Vincent Volckaert – Regional Manager Africa - D1 Oils Plant Science

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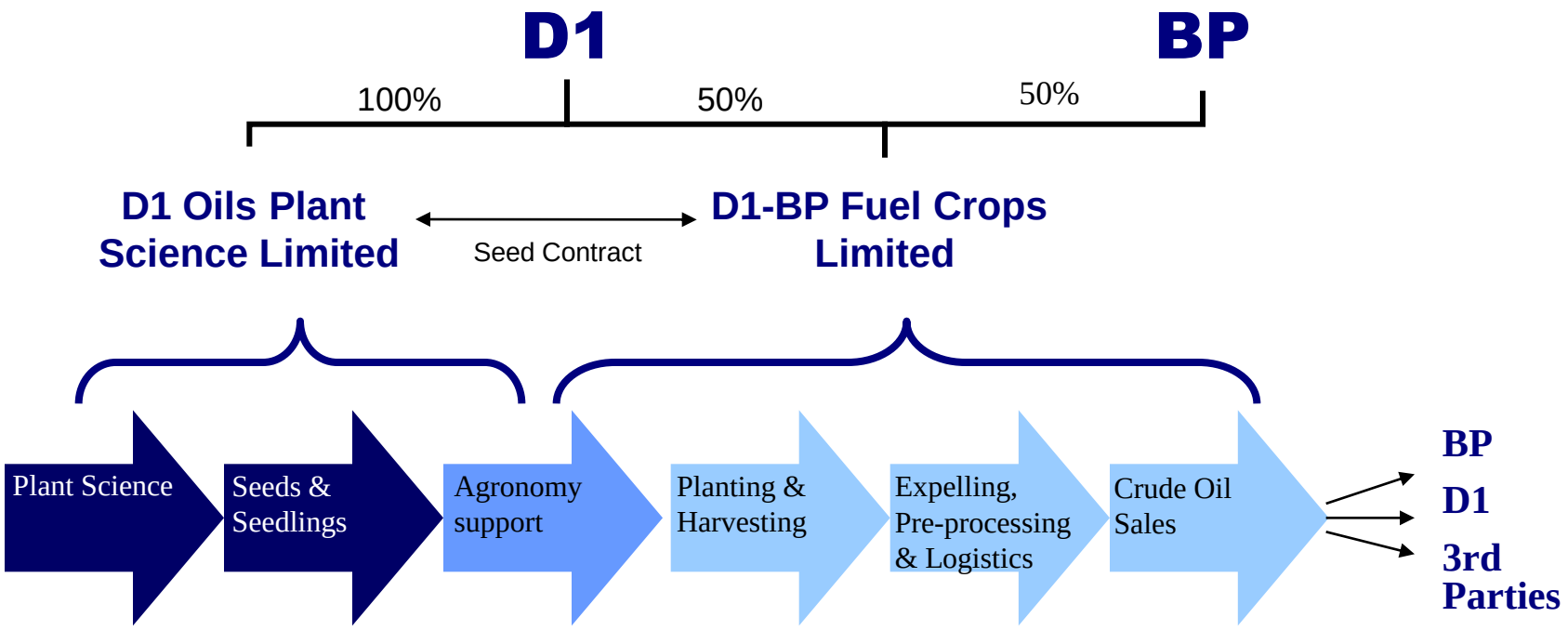
Jatropha curcas: beyond the myth of the miracle crop.

D1 Oils and D1-BP Fuel Crops



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Global plant science programme

D1 Oils Plant Science – Organization

- Breeding and Technology Development
- Product Placement and Agronomy Research
- Multiplication (Seeds and Seedlings)
- Sustainable Oil Supply Program
- Regulatory Affairs and New Projects

Jatropha curcas L.

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Why Jatropha curcas?

- Jatropha curcas is a hardy oilseed bearing tree.
  - Centre of Origin in Central America.
  - Commonly used in tropical growing areas as a hedge and source of oil.
  - Can tolerate some drought spells.
- A plant of many revenue opportunities – oil, power generation, animal feed and fertiliser
- Strong global demand for a sustainable energy product, will help countries/ industries meet climate treaty requirements.
- Jatropha curcas has high sustainability potential:
  - Can be mixed or intercropped alongside existing vegetables/grains, resulting in additional and balanced cash income for farmers.
  - Potential GHG savings of up to 66%.
- Jatropha curcas remains to be domesticated.

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Some myths about Jatropha

- **1. Can grow anywhere, even on marginal soils.**
- => Can survive in marginal conditions, but will give marginal yields in those conditions.

- **2. It's a hardy non-edible tree.**
- => Jatropha is not eaten by larger animals, but has many pests and diseases

- **3. Does not need fertilizer.**
- => Jatropha can survive in low-nutrient conditions but better growth and higher seed yield is observed with higher nutrient levels.

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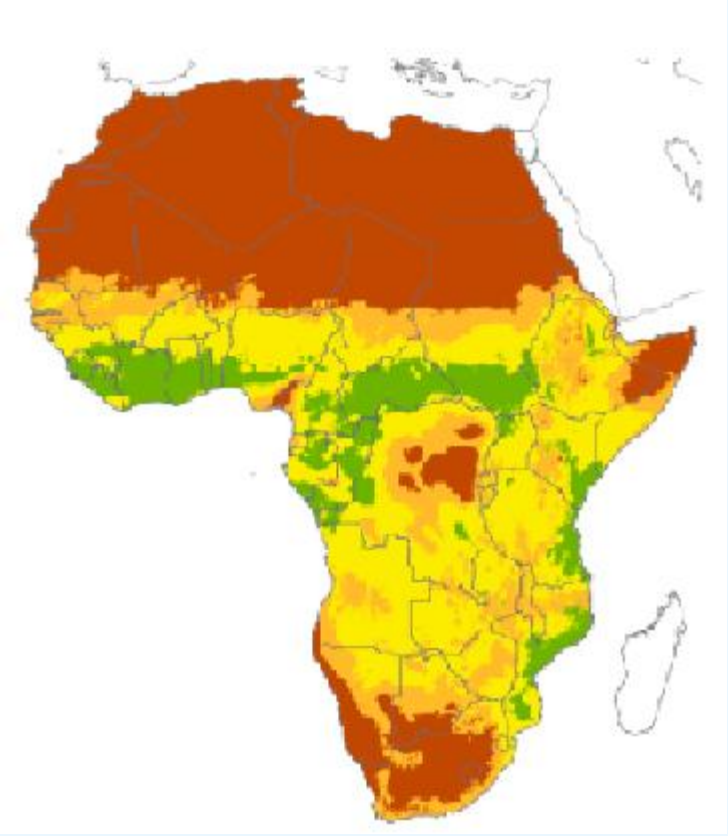
Myth 1: can grow in marginal conditions

- Jatropha can survive in marginal conditions but this also means marginal yield.
- Development of crop suitability criteria: annual rainfall, minimum temperature, average temperature, precipitation in driest and wettest quarter, diurnal range, soil type, ..etc
- Red to Green maps



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Myth 2: Jatropha is a tough and robust tree

- Single trees are looking healthy but once you grow the crop in monoculture you will notice very quickly the presence of several pests and diseases.
- These are now categorized in Major and Minor P&D.
- Eg Major P&D on continental Africa are the golden flea beetle, leaf miner, mildew, termites, mites, ….
- Currently collecting data for label extensions of chemical control agent together with the major Ag Chem companies, but we are also looking at Integrated Pest Management (IPM).
- More P&D on weaker plants, therefore important to have healthy plants in the field.

