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Evaluation for Distinctness and Variability in Morphological Characters of Some Cassava (*Manihot esculenta* Crantz) Genotypes

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Abstract **– Some cassava genotypes were evaluated for distinctness of morphological characters and genetic variability for root yield and its components during 2012 and 2013 cropping seasons. The following data were collected; severity of Cassava Bacteria Blight (CBB), Cassava Mosaic Disease (CMD), Sprouting percentage, Plant height, Root number, Root weight, Shoot weight and Root dry matter. High heritability and genetic gain were observed in cassava mosaic disease 69.3%, 62.4%., root number 71.69%, 38.9% and plant height 92.0%, 32.42% as indicated, suggesting that the traits are primarily under genetic control and that reliable selection with simple recurrent phenotypic selection would be appropriate. Genotypes IITA TMB 419, IITA TMS I 011412 and IITA TMS I 30572 showed distinctness in root yield with 36.15, 29.82 and 26.55 metric tons per hectare respectively and were found to constitute a pool of germplasm with adequate genetic variability from which selection bring about significant progress in cassava improvement programme.**

Keywords **– Distinctness, Variability, Morphological Characters, Germplasm, Recurrent, Phenotypic Selection.**

I. INTRODUCTION

Cassava is cultivated and considered as a major source of food for human diet in the tropical and sub-tropical regions of the world. It is likely that the vast majority of genes within the species are as a result of selection pressure exerted in Brazil as the main Centre of origin, with the greatest genetic diversity of the genes. No doubt, it is a dietary staple in most of tropical Africa and good source of calories that is rich in carbohydrate, calcium, vitamin B and C as well as essential minerals. However, nutrient composition differs according to variety and age of the harvested crop, soil conditions, climate and other environmental factors during cultivation (IITA, 2000). The crop has broad adaptability to a variety of climatic conditions, it tolerates drought and has ability to grow in depleted and marginal soil (Matthew *et al*., 1993). More so, it growth and yield in different environment shows different growth behaviours in different locations as a result of variation in climatic and soil conditions (Akinwale *et al*. 2010). Therefore, as new genotypes are developed, there is need to evaluate their performance in different agro-ecologies in order to identify those that are distinct in terms of morphology and yield across varying environments. Despite all these great importance of cassava, it is faced with some major constraints, responsible for poor yield and threatens food security; among the most important are viral and bacterial diseases weeds and abiotic constraints, poor shelf-life of cassava roots after harvesting in less than three days which can render it unpalatable and unmarketable. So far, the genetic potential of cassava has been demonstrated and considerable progress has been made. Many breeding programs are on-going in Africa and other parts of the world focusing on improving the traits of end user preference, yielding potentials and quality traits such as high tuber yield, pest and disease resistance, tolerance to abiotic stress, micro nutrients, starch quality, dry matter content etc through development of new cassava genotypes with a view to further broadening the genetic base of cassava. Yield is controlled polygenically and being a complex character, its expression is therefore highly variable and it is improved by selecting for the components of yield (Akinyele and Osekita 2006; Osekita and Akinyele 2008 and Odeleye *et al* 2007). Selecting for one of the components may however fail to result in yield increase because of negative association among components (Makame, 1995). The degree of these correlations is not only of interest from theoretical point of quantitative inheritance of characters, but also of practical value of selecting for two or more traits simultaneously. However, knowledge of heritability of various characters contributing to yield and to develop optimal breeding procedure is therefore needed by cassava breeders. The objectives of the research are, to estimate the genetic variability among the varieties and the agronomic traits that contributes to root yield as well as determine the severity of disease infections.

