005-003

Varietal selection of high beta-carotene cassava genotypes adapted to dry and humid Caribbean Region of Colombia

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Introduction

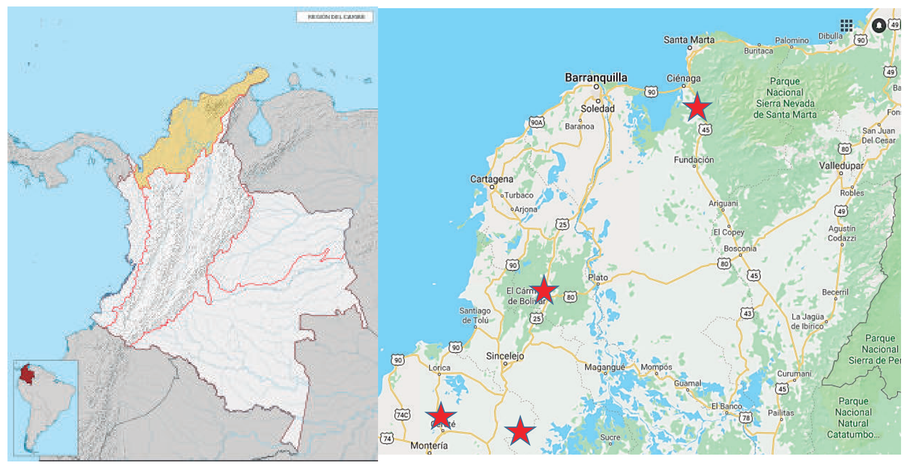
Cassava (Manihot esculenta Crantz) is a four staple crop for human consume worldwide after rice, wheat and corn. Mainly, it is used as energetic source due high carbohydrate content; however, improvement of its nutritional quality can contribute to food security, especially in vulnerable region as Caribe, where several factors have threaten with nutritional balance in children. In Colombia, close to of children are born with a birth weight of less than 2,500 grams, which is one of the main risk factors for the mortality of newborns. In children less than 5 years old, 43,3% has zinc deficiency, 24,3% has A vitamin deficiency and 10,6 has Iron deficiency.

Materials and methods

Plant material

N°	Clon
1	SM3761-110
2	SM3757-81
3	SM3762-15
4	GM5194-13
5	GM5146-16
6	GM5194-5
7	GM5146-19
8	GM5257-5
9	SM3695-82
10	SM3761-103
11	SM3767-84
12	GM1556-4
13	SM3694-54
14	GM5177-3
15	GM3518-66
16	GM3518-42
17	SM3536-44
18	GM3649-68
19	GM3426-5
20	GM3518-68

Environmental conditions



Checks Corpoica Tai - Corpoica Veronica - ICA Costeña - Venezolana

	Cereté	Sevilla	Carmen Bolívar	La Unión
Mean Temperature (°C)	27.7	29	27	30
Accumulated precipitation (mm/year)	1264	900	1179	2800
Altitude (m.a.s.l.)	13	30	158	65

Cropping seasons: 2016-2017 and 2017-2018

Selection index (SIN)

CIAT generally applies a selection index (SIN) that integrates relevant variables (Ceballos et al., 2012):

SIN=(FRY * 10)+(DMC * 10)–(PTS * 5)+(TBC * 8)

CropInd: is a R tool for SIN stimation, allows to obtain a General SIN and Local SIN

Fresh root yield (FRY)
Dry matter content (DMC)
Suitable plant architecture, and resistance to locally or regionally relevant pests and diseases (PTS)
Total β-carotene content (TBC)

Results

Genetic and environment effects on FRY and DMC

Table 1. Mean and mean squares in individual analysis of variance

		FRY				DMC		
Environments	**Mean (t/ha)**	**Block**	**Genotype**	**Error**	**Mean (%)**	**Block**	**Genotype**	**Error**
df		2	23	56		2	23	56
Carmen_ Bolivar-2016	16,89d	51.16	299.9***	74.45	29,81d	4.98	46.65***	3.58
Carmen_ Bolivar-2017	26,60b	179.0	279.4	113.3	30,66cd	1.84	34.34***	2.56
Cerete-2016	18,15cd	16.36	177.7***	16.3	35,57a	2.90	31.65***	1.43
Cerete-2017	14,33d	4.30	245.55***	26.02	32,37bc	17.48	42.83***	7.92
Sevilla-2016	37,16a	383.0	463.6*	220.6	32,50b	1.84	33.83***	1.79
Sevilla-2017	35,01a	305.27	588.76	296.9	34,48a	2.53	27.35***	4.24
Union-2016	24,14bc	734.65***	148.90**	37.24	29,75d	0.15	35.40***	0.73
Union-2017	27,51b	54.87	113.51***	36.49	33,83ab	0.07	27.96***	0.31

