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Jatropha curcas elite seeds
Jatropha cultivation technologies

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Executive summary

- Jatropower, established in 2008 in Baar, Switzerland, operates through its fully owned subsidiary in India and other experimental sites
- Jatropower's jatropha genotype collection is among the most diverse and represents the genetic diversity available in all jatropha hotspots in the world; this is a major asset company
- The company's present elite seed portfolio includes 4 elite line cultivars including one edible, non-toxic variety and two F1 hybrids
- The company employs state of the art marker assisted selection and breeding techniques to accelerate maturation of the elite seed pipeline
- The company enjoys cost and price leadership among jatropha companies and is the only jatropha breeding company that has sold commercial quantities of conventional and edible jatropha seeds in the market till date

Slide 3

Jatropower AG - International spread

Starting year: 2008, key personnel in jatropha sector since >20 years
Financing: private equity of the promoters
Facilities: Own research farms and laboratory, collaborative research on client farms,
Research collaboration: Public universities and research institutes in Germany, Italy and India

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Business focus

- Develop elite Jatropha curcas seeds by selection and breeding
- No use of artificial genetic engineering tools or transgenic development, only conventional plant breeding
- Produce seeds in the two focal lines:
  - Conventional jatropha elite seeds to facilitate new generation fuel feedstock production and land reclamation
  - Edible jatropha varieties for edible vegetable oil and plant proteins from less optimal soil conditions and land reclamation
- Develop cultivation techniques for efficient agronomic management of jatropha plantations
- Develop robust small-scale techniques for processing jatropha seeds into valuable products

Two main jatropha lines under development

- Jatropower is developing two varieties of jatropha parallelly
  - A new edible edible variety of jatropha curcas – the products are:
    - Seed oil for use as edible oil
    - Seed kernel meal as human food and animal feed ingredient
    - Seed shells as biomass burning fuel
    - This variety occurs naturally in Mexico and Jatropower has improved it by selection and breeding
  - The conventional toxic variety – main product is oil as a biofuel feedstock and by-product is seed cake as fertilizer
  - The difference between the edible Jatropha (called Xuta in its native region in Mexico) and conventional toxic variety is the absence of the toxic factor, **phorbol esters** in the former. Otherwise the seed composition is the same for both varieties as shown in slide 11

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Why Jatropha curcas?

- Jatropha seeds contain more than 35% oil that is a suitable feedstock for biodiesel and hydrotreated vegetable oils (HVOs), in the case of xuta, also as edible oil
- Perennial plant yielding for more than 15 years after plantation
- Adaptable plant and an efficient user of nutrients and water
- Can grow on wasteland and improve quality of soils over time
- Needs relatively less chemical inputs
- Seeds easy to harvest, store and process
- High potential for carbon sequestration when planted on denuded land

Jatropha is by nature a highly adaptable plant

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Jatropha curcas is a highly adaptable plant belonging to the family Euphorbiaceae.
It can grow and yield seeds even in hot deserts if irrigated
The picture shows a Jatropha plantation in Luxor, Egypt irrigated with sewage water (photo taken with permission from the Egyptian ministries of Environment and Agriculture, to whom the plantation belongs)


Pictures taken from the EnBW jatropha project in Madagascar that uses Jatropower's elite seeds for its plantation on denuded wasteland
Jatropha plantations using Jatropower's elite seeds have the potential to re-green eroded lands, reclaim soil, sequester CO2 in biomass (3-4 tonnes per ha per year under these conditions), provide renewable fuel feedstock that generates about 80% less CO2 emissions compared to fossil fuels and result in new economic activity in structurally weak areas in many tropical countries


Jatropower breeding has resulted in elite jatropha seed material
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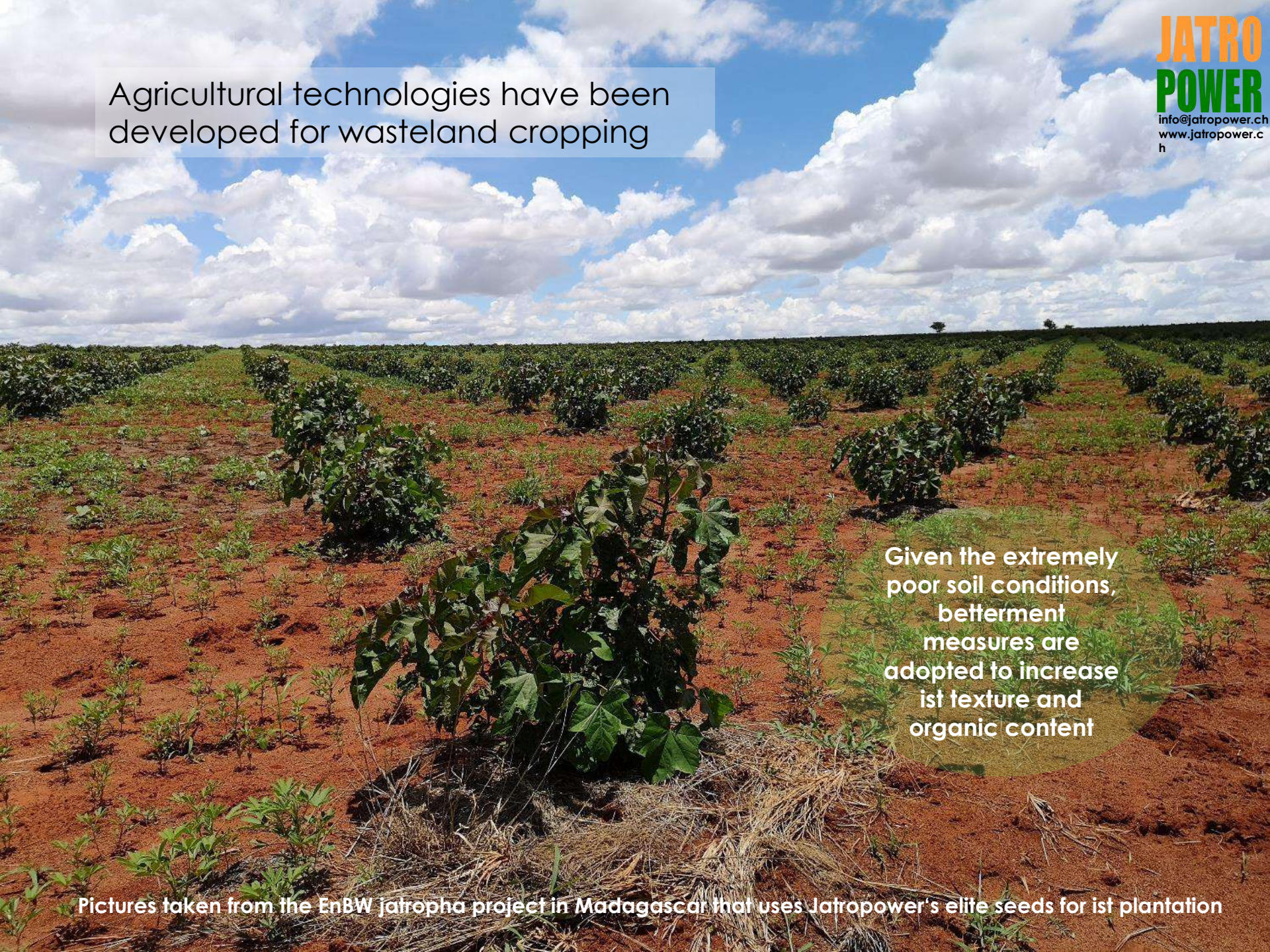
The standardised elite seeds are capable of robust and uniform growth under stressful soil and climate conditions,
Pictures taken from the EnBW jatropha project in Madagascar that uses Jatropower's elite seeds


Agricultural technologies have been developed for wasteland cropping
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Given the extremely poor soil conditions, betterment measures are adopted to increase ist texture and organic content
Pictures taken from the EnBW jatropha project in Madagascar that uses Jatropower's elite seeds for ist plantation

Agricultural technologies have been developed for wasteland cropping

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The leguminous intercrops and cover crops help the jatropha plants and to reclaim the soil eventually

Pictures taken from the EnBW jatropha project in Madagascar that uses Jatropower's elite seeds

