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Enhancing Food Security through Cultivation of Good Varieties of Watermelon (*Citrullus lanatus* L.) in Ejigbo, Osun State

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Abstract

Watermelon (*Citrullus lanatus* L) is a vegetable fruit whose consumption has increased in popularity because of its numerous health benefits. In Nigeria, this vegetable crop is still under-produced in the relatively more humid southern part where it is highly consumed because only a few varieties can thrive in the region. There is the need to determine varieties that are high yielding and produce good quality fruits. In this study, field trials were conducted on a sandy loam acid soil at Osun State University's Teaching and Research Farm, Ejigbo, Osun State. The experiment comprises of three varieties of watermelon namely; Heracles, Kaolack and Sweet pink which was laid out in a randomized complete block design with three replications. The results after 75 days of planting, showed significant differences among the varieties during the vegetative stage. Heracles variety had the highest value for vine length, leaf length, leaf breadth with 160.47, 21.44, 20.99, 229.66cm respectively. Although these were not significantly different from what was recorded from Kaolack but significantly different from those from Sweetpink. In the yield parameters (fruit length, fruit width and fruit weight), Heracles also gave the highest yield which are 26.47cm, 47.33cm and 2.26kg respectively. Although there was no significant difference among the varieties used in this study for the yield parameters, for improved growth and yield of watermelons on sandy loam soils in the Ejigbo region and for edaphologically similar agricultural environments in the derived savannah, it is recommended that farmers plant the exotic Heracles variety.

Key words: Watermelon, Vegetative growth, Food security, Fruit yield, Agro-ecological zone

Introduction

Watermelon (*Citrullus lanatus* L.) belongs to the Cucurbitaceae family, a large family that occurs in the warmer parts of all continents (Park et al., 2018). Other popular members of the family include Cucurbita (squashes and squashes), Cucumis (melons) and Lagenaria (bottle gourd / calabash) (Habibur et al., 2013). Watermelon is native to tropical Africa but China is the world's largest watermelon producer with about 70% of the world's total production. World production in 2017 was 118 million tons (FAO, 2018) and it is the third most widely consumed fruit in the world (Zhao et al., 2013). It is the most preferred among five other exotic vegetables examined in Ibadan Metropolis (Oguntola, 2006).

Food security means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life (FAO, 2018). About 2.37 billion people (or 30% of the global population) lacked access to adequate food in 2020 (FAO, 2021) and an estimated 2 billion people are affected by insufficient intakes of micronutrients (WHO, 2016). It thus means that food security goes beyond calorie intake but include the quality of food taken. Factors responsible for the food insecurity include conflict, socio-economic conditions, natural hazards, climate change and pests.

Watermelon contains over 92% of water, the remaining percent comprises fiber, proteins, vitamins (B6, C, E and A), minerals and antioxidants particularly, lycopene (Sawn et al., 2020). It is a prolific vegetative producers and also supply man with delicious and nutrient rich fruits. Watermelon contains important compounds such as lycopene and citrulline that confer health benefits on man (Bianchi et al, 2018). It aids healthy growth and weight loss due to its low sodium, saturated fat, cholesterol and high amount of anti-oxidants. It thus can supply man with the much desired micro-nutrients.

The high demand for this vegetable fruit is not fully met in the southwest of Nigeria, as this part of the world has change in climate conditions that affect vegetable fruit production (Amao et al., 2014; Adekunle et al., 2007). Varietal differences affect or determine the growth and yield of crops. There is therefore the need to subject varieties to test in order to determine which one will adapt best to a zone. Genetic factors have been linked with growth characteristics like plant height, vine length, leaf area, number of leaves or branches, and fruit production (Udit et al., 2020). The availability of the fruit throughout the year will lead to improved nutritional status of the people, contribute to food security, provide employment opportunities and increase in the income of the producers who are mostly peasant farmers. This study was therefore conducted to determine the variety that will best adapt to Ejigbo, in the rain forest zone of Osun State, South –West Nigeria, give highest vegetative growth and yield, thereby ensuring the availability of the fruit throughout the year.

Materials and Methods

Description of experimental site and materials

The field experiment was conducted at the teaching and research farm of the College of Agriculture, Osun State University, (Latitude 7°, 52'28.37"N and Longitude 4°, 18'13.76"E) Ejigbo campus from June to September, 2020. The climate is typically rain forest type with two peaks of rain (bimodal rainfall) which is between 1,158 mm-1,250 mm per annum. The temperature regime is high all the year round with mean of 28°C-33°C, relative humidity of about 85%, except during dry season and sunshine of 5.1%. The climate of the area is characterized by pronounced wet and dry seasons. Three varieties of watermelon namely Heracles, Kaolack and Sweet pink were procured from Osun State Agrofarm Shop, Ogo Oluwa area, Osogbo, Osun State.

