Evaluation of Cassava (Manihot Esculenta crantz) Genotype for Yield and Yield Component, Tuber Bulking, Early Maturity in Cross River Basin Flood Plains, Itu, Akwa Ibom State, Nigeria

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ABSTRACT

Field experiments was conducted in 2013 and 2014 at Cross River flood plains , Itu, Akwa Ibom State to assess the yield, yield components, early tuber bulking and maturity among cassava genotype and identify superior ones for the environment. Experiment was conducted at Itu Irrigation Erosion and Flood Control project farm of the Cross River Basin Development Authority Oku Iboku. A land area of 416m² was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. Five cassava genotypes: NR 8082, TMS 01/1168, TMS 01/1412, TME 419 and a local cultivar (obubit okpo) constituted the treatments. Growth parameters studied were: plant height (cm), Number of branches, leaf area (cm), Number of leaf lobes, stem girth (cm) and length of petiole (cm). Also, Number, length (cm), and circumference of tubers and tuber yield per hectare (t/ha) were studied at 4,6,8,10 and 12 months after planting (MAP). Analysis of variance was conducted on all the characters and significant means separated with least significant difference (LSD) at 5% probability level. Plant height (cm), number of branches and leaf area (cm²) at harvest showed significant differences ($p<0.05\%$) among cassava genotypes .Yield parameters also differed significantly ($p<0.05$) at 4,6,8 and 10 MAP for circumference of tubers, number of tubers and tuber yield per hectare (t/ha). TMS 01/1412 produced largest cassava tubers (40.10 cm and 39.40 cm) at 8 MAP in both cropping seasons, highest number of tubers at 6 MAP (13.20 and 11.80), 8 MAP (13.60 and 11.80), 10 MAP (1 3.80 and 11.80) and 12 MAP (13.80 and 11.80) and highest tuber yield per hectare at 8 and 10 MAP (42.60t, 46.30t and 46.30t, 46.00t), respectively. Therefore TMS 01/1412 with early rooting, rapid tuber bulking potential, early maturity and highest tuber yield (t/ha) at 8 MAP would best fit into the farming systems of Cross River flood plains, since it will mature before the peak of flood water.

Keywords: *Yield component, Tuber bulking, Early maturity, Cassava genotype, Flood plain.*
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1. INTRODUCTION

The desired attributes of good cassava types for wet land are early rooting, rapid tuber bulking and early maturity period, starch accumulation, good in ground storability and good cooking quality. Early bulking keeps pace with crop growth rate and determines timely entry and exit at the plains. Cassava varieties could be screen for top growth ratios, rapid tuber bulking potential and maturity [1, 2]. According to Githunguri, et al. [3] the power of source and capacity of sink will increase from four to six months after planting, fell at ten months and then leveled there after in regions with high rainfall. However, hydrologic variability (very heavy rainfall and flooding) characterize the cross river basin. These challenges may grow with increasing climate change resulting in coastal inundations and flooding exceeding the plains. These have also aided heavy build up of organic materials in the plains after each flooding leading to increase in yield. With increasing human population and high demand for cassava products, there is need for paradigm shift to the early maturing cassava types [2].

According to International Institute of Tropical Agriculture (IITA) [4] early tuber initiation and bulking is affected by assimilate supply. Cock [5] earlier observed that tuberous roots thicken as assimilate is conducted to the tubers. At full development of the canopy, root growth rate gradually decreases. However, too early harvesting of the crop, due to seasonal flooding in areas prone to flood may leads to very poor harvest and a reduction in tuber yield, while delayed harvesting result in deterioration in root qualities and total loss of the food crop to flood water. seasonal flooding constitutes an impediment to the dominant occupation of farmers inhabiting the flood plains, and influences their social, economic, cultural and political life. Tuber quality assessment for early maturity of cassava genotypes and combination of inputs could bring about yield maximum production cassava in the environment and enhance food security through timely entry and exit of the crop. According to Udoh [6] Annual river levels in the basin increase as year advances indicating July as the peak period of flooding which extends through August and October each year. This phenomenon depict plant root zone of oxygen for respiration, causes tuber rots, and poor crop growth and also reduces strength of the power of source and capacity of the sink. Screening for early maturing cassava, high sink capacity and nutrient uptake enable cassava varieties fit into the existing flood plains cropping system thereby ensuring that cassava matures before serious flood disasters. According to. Against this background a study was undertaken to assess cassava genotypes for tuber bulking and optimum harvesting time in Itu, Cross River Basin with a view to identify suitable ones for the environment.

