First generation of *M. pseudoglaziovii* x cassava

NASSAR, N. M. A. 1997. Development of cassava interspecific hybrids for savanna conditions. **J. Root Crops 22:9-17.**

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First generation of *M. neusana* x cassava

NASSAR N.M.A.; NASSAR HALA, N.M..; VIEIRA, C.; SARAIVA S.L. 1995. Cytogenetic behavior of interspecific hybrids of cassava and *M. neusana* Nassar. **Can. J. Sci., 75:675-678.**

http://www.geneconserve.pro.br/reprints18.htm

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Selections of second generation progeny

1. *M. dichotoma* x cassava

NASSAR, N. M. A 2003b UnB 033 An interesting cassava hybrid. **Ceres vol. 50:22-26**.

http://www.geneconserve.pro.br/reprints27.htm

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Selections of second generation progeny

2. *M. glaziovii* x cassava

NASSAR, N. M. A. 1997. Development of cassava interspecific hybrids for savanna conditions. **J. Root Crops 22:9-17.**

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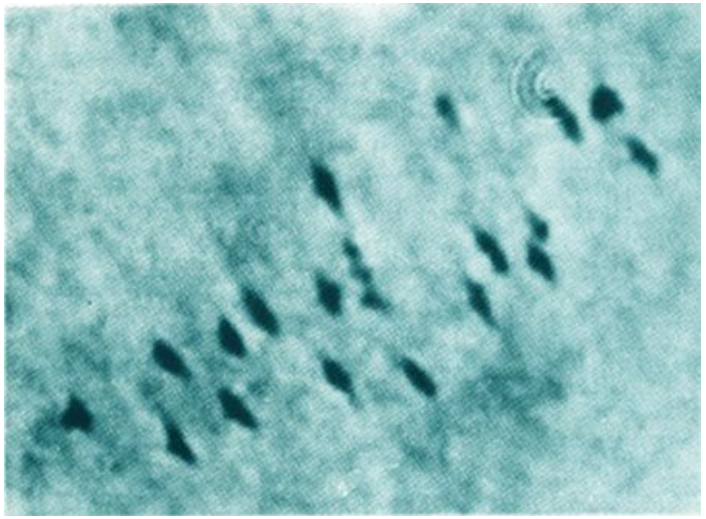
Selections of second generation progeny

3. *M. cearulescens* x cassava

Development of interespecific hybrids
Induction of productive aneuploid



NASSAR N.M.A.; NASSAR HALA, N.M..; CARVALHOC A.; VIEIRA, C. 1996. Inducion of a productive aneuploid in cassava, *M. esculenta* Crantz. **Braz. J. Genet 19:123-125.**

http://www.geneconserve.pro.br/reprints9.htm

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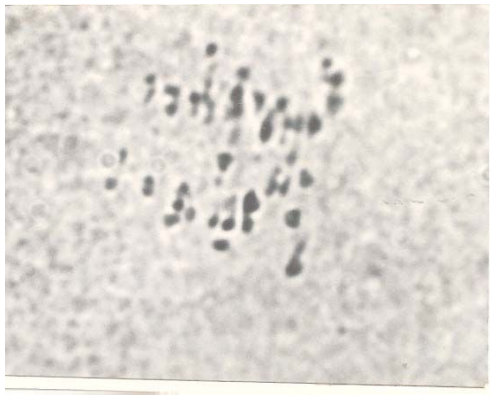
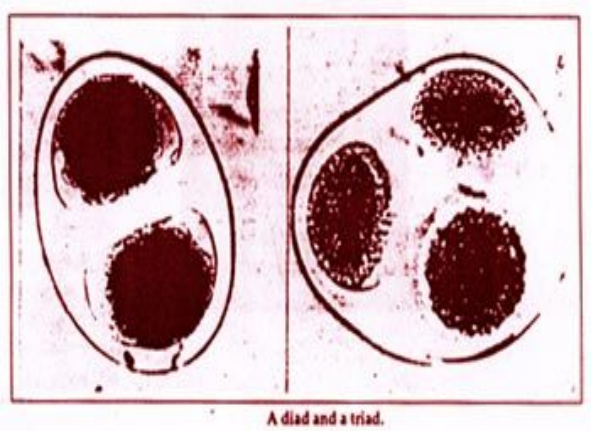
Production of triploid cassava by hybrid diploid gametes