Land preparation and Experimental Layout

The experimental site was cleared off its vegetation by ploughing twice and harrowed once manually. The site was mapped out at 18 m x 18 m and divided into 3 treatment plots of 4.5m x 4.5m respectively with 1m border line in between each block apart and 0.5 m apart to differentiate the replicates. The experiment was laid out in a randomized complete block design (RCBD) design with three replications.

Soil Analysis

Soil samples were taken at a depth of 0-15cm using random sampling techniques. The samples were mixed to form a composite, air dried and sieved using 2mm sieve. Physical and chemical properties were determined in the Department of Agronomy laboratory, Osun State University, Ejigbo, Osun State. The determination of Nitrogen was by Khedjahl method using automated kjeldhal distillation apparatus (Page et al., 1982). The exchangeable bases were carried out using flame photometer. Available phosphorus was determined using UV/Visible spectrophotometer at a specified wavelength (Bray and Kurtz, 1945). Organic carbon and organic matter were done by titration method of sample against ferrous sulphate using appropriate indicator (Bremner and Mulvaaney, 1982). Particle size and pH were determined by hygrometer and pH meter respectively (Gee and, Bauder, 2002).

Cultural Practices

Weeding was done at three-week intervals till maturity and harvest. Inorganic fertilizer (NPK 15:15:15) was applied at the rate of 150 kg ha⁻¹ three weeks after planting (WAP). Liquid forms of plant protectants including Metazeb 72WP, Termex and Diutryn 11EC was applied to control pest infestation and disease infection at 6 WAP as used by Oraegbunam et al. (2016).

Data collection and Analysis

In each plot, data was collected on four randomly selected plants. Parameters taken using International Union for the Protection of New Varieties of Plants UPOV guides (2013), include:

- Days to emergence: this implies days to emergence from sowing date; days to first and 50% flowering: number of days from sowing to stage when 50% of plants in one accession have begun to flower was recorded and also number of nodes, taken on the main branch up to and including 1st tendril.
- Days to first mature fruit this was the number of days from sowing to first mature fruit. Fruit data taken after harvest were: Fruit length and fruit width (cm), measured at harvest using meter ruler.
- Fruit length/width ratio: The length from stem end to blossom end of the fruit divided by the

width at the broadest point fruit number was determined by counting and fruit weight in kilogram using weighing balance.

The data collected were subjected to analysis of variance (ANOVA) and the least mean square was calculated for significant values of accession mean sum of square using the GLM procedure of SAS (Version 9.4).

Results and Discussion

Physico-chemical properties of the experimental site

The physico-chemical properties of the study area are shown in Table 1. The soil was predominantly sandy. The surface had more sand than the subsurface. Texturally, the experimental site was classified as sandy clay. The soil is generally neutral with a pH of 6.3. The organic matter and total nitrogen content were low with values of 0.49% and 0.03 gkg⁻¹ respectively. The available phosphorus (P) was equally low with a value of 1.04mg/kg. The exchangeable cations were low in status with values of 1.86 cmolkg⁻¹ for calcium (Ca) and 0.087 cmolkg⁻¹ for magnesium (Mg) The values obtained for potassium (K) (1.12 cmolkg⁻¹) was low. This could be attributed to low activity clay of the study area while the low values obtained for organic (C), total nitrogen and P were as a result of erosion that is predominant in the area and subsequent leaching of the nutrient beyond the root zone.

Table 4.1 Physio-chemical properties of the soil

PARAMETERS	Soil
Chemical Properties	
pH (H ₂ O)	6.30
Org. carbon (%)	0.49
Total N	0.039
Available P (mg/kg)	1.07
Na ⁺ (Cmol/kg)	0.18
K ⁺ (Cmol/kg)	1.22
Ca ²⁺ (Cmol/kg)	1.86
Mg ²⁺ (Cmol/kg)	0.09
Bulk density (cm ³)	1.2
Physical Properties of Soil	
Sand	79.1
Silt	15.5
Clay	15.4
Textural class	Sandy loam

Key: % = Percentage, H₂O = Water, Org. C = Organic carbon, gkg⁻¹ = gram per kilogram, N = Nitrogen, P = Phosphorus, mgkg⁻¹ = Milligram per kilogram, cmol kg⁻¹ = centimole per kilogram, Ca = Calcium, Mg = Magnesium, K = Potassium, Na = Sodium.

