INFLUENCE OF PLANTING DATES AND VARIETIES ON THE PERFORMANCE OF WATERMELON *(Citrullus lanatus*) IN IKOM, NIGERIA

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Abstract
Field experiment was conducted under rainfed condition at Nlul1- Nnam in Ikom Local Government Area of Cross River State, Nigeria to investigate response of watermelon varieties [*Citrullus lanatus (Thunb Mansf)] to* varying planting dates. The treatments consisted of three planting dates (8th September, 28th September and 18th October, 2018) and three varieties of watermelon (koloss, Kaolack and Sugarbaby). The treatments combination was arranged in split-plots fitted into randomized complete block design and replicated three times. The study revealed that the 8th September planting date influenced best growth and yield performance of watermelon as it out-yielded the 28th September and 18th October planting dates by 36.94 and 74.38% respectively for number of fruits produced per plant. koloss variety was significantly ($p \leq 0.05$) superior to Kaolack and sugarbaby varieties in most of the vegetative growth and yield parameters. Koloss variety out-yielded Kaolack and Sugarbaby varieties by 45.33 and 117.11%, respectively for number of fruits recorded. Furthermore, Koloss variety also produced the heaviest and widest watermelon fruits than the other varieties. The interaction of Koloss variety and September 8 planting date, produced longer vine, higher number of leaves, higher number of fruits and higher total fruit yield (47.77t/ha) than the others. The production cost and economic returns analysis for the study also showed that, highest profit from watermelon production was maximized by the 8th September planting date with Koloss variety.

Key words: Varying Planting dates, response of watermelon varieties, growth and yield.

Introduction

Watermelon *[Citrillus lanatus (Thunb Mansf)],* is a native of tropical and sub-tropical Africa and belongs to the family cucurbitaceae (Guillaume *et al., 2014)*. David (2005) verified this when he found watermelon growing wild in Kalahari Desert, Botswana in the 1850's. The crop is a vine fruit vegetable widely consumed around the world (Thulaja, 2005). Watermelon originated from Africa, then spread to Asia, Europe, North America and other parts of the world (Chomicki and Renner, 2005). China is the world leading producer of watermelon (FAO, 2011). In Nigeria production is mainly carried out in the northern parts of the country, and there seems to be no official watermelon production figures available. However, the crop is now gaining recognition in other

parts of Nigeria, particularly in the Southern Forest zone which experiences some period of dry season suitable for the growth of the crop (Ibudialo *et al., 2013). An* undamaged watermelon fruits provides a germ-free substitute for water and this is possibly their most valuable quality as well as their rich nutritive value. Watermelon fruits contain vitamins, A, B (B6 and B12), proteins, carbohydrates and minerals such as iron, calcium, phosphorus and potassium. Watermelon fruit has been found to contain malic acid, fructose, glucose, amino acid, lycopene, carotene, fat and phosphoric acid (Sonia, 2011).

The choice of planting dates can significantly impact on the growth and yield of crops, particularly during critical developmental phases where plants require adequate moisture and ideal temperatures at planting and seedling establishment (Uwah *et al.,* 2014). Wrong planting dates selection subject crops to water and heat stresses (Passioura, 2007). Strivastava and Andrianor (2004) stated that planting dates have been shown to have different environmental conditions. Some of the indices that influenced choice of planting dates include rainfall and temperature (Adekoya, 2008). Genetic differences in growth and yield among varieties exist (Tindal, 1986). The observed differences in growth pattern among watermelon varieties could be attributed to their inherent varietal characteristics (Uwah and Solomon, 1999).

Since watermelon is widely consumed around the world, and factors such as planting dates and varieties significantly influence its performance, also in Nigeria watermelon production is mainly carried out in the northern savanna region of the country. Increase in the production is required to meet the ever-increasing demand of the crop in Nigeria. This study was therefore carried out in south-southern part of Nigeria, with a view to determining appropriate planting dates and suitable watermelon varieties for the area, to maximize its production.

Materials and methods

Field experiment was carried out at Nlul-Nnam community in Ikom LGA of Cross River State, Nigeria, from September to December, 2018. Ikom is located on longitude 8^0 37'E and latitude 6^0 05'N and has an annual rainfall of 2000 – 2500 mm, with temperature range of 25.4 to 28 .6^0 C, with a sandy loam soil (Ministry of Agriculture, Ikom, 2018). The experimental site was in a rainforest zone and has a slightly sloping topography. Watermelon seeds from three varieties (Koloss, Sugarbaby and Kaolack) were sourced from the Cross River Agricultural Development Project, Calabar. The planting dates used for the trial were (8^{th} September, 28^{th} September and 18^{th} October). The experimental design used was split plot fitted into randomized complete block design (RCBD), with three replications. The gross plot size was 44.4 m x 14.8 m (657.12 m^2), each block was 12.8 m x 12.8 m (163.84 m^2) while the size of each bed was 3.6 m x 3.6 m (12.69 m^2). Each plot had 1 m path separating them while the replicates were separated by 1.5 m path. Soil Sample was collected and analyzed to determine the fertility status of the area (Ojeniyi, 2010; Brady and Weil, 2014).

