Jatropha curcas

LOCAL NAMES

- Oriya : Jahazigaba.
- Assamese : Bongalibhotora.
- Punjab : Jamalgota Kalaerenda.
- Tamil : Kadalamanakku, Rattamanakku.
- Sanskrit : Kananaerend, Parvataranda.
- Malyalam : Kattavanakka, Kadalavanakka.
- Hindi : Bagherenda, Jangliarandi, Safedaranda.
- Telugu : Nepalamu, Peddanepalamu, Adaviamidamu.
- Gujarati : Ratanjyot, Jamalgora, Parsierenda, Kala erenda.
- Kanada : Adalubaralu, Bettadaharalu, Maraharalu, Karnocchi
- Marathi : Mogalierenda, Ranayeranda, Vanaerenda, Chandri, Chandrajyot.

Knowing the Species

(a) Natural Habitat and Classification

Jatropha curcas belongs to the family Euphorbiaceae and is thus closely related to some other important cultivated plants like rubber tree and castor etc.

In the 'Forest Flora of the Bombay Presidency' by W.A. TALBOT, and 'Wealth of India' *Jatropha curcas* (Euphorbiaceae) has been described as a small ever-green, nearly glabrous tree or soft wooded shrub, 3 to 4 metres high. It is indigenous to America, cultivated in most tropical parts of India, common in hedges, cultivated or naturalized.

It is believed to be a native of South America and Africa spread to other continents of the world by the Portuguese settlers. The Arabs have been using this plant for medicinal purposes. Today it is found in almost all the tropical and sub-tropical regions of the world and known by nearly 200 different names, which indicates its significance and various possibilities of its uses.

(b) Distribution

In India *Jatropha curcas* is found in almost all the states and is generally grown as a live fence for protection of agricultural fields against damage by livestock as unpalatable to cattle and goats.

Jatropha curcas in India grows in semi-wild condition in the vicinity of villages. It is easily propagated by seeds or cuttings, grows rapidly, is drought hardy and not browsed by animals. It may be cut or lopped at any desired height and is suited as a hedge plant.

(c) Growth Statistics

Jatropha curcas is adapted to a wide range of climates and soils. It can grow almost on any type of soil whether gravelly, sandy or saline and thrives even on the poorest stony soils and rock crevices. To combat phosphate deficiency it avails of the symbiosis with root fungi (Mycorrhiza). The leaves shed in winter months form a mulch around the plant base and organic matter there from enhances earthworm populations around the root-zone of the plants, a fair indicator of improvement in micro fauna and soil fertility.

Climatically *Jatropha curcas* prefers the warmer regions of tropics and sub-tropics, although it does well even in slightly cool conditions and can withstand a high frost. It water requirement is extremely low and withstands long periods of drought by shedding most of its leaves to reduce transpiration losses. The organic mulch around the base of the plant formed by the fallen leaves also considerably reduces water loss due to surface evaporation. The species is thus well adapted to arid conditions.

Jatropha curcas is also a suitable species for soil conservation areas and stabilization of shifting sand dunes. It can be successfully introduced on wastelands as a first step towards their rehabilitation. Because of the hardy nature of this species and the fact that it can be propagated easily by branch cuttings or direct seed sowing, it makes an ideal choice for the ecological and economic rehabilitation of wastelands in the tropical and sub-tropical regions of the world.

In India, it flowers between September to December. The fruits mature two to four months after flowering, turning yellow when mature. Jatropha can be grown over a wide range of arid or semi-arid climatic conditions. A hot and humit climate helps in the early germination of seeds.

(d) As a Plantation Tree/Shurb

India has about 75 million hectares of wastelands, which need revegetation. *Jatropha curcas* is a wild growing hardy plant well adapted to harsh conditions of soil and climate. Moreover it can be conveniently propagated from seeds as well as branch cuttings which make the species most suitable for afforestation of stress sites on an economical budget. *Jatropha curcas* however can also be profitably grown as a perennial non-edible oil crop on irrigated and partially irrigated lands.

Utilization of the Species

Jatropha curcas oil finds wide usage and has high economic potential for large scale industrial use. However, the cultivation practices of this plant and the economic exploitation of its oil yet remain neglected to be investigated systematically. Progressive research for systematic cultivation; detoxification of oil for edible purposes and development of a suitable technology for its use as a fuel for engines re-discovering Jatropha for its economic potential.

