Study of Gene Flow in *Manihot* in Brazil: Allowances for Risk Analysis



Cartagena de Indias, Colombia, June 2012

Component 1: Strengthening technical capacity in knowledge generation for biosafety risk assessment and management

Lead Scientist: Carlos Alberto da Silva Ledo

Institution: Embrapa Cassava and Fruits

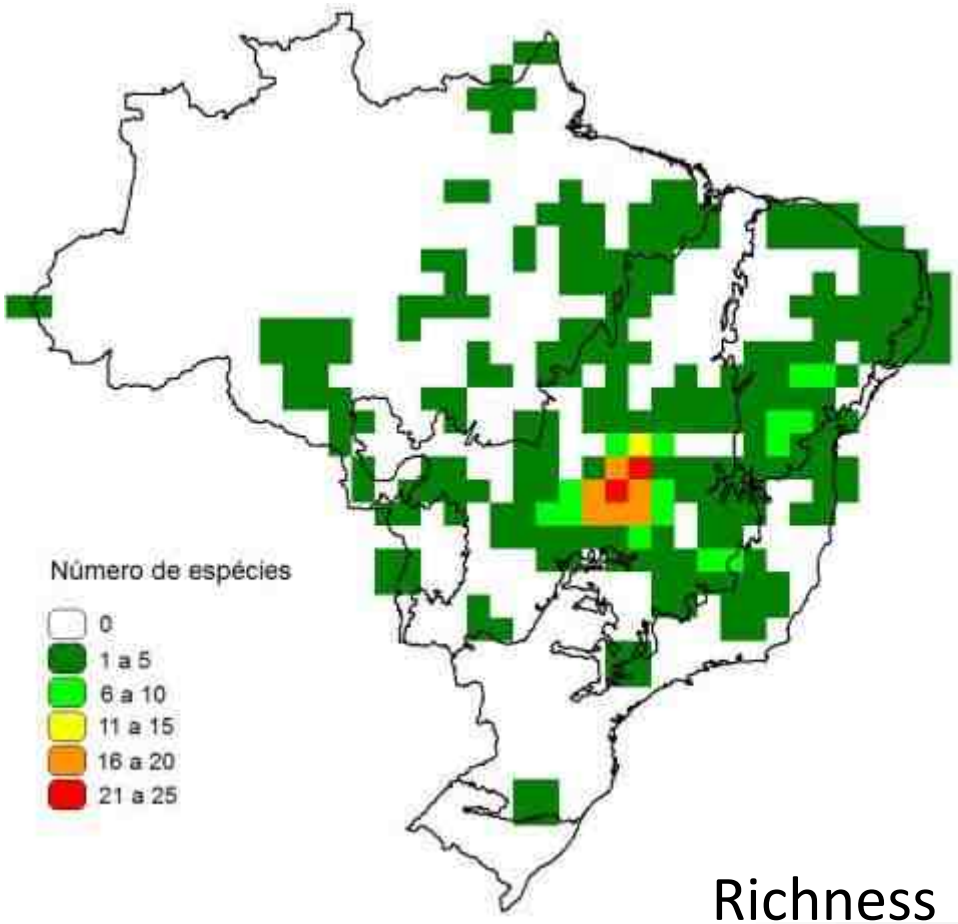
Collaborating Institution: CIAT, UFRB

Staff: Genetics and Plant Breeding, Cell Biology and Plant Tissue Culture, Plant Disease Management, Crop Management, Remote Sensing, Plant Genetic Resources, Biotechnology

Genus *Manihot*

- 98 species
(Rogers and Appan, 1973)

- 75 brazilian species



Richness

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General Objective

This subproject aims to study aspects of the biological reproduction of *Manihot esculenta* and wild relatives that are phylogenetically close to help analyze the risk of genetic contamination between genetically modified crops and wild *Manihot* species in Brazil

Specific Objectives

1. Generate an up-to-date map of the geographic distribution of *Manihot* species in Brazil
2. Collect visiting insects and identify effective pollinators
3. Assess yield, viability and pollen grain conservation in *Manihot* species
4. Generate inter-specific hybrids between *Manihot esculenta* and wild cassava species
5. Evaluate voluntary plants in commercial plantations of *M. esculenta*

Results

1. Generate an up-to-date map of the geographic distribution of *Manihot* species in Brazil

- Herbariums

  ALCB, ASE, CEN, CEPEC, CPAP, CVRD, EAC, ESA, FLOR, FURB, HAS, HB, HERB, HPBR, HPUC, HST, HUEFS, HUFU, HVASF, ICN, IMA, IPA, MBML, NY, PEUFR, RB, SP, SPF, UFP, UNB e VIES, F, FM and K