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Myth 3: Does not need fertilizer

- As any agricultural crops, Jatropha cannot grow without nutrients.
- Single nutrient trials show clear response to fertilizer. In African soils especially to Phosphorus in the early stages of development.
- Currently setting up multi-factorial fertilizer trials running over a number of years. These will give clear indications of nutrient requirements of Jatropha.
- Observations: Response to organic fertilizer is impressive. Early flowers on top of an old kraal.

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Jatropha curcas is not a miracle crop

- Like any crop cultivated to produce a harvest, Jatropha curcas also needs:
  - Proper management:
    - Planting techniques
    - Pruning
    - Disease and Pest control
    - Selection of optimal cultivation zones
  - Proper Genetics selection:
    - Commercial cultivar development
    - Adapted cultivars for target growing areas
  - Proper Crop inputs:
    - Watermanagement
    - Fertilization
- In the past this was not properly recognized by D1 Oils; Since beginning 2007 a proper Plant Science programme was established to systematically analyze and manage these issues

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1. Seeds

- Use Jatropha Seeds (produced and harvested for planting purposes) instead of Jatropha grain (found on or under any Jatropha tree).
- Best germination when harvested at right time and dried in the shade.
- Improved varieties are expected soon. D1 was making announcements for 2010.
- Important to look at seed moisture content when storing seeds. Handheld moisture meter calibrated for Jatropha.
- Optimal moisture content for storage around 7%

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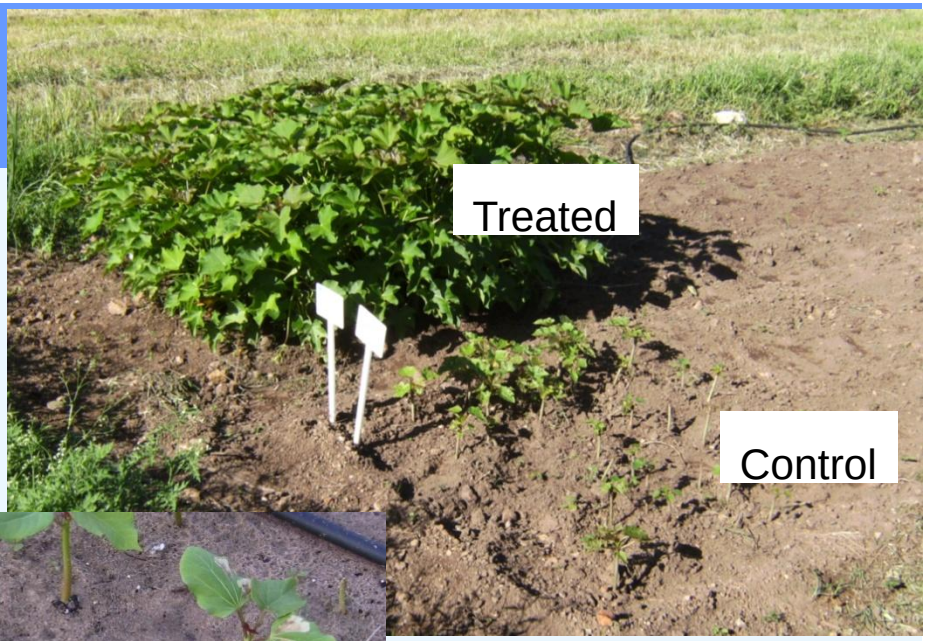
Seedbed and seedlings

- Adequate protection of plants in seedling nursery against pests.
- Seedbeds should be deep enough for taproot to develop.
- If Polybags are used:
- Should be tall enough (minimum 30 cm).
- Right type of compost



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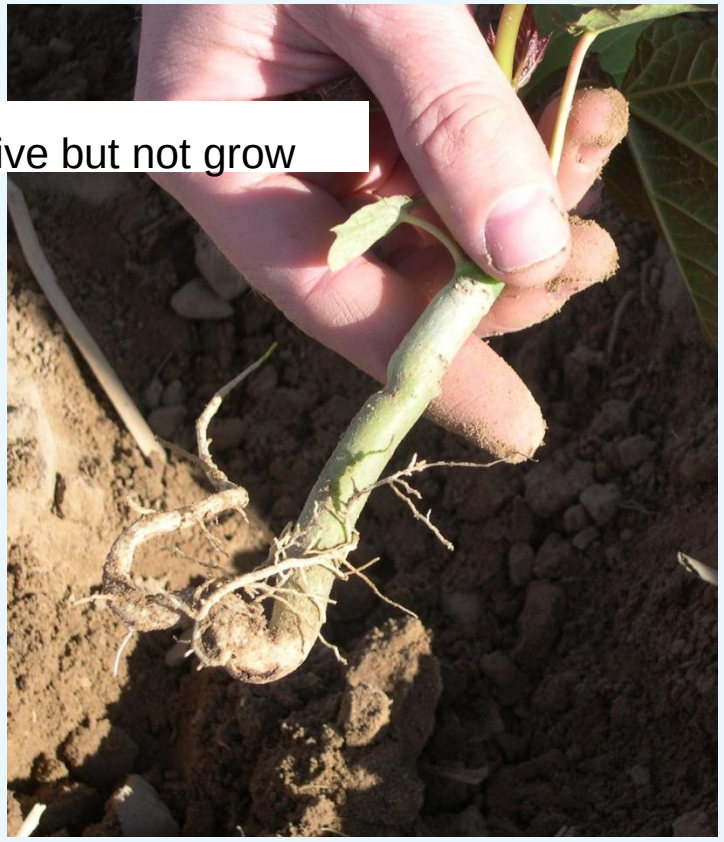
Quality of Planting practice is extremely important

J-rooted plant will survive but not grow



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Pruning and Pinching

- Early pruning to induce branching.
- Never prune in winter but at start of new season.