Table 2. Mean and mean squares in combined analysis

		FRY		DMC	
	DF	**Mean Square**	**Explained Percent**	**Mean Square**	**Explained Percent**
Rep/Env	16	231.0**		4.28	
Env	7	5294.4***		338.13***	
Gen	23	496.9***		153.7***	
Env X Gen	152	251.5***		17.06***	
IPCA1	29	530.1***	41.5	29.61***	34.1
IPCA2	27	249.2***	18.2	20.93***	22.4
IPCA3	25	198.0ns	13.4	20.01***	19.9
Residuals	460	109.2		3.23	

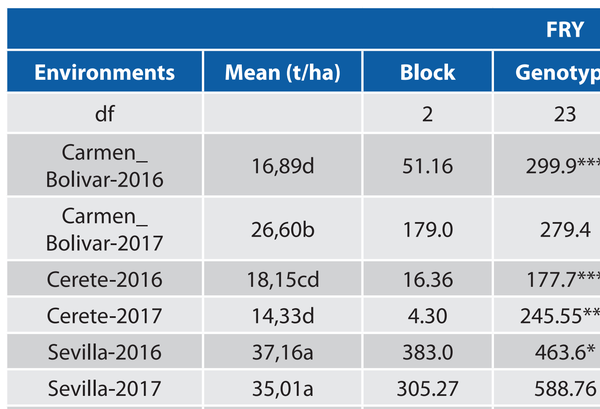


Figure 1. Biplot obtained by AMMI analysis for FRY

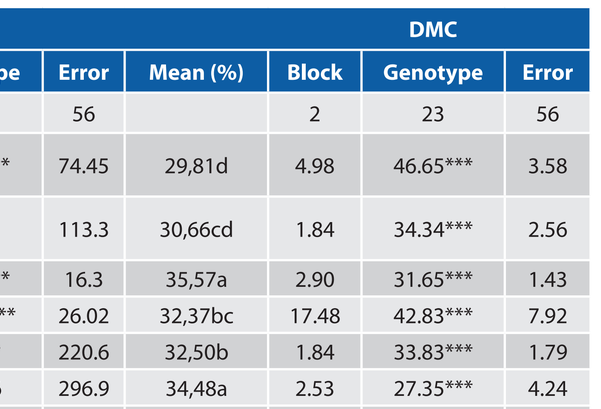


Figure 2. Biplot obtained by AMMI analysis for DMC

Genetic and environment effects on TBC and TC

Table 3. Mean squares in analysis of variance for total carotene and beta carotene

		Total Carotenes		B-carotene	
	DF	**Mean Square**	**Explained Percentage**	**Mean Square**	**Explained Percentage**
Rep/Env	14	0.01		0.001	
Env	6	19.89***		8.78***	
Gen	23	438.37***		217.69***	
Env X Gen	126	10.55***		5.03***	
IPCA1	28	23.34***	49.5	9.42***	41.7
IPCA2	26	9.14***	18.0	6.82***	28.0
IPCA3	24	9.01***	16.4	4.54***	17.2
Residuals	313	0.03		0.004	