Jatropha fruit and proportion of its fractions

Dry Fruits 100 %

Seeds 60 %

Husk 40 %

Kernels 65 %

Shell 35 %

Oil 60 %

Kernel meal 40 %

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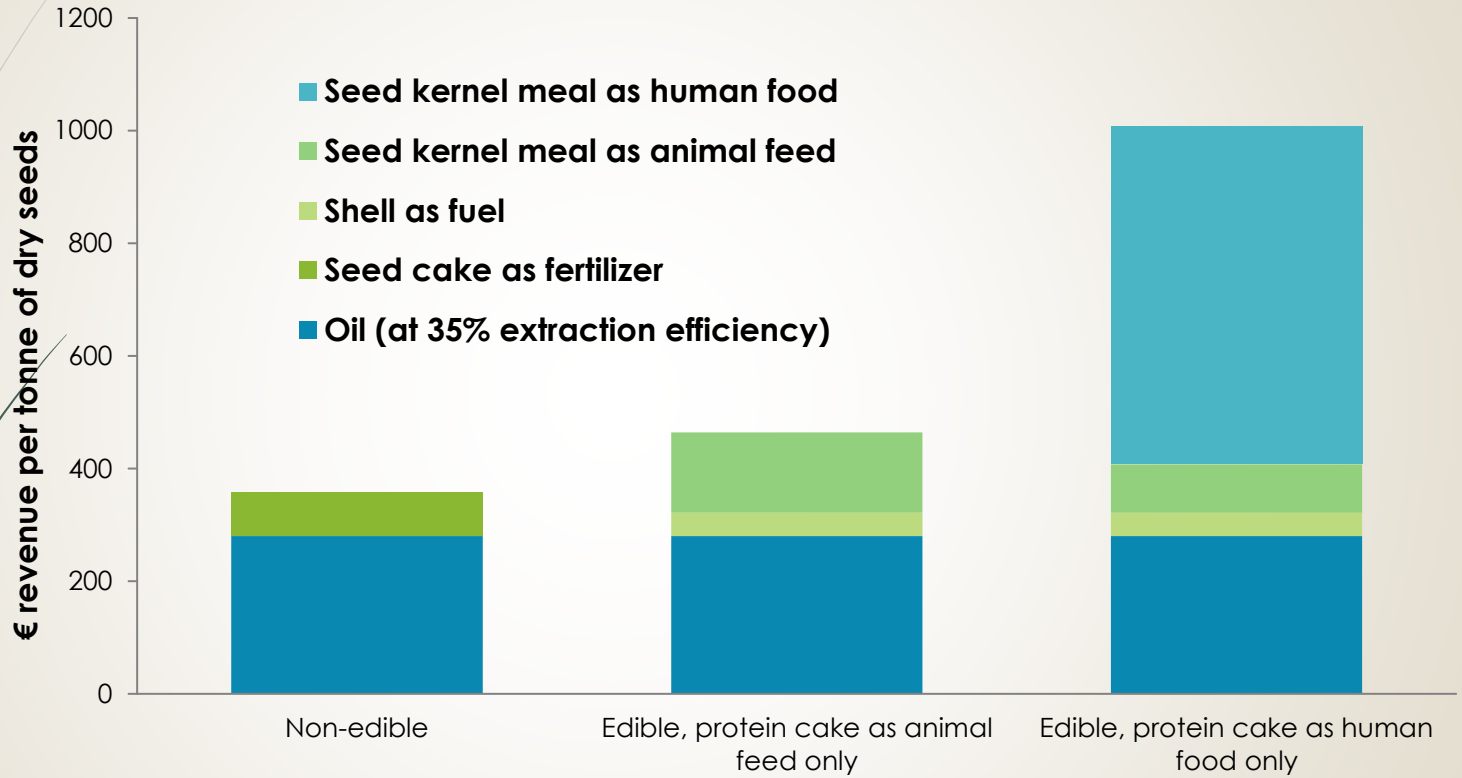
Edible jatropha (Xuta)

- Jatropower has pioneered the development of high-yielding edible jatropha(Xuta) seeds
- The first ever standardised edible jatropha elite seeds, JPNT-1, already being marketed (Ref http://www.jatropower.ch/edible-high-performance-jatropha/)
- Further cultivars and F1 hybrid Xuta seeds in the pipeline.

Why Xuta (edible jatropha variety)?

