

THE CONTRIBUTION OF JATROPHA CURCAS PRODUCTION IN SOUTH AFRICA TO BIO-FUEL PRODUCTION

1. INTRODUCTION

Jatropha curcas is a perennial plant that produces seed for a period up to 50 years. It is a shrub or small tree, a member of the Euphorbiaceae species and could grow to a height of up to 6 m. It is considered one of the medicinal plants of Southern Africa (1).

According to information supplied by Kirstenbosch, the plant naturally grows in Africa, between 15 degrees north and 15 degrees south (high rainfall), as well as a part of South Africa with lower rainfall, where the lowest temperature remains higher than 2°C. The coastal temperatures of KwaZulu-Natal and the Eastern Cape particularly conform to these requirements (2).

Reference (3) provides an overview of *Jatropha* production in Africa and comments on its possible utilisation, as considered in 2003.

Jatropha utilisation in India, particularly on marginal land, is explained in detail on the internet, (see references) promoting projects for job creation and alleviation of poverty.

Locally, massive attempts have been made to influence decision-makers to support *Jatropha* production and utilisation, e.g. the Sonnenberg Group, Bernd Schmidt (Bio-Diesel Africa), D1 Power and Emerald Oil. One Dutch Reformed Church Congregation (Garsfonteinpark) joined the efforts in planning projects.

The valuable contribution of research in Nicaragua, in co-operation with the Karel-Franzens University in Austria (4), regarding *Jatropha* oil as the basis for bio-diesel production, will be discussed in more detail below.

2. COMPOSITION OF JATROPHA SEED AND FLOUR

According to Makkar *et al* (5) the seed core contains 26 % protein and 57 % oil. This means that the flour contains 61 % of the crude protein once all oil had been removed. After removal of the oil, soybean oilcake meal contains 46 % crude protein (5). However, all information confirms that *Jatropha* protein cannot be used as food or animal feed, because it contains toxins [Van Wyk *et al*, (1), Mampane *et al* (6), SciFinder Scholar (7). Reference (7) provides 21 summaries of journal articles on the subject.

Foidl *et al* (4) also provide feed composition figures for the seed. Oil content of two varieties varies between 53 and 57 % with protein values between 18 and 29 %.

Henning (3) mentions that a non-toxic variety of *Jatropha* was found in Mexico. If this can be confirmed, it will enhance the commercial *Jatropha* potential significantly.

3. JATROPHA OIL COMPOSITION

Jatropha oil has a favourable composition for producing fuel (it contains 34 to 45 % oleic acid and 31 to 43 % linoleic acid). In addition, it contains very little linolenic acid, which means good stability of the oil and bio-diesel [Mittelbach et al (8)].

However, the oil is not suitable for food, as it also contains toxins (8).

4. JATROPHA OIL AS BASIS FOR BIO-DIESEL

The most useful technical information about this was provided by the research study group in Nicaragua (4). Prof Mittelbach and co-workers designed a pilot plant for bio-diesel production and conducted test runs. Although the project showed technical success, labour problems hampered the commercialisation process. According to Geoff Oliver, Dr Foidl described it as a dormant project - largely because of "people problems."

In a study funded by the Department of Science and Technology, managed by the SABS (9), six plant oils were used to manufacture bio-diesel. Jatropha oil was included in the group to compare its technical potential with better known oils such as rapeseed, sunflower, soy, etc. Jatropha oil proved particularly successful upon analysing the specifications and comparing the results. The particular bio-diesel sample complied with all EU bio-diesel specification characteristics. The South African bio-diesel specification, SANS 1935, is based on the EU specification.

5. AGRICULTURAL INFORMATION ON JATROPHA

According to Henning (10), Mali is the only African country in which Jatropha production is progressing well. Fences comprising a distance of about 10 000 km were established, showing potential to produce 5 million litres of oil per annum. Projects have been under way since 1993, mainly to alleviate poverty and to limit soil erosion. De-oiled cake is used as organic fertiliser.

The yield per hectare can be determined according to Foidl *et al* (4), based on plantings over a period of three years.

TABLE 1: EXPECTED SEED YIELD OVER FOUR YEARS (KG/HA)

YEAR	SEED YIELD
1996	1600
1997	1900
1998	2350
1999	2350*

* Calculation was based on yields of single mature plants.

This means that the oil yield per hectare would be about 760 kg.

The above data are similar to yield estimates for poor soil according to Becker *et al* (5). They estimate an oil yield of 500 to 750 kg per ha. In addition, they mention a possible seed yield of 12 tonnes per ha if conditions are good. According to their estimates, plants could be productive over a period of 30 years.

D1 Power's document (2) provides a table showing the oil yield per ha for a large number of crops. An excerpt is provided to put the *Jatropha* yield in perspective.

TABEL 2: OIL YIELD PER HECTARE FOR KNOWN CROPS COMPARED TO *JATROPHA CURCAS*

CROP	KG OIL PER HA
Maize	145
Cotton	273
Soy	375
Sunflower	655
Peanut	890
Rapeseed	1000
JATROPHA	1590
Avocado	2217
Coconut	2260
Oil palm	5000

The big question remains whether the oil yield given above for *Jatropha* applies only to plants under favourable conditions.

Information about growing these plants in South Africa remains limited. Planting commenced in Zimbabwe in 1996, at Makosa Mutoka, the objective being to press oil for energy and soap production. The project is driven using foreign support (3).

Henning (3) also mentions that there is interest in Mozambique, Zambia and Malawi.

