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Jatropha: Possible Jet Fuel but Difficult to Scale Up

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If you had not gathered this before, then you should know that I have been favorably impressed with the potential of algae as a future source of biofuels. However I recognize that there is a considerable amount of research and business development and growth that will have to occur before such fuel makes a significant impact in the market place.

Of the other alternative biofuel sources, I was also considerate of jatropha, which seemed to have some significant potential. The fuel comes from the nuts which the shrub produces, and since it can be grown on quite poor land, and in some countries is already in use a fencing plant I anticipated that its potential would be increasingly recognized. Well, it has not quite turned out the way that I thought it would, at least not yet.

And so some comments on what has, and has not, happened. Jatropha seems to have its own slogan "Soil to Oil" with a Center for Jatropha Promotion & Biodiesel located in Rajasthan in India. Jatropha curcus is a shrub or small tree that can grow on poor to marginal land in tropical parts of the world, growing to a height of perhaps 15 feet. It produces a nut in clusters of around 10, and the nuts contain seeds which are about 37% of an oil that will run a diesel engine without further refining.

The oil has been used in a 50:50 blend with jet fuel to power one engine of an Air New Zealand 747 on a 2-hour flight last December 30th. The oil has a lower freezing temperature than jet fuel, and has been estimated to cost around $43 per barrel. This flight was followed, on January 7th by a Continental Airlines flight which used a 737-800, and a mix of oil from jatropha and algae. The flight saw a 3% savings in fuel by the engine using the biofuel. The algae oil came from Sapphire Energy; the jatropha came from Terasol Energy. The biofuel was mixed 50:50 with jet fuel, and there were no modifications made to the engine.

The success of the test has encouraged Sapphire, who is now predicting that they will be able to produce 1 million gal/year (65 barrels/day) of diesel and jet fuel, rising to 10 million gallons (650 bd) by 2018 and 1 billion gallons (65 kbd) by 2025. Sapphire is based in San Diego.

Terasol supplies both oil and feedstocks, concentrating, at the moment, on jatropha and castor bean oil.

Japanese Airlines carried out their own test on January 30th. The Japanese flight, an hour-and-a-half long, used a mixture of 84% camelina, under 16% jatropha oil, and under 1% algal oil.

Camelina, (or wild flax) incidentally looks as though it deserves more investigation, since it grows

on poor ground and has twice the yield of soy. Further it also has a low gell temperature. The spent biomass is recognized as a good animal feed, and it grows in places like Kansas and Montana, perhaps alternating with wheat, in which combination it apparently increases the wheat yield by 15%, and gives 100 gallons/acre of oil.
According to the article:

> Dr. Bill Schillinger at Washington State University recently described camelina's business model to Capital Press as: "At 1,400 pounds per acre at 16 cents a pound, camelina would bring in $224 per acre; 28-bushel white wheat at $8.23 per bushel would garner $230."

Returning to jatropha, the President of Terasol recently answered some questions for Scientific American. He noted that the main problem the fuel now faces is one of scale.

> . . . the main obstacle is the lack of research and practice in large-scale commercial cultivation, as well as mechanized harvesting. Currently most jatropha and castor are grown on smaller, independent farms. The second obstacle is yield and unit of input. Research in plant breeding needs to continue in order to improve the quantity and quality of oils being produced.

They see commercial quantities of the jatropha being available in 3-5 years.

The optimistic view of jatropha's future is becoming less common, even as it is projected as a fuel of the future. There in fact some doubts about its feasibility:

> Not only was the cultivation of jatropha supposed to absorb more CO2 from the atmosphere than it released, but the miracle tree could also stabilize and restore degraded soils. That's surely why Scientific American in 2007 called jatropha "green gold in a shrub," a plant that "seems to offer all the benefits of biofuels without the pitfalls."
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> Fast forward a couple of years. By 2009, governments from China to Brazil, along with several major biofuel companies, had planted — or vowed to plant — millions of acres of jatropha. In India alone, the government has announced plans to subsidize an intensive program to plant jatropha for biofuels on 27 million acres of "wastelands" — an area roughly the size of Switzerland.

The problem, again, is one of scale. With the average farm being around 12 acres (at 2-300 gal/acre/year) the current gains come mainly from local use, rather than collection to meet larger national goals.

For example, in Mali the nation has some 10,000 km of jatropha hedges that yield about 1 kg/meter/year. If all the nuts were collected and processed this would yield around 5 million liters per yr of oil (85.8 bd). Typical village hedge lies between 2 & 15 km, making oil generation very much a local enterprise. It is growing because there has been a move to provide local women with engine powered grain mills, to start small businesses. But the fuel cost was prohibitive. Collecting and processing the nuts can not only provide the needed fuel, but also inject about $3,800 on average, per village per year. As a result local hedges are growing in length, though somewhat slowly (from 5 – 15 km in 8 years.) The projects have also benefitted from development of a shelling machine for the nuts.

But while the growth is commendable, it is nowhere near working at the scale needed to have a significant market impact. The latest news is that to get high yields, huge water inputs are needed--20,000 liters of water to produce one liter of biofuel. This news will further make scaling up oil production from jatropha difficult.