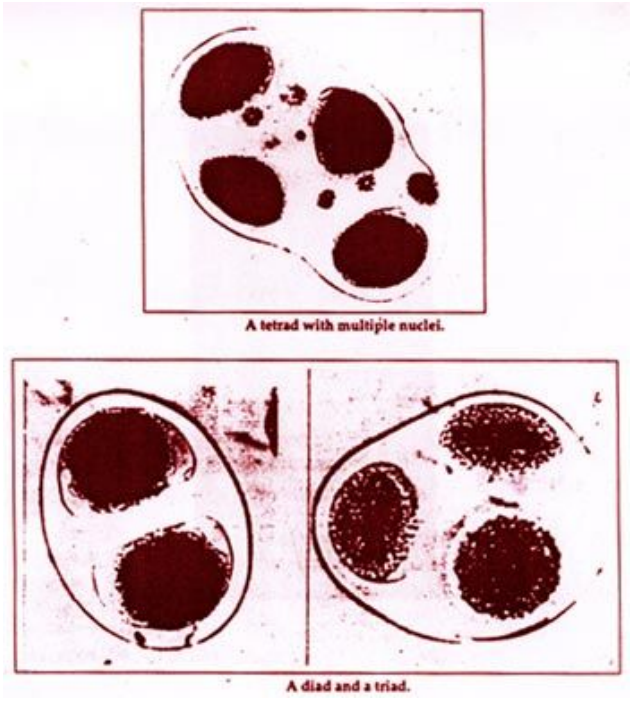


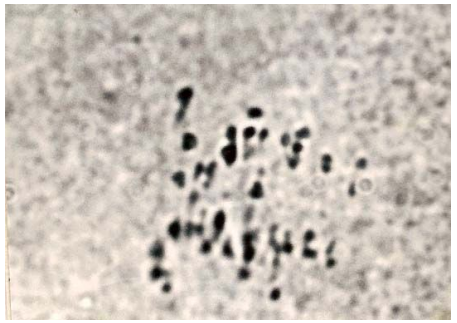


NASSAR N.M.A. 1992. Production of triploid cassava, Mnihot esculenta crantz by hibrid diploid gametes, Field Crops Research, 30:173-182.

http://www.geneconserve.pro.br/reprints25.htm

Development of interespecific hybrids
Manipulation of Meiotic Restitution





NASSAR, N.M .A. 1991. Production of triploid cassava, *Manihot esculenta* Grantz by hybrid diploid gametes. **Field Crops Research, 13: 173-82**

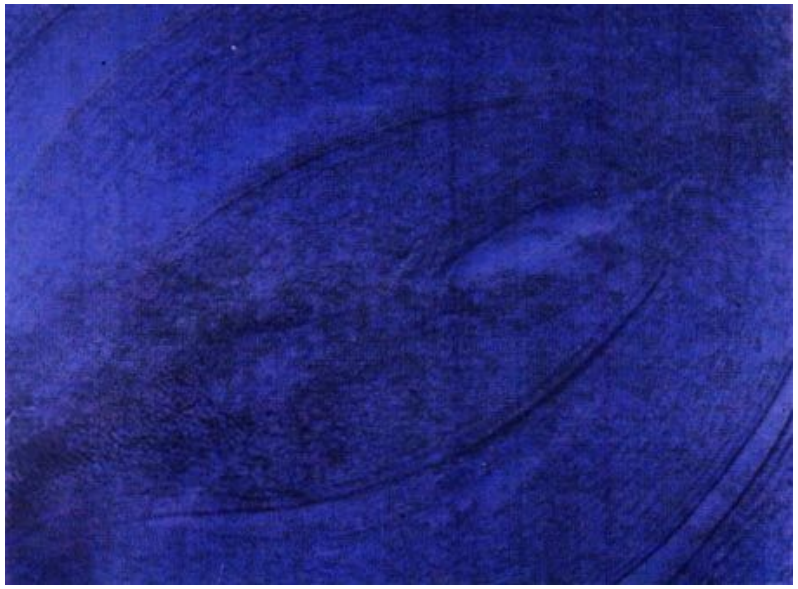
NASSAR, N. M. A.., Freitas, M.. Prospects of polyploidizing cassava by unreduced microspores. Plant Breeding, Alemanha, v. 116, p. 195-197, 1997.

