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Phenotypic Variability and Seed Yield of *Jatropha curcas* L. Introduced in Tunisia

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Marrakech, November 15th 2013

Plant Material

Eight *Jatropha curcas* accessions were introduced to Tunisia from four countries: Brazil, Suriname, Mozambique and Tanzania

- Brazil : **NMB, PAR, MGB, VFB and RSB**
- Suriname : **SUR**
- Mozambique: **MOZ**
- Tanzania : **ARU**

Experimental site

- Dissa experimental station (Gabes, Tunisia; 33° 54' N and 10° 02' E), South of Tunisia
- Area :1000 m^2,
- Altitude :44 meters
- Bioclimate: lower semi-arid
- Annual rainfall averages :130 mm / year
- Annual Potential Evapo-Transpiration (PET):1400 mm
- Annual temperature : 24,5°C
- Maximum temperatures : 34°C
- Minimum temperature : 12,8°C

Soil Characteristics

- Soil is calcimagnesic
- 15 - 35% of gypsum ($CaSO_4 2H_2O$) at depths of 50-100 cm
- 15% of Calcium carbonate ($CaCO_3$).
- Soil texture was drained and sandy; 85% sand, 10 % clay and 5 % silt.
- PH is 7,7
- Electric conductivity EC = 2,2 mS/ cm.

Irrigation Water

- Irrigation: treated wastewater
- pH= 6,9
- EC = 4,7 mS/cm,
- COD (Chemical Oxygen Demand) = 168 mgO_2/l
- BOD5 (Biochemical Oxygen Demand) = 40 mgO_2/l.
- Cl^- : 39.4 $mg.l^{-1}$
- Ca^{++}: 0.44 $mg.l^{-1}$
- Mg^{++} : 0.32 $mg.l^{-1}$
- SO_4^{2-} : 450 $mg.l^{-1}$.

Experimental protocol

- 25 plants per accession were planted in March 2008
- spacing was 2m x 3m

Studied Parameters

- Plant height (PH) was measured for each individual every year
- canopy circumference (CC) was measured in 2012
- Mature fruits were harvested and Seeds obtained were weighed every year

Morphological paramters

- Petiole length (PL),
- limb length (LL)
- limb width (LW)
- Foliar surface (FS)
- Number of nodes (NN)

Seed morphology

- Forty seeds per accession
- Seeds were photographed with a Nikon D60 camera adapted in a tripod.
- Five magnitudes in relation with morphology where obtained from each image:
  - area,
  - perimeter,
  - length/width,
  - circularity index
  - J index.

$$I = 4\pi \frac{\text{area}}{(\text{perimeter})^2}$$

$$J = \frac{\text{area (C)}}{\text{area (C)} + \text{area (D)}} x100$$

area (C) :common region and area (D): regions not shared

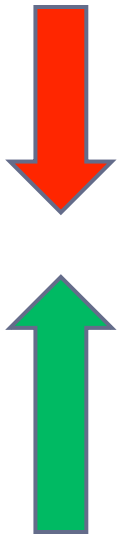
Salt conditions

March, 2013

- Installation of experimental station in the region of El Hicha (Gabes) characterized by:
- Eight plants per accession (three months)
- Salt soil: pH = 8.43
- EC = 24.9 mS/cm
- Rate of gypsum ($CaSO_4 2H_2O$) : 18.65%
- Rate of Calcium carbonate ($CaCO_3$) : 5.8%
- Irrigation with salty waters: 6g NaCl / l

Plant development

Accessions	PH						CC
	June 2008	July 2009	July 2010	July 2011	June 2012	March 2013	June 2012
NMB (n=22)	48	129	141	152	164	185	483
PAR (n=21)	38	134	144	157	164	204	474
MGB (24)	50	153	166	170	173	206	408
VFB (n=14)	32	124	138	152	153	178	368
RSB (n=22)	46	134	148	161	187	195	481
SUR (n=22)	54	147	164	176	182	204	548
MOZ (n=16)	44	150	164	178	184	211	586
ARU (n=11)	25	138	152	170	184	217	594



