CHIBAS

Centro Hispaniola de Investigación en Bioenergías y Agricultura Sostenible

Breeding Jatropha as a sustainable energy crops for Hispaniola

The goal of this proposed research is the development of an efficient sustainable energy-crop agro-system to provide an alternative source of energy in developing countries and Hispaniola in particular. This system would rely on *Jatropha curcas* (hereafter '*Jatropha*') nuts, which are rich in oil that has proven to be highly suitable for the production of bio-diesel (methyl or ethyl-esters); additionally, the straight vegetable oil can be burned directly in slightly modified diesel engines. Recent changes in the global energy market mean that the oil-rich nut of *Jatropha* could create significant wealth for farming communities and for the economy of the world's poorest countries. Such Jatropha system will rely on feedstock availability and therefore farmers being provided with productive varieties that allow them to have significant income from growing Jatropha.

Current information on Jatropha is anecdotal at best; it is not enough for our policy makers to make informed decisions about land use and the promotion of a biodiesel agro-industry. Our project will be providing such science based public information. We propose a program aimed at the release of improved *Jatropha* varieties and corresponding seed and propagation technologies along with the best agronomic management practices that will allow for the development and establishment of successful *Jatropha* agro-systems.

Goals and projected outputs

The aim of this project is to evaluate the genetic resources of the tropical shrub *Jatropha* as an energy crop suitable for marginal and degraded lands of the tropics and to establish a corresponding breeding program along with the establishment of good agronomic practices for this new crop management.

- We aim at establishing an efficient *Jatropha* germplasm repository (live collection) and the development and release of germplasm (new improved varieties) adapted to the new needs for oil and biodiesel production.
- We will systematically evaluate the germplasm and make the results readily available. This germplasm will be evaluated for traits such as seed toxicity, oil content as percentage of dry matter, high oil oxidative stability, protein content, resistance to pest and diseases and traits enabling the mechanization of fruit harvesting.
- We will be releasing Jatropha varieties aimed at biofuel (biodiesel) production and adapted to the marginal areas and degraded land of tropical countries. We will characterize Jatropha yield components and look for genes/alleles maximizing all desirable traits. Through breeding and the use of all available techniques, we will pyramid these alleles into ever more productive Jatropha varieties.
- Development and evaluation of inexpensive mass propagation methodologies for clonal reproduction or improved hybrid seed production in order to cheaply mass produce plantlets for farmers.

- We will evaluate and establish the most appropriate agronomic practices under different scenarios (low input agriculture or maximization of production/cost ratio)

Why do we need to breed *Jatropha*? (Why can't we just use available ecotypes and clones?)

Plant breeding is the most cost-effective way to achieve an increased and stable yield. While native *Jatropha* or outstanding individuals that can readily be cloned offer an already-substantial yield and drought tolerance, plant breeding would allow for continuous increase and release of ever more productive varieties. In industrial terms, this increase will translate to, for example, oil with increased oxidative stability and other properties that will lower the cost of making biodiesel and enhance its quality. Varieties with higher oil content in percent of dry weight will also provide increased revenue per working-hour for the farmers. The development of non-toxic varieties will allow farmers to have additional markets for their product (not just biodiesel). *Jatropha* cake meal is protein rich, making it a highly attractive animal feed. Making *Jatropha* seeds edible will increase its economic value (two income-generating products instead of one). The 'green revolution' for major cereals would not have been made possible without the release of outstanding varieties. A new green revolution will require also new outstanding energy crop varieties.

Low cost mass propagation methodologies

It is not enough to have a good clone; we have to provide the ways to deliver it to the growers!

Jatropha can be propagated through seeds, plantlets from tissue culture, from grafting and finally from cuttings. Grafting shortens time to maturity and harvest by 4 months allowing individuals to yield within the first year. Cuttings and tissue culture allow for the rapid mass production of plantlets.

The project will aim at testing and developing the required technology and techniques for mass seed and/or plantlet production. Effect of these strategies on agronomic performance, yield and drought tolerance will be evaluated. We will publish and make public (free to use) the methodologies developed and ensure that adequate training is provided to partner NGOs, seed companies, private sector partners, and farmers organizations for mass seed or plantlets production. We will focus on methods for mass production of cuttings and scions along with efficient root production methods in order to provide an inexpensive technology capable of producing large amount of plantlets to the growers.

Crop management; how to grow Jatropha?

Jatropha agriculture will require establishing the methodologies for managing this new crop. We will establish research in areas such as intercropping, pruning, use of bee hives to enhance fruit production, minimization of agricultural input, maximization of production/cost ratio (best use of agricultural input), and finally mechanization of harvesting.

Networking and international exchanges on Jatropha

CHIBAS has already established contacts and initiated collaborations with a number of international partners interested in establishing a Jatropha research community. These include researchers at Cornell University and Texas A&M University in the United States of America, Tamil Nadu University and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India. We believe it is essential to promote the exchange of genetic material, information and knowledge to allow to rapidly reaching our goals.

Timetable for research (Project expected deliverables)

Results in	1st and 2nd year	3 years	5 years
Live collection and Germplasm evaluation	All information and clones are Public Domain	All information and clones are Public Domain	All information and clones are Public Domain
Agronomy		Partial (2)	Best practices (3)
Promising varieties		Medium scale multilocation trials with partner NGOs and private sector (2)	
Released varieties			New varieties are released every year from year 5 onwards (3)
Mass propagation methods for plantlets and scions	Partial	Completed (1)	

(1) Low cost mass propagation methodologies (propagation of elite clones as scion or plantlets) will be optimized in the first three year of the project.

(2) Promising varieties should be available to be planted by partner NGOs and private sector three years into the project. These partners will have agreed to contribute to these early trials. These partners would have access along with these promising varieties to the current state of our research on the 'crop management practices'

(3) Fully evaluated varieties will start being released by the project in year 5 onwards. Ever more productive varieties will be released along with a 'crop management itinerary'. We will be releasing varieties along with the corresponding crop management itinerary for both low input and production/cost maximization scenarios.