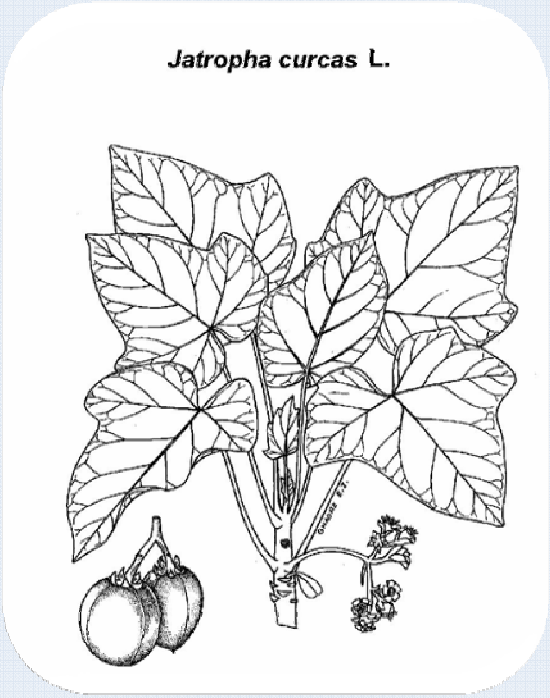
2nd JatroMed International Workshop
8 May 2014, Algiers, Algeria

JatroMed implementation in North Africa

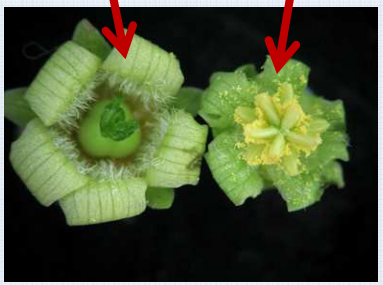


AGRICULTURAL UNIVERSITY OF ATHENS
Dr. Eleni G. Papazoglou, email: elpapazo@aua.gr

Jatropha curcas L. (physic nut, γιατρόφα)

Family: Euphorbiaceae

Perennial shrub or small tree (3-5 m in height)
Life-span more than 50 years
Semi-evergreen plant
Monoecious plant
Fruits bearing 3 black seeds
Non food crop
Seeds and oil are toxic and poisoning to humans and animals



Ecological Requirements

Survive in a wide range of environmental conditions

Soil

Marginal and unutilised soils

Best soils: aerated sands and loams

Preferred pH: 6.0 and 8.0

Temperature

Mean annual temperatures: 18-28° C,

Mean maximum temperatures: 35-45° C

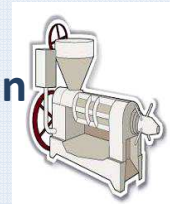
Sensitive to frost

Favorable attributes and considerable potentials

- ✓ hardiness
- ✓ drought resistance
- ✓ rapid growth
- ✓ high oil content
- ✓ low input requirements
- ✓ multiple uses

Fruits/seeds

Extraction facility



Seedcake

Crude oil

Trans-esterification

Fertilizer

Solid biomass

Animal feed

Biogas

Evaluation of the energy crop Jatropha curcas as a mean to promote renewable and sustainable energy for the Mediterranean region (JatroMed)

JatroMed is co-financed by the European Union

Reference Call for Proposals : EuropeAid/128320/C/ACT/Multi)

Title of the Call for Proposals: Thematic Programme for Environment and sustainable management of natural resources, including energy

Contract Number: 2011 / 221-037

Duration: 4years (Start Date: 28 June 2011)

Budget: 1.817.496 Euro

JatroMed CONSORTIUM

COORDINATOR:

Agricultural University of Athens-Research Committee (AUA), GREECE

PARTNERS:

1) Agricultural Engineering Unit, the Agricultural Research and Experimental Council (CRA ING), ITALY

2) City for Scientific Research and Technology Applications (MuCSAT), EGYPT

3) Centre de Développement de la Région de Tensift (CDRT), MOROCCO

4) Centre de Développement des Energies Renouvelables (CDER), ALGERIA

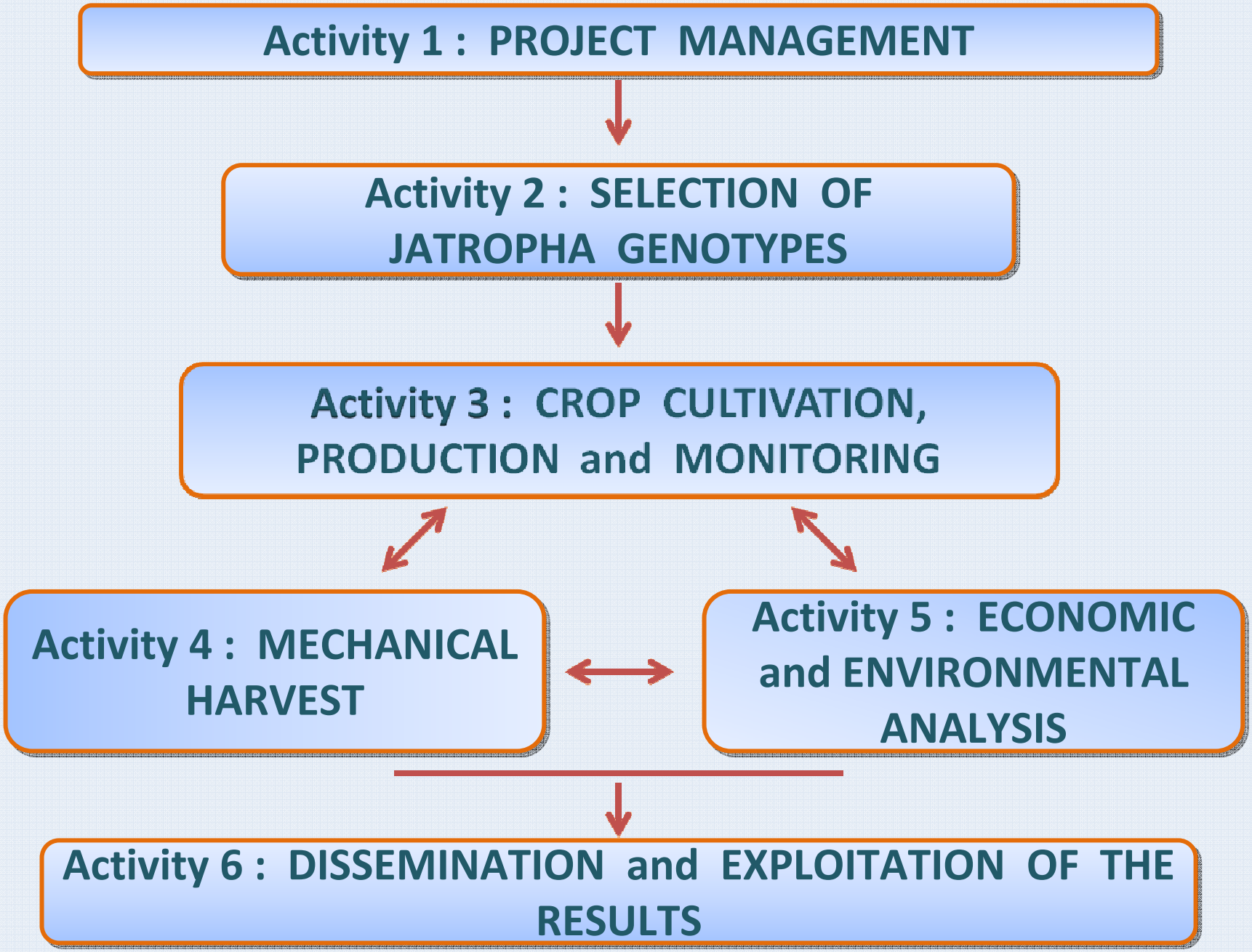
OBJECTIVES

OVERALL OBJECTIVE: promote *Jatropha curcas* production as part of the sustainable development policies/strategies, in the sectors of energy and agriculture, in undeveloped rural areas of Egypt, Morocco and Algeria

SPECIFIC OBJECTIVES:

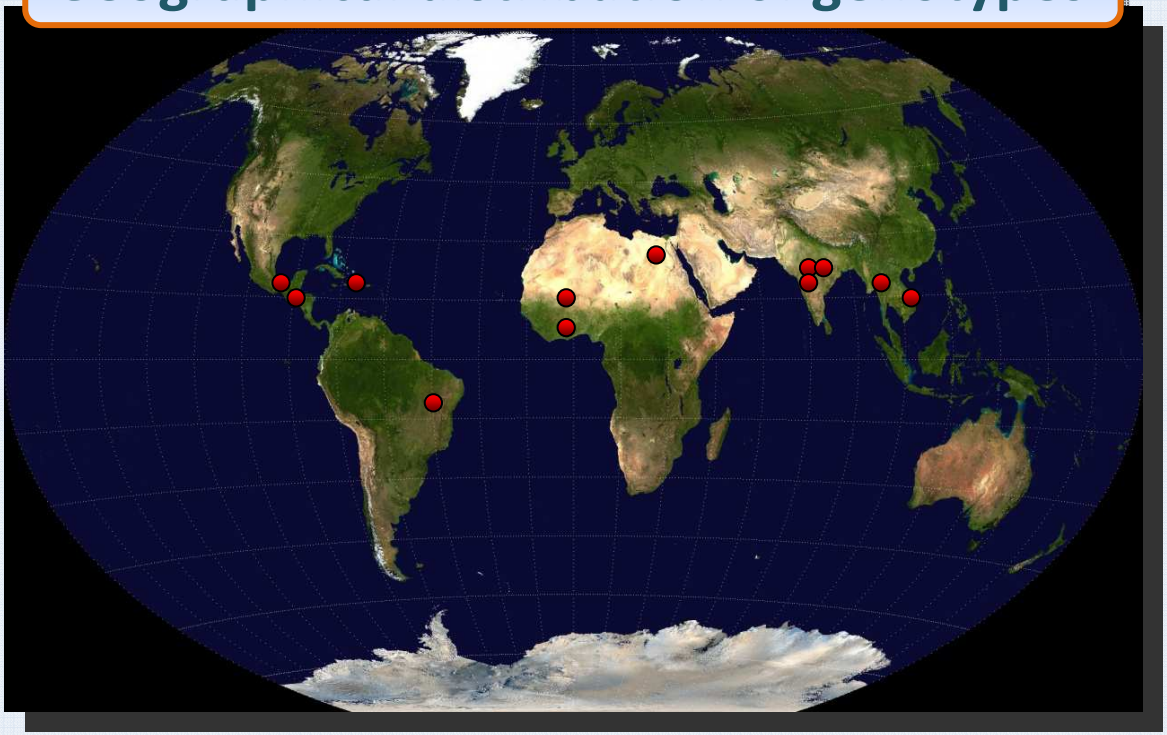
- ✓Test the adaptability and assess the agronomic potential of a wide range of genotypes of JC in demo fields
- ✓Analyze the cost/benefit of producing JC oil and of the environmental impact of Jatropha cultivation in each target country
- ✓Introduce the most suitable mechanical harvest method according to the size of the plantation
- ✓Contribute to promoting JC production, both locally, particularly in poor arid or semi-arid areas, and at the national level
- ✓Familiarise local population and stakeholders with JC crop, its management and uses

ACTIVITIES


Activity 1 : PROJECT MANAGEMENT
Activity 2 : SELECTION OF JATROPHA GENOTYPES
Activity 3 : CROP CULTIVATION, PRODUCTION and MONITORING
Activity 4 : MECHANICAL HARVEST
Activity 5 : ECONOMIC and ENVIRONMENTAL ANALYSIS
Activity 6 : DISSEMINATION and EXPLOITATION OF THE RESULTS