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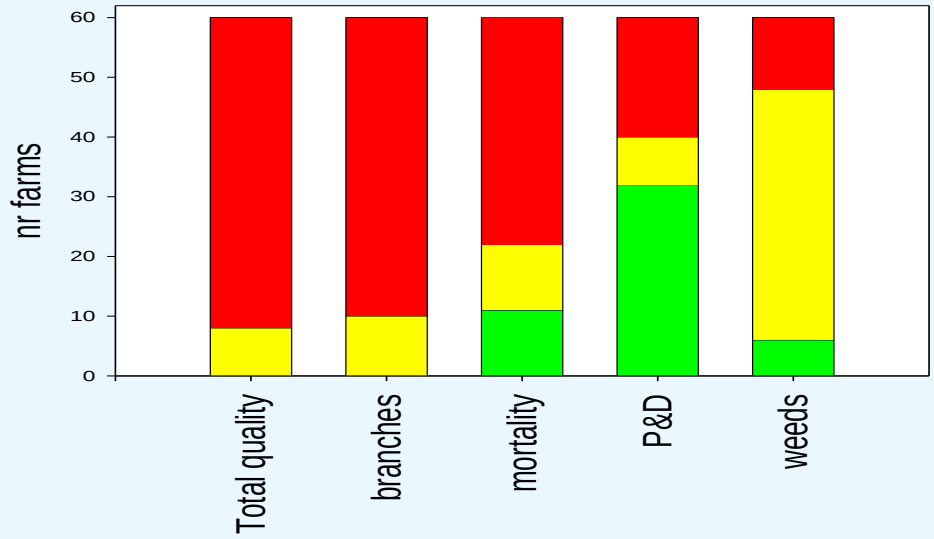
Field Survey Jatropha planting- Quality Assessment



- **Based on 4 quality parameters**
  - **Number of branches**
  - **Mortality of plants**
  - **Pests and Disease Incidence (P&D)**
  - **Weed abundance**

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Jatropha Biological Calendar

Jathropha biological calendar

	year 1												year 2												year 3											
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Seedbeds																																				
Transplanting					Planting												Gapfilling												Gapfilling							
Pinching/Pruning																																				
P induced branching																																				
Flowering																																				
Fruiting																																				
Harvest																																				
Senesence																																				
Rain (mm avge 1951-1980	0	0	3	10	74	191	223	172	92	24	3	0	0	0	3	10	74	191	223	172	92	24	3	0	0	0	3	10	74	191	223	172	92	24	3	0
Max Temp (1951-1980)	24	27	31	32	32	28	28	28	28	28	26	25	24	27	31	32	32	28	28	28	28	28	26	25	24	27	31	32	32	28	28	28	28	28	26	25
Min Temp (1951-1980)	8	11	14	17	18	18	18	9	17	14	11	9	8	11	14	17	18	18	18	9	17	14	11	9	8	11	14	17	18	18	18	9	17	14	11	9

status

- D1 Oils Plant Science develops new varieties of *Jatropha curcas* and the knowledge to grow them in various regions.
- A first product has been released. New products will be released in 2010 and 2011 with a potential oil yield superior to 2 t/ha/y at maturity on well managed plantations.
- An extended network of product placement and agronomy research trials has been established with locations in Southern Africa, India, Thailand and Indonesia.
- A range of knowledge and tools have been developed and are being deployed on how to grow Jatropha successfully.
- A process has been invented and protected (patent application filed) to turn Jatropha seedcake into a highly valuable protein source for animal feed use. The process is currently being upscaled and tested on higher animals.
- D1 Oils Plant Science continues to seek partners in the world to co-develop this exciting crop.

PLANT MATERIAL – CUTTINGS vs SEEDLINGS

JC-2008-21

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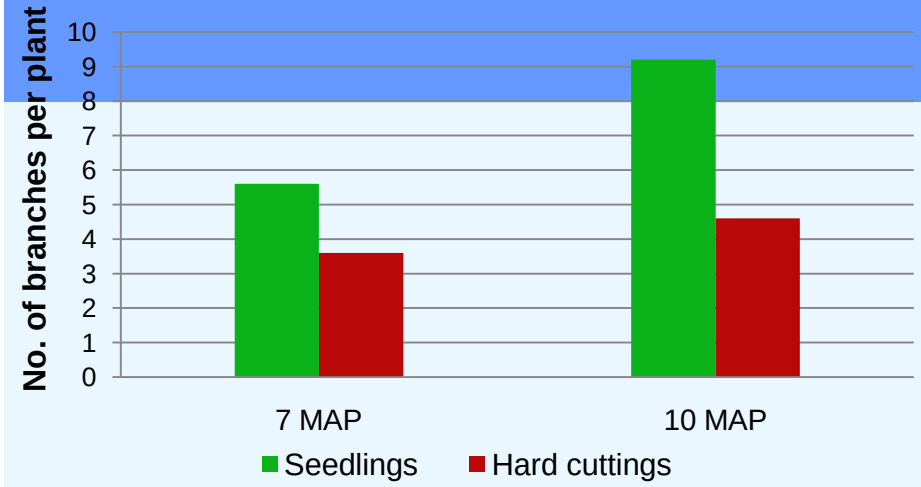
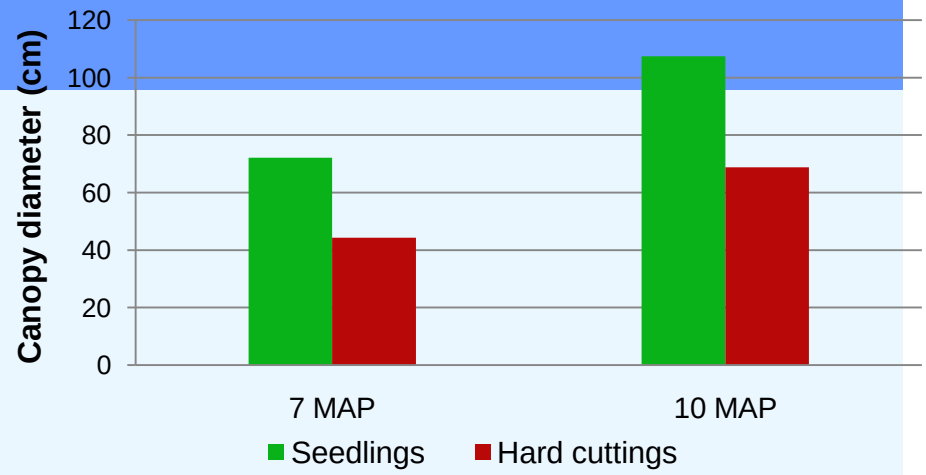
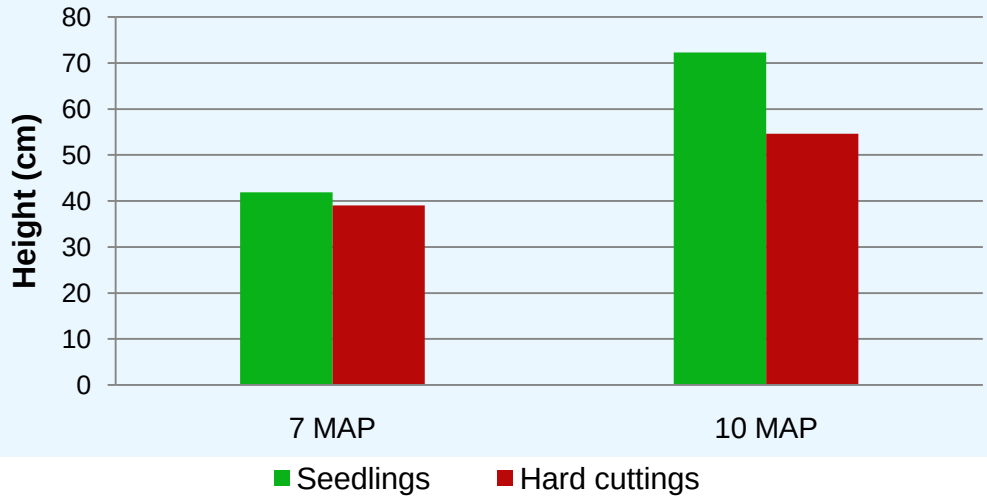
Branches - JC-2008-21