2. MATERIALS AND METHODS

Itu is one of the coastal settlements in Akwa Ibom state, Nigeria with a mean annual rainfall of 1,830mm to 2,500mm [7] with July and September as peaks while flooding occurs from August to September [6]. A land area of 416m^2 was ploughed, harrowed, ridged and laid in Randomized Complete Block Design(RCBD) and replicated three times. Five cassava genotypes (NR8082, TMS 01/1168, TMS 01/1412, TME 419 and Local best (*obubut okpo*)) constituted the treatments. Growth parameters studied were: plant height (cm) number of branches, leaf area (cm), number of leaf lobes, stem girth (cm) and length of petiole (cm) on four randomly selected plants per genotypes at harvest. Yield parameters were studied at 4, 6, 8, 10 and 12 months after planting (MAP) on number of tubers, length of tubers (cm), circumference of tubers (cm) and tuber yield (t/ha). Analysis of variance was conducted on all the characters and significant means separated with the Least Significant Difference (LSD) at 5% probability [8].

3. RESULTS

There were no significant differences (P≤ 0.05) for number of leaves, stem girth, length of petioles and number of leaf lobes among the cassava genotypes in both years. However, plant height, number of branches and leaf area differed significantly (p≤0005). The Local check and TME 419 (344.00cm and 305.00cm) produced the tallest plants among the cassava genotypes, followed by TMS01/1412 (235.00cm and 301.00cm) while the shortest was from TMS 01/1168 (198.00 cm and 168.00 cm) in both years. NR8082 and TMS 01/1412 produced more number of branches than other genotypes in both year 2013 and 2014. Similarly, TME419 NR8082 (500.00cm and 403.00cm) produced the widest leaf areas followed by the check (408.00cm and 400.00cm) in 2013 and 2014 cropping seasons, while TMS 01/1168 (140.00 cm) and TMS 01/1412 (288.00cm) produced least among the cassava varieties. the cassava genotypes were significantly different (p≤0.05) at 4, 6, 8 and 10MAP for circumference of tubers, number of tubers and tuber yield (t/ha) in both years, but no significant different for length of tubers. The results revealed that TMS 01/1412 produced largest cassava tubers (24.00 and 28.10, 32.60 and 36.90, 40.10 and 39.40, 41.60 and 40.20cm) and highest number of tubers per plant (8.10 and 9.40, 13.20 and 11.80, 13.60 and 11.80, 13.80 and 11.80, 13.80 and 11.80) respectively at 4, 6, 8 and 10MAP in both cropping seasons. The tuber circumference and number of tubers per plant were obtained from local best cultivar. Among the cassava genotypes, TMS 01/1412 also produced the highest fresh tuber weight of 8.32 and 8.00, 28.66 and 27.94, 42.60 and 46.30, 46.30 and 46.00, 48.10 and 48.30 t/ha in 2013 and 2014 respectively, followed by TMS 01/1168,NR8082 and TME419 genotypes in that order. The Lowest tuber yield was obtained from the Local best 4.00 and 4.20, 18.30 and 17.65, 24.60 and 24.10, 26.60 and 26.90 28.01 and 28.40 t/ha respectively. Although significant effect (p≤0.05) was not observed for tuber length leading, TMS 01/1412 had the highest mean leading at 4, 6, 8, 10 and 12MAP and in all yield parameters. The result therefore revealed increase in cassava tuber across genotypes with increasing growth period. TMS 01/1412 recorded 244.47 and 249.25 per cent increase from 4MAP to 6MAP, 46.89 and 65.71 per cent increase from 6MAP to 8MAP, 20.42 and -0.65 per cent increase at 10MAP and 3.88 and 5 per cent increase, respectively at 12MAP in 2013 and 2014.