ACTIVITY 2: SELECTION OF *J. curcas* GENOTYPES

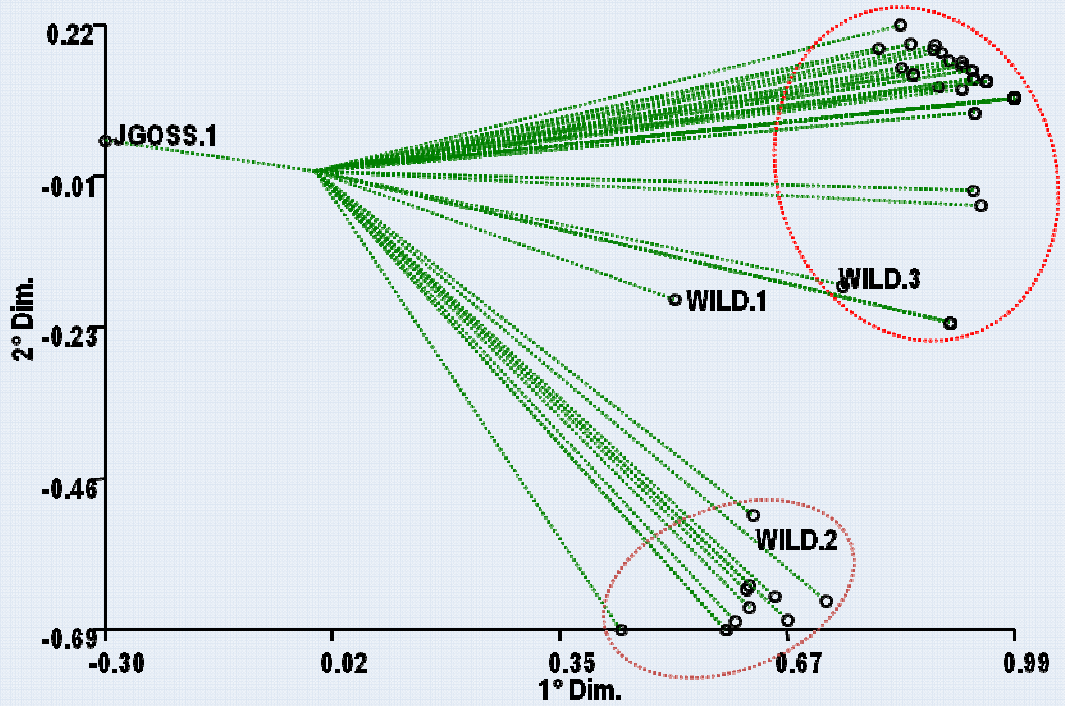
Geographical distribution of genotypes



Allocation of genotypes to target countries

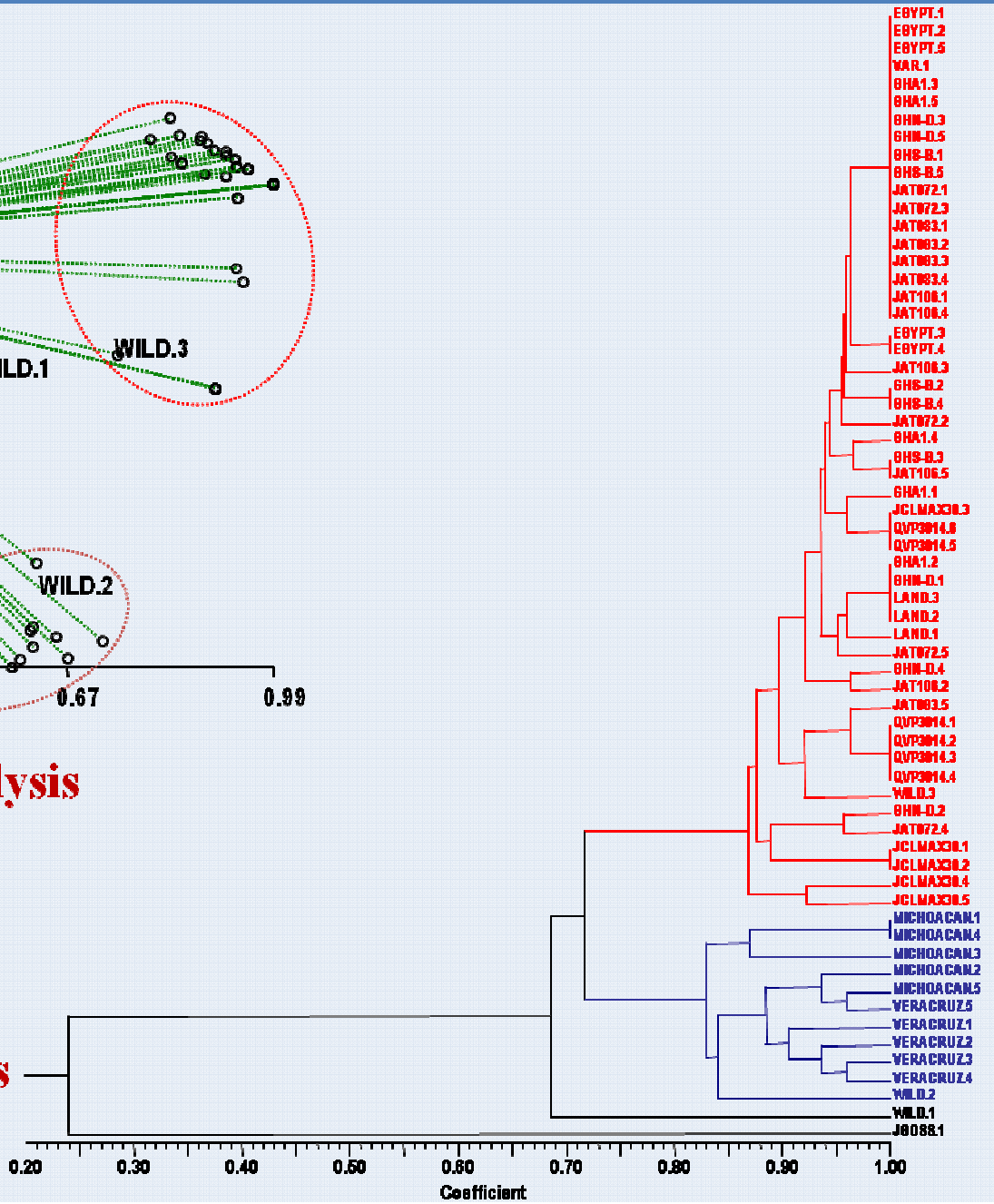
EGYPT	MOROCCO	ALGERIA
Michoacán (Mexico)	Michoacán (Mexico)	Michoacán (Mexico)
JCLMax 3.0 (India)	JCLMax 3.0 (India)	JCLMax 3.0 (India)
GHS-B (Brazil)	Mali (Mali)	Veracruz (Mexico)
JAT106 (India)	QVP 3014 (India)	GHN-D (Dominican Republic)

Genetic diversity between *J. curcas* genotypes



Principal Component Analysis

Cluster Analysis



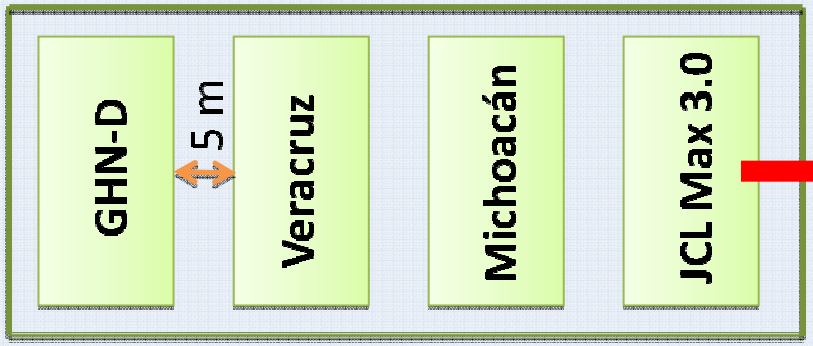
Activity 3 : CULTIVATION, PRODUCTION & MONITORING

CDRT demo field in Essaouira

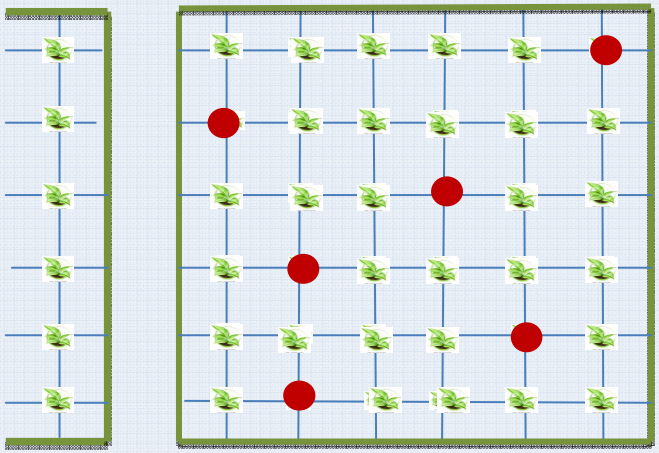
CDER demo field in Adrar

MuCSAT demo field in Borg El Arab

Activity 3: LAYOUT OF DEMONSTRATION FIELDS



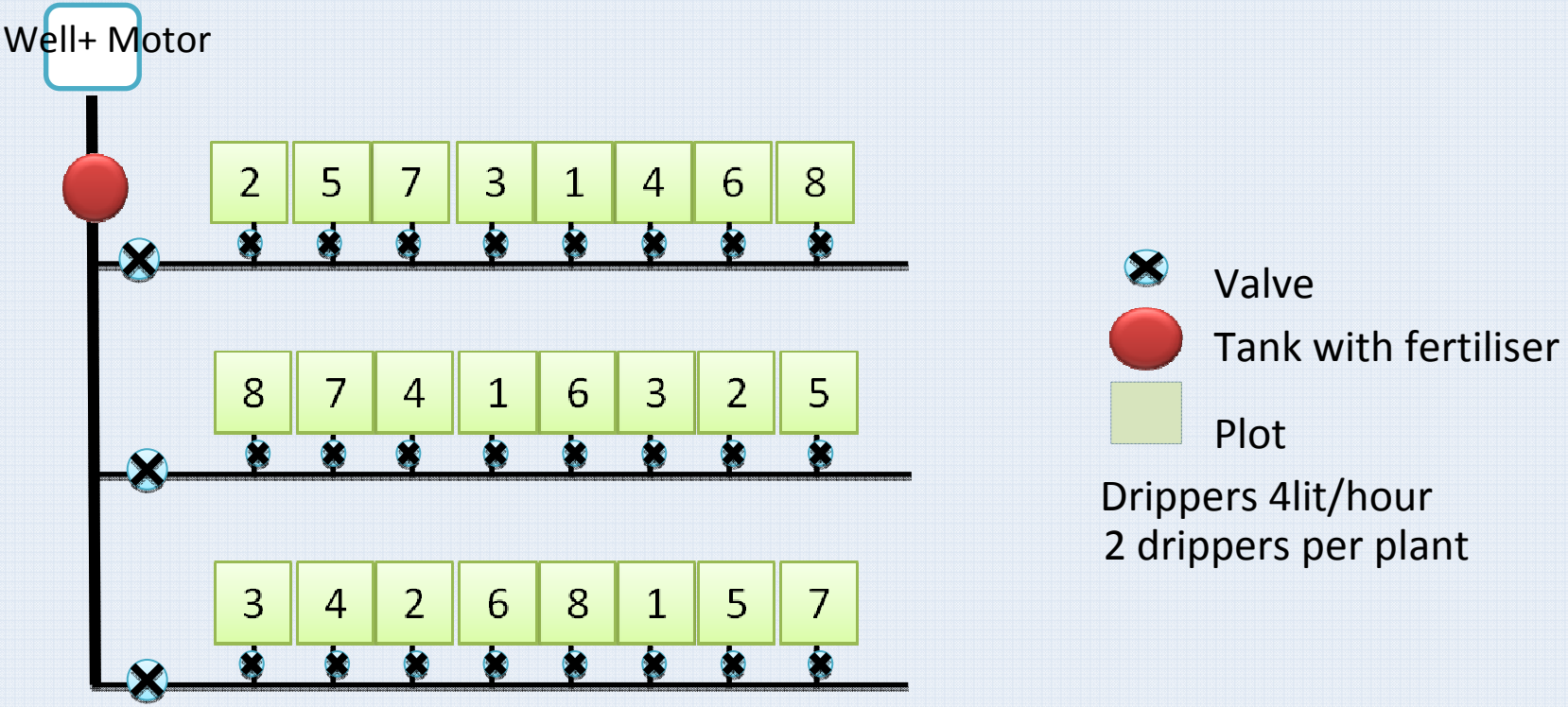
2	5	7	3	1	4	6	8	I
8	7	4	1	6	3	2	5	II
3	4	2	6	8	1	5	7	III



Measured parameters in the field: 18
Measured parameters in laboratory: 11

Activity 3: DEMO FIELDS - IRRIGATION SYSTEM

Area per country:	4 hectares
Area per genotype:	1 hectare
Number of plots per genotype:	24
Total number of plots per country:	96
Surface of each plot:	279 m^2
Number of plants per plot:	36
Number of plants per genotype:	864
Number of plants per country:	3456



Activity 3: TREATMENTS

TREATMENT A: Fertilization

Treatment A1: 10 g of urea per plant

Treatment A2: 10 g of 20 N-20 P-20 K per plant

Every month both doses will be increased by 5 g

TREATMENT B: Irrigation

Treatment B1: 4L/hour every 7 days

Treatment B2: 8L/hour every 7 days

TREATMENT C: Pruning

Treatment C1: Cup-shaped plants

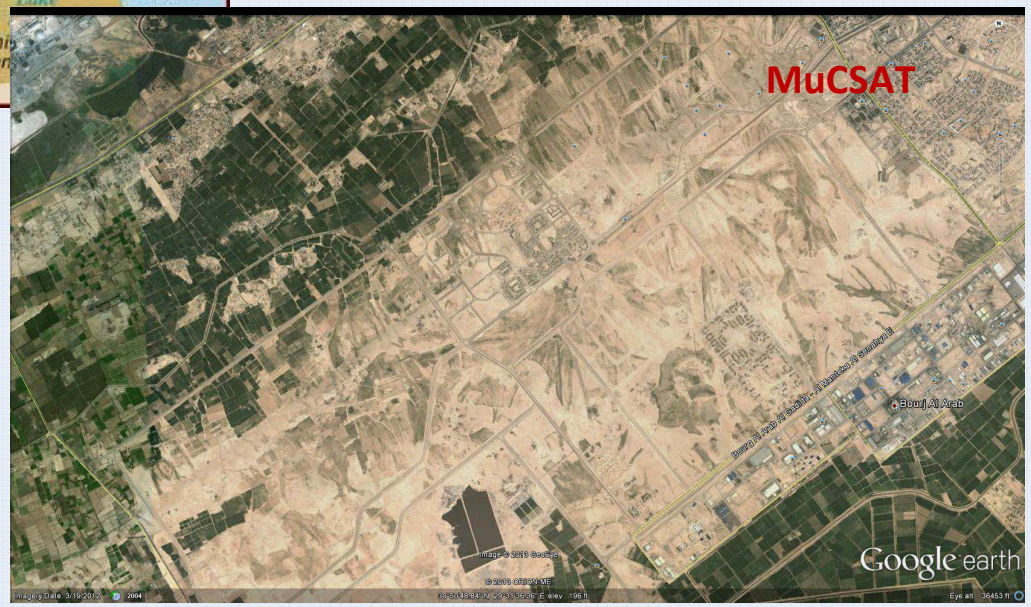
Treatment C2: Tree-shaped plants

Plots		Treatments
1	→	A1-B1-C1
2	→	A2-B1-C1
3	→	A1-B2-C1
4	→	A2-B2-C1
5	→	A1-B1-C2
6	→	A2-B1-C2
7	→	A1-B2-C2
8	→	A2-B2-C2

Activity 3: JatroMed IMPLEMENTATION IN EGYPT

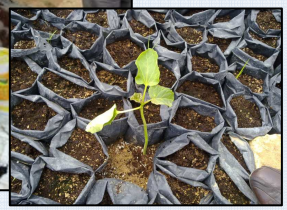
Egypt

Borg El Arab Region - 30 ° 53´ 32.13´´ N, 29 ° 32´ 54.98´´ E



Activity 3: JatroMed IMPLEMENTATION IN EGYPT

Nursery



12 January 2012

15 March 2012

23 April 2012

Activity 3: JatroMed IMPLEMENTATION IN EGYPT

Field preparation

Activity 3: JatroMed IMPLEMENTATION IN EGYPT

Transplantation

2-4 July 2012

Activity 3: JatroMed IMPLEMENTATION IN EGYPT

7 September 2012

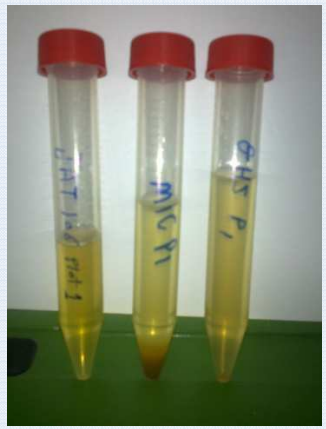
20 November 2012

Activity 3: JatroMed IMPLEMENTATION IN EGYPT



15 June 2013





15 November 2013

Activity 3: JatroMed IMPLEMENTATION IN EGYPT

C1: Cup shape

C2: Tree shape

25-26 February 2014: Second year pruning

Activity 3: JatroMed IMPLEMENTATION IN EGYPT

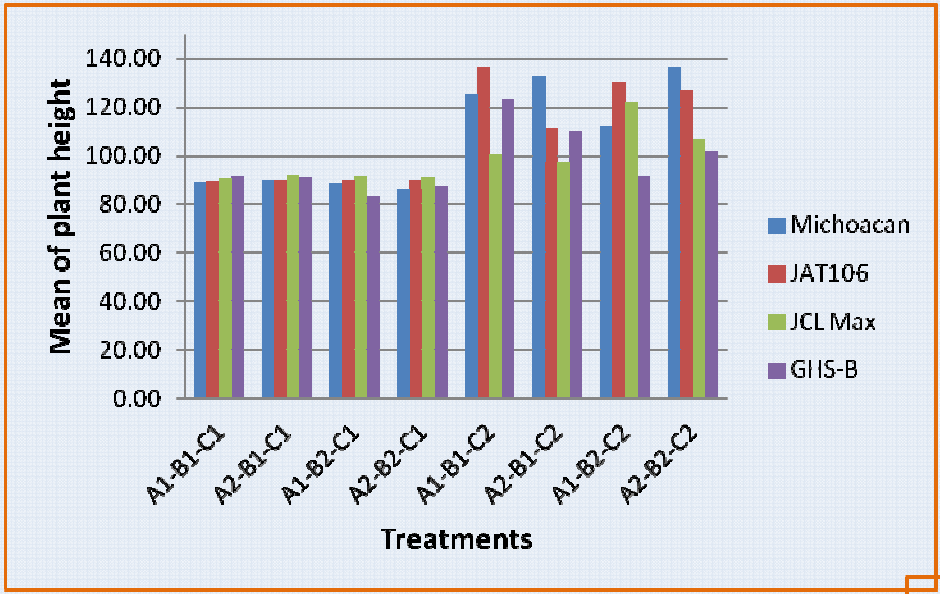
Oil extraction and analyses

	JCL Max 3.0 (%)	Michoacán (%)	GHS-B (%)	JAT-106 (%)
A1B1C1	31.78	40.11	38.37	37.58
A2B1C1	31.40	34.42	27.50	36.85
A1B2C1	37.11	37.93	36.76	32.13
A2B2C1	33.96	35.14	36.44	33.75

Oil content in seeds

Activity 3: JatroMed IMPLEMENTATION IN EGYPT

Data



TREATMENT A: Fertilization

Treatment A1: 10 g of urea per plant

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TREATMENT B: Irrigation

Treatment B1: 4L/hour every 7 days

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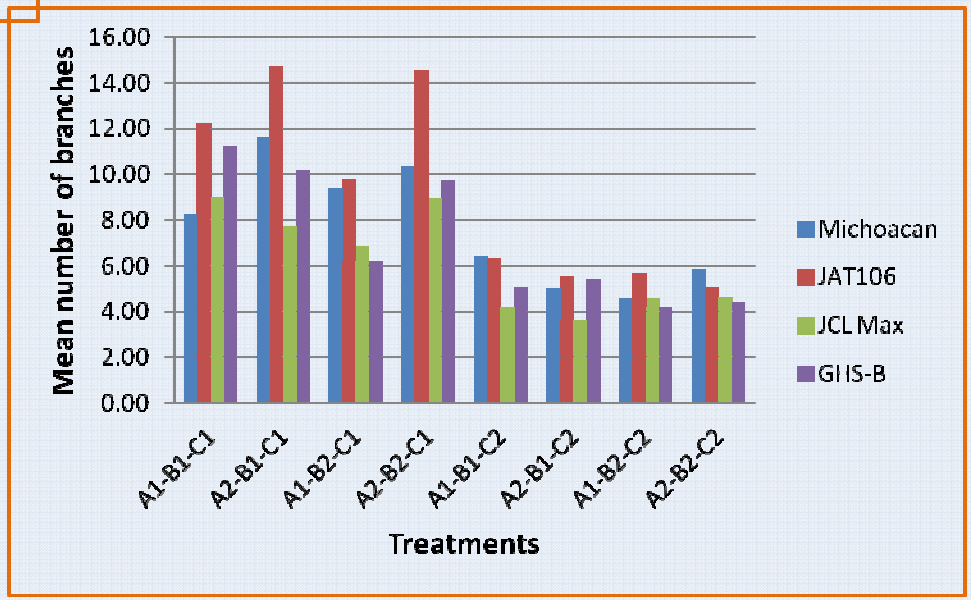
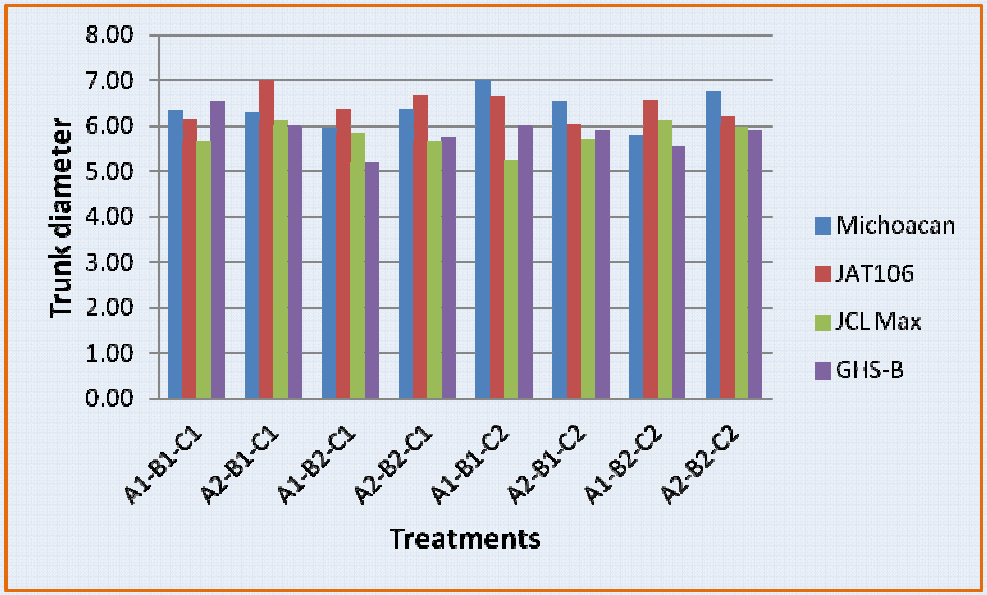
TREATMENT C: Pruning

