BREEDING CASSAVA GENOTYPES FOR EARLY MATURITY, HIGH STARCH CONTENT, DRY MATTER CONTENT AND RESISTANCE TO BIOTIC AND ABIOTIC STRESS

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Abstract
A two year field trial was conducted to evaluate the performance of some cassava genotypes under the uniform yield trial for early maturity, high starch and dry matter content and resistance to biotic and abiotic stress at National Root Crops Research Institute, Umudike. The trial is a randomized complete block design experiment replicated three times. Ten cassava genotypes and two standard checks were used. Disease, yield and yield component data were collected and statistical analysis performed. The result of the analysis showed that varieties has significant ($p<0.05$) diversities for biotic stress, yield, dry matter and starch content with most of the varieties showing disease free or tolerance to biotic stress. Variety NR04/0071 showed the highest value for yield and dry matter but variety NR04/0351 showed the highest starch content while variety NR04/0081 showed the least starch content for the two years.

Keywords: Cassava breeding, dry matter content, biotic and abiotic stress

Introduction

Cassava (*Manihot esculenta* Crantz) also known as 'tapioca' or '*manioc'* is one of the major crops grown in Nigeria. Cassava is grown throughout the tropics and could be regarded as the most important root crop in terms of area cultivated and total production. More than 75% increase in cassava production over the past years has come from increase in land area as against an increase in yield (Nweke, *et al.,* 1994). Increase in production from acreage alone is not sustainable since cassava is also strategically valued for its role in food security and poverty alleviation. Nigeria is the largest producer of cassava in the world, with its annual production estimated at 38.18 metric tons from 4.1 million hectares of land (FAO, 2010). About 90% produced is used for food, animal feed, industrial, Pharmaceutical and unquantifiable quantities for export (Eke-Okoro 2008). Diseases and pests in cassava can bring about yield losses that can be as high as 90% in highly susceptible varieties which can be traced to the use of low yielding, pest and diseased susceptible varieties, and extremely low- input agriculture. The challenge is to efficiently introduce disease and pest resistance and genes for high and early dry matter yield, use of best agronomic and cultural practices for cassava production within a reasonable time frame (Egesi *et al.,* 2007).The objectives of the study incluse: breed for cassava genotype with high dry matter, resistance to diseases and pests, early maturing and high yielding through the breeding scheme for the benefit of both commercial and rural farmers.

Materials and Methods

Field trial was conducted to evaluate the performance of some cassava genotypes under the uniform yield trial at National Root Crops Research Institute, Umudike located on lat 05 29N and long 07 32 E. The altitude is 122 meters above sea level. There are two distinct seasons, the rainy season start April and ends in October, and the dry season from November to March. The rainy season has a bimodal distribution with peaks in July and September. The trial is a randomized complete block

design experiment replicated three times. Ten cassava genotypes and two standard checks were used. The varieties are: NR04/0049, NR04/0053, NR04/0071, NR04/0081, NR04/0200, NR04/0202, NR04/0276, NR04/0346, NR04/0351, NR04/0382 and two standard checks NR8082, TMS30572. The genotypes were scored for plant architecture (type) of 1 to 5 where 1=best and 5=is the poorest, response to pests and diseases such as CMD, CBB and CGM during growth period of the plant. At a time before harvesting sample of roots from the different genotype were taken for dry matter content determination. Dry matter content (DMC) assessment was done by peeling of the back of the fresh tuber and oven dried at 60c for 48hours after which the difference between the fresh weight and dry weight was measured and the percentage dry matter was calculated using the formula

$$\%dmc = \frac{(wt\ of\ the\ oven\ dried\ samples + wt\ of\ the\ petri\ dish) - wt\ of\ petric\ dish}{(wt\ of\ the\ fresh\ sample + wt\ of\ the\ petri\ dish) - wt\ of\ the\ petri\ dish} \times 100$$

At 12 months after planting (MAP) the entire trial were harvested and all the genotypes evaluated for fresh root yield and other yield related parameters. Harvest index was computed as the ratio of root yield to the total harvested biomass per genotype on fresh basis. All the necessary data were collected and statistical analysis performed.

