



1st Brazil U.S. Biofuels Short Course:

Providing Interdisciplinary Education in Biofuels Technologies

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Breeding, Improvement and Germplasm – *Jatropha curcas*, native species and others

Edson J Leite
Embrapa Genetic Resources and
Biotechnology
Brasília, Brazil

General Characteristics

- *Jatropha curcas* L. (Euphorbiaceae), physic or purging nut
- Geographical distribution: Mexico to Central America
- Range of genetic diversity of the species still uncertain
- Introduced in other parts of the Americas, Africa and Asia

- Adapts well to semi-arid marginal sites
- Oil can be used as a diesel fuel substitute
- Almost total lack of genetic improvement and breeding programs

- Pollination by insects
- Uncommon collecting seed from “wild” individuals. Most collecting from living fences in landholdings

- Toxic
- Medicinal
- Seed oil used formerly for soap production
- Biodiesel
- Fertilizer

Definitions in conservation of genetic resources

- **Base collection** is the largest sample of accessions stored and maintained for long time
- **Gene bank** is a subsample of a base collection from which breeders rely on for routine activities and studies
- **Prospecting** and **collecting** are planning and undertaking, respectively, of gathering germplasm for conservation and breeding

- **Germplasm** is the material basic unit of genetic variability made up by the sample's DNA
- **Accession** is the single most reliable sample of a given provenance
- **Provenance** is the place of collection of the species germplasm
- **Center of Origin** is the known place where the wild relative of the species has evolved and dispersed

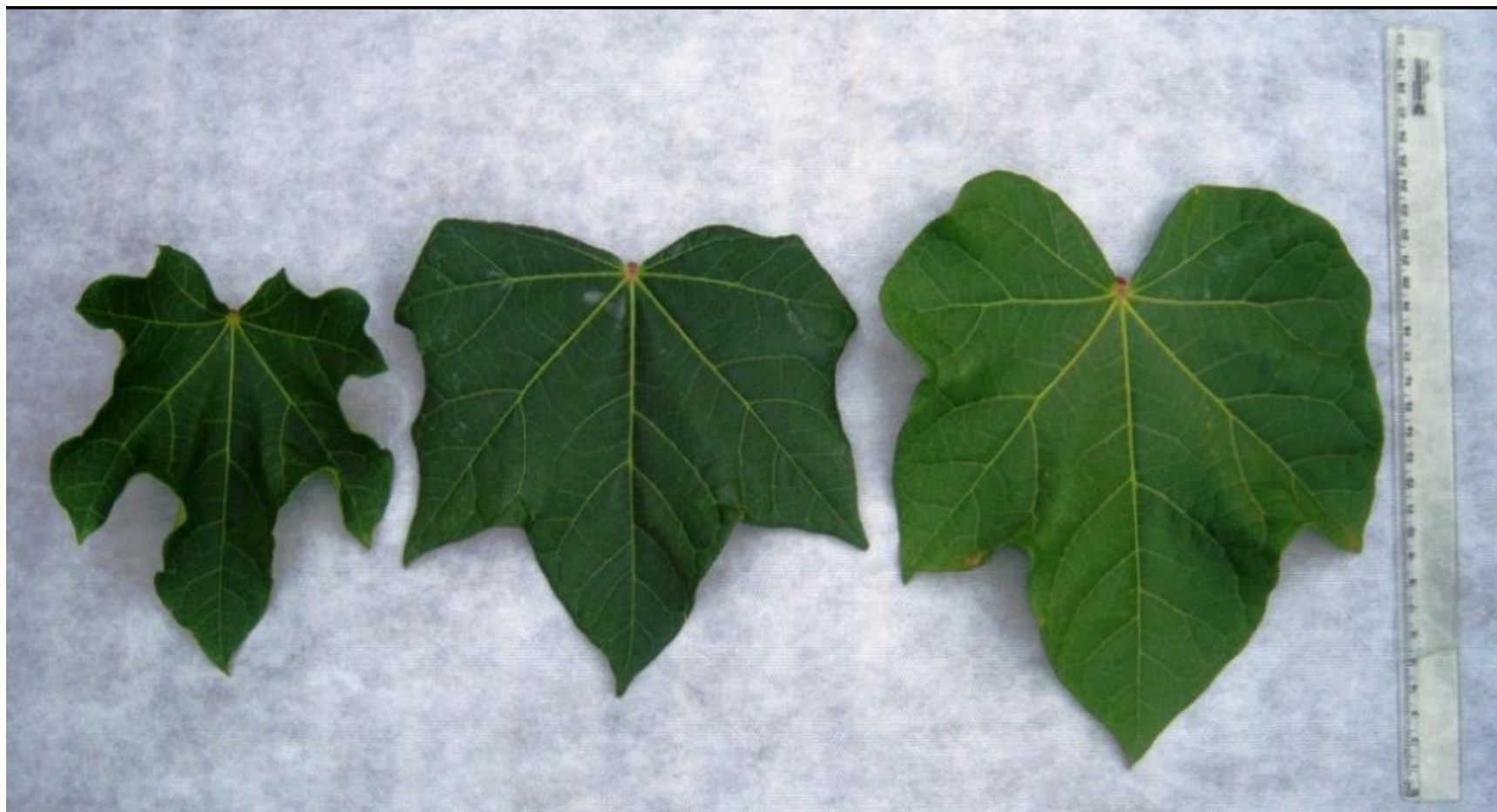
Action

Evaluation and characterization of systematically established gene banks: use of molecular tools such as RAPD and microsatellite markers.