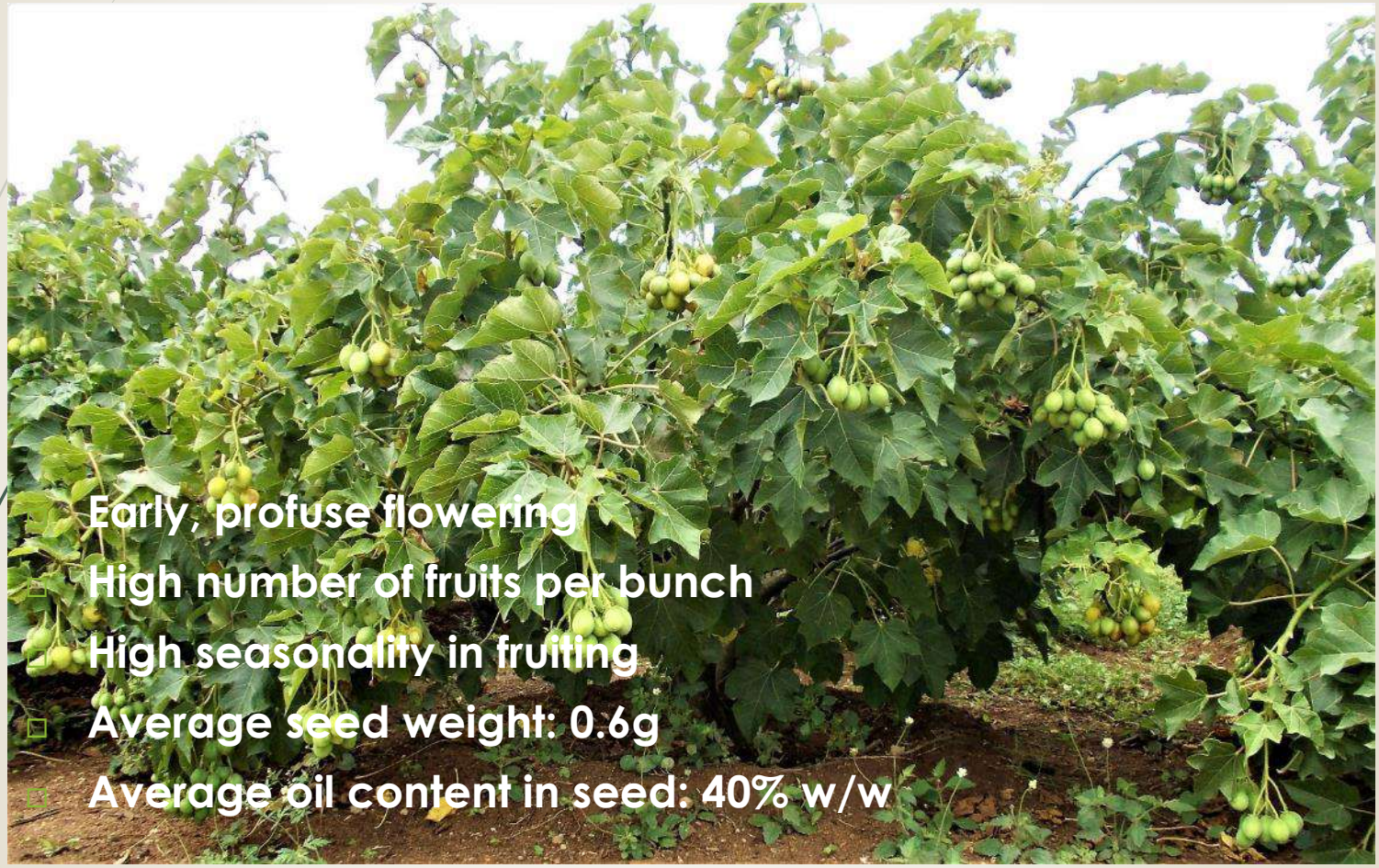
- Xuta oil is a healthy, edible vegetable oil containing 43% PUFA content (poly unsaturated fatty acids)
- The Xuta kernel meal after oil extraction has more than 60% high quality protein (compared to 48% protein in high-protein soybean meal)
- The protein quality of edible jatropha has been proven in several feeding trials and is suitable for inclusion as a protein concentrate in human and animal nutrition
- Above all, edible jatropha can be cultivated under conditions (stressful climate, poor soil) where other comparable crops such as soybean will not grow.

Edible jatropha has high potential to increase jatropha crop returns



Assumptions: The bio oil price is assumed to be €800/ton. The toxic seed cake can at best be used as fertilizer. It is usually not suitable as fuel because of high N content. The €125/ton assumed is the expected price for this fraction. For edible Jatropha, the kernel meal price for animal feed is assumed to be €450/ton and that as human food to be €1800/ton; Jatropha shell has a calorific value of over 18MJ/kg and hence valued at a minimum price of €125/ton.