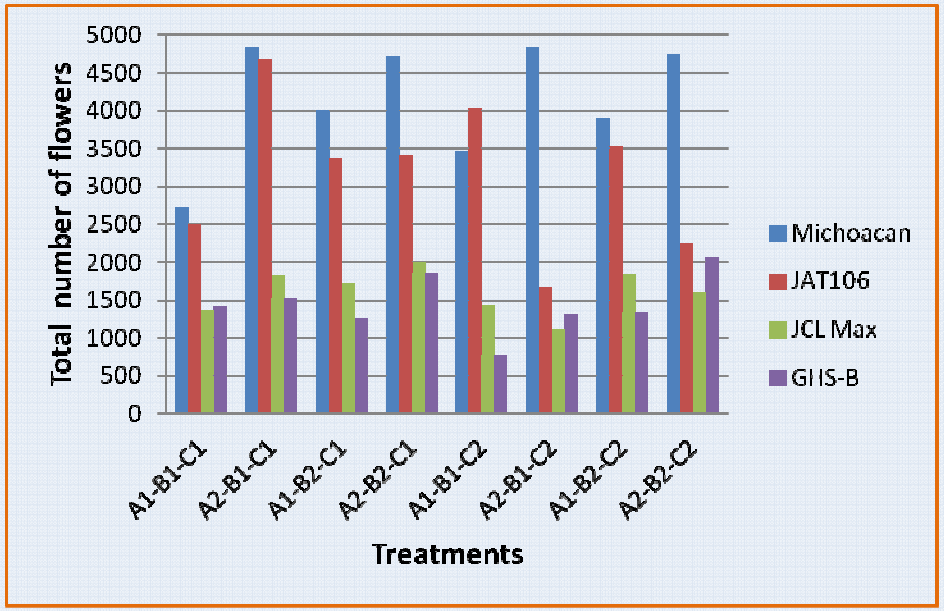
Treatment C1: Cup-shaped plants

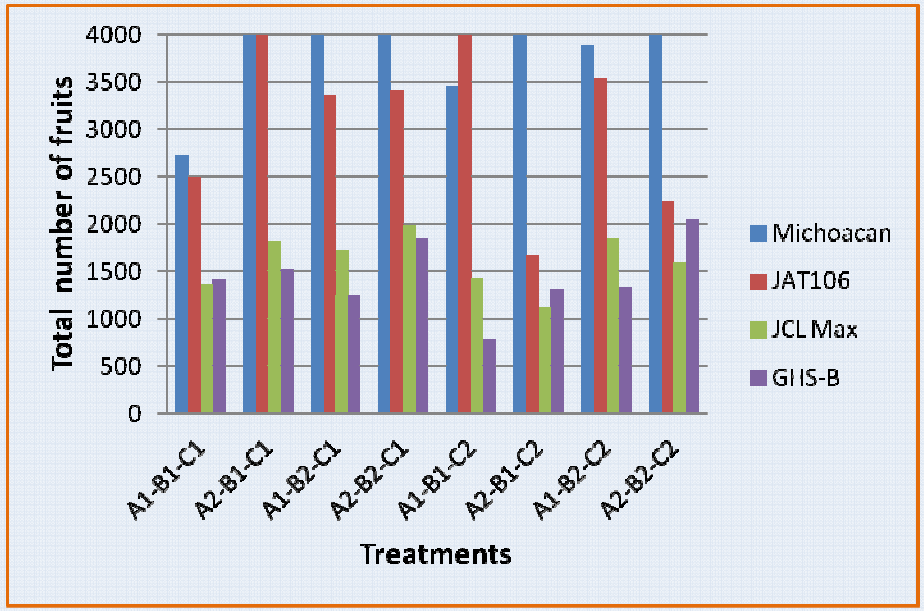
Treatment C2: Tree-shaped plants



Activity 3: JatroMed IMPLEMENTATION IN EGYPT



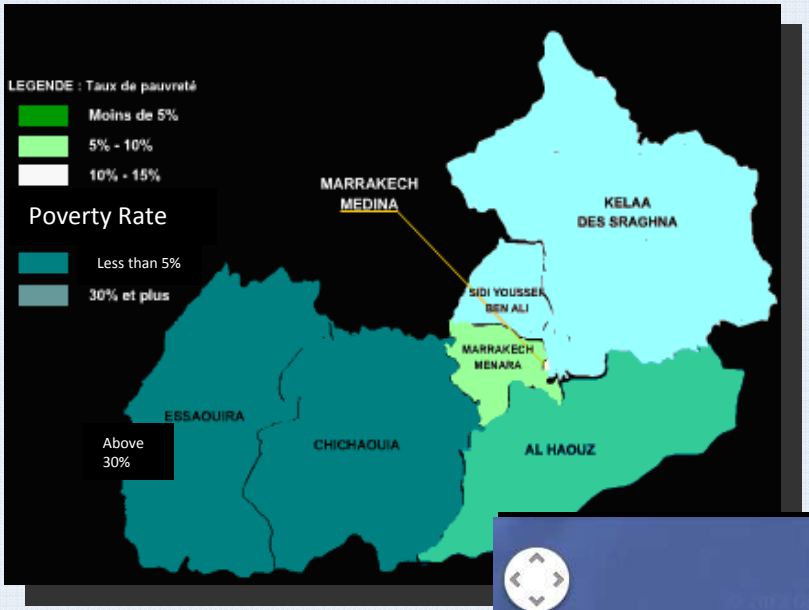




ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

Morocco

Essaouira Region: commune Hadd Dra - 31 ° 34´ 39.56´´N, 09 ° 32´ 19.45´´ W



ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

Nursery

4 March 2012

18 March 2012

18 April 2012

30 May 2012

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

Field preparation

March 2012: the demo field at the initial state

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO



Field clearing and leveling


ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

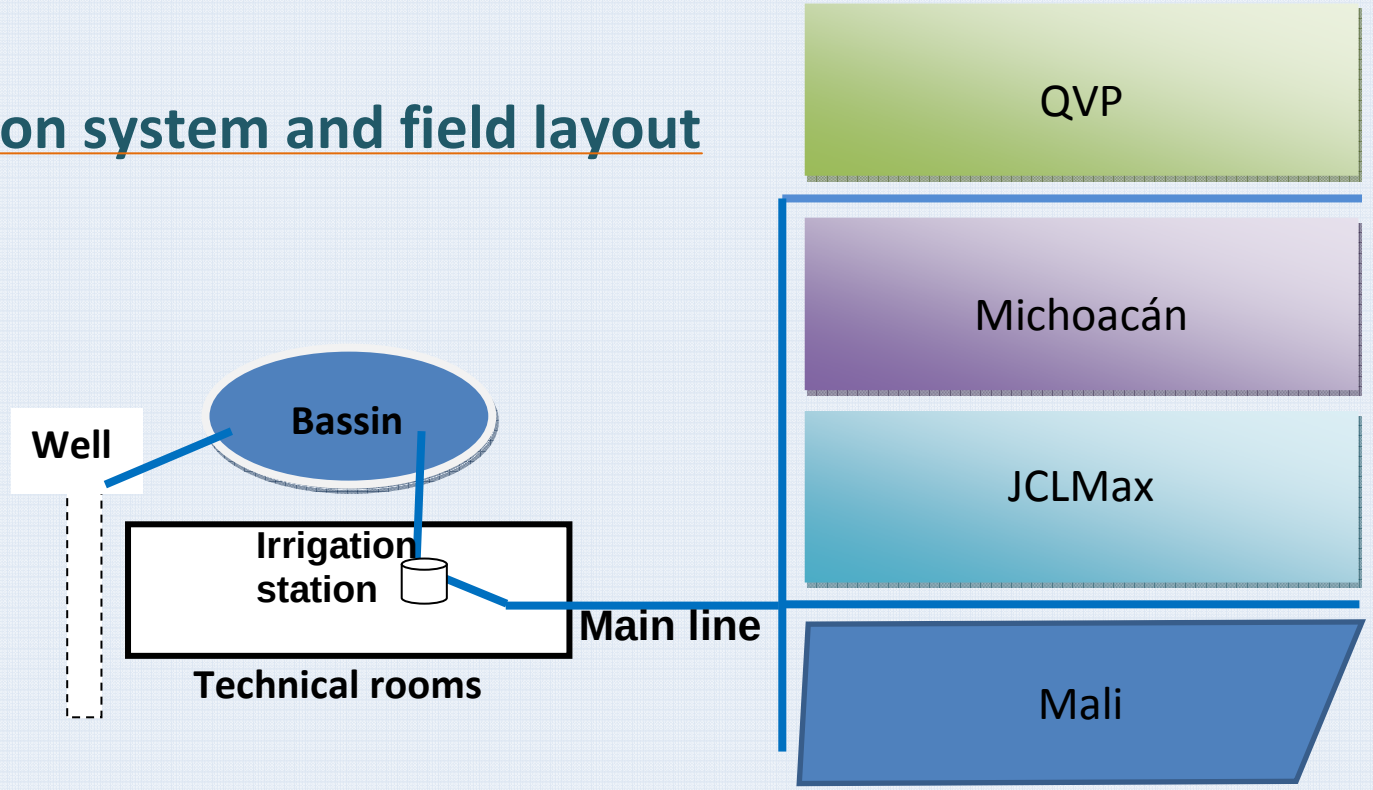


Digging the borehole


Water basin and operation room construction

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

Irrigation system and field layout



ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

Transplantation

23 September 2012

Transplantation success: 99%

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

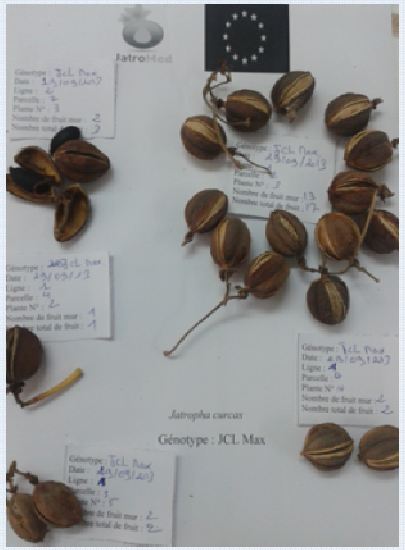
23 November 2012

17 February 2013

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

7 July 2013

29 September 2013

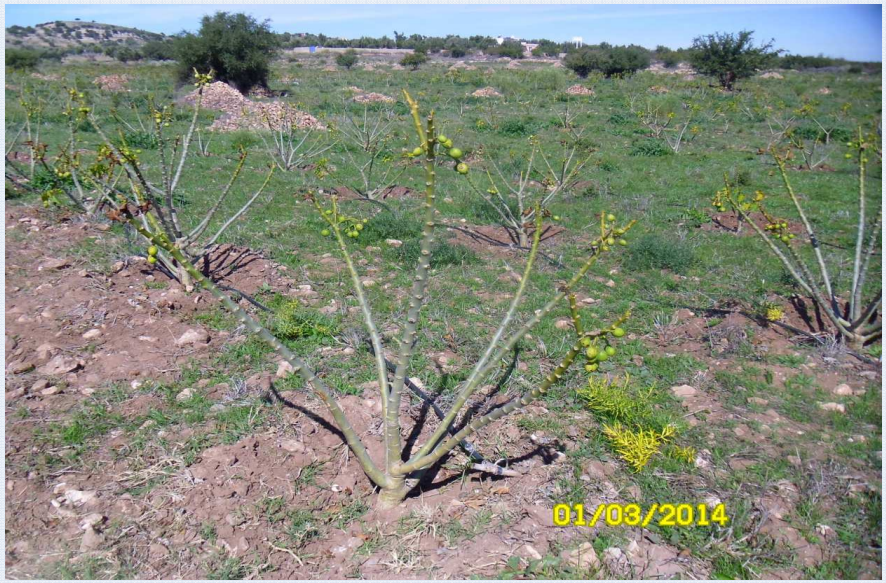


ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

10 October 2013

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

9 February 2014



1 March 2014

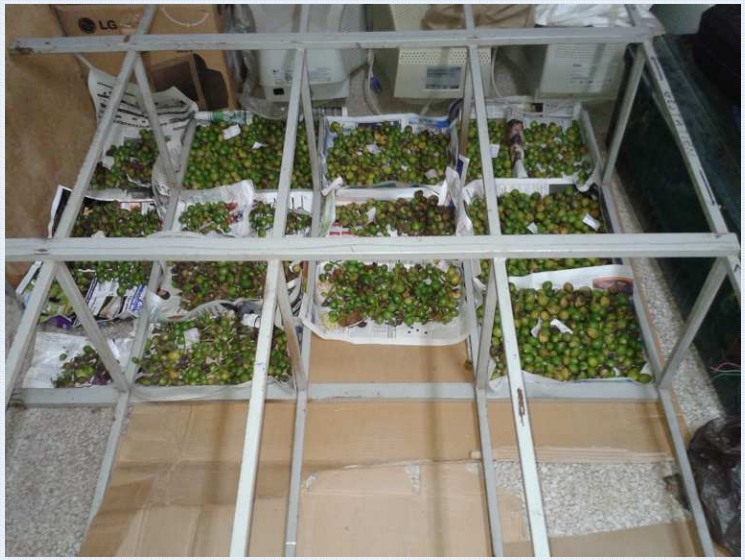
ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

8 March 2014: harvested fruits before pruning

8-9 March 2014: Second year pruning

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

Oil extraction



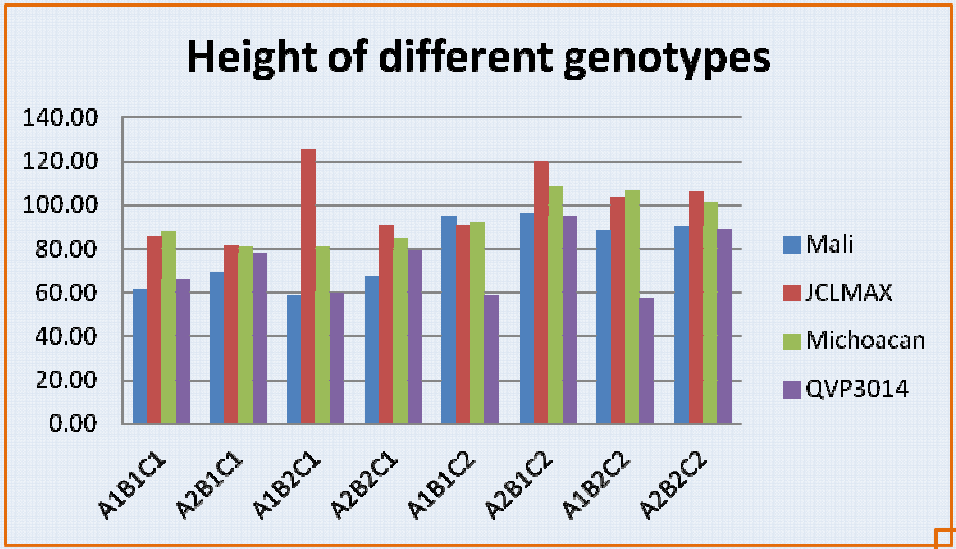
Fruits harvested on March 2014

Oil extraction using the Soxhlet method

	JCL Max 3.0 (kernel)	Michoacán (kernel)	Mali (seeds)	QVP (seeds)
Oil content	53.20%	39.60%	46.00%	37.50%

