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Sterculia urens: Karaya Gum tree–Need conservation

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ABSTRACT

Sterculia urens Roxb. commonly known as the "Karaya Gum Tree" or "Indian tragacanth" is known for its medicinal properties and ecological significance. It is a medium sized tree which attains height of around 15–20 meters and is enormously bushy in shape. Karaya gum has been used commercially as an additive or alternative to gum treagacanth for many years. *Sterculia urens* is an important plant of Rajasthan and it has several traditional and pharmacological uses. It has several industrial and therapeutic applications. In this study its uses as well as its overall impact on local inhabitants are studied. Seed collection of this species is limited reflecting potential need for conservation. This species is currently in danger and require attention and local support. In this paper review on its significance and potential to improve livelihood and other environmental aspects has been performed.

Keywords: *Sterculia urens*; Sterculiaceae; Karaya gum tree; Indian treagacanth; Threatened plant; Medicinal value; Industrial uses; Seed size.

1. Introduction

Rich biodiversity of India includes variety of flora and fauna. Among floral treasures *Sterculia urens* Roxb. commonly known as the “Karaya Gum Tree” or "Indian tragacanth" is known for its medicinal value and ecological importance. *Sterculia urens* Roxb. was earlier placed under the family sterculiaceae is now placed under Malvaceae (Galla and Dubasi, 2010). Its generic name comes from Latin word “stercus” that actually means “manure or filth” due to unpleasant odour of the flower of some plant species. Gum karaya tree is known for its significant gum commonly known as Indian tragacanth found mainly in India (Gautami and Bhat, 1992; Coppen, 1995 and Solni, 1995). The tree is native to India, Srilanka and was introduced to Burma lately (Verbeken et al., 2003; Nussinovitch, 2009 and Sivaraj et al., 2017). The species is found in the tropical Himalayas, central and western India throughout Eastern and Western Ghats of India. It is found on steep, rock-strewn slopes at altitude between 400-800 meters (1300 to 2600 feet) [The wealth of India, 1952; Roecklein and Ping, 1987 and Galla and Dubasi, 2009]. It is a medium sized tree which is pale in colour.

It is native to southern India and the tropical Himalayas widely dispersed throughout India (Assam, Bihar, the eastern and western Peninsula, the northeast of Belgaum, Maharashtra, Madhya Pradesh, and South Gujarat) (Kumar and Desai, 2016). This tree is also found in Malaysia, Sri Lanka, Australia, Pakistan and Panama.

The plant is predominantly found in tropical and subtropical regions, thriving in semiarid to arid conditions of northern region of India such as Rajasthan and Gujarat. It is a common species and grows in deciduous forests both wet and dry (Ramprasad and Bhatnagar, 1991; Bhattacharya et al., 2003). It is distributed in different agro ecological zones of Andhra Pradesh, Maharashtra, Gujarat, Orissa, Rajasthan, Karnataka, Bihar, etc. It is found throughout Andhra Pradesh, Telangana and Tamilnadu. In Karnataka it is found in Kolar, Billari and Chamrajnagar. It is found in Kozhikode, Malappuram, Palakkad, Thrissur, Jalukki and Thiruvananthapuram districts of Kerala. In Orissa it is found in Angul, Balasore, Bargarh, Bolangir, Boudh, Cuttack, Deogarh,

Dhenkanal, Gajapati, Ganjam, Kalhandi, Kandhamal, Kendrapara, Keonjhar, Khurda, Koraput, Malkangiri, Puri, Rayagoda, Mayurbhanj, Sambal, and Sundergarh. It is also found in Chattishgarh and Madhya Pradesh.

Sterculia urens varies for its medicinal value in different agro ecological regions of India due to variation in climate, soil type and other environmental factors. Andhra Pradesh, Maharashtra, Gujarat, Orissa, Rajasthan, Karnataka, Bihar, etc., are among main Gum karaya producing states.