(a) Use as Fence

Jatropha curcas can be maintained as a hedge and is commonly grown as a live fenced around agricultural fields. It can be cut or lopped at any desired height and shelters agricultural crops from dessicating winds while not completing with them adversely. Its use as a hedge plants for field bunds needs to be popularised by extension. *Jatropha curcas* may also be used as a bio-fence around pastures and plantation areas and in the rehabilitation of badly eroded areas.

(b) Potential Oil Crop

Analysis of *Jatropha curcas* seed indicates the following chemical composition; moisture 6.62; protein 18.2; fat 38.0; carbohydrates, 17.30; fibre 15.50; and ash 4.5%. The oil content is 35 to 40% of seed weight and 50 to 60% of the kernel. The oil contains 21% saturated fatty

acids and 79% unsaturated fatty acids. The seeds contain some poisonous chemical with purgative properties rendering Jatropha oil unfit for human consumption. Technologies are now available, whereby Jatropha oil could be detoxified for use as an edible oil. The oil is obtained from decorticated seeds by extraction and is known in trade as Jatropha oil. A non poisonous species of Jatropha is reported from Brazil

(c) Raw Material for Industrial Use

Jatropha oil has a very high saponification value and is extensively used in India and other countries for making soap. At present *Jatropha curcas* oil is imported to meet the demand of cosmetic industry. In China, a varnish is prepared by boiling the oil with iron oxide and in England the oil is used for wool spinning. Villagers use the oil as an illuminant as it burns without emitting smoke the oil is also a lubricant, hydraulic oil and useful for making like candle castor oil. The proteins in the Jatropha oil cake could be used as raw material for making plastics and synthetic fibres.

(d) Use as Fuel

Jatropha oil is an environmentally safe, cost effective renewable source of non conventional energy and a promising substitute for diesel, kerosene and other fuel oils.

Jatropha oil is an alternative source of energy with a promise as it can be produced on a massive scale within the country. Moreover, cultivation of Jatropha, as an agroforestry venture can generate millions of jobs in rural India particularly in regions practicing dry land farming or subsistence agriculture.

In the developing countries 70 per cent of the wood harvest is used for cooking and heating yet fuelwood is becoming increasingly scarce. Fuelwood shortages afflict more than 30 million people in Asia and Pacific region. The natural forests are receding farther and farther from human habitations as time passes by and the women folks have to undergo the drudgery of tracking long distances and ferrying fuel loads for the hearth and home. On account of increasing population, the demand for fuel supply making fuelwood plantations an urgent necessity, so much so that in some areas though food is available, but now enough wood to cook it. The widening gap between demand and supply of fuelwood is the main cause of rapidly depleting forest cover which, has proved to be ecologically disastrous, leading to floods, soil erosion and drought. By the year 2000 the annual requirements of fuelwood in India is estimated to be 200 million tones against a supply of 63 million tons. To bridge this gap between demand and supply, 34 million hectares of land area is required to be planted with fuelwood crops during the next decade.

High density plantations of the species can be an ideal way of sequestering maximum solar energy over a short gestation period as *Jatropha curcas* is fast growing and can be grown successfully on all kinds of barren and unproductive wastelands. Also it does not compete with food crops for land area, on the contrary, the rich organic manure obtained from Jatropha enrich the soils for increased food production.

Jatropha curcas has a productive life of nearly forty to fifty years without necessitating re-planting or retending unlike with fuelwood crops.

(e) Use for Rehabilitating/Planting Wastelands

All barren and denuded areas can be expeditiously and successfully revegetating with *Jatropha curcas*. Animals do not eat or damage Jatropha plants. In many regions of the

country Jatropha is therefore being extensively used as a live fence along the periphery of agricultural fields.

Use of Jatropha oil cake as organic fertilizer can curtail dependence on chemical fertilizers and also present under ground water pollution which makes it unsafe for drinking purposes.

(f) Other Uses

(i) Medicine

The latex of *Jatropha curcas* contains an alkaloid known as "Jatrophine" which is believed to be having anticancerous properties. Curcas oil possesses purgative properties (purging dose 0.3 to 0.6 cc or 5 to 10 ml). It differs from castor oil in that it has a low viscosity. It is used as an external application for skin diseases and rheumatism, it is reported to be an abortifacient and also efficacious in dropsy, sciatica and paralysis. In Java, the oil is applied to hair as a growth stimulant. It is also used as an application for sores on domestic livestock. Tender twigs of the plant are used for cleaning teeth. The juice is reported to relieve toothache and strengthen gums. The juice of plant is also used as a purgatiave and haemostatic in Java. The leaves are considered rubefacient and lactogogue. The leaves juice is used as external application for piles. It is also applied for inflammation of the tongue in babies. The twig sap is considered stypic and used for dressing wounds and ulcers. An emulsion of the sap with benzyl benzoate is said to be effective against scabies, wet eczema and dermatitis. A decoction of leaves and roots is recommended for diarrhoea. The root is reported to contain a yellow oil with strong anthelmintic action.

The root bark is used for external applications for sores. In Konkan, the bark is rubbed with asafoetida and buttermilk and its paste used for the cure of dyspepsia and diarrhea. A decoction of the bark is given for rheumatism and leprosy. In Travancore, the seeds are fried, powdered and taken with molasses for stomach ache and as an antidote for poisoning. The roots are also reported to be used as an antidote for snake bite.

The seeds are considered anthelmintic in Brazil. They are ground with palm oil and used as rat-poison in Gabon. Aqueous extract of its leaves is reported to have insecticidal properties. In Ghana, the leaves are used for fumigating houses against bed-bugs. The ether extract of leaves shows antibiotic activity against *Styphylococcus aureus* and *Escherichia coli*. The juice of the whole plant is used for stupefying fish in Phillippines.

(ii) Bark dye

The bark of *Jatropha curcas* yields a dark blue dye which is reported to be used in Phillippines for colouring cloth, fishing nets and lines. The dry may be extracted from leaves and tender stems and concentrated to a yellowish syrup or dried to a blackish brown lumpy mass. The dye imparts to cotton different shades of tan and brown which are fairly fast. Further research in this field can open up great possibilities.

(iii) Food/Feed

In Java and Malaysia, cooked tender leaves are reported to be eaten. In Assam, Jatropha leaves are used as feed for tusser silk worm. The oil cake is rich in protein but contains some toxic principles and as such it is considered unfit for use as cattle feed. It is reported that the poisonous ingredients can be removed with the oil with solvent extractions using alcohol.

With further research it may be possible to utilize the presently non-edible oil cake as protein rich cattle, poultry feed.

(iv) Fuel from generation of electric power

With sustainable research and development efforts Jatropha oil could be used as a furnace fuel for running engines and generation of power. Research findings though scanty indicate the potential for using Jatrophaoil as fuel for engines.

(v) Biofertilizers

Tender branches and leaves of *Jatropha curcas* are used as green manure for coconut trees. Jatropha oil cake can, hopefully, replace chemical fertilizers if made available in the requisite quantity. The leaves provide plentiful organic matter and increase the microbial activity including that of earthworms an indicater of site improvement.

Jatropha curcas can play a significant role in meeting our fertilizer needs and enhance agricultural production without the use of polluting chemicals. Jatropha oil cake as an organic fertilizer is superior to cow-dung manure and is in great demand by the agriculturists.

The percentage of nutrients N.P. & K in Jatropha oil-cake and other organic fertilizers are depicted in the table below –

Fretilizer	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Jatropha curcas oil cake	4.44	2.09	1.68
Cow-manure	0.97	0.69	1.66
Chicken manure	3.04	6.27	2.08
Duck manure	2.37	2.10	1.09
Compost of raw straw	0.81	0.18	0.68
Compost of water hyacinth	1.48	0.46	0.48
Compost of municipal wastes	1.25	0.25	0.65
Karanj-oil cake	4.00	1.00	1.00
Neem oil cake	5.00	1.00	1.50

Nursery Practices of the Species Including Calendar

Seedlings should be raised in polybags of half kilogram capacity filled with a mixture of soil and organic manure in the ratio of 4:1 Two seeds be sown in each poly bag at a depth of 6 cm and watered regularly. When the seedlings are around 4 weeks, the weaker of the two seedlings be removed and used for gap filling.

Planting Practices for the Species Including Calendar

(a) Reproduction

Jatropha can be propagated from seed as well as from cuttings. Seeds or cuttings can also be directly planted in the field for raising plantations at the onset of the monsoon season.

(b) Spacing and Seed Rate

For planting 1 hectare, around 5 to 6 Kg. of seed is enough. The distance between the two rows should also be 2 metres. This spacing will accommodate 2500 plants/ha. under irrigated or partially irrigated conditions. On rainfed wastelands, high density planting at 2 m x 1 m or 1.5 x 1.5 metre accommodating 5000 or 4444 plants per hectare respectively, shall be desirable.

(c) Direct Planting

The land should be ploughed once or twice depending on the nature of soil. In case of heavy soils deep ploughing is given whereas in light soils, shallow ploughing is enough. The seed/cutting are planted in the field with the onset of monsoon. Two seeds should be dibbled at each spot at a spacing indicated above. When the seedlings are 4 weeks old, weaker seedlings should be removed to retain one healthy seedling per pit and the seedlings so removed could be used for gap filling.

(d) Transplanting

The planting site is prepared by digging small pits of 30x30x30 cm at specified spacing indicated above. Pits are filled with soil and 400 gm compost or organic manure per pit. Basal dressing of fertilizers may be applied at the rate of 20 g urea + 120 g single super phosphate whereas Muriate of Potash 16 g should be mixed with soil at the time of filling pits.

(e) Fertilizer Application

Apart from organic manure mixture, fertilizers containing N,P,K, should be applied. For direct planting 20 g urea + 120 g single super phosphate and 16 g Muriate of Potash should be applied near the planting hole and the fertilizers should be covered with soil. In case of transplanted crop, the above mentioned fertilizers should be applied at the time of transplanting or immediately after the plants establish in the pits. The remaining dose of urea should be applied in two splits @ 10 g per plant. The first split should be applied one month after basal dressing and second split after two months of basal dressing. This application would supply NPK @ 46:48:24 per hectare. Jatropha oil cake can also be used for recycling of nutrients to maintain the productivity of the soil.

(f) Inter-Cultivations

The field should be kept free from weeds all the times. Around 3-4 weedings in the initial period are enough to keep the field free from weeds until the crop crosses the grand growth period stage. Light harrowings are beneficial.

(g) Irrigation

In case the monsoon is normal and well distributed additional irrigation during rainy season is not required. During dry period, the crop should be irrigated as and when required. Usually from second year onwards irrigation is not required unless the soils are shallow and sandy. In such cases, irrigate as and when necessary.

Cultural Operations and Its Calendar

By Seed: Use large, heavy seeds. Seed production expected in 3-4 years

- **Treatment**: Overnight pre-soaking
- **Direct Seeding**: (5-6 kg seed/ha)

- **Spacing**: Irrigated or partially irrigated: 2 m x 2 m.
- **Rainfed**: 0.5 – 1.5 m x 1 – 2 m.
- **Depth**: 2 – 3 cm (two seeds per hole)
- **Thinning**: After 4 weeks.
- **Transplanting**: Spacing 1-3 m. Planting hole or furrow fill; Soil, Compost, Manure.

By Cuttings: Seed production expected in less than 1-2 years.

Planting Material

- **Length**: 45-100 cm (obtained as far as possible from base of stem)
- **Thickness**: 3-4 cm.
- **Quality**: Short internodes with many eyes: Healthy smooth and shiny grey Bark.
- **Spacing**: Determined by use, soil quality, humidity, climate, (intercropping, etc.)
- **Plantation**: 2-3 m x 1.5 – 3 m.

Hedge Rows/Soil Conservation:

- **Single Row**: 15 cm – 25 cm
- **Double Rows**: 15 cm – 25 within and between rows.
- **Treatment**: Fill planting hole or furrow: Soil, compost, manure.

Yield and Management of the Species

Expected Yield

With good care the annual average seed production is expected to be as follows:

Years after Planting	Expected yield/ha Rainfed Crop (kg.)	Expected yield/ha Irrigated Crop (kg.)
1st	--	250
2nd	250	1000
3rd	1000	2500
4th	2000	5000
5th	3000	8000
6th & Onwards	4000	12000

Sixth year onwards the expected average oil seed yields per hectare of irrigated plantations are 12,000 kg and from rainfed plantations 4000 kg. Afforestation and reforestation of degraded wastelands with *Jatropha curcas* can convert presently unproductive lands into productive national assets thereby significantly contributing to the G.N.P.

It is heartening to mention that Co-operative Land Development Bank of Maharashtra and Co-operative Agricultural Development Bank Hyderabad have come forward to finance *Jatropha curcas* plantations for greening wastelands, NABARD has also proposed to refinance such projects.

Extraction of Seed Oil

The extraction of Jatropha seed oil can be done either chemically with solvent or mechanically, hydraulically using a press. Solvent extraction (with hexane) generally yields the maximum seed oil – 35 % by seed weight, or 95-99% of the total available oil. But mechanical pressing of oil from seeds is simpler and more appropriate for rural areas.

Augmenting of Yields

Besides *Jatropha curcas* there are over160 other species or varieties in the genus Jatropha. These species can possible by used to improve *Jatropha curcas* for its oil contents both in quantity and quality. There are a number of reports that indicate the existence of many varieties of *Jatropha curcas*. There are plants with yellow, pink or green corolla, with red and green leaves; with big or small non-poisonous or highly poisonous seeds. Research and documentation of information on them could be gainfully utilised in the genetic improvement of *Jatropha curcas*. In *Jatropha curcas*, both male and female flowers grow separately on one and the same plant. The longer the exposure to sunlight the more the number of female flowers have been observed. As in case of Castor mild spray of gibberellin (a plant hormone) increases the number of female flowers, the same treatment may be applied to *Jatropha curcas* as only the female flowers can yield seeds (the main yield). Drip irrigation could also fetch higher yields as the plant remains evergreen and productive for a longer period than under rainfed condition. There are immense possibilities for research and development on these aspects.

Economic of the Planting Species

A good reason for developing Jatropha as an energy is that it does not compete with food crop for land and water resources because of its remarkable adaptability to marginal and degraded lands and ease of cultivation. The adaptation of Jatropha to arid conditions makes it an important commercial plant, capable of sustainable oil seed production of high energy value.

Jatropha oil is a versatile energy source and can cater to the needs of a variety of consumers. It may be used as an alternative to diesel, kerosene, coal, L.P.G. and fuelwood to meet the energy needs of daily household chores and agriculture and village small industries.

Jatrophaoil is a potential substitute for diesel providing the country a cheap and renewable source of energy for transport and power and can effect sizeable savings on foreign exchange. The main advantages accruing by Jatropha cultivation are:

- Availability of cheap fuel cater for local energy needs, particularly as a substitute/supplemental energy for agriculture.

- Use of Jatrophaoil cake as a source of plant nutrients/manure for boosting land productivity.

- An effective and low cost method of rehabilitating barren wastelands for productive gains and generating rural employment.

- Savings in foreign exchange.

Harvesting and Its Calendar

The flowering of Jatropha depending on the location takes place between September to December in India, May to September in Cape Verde, and November and May in north east Thailand. Fruits mature two to four months after flowering and turn yellow when they are mature. Harvesting often takes place during the dry season when there is little competition for labour required for agricultural persuits. The fruits can be easily plucked from the bushes and can provide casual employment for rural women workers.

Market and Marketable Products, Used as Raw Material in Forest Based Industries

The chemical composition of Jatropha oil cake indicates its potential as a rich organic fertilizer and can be produced in our country on a large scale. At present we depend upon import of raw materials like naptha, rock sulphar, phosphoric-acid etc. for manufacture of chemical fertilizers utilising foreign technology which involves a considerable drain on foreign exchange reserves. Fertilizer factories located in urban centres are also a major source of environmental pollution. Whereas organic fertilizer in the form of Jatropha oil cake is far superior and an indigenous product available to the farmers right at their door steps. Jatropha plantations raised by farmers can pave the way to overcome the dependence on chemical fertilizers use of which may be effectively curtailed in course of time. Subsidies on initial planting can act as an incentive to farmers for undertaking this useful and productive programme willingly.

India's nearly 175 million hectares of wastelands, if brought under *Jatropha* sp. can annually produce over 400 million tones of organic fertilizer, saving considerable foreign exchange. Chemical fertilizer manufacturing units are highly energy intensive and consume fossil fuels like coal, gas etc. on a large scale. On the contrary Jatropha oil cake as a valuable and safe organic fertilizer is a residual product of Jatropha seeds after extraction of oil which is rich in energy.

Source Institutions for Detailed Information

Detailed information can be obtained from Institutes listed below:

- Forest Research Institute, Dehradun, Uttranchal.
- Institute of Wood Science and Technology, Bangalore
- Institute of Forest Genetics and Tree Breeding, Coimbatore

Source: Indian Council of Forestry Research and Education, Dehradun. *Jatropha curcas*. Dehradun, Forest Research Institute. 11p.