The experimental site was dominated with the following weeds; *Calapogonium mocunoides, Pannicum maximum, Mucuna puriens, Pennesetum purpurrum,* and *Chromolaena odorata*, the vegetation was cleared off with machete manually. The land was ploughed and harrowed into flat tilled beds, with the use of hand hoe. The watermelon was sown at spaced of 1.2 x 1.2 m (1.44 m^2) with seeds sowed at a depth of 2 to 5 cm. Two seeds were sowed per hole and seedlings were later thinned to one per stand at 2 weeks after planting (WAP). Weeding was done manually with hand hoe and hand pulling at 3, 6 and 9 WAP. Data were collected for growth and yield parameters from four tagged plants in the net plot area. The data were first collected at 3 WAP and subsequently at every 2 weeks interval till harvesting. From the 4 tagged plants the following growth and yield attributes were determined: Length of vine, number of leaves per plant etc.

Data generated were subjected to analysis of variance using GENSTAT Package statistical soft- ware Version 8.1. Significant means were compared using Fisher's Least Significance difference at 5% level of probability. Production cost and economic return analysis was carried out following the method described by (Kingsley *et al.,* 2018).

Results and discussion

The soil used for the experiment was sandyloam, slightly acidic (pH 5.4), high in base saturation (91.2%) with organic carbon and total contents of 0.8 and 0.09% respectively (Table 1). The soil was moderately high in available P (28.11 mg/kg). The slightly acidic and high base saturation contents indicated high fertility status of the soil.

Table 1: Physico-chemical properties of top soil (0-30 cm) of experimental site

Properties	Values
Sand (%)	93.3
Silt (%)	5.0
Clay (%)	1.7
Textural class	Sandy loam
Soil pH (H_2O)	5.4
Organic carbon (%)	0.8
Available P (mg/kg)	28.11
Total nitrogen (%)	0.09
Exch. Ca^+ (cmol/kg)	3.0
Exch. Mg (cmol/kg)	1.0
Exch. K (cmol/kg)	0.10
Exch. Na (cmol/kg)	0.09
Exch. H^+ (cmol/kg)	0.4
ECEC (cmol/kg)	4.55
Base Saturation (%)	91.2

Effect of planting dates on the performance of watermelon varieties

The effect of planting date was significant on number of leaves, total dry matter weight, days to 50% flowering and days to first harvest (Tables 2 to 3). Equally, the effect of planting dates was significant on number of fruits per plant, weight of fruits at harvest (kg), fruit girth (cm) and total fruit yield (Table 4). The performance of watermelon at the 8th September planting date was better than those at the 28th September and 18th October planting dates for all the parameters measured. The September 8 planting date recorded the shortest number of days to first harvest (Table 3). The september 8 planting date out yielded the 28th September and the 18th October planting dates by 36.94 and 74.38% respectively for numbers of fruits produced per plant(Table 4). The 8th September planting date recorded significantly ($p \leq 0.05$) heavier fruit weights and wider fruit girths than the other planting dates. Similarly, the total fruit yield produced at the 8th September planting date was significantly ($p \leq 0.05$) higher than those at 28th September and 18th October planting dates. The September 8 planting date also recorded the shortest number of days to first harvest. The best performance of watermelon shown at the September 8 planting date could be attributed to the differences in the agro meteorological conditions associated with the vegetative growth and yield of the crops. Neidz *et al.* (1990); Musniki *et al.* (1999), Uwah *et al.* (2004) and Adekoya (2008) explained in their works that environmental factors such as; rainfall, temperature, relative humidity and sunshine duration significantly influenced the growth and yield of watermelon, as well as crops in general.

Effect of varieties on the performance of watermelon

Koloss variety of watermelon exhibited significantly ($p \leq 0.05$) longer main vine at 3 and 4WAP, higher number of leaves per plant at 7 and 9 WAP and higher total dry matter production. Koloss variety equally had significantly ($p \leq 0.05$) higher number of fruits, heavier weight of melon, wider fruit girth and higher total fruit yield per hectare (Tables 2,3 and 4). Koloss variety out-yielded Kaolack and Sugarbaby varieties by 45.33 and 117.11% respectively, for number of fruits per plant. koloss again out-yielded Kaolack and Sugarbaby varieties by 19.30 and 70.65% respectively for weight of melon produced, while for total fruit yield (t/ha) it out-yielded Kaolack and Sugarbaby varieties by 19.63 and 71.16% respectively. Koloss variety also produced melon with the widest girth than the other varieties. Although the effect of varieties on number of days to first harvest revealed that Sugarbaby variety flowered earliest and had the shortest number of days to first harvest than the other varities (Tables 3 and 4).