Results and Discussion

The result of the effect of CMD, CBB and CGM scores on varieties, Plant type, tuber number, yield, dry matter and starch content on the study are presented in Tables 1-3. Effect of treatment on the CMD and CBB CGM status showed that for CMD Score there was no significant($P>0.05$) difference among the genotypes and similarly no significant across the year and the interaction. There was significant difference ($P<0.05$) in the CBB score across the treatment effect of the genotypes and in year effect. However there was no interaction effect. CGM was significantly different ($P<0.05$) in the genotype effect, but was not significant in both year and interaction (Table 1). The effect of treatments on tuber numbers, yield and harvest index represented in Table 2, showed that tuber number was significantly different in genotypes and year. Genotype NR04/0382 had the highest mean tuber number of 168.0 tubers/ha and TMS 30572 with mean least of 86.9 tubers /ha. Year 2009 has the highest number of tubers over 2008 and was significant. There was no interaction effect on the treatment (Table 2). For yield (t/ha), the treatment had significant effect on the year with 2009 having higher tuber yield ($p<0.05$) than 2008. For varieties NR04/0071 produced the highest mean yield of 26.9 t/ha but was not significantly ($p>0.05$) different from values obtained from other genotypes, followed by NR04/0049, NR04/0053, and NR 04/0200 with 23.41, 22, 72 and 22.62t/ha respectively. There was no interaction effect (Table 2). The result on harvest index, showed significant effect on the genotypes and year. Genotype NR04/0200 had the highest mean value of 0.7361, while TMS 30572 of the control having least mean of 0.5730. Similarly 2009 had the highest mean of 0.6877 compare to 2008 with 0.6302. Interaction effect was not significant (Table 2). The analysis of variance for Dry matter showed that there was significant ($p<0.05$) difference in both genotypes and year. Genotype NR04/0071 has the highest mean weight of 27.7, followed by NR04/0053 and NR04/0351 with 26.2 and 25.7 respectively (Table 3). Starch content was significantly different among genotypes and year. Of the twelve cassava genotypes, NR04/0351 had the highest starch content of 35.40% and NR04/0081 having the least of 20.64%. Similarly, the year effect was also seen to be significant ($p<0.05$) however there was no interaction effect among the genotypes and year (Table 3). From the result, the effect treatment on plant type for the genotypes were however not significant but some of genotype scored up to 3 type which was good considering that 5 type was the best. Consequently year effect was significantly ($p<0.05$) different with 2008 showing a better performance to 2009. The interaction effect was not significant (Table 3).

Table 1: Disease and Pest score in the evaluation of some cassava genotypes Under Umudike condition

Varieties	C MD(0-5)			CBB(0-5)			CGM(0-5)		
	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
NR04/0049	1.000	1.000	1.000	2.750	1.250	2.000	2.000	2.000	2.000
NR04/0053	1.500	1.000	1.250	3.000	1.500	2.250	2.000	2.000	2.000.
NR04/0071	1.000	1.000	1.000	3.500	2.250	2.875	2.000	2.000	2.000
NR04/0081	1.750	1.000	1.375	2.750	1.500	2.125	2.000	2.000	2.000
NR04/0200	1.000	1.000	1.000	3.000	1.500	2.250	2.000	2.000	2.000
NR04/0202	1.000	1.250	1.125	3.500	1.500	2.500	2.000	2.000	2.000
NR04/0276	1.250	1.000	1.125	2.750	1.250	2.000	2.000	2.000	2.000
NR04/0346	1.500	1.000	1.250	2.750	1.750	2.250	2.000	2.000	2.000
NR04/0351	2.000	1.250	1.625	2.750	1.250	2.000	2.000	2.000	2.000
NR04/0382	1.500	1.000	1.250	2.750	1.750	2.250	2.000	2.000	2.000
NR8082	1.250	1.250	1.250	3.250	1.000	2.125	2.000	2.000	2.000
TMS30572	1.250	1.000	1.125	2.500	1.000	1.750	1.750	1.750	1.750
Mean	1.333	1.062		2.938	1.458		1.979	1.979	
LSD (0.05) FOR VARIETIES = 0.5355				LSD (0.05) FOR VARIETIES = 0.4836			LSD (0.05) FOR VARIETIES=0.141		
LSD (0.05) FOR YEAR = 0.2186				LSD (0.05) FOR YEAR = 0.1974			LSD (0.05) FOR YEAR = 0.058		
LSD (0.05) VXY = 0.7573				LSD (0.05) FOR YEAR = 0.6839			LSD (0.05) FOR YEAR = 0.199		

Table 2: Yield and component in the evaluation of some cassava genotypes under Umudike condition

