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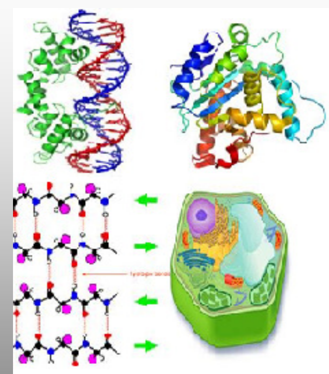

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REVIEW ARTICLE

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Jatropha curcas L.: An Important but Neglected Plant in Nigeria

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ABSTRACT

This study examined the importance of Jatropha curcas – a multi-purpose plant species but neglected in Nigeria with a view to bringing to limelight some of the areas this species can be better used for the benefit of the society. It is emphasized that J. curcas has a lot of medicinal, industrial, environmental as well as being used as food in some areas but much is yet to be known about this species. While it is known that the seeds yield biofuel, little is known about the plant management and plantation. The paper concluded that for sustainable production of this valuable crop, Jatropha curcas, it is advisable to plant it both in plantations in mixed plantation, preferably in agro – forestry alley cropping system while the interaction with the soil, food reserve is monitored overtime.

Keywords: Jatropha curcas, values, biofuel, other uses

INTRODUCTION

Jatropha curcas L. commonly called physic nut is a shrub and flowering plant and belongs to family Euphorbiaceae, it is native to Mexico and Central America (Janick and Robert, 2008). It is cultivated in tropical and subtropical regions around the world becoming naturalized in some areas including Africa and Nigeria. *Jatropha* is derived from the Greek word jatros (doctor), trophe (nutrition /food) which implies that it is a medicine and the plant is planted as a hedge (living fence) by farmers all over the world because it is not browsed by animals (Ige *et al.,* 2010). It is a drought resistant perennial plant growing well in marginal soil

(Agbogidi *et al.,* 2010). *J. curcas* is a poisonous semi-ever green shrub or small tree reaching a height of 6m. It is resistant to high aridity, and can be grown in deserts (Singh *et al*., 2007). It is used as living fences by farmers in the tropics around their homes and gardens, and their fields to protect crops against roaming animals. The seeds are not used for any purpose by rural farmers hence it is not planted for fruit or seed yield.

This species however, has a lot of medicinal, industrial and environmental functions some of which have not be fully harnessed but because it is a non-edible plant species it has been neglected over the decades especially in African and other developed world. This study was carried out to examine the importance of this neglected species with a view to brining to limelight some of the areas this species can be better used for the benefit of the society.

BOTANY AND DISTRIBUTION

In Nigeria, it is commonly called "Barbados nuts" "purging nut" "Itiakpa" by the Urhobos and "lapalapa" in Yoruba. The plant has thick glabrous branches and the leaves are arranged alternately. The branches contain whitish latex which causes brown stains that are very difficult to remove (Wini *et al.,* 2006). *J. curcas* is a monoecious perennial and deciduous shrub. Generally, it grows up to 6m tall but a height of between 8 and 10m can be attained under more favourable conditions (Heller, 1996; Henning, 1998; Henning, 2008). When propagated from seeds, it develops tap roots and lateral roots. When propagated from cuttings, only lateral roots with one perhaps are developing into a pseudo tap root that may reach only ½ to 2/3 the length of a normal top root (Henning, 2008). The leaves are large green to paler green to sub-opposite, three to 5 – lobed with a spiral phyllotaxis. The length of the petiole ranges between 6 and 23mm.The leaves and nuts of *Jatropha sp* are dexic (contain phorbol esters and curcin, a highly toxic protein similar to ricin in castor (Awe *et al.,* 2010). The flowers; male and female are produced on the same inflorescence, averaging 20 male flowers to each female or 10 male flower to each female flower (Juhasz *et al.*, 2009). The inflorescence is formed in the leaf axils. Flowers are formed terminally individually with the female usually slightly larger and occur in the hot seasons (Juhasz *et al.,* 2009). Unbalance of pastilles or staminate flower production occurs in a high number of female flowers in conditions while continuous growth occurs. The fruit – a three bi-valved coccid is formed after seeds mature and the fleshy exocarp dies. The fruits are produced in winter or dry seasons when the shrub is good and the temperature are sufficiently high (Biswas *et al.,* 2006). Each inflorescence yields a bunch of approximately 10 or more ovoid fruits.

The seeds become mature when the capsule after two to four months (Henry, 2009). The seed pod is usually a three – bi-valved coccid containing two or three large black seeds. The seed has 42% husk and 58% kernel; the seeds lead a lot of genetic variability in terms of growth biomass, seed yield and oil content (Achten *et al.,* 2007). The fruit contains 37.5% shell and 62.5% seed (Singh *et al*., 2007). The plant can grow in wastelands and on almost any terrain including on gravelly, sandy, stony, saline and nutrient depleted soil (Kumar *et al.,* 2000a; Openshaw, 2000). Complete germination of *J. curcas* seed is achieved within nine days under good moisture regime (Heller, 1996; Henning, 1998; Agbogidi *et al.,* 2010). Ploughing is not necessary; the shrub has a life expectancy of about 40 years, (Juhasz *et al*., 2009). The use of pesticides is not necessary due to its pesticide and fungicidal properties of the plant (Agbogidi *et al*., 2010). The plant starts yielding from 9-12 mouths time and the best yields are obtained only after 2-3 years time (Michael, 2006). However, the productivity with time in plantations has been adequately studied in Nigeria. Although, native to the Caribbean, *J. curcas* today is cultivated though not in plantation, in almost all tropical and subtropical countries including Africa and Asia as protection hedges around gardens and fields. It grows well in all soil types including low nutrient content soils although root formation and penetration nay be reduction in heavy soils (Kumar *et al.,* 2008a). The plant has a wide range of ecologies requirements if occurs at (Saika *et al.,* 2009; Keyejo *et al.,* 2010) altitudes (10-500m) in areas with average annual temperatures well above 20^oC but can grow at higher altitudes and tolerates slight frost (Openshaw, 2000; Agarwal and Avinash, 2007), *Jatropha curcas* is not a weed and self propagating (Jepson *et al.,* 2006).

ECONOMIC IMPORTANCE OF *JATROPHA CURCAS*

INDUSTRIAL VALUE

Although several crop plants produce biofuel, *Jatropha curcas* is considered the best option because it is a multipurpose crop, does well in marginal soils, has good growth under saline and harsh conditions, drought tolerant and high water use efficiency, an important energy crop, low labour in plants, does not complete with food crops and it is a wonder biofuel crop (Anon*,* 2007; Kumar *et al.,* 2008b). The uses of different parts of *Jatropha curcas* is shown in Table 1. After harvest, the fruits of *J. curcas* are transported in open bags to the processing site. Here, they are shade dried until all the fruits have open. The direct sun has a negative effect on seed viability. When dried, the seeds are separated from the fruits and cleaned. The seeds are then crushed and processed. The resulting oil can be used in a standard diesel engine while the residue can be processed into biomass feed stock to power electricity plants (Michael, 2006). Similarly, aviation fuels may be more widely substituted with biofuels such as *Jatropha* oil than fuels for other forms of transportation. The oil from *Jatropha curcas* has a very saponification value and is used extensively for soap production in many countries. Besides, the oil burns without emitting smoke (Mc Kenna, 2009). The bark dye which gives tan and brown dye used for colouring cloths, fishing nets and lines. The rapid development of the global biodiesel industry has been closely observed by countries interested in simulating economic growth improving the environment and reducing dependency on imported oil (Bhojoaid, 2005; Basubutra and Subliponpeibum, 1982).

Developing biofuel represents the most immediate and available response to four key challenges and opportunities according to Raina (1985) and Reidacker and Roy (1998). Coping with depleting reserves, the need for oil – importing countries to reduces their dependence on a limited number of exporting nations by diversifying this energy source and supplies, to challenge for emerging economies to tropical regions to supply the global energy market with competitive price liquid biofuel and meeting growing energy demand in developing countries in particular to support development in rural areas.

The use of *J. curcas* for biodiesel compared to other vegetable oil like palm is cheaper. *Jatropha* oil is a promising clean alternative energy, used for biofuel. It is the seeds of *J. curcas*. The oil is free of fatty acids. Biodiesel produced from *Jatropha* is one of the most promising solutions from transport. The high cost and inaccessibility of fossil fuels, leaves approximately 2 billion people worldwide without reliable energy sources, without refrigeration, basic communication, heat or even light. For developing countries climate change and world's energy policies are a source of oppression, a source of sickness and a source of human suffering. Since, the two thirds of the people in the developing world who derive their income from agriculture and *Jatropha* based biodiesel has enormous potential to change their situation for the better and poverty can be broken by *Jatropha* cultivation as this useful crop has a huge potential for replication world-wide, improving the livelihood of many *Jatropha* plants cultivation can also yield extra earnings by utilizing the land that was of no use.

MEDICINAL VALUE

J. curcas plant is used as a natural pesticide because of its toxicity (Makkar *et al*., 2001; Aregheore *et al.*, 2003; Awe *et al.,* 2010). *J. curcas* has also been used as antidote, remedy, medicine and potential source of herbal drugs in dental complaints and against constipation (Awe *et al.,* 2010). The milky sap is used for the treatment of dermatomucosal diseases. The leaves are used to make tea to treat malaria and the sap to stop breeding (Awe *et al.,* 2010). Kaushik *et al.,* 2007) reported that *J. curcas* contains an alkaloid known as jatrophine which is believed to have anti-cancerous properties. The seeds have also been used as insecticides and pesticides as a plant, moreover in plantation; it stands to play a good role in Co_2 sequestration, purifying the air as it releases oxygen into the atmosphere. *J. curcas* helps to promote erosion control and energy supply for the household and stationary engines in the rural areas (Tigere *et al.,* 2006). Latex, which contains alkaloids (jatrohine, jatrophan, jatrophone and curcain has anticancerous properties and is inhibitory to watermelon mosaic virus (Prakash*,* 2006). The latex can be used as a remedy for alopecia, anasorca, burns, dropsy, eczema, inflammation, paralysis and yellow fever (Japes *et al*., 2006). Preliminary research indicates that Jatropha may display certain anti-tumor properties, anti-malaria properties and research is advancing related to HIV/AIDS and urine system responses enhancement.

ENVIRONMENTAL VALUE

J. curcas as biodiesel plantation tree and a renewable fuel tree may lead developing countries like Nigeria in reducing emission from combination to fossil fuel beside reducing deforestation, improving energy efficiency and transforming urban domestic fuel consumption such approach can simultaneously support economic recovery and encourage growth in areas that mitigate the impact of climate change as well as reducing dependency on imported oil. Kumar *et al.* (2008a) reported that *J. curcas* is capable of out-competing weeds and its toxicity defers livestock thereby requiring less attention compared to other trees. *J. curcas* helps to improve soil enrichment. The oil cake is rich in nitrogen, phosphorus and potassium and can be used as organic manure (fertilizer which can improve soil quality and consequently growth, development and yield of economic crop plants (Fairless, 2007; Janick and Robert, 2008). The plant also has the possibility of retaining marginal and degraded soils by reanchoring the soil with its substantial roof and reduces possibility of erosion (Jepson *et al.,* 2006; Agbogidi *et al.,* 2010). Jatropha curcas oil cake contains about 6% Nitrogen 2.75% phosphate and 0.94% potassium and thus can be used as organic manure (Makkar *et al.,* 2001). Substitution of fire wood by plant oil for household cooking in rural areas will not only alleviate the problem of deforestation but also, improve the health of rural women who are subjected to the indoor smoke pollution from cooking by inefficient fuel and stoves in poorly ventilated space (Achten *et al.,* 2008; Kumar *et al.,* 2008b). *J. curcas* is considered as the best source of biofuel among plant based fuel resources spread across the globe because it is a valuable multipurpose crop to alleviate soil degradation, and it can also be used for bio-energy to replace petrol, diesel, soap production and environmental protection. *J. curcas* planted to prevent water erosion and for soil conservation, used as soil enrichment, promising live fence, useful in controlling sand drift and desertification and used for erosion control.

OTHER USES

The leaves of *J. curcas* are used as food for feeding tuber silkworm. *J. curcas* wood and the seed cakes can be used as fire wood or charcoal (Kumar *et al.,* 2008b). Preliminary research indicates that Jatropha may display certain anti-tumor properties, anti-malaria properties and research is advancing related to HIV/AIDS and urine system responses enhancement. Better exploitation of Jatropha could offer income forming a wide range of innovative products and help to reduce unsustainable wood cutting. The bark of the plant produces a dark blue dye, which is used for coloring cloth, fishing nets and lines (Biswas *et al.*, 2006). The seed cake can be used as animal feeds. The leaves can be used as food for tussle silkworms. Burnt root ashes are used as salt substitute (Morton, 1981). In China, the oil is used to produce furniture vanish after boiling it with iron oxide. The most exploited uses of oil pressed from the seeds in rural-industrial development include lubrication, soap and candle – making. The latex strongly inhibits the watermelon mosaic virus used for making ink and ethno medicine (Janick *et al.,* 2008).

The plant may yield more than four times as much fuel per hectare as soybean, as and more than ten times that of maize (corn). A hectare of *jatropha* has been claimed to produce 1,829 liters of fuel (Michael, 2006). Fairless (2007) noted however, that as it has not yet been domesticated or improved by plant breeders, besides, yields are variable. The use of jatropha oil for automotive use is on although, *jatropha* oil as fuel is yet to reach optimal quality, it already fulfils the European Union (EU) norm for biodiesel quality. Fairless (2007) reported that many Mercedes cars powered by *Jatropha* diesel have already put some 30,000 kilometers behind them. *Jatropha curcas* has been cited as one of the best candidates for future biodiesel production.

USE AS JET FUEL

Aviation fuels may be more widely substituted with biofuels such as *jatropha* oil that fuels for other forms of transportation. There are fewer planes than cars or trucks and far fewer jet fueling stations to convert than gas stations (Kanter, 2008). In New Zealand, different trials of jets using only *jatropha* oil or on a 50:50 blend of *jatropha* oil and jet A – I fuel for running since 2008. Japanese is not also left out in this direction. Biologically, the oil has low acidity and good oxidation stability as compared to soybean oil, lower viscosity as compared to castor oil less of processing cost than ethanol and better cold properties as compared to palm hence it is potentially very valuable (Kanter, 2008). *J. curcas* biodiesel has the desired physio-chemical and performance characteristics comparable to petrol–diesel (Kureel, 2006). It has a higher acetone number (51) than other vegetable oils and petrol-diesel 946 – 50) (Kureel, 2006). This according to Kanter (2008) makes it an ideal alternative fuel and requires no special modification in the engine. Biodiesel is an eco-friendly, alternative fuel prepared from vegetable oils (edible or non – edible and animal fat which are renewable (Singh *et al.,* 2007).

JATROPHA SEEDS AS FOOD

The seeds in the zone around Miscants, Veracruz are very appreciated by the population as food once they have been boiled and roasted. It is however, unclear if this is due to the existence of a non-toxic variety of *Jatropha* in Mexico and Central America or if the seeds become edible once processed by cooking. Fairless (2007) also reported that *jatropha* seed become edible once the embryo has been removed and this may not be unconnected with the fact that the seeds coming from a local non-toxic variety, (hydrogen cyanide) HCN is present in the leaves. The ashes of the roots are used as salt substitute where HCN and Rotenone are present. The young twig is cooked and eaten. The nuts are sometimes roasted and eaten, although may be purgative. The young leaves may be eaten, steamed or stewed, cooked with goat meat to advantageously counteract its smell; the leaves are used as food for the tusser silkworm.

THE WAY FORWARD

The way forward in making this multipurpose species a sustainable species is the production and selective of good planting seeds or seedlings as good plant quality is the basis for *Jatropha* planting success. The only way to commercially produce *Jatropha* sustainably is to establish it in large scale plantations for biodiesel production. So far *Jatropha* is not planted in large scale as a plantation in Nigeria. Consequently, the silviculture is not known. In Kenya where the biodiesel crop is grown extensively, it has been observed that the *Jatropha* tree has scant commercial value in monoculture with time and could add to food insecurity. It was also observed that the crop is not economically viable when grown as a monoculture or in plantations over a long period (Spore, 2010). To avert attendant food insecurity where fertile forest lands are to be cleared for *Jatropha* plantation, it is advisable to establish such plantations in polyculture with food crops. Alley cropping would be a good alternative in which *Jatropha* is planted as a hedgerow while selected food crops are planted I the alleys. It is also necessary to investigate the productivity of the crop in arid areas before growing into plantation establishment. This is because the tree crop has succulent stems, an indication of its water requirements in response to the large foliage transpiration activities. While it is known that the seeds yield good biofuel little is known about the plant management in plantation. For sustainable production of this valuable crops *Jatropha*, it is advisable to plant it is mixed plantation, preferably in agroforesty alley cropping system while the interaction with the soil food reserves is monitored over time.

A clarion call has been made that for energy sector which is an essential role in transforming industrial agriculture system, the government is encouraging for cultivation of physic nut plants nationwide and the technical knowhow that can refine physic nuts to biodiesel has also identified. Peasant farmers should be encouraged to cultivated physic nut plants on a commercial scale with major aims for emergence of industrial agricultural system for fulfilling rural electrically supply and energy needs, for supporting rural areas development and import substitute economy. With mass cultivation of *jatropha* plants in Myaninar there is hope to replace the country's oil imports of about 40,000 barrels a day with home – brewed, *Jatropha* derived bio fuel. Other Governments envisaged a situation where Myanmar would soon start exporting *jatropha* oil. Some countries have started growing *jatropha* plants with the aim of selling the seeds in large quantities both at local and foreign markets. This will further increase and strengthen research on *Jatropha* plants for higher quality seeds and better yields.

CONCLUSION

Generally, *jatropha* oil –a promising clean alternative energy, used for biofuel, it is a vegetable oil produced in the seeds of J cur, the oil is free of fatty acid. The plant is useful in climate protection hence deserves specific attention.

Despite its abundance and use as a reclamation plant none of the *Jatropha* species has been properly domesticated and, as a result, its productivity is variable, and the long-time impact of its large – scale use on soil quality and the environment is unknown (Fairless, 2007). Besides, *Jatropha curcas* is list as a weed in Brazil, Fiji, Honduras, India, Jamaica Panama, Puerto and Salvador.

Table 1. Use of different parts of *Jatropha curcas*

Whole plant	Roots	Leaves	Latex	Seeds	Bark	Twig
1. Planted to prevent water erosion and fo conservation	Used as ethno- medicin	Used as ethno- medicin	Resembles shellac	Source of oil suitable as fuel f diesel engine	Yields tannins (37%)	Used as tv
2. Promising live fenc		Yield a dy used to gi tan and brown	Used for making ink	Used as illuminar lubricant, in soa and candle maki		Used ad da un(Herba tooth bru
3. Useful as green manure, in controllin sand drift and posses allelopathic propertie		Useful a botanica	Used in ethr medicine	Used as medicin both internally a externally		Young or cooked ar eaten

Adapted from Agbogidi *et al.* (2010) and Ige *et al.* (2010)

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