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seed yield

Accessions	December 2011	August 2012	November 2012	January 2013	August 2013	October 2013	total
NMB	16 (n=4)	19 (n=2)	114 (n=4)	98 (n=10)	256 (n=12)	69 (n=8)	572
PAR	35 (n=6)	112 (n=3)	0	120,6 (n=8)	199,5 (n=9)	26,7 (8)	493.8
MGB	4 (n=5)	20 (n=3)	150,6 (n=3)	101.3 (n=11)	144,4 (14)	34.7 (11)	455
VFB	7 (n=1)	15 (n=15)	0	64.2 (n=4)	211,3 (n=6)	43.6 (6)	341.1
RSB	12,5 (n=8)	53,2 (n=5)	0	112 (n=8)	215,4 (n=10)	39.5 (8)	432.6
SUR	25,3 (n=6)	43 (n=2)	0	64.4 (n=11)	90,3 (n=7)	16.7 (8)	239.5
MOZ	7,6 (n=5)	8,5 (n=4)	0	78.2 (n=8)	63,6 (n=5)	29.3 (9)	187.5
ARU	14 (n=3)	24 (n=2)	0	140.4 (n=7)	171,3 (n=8)	26.3 (7)	376

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Morphological variability

- Significant effect (P< 0,05) of accession for all five characters under study (FS, LL, LW, PL, NN).
- The eight *J. curcas* accessions showed high phenotypic diversity
- VFB forms an isolated group with higher values of LL and PL;
- MGB, have higher values of LW and FS.
- All foliar parameters are lower for MOZ.
- The highest number of nods is observed for MGB, and lowest for VFB

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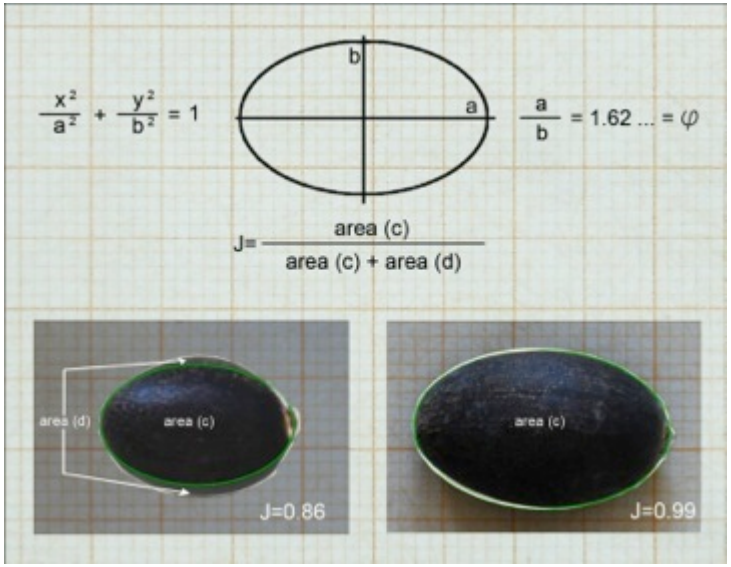
Seed morphology

- Area and perimeter were lower in seed populations obtained from SUR and MOZ, and higher in seed populations from ARU.
- Length to width ratio was lower in MOZ and higher in MGB
- Circularity index values were lower in MGB and higher in MOZ



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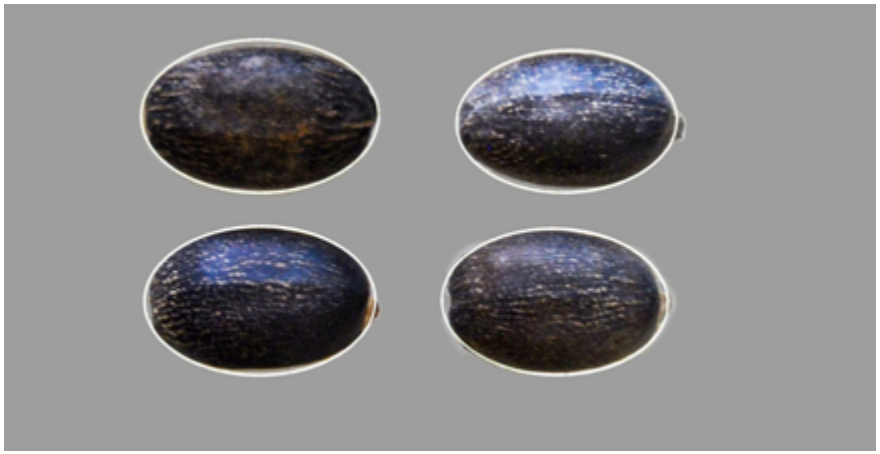
Seed morphology

- J index oscillates between 0,86 and 0,99 (0,95),
- Mean values are lower in MOZ,
- and higher in VFB and MGB.