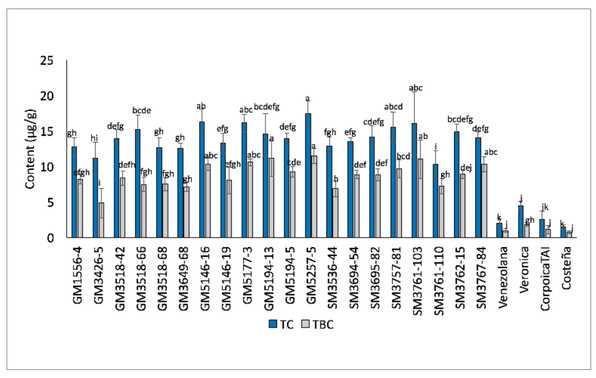


Figure 3. Total carotene and β-carotene content among genotypes

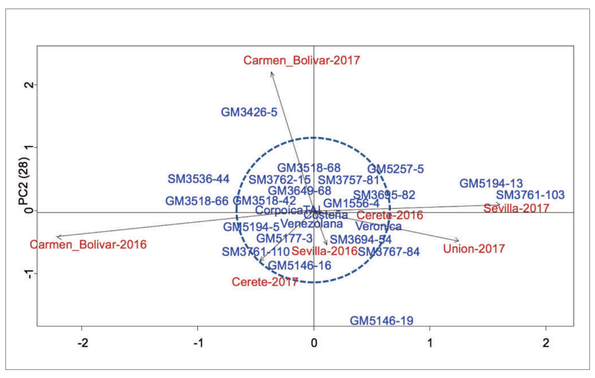


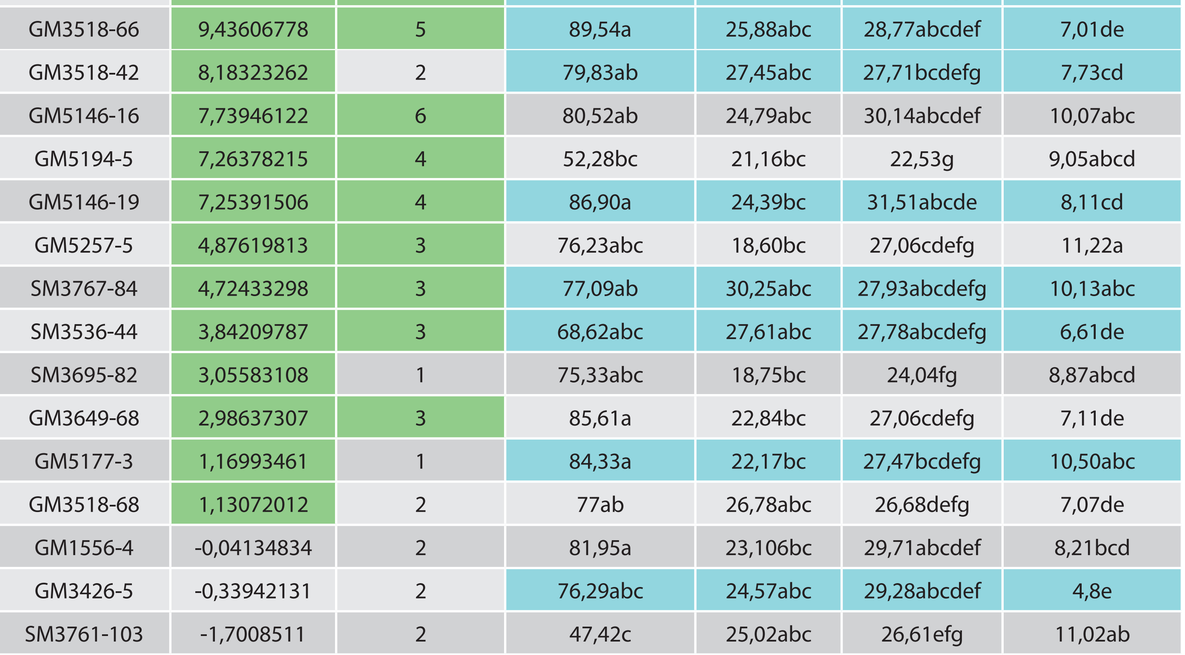
Figure 4. Biplot obtained by AMMI analysis for TBC

Genotype selection for high-betacarotene content

Table 4. Selection index and mean of desired traits in evaluated genotypes

	Selection Index		Mean			
Genotypes	**General SI**	**selected Env**	**% germination**	**FRY (t/ha)**	**DMC (%)**	**TBC (µg/g P.F.)**
SM3757-81	13,065814	4	75,42abc	20,82bc	28,31abcdefg	9,42abcd
SM3762-15	10,6006666	6	84,19a	26,59abc	30,77abcde	8,68abcd
GM5194-13	10,1690226	5	71,28abc	25,68abc	26,26efg	10,51abc
GM3518-66	9,43606778	5	89,54a	25,88abc	28,77abcdef	7,01de
GM3518-42	8,18323262	2	79,83ab	27,45abc	27,71bcdefg	7,73cd
GM5146-16	7,73946122	6	80,52ab	24,79abc	30,14abcdef	10,07abc
GM5194-5	7,26378215	4	52,28bc	21,16bc	22,53g	9,05abcd
GM5146-19	7,25391506	4	86,90a	24,39bc	31,51abcde	8,11cd
GM5257-5	4,87619813	3	76,23abc	18,60bc	27,06cdefg	11,22a
SM3767-84	4,72433298	3	77,09ab	30,25abc	27,93abcdefg	10,13abc
SM3536-44	3,84209787	3	68,62abc	27,61abc	27,78abcdefg	6,61de
SM3695-82	3,05583108	1	75,33abc	18,75bc	24,04fg	8,87abcd
GM3649-68	2,98637307	3	85,61a	22,84bc	27,06cdefg	7,11de
GM5177-3	1,16993461	1	84,33a	22,17bc	27,47bcdefg	10,50abc
GM3518-68	1,13072012	2	77ab	26,78abc	26,68defg	7,07de
GM1556-4	-0,04134834	2	81,95a	23,106bc	29,71abcdef	8,21bcd
GM3426-5	-0,33942131	2	76,29abc	24,57abc	29,28abcdef	4,8e
SM3761-103	-1,7008511	2	47,42c	25,02abc	26,61efg	11,02ab
SM3694-54	-4,74036958	2	74abc	24,53abc	24,05fg	8,69abcd
SM3761-110	-9,23042677	0	64,38abc	39,03a	24,58fg	7,12de
Costeña	9,600918		79,9ab	31,57ab	33,00abc	0,75f
Veronica	7,49928613		91,60a	30,15abc	32,81abcd	1,57f
CorpoicaTAI	1,75925972		77,21ab	31,82ab	30,81abcde	1,14f
Venezolana	-6,76680309		88,19a	16,72c	33,30ab	1,49f

Promising genotypes as biofortified cassava varieties



Conclusions

First enhanced β-carotene varieties will be released soon. Improvement of food security by enhancing nutritional quality in cassava. Offer new improved cassava varieties for human consume