ACT.3 JatroMed IMPLEMENTATION IN MOROCCO

Data



TREATMENT A: Fertilization

Treatment A1: 10 g of urea per plant

Treatment A2: 10 g of 20 N-20 P-20 K per plant

TREATMENT B: Irrigation

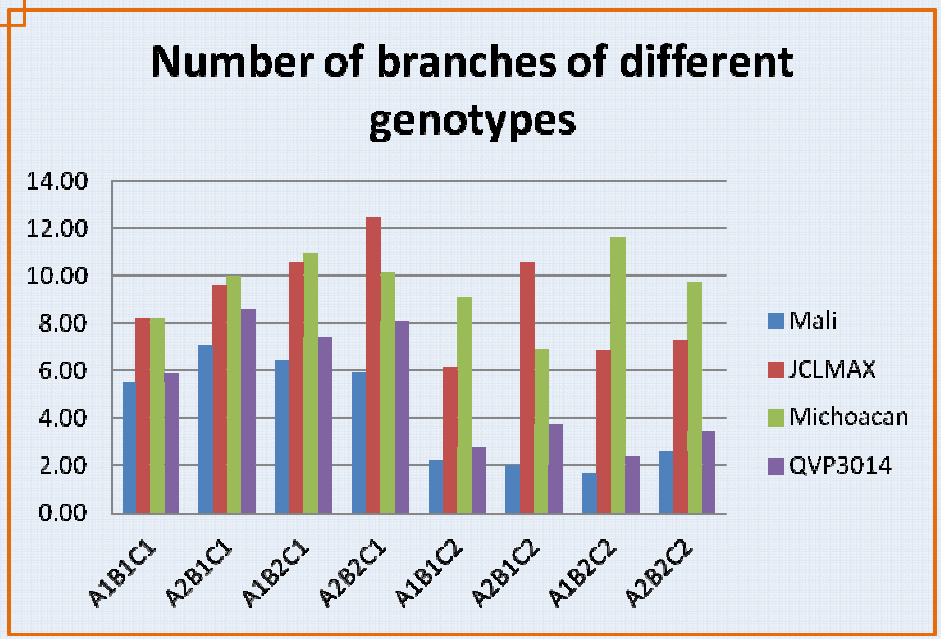
Treatment B1: 4L/hour every 7 days

Treatment B2: 8L/hour every 7 days

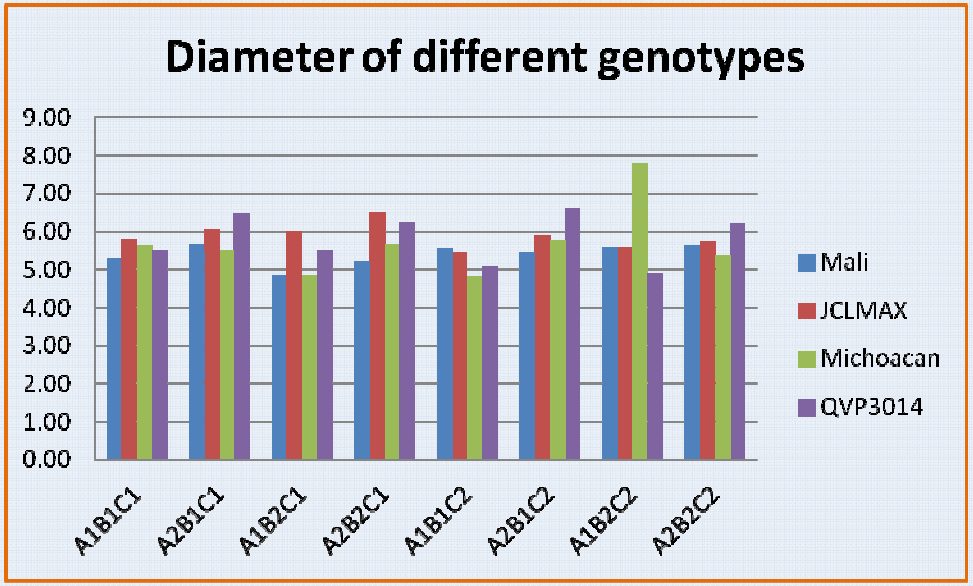
TREATMENT C: Pruning

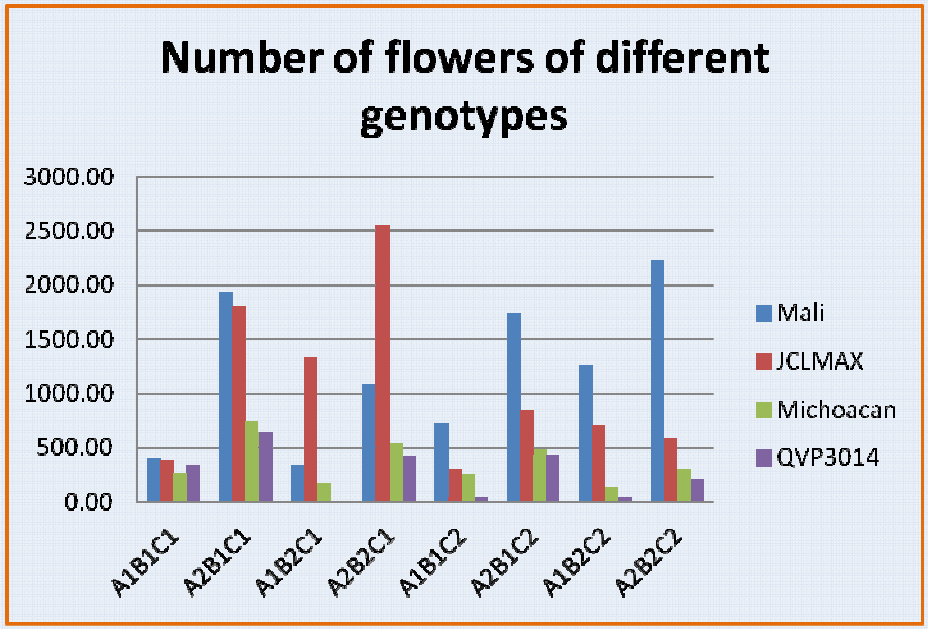
Treatment C1: Cup-shaped plants

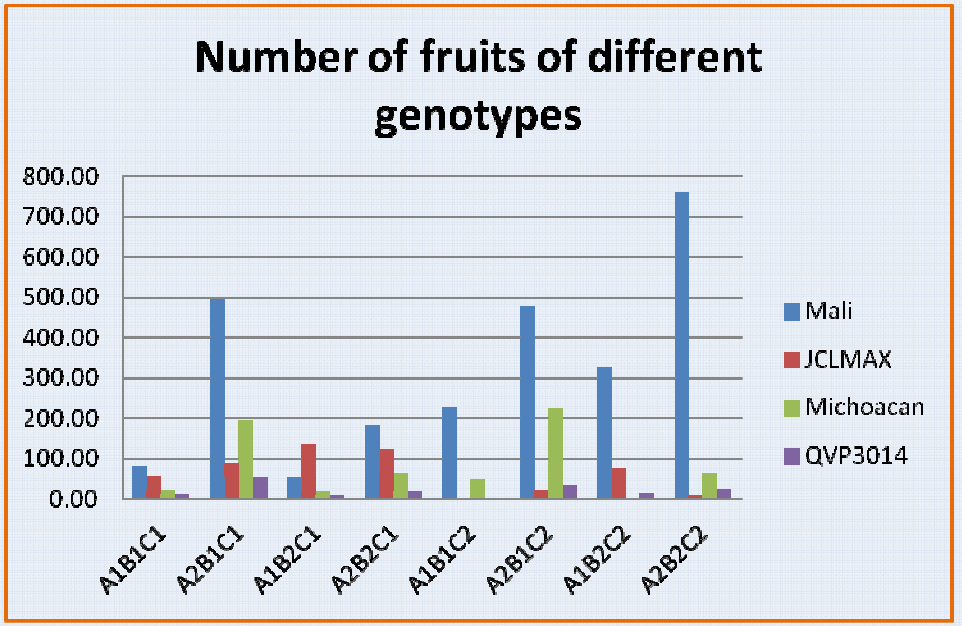
Treatment C2: Tree-shaped plants



ACT.3 JatroMed IMPLEMENTATION IN MOROCCO



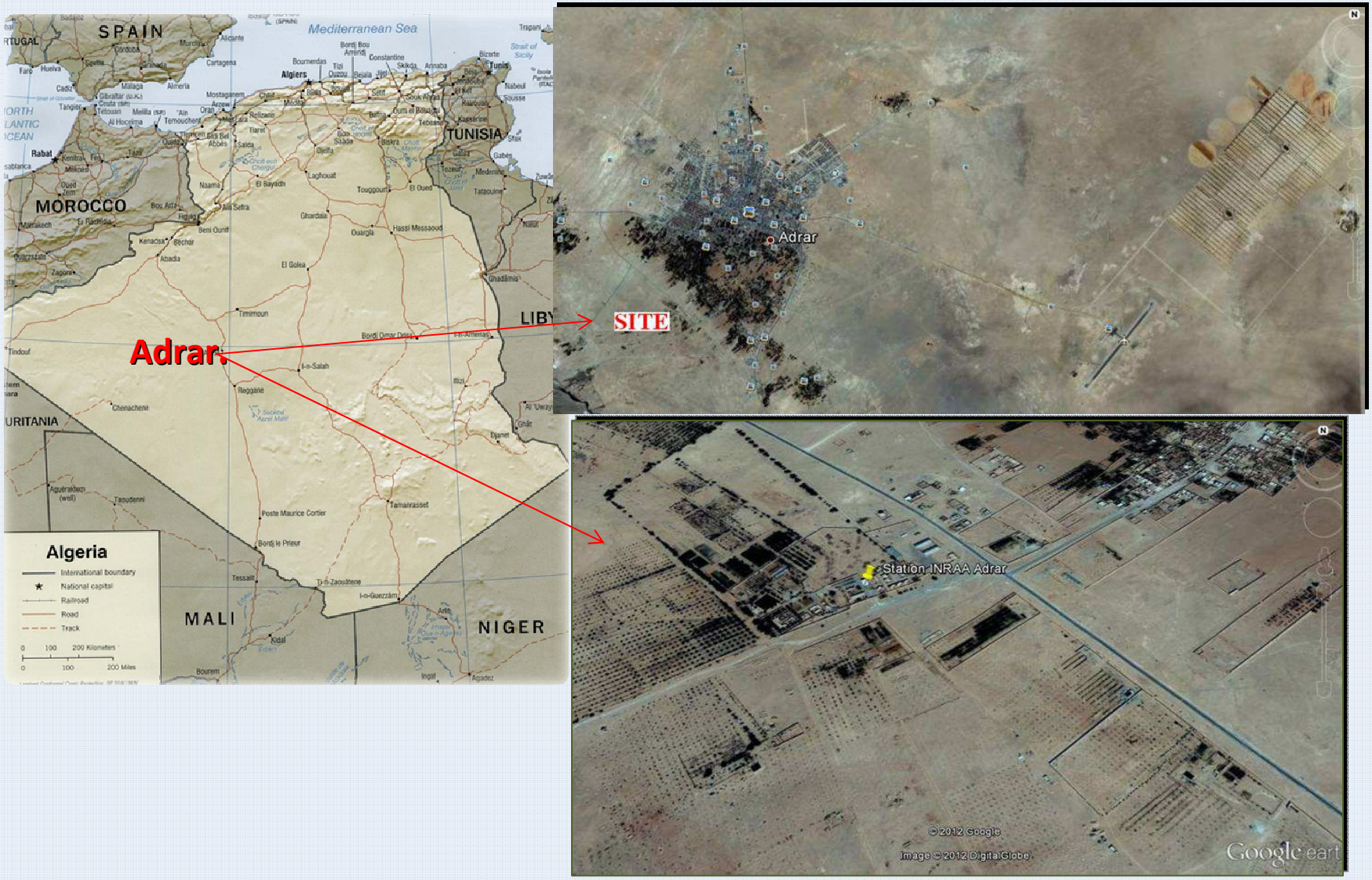




Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

Algeria

Adrar Region - 27° 54' N, 00° 11' W

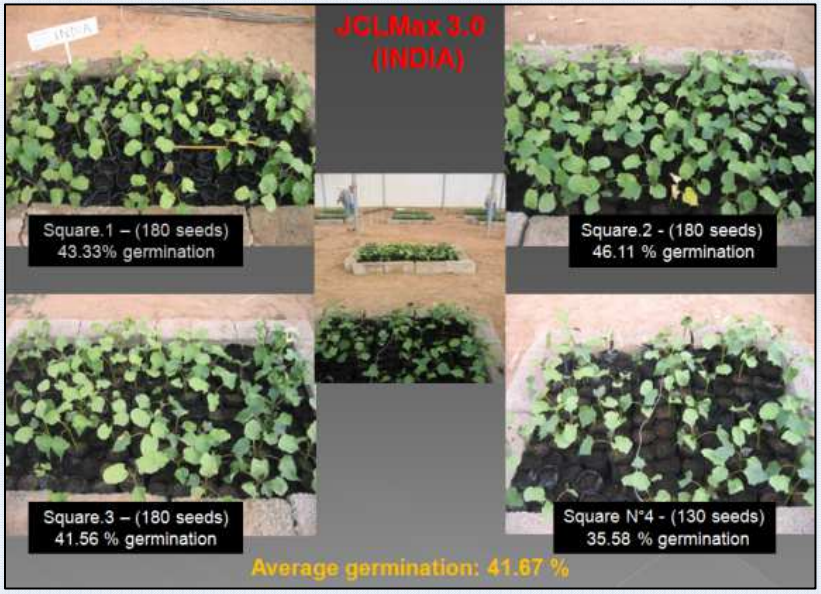


Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

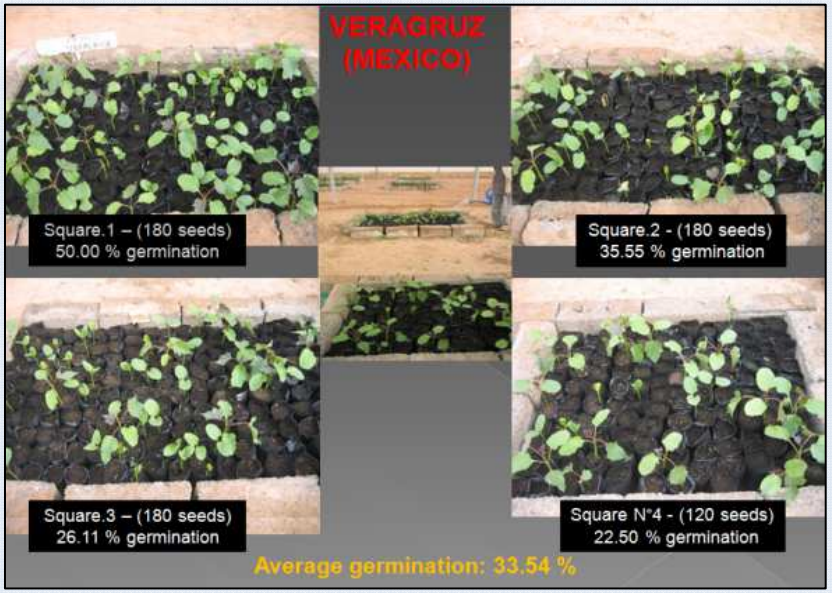
Nursery

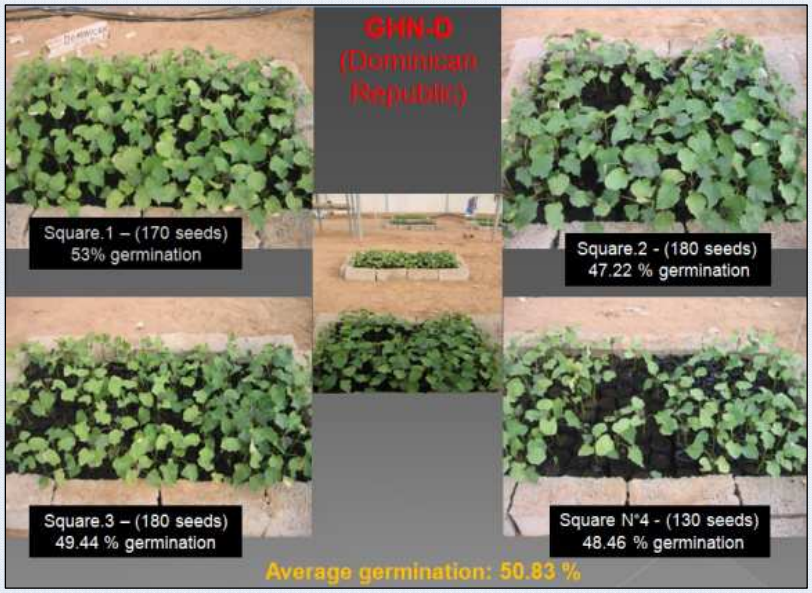
29 February 2012

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA



4 April 2012





Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

Transfer to a shady place
14 May 2012

Nursery 1:
23 January 2013

Nursery 2:
28 January 2013

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

Field preparation

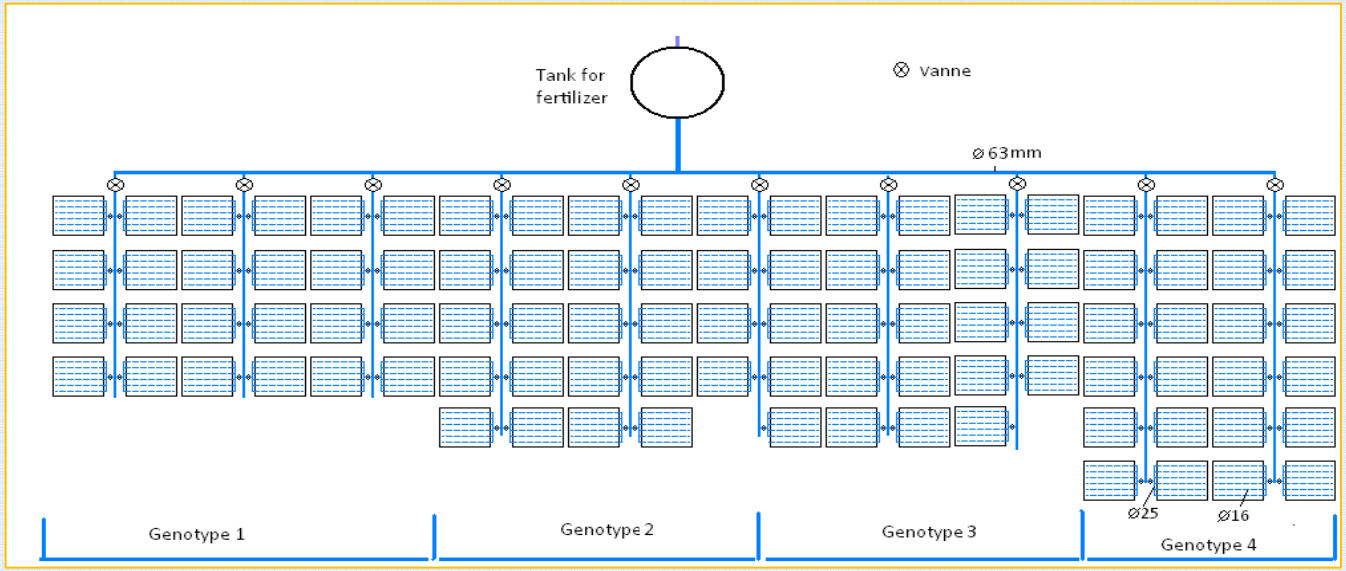
Overall view of the 04 ha field

Levelling operation

Field preparation accomplished on two periods: March and October 2012

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

Irrigation system



Layout of irrigation system

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

October-November 2013

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

11 January 2014

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

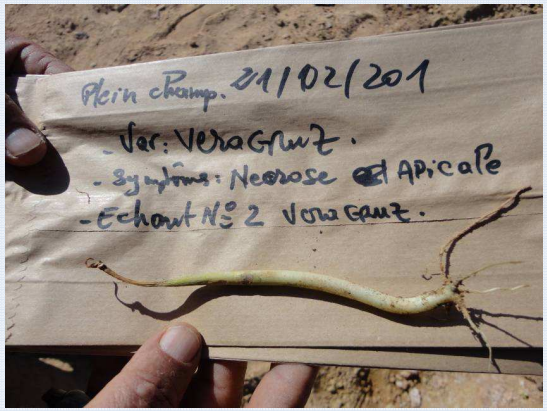
1 April 2014

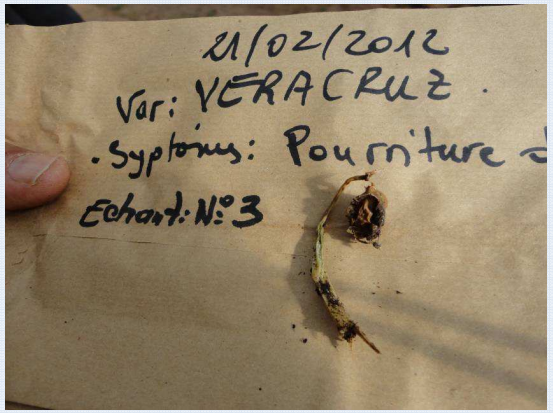
Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

Problems faced

Cricket attack

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA





Fusarium infection

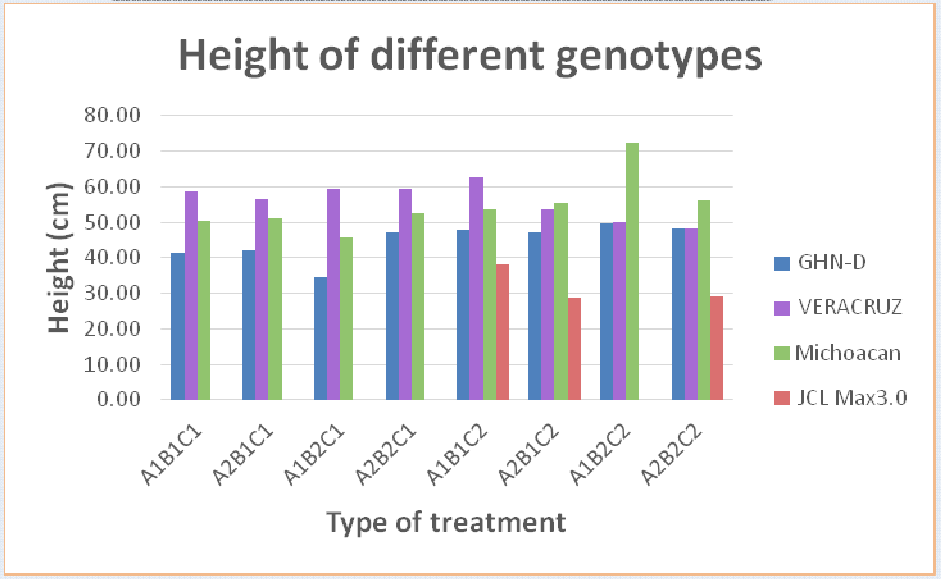
Verticillium infection

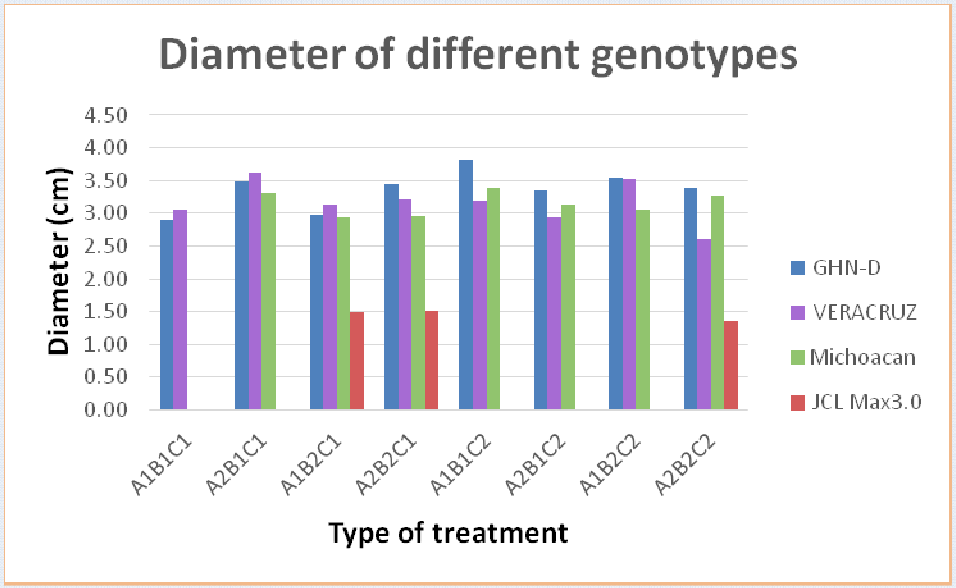
Technical visit
11 January 2014

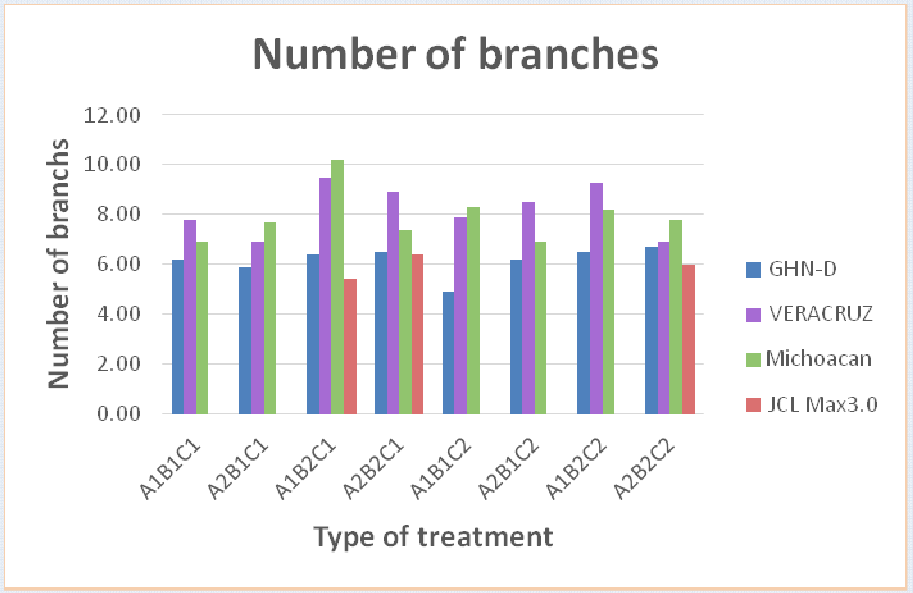
Pith affected by bacteria

Activity 3: JatroMed IMPLEMENTATION IN ALGERIA

Data





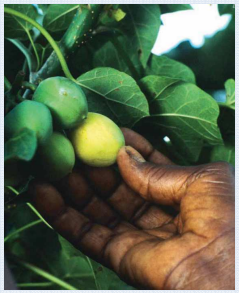


Activity 4: Mechanical harvest

Jatropha characteristics affecting harvest

- Wide flowering and ripening period
- Flowering and, therefore, fruiting are continuous
- At the same inflorescence there are fruits of different ripening stage
- Harvest is labor intensive and difficult to mechanize

The yellow and brown fruits are harvested by beating the branches with sticks to knock them to the ground, or by hand picking.



