

Introgression of enhanced micronutrients and other important traits from Latin American germplasm into elite Nigerian cassava cultivars

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BACKGROUND

Cassava is an energy rich food crop that has some major nutritional drawbacks as they contain low levels of essential micronutrients. Micronutrient malnutrition is widespread in Nigeria. Recent surveys show that a third of Nigerian children under five are deficient in pro-vitamin A (Maziya-Dixon et al., 2004). Cassava enriched with micronutrients (Fig.1) presents a sustainable avenue for alleviation of chronic conditions in impoverished populations who depend on the staple. Development of new varieties addressing the issue of this 'hidden hunger' presents a sustainable approach to mitigating this challenge. Identification and selection of local and introduced germplasm for use as parents in crosses with the aim of combining useful traits in the gene pools is reported in this study.

BREEDING FOR HIGH BETA CAROTENE CONTENTS

Roots of several cassava varieties were used in studies involving evaluation of cassava genotypes with high levels of beta carotene in multiple environments. The study was conducted at eight sites in Nigeria representing major cassava growing agro-ecologies in the country. Twenty five cassava genotypes with yellow roots at advanced stages of breeding and three checks were used in the study. The results indicate high variability among the genotypes studies for carotenoid contents (Table 1). For instance at Ibadan beta carotene contents ranged from 0.6 to 8.9 µg/g. At Zaria it ranged from 0.7 to 9.4 µg/g. This is indicative of significant variation in available germplasm for rapid progress in breeding for increased beta carotene contents (pro-vitamin A) in cassava. The high coefficient of variation indicated adequacy of sampled genotypes for progress in generating high beta carotene varieties through genetic gain.

Biplot analysis showed a good number of genotypes with very high levels of stable carotene contents across locations (Fig 2). They contrasted significantly from the three white checks. AMMI analysis identified seven genotypes as candidate genotypes for breeding for enhanced pro vitamin A in cassava. These genotypes include TMS 01/1371, TMS 01/1610, TMS 01/1277, TMS 01/1115, TMS 01/1412, TMS 01/1368 and TMS 01/1663. They were stable in their performance for carotenoid concentration across all locations studied. This corroborates earlier reports of carotenoid stability in cassava (Iglesias et al. 1997). Yellow garri derived from palm oil addition to white root cassava is well accepted in Nigeria and farmers mutually share valuable resources so it is expected that adoption will be easier if farmers and processors are involved early in yellow root variety development.



Fig 1. Micronutrient-dense cassava

Table 1. Variation for carotene content (µg/g) of fresh roots in Cassava grown in Nigeria

	Location				
	Ibadan	Mokwa	Onne	Ubiaja	Zaria
Mean	4.51	5.38	4.11	5.18	5.61
Min	0.60	0.80	0.00	0.40	0.70
Max	8.90	11.0	9.40	9.30	9.40
SD	1.92	2.22	2.23	2.13	2.40
CV (%)	42	37	35	41	42

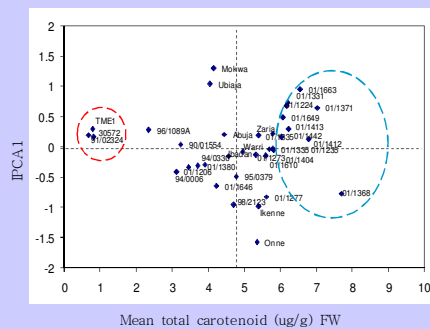


Fig 2. Biplot Analysis showing high beta carotene cassava varieties

Table 2. List of Selected Latin American cassava germplasm being crossed to Local Elite clones

Female Parents	Male Parents
TMS 05/0100	CPCR 27B - 30
TMS 05/0473	CPCR 24B - 28
TMS 05/1601	CPCR 15B - 40
TMS 05/1636	CPCR 15B - 68
TMS 05/1652	CPCR 11B - 29
TMS 05/1662	
TMS 05/0186	

INTRODUCTIONS FROM LATIN AMERICAN GERMLASM

A total of 1,555 seeds were derived from the seventeen parents in different combinations. The number of plants successfully established *in vitro* from embryo axes was 981 (68%) from 32 families (Table 1). Fourteen percent (14%) of the plants (138) were selected for CMD resistance from 16 families (50%) and further micro-propagated to generate 8-10 plants each using two flanking CMD markers, NS158 and RME1. The selected CMD-resistant genotypes with enhanced nutritional attributes were shipped as *in vitro* materials to NRCRI. A total of 687 plants were shipped. The high protein and beta carotene germplasm are undergoing field evaluations. Molecular markers shall be screened for identification of germplasm that combine high nutrition, disease resistance and excellent field performance to enhance their acceptability.

INTROGRESSION OF NUTRITIOUS TRAITS INTO ADAPTED GERMLASM

A group of selected local elite lines have been identified and used in establishing a crossing block. The local genotypes being used as parents possess desirable characteristics such as disease resistance and other culinary qualities. The Latin American cassava genotypes are being used as the male parent while the Nigerian germplasm are the female. Selection for high micronutrient contents (protein and beta carotene) will be done after evaluations of the seedlings being developed. Molecular markers associated with the trait have been identified at CIAT. These include SSY313, NS251 and NS717 and will be useful for application in marker-assisted breeding.

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