4. DISCUSION

The observed differences in growth, yield and yield components of cassava genotypes could be attributed to the inherent varietal characteristics and environmental factors. Ndaeyo, et al. [9] reported that considerable variations exist both within and between varieties for most characters, and that the coefficients of variation for phenotypes and genotypes were largest for root yield, especially large for roots per plant and root size and moderate for harvest index and plant height at harvest. Ndaeyo, et al. [9] also showed that varietal difference in conjunction with other factors such as location and cultural practices affected yield of root and tuber crops. Similarly, Akoroda [10] reported that number of roots which eventually form tubers as well as earliness of tuber bulking and maturity depend on the genotype, assimilate supply, photo period and temperature. Sharma [11] further observed that tuber yield depends not only on an adequate production of photosynthate but also on an adequate and strong sink to accept it as sink capacity might limit the tuber growth and yield as well as the source capacity. That the sink strength is by and large determined by the tuber size and bulking capacity and an increase in either component could enhance the power of the sink. The TMS 01/1412 with outstanding yield, tuber bulking and quality components, corroborate with Bassey and Harry [2] that desire attributes of a good early cassava types are early rooting, rapid tuber bulking and short maturity period, starch accumulation, good in ground storability and good cooking qualities. Tuber qualities of the cassava genotypes under study also meet the preference of flood plain farmers and agriculture that is: cassava varieties with powerful sink, high yielding and early maturity. Further

more, studies by Udoh [6] indicated July as the peak period of flooding in the plain which occurs through August to October each year. The cassava genotypes in this study whose tuber qualities and tuber bulking rate increase rapidly up to 8MAP, will correspond to their cropping calendar (November to June), and will be adaptable to seasonal flooding in the plain. Consequently, poorly planned harvesting of crops which may lead to poor tuber quality and yield could be controlled thereby fitting the cassava varieties into the existing flood plain cropping systems. The study also revealed that NR8082 (39.70 and 40.10), TMS 01/1168 (40.40 and 39.90) and TME 419 (36.10 and 42.00) genotypes with high tubers yield above 30 tonnes per hectare could be harvested at 8MAP before flood disaster occurs.

5. CONCLUSION

Tuber quality assessment for early maturity of cassava genotypes revealed that TMS 01/1412 produced outstanding yield and possessed better tuber bulking potentials. The study also revealed NR8082, TMS 01/1168 and TME 419 as better genotypes with high tuber yield above 30 t/ha. This outstanding performance makes the genotypes recommended for production by farmers in the Cross River flood plain.

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Table-1a. Growth Parameters of Cassava Varieties at Harvest in Cross River Basin Flood Plain, Itu Project, Akwa Ibom State

Cassava Genotypes	Plant Height (CM)		Number of Leaf Lobes Per Leaf		Number of Branches/ Plant		Stem Girth (CM)	
	2013	2014	2013	2014	2013	2014	**2013**	**2014**
NR8082	204.00	196.00	6.00	6.20	7.00	5.63	12.00	**12.11**
TMS 01/1168	198.00	164.00	5.00	5.00	5.50	6.50	10.00	**10.22**
TMS 01/1412	235.00	201.00	5.00	5.40	5.00	7.00	10.20	**10.04**
TME 419	322.00	305.00	7.00	7.00	2.00	2.00	10.50	**10.94**
LOCAL (Check)	344.00	301.00	7.00	7.00	1.00	1.70	9.50	**9.59**
LSD (P≤0.05)	**8.34**	**6.02**	**NS**	**NS**	**2.83**	**0.55**	**NS**	**NS**

NS: Non Significant

Table-1b. Growth Parameters of Cassava Varieties at Harvest in Cross River Basin Flood Plain, Itu Project, Akwa Ibom State

Cassava Genotypes	Length of Petiole (cm)		Leaf Area (CM^2)		Numberof Leaves/ Plant	
	2013	2014	2013	2014	**2013**	**2014**
NR8082	23.00	22.00	432.00	403.00	70.14	**65.88**
TMS 01/1168	20.00	20.10	140.00	324.00	64.17	**71.04**
TMS 01/1412	21.30	19.00	340.00	288.00	68.44	**76.11**
TME 419	22.50	23.00	500.00	324.00	57.86	**61.00**
LOCAL (Check)	20.00	18.90	408.00	400.00	61.22	**63.50**
LSD (P≤0.05)	**NS**	**NS**	**3.07**	**5.61**	**NS**	**NS**

NS: Non Significant

Table-2. Number of Tubers of Cassava Genotypes in Cross River Basin Flood Plain, Itu Project, Akwa Ibom State