- Bibliographic literature

- Locations georeferenced in germplasm collection

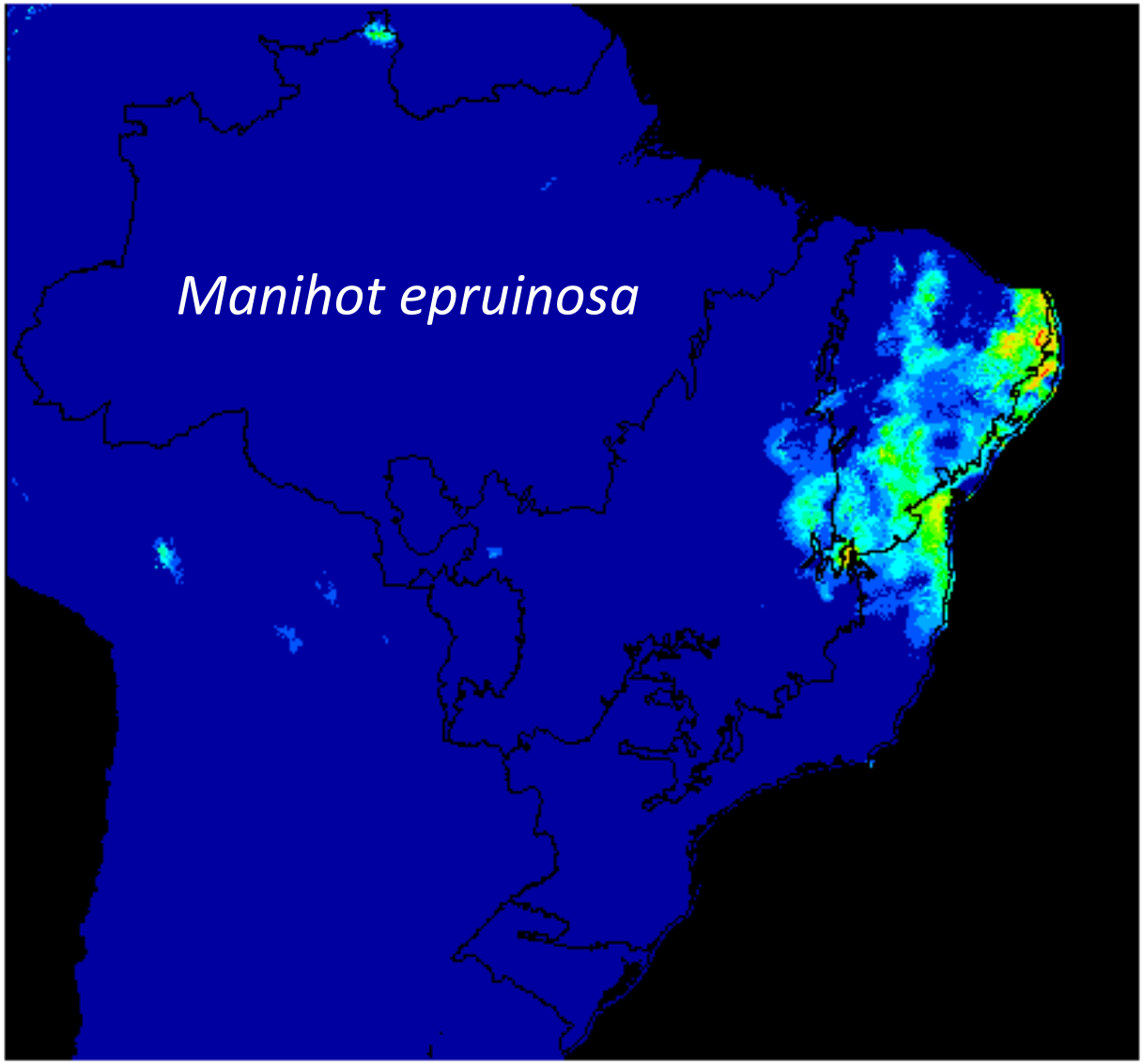
Results

1. Generate an up-to-date map of the geographic distribution of *Manihot* species in Brazil

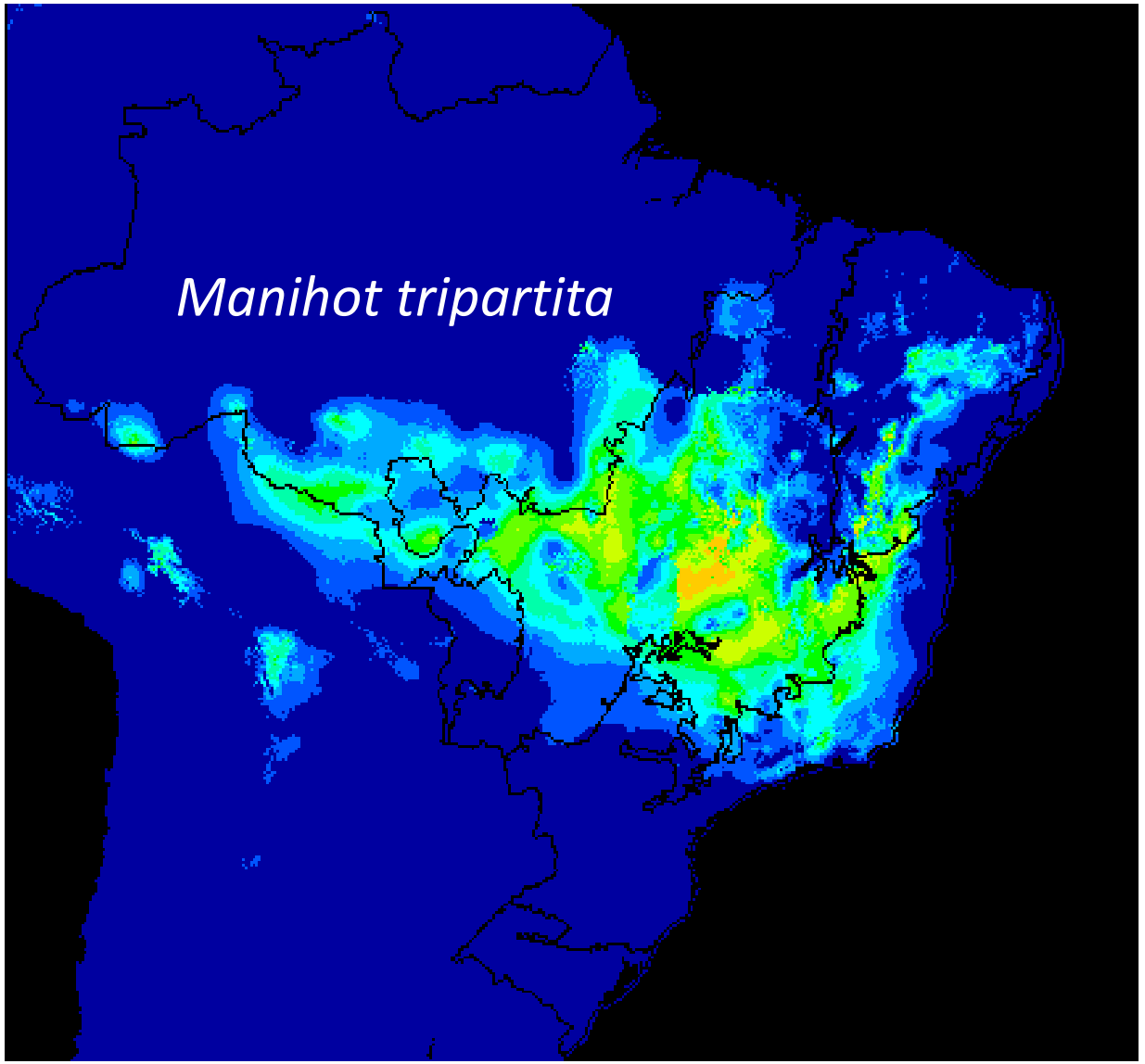
- data from 75 brazilian wild species
- 3500 records

M. acuminatissima, M. anomala, M. brachyandra, M. caerulescens, M. carthaginensis, M. compositifolia, M. diamantinensis, M. dichotoma, M. grahamii, M. hassleriana, M. inflata, M. jacobinensis, M. janiphoides, M. jolyana, M. leptopoda, M. maracasensis, M. paviaefolia, M. pentaphylla, M. reniformis, M. tripartita and more 8 new species

Results



Results



Results

2. Collect visiting insects and identify effective pollinators

- 825 insects were collected represented by 6 orders:
  Hymenoptera (89.2 %), Diptera (5.3%), Coleoptera (3.3%), Hemiptera (1.7%), Orthoptera (0.2%) and Mantodea (0.2%)