http://www.geneconserve.pro.br/prospects_of_polyploidizing.pdf

Course by Nagib Nassar

Production of apomitic clones

Transference of Apomixis genes



Nassar, N.M.A., E. Santos, S. David. 2000. The transference of Apomixis genes from *Manihot Neusana* Nassar to cassava, *M. esculenta* Crantz. **Hereditas 132:167-170.**

http://www.geneconserve.pro.br/reprints8.htm

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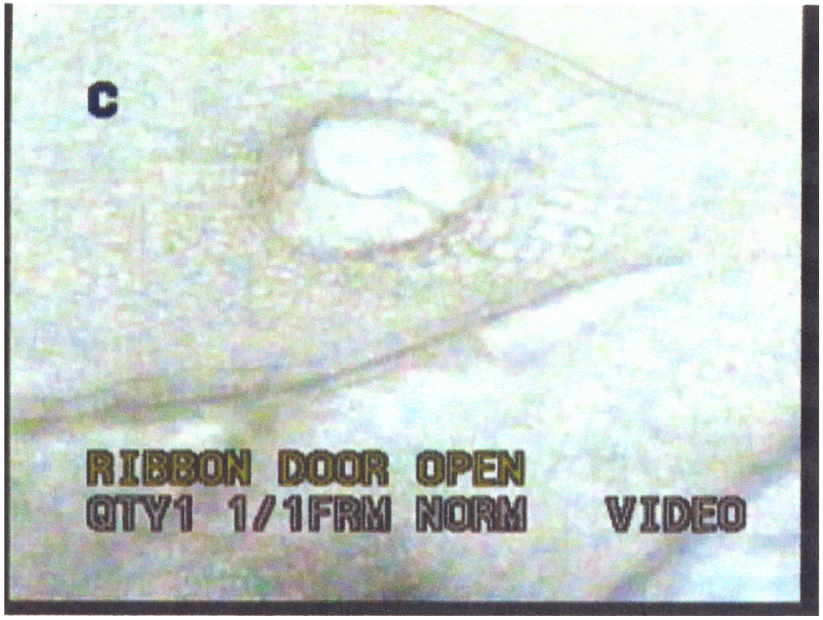
Production of apomictic clones

Their Evaluation and Development



NASSAR, N. M. A 2005b. Microsatillite markers confirm high apomixis level in cassava inbred lines. **Hereditas 142:1-5.**

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Course by Nagib Nassar

I 4. **Contin...** Development of interespecific hybrids

2. Breeding cassava for higher protein content

Average protein and fibre percentages in the roots of cassava species on a dry matter basis

Species	Crude protein %	Crude fibre %
M. oligantha subsp. nesteli	7.10 ± 0.58	26.67 ± 4.86
M. tripartita	6.88 ± 1.48	33.48 ± 6.36
M. anomala	3.74 ± 0.63	23.44 ± 4.82
M. zehntneri	3.06 ± 0.82	21.52 ± 4.84

Hydrocyanic acid content of unpeeled wild Manihot species root

Species	HCN content in fresh tuber (mg/kg)	HCN content on dry matter basis (mg/kg)
M. tripartita Mueller	238.1a	657.2b
M. anomala Pohl	199.2a	1026.3a
M. zehntneri Ule	125.8b	504.2b
M. gracilis Pohl	97.2c	291.2c
M. oligantha Pax, emend. Nassar subsp. nesteli	62.3d	183.2d

a-d Means within a column followed by the same letter are not significantly different by Duncan's multiple range test (P=0.5).

NASSAR, N.M.A & DOREA G. 1982. Protein contents of cassava cultivars and its hybrid with *Manihot* species. **Turrialba, 32(4):429-32.**

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NASSAR, N.M. A . 1986 c.Genetic variation of wild *Manihot* species native to Brazil and its potential for cassava improvement. **Field Crops Research, 13:177-84.**

Course by Nagib Nassar

Hybrid ICB 300

NASSAR, N. M. A. ; JOSE, G. N. . Protein Content Of Cassava Cultivars And Its Hybrid With Wild Manihot Species.. TURRIALBA, Turrialba, v. 32, n. 4, p. 429-432, 1982.

Contin... Hybrid ICB 300

Table 1. Protein content of tubers of cassava clones.

Clone	Approximate size	Protein in peel %	Protein in pulp %
CBM 0206	200 g	2.13	0.90
	50 g	2.09	1.25
EAB 348	200 g	1.41	0.85
	50 g	1.89	1.04
BGM 188	200 g	—	—
	50 g	1.68	1.45
CPM 0231	200 g	—	—
	50 g	1.56	1.26
CPM 2002	200 g	—	—
	50 g	2.08	0.99
CPM 0232	200 g	2.00	1.02
	50 g	1.82	1.15
BGM 808	200 g	1.63	0.93
	50 g	—	—
CPM 0225	200 g	1.38	0.89
	50 g	1.25	0.95
BGM 204	200 g	1.24	1.06
	50 g	—	—
CPM 1805	200 g	1.14	0.72
	50 g	1.37	1.00
EAB 1156	200 g	1.58	0.84
	50 g	1.28	1.16
EAB 484	200 g	1.96	1.07
	50 g	—	—
BGM 048	200 g	1.41	0.82
	50 g	1.11	1.17
BGM 020	200 g	1.80	0.98
	50 g	1.53	1.23
CPM 1060	200 g	—	—
	50 g	1.58	1.19
EAB 675	200 g	1.36	0.70
	50 g	1.51	0.93
Hybrid	200 g	6.63	4.56
	50 g	8.06	4.56

NASSAR, N. M. A. ; JOSE, G. N. . Protein Content Of Cassava Cultivars And Its Hybrid With Wild Manihot Species.. TURRIALBA, Turrialba, v. 32, n. 4, p. 429-432, 1982.

Contin.. Hybrid ICB 300 - Amino acids content

Samples

	UnB 1 Rootz	ICB 300 root (sample code 3)	Progeny no 10 root	Progêny no. 4 root	Progeny no.9 root 9	ICB 300 root (sample code: diplod)
AA	**g/100 g of sample**	**g/100 g of sample**	**g/100 g of sample**	**g/100 g of sample**	**g/100 g of sample**	**g/100 g of sample**
Ala	0,020	0,093	0,017	0,019	0,040	0,098
Arg	0,037	0,261	0,061	0,082	0,320	0,108
Asp	0,016	0,146	0,023	0,033	0,052	0,137
Cys	0,027	0,029	0,026	0,025	0,026	0,025
Glu	0,039	0,222	0,044	0,065	0,151	0,221
Gly	0,012	0,078	0,012	0,015	0,037	0,075
His	0,000	0,038	0,010	0,010	0,027	0,036
Ile	0,008	0,068	0,010	0,010	0,018	0,069
Leu	0,016	0,131	0,013	0,000	0,041	0,127
Lys	0,010	0,098	0,020	0,019	0,034	0,079
Met	0,014	0,041	0,004	0,000	0,019	0,037
Phe	0,016	0,129	0,058	0,000	0,065	0,120
Pro	0,000	0,054	0,000	0,000	0,000	0,066
Ser	0,012	0,088	0,013	0,018	0,033	0,078
Thr	0,008	0,061	0,007	0,013	0,022	0,066
Tyr	0,000	0,000	0,000	0,000	0,000	0,000
Val	0,019	0,115	0,027	0,025	0,039	0,112
Total	**0,254**	**1,654**	**0,344**	**0,336**	**0,922**	**1,454**