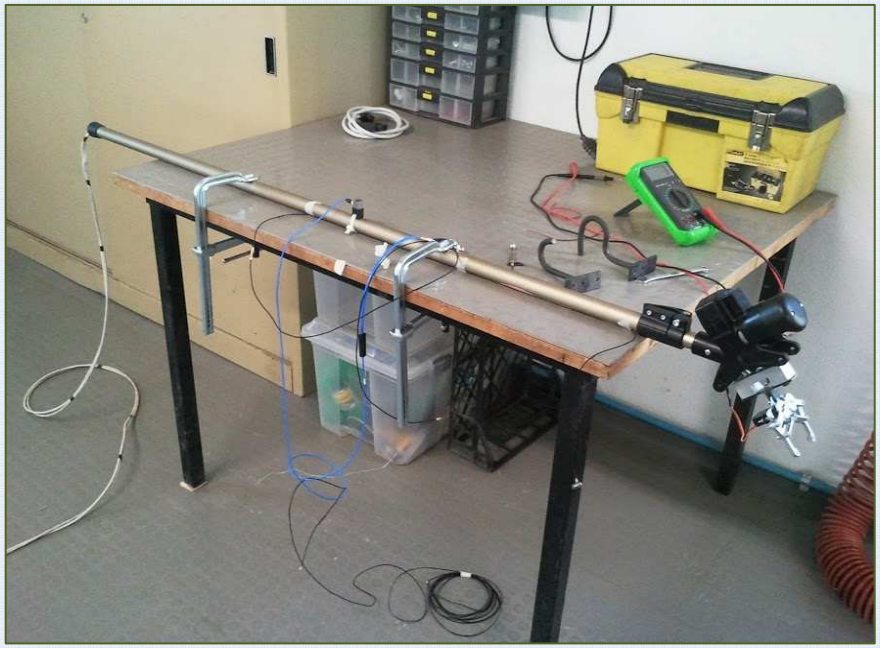
Manual harvest

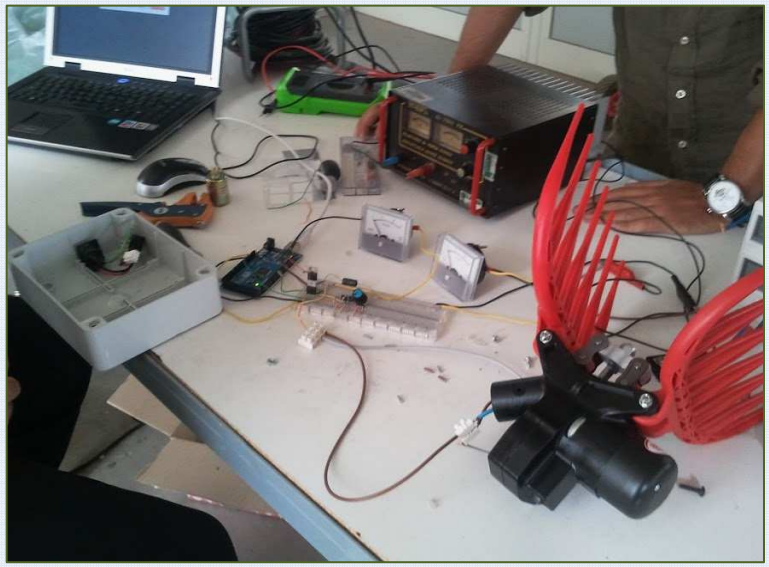
Pros: cheap; no maintenance; selective harvesting

Cons: labor intensive work; time consuming relative to the amount of oil produced (with 50 kg in average per person per day)

Mechanical harvest

Laboratory tests





Activity 4: Mechanical harvest

Field tests in Agadir, Morocco (22-26 October, 2012)

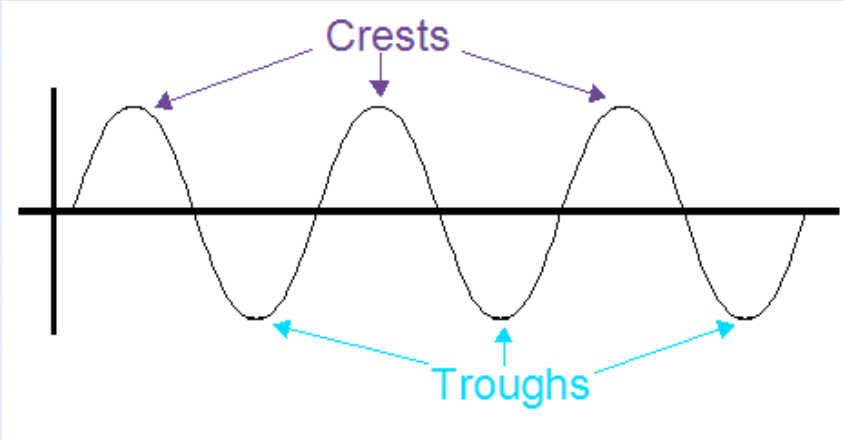
Activity 4: Mechanical harvest

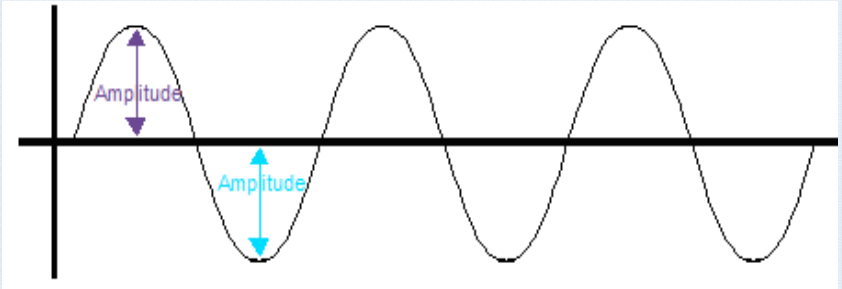
Fruit detachment force (FDF) and its ratio with fruit weight

	Fruit					
	Unripe			Ripe		
	mean	max	min	mean	max	min
FDF (N)	14,5	23,2	4,6	11,5	20,6	2,4
FDF W^{-1} ($N\ g^{-1}$)	2,54			1,17		

	FDF W^{-1} ($N\ g^{-1}$)	
	Unripe	Ripe
Olive tree	49.72	10.02
Almond	20.60	1.80
Pistacio	38.70	6.80

Activity 4: Mechanical harvest





- Frequency is a measurement of how many cycles can happen in a certain amount of time (cycles per second).
- Hertz is the unit of frequency, and just means how many cycles per second (Hz).

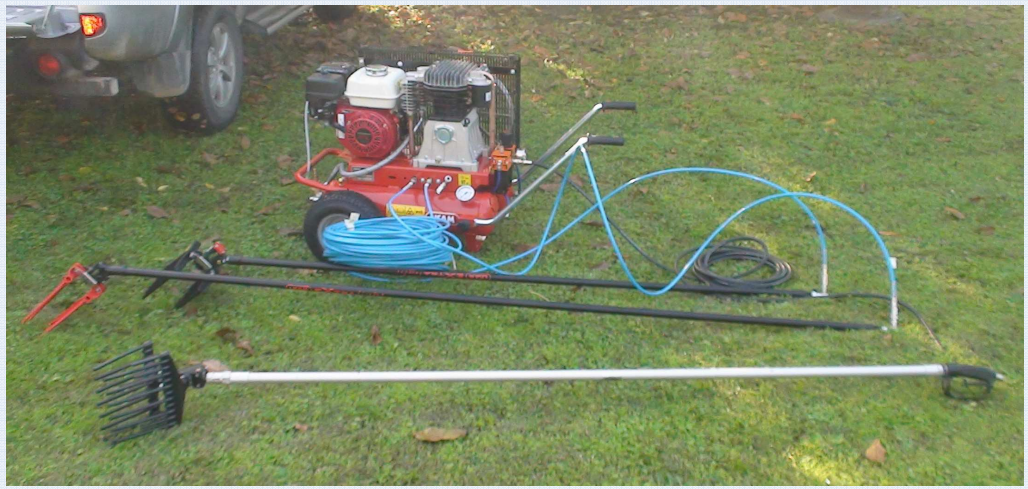
- Amplitude is a measure of how big the wave is.
- It takes more energy to make a bigger amplitude wave.
- The amplitude of a wave is measured as: the height from the equilibrium point to the highest point of a crest or the depth from the equilibrium point to the lowest point of a trough

Range of frequencies and amplitudes required to drop down only the ripe fruits

Activity 4: Mechanical harvest

Modifying a commercial machine with beating harvesting system

Beating system that will be adapted or modified to different needs or applications. The device is compound of an air compressor with the capacity to supply two pickers (rakes) and two pneumatic scissors at the same time.



Activity 5: ECONOMIC & ENVIRONMENTAL ANALYSIS

Main goals:

- ✓Analyze the costs of jatropha cultivation
- ✓Compare the costs of jatropha in the three demo fields (Egypt, Morocco, Algeria)
- ✓Implement an environmental-energy analysis of the jatropha production process

Software package for the analysis of costs of investment projects in agriculture
(http://www.abc.aua.gr/)

Laboratory of Agribusiness Management
Agricultural University of Athens

Activity 5: ECONOMIC & ENVIRONMENTAL ANALYSIS

A/A	Country	Genotypes	Treatments
1	Egypt	Michoacan	A1B1
2			A2B1
3			A1B2
4			A2B2
5		JCLMax 3.0	A1B1
6			A2B1
7			A1B2
8			A2B2
9		GHS-B	A1B1
10			A2B1
11			A1B2
12			A2B2
13		JAT106	A1B1
14			A2B1
15			A1B2
16			A2B2

A/A	Country	Genotypes	Treatments
17	Morocco	Michoacan	A1B1
18			A2B1
19			A1B2
20			A2B2
21		JCLMax 3.0	A1B1
22			A2B1
23			A1B2
24			A2B2
25		QVP 3014	A1B1
26			A2B1
27			A1B2
28			A2B2
29		Mali	A1B1
30			A2B1
31			A1B2
32			A2B2

A/A	Country	Genotypes	Treatments
33	Algeria	Michoacan	A1B1
34			A2B1
35			A1B2
36			A2B2
37		JCLMax 3.0	A1B1
38			A2B1
39			A1B2
40			A2B2
41		Veracruz	A1B1
42			A2B1
43			A1B2
44			A2B2
45		GHN-D	A1B1
46			A2B1
47			A1B2
48			A2B2

ABC simulation platform. Cost analysis scenarios per country - all genotypes and treatments considered (48 scenarios)

Activity 5: ECONOMIC & ENVIRONMENTAL ANALYSIS

The activities considered for the economic analysis are:

1. Sowing seeds in nurseries
2. Field preparation
3. Transplantation
4. Fertilization
5. Irrigation
6. Pest control
7. Weeding
8. Pruning
9. Harvesting
10. Preparation of harvested fruits and possible storage
11. Transportation of seeds to oil extraction
12. Oil extraction

Activity needs:

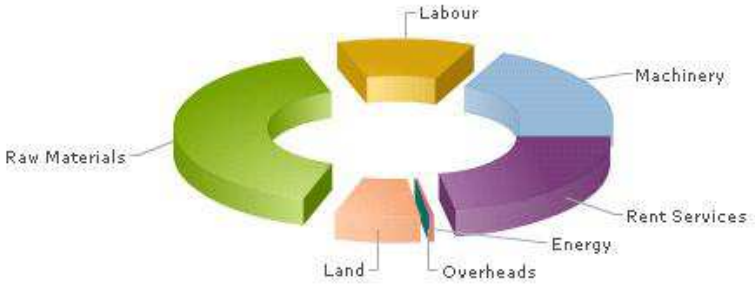
- ✓Labour
- ✓Machinery (tractors, pumps, etc.)
- ✓Energy (fuel, electricity, etc.)
- ✓Raw material (seeds, fertilizer, etc.)