II. MATERIALS AND METHODS

Varieties IITA TMS I 130572, IITA TMS I 011412, IITA TMS I 011371, IITA TMB 419 and IITA TMS I 011368 obtained from the International Institute of Tropical Agriculture, Ibadan. Nigeria was evaluated for distinctness and variability in their morphological characters at the research field of Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba-Akoko. Ondo State. Nigeria. The varieties were selected from the breeding lines of IITA, Ibadan, Nigeria and selection was based on the varying flesh colour of their roots. The cassava varieties were grown in a randomized complete block design (RCBD) replicated three times. Plants were spaced at 1m X 1m in a $10m^2$ plot. Weeding was done manually and fertilizer was at zero level. Different quantitative traits were taking on sprouting percentage, plant height, cassava mosaic disease

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(CMD) and cassava bacteria blight (CBB) severity, root number, root weight, shoot weight and root dry matter. Records of disease severity were taking at regular intervals to monitor disease pressure.

Statistical analysis

Analysis of variance (ANOVA) was done to assess the genotypic effects using the procedure for randomized complete block design in SAS (1996) from which estimates of variance components were generated. Broad sense heritability (h^2) was calculated as the ratio of the genotypic variance to the phenotypic variance using the formula:

h^2 = Vg/Vp x 100 according to Allard (1960)

where,

h^2 = broad sense heritability (%),

Vg = genotypic variance and

Vp = phenotypic variance

Phenotypic and genotypic coefficients of variation were computed with the following.

PCV = $\sqrt{Vp}/\bar{a}$

GCV = $\sqrt{Vg}/\bar{a}$

Where $\bar{a}$= mean of the population.

Genetic advance for selection was estimated according to Allard (1960) as follows:

Gs = (k) (σA) H

Where Gs represent the expectation of genetic advance, it measures the difference between the mean genotypic value of the selected lines, that is, $\bar{a}$s, and the mean genotypic value of the n original lines, $\bar{a}$. Thus Gs = $\bar{a}$s – $\bar{a}$.

σA is the phenotypic standard deviation of the mean yield of the original n lines.

H is the heritability coefficient, estimated as the ratio formed by dividing the genotypic variance by the phenotypic variance.

Genotypic and phenotypic correlations between pairs of traits were calculated from the components of variance and covariance estimates following the procedures of Steel and Torrie (1980).

III. Results and Discussion

The mean performance of cassava varieties evaluated for yield and its components were presented in Table 1. With the varieties showing distinctness of at least 80% in sprouting and a surprising root number per 10 square meter of 108.64 in IITA TMB 419 and lowest number of 34. 83 in variety IITA TMS I 011368.

Table 1: Mean performance of cassava varieties evaluated for root yield and its components.

Characters / Varieties	Sprouting percentage	CBB (1-5)	CMD (1-5)	Plant height(cm)	Root number	Root weight (kg)	Shoot weight (kg)	Root dry matter
IITA TMS I 30572	90.21±1.31	2.58±0.01	1.75±0.06	259.81±4.74	56.50±1.60	26.55±0.89	16.83±0.65	33.62±0.60
IITA TMS I 011412	94.38±1.84	2.50±0.03	1.33±0.08	181.22±3.89	85.60±3.22	29.82±1.20	12.60±0.72	30.47±0.52
IITA TMS I 011371	79.03±1.56	2.42±0.06	2.45±0.02	207.03±4.89	52.10±3.72	23.41±0.99	20.80±0.64	28.23±0.38
IITA TMB 419	87.08±1.01	2.67±0.01	1.00±0.04	200.73±5.23	108.64±1.78	36.15±1.02	23.04±0.52	31.10±0.35
IITA TMS I 011368	82.50±1.92	2.75±0.02	1.00±0.04	164.00±4.73	34.83±4.86	18.03±0.92	6.93±0.98	26.22±0.39

CBB – Cassava bacteria blight; CMD – Cassava mosaic disease

Variety IITA TMB 419 showed distinctness in almost all the yield components that is, in plant height, root weight and root dry matter.

The combined analysis of variance for yield and its components as shown in Table 2 revealed significant variation in all the root yield components with high coefficient of variation of 32.59%, 25.63% and 24.78% for shoot weight, root number and root weight respectively. The result of the combined analysis was pooled over two seasons and the estimate of the expected yield. It was however, revealed that IITA TMS I 011368 yielded 18.03 tons per hectare which is the least harvest and the highest yield of 36.15 tons per hectare was recorded on variety IITA TMB 419 this is shown in Table 1.