Cultivar JPNT-1 (Xuta or edible Jatropha)



- Early, profuse flowering
- High number of fruits per bunch
- High seasonality in fruiting
- Average seed weight: 0.6g
- Average oil content in seed: 40% w/w

Edible jatropha is certainly a crop to mark for the future

18 month old edible jatropha cultivar cultivar JPNT-1 on wasteland in Madagascar

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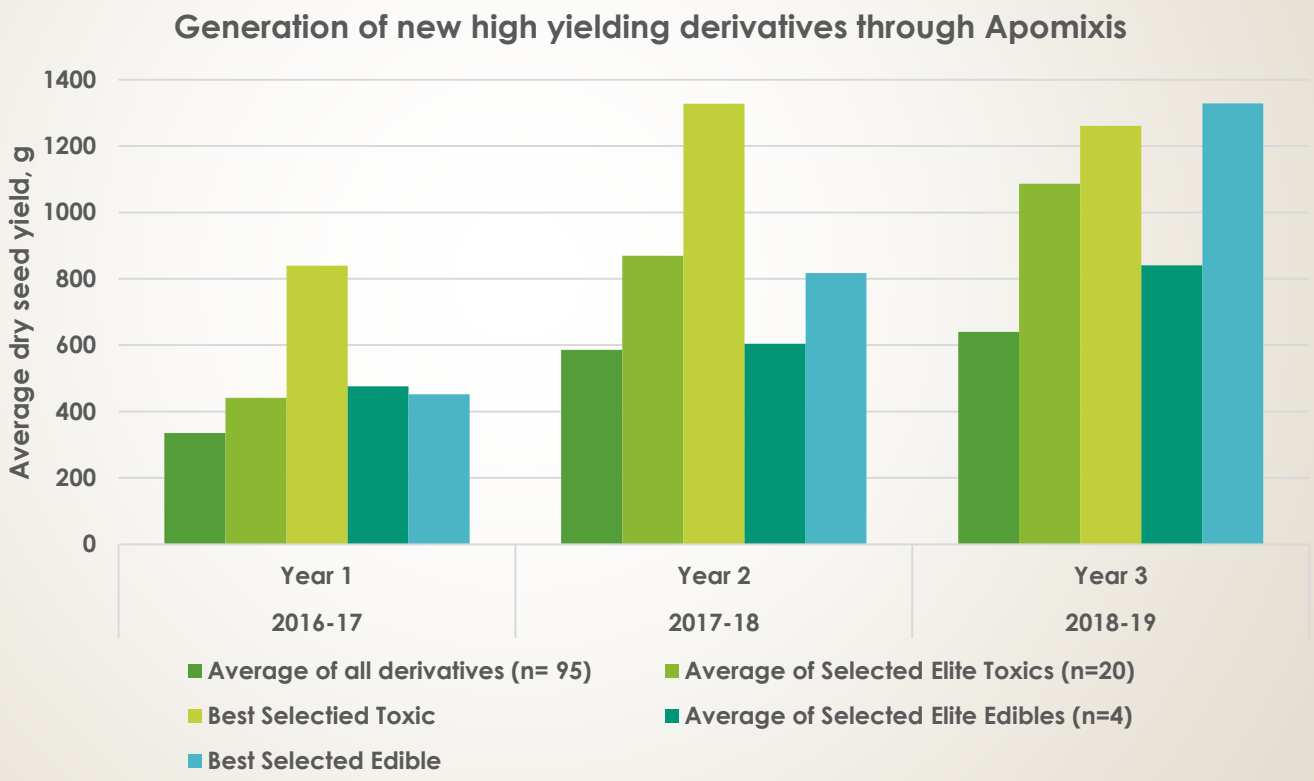
Further development of edible jatropha cultivars

- Jatropower edible (NT) provenance collection do show a certain phenotypic variation
- The genetic distance measurements were repeated in 2018 with state-of-the-art techniques
- A new selection of parents have been effected based on these and new NTxNT crosses have been initiated in 2020
- A further interesting source of NT variability comes from NT plants derived from apomixis
- The present Jatropower pipeline has several promising cultivars/derivatives that will be offered shortly in the market

Increasing the variability for selection of elites is critical for edible and conventional jatropha development



Conventional Jatropha curcas seeds

- These seeds are meant for
  - Cultivation of wasteland and their eventual reclamation
  - Production of feedstock oil for biofuels
  - Jatropower has several elite conventional jatropha cultivars and hybrids currently in its portfolio
  - Details can be obtained from:
  - http://www.jatropower.ch/non-edible-high-performance-jatropha-elite-cultivars/
  - Jatropower's proposed climate solution "**Jatropha F1 Hybrid Seeds for New Generation Fuel Production**" has been one of the early selections to the elite "**1000 Solutions to protect the environment**" of the Solar Impulse Foundation, Switzerland. More details at https://solarimpulse.com/efficient-solutions/jph1-seeds
  - The same solution has been selected as one among 5 climate solutions (out of over 360 solutions) by the International Finance Corporation (IFC) for pitching to global investors