Varieties	Tuber No			Tuber wt {t/ha}			HI		
	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
NR04/0049	81.5	170.5	126.0	19.91	26.90	23.41	0.6529	0.6874	0.6702
NR04/0053	55.8	157.8	106.8	19.01	26.43	22.72	0.6219	0.6463	0.6341
NR04/0071	65.5	167.0	116.2	26.06	27.85	26.96	0.6941	0.6728	0.6835
NR04/0081	61.5	147.5	104.5	19.45	25.44	22.44	0.6373	0.7227	0.6800
NR04/0200	87.5	160.2	123.9	19.70	25.54	22.62	0.6836	0.7887	0.7361
NR04/0202	88.0	162.0	125.0	16.85	22.11	19.48	0.5840	0.6383	0.6112
NR04/0276	82.5	165.2	123.9	19.72	23.96	21.84	0.6553	0.7195	0.6874
NR04/0346	88.5	170.5	129.5	20.10	23.73	21.92	0.6623	0.7140	0.6881
NR04/0351	81.0	132.0	106.5	23.70	18.64	21.17	0.6259	0.6384	0.6322
NR04/0382	142.5	193.5	168.0	15.87	27.81	21.84	0.5051	0.6900	0.5976
NR8082	80.2	155.8	118.0	23.80	25.90	24.85	0.7016	0.7263	0.7139
Tms30572	47.5	126.2	86.9	16.40	27.50	21.95	0.5381	0.6080	0.5730
Mean	80.2	159.0		20.05	25.15		0.6302	0.6877	
LSD (0.05) for Varieties = 37.70				LSD (0.05) for Varieties = 4.972			LSD (0.05) for Varieties = 0.0		
LSD (0.05) for year = 13.35				LSD (0.05) for year = 2.030			LSD (0.05) for year=0.0273		
LSD (0.05) for VXY = 46.24				LSD (0.05) for VXY = 7.032			LSD (0.05) for VXY=0.0947		

Table 3: Data on plant type, Dry matter and starch content in the evaluation of some cassava genotypes under Umudike

Varieties	Dry Mater (%)			Starch (%)			Plant Type (0-5)		
	2008	**2009**	**Mean**	**2008**	**2009**	**Mean**	**2008**	**2009**	**Mean**
NR04/0049	24.13	20.43	22.28	31.54	35.25	33.40	3.750	2.750	3.250
NR04/0053	27.64	24.85	26.24	33.21	36.00	34.61	2.750	2.750	2.750
NR04/0071	28.90	26.62	27.76	33.47	35.75	34.61	3.500	2.250	2.875
NR04/0081	16.31	14.58	15.44	19.77	21.50	20.63	3.000	2.500	2.750
NR04/0200	19.29	16.80	18.04	24.26	26.75	25.51	4.000	2.500	3.250
NR04/0202	25.32	23.10	24.21	29.77	32.00	30.89	3.250	3.000	3.125
NR04/0276	26.01	23.40	24.70	31.22	33.83	32.53	3.750	3.000	3.375
NR04/0346	17.27	13.70	15.49	24.42	28.00	26.21	3.000	3.000	3.000
NR04/0351	27.38	24.18	25.78	33.79	37.00	35.40	3.750	2.500	3.125
NR04/0382	23.03	20.38	21.71	28.34	31.00	29.67	3.250	2.750	3.000
NR8082	23.20	20.10	21.65	29.40	32.50	30.95	3.250	2.500	3.000
TMS30572	25.68	22.08	23.88	32.89	36.50	34.70	3.250	2.750	3.000
Mean	**23.68**	**20.85**		**29.34**	**32.17**		**3.396**	**2.688**	
LSD (0.05) for Varieties = 3.008				LSD (0.05) for Varieties = 3.008			LSD (0.05) for Varieties = 0.647		
LSD (0.05) for year = 1.228				LSD (0.05) for year = 1.228			LSD (0.05) for year = 0.264		
LSD (0.05) for VXY = 4.253				LSD (0.05) for VXY = 4.253			LSD (0.05) for VXY = 0.9158		

Conclusion

Varieties showed significant diversities for biotic stress, yield, dry matter and starch content with all most of the varieties showing disease free or tolerance to biotic stress. Variety NR04/0071 showed the highest value for yield and dry matter but variety NR04/0351 has the highest starch content while variety NR04/0081 showing the least starch content.

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