baby variety also had the highest number of branches/plant with a mean value of 7.0, while Ice box variety which had a mean value of 4.0 had the lowest number of branches/plant. Based on variety, the order of superiority in number of branches/plant of watermelon was Sugar baby > Charleston gray > Crimson sweet > Green gold > Jubilee > Ice box.

Weight of fruits (tha^{-1}) of watermelon varieties at 75 days after sowing in 2011 and 2012

The weight of fruits of watermelon at 75 days after sowing in 2011 and 2012 cropping seasons is shown in Table 5. There were significant differences in weight of fruits of the varieties investigated. In both years of evaluation, Sugar baby variety had the highest weight of fruits with a mean value of 1315.43 tha^{-1} while Ice box variety had the lowest weight of fruits with a mean value of 756.30 tha^{-1}. Based on variety, the order of superiority in weight of fruits of watermelon was Sugar baby > Charleston gray > Crimson sweet > Green gold > Jubilee > Ice box.

DISCUSSION

Vine length of six watermelon varieties at different weeks after sowing in 2011 and 2012

The higher mean value of vine length of Sugar baby variety over other watermelon varieties tested may be

Table 3. Number of leaves/plant of six watermelon varieties at different weeks after sowing in 2011 and 2012.

	Weeks after sowing								
	4			6			8		
	number of leaves/plants								
Varieties of watermelon	2011	2012	Mean	2011	20012	Mean	2011	20012	Mean
Sugar baby	29.6$_a$	31.4$_a$	30.5$_a$	32.2$_a$	34.8$_a$	33.5$_a$	38.4$_a$	42.4$_a$	40.4$_a$
Charleston gray	27.2$_b$	29.6$_b$	28.4$_b$	30.4$_b$	32.2$_b$	31.3$_b$	34.2$_b$	38.6$_b$	36.3$_b$
Crimson sweet	24.4$_c$	26.4$_c$	25.4$_c$	26.2$_c$	28.6$_c$	27.4$_c$	32.0$_c$	35.0$_c$	33.5$_c$
Green gold	21.3$_d$	23.5$_d$	22.4$_d$	24.0$_d$	26.2$_d$	25.1$_d$	28.2$_d$	30.2$_d$	29.2$_d$
Jubilee	19.2$_e$	20.6$_e$	19.9$_e$	20.6$_e$	24.2$_e$	22.4$_e$	24.4$_e$	26.0$_e$	25.2$_e$
Ice box	17.0$_f$	18.2$_f$	17.6$_f$	18.2$_f$	20.2$_f$	19.2$_f$	22.1$_f$	24.3$_f$	23.2$_f$

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

Table 4. Number of branches/plant of six watermelon varieties at different weeks after sowing in 2011 and 2012.

	Weeks after sowing								
	4			6			8		
	number of branches/plants								
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
Varieties of watermelon									
Sugar baby	5.0$_a$	5.0$_a$	5.0$_a$	6.0$_a$	6.0$_a$	6.0$_a$	7.0$_a$	7.0$_a$	7.0$_a$
Charleston gray	3.0$_b$	3.0$_b$	3.0$_b$	4.0$_b$	4.0$_b$	4.0$_b$	5.0$_b$	5.0$_b$	5.0$_b$
Crimson sweet	3.0$_b$	3.0$_b$	3.0$_b$	4.0$_b$	4.0$_b$	4.0$_b$	5.0$_b$	5.0$_b$	5.0$_b$
Green gold	2.6$_b$	2.4$_b$	2.5$_b$	3.5$_b$	3.5$_b$	3.5$_b$	4.4$_b$	4.6$_b$	4.5$_b$
Jubilee	2.4$_b$	2.4$_b$	2.4$_b$	3.4$_b$	3.2$_b$	3.3$_b$	4.2$_b$	4.2$_b$	4.2$_b$
Ice box	1.8$_c$	2.2$_b$	2.0$_{bc}$	2.8$_c$	3.2$_b$	3.0$_{bc}$	3.8$_c$	4.2$_b$	4.0$_{bc}$

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

attributed to differences in its genetic constitution with respect to higher growth rate of the vine, and to suitability of Asaba agro-ecological conditions for the variety. This is similar to the findings Majanbu *et al*., (1996); Ibrahim *et al*., (2000); and Sajjan *et al*., (2002), who reported that genetic constitution of crop varieties influence their growth characters. It is also in harmony with the findings of Iken and Anusa (2004) who attributed the growth and yield differences among crop varieties to right choice of suitable agro-ecological zone.