The better performance significantly shown by Koloss variety in growth and yield attributes over kaolack and Sugarbaby varieties is attributed to differences in the genetic makeup of the individual varietiy studied. Koloss variety was characterized by higher vegetative growth than Kaolack and Sugarbaby varieties (Table 2). These attributes could have given it the advantage over the other varieties in yield characters (Chadha, 2007). The outcome of their

performance may also be due to varietal differences. Tindal (1986); Uwah and Solomon (1999); Blomberg (2004) and Achigan-dako (2008) reported significant difference in the growth and yield performance of different varieties of watermelon. This varietal difference may be responsible for the higher yield exhibited by Koloss variety, when compared to the other varieties.

Effect of interaction between planting date and varieties on the performance of watermelon

Interaction of 8th September planting date with Koloss variety gave significantly ($p \leq 0.05$) longer length of main vine (cm), higher number of leaves per plant, higher number of fruits per plant and higher total fruit yield (t/ha) than the other interactions (Tables 2,3, and 4). The higher number of fruits per plant and higher total fruit yield produced from interaction of September 8 planting date and Koloss variety can be attributed to the longer main vine and higher number of leaves. The interaction effect between the 28th September planting date and Sugarbaby variety exhibited the least performance among the various interactions studied.

The outcome of these interaction effects between planting dates and varieties are in conformity with the reports of Ibudialo *et al*. (2013) and Akpan *et al*. (2016) who reported that planting dates in conjunction with varieties influenced performance of watermelon. Furthermore, the results on interaction effects indicated that the environmental conditions at the 8th September planting date was more favourable for Koloss variety to fully express its genetic potentials (Neidz *et al*., 1990, Musniki *et al*., 1999).

Table 2: Influence of planting dates and varieties on number of leaves per plant of watermelon in Ikom

Treatments	Weeks after planting				
	3 WAP	5 WAP	7 WAP	9 WAP	11 WAP
Planting dates					
8th September	9.53	34.20	113.30	129.20	131.31
28th September	8.21	25.32	90.21	111.61	133.62
18th October	6.44	20.05	86.22	97.82	98.90
LSD (0.05)	1.02	3.18	6.01	10.20	9.50
Varieties					
Koloss	8.45	33.35	117.71	128.83	129.51
Sugarbaby	6.23	24.74	94.24	106.32	120.62
Kaolack	8.11	29.18	114.60	125.70	128.90
LSD (0.05)	NS	NS	2.14	2.55	NS
Interactions					
PD1 X V1	9.73	36.61	114.35	127.80	129.57
PD1 X V2	8.65	29.54	93.51	97.63	102 82
PD1 X V3	7.21	26.55	110.81	121.43	123.54
PD2 X V1	8.56	24.81	103.63	111.16	113.14
PD2 X V2	9.81	27.75	88.51	89.25	91.13
PD2 X V3	8.71	28.15	87.72	101.19	103.19
PD3 X V1	6.54	24.50	84.91	96.48	102.33
PD3 X V2	7.39	23.42	74.80	85.21	88.35
PD3 X V3	8.49	25.21	85.91	88.94	91.16
LSD (0.05)	NS	NS	3.07	NS	NS

PD (1,2, and 3), Varieties (1,2 and 3) and NS = Planting dates (8th September, 28th September and 18th Octerber), Varieties (Koloss, Sugarbaby and Kaolack) and Not Significantly different at 5 percent level, using F-LSD

Table 3: Total dry matter (g), days to 50% flowering (per plant) and days to first harvest as Influenced by Planting dates and Varieties of Watermelon in Ikom

Treatments	Total dry matter (g)	Days to 50% flowering	Days to first harvest
Planting dates			
8th September	23.58	31.78	72.18
28th September	18.13	33.29	78.98
18th October	17.08	33.50	80.61
LSD (0.05)	3.19	0.30	1.12
Varieties			
Koloss	22.48	31.00	70.11
Sugarbaby	17.11	29.22	65.61
Kaolack	20.30	33.00	73.06
LSD (0.05)	2.13	1.16	1.18
Interactions			
PD1 X V1	23.17	31.67	72.78
PD1 X V2	20.33	30.67	68.08
PD1 X V3	21.10	33.00	73.67
PD2 X V1	20.80	32.33	72.03
PD2 X V2	18.15	31.67	68.50
PD2 X V3	21.40	31.73	73.42
PD3 X V1	22.62	30.09	78.25
PD3 X V2	19.93	31.39	80.10
PD3 X V3	18.59	29.19	73.22
LSD (0.05)	NSS	NS	NS

PD (1,2, and 3), Varieties (1,2 and 3) and NS = Planting dates (8th September, 28th September and 18th Octerber), Varieties (Koloss, Sugarbaby and Kaolack) and Not Significantly different at 5 percent level, using F-LSD

Table 4: Number of fruits (per plant), mean fruit weight (kg), fruit girth (cm), and total fruit yield (t/ha), as Influenced by planting dates and Varieties of watermelon in Ikom.