Canopy diameter - JC-2008-21



Height - JC-2008-21



Left : Seedlings

Right : Cuttings

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Generative versus vegetative propagation in *Jatropha curcas*

Success factors	Propagation method	
	Vegetative	Generative
Period required from 1 seedling to 1 million plants	Soft cuttings 87 weeks Hard cutting 94 weeks Tissue Culture 107 weeks Budgrafted plants 91 weeks	Seedlings: 91weeks
FTE 's required for production of 1 million plants out of 1 seedling	Soft cuttings: 47.0 FTE Hard cutting: 29.6 FTE Tissue Culture : 40.8 FTE Budgrafted plants : 20 FTE	Seedlings: 2.2 FTE
Root development	No proper tap root development, creating a serious legacy in established plantations. (exc. Bud-grafting).	Normal root development with proper planting practises.
Start of flowering and fruiting	Not uniform in cuttings and mother-plants	Start of flowering and fruiting more uniform in narrow populations
Seed yield from 1st year seed orchard	2.91 g/tree/month	3.99 g/tree/month

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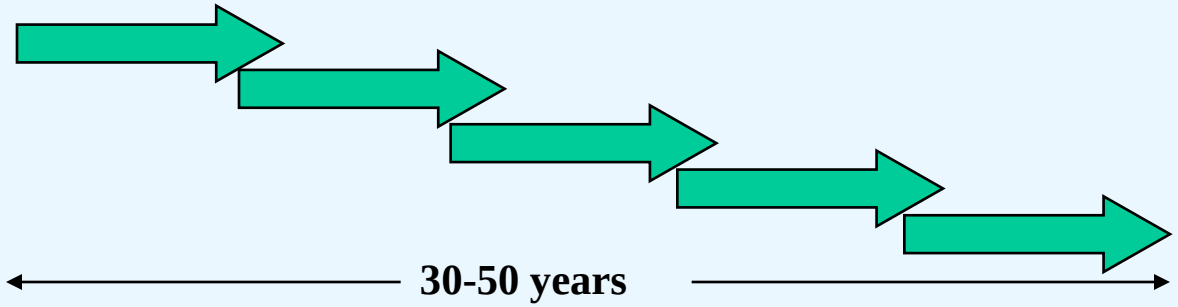
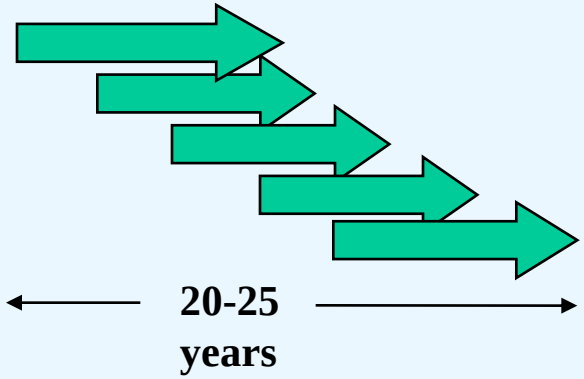
New Crop Opportunities with new technology platforms

- **Traditional crop development:**



- **New Crop development**



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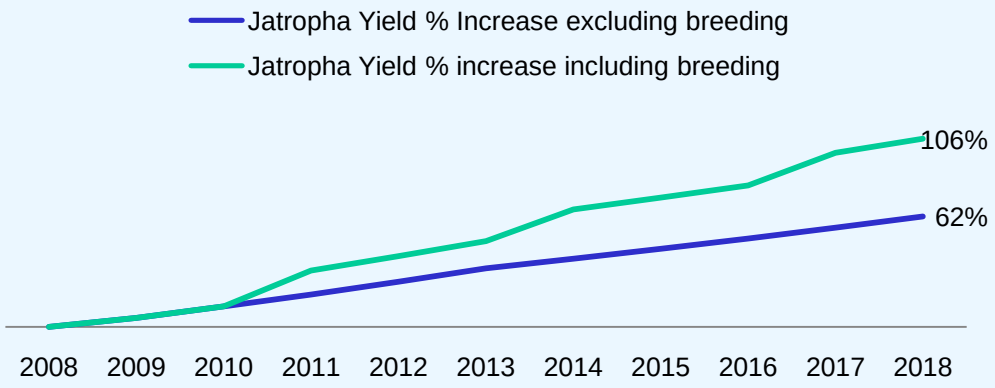
Yield improvement Jatropha

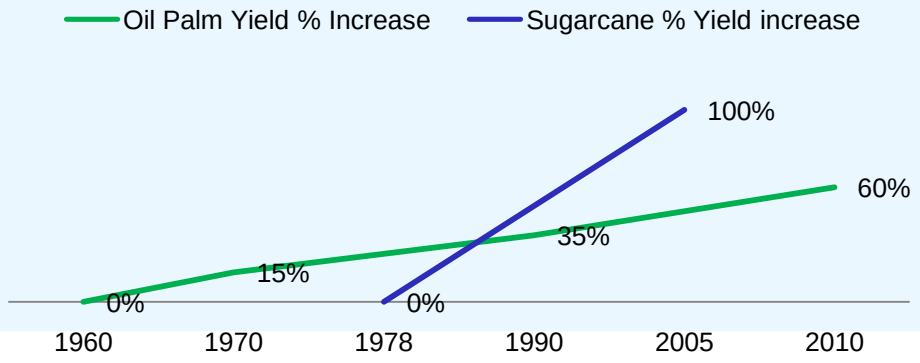
Jatropha Yield % Increase



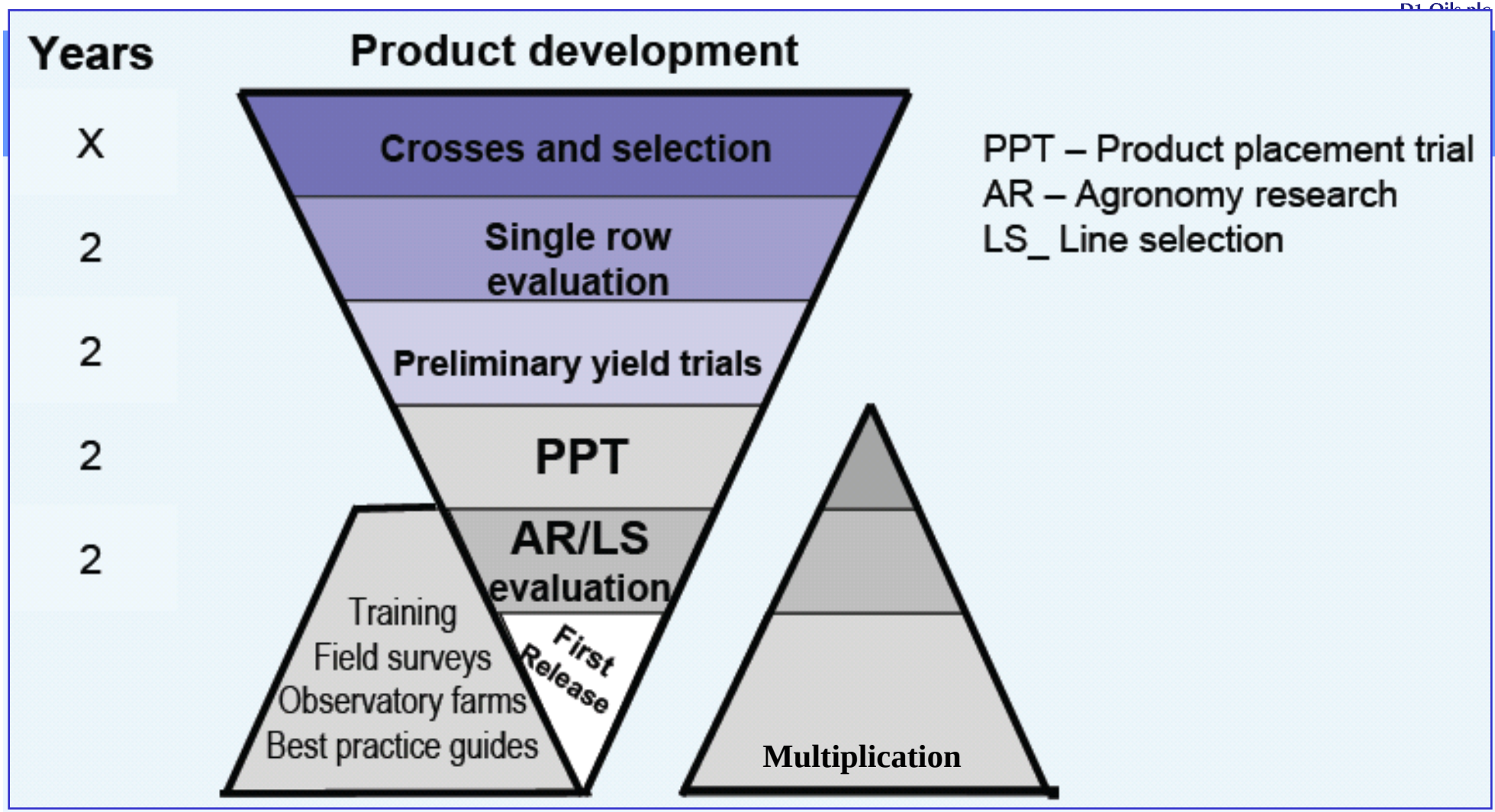
Yield increase tons oil/ha

- Agronomy research
- Breeding/selection

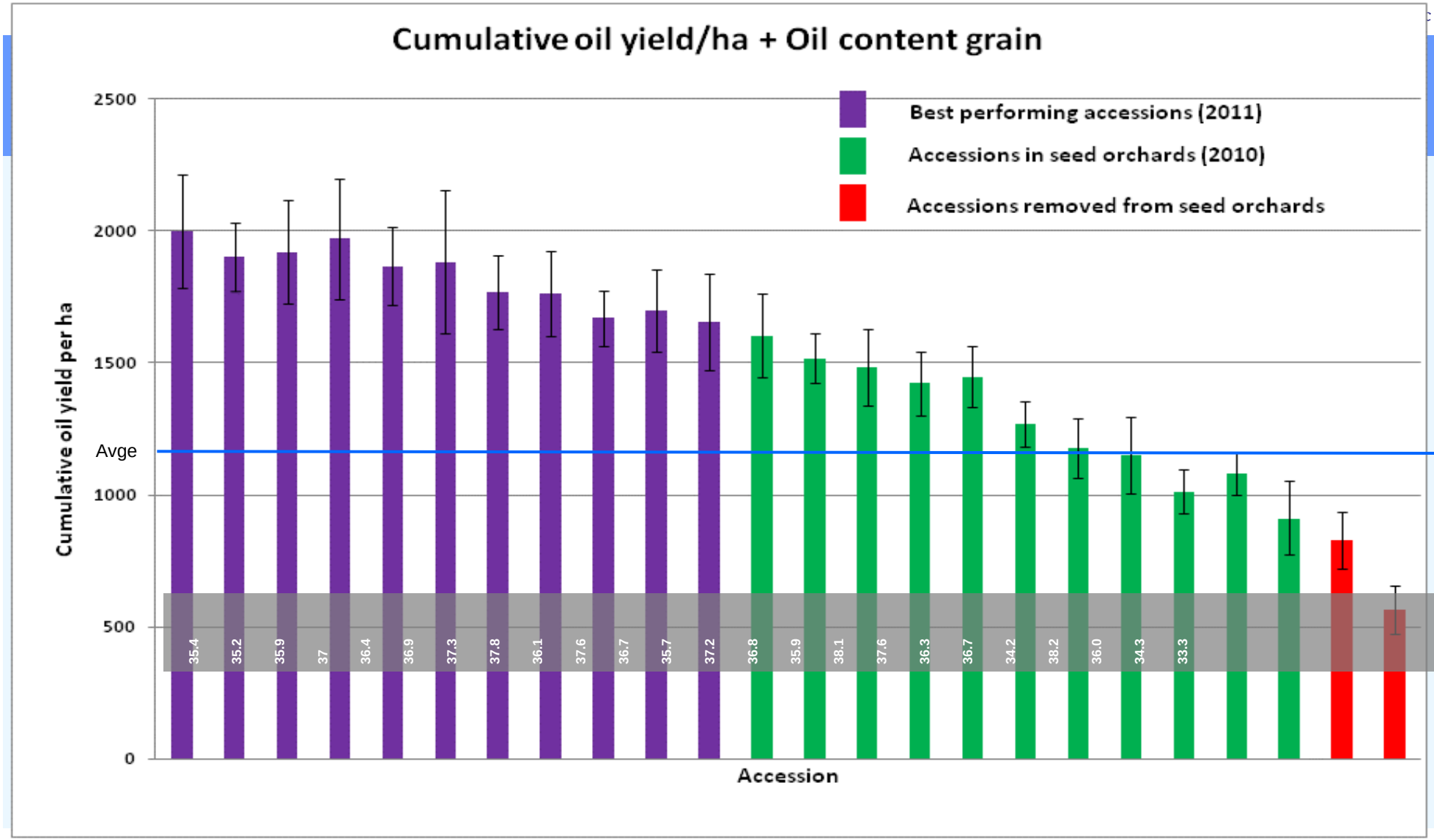
% Yield Increase Oil Palm and Sugarcane



Developing cultivars in Jatropha curcas



First candidate cultivars coming up



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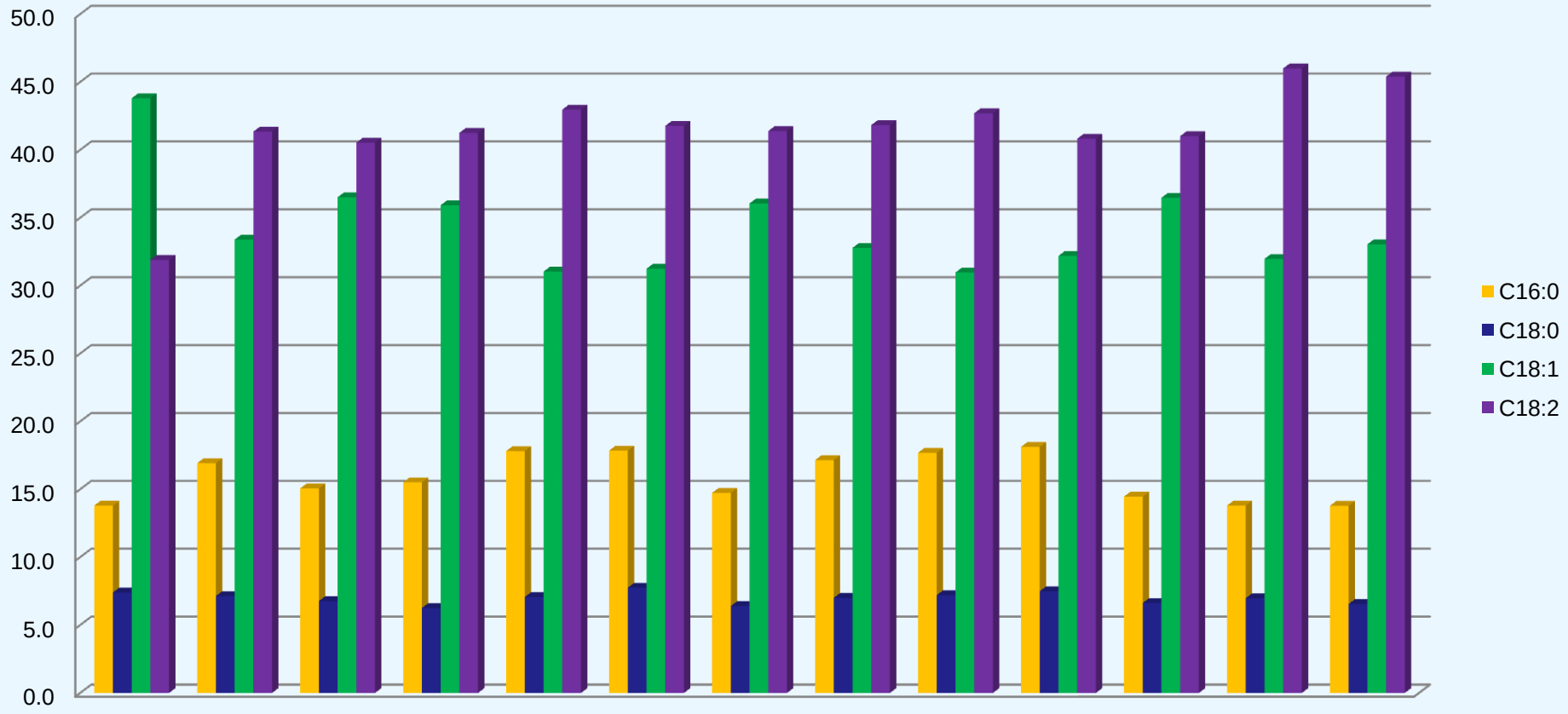
Oil profile Jatropha accessions



JC-2007-09 : PPT BENGKULU - INDONESIA

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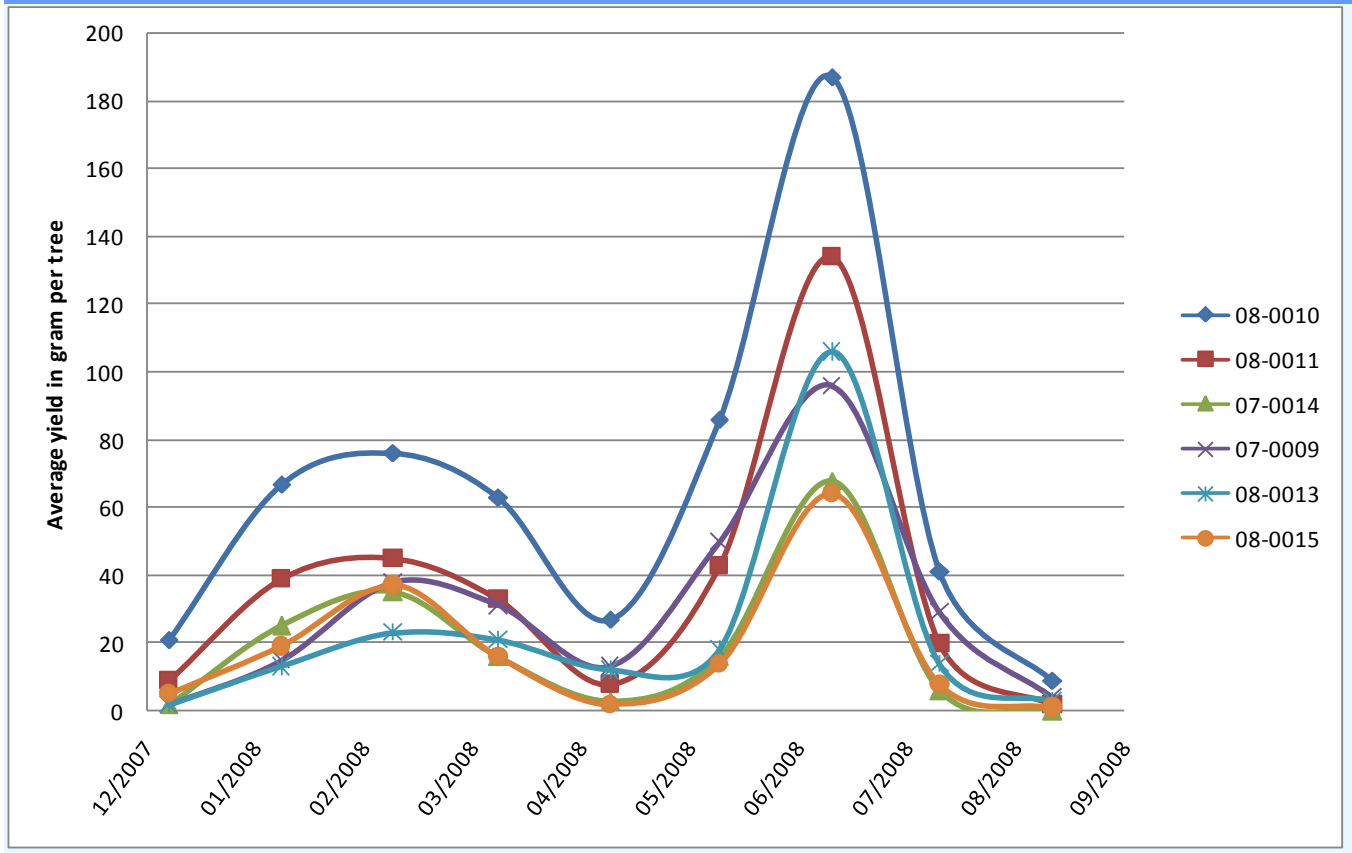

Accession 08-0010:

- Oil content: 35%
- FA:
  16:0: 13.8
  18:0: 5.4
  18:1: **47.3**
  18:2: 32.5

Accession 08-0011:

- Oil content: 35.6%
- FA:
  16:0: 14.5
  18:0: 5.7
  18:1: **46.8**
  18:2: 31.9

D1 Oils Plant Science

- D1 has established a plant science based programme to increase the productivity of Jatropha

- Plant Science objectives for Jatropha curcas
  - Improve oil yield per hectare of Jatropha through agronomy and breeding.
  - Select and breed Jatropha cultivars adapted to different target growing areas.
  - Optimise oil quality for different end use markets.
  - Ensure maximised economic value from by-products – e.g. meal for animal feed.
- Expansion of expertise and infrastructure towards applications in new crops
  - E.g. Sweet Sorghum.