Variations among Watermelon

The analysis of variance for the characters of the three varieties evaluated for vegetative and yield potential which are vine length, number of leaf, leaf breadth, leaf length, leaf area index, fruit weight, fruit length, and fruit breadth is given in Table 2. The result revealed highly significant varieties sum of squares for vine length (12485.59cm), number of leaves (238.97), leaf area index (7489.02) and number of nodes (43.09). In addition, fruit length (14.24cm) and breadth (20.29cm) gave significant varieties mean sum of squares. The coefficient of variation ranged from 9.06% (fruit breadth) to 30.41% (fruit weight).

Table 2: Analysis of Variance of characters Watermelon (*Citrullus lanatus* L.) varieties

S/n	SOV	df	V. lgt.	No. Lf.	Lf. Lght	Lf. Brt.	LAI	Nodes	Fr. Wgt.	Fr. L.	Fru. Brt
1.	Block	2	1561.33	49.23	1.15	7.56	785.88	2.82	3.15	37.92	12.82
2.	Variety	2	12485.59**	238.97**	14.24*	20.29*	7489.02**	43.09**	0.13 ^{ns}	7.55 ^{ns}	7.76 ^{ns}
3.	Error	40	498.23	14.77	3.74	4.41	1512.12	1.68	0.44	21.86	17.99
4.	CV (%)		16.17	11.35	9.38	10.50	8.48	13.53	30.41	18.03	9.06

Key: * = significant at $p \leq 0.05$, ** = highly significant at $p \leq 0.01$, CV% = Coefficient of Variation, SOV = Sources of variation, DF = Degree of freedom, V. lgt = Vine length, No. Lf = Number of leaf, Lf. brdt = Leaf breadth, Lf. Lght = Leaf length, LAI = Leaf area index, Fr. Wght = Fruit weight, Frt. L = Fruit length, Fru. Brt = Fruit breadth.

Table 3: Growth and yield performance of the three watermelon varieties

S/n	Varieties	V. lgt	No. Lf.	Lf. Lght	Lf. Brt.	LAI	Nodes	Fr. Wgt.(kg)	Frt. L.(cm)	Fru. Brt (cm)
1.	Heracles	160.47 ^a	35.33 ^a	21.44 ^a	20.99 ^a	229.66 ^a	9.93 ^b	2.26 ^a	26.47 ^a	47.33 ^a
2.	Kaolack	148.11 ^a	36.89 ^a	20.88 ^{ab}	20.25 ^{ab}	215.81 ^a	11.07 ^a	2.19 ^a	25.13 ^a	47.13 ^a
3.	Sweet pink	105.48 ^b	29.33 ^b	19.53 ^b	18.71 ^b	185.95 ^b	7.73 ^c	2.07 ^{ab}	26.20 ^a	46.00 ^{ab}

Key: ab = means on the same (column) with different superscripts are significantly different ($P < 0.05$). V. lgt = Vine length, No. Lf = Number of leaf, Lf. brgt = Leaf breadth, Lf. Lght = Leaf length, LAI = Leaf area index, Fr. Wght = Fruit weight, Frt. L = Fruit length, Fru. brt = Fruit breadth.

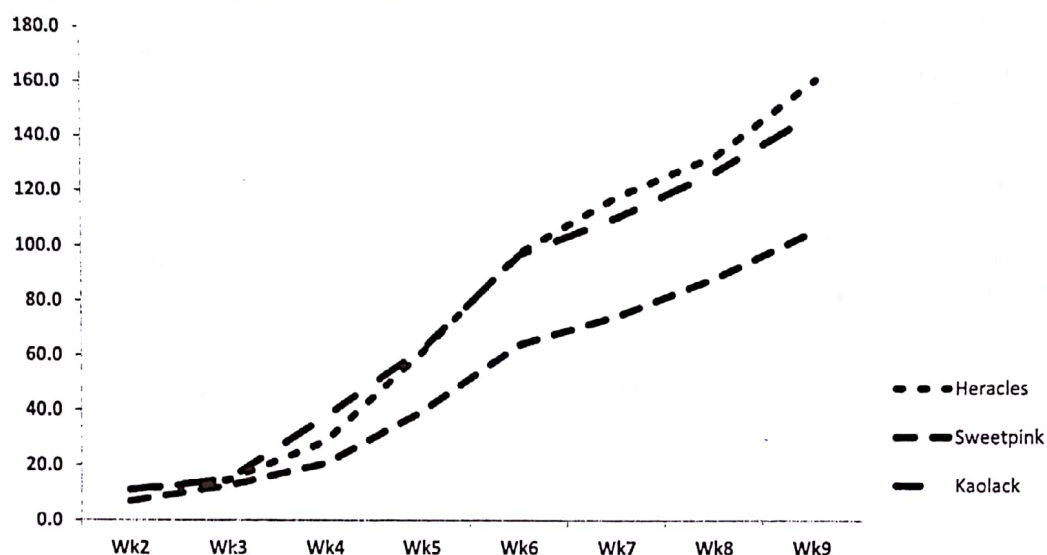


Figure 1: The graphical representation of vine length of the 3 watermelon varieties