NASSAR, N. M. A. ; SOUZA, M. . Amino acid profile in cassava and its interspecific hybrid. Genetics and Molecular Research, v. 06, p. 192-197, 2007. http://www.geneconserve.pro.br/artigo_35.htm

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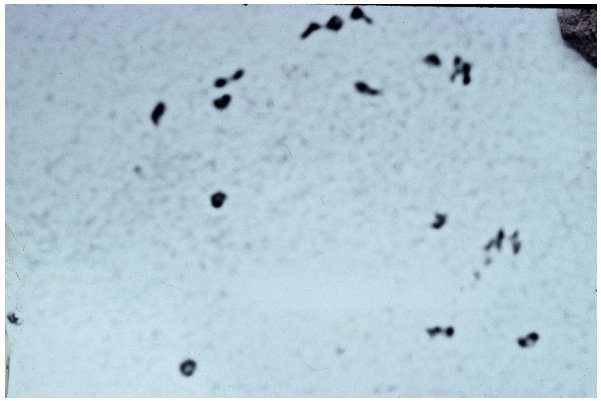
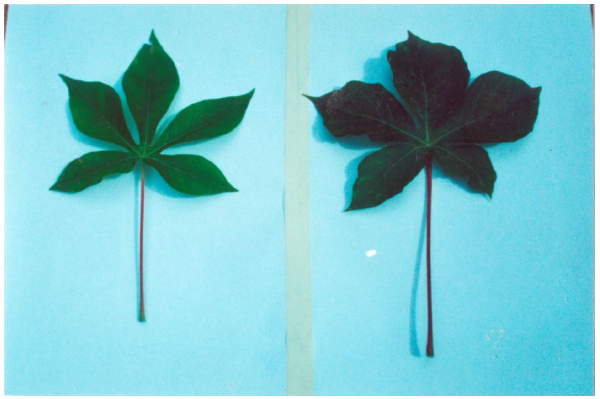
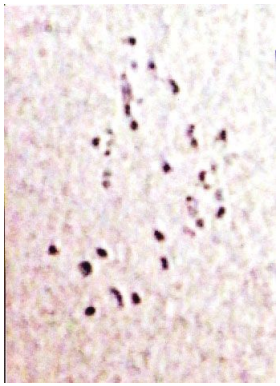
I 4. contin... Development of interespecific hybrids

Poliploidizing the interespecific hybrids

M. glaziovii, diploid (left), poliploid (right)







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NASSAR, N. M. A. (2006). The synthesis of a new cassava-derived species Manihot vieiri **Nassar. Genet. and Mol. Res. 5: 536-541.**

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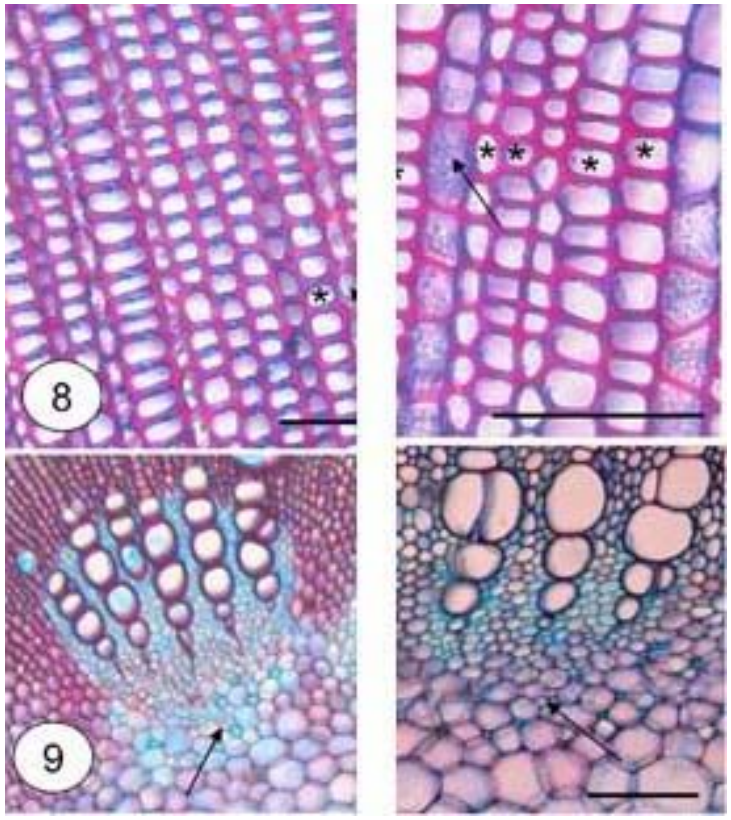
Chimera formation