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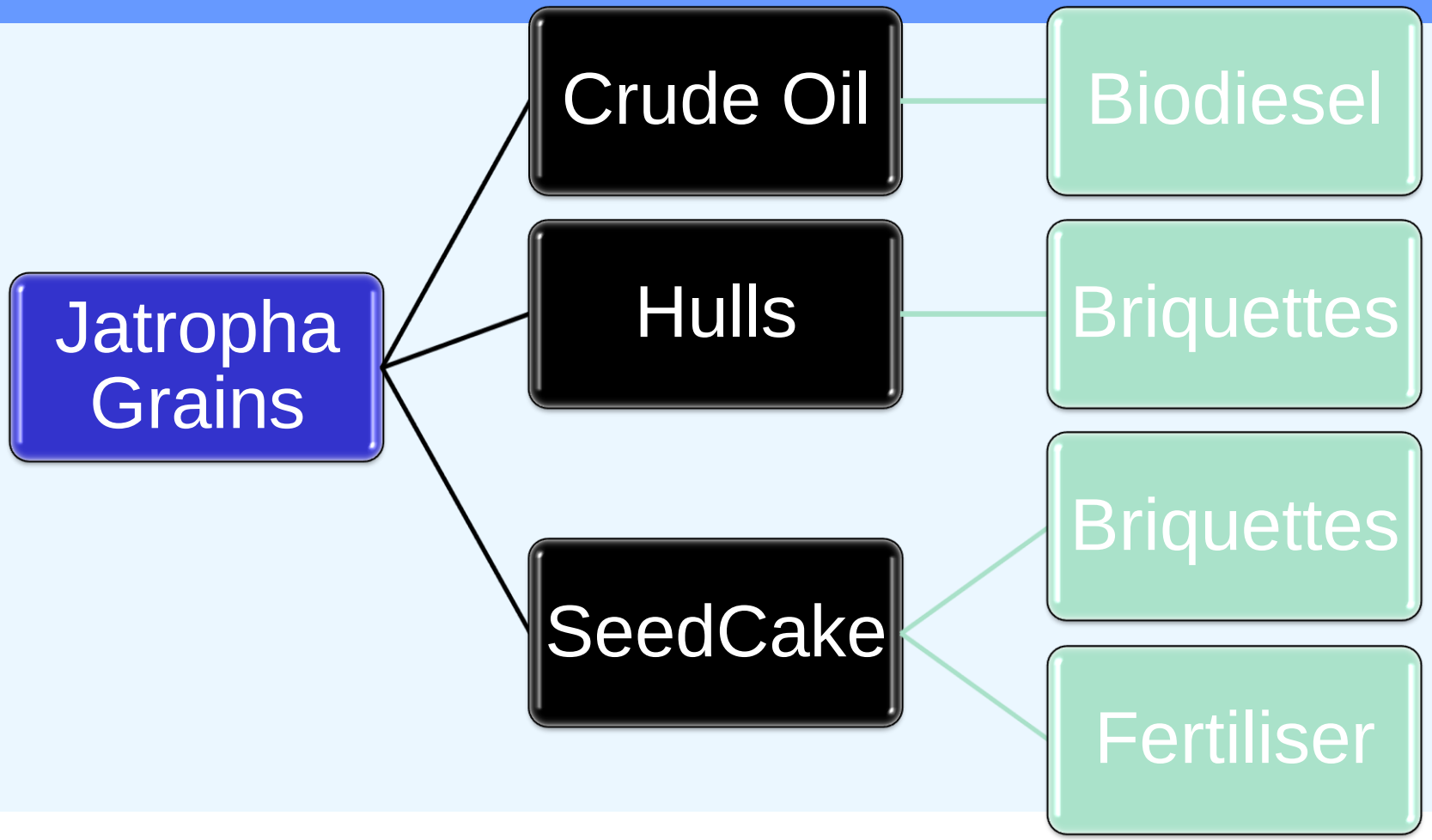
Conventional uses



D1 has been running a project since 2006 to confirm high value meal is a viable prospect. The project is focused on seedcake to meal part of value creation.

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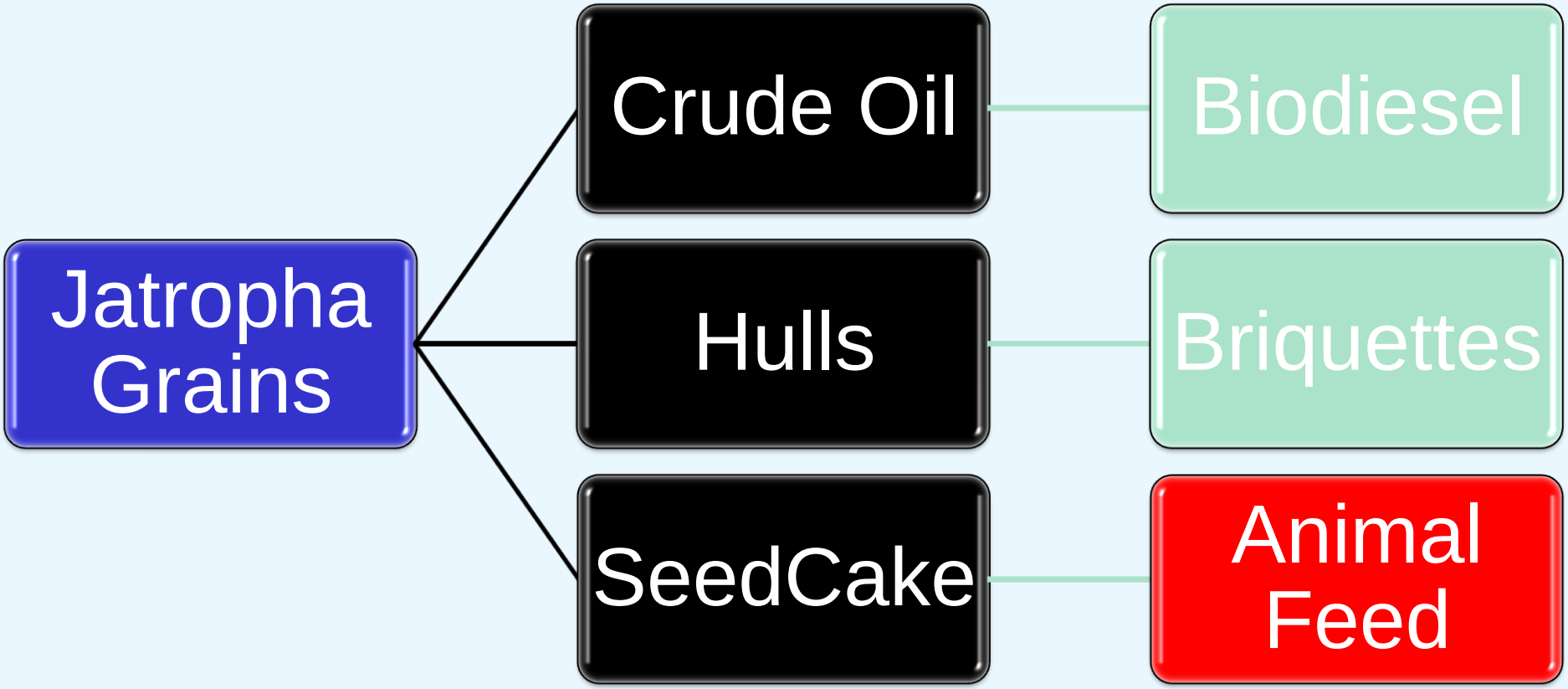
Higher Value Uses