Heracles gave the highest mean value for vine length (160.47cm), this was, however, not significantly different from the 148.11cm gotten from Kaolack. Sweetpink gave lowest value of 105.48cm, this was significantly different from the values from the other two varieties under consideration.

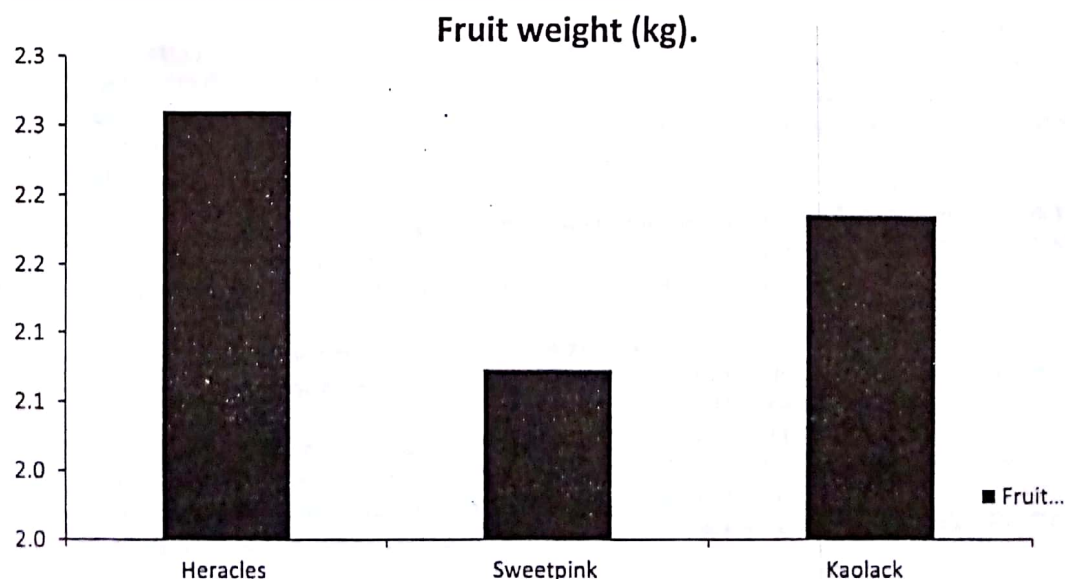


Figure 2: The graphical representation of fruit weight of various watermelon varieties

In terms of fruit weight, Heracles also gave the highest mean value of 2.26kg which was not significantly different from the 2.19 and 2.07kg seen in Kaolack and Sweetpink respectively.