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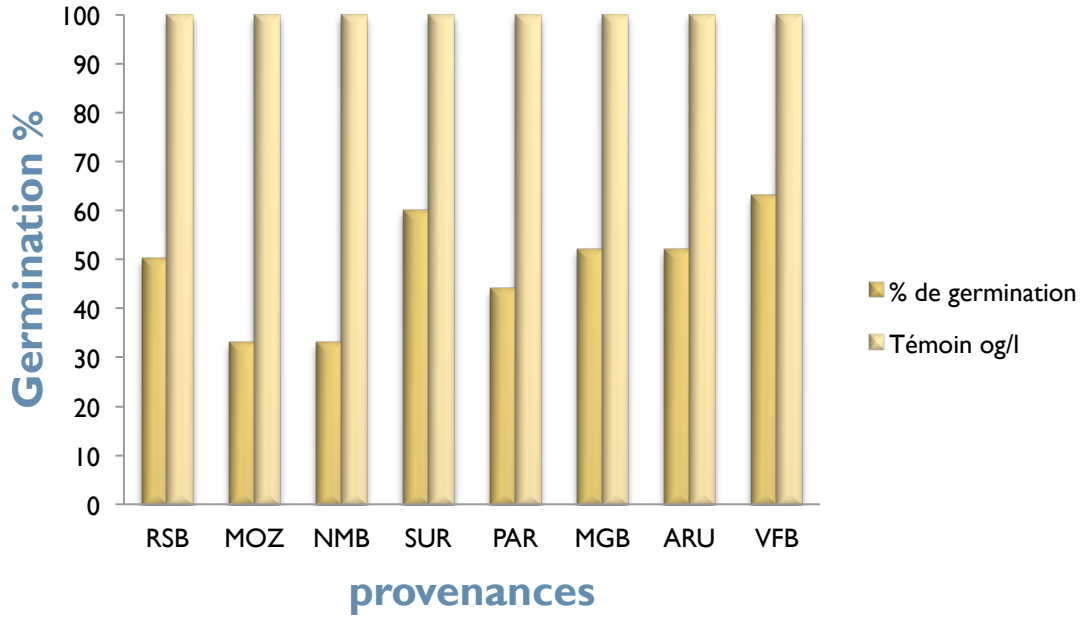
Salt tolerance
Preliminary results

- Low tolerance to salt stress
- Rate of mortality raised for MOZ et MGB
- A better tolerance for PAR et ARU
- Appearance of a disease in August, 2013, caused probably by a fungi: high rate of mortality

Test germination (9 g NaCl / l)

- MOZ % germination low
- VFB % germination elevead



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Conclusions

- Eight accessions of *Jatropha curcas* are variable
- Variability : growth, morphology and seeds yield.
- Size and shape of seeds are different between provenances,
- NMB and MGB are the most productive provenances
- MOZ and SUR are the least productive provenances
- In Gabes station, the productivity of *J. curacs* is low, in comparison with other countries (

Discussions

- MGB, VFB and MOZ showed different morphological parameters and different behavior
- high phenotypic diversity joins the result obtained in America (Ovando-Medina *et al*., 2011b, He, 2011, Brasileirio*et al*., 2013), China, India and Philippines (Gohil and Pandya, 2009, Vijayanand*et al*., 2009; Das *et al*., 2010, Zapico*et al*., 2011, Guan *et al*., 2013).
- high morphological variability does not always reflect high genotypic variability (Xu *et al*., 2012).
- the high phenotypic variability and the difference in productivity represented a good potential for early selection
- Environmental factors seem important on the behavior of the provenances
- Indeed, the productivity of *J. curcas* varies with genotypes, varieties and ecological conditions (Sosa-Segura *et al*., 2012).
- The study of the size and the shape of the seed is interesting, these parameters are in connection with the oil yield and the level of toxicity (Makkar, 2008).

Perspectives

- Follow the behavior of various provenances in the conditions of salt stress
- Study the effect of cutting on the growth and the production
- Analyze the yield in seeds oil for every provenance (Study realized by my colleagues)
- Installation of experimental station in the region of Kebili, in the Saharan conditions
- Allelopathic effect of *Jatropha curcas* on germination of cultivated species in the South of Tunisia

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