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How good is Jatropha Animal feed?

Feedstock	Market share (%)	Energy Content (MJ/kg DM)	Protein Content (%)	Fiber Content (NDF %)	Anti Nutritional Factors	Detox treatment methods
Soybean Meal	70	12	53	6%	Trypsin Inhibitor, Phytic Acid, Lectins, Oligosaccharides, Bitter taste	Heat treatment and solvent extraction
Rapeseed Meal	12	12	39	12-14%	Glucosi	Controlled feeding levels
Sunflower Meal	6	9.5	37	15%		
Cotton Meal	6	11.5	40	15%	oss	Controlled feeding levels, Breeding, Solvent extraction
Jatropha Meal	0	18	56-68	10%	Phorbol esters, Curcin, Trypsin Inhibitor, Lectins, Saponin, Phytates, Bitter taste	UNDER DEVELOPMENT – Solvent extraction and heat treatment

Better than Soybean

(others: Peanut, Copra, Palm)

(source: USDA, KW feeds, AB Agri, Makkar, D1 Labs, US Labs)

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The new product: protein rich animal feed

- No curcin activity
- < 25 ppm phorbol ester
- No lectin activity
- No trypsin inhibitor activity
- No saponins

- Ca 65 % protein content
- > 90 % digestibility in ruminant assay

- No toxicity in brine shrimp assay
- No toxicity in Drosophyla larvae assay
- Feeding with livestock trials ongoing

- First estimated value: slightly below or similar to soybean meal based on quality observed 250-300 USD/ton).

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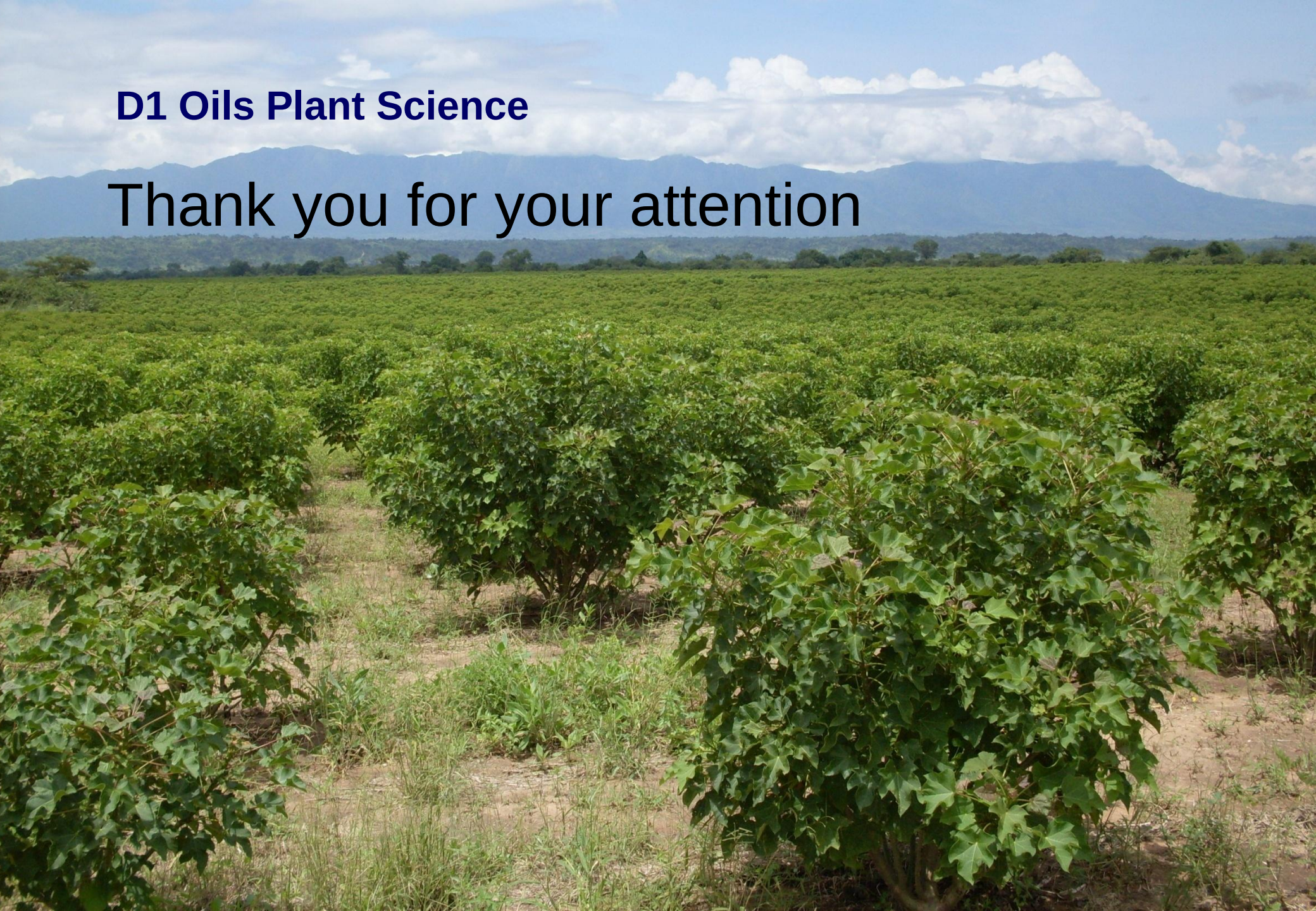
Conclusions

Jatropha is not a miracle crop, but when farmed correctly it can deliver its high potential as a sustainable and economically biodiesel feedstock.

Most of the plantings are still done with “weeds from the wild”. These cannot be expected to bear high yield, especially without the proper farming practices.

D1 Oils Plant Science (DOPSL) has one of the most comprehensive global research programs on this crop and has learned to identify critical success and failure factors.

DOPSL is currently the only company that has an industrial process to convert toxic Jatropha cake into valuable animal feed.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Thank you for your attention