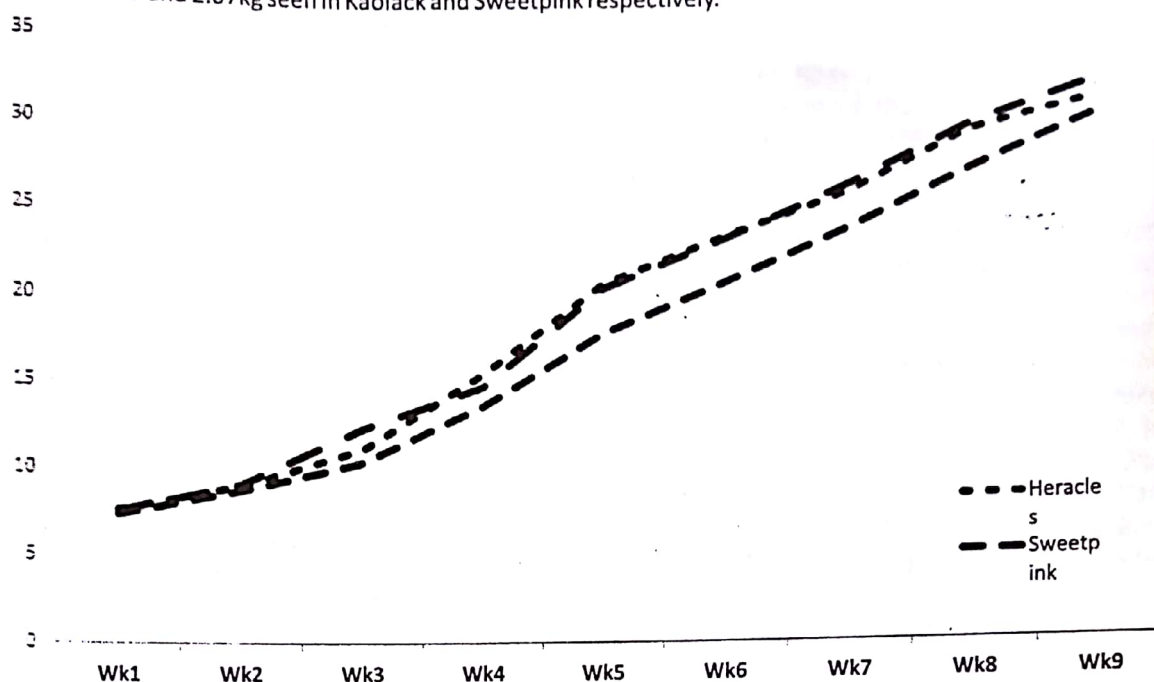


Figure 3: The graphical representation of number of leaves of various watermelon varieties

At the end of the experiment, Kaolack gave the highest value for number of leaves (36.89) while the lowest (29.33) was from sweetpink. Heracles gave 35.33 number of leaves but this was not significantly different of that from Kaolack.

Morphological performance of three varieties of watermelon

The morphological performance of the three varieties of watermelon is given in Table 3. The result revealed significant differences among the varieties for some of the characters. Heracles depicted the highest value for vine length, leaf length, leaf breadth with 160.47, 21.44, 20.99, 229.66 cm respectively while sweet pink recorded the lowest value for vine length (105.46), girth (19.53cm), leaf breadth (15.71cm), and leaf area index (185.94). Similarly, sweet pink recorded the lowest value for number of leaves (29.33) and number of nodes (7.73). In the same vein, Kaolack gave the highest value for the same character with 36.89 and 11.07 respectively.

Plants with larger leaf area are expected to produce more photosynthesis and thereby resulting in a higher yield (Ngomuo et al., 2017). Similar result was obtained by Oraegbunan et al. (2016) who confirmed that Legone showed the shortest vine length while Koloss had the longest vines and also gave the highest value during reproductive growth. The maximum number of leaves obtained by Kaolack compared to others can be attributed to the higher mean value of the harvesting traits of the watermelon variety Kaolack, which is due to differences in its genetic constitution, appropriate weed control and agroecological conditions for the variety (Enujeke, 2013).

Kaolack and Sweetpink had the highest and lowest number of nodes/internodes, respectively. Watermelon develops flowers at nodes. Therefore, many internodes means optimal productivity (Buczky and Yamaguchi, 1997). The appearance of more nodes in kaolack did

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Kaolack and Sweetpink had the highest and lowest number of nodes / internodes, respectively. Watermelon develops flowers at nodes. Therefore, many internodes means optimal productivity (Rubatzky and Yamaguchi, 1997). The appearance of more nodes in kaolack did not result in an increase in the number of fruits in size and weight. In the same way, Oraegbunan et al. (2016) found that Chaleston gray did not result in higher numbers of fruits and fruit yields despite producing a higher number of nodes. The non-differences in the fruit yield of watermelon varieties agreed with Anikwe et al. (2016) who showed that yield differences between watermelon varieties appear to be environmentally specific. This corresponds to the fruit yield from the experiment carried out by Danata. (2014), in which it was found that five different varieties were statistically the same. However, Dantata and Babatunde (2013) reported that the increase in fresh sprout mass in the watermelon is due to a large variability in harvest performance that can be caused by the variety, propagation methods, seasons and soil factors.

Conclusion

High viability was found among the watermelon varieties for vine length, leaf length, leaf breadth, leaf area index and number of nodes. Highest yield was recorded for Heracles and Kaolack while the lowest yield was found in Sweet pink, although there was no significant difference among the varieties used in this study for fruit weight and fruit length. However, there were significant differences among the varieties during the vegetative stage, which shows that the use of Heracles variety in the study can increase watermelon yield in the study area.

For improved growth and yield of watermelons on sandy loam soils in the Ejigbo region and for edaphologically similar agricultural environments in the derived savannah, it is recommended that farmers plant the exotic Heracles variety.

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