In South Africa one of the trial planting sites is at Mafikeng (North West Province). Invest North West planned the project and the Department of Agriculture was not directly involved. According to reports the plants were grown in hothouse conditions, not open fields. The selection of locality in North West is not certain and the temperature limitation (lowest temperature above 2 °C) was probably overlooked.

A second site is at Jozini, Makatini. Plants were sighted at a height of 1.5 m (3) and seed production was measured at about 2.5 kg per tree. Seed was supplied to emerging farmers for planting.

A third trial site is at Ukulinga Experimental Farm, KwaZulu-Natal. They are striving to achieve the following objectives:

- a) the relationship between water usage and seed yield;
- b) labour to harvest seeds;
- c) influence of other crops on the *Jatropha* plant;
- d) the effects of plant density on yield.

There were recent reports of problems relating to a beetle that destroys plants, with a resultant decrease in yields. The contact details of one of the scientists is attached (11).

The journal, *25 Degrees in Africa* (12), published the following information about growing and promoting the crop in southern Africa.

D1 Oils Africa reported that they obtained the rights to grow *Jatropha* on 41 044 ha in Swaziland, Zambia and Madagascar. In Swaziland the 9 244 ha will be distributed in the form of 227 ha managed plantations and 8 017 ha as contract farming. In Zambia 2 411 ha will be planted as managed plantations with contract farming on 20 760 ha. No information was provided about the type of farming in Madagascar. The Chief Executive Officer is Demetri Pappadopoulos and they are prepared to produce inedible, low cost raw material for bio-fuel. Job creation is a high priority (13).

Information about the company Deulco is provided (14). They are involved in growing *Jatropha* seedlings. Three areas in Mozambique are used to grow the seedlings.

6. Summary and Conclusion

- 6.1. *Jatropha* oil is technically suitable for the production of bio-fuel. In various developing countries there are projects underway to achieve this objective.

- 6.2. Jatropha oil is not suited for the human or animal food market, and the by-product, oil cake or flour, is also inedible.
- 6.3. The only way in which Jatropha could be considered non-competitive with food production is if it were planted on land that is not suitable for agriculture. If it were planted on sites with fertile soil, under favourable agricultural conditions, the crop will compete with food crops.
- 6.4. Jatropha seed yield is not known under unfavourable, average or favourable conditions.
- 6.5. Growth potential of Jatropha in South Africa has not been determined scientifically. It is alleged that Jatropha does not seed or propagate itself and it therefore has no intruder potential. A thorough agricultural investigation, planned and implemented scientifically, is required to provide answers. The most suitable varieties must be identified.
- 6.6. A severe technical disadvantage is that Jatropha needs to be harvested by hand. Technical reports show that one labourer can harvest only a few kilograms of seed per day. This may be the reason why the project in Nicaragua could not reach commercial maturity.
- 6.7. **Comments:** The most important argument offered by Jatropha supporters for promoting their business is that the plant does not compete with food crops. Because the seed, oil and oil cake are inedible, if planted on land that is suitable for growing food crops, it competes with food production. The question about the Jatropha yields on marginal or poor land remains unanswered. Would the yield justify the establishment, maintenance and particularly, harvesting, costs?

7. Literature

- (1) Van Wyk, B et al, *Medicinal Plants of South Africa*. 2nd ed 2000, Briza Publications
- (2) Anon. *D1 Power Jatropha Document*
- (3) Henning, R *Jatropha curcas in Africa*, www.jatropha.org 2003
- (4) Foidl N et al, *Jatropha curcas L as a source for the production of biofuel in Nicaragua*. Bioresource Technology 58, 77-82, 1996.
- (5) Makkar et al Food Chem 62, 207-215, 1998 reported by Becker K et al, *Biodiesel from Jatropha plantations on degraded land, Multifunctional Plants – Food, Feeds and Industrial Products*, Univ. Hohenheim, Stuttgart.
- (6) Mampane KJ et al *Jatropha curcas: Use as a traditional Tswana medicine and its role as a cause of acute poisoning*. Phytotherapy Research 1(1) 50-51, 1987.
- (7) SciFinder Scholar search on *Toxins in Jatropha curcas seeds*. Abstracts of 21 scientific articles. Dec 2005.
- (8) Mittelbach M et al *Biodiesel – The comprehensive handbook*, 3rd ed 2006, Martin Mittelbach Publisher, Graz, Austria

- (9) Du Plessis LM et al *Report on the pilot-scale preparation of six plant oil biodiesel samples and their compliance with draft EU standards*. Standards South Africa, May 2005
- (10) Henning R *Combating desertification: The Jatropha project of Mali, West Africa* 1996, <http://ag.arizona.edu/OALS/ALNaln40/jatropha.html>
- (11) Contact Person: Dr Colin Everson, CSIR, tel 033 2606195
- (12) Anon. Growing the future, 25 Degrees in Africa 2(2), 24, 2007.
- (13) D1 Oils Africa, tel +27 (11) 9966800, e-mail penny.healy@d1plc.com. Website www.d1plc.com.
- (14) Anon. Extensive research in Jatropha seedling production methods. 25 Degrees in Africa, 2(2), 26, 2007. Deulco, PO Box 38213, Garsfontein, 0042, e-mail info@deulco.com website www.deulco.com
- (15) [www.underutilized-species.org/Documents/PUBLICATIONS/jatropha curcas india.pdf](http://www.underutilized-species.org/Documents/PUBLICATIONS/jatropha_curcas_india.pdf)
- (16) www.jatrophabiodiesel.org/aboutUs.php

Dr Lourens du Plessis, 15 August 07