- Hymenoptera order
  Aphidae (87 %) and Vespidae (13%)

- *Apis mellifera* species (African bee) was the most frequent and most abundant insect observed in all time periods (72 %)

- *Trigona spinipes* (Abelha irapuá)

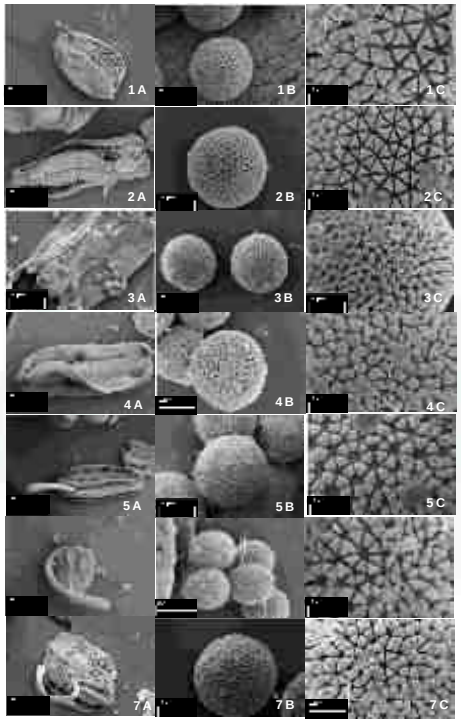
Results

2. Collect visiting insects and identify effective pollinators

Código Planta	Data	Hora	Órgão Visitado[1]	Com Pólen?	Ordem Inseto[2]	Outras observações visuais[3]
FRF- 1522- 01/ B02 - P07	22/set	09:00	FOLHA PARTE DE CIMA	NÃO	GRILO VERDE	
CTM- 02/ B05 - P22	22/set	09:05	FLOR FEMININA	SIM	ARAPUA	
CTM- 02/ B05 - P22	22/set	09:07	FOLHA PARTE DE BAIXO	NÃO	VESPA AMARELA	
CTM- 04/ B05 - P24	22/set	09:11	FLOR MASCULINA	NÃO	ABELHA	
COM- DF- 02	22/set	09:16	CAULE	NÃO	MOSCA	
A4494- 03 DF/ B15 - P15	22/set	09:20	FLOR MASCULINA	NÃO	ARAPUA	
M- 212- 02 DF/ B15 - P17	22/set	09:25	FOLHA PARTE DE BAIXO	NÃO	VESPA AMARELA	
PER- 003- 06/ B16 - P24	22/set	09:30	FLOR FEMININA	NÃO	ARAPUA	
PER- 003- 06/ B16 - P24	22/set	09:32	FLOR FEMININA	NÃO	ABELHA	
PER- 005- 07/ B20 - P19	22/set	09:43	FOLHA PARTE DE BAIXO	NÃO	JOANINHA	
PER- 005- 07/ B20 - P19	22/set	09:45	FOLHA PARTE DE CIMA	NÃO	ABELHA	
PER- 002- 13/ B16 - P13	22/set	09:47	FLOR MASCULINA	NÃO	ARAPUA	
PER- 002- 13/ B16 - P13	22/set	09:47	FLOR MASCULINA	NÃO	ABELHA	

Results

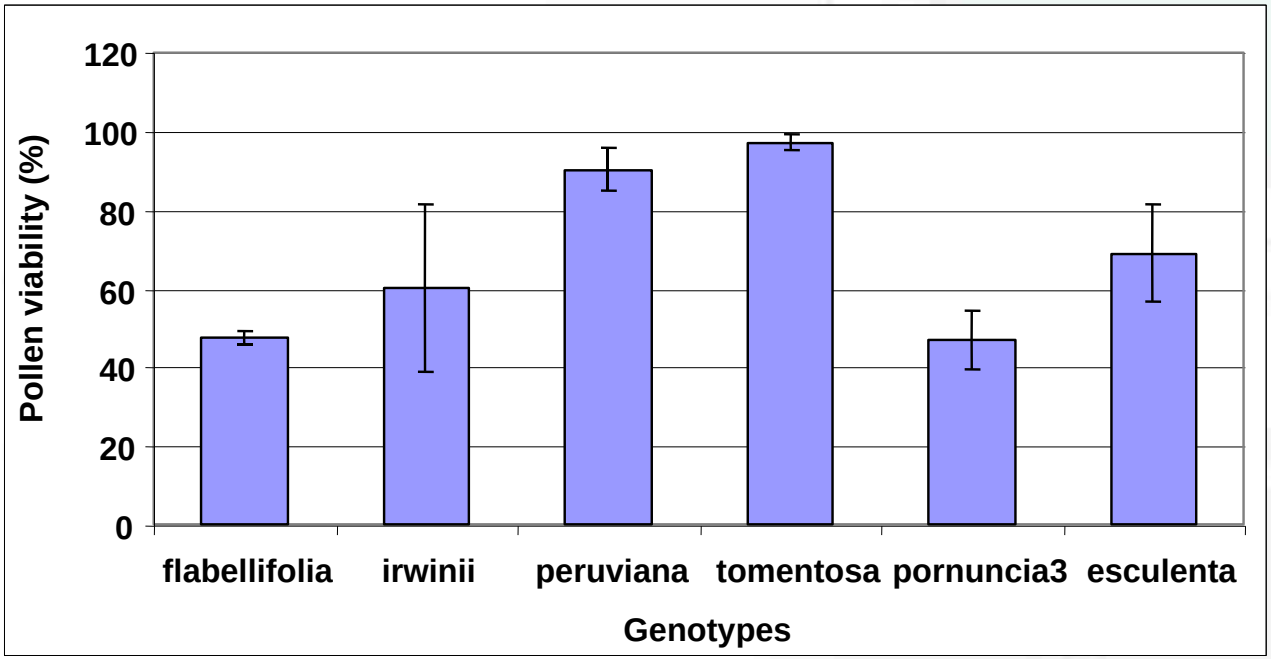
3. Assess yield, viability, and pollen grain conservation in *Manihot* species

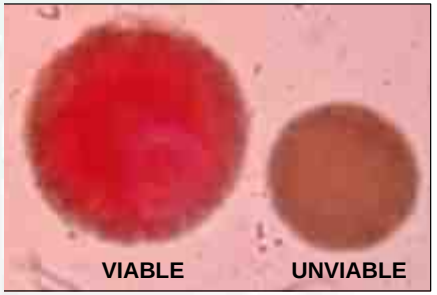


- Morphology of the pollen grains: isolated, spherical and apolar

Results

3. Assess yield, viability, and pollen grain conservation in *Manihot* species

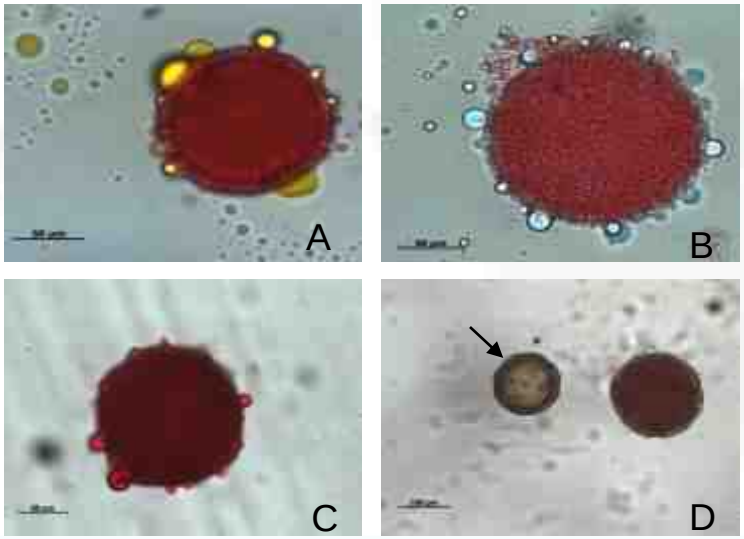




Results

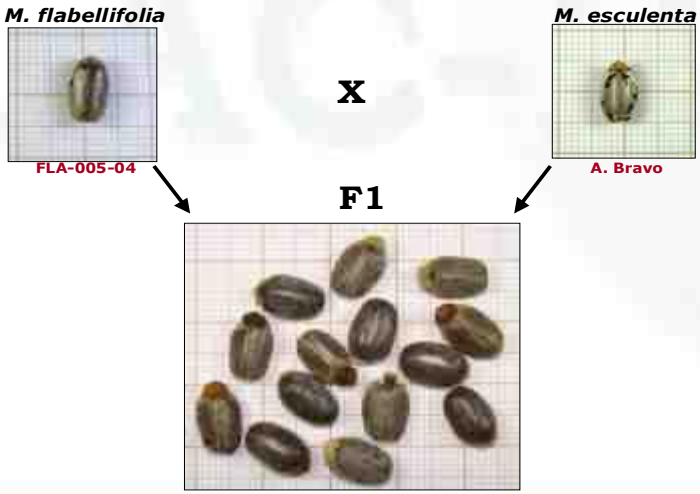
3. Assess yield, viability, and pollen grain conservation in *Manihot* species