Treatments	No. of fruits (per plant)	fruit weight (kg)	Fruit girth (cm)	Total fruit yield (t/ha)
Planting dates				
8th September	7.08	5.90	79.23	40.97
28th September	5.17	4.10	68.10	28.47
18th October	4.06	3.48	63.29	24.17
LSD (0.05)	1.50	1.50	5.01	5.12
Varieties				
Koloss	8.88	6.86	78.71	47.77
Sugarbaby	4.09	4.02	73.34	27.91
Kaolack	6.11	5.75	74.53	39.93
LSD (0.05)	1.21	1.10	2.17	7.15
Interaction				
PD1 X V1	8.53	6.43	78.63	40.12
PD1 X V2	6.17	3.66	69.26	26.57
PD1 X V3	7.30	5.31	71.51	38.91
PD2 X V1	7.11	6.24	75.83	39.40
PD2 X V2	6.21	5.61	67.70	23.34
PD2 X V3	6.33	4.58	74.83	27.19
PD3 X V1	5.90	4.41	70.11	28.33
PD3 X V2	4.33	3.37	65.19	23.57
PD3 X V3	5.20	4.17	68.40	27.44
LSD (0.05)	1.63	NS	NS	2.91

PD (1,2, and 3), Varieties (1,2 and 3) and NS = Planting dates (8th September, 28th September and 18th Octerber), Varieties (Koloss, Sugarbaby and Kaolack) and Not Significantly different at 5 percent level, using F-LSD

Production cost and economic returns for planting dates and varieties of watermelon

The outcome of production cost and economic returns for the various planting dates revealed that production of watermelon at the 8th September planting date generated the highest revenue as well as the highest profit margin when compared to the other planting dates. September 8 planting date had #27,300 as profit from the production of watermelon. This was followed by the 28th September planting date which recorded #15,000 as profit, while the 18th October planting date recorded a loss of # - 17,200 as shown from the economic returns of watermelon production at Ikom (Table 5).

The outcome of economic returns for varieties revealed that, Koloss recorded the highest profit from watermelon production when compared to the other varieties. The profit shown from the three varieties were in

this order; Koloss variety (# 134000) >Kaolack variety (# 41000) > Sugarbaby variety (# 15000). The production cost and economic returns showed that adoption of the 8th September planting date and Koloss variety of watermelon generated higher revenue and profit than other planting dates and varieties (Table 6).

Table 5: Production cost and economic returns analysis for watermelon production at three planting dates in Ikom.

Cost of material and inputs (#)	8th September planting dates	28th September planting dates	18th October planting dates
Land acquisition	15,000	15,000	15,000
Seeds purchase	18,000	18,000	18,000
Fertilizer purchase	15,000	15,000	15,000
Tools and implements	10,000	10,000	10,000
Labour	20,000	20,000	20,000
Total cost of materials and inputs (#)	78,000	78,000	78,000
Number of fruits produced	350	159	152
Weights of fruits (kg)	4-6	3-5	2-4
Price of fruits (#)	800-1000	300-700	200-600
Revenue (#)	280,00-350,000	47,700-111,300	304,000-91,200
Gross revenue generated (#)	315,000	79,000	60,800
Net profit (#)	237,000	15,000	-17,200

Source: (Production cost and economic returns data for planting dates, 2018).

Table 6. Production cost and economic returns analysis for three Varieties of watermelon produced at Ikom, Nigeria

Cost of materials and inputs (#)	Koloss variety	Sugarbaby variety	Kaolack variety
Land acquisition	5,000	5,000	5,000
Seeds purchase	10,000	3,000	6,000
Fertilizer purchase	5,000	5,000	5,000
Tools and implements	9,000	9,000	9,000
Labour	7,000	7,000	7,000
Total cost of materials and inputs (#)	36,000	29,000	32,000
Number of fruits	200	110	140
Weights of fruits	4-6	2.5-4.0	3.5-5.0
Price of fruits	700-1000	300-500	350-700
Revenue (#)	140,000-200,000	33,000-35,000	98,000-49,000
Gross revenue generated (#)	170,000	44,000	73,500

Net profit (#)	134,000	15,000	41,00

Source: (Production cost and economic returns data for varieties of watermelon, 2018).

Conclusion

The findings of this study showed that the 8th September planting date optimized the growth and yield of watermelon in the study area. Koloss variety responded better to the September 8 planting date as it exhibited superior performance relative to the other varieties in most of the measured parameters as well as having higher economic returns and profit from watermelon production in the study area.

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