Activity 5: ECONOMIC & ENVIRONMENTAL ANALYSIS

ALGERIA

Jatropha - Michoacan - A1B1

Country/Region:	Algeria
Annual yield:	10,5 ton
Economic life:	20 yr
Selling Price:	200 €/ha



Investment costs are expressed in actual (NOT annual equivalent) values

TOTAL ESTABLISHMENT OR INVESTMENT COST(€/ha)

Operations	Energy	Labour	Land	Machinery	Overheads	Raw Materials	Rented Services	Total
(Land Rent)			400					*400,00*
Land Preparation	4,5	300		990,24		120	237,5	*1.652,24*
Pre Cultivation In Nursuries	19,2	336				2045,43	968,37	*3.369,00*
Transplantation	0,34	12						*12,34*
TOTAL	24,04	648,00	400,00	990,24		2.165,43	1.205,87	*5433,58*

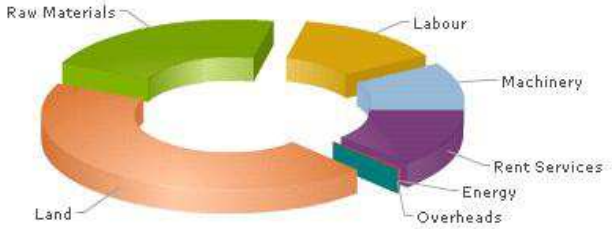
Investment cost of jatropha plantation
(representative for all other treatments and genotypes)

Investment cost for ALGERIA if greenhouse+irrigation are owned: 3300 €/ha
Investment cost for EGYPT: 3700 €/ha (greenhouse+irrigation: 2200 €/ha)
Investment cost for MOROCCO: 5300 €/ha (greenhouse+irrigation 3200 €/ha)

Activity 5: ECONOMIC & ENVIRONMENTAL ANALYSIS

Jatropha - Michoacan - A1B1

Country/Region:	Algeria
Annual yield:	10,5 ton
Economic life:	20 yr
Selling Price:	200 €/ton
Sales:	2100,00 €/ha
Cost:	**987,21** €/ha
Profit:	1112,79 €/ha
Subidies:	



TOTAL ANNUAL EQUIVALENT COSTS INCLUDING INITIAL INVESTMENT(€/ha)

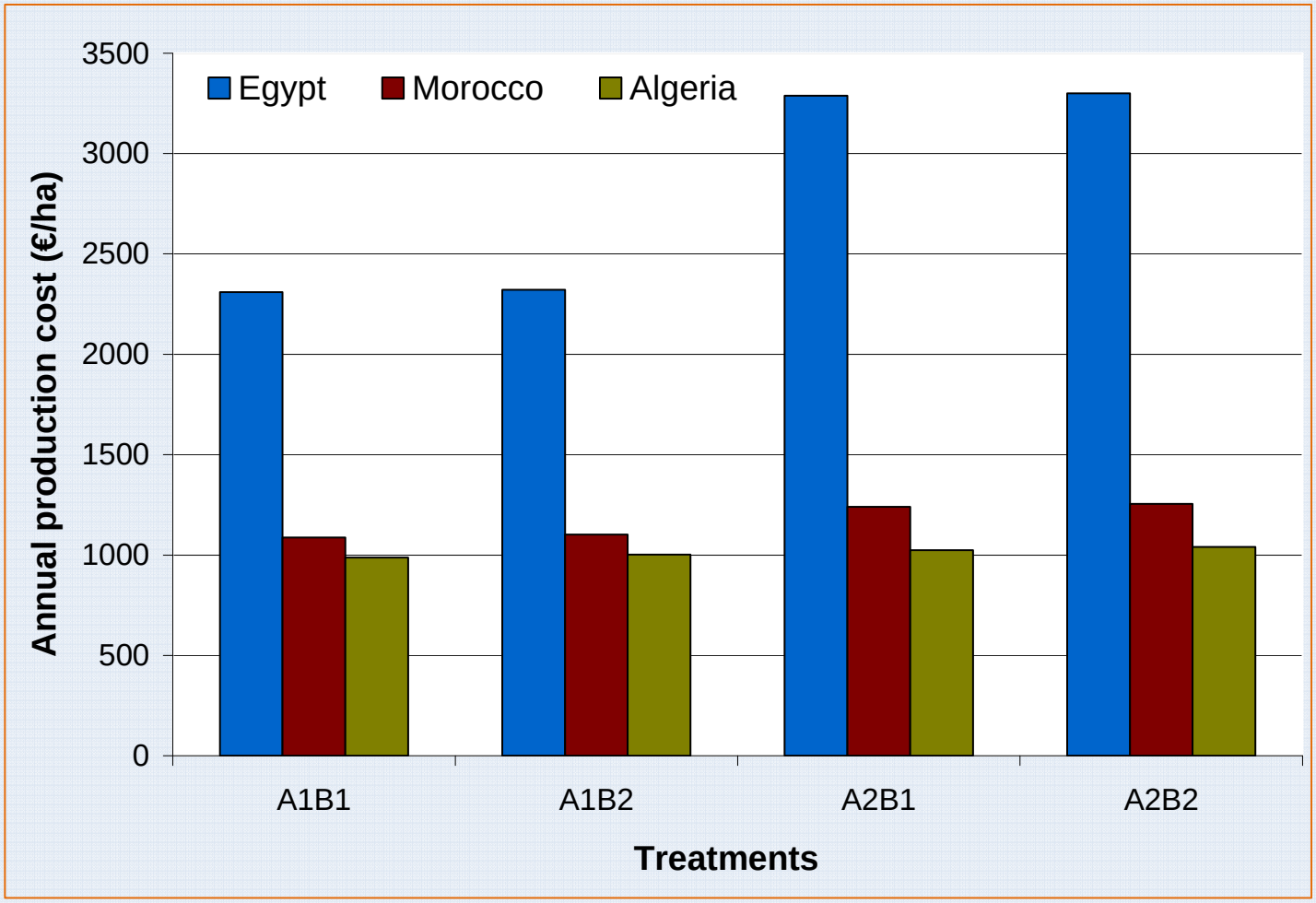
Operations	Energy	Labour	Land	Machinery	Overheads	Raw Materials	Rented Services	Total
(Land Rent)			433,19					*433,19*
Fertilization		14				0,1		*14,10*
Irrigation	0,77	14,66					25	*40,43*
Land Preparation	0,37	24,9		82,18		9,96	19,71	*137,12*
Mechanical Weed Control	0,24	36		3,49				*39,73*
Pre Cultivation In Nursuries	1,59	27,88				169,74	80,36	*279,57*
Spraying (Pests)		8		0,32		33,69		*42,01*
Transplantation	0,03	1						*1,03*
TOTAL (€/ha)	3,00	126,44	433,19	85,99		213,49	125,07	*987,18*

Annual equivalent cost of production of Jatropha for treatment A1B1

Annual equivalent cost of production for EGYPT: 2300 €/ha

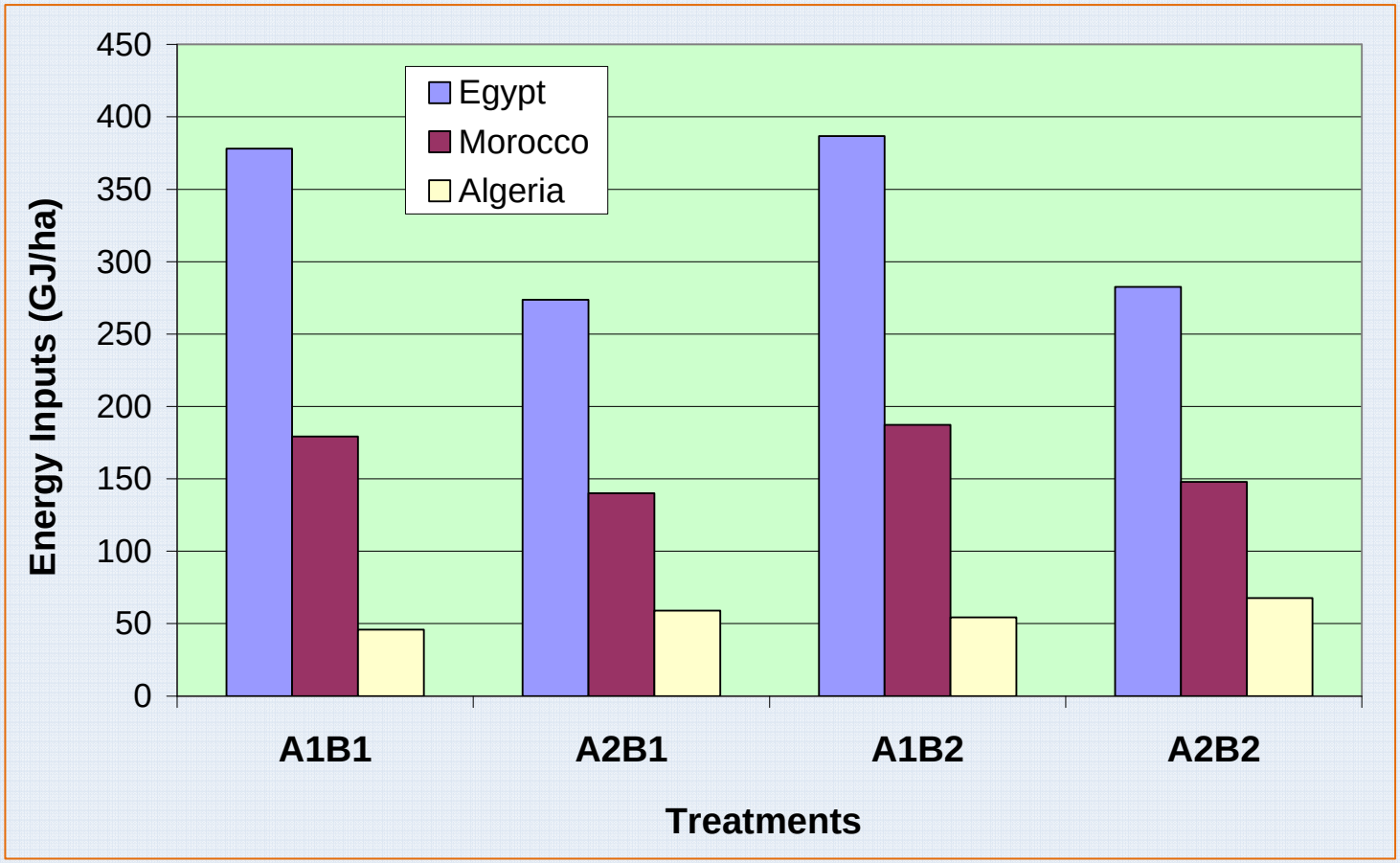
Annual equivalent cost of production for MOROCCO: 1100 €/ha

Activity 5: ECONOMIC & ENVIRONMENTAL ANALYSIS



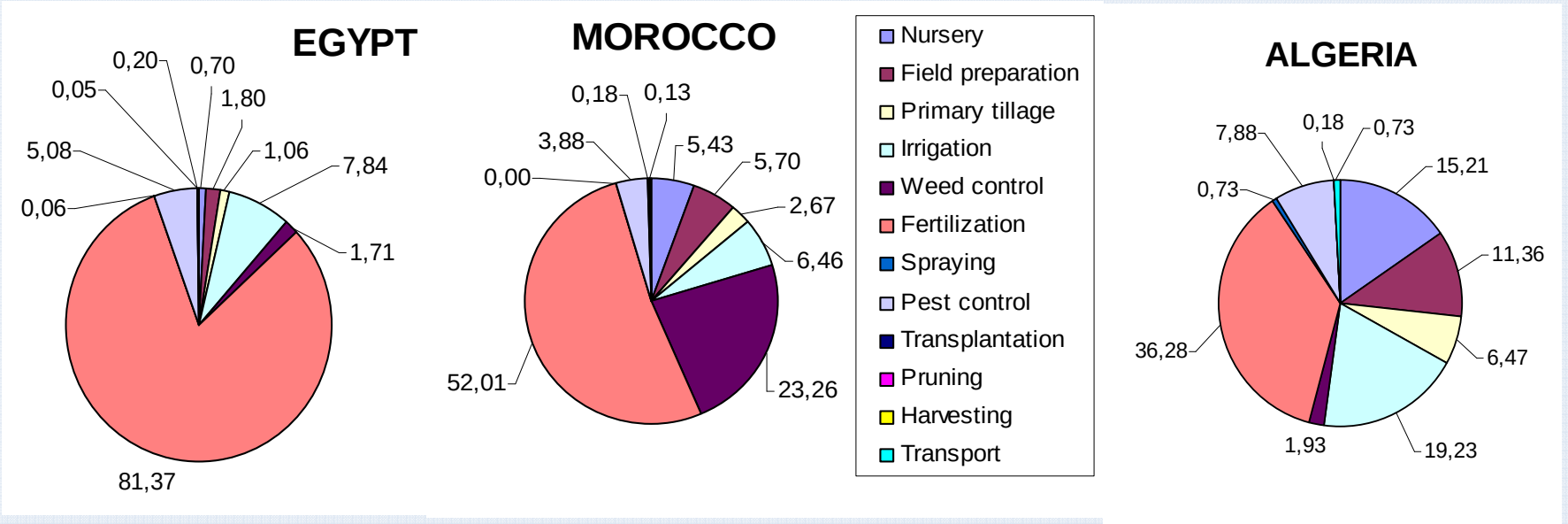
Comparison of total Annual equivalent cost between Egypt, Morocco and Algeria

Energy Analysis for Jatropha demo fields



Comparison of energy inputs for the three fields and for combinations of treatments of irrigation and fertilization

Activity 5: ECONOMIC & ENVIRONMENTAL ANALYSIS



Distribution of Energy Inputs in all Operations for the three regions – Case of Highest Inputs

Activity 6: DISSEMINATION & EXPLOITATION OF RESULTS

- ✓Website (www.jatromed.aua.gr)
- ✓Social media (https://www.facebook.com/Jatromed?ref=hl)
- ✓Three newsletters released
- ✓14 publications in International Conferences
- ✓One publication in scientific journal
- ✓Meetings with farmers, local population, politicians, stakeholders
- ✓Field visits by farmers and stakeholders
- ✓Knowledge transfer events

Knowledge transfer events

EGYPT

MOROCCO

ALGERIA

THANK YOU FOR YOUR ATTENTION

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