



Pongamia pinnata: A bio-diesel Tree spp of India

Ashish Dwivedi¹ and Vineet Kumar²

¹Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India

²Department of Soil Science, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India

(Email : ashishdwivedi842@gmail.com)

Abstract

Biofuel development in India centres mainly on the cultivation and processing of *Jatropha* plant seeds which are very rich in oil (40%). The drivers for this are historic, functional, economic, environmental, moral and political. *Jatropha* oil has been used in India for several decades as biodiesel for the diesel fuel requirements of remote rural and forest communities; *jatropha* oil can be used directly after extraction (*i.e.* without refining) in diesel generators and engines. *Jatropha* has the potential to provide economic benefits at the local level since under suitable management it has the potential to grow in dry marginal non-agricultural lands, thereby allowing villagers and farmers to leverage non-farm land for income generation. As well, increased *Jatropha* oil production delivers economic benefits to India on the macroeconomic or national level as it reduces the nation's fossil fuel import bill for diesel production (the main transportation fuel used in the country); minimizing the expenditure of India's foreign-currency reserves for fuel allowing India to increase its growing foreign currency reserves (which can be better spent on capital expenditures for industrial inputs and production). And since *Jatropha* oil is carbon-neutral, large-scale production will improve the country's carbon emissions profile. Finally, since no food producing farmland is required for producing this biofuel (unlike corn or sugar cane ethanol, or palm oil diesel).

India's total biodiesel requirement is projected to grow to 3.6 million tonnes in 2011–12, with the positive performance of the domestic automobile industry. Analysis from Frost and Sullivan, *Strategic Analysis of the Indian Biofuels Industry*, reveals that the market is an emerging one and has a long way to go before it catches up with global competitors (Katwal and Soni, 2003).

The Government is currently implementing an ethanol-blending programme and considering initiatives in the form of mandates for biodiesel. Due to these strategies, the rising population, and the growing energy demand from the transport sector, biofuels can be assured of a significant market in India. On 12 September 2008, the Indian Government announced its 'National Biofuel Policy'. It aims to meet 20% of India's diesel demand with fuel derived from plants. That will mean setting aside 140,000 square kilometres of land. Presently fuel yielding plants cover less than 5,000 square kilometres

It is considered the most politically and morally acceptable choice among India's current biofuel options; it has no known negative impact on the production of the massive amounts grains and other vital agriculture goods India produces to meet the food requirements of its massive population (circa 1.1 Billion people as of 2008). Other biofuels which displace food crops from viable agricultural land such as corn ethanol or palm biodiesel have caused serious price increases for basic food grains

and edible oils in other countries.

About the tree species : *Pongamia pinnata* is a fast growing known as Pongam tree, very variable, medium sized, glabrous, evergreen tree species, and native to Western Ghats. However, the tree species shed its leaves in dry season while growing in a tropical dry environment. It belongs to Fabaceae family of the flowering plants and is vernacularly called as Karanj.

The tree produces short bole with a spreading crown and drooping branches. The bark is fairly thin, smooth, grey and yellowish inside. It can attain height upto 25 m with a trunk diameter to 60 cm. The wood is yellowish white, coarse, hard and beautifully grained, but not durable. The leaves are imparipinnate, leaflets are 5-7 in numbers ovate or elliptic. The racemes of lilac flowers appear from April to June. Flowers white tinged or pink or white and are fragrant. The pods ripen from March to May the following year. *Pongamia pinnata* is a prolific seed producer. A single tree is said to produce 9-90 kg seed per tree, indicating a yield potential of 900-9000 kg seed per hectare. The pods are woody, indehiscent, yellowish grey when ripe and are 1 or 2 seeded. They are pointed at both ends (Haas and Mittelbach, 2000).