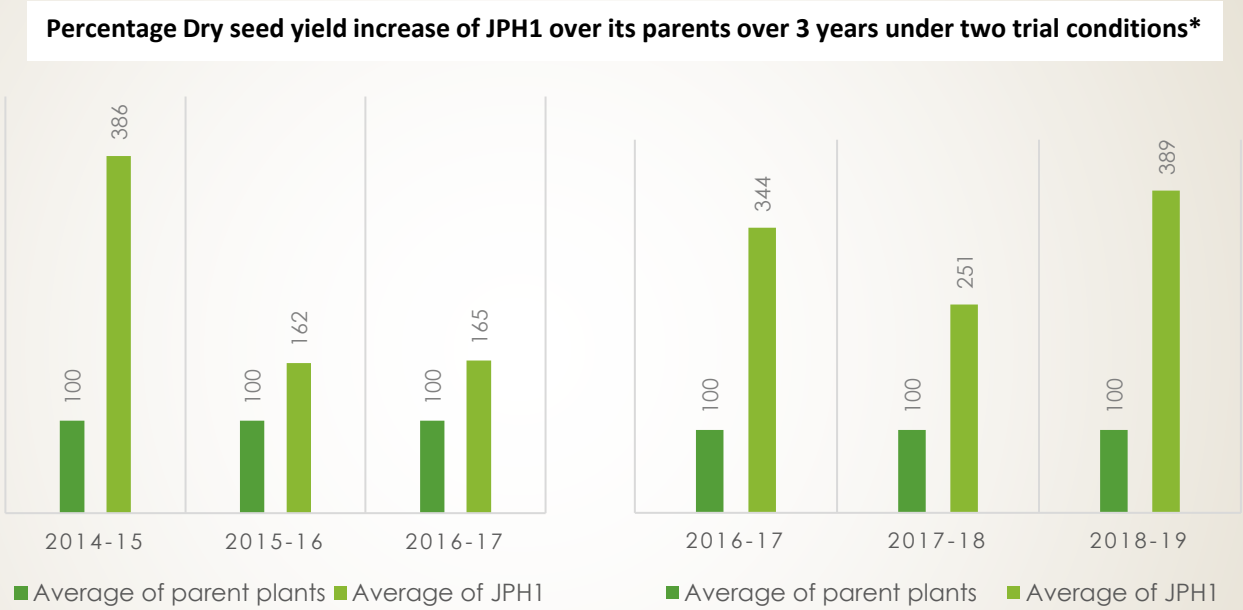
The best JP hybrid so far (JPH1)

Early and heavy bearing – One year old JPH1 in India

Big fruit bunches on all branches

More details on characteristics and yield at
http://www.jatropower.ch/non-edible-high-performance-jatropha-f1-hybrids/

JPH1s performance in drought years inspire confidence



** 2015-16, 16-17 and 17-18 were extreme drought years at both the sites in S. India where the trials were conducted.*

Scalable F1 hybrid production system using pistillate jatropha plants

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Pistillate J curcas with only female flowers

Normal J curcas with male and female flowers

The first scalable hybrid production farm established for the second Jatropower F1 hybrid, JPH2

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In house laboratory facility

- Capabilities
  - Seed morphology
  - Seed oil content
  - Non-destructive dry matter determination
  - Free fatty acid determination
  - Non-destructive seed oil determination
  - Fatty acid composition of plant oil
- External collaboration
  - Marker analysis
  - Fatty acid composition analysis
  - Phorbol ester analysis

Other Jatropha species available at the farm for crossing trials

- Jatropha gossypifolia
- Jatropha mahafalensis
- Jatropha glandulifera
- Jatropha integerrima
- Jatropha pandurifolia
- Jatropha platyphylla

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Focus of actions in short term

- Further increasing the genetic quality of jatropha seeds, with emphasis on edible jatropha (xuta)
- Obtain regulatory permission to market xuta products in the EU (and subsequently in other markets) as human food/edible oil
- Continue supporting the client jatropha plantation project in Madagascar to develop it into a full-fledged demonstration of jatropha under challenging conditions (ongoing project)
- Realize a demo xuta farm with a client in a middle eastern country, under desert-like conditions (business acquired in 2020)
- Develop a highly promising client contact for a big plantation project in Africa to realisation in 2021

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Jatropower AG welcomes partners in tropical countries and supports them in their goal towards inclusive development through climate-smart agriculture on sub-optimal, denuded land

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