Table 2: Combine analysis of variance for yield and its components

Source of variation	Degree of freedom	Sprout	Plant height (cm)	Root number	Root weight (kg)	Shoot weight (kg)	Root dry matter
Replication	2	4582.27**	1094.45**	662.42**	11300.52**	14325.75**	1042.63**
seasons	1	7835.62**	1025.15**	593.24**	11985.53**	14878.65**	1337.67**
Variety	4	1059.91**	7889.44**	4204.21**	318.44**	175.23**	40.34**
Var X Sea	4	637.59**	857.61**	1259.85**	275.53**	135.27**	32.27**
Error	8	173.56	450.61	342.70	69.04	43.20	10.35
CV		14.21	9.72	25.63	24.78	32.59	8.69

** indicate 0.01 level of significance

Table 3: Mean squares of disease severity of CMD and CBB

Source of variation	Degree of freedom	Cassava mosaic disease (CMD)	Cassava bacteria blight (CBB)
Replication	2	4.92**	38.85**
seasons	1	24.37**	3.35**
Variety	4	0.50**	5.89**
Var X Sea	4	1.59**	0.41**
Error	8	0.08	0.09
CV	-	0.13	9.05

** indicate 0.01 level of significance, ns means non-significance

Table 3 shows the mean squares of disease severity for *Cassava mosaic disease* (CMD) and *Cassava bacteria blight* (CBB). It was observed that most of the varieties had moderate severity and disease incidence to CBB and CMD. The results of the analysis of variance showed significant differences among the varieties and over replications, therefore it is an indication of incidence and severity of the diseases on the yield of the cassava genotypes. The coefficients of variation for the two diseases are 0.13% and 9.05% for CMD and CBB respectively indicating the degree of precision on the interaction of the diseases with the yield components. Table 4 shows the estimate of genetic variability of yield components. The least heritability was observed in *Cassava bacteria blight* with 28.0% and the highest of 92.0% heritability in plant height, other component traits fall within the range. The genotypic coefficient of variation (GCV) was also estimated with the highest value of 36. 25 in CMD and the least of 4.62 in root dry matter. Similar cases were observed in phenotypic coefficient of variation (PCV) with root dry matter having the least PCV values of 6.94 and highest PCV values of 42.25 in CMD. All the yield components had considerable genetic gain from the above result with the highest genetic gain 38.9% observed for root number and the least genetic gain of 6.7% in root dry matter.

Table 4: Estimate of genetic variability of yield components

Traits	Mean	GCV	PCV	Heritability (%)	GAM (%)
CBB	2.58	5.43	10.12	28.00	5.40
CMD	1.51	36.25	42.25	69.30	62.40
Sprouting (%)	86.64	9.30	12.56	56.70	17.20
Plant height(cm)	202.56	13.25	14.54	92.00	32.42
Root number	67.53	26.54	30.32	71.69	38.90
Root weight (kg)	26.19	17.30	20.36	62.16	24.90
Shoot weight (kg)	16.04	14.45	21.14	47.02	20.23
Root dry matter	29.93	4.62	6.94	54.67	6.70

Table 5: Phenotypic and genotypic correlation coefficient for yield traits

Traits	CBB	CMD	Plant Height (cm)	Root Number	Root Weight(kg)	Shoot Weight (kg)	Root dry matter
Sprouting (%)	-0.1103 -0.2312	-0.4507** -0.5432**	-0.1603 -0.2143	0.6512** 0.7413**	0.6221** 0.8613**	0.1802 0.2531	-0.2542* -0.4533**
CBB		0.2007 0.4226**	0.1812 0.1917	0.3507** 0.5213**	-0.3204** -0.5510**	-0.1002 -0.1704	-0.1003 -0.2403
CMD			0.2214 0.2508*	0.1216 0.1802	-0.1603 -0.3612**	-0.3227** -0.6713**	-0.1102 -0.4007**
Plant height (cm)				-0.0312 -0.0407	-0.0200 -0.0712	0.1502 0.1723	-0.0413 -0.1417
Root number					0.7914** 0.8934**	0.4243** 0.5008**	0.0100 0.0300
Root weight (kg)						0.1113 0.3425**	-0.1127 -0.2934*
Shoot weight (kg)							-0.1424 -0.3112*