Distribution and ecology : *Pongamia pinnata* tree is common almost over India, up to 1,200 m. It is the constituent species of tidal forests. The tree species has the ability to grow on any type of soil. It is found on variety

Table 1 : Comparison of fuel properties of jatropha oil, jatropha oil methyl ester and diesel

Property	Unit	Jatropha oil	Jatropha oil methyl ester	Diesel	ASTM D 6751-02	DIN EN 14214
Density at 15 ⁰ C	kg/m ³	918	880	850	875-900	860-900
Viscosity at 40 ⁰ C	mm ² /s	35.4	4.84	2.60	1.9-6.0	3.5-2.0
Flash point	⁰ C	186	162	70	>130	>120
Pour point	⁰ C	-6	-6	-20	-	-
Water content	%	5	Nil	0.20	<0.03	<0.05
Ash content	%	0.7	Nil	0.01	<0.02	<0.02
Carbon residue	%	0.3	0.025	0.17	-	<0.3
Sulphur content	%	0.02	Nil	-	0.05	-
Acid value	mg KOH/g	11.0	0.24	0.35	<0.8	<0.50
Iodine value	-	101	104	-	-	-
Saponification value	-	194	190	-	-	-
Calorific value	MJ/kg	33	37.2	42	-	-
Cetane number	-	23	51.6	46	-	-

of soils along the stream and river banks or near the sea coast. However, it grows best, in fairly moist situations on porous well drained soil. It has the ability to thrive even on pure sand. The tree is a shade bearer, and is often found growing naturally along water courses under the shade of other trees. The plant species generally propagates through seeds. *Pongamia pinnata* is extremely tolerant to salinity and sodicity.

Economic importance : *Pongamia pinnata* is a multipurpose tree species. It is planted for afforestation especially in watersheds and arid and semi-arid, semi-moist areas and waterlogged areas. The tree species has the ability to bind the shifting sand-dunes and check erosion.

Pongamia pinnata is highly tolerant to salinity and alkalinity and can survive even with its roots in salt water and alkaline lands, hence the tree species is used for the restoration of saline and sodic soils. Moreover, due to easy establishment, faster growth rate, hardy nature and nitrogen fixing attribute, the *Pongamia pinnata* is used for the reclamation of eroded and mined lands. Besides this, the tree species is planted along avenues and roadsides for its fragrant flowers and evergreen foliage.

The leaves being rich in protein are used as valuable lactagogue fodder to feed the livestock population. The nitrogen rich leaves (>2.5% nitrogen) of *Pongamia pinnata* are also used as green manure to raise the fertility of the soil. The leaves are thought to reduce nematode infestations in soil. Dried leaves are used in stored grains to repel insects.

In traditional system of disease treatment, the leaves are applied in the form of poultice to ulcers infested with worms. The juice of leaves is used for colds, coughs, diarrhoea, dyspepsia, flatulence, gonorrhoea and leprosy.

Roots are used for cleaning gums, teeth and ulcers. Bark is used internally for bleeding piles. Powdered seeds

are valued as a febrifuge, tonic and in whooping cough and bronchitis. Flowers and young shoots are used against diabetes and rheumatism, respectively. The seed contain oil which is thick, red brown in colour, non-drying and non-edible and 27-36% by weight.

The seed oil of *Pongamia pinnata* possesses medicinal attributes. Oil is used in the treatment of skin diseases (herpes, leucoderma, eczema, scabies and ringworm) and rheumatism. Oil possesses insecticidal and antibacterial properties as well. The oil cake has about 3.9% nitrogen, which is used as a concentrated organic manure.

Seed oil is used for leather dressing, soap making, lubrication and also for illumination purposes. Besides this, the formulated seed oil through micro-emulsification and trans-esterification can be used as 'bio-diesel'. Thus *Pongamia pinnata* is seen as the source of "bio-diesel". Hence the tree species has been nick named as "Indian bio-diesel tree".

The timber of the tree is used in cabinet work, yokes, carts, ploughs, cartwheels etc. The wood is used as a fuel (calorific value 4,670 k cal per kg). Twigs are used as a tooth stick for cleaning the teeth. *Pongamia pinnata* also serve as host plant for lac insects.

References

- Agarwal, A.K. (1998). Vegetable oils verses diesel fuel: development and use of biodiesel in a compression ignition engine, *TIDE*, 8(3) : 191-204.
- Haas, W. and Mittelbach, M. (2000). Detoxification experiments with the seed oil from *Jatropha curcas*. *Industr. Crops Prod.*, 12(2) : 111-118.
- Katwal, R.P.S. and Soni, P.L. (2003). Biofuels: an opportunity for socio-economic development and cleaner environment, *Indian For.*, 129(8) : 939-949.

Received : 14.07.2017

Revised : 18.10.2017

Accepted : 03.11.2017