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http://www.geneconserve.pro.br/gmr399.pdf

Course by Nagib Nassar

II Indigenous cassava clones

II 1. Selection for high B-carotene clones

Table 1. Quantification (μg/g of tissue) of lutein, *trans*-β-carotene and *cis*-β-carotene of some manihot cultivars organs.

	Lutein	*trans*-β-carotene	*cis*-β-carotene
Roots			
Pohli	-	0.16	0.09
UnB-400	236.83	1.24	0.96
ICB-300	-	0.19	0.12
Leaves			
Poli	782.15	13.85	2.37
UnB-400	3081.69	24.12	3.28
ICB-300	9108.98	18.02	1.88

NASSAR, N. M. A. , C. S. Vizzotto, H. L. da Silva, C. A. Schwartz, O. R. P. Junior (2005). Potentiality of cassava cultivars as a source of carotinoids. **JFAE 3:33-35.**

http://www.geneconserve.pro.br/artigo_26.htm

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II Selection for rich in lycopene clones

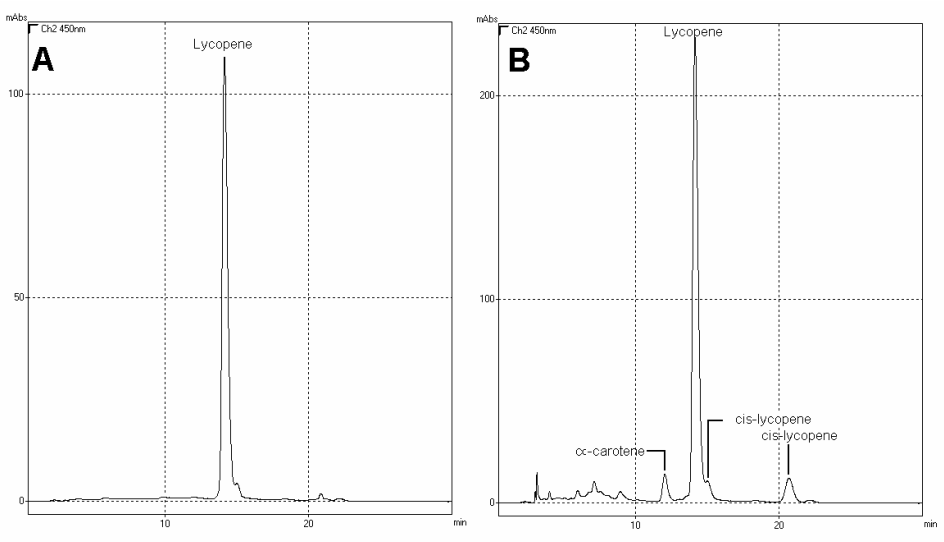

Figure 1. Chromatogram profile of (A) lycopene and (B) cassava clone, showing peaks of trans-α-carotene, lycopene and cis lycopene. HPLC analysis conditions: RP column C18 Vydac 218TP54 column 250x4.6 mm, mobile phase 100% MeOH, flow 1.0 ml/min.

NASSAR, N. M. A. ; C.Vizzotto ; C.Schwartz ; pires junior . Cassava diversity in Brazil:the case of carotenoid-rich landraces. Genetics and Molecular Research, v. 06, p. 116-121, 2007.

http://www.geneconserve.pro.br/artigo_31.htm

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Cassava hybrids to improve livelihood of small farmers

For more informations consult

www.geneconserve.pro.br

Thank You