Genotypes	Months After Planting (MAP)									
	4		6		8		10		**12**	
	2013	2014	2013	2014	2013	2014	2013	2014	**2013**	**2014**
NR8082	5.6	5.7	6.8	6.8	8.8	8.6	8.9	8.8	8.9	**8.8**
TMS 01/1168	3.6	3.4	5.6	6.0	6.9	6.7	7.0	6.8	7.1	**6.8**
TMS 01/1412	8.1	9.4	13.2	11.8	13.6	11.8	13.8	11.8	13.8	**11.8**
TME 419	7.6	7.1	7.1	7.3	8.2	7.9	8.4	8.0	8.4	**8.0**
Local (Check)	3.6	3.5	4.4	4.1	4.8	5.0	5.6	56	5.6	**5.6**
LSD (P≤0.05)	**NS**	**NS**	**2.86**	**2.44**	**4.03**	**3.11**	**2.66**	**2.08**	**6.13**	**3.40**

Table-3. Length of Tubers (cm) of Cassava Genotypes in Cross River Basin Flood Plain, Itu Project, Akwa Ibom State

Cassava Genotypes	Months After Planting (MAP)									
	4		6		8		10		**12**	
	2013	2014	2013	2014	2013	2014	2013	2014	**2013**	**2014**
NR8082	36.40	38.10	42.10	41.40	50.30	48.8	54.20	53.60	54.60	**53.80**
TMS 01/1168	38.20	40.00	46.10	49.20	58.30	56.20	58.60	56.80	59.00	**56.90**
TMS 01/1412	41.00	40.30	48.30	51.40	62.30	64.80	63.60	65.00	63.80	**65.70**
TME 419	37.20	39.00	43.20	46.20	52.80	66.10	62.10	68.40	62.60	**68.80**
Local (Check)	26.60	26.40	36.10	35.30	46.30	48.00	50.20	49.00	50.60	**49.30**
LSD (P≤0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

NS: Non Significant

Table-4. Circumference of Tubers (cm) of Cassava Genotypes in Cross River Basin Flood Plain, Itu Priject, Akwa Ibom State

Cassava Genotypes	Months After Planting (MAP)									
	4		6		8		10		**12**	
	2013	2014	2013	2014	2013	2014	2013	2014	**2013**	**2014**
NR8082	22.30	21.40	32.00	33.40	32.60	33.60	36.30	36.40	37.00	**37.50**
TMS 01/1168	22.60	23.80	24.00	25.10	33.40	32.60	38.20	39.60	42.00	**41.80**
TMS 01/1412	24.00	28.10	32.60	36.90	40.10	39.40	41.60	40.20	42.00	**41.30**
TME 419	22.60	23.00	23.40	26.10	26.40	29.30	28.60	31.31	30.30	**31.80**
Local (Check)	15.00	15.60	20.30	20.80	22.80	21.40	23.00	21.80	23.20	**21.80**
LSD(P≤0.05)	**NS**	**NS**	**NS**	**NS**	**3.04**	**2.18**	**NS**	**NS**	**NS**	**NS**

NS: Non Significant

Table-5. Weight of Tuber Yield (t/ha) of Cassava Genotypes in Cross River Basin Flood Plain, Itu Project, Akwa Ibom State

Cassava Genotypes	Months After Planting (MAP)									
	4		6		8		10		**12**	
	2013	2014	2013	2014	2013	2014	2013	2014	**2013**	**2014**
NR8082	6.94	7.10	21.60	23.80	39.70	40.10	41.40	41.80	44.75	**44.60**
TMS 01/1168	7.78	7.61	27.30	26.90	40.40	39.90	45.10	44.18	46.70	**45.20**
TMS 01/1412	8.32	8.00	28.66	27.94	42.60	46.30	46.30	46.40	48.10	**48.30**
TME 419	6.15	6.00	21.32	21.00	36.10	42.00	42.00	40.80	45.80	**45.00**
Local (Check)	4.00	4.20	18.30	17.65	24.60	24.10	26.60	26.90	28.01	**28.40**
LSD(P≤0.05)	**4.20**	**2.24**	**NS**	**NS**	**1.24**	**2.56**	**2.02**	**1.86**	**NS**	**NS**

NS: Non Significant