Number of leaves of six watermelon varieties at different weeks after sowing in 2011 and 2012

The number of leaves/plant of Sugar baby variety was higher than that of other varieties investigated possibly because Sugar baby had higher photosynthetic activities, better distribution of leaf surface, superior leaf arrangement and chlorophyll content, and more active photosynthetic enzymes. This is similar to the findings of Ray and Sinclair (1997) and Enujeke (2013) who

Table 5. Weight of fruits (tha^{-1}) of watermelon varieties at 75 days after sowing in 2011 and 2012

Varieties of watermelon	Weight of fruits (tha^{-1})		
	2011	2012	Mean
Sugar baby	1232.02$_a$	1398.84$_a$	1315.43$_a$
Charleston gray	1120.24$_b$	1184.20$_b$	1152.22$_b$
Crimson sweet	1004.20$_c$	1124.10$_c$	1064.15$_c$
Green gold	960.04$_d$	984.04$_d$	972.04$_d$
Jubilee	824.02$_e$	862.32$_e$	843.20$_e$
Ice box	744.40$_f$	768.20$_f$	756.30$_f$

Means with the same letter(s) under the same column are not significantly different ($P \leq 0.05$) using Duncan Multiple Range test (DMRT).

attributed the differences between the growth characters of crop varieties to photosynthetic activities of leaves, differences in distribution of leaf surface and crop canopy, leaf arrangement, differences in chlorophyll content and activity of photosynthetic enzymes.

Number of branches/plant of six watermelon varieties at different weeks after sowing in 2011 and 2012

Higher number of branches/plant was observed in Sugar baby variety possibly because that particular variety combined its good genetic make-up to exploit the newly found favourable agro-ecological conditions of the study area for rapid growth and branching. This is in harmony with the reports of Akinfoesoye *et al*., (1997) and Ray and Sinclair (1997) who attributed the growth characters of crop species not only to genetic constitution of the crop but also to the suitable agro-ecological zone where they can express their full genetic resources for growth and yield enhancement.

Weight of fruits (tha^{-1}) of six watermelon varieties at different weeks after sowing in 2011 and 2012

The higher weight of fruits observed in Sugar baby variety over other varieties investigated may be attributed to its higher stomatal conductance value, better partitioning of photosynthetic materials towards economic yield, better genetic structure and higher potential to transport photosynthetic material within plants. This is in harmony with the reports of Costa and Campos (1990); Gardner *et al*., (1990) and Zaki *et al*., (1999) which attributed the yield differences in crop cultivars to stomatal conductance value and to differences in partitioning of photosynthetic materials towards economic yield. It is also in consonance with the findings of Clark *et al*., (1997) who attributed the differences in yield and its components between crop genotypes to variations in genetic structure, mineral concentration and potentials to transport photosynthetic materials within plants.

CONCLUSION AND RECOMMENDATION

This study was carried out to assess some growth and yield indices of six watermelon varieties in Asaba Area of Delta State, Nigeria. It was conducted in a Randomized Complete Block Design (RCBD) with three replicates. The parameters assessed to achieve the objective of the study were vine length, number of leaves/plant, number of branches/plant and fruit weight of the different varieties. The results obtained showed that Sugar baby variety was superior in the parameters investigated. Based on the findings of the study, it was recommended that farmers in the study area plant Sugar baby variety of watermelon for enhanced growth and yield.

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