As for the carmim acetic test, it showed that even after six months of storage the pollen grains of the accession evaluated were still moderately viable



Results

4. Generate inter-specific hybrids between *Manihot esculenta* and wild cassava species



Results

4. Generate inter-specific hybrids between *Manihot esculenta* and wild cassava species

MOTHER	X	FATHER	# Pollinated Flowers	% Fertilized Flowers	% Fruit Set	% Produced Seeds	Dehiscense (days)
Wild species (13 sp.)	X	*M. esculenta* (25 var.)	638	36.0	9.8	6.0	69
M. esculenta (14 var.)	X	Wild species (7 sp.)	147	59.2	18.4	6.8	70
TOTAL			998	39.4	11.0	6.1	70

Results

WILD SPECIES x CULTIVATED

MOTHER (wild)	X	FATHER (cultivated)	# Pollinated Flowers	% Fertilized Flowers	% Fruit Set	% Produced Seeds	Dehiscense (days)
M. anomala		*M. esculenta*	92	43.5	2.2	1.5	66
M. flabellifolia		*M. esculenta*	318	23.3	10.4	8.5	68
M. jacobinensis		*M. esculenta*	43	20.9	9.3	6.2	48
M. peruviana		*M. esculenta*	80	35.0	11.2	6.7	79
M. tomentosa		*M. esculenta*	89	76.4	10.1	4.1	81
Pornúncia		*M. esculenta*	16	18.8	6.2	0	82
TOTAL			638	34.8	9.1	6.3	71

CULTIVATED x WILD SPECIES

MOTHER (wild)	X	FATHER (cultivated)	# Pollinated Flowers	% Fertilized Flowers	% Fruit Set	% Produced Seeds	Dehiscense (days)
M. esculenta		*M. anomala*	14	50.0	14.3	0	66
M. esculenta		*M. flabellifolia*	62	66.1	35.5	15.1	66
M. esculenta		*M. jacobinensis*	20	70.0	0	0	0
M. esculenta		*M. peruviana*	15	100.0	0	0	0
M. esculenta		*M. tomentosa*	23	30.4	13.0	2.9	77
M. esculenta		*Pornúncia*	13	23.1	0	0	0
TOTAL			147	59.2	18.4	6.8	70

Results

5. Evaluate voluntary plants in commercial plantations of *M. esculenta*

In Brazilian conditions of the northeast region, where commercial varieties with low flowering are used, no voluntary plants were found in commercial plantations

Studies regarding evaluation of voluntary plants are being carried out in the mid-south region in Brazil

Partnerships at Regional Level

Universidade Federal
do Recôncavo da Bahia

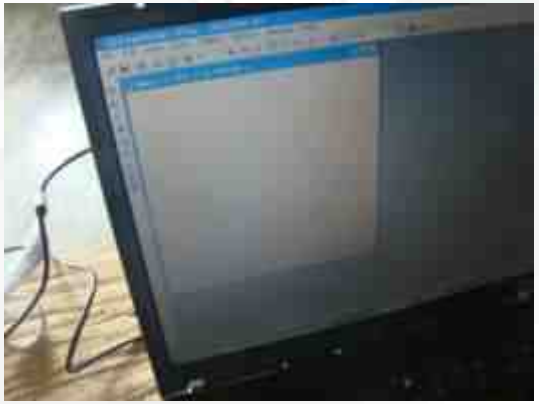
M. paludosa

A remarkable new *Manihot* (Euphorbiaceae) from the coastal sand plains of Sergipe, Brazil

Phytotaxa 32: 57–60 (2011)
www.mapress.com/phytotaxa/

M. breviloba

Training Results



Conclusion

Since Brazil is the center of diversity of the Manihot genus, the occurrence of wild species in the Cerrados biome, which represents 25% of the national territory, the occurrence of commercial plantations in most parts of these regions, the abundance of pollination vectors and high controlled crossability between wild species and commercial cultivars, genetic contamination is probable between genetically modified plantations and wild relatives of Manihot

More elaborate studies of gene flow must be carried out in order to subsidize, in a more efficient manner, use risk analysis of genetically modified cassavas in Brazil

Thank you!

Carlos Alberto S. Ledo
ledo@cnpmf.embrapa.br

http://www.cnpmf.embrapa.br