Phenotypical traits evaluation of a gene bank at Embrapa, in Brasilia, has showed for 190 different provenances from Brazil, six diverging groups

Narrow genetic base - 92% of accessions ranked in only one group

Laviola, personal communication



Phenotypical variation in Jatropha leaves from different Brazilian provenances

Brazilian Northeast region trials

Out of ten accessions tested in semi-arid just one stood out

Accessions were the best obtained from a previous selection trial in another locality in the region

Highly significant variation in number of branches at 0.5 m of height per plant

Drumond, personal communication

Senegal trials

Provenance trials - strong GxE interaction

Plant height was not a very reliable parameter to account for adaptation of provenances to test sites

Significant differences among provenances for yield

Positive correlations between the 1000-seed weight and percentage of crude fat content was observed

Heller, 1992

Caution

It cannot simply be concluded that higher 1000-seed weight, leading to higher crude fat content, will yield more oil per hectare

Higher 1000-seed weight can also be the consequence of a low seed yield per shrub

India trials

23 provenances raised through seeds, 3m x 2m spacing of 10 plants each replication

Yield potential of different provenances collected from different parts of India, grown on wasteland, only three provenances stood out

Highly significant correlation - number of capsules/plant x number of seeds/plant and also between seed yield/plant x number of seeds/plant

Heller, 1992

Conservation and seed storage

Conservation of genetic stocks is particularly done through *on farm* approach, for most of existing populations in centers of origin are used as hedges

Seed storage of *Jatropha* follows standard orthodox behavior, but a likely primary dormancy mechanism should be more investigated in order to explain low initial germination right after harvest

Behavior of Jatropha seed stored in base collection at Embrapa, Brasilia

Accession	Germination % on 08/21/2008	Germination % on 10/30/2008	Seed moisture (%)
BRA000035	47.5	56.7	5.3
BRA000051	70	70	5.1
BRA000205	95	43.3	5.3
BRA000302	100	46.7	5.4
BRA000311	100	66.7	5.3

Recommendations to Plant Breeders

Reduced plant height to facilitate harvesting of capsules and development of non toxic cultivars, where the seed cake could be used as fodder.

Also pests and diseases prone to attack under extensive planted acreages and irregular maturation of fruits should be investigated in order to obtain varieties appropriate to alleviate such shortcomings.

Breeding method could be a simple mass selection when superior selected plants are involved.

Selection based on provenance trials should be sought after as they estimate the differences between populations or environments relative to their productivity, and allow for net gains.



Adult individual of *Jatropha*, Itapecuru-Mirim, Maranhão State.



Jatropha at 10 months old, Itapecuru-Mirim, Maranhão State.



Jatropha sample for herbarium holding, Maranhão State.



Jatropha nine-months old, Chapadinha, Maranhão. Provenance Araçaí, Minas Gerais State.



Well developed *Jatropha* individual from Araçaí provenance, State of Minas Gerais, at Chapadinha, State of Maranhão.



Dead Jatropha due to disease , Chapadinha, State of Maranhão.



Typical occurrence of Jatropha along farm fences
Minas Gerais state.



“Purple” Jatropha, *Jatropha gossypifolia*, Minas Gerais state.



Jatropha provenance test at two months after planting at Embrapa, Brasilia



Jatropha provenance test at two months after planting at Embrapa, Brasilia.



Jatropha provenance test at two months after planting and testing fertilizer input, at Embrapa, Brasilia.



Jatropha provenance test at two months after planting at Embrapa, Brasilia.



Jatropha tree originated from cutting at Embrapa, Brasilia.



Jatropha at University of Brasilia (UnB), Experimental Farm, Brasilia.



Jatropha at four months at UnB Experimental Farm, Brasilia.



Jatropha at four months at UnB Experimental Farm, Brasilia.



Vegetative propagation of Jatropha at UnB Experimental Farm, Brasilia.



Jatropha experiment four years old at UnB Experimental Farm, Brasilia.



Jatropha experiment four years old at UnB Experimental Farm, Brasilia.

Native and other species in Brazil considered for biofuel production

- Babassu, *Orbignya phalerata*
- Caiaué, *Elaeis oleifera*
- Castor Bean, *Ricinus communis*
- Moringa, *Moringa oleifera*
- Pequi, *Caryocar brasiliense*
- Oil Palm, *Elaeis guineensis* (not native)

- licuri, *Syagrus coronata*
- favela, *Cnidoscolus phyllacanthus*
- cártamo *Carthamus tinctorius*
- tucumã, *Astrocaryum aculeatum*
- macaúba, *Acrocomia aculeata*

Many Thanks

eleite@cenargen.embrapa.br