(Phenotypic correlations above and genotypic correlations below)

Correlation measures the degree of association between two or more characters.That is the relationship which can reveal whether the change in one variable would cause change in the other or not, such relationship between the two sets of characters or variable can be expressed quantitatively by the degree of relationship called correlation coefficient Kar and Halder (2006). The phenotypic and genotypic correlation coefficients for yield traits were presented in Table 5: sprouting % had significant but negative association r= (-0.4507) and (-0.5432) with cassava mosaic disease (CMD) and root dry matter (-0.2542) and (-0.4533), this was corroborated by the findings of Makame (1995), it also had positive correlation with root number (0.6512), (0.7413) and root weight (0.6221), (0.8613). Root number had highly significant positive correlation with root weight (0.7914), (0.8934) and shoot weight (0.4243), (0.5008). Root dry matter had negative correlation with all traits studied except root number which had positive but insignificant correlation. This finding is in line with the results of Aina (2007) and Akinwale *et al* (2010). Selection is an important phenomenon in breeding experiment therefore; significant correlation of root number with root weight and shoot weight would be the parameter to be considered in selecting for yield improvement in subsequent breeding programmes. Therefore, the same conditions exist for sprouting percentage which had positive and significant association with root number and root weight which is the economic yield of the cassava genotypes. Invariably, conclusions could be drawn from the above findings by ensuring that adequate crop care procedures should be employed in order to maintain yield of 36.15 metric tons per hectare obtained in this research to 45 metric tons per hectare even without application of soil conditioners, also the severity of CMD and CBB should be adequately taken care of through preventive and control measures.

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REFERENCES

[1] Aina F. A. (2007). Genetic variability in cassava as influenced by root yield in Nigeria. *J. Biol. Sci*. 7(5): 765-770.

[2] Akinwale M. G., B. O. Akinyele; A. G. O. Dixon and A. C. Odiyi (2010). Genetic variability among forty-three cassava genotypes in three agro-ecological zones of Nigeria. *Journal of Plant Breeding and Crop Science*. Vol. 2(5); 104-109.

[3] Akinyele B. O. and Osekita O. S. (2006). Correlation and Path coefficient analyses of seed yield attributes in Okra (*Abelmoschus esculentus* (L.) Moench). *African Journal of Biotechnology*. Vol. 5(14): 1330-1336.

[4] Allard R. W. (1960). Principles of Plant Breeding. John Wiley and Sons Co. New York. Pp 75-108.

[5] Dipak Kr Kar and Soma Halder (2006). Plant Breeding and Biometry. New Central Book Agency (P) Ltd. India. Pp 203.

[6] International Institute of Tropical Agriculture (IITA, 2000). Cassava crop: www.iita.org

[7] Makame M. (1995). Genetic variation, stability of performance of cassava clones and their responses to intercropping with sweet potato in Zanzibar. PhD. Thesis, University of Ibadan, Nigeria. Pp. 248.

[8] Matthew H., Schopke S., Carcamo R., Chavarriaga P., Fauquet C. and Beachy R. N. (1993). Improvement of somatic embryogenesis and plant recovery in cassava. *Plant cell Rep*. 12: 328-333.

[9] Odeleye F. O., Odeleye O.M.O., Olaleye A. O. and Yakubu F. B. (2007). Effect of sowing depth on emergence, growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). *J. Food Agric. Environ*. 5(1): 205-207.

[10] Osekita O. S. and Akinyele B. O. (2008). Genetic analysis of quantitative traits in ten cultivars of okra- *Abelmoschus esculentus* (L.) Moench. *Asian J. Plant Sci*. 7:510-513.

[11] Steel, R.G.D and J.S.Torrie. (1980). Principles and procedure of statistics. A Biometrical Approach, second ed. Mc Craw-Hill Book Company Inc., New York. P. 633.