2. Botanical Description

Sterculia urens is a medium sized tree which attains height of around 15–20 meters and is enormously bushy (Goldstein, 1954). Stem bark of tree is grayish-white to red in colour having shiny appearance. Its leaves are compounded with long petiole having 20–30 cm in diameter crowded towards the end of the branches. Lower surface of leaves have short, thick hairs while upper surface does not have hairs. Its flowers are pedicellate, high in number, small in size and greenish-yellow in colour with complex branched panicle inflorescence. It is diploid (2n) plant having chromosome number 40 (Darlington and Wylie, 1955). Tree is andro-monoceious having mixture of bisexual (0.3–7.8 percent) in number and functionally female and male flowers in greater abundance than the former. Its pollination takes place by *Apis indica* & flower do not produce nectar (Sunnichan et al., 2004). Seeds have oblong shape and an outer brownish-black hard seed coat. Flowering takes place from December to January and fruiting season is from April to June.

The seeds of plant have physical and chemical dormancy. It has hindrance for germination is due to its poor fruit set and self-incompatibility (Sunnichan et al., 2004). Freshly harvested seeds have 100% germination rate but stored seeds have poor seed germination. Percent seed germination reduces to 70 % on 10 months of storage (Sunnichan et al., 1998). Hard seed coat faces both physical and physiochemical dormancy (Subhashini et al., 2012). Physical dormancy can be cut using acid and mechanical scarification while for chemical treatment phytohormone GA_3 is proved better (Subhashini et al., 2012). The optimum germination ability can continue for a long period by retaining the standard moisture content required to germinate seeds. Storage of seeds requires optimum temperature (0–4 °C) in a polythene bags (Sunnichan et al., 1998; Subhashini et al., 2012 and Damle, 2014).

Karaya gum is used commercially as an additive or alternative to gum tragacanth. The Rubber is processed into various grades as per requirement and exported to various countries viz. USA,UK, Japan, France, Germany, Italy, Singapore, Thailand and Malaysia. Almost 100% of the Karaya rubber is exported. Annual world production is estimated at 5500 tonnnes while India share is around 3000–3500 tonnes. This gum is used in variety of products including hair spray, cosmetics and volatizing lotions.

3. Propagation

Freshly collected seeds germinate in about 10–15 days and gives almost 100 percent seedlings that reach 15–20 cm in height within 3 months. Physical dormancy of seeds is due to hard seed coat which can be overcome by scarifying the seeds. When scarified seeds soaked in water it allows water to penetrate into it and seed germinate. The wedge around seed should also be removed carefully protecting embryo from damage. Seeds germinate optimally at temperature between 20–30 ˚C. These can be sown in nursery or container. It has been reported that properly treated seed gives upto 95 percent germination within 2 weeks of sowing.

4. Gum Extraction

Best time to get quality gum is January to June. Tapping of tree by blazing and stripping off the tree bark are two methods of gum extraction. After blazing most of gum is produced within 24 hours and it lasts for few days. Solidified gum is known as Gum karaya. Tapping should be avoided during raining season. For gum tapping tree should be performed at least 3 feet in girth and it should be done above 3 feet height from ground level. Depth of blaze should be alternate and should not exceed 1.2 inch till second layer is exposed and each blaze should be a semi-circle with 6 inch wide base. For next year blazing should be done above 5 cm of pervious year and no blazing should be done in old wound infection area. Tapping should not be done continuously so that tree gets healing time to resume normal activity.

5. Beneficial Properties and uses of Gum Karaya

Sterculia urens is very useful in traditional medicine System due to its gum which has cooling, demulcent and anti-inflammatory properties. It is regarded very valuable in Ayurveda. Its leaves, bark, seeds and roots contain several bioactive compounds with therapeutic potential. Decoction of its bark is used to alternate diarrhea and dysentery while seeds are used for their laxative property. Its Leaves are useful as fodder for livestock. Its bark is used in making rope and rough cloth. Its gum is used in removing blisters, food additive, tablet binder and gelling agent. Its seeds are eaten after roasting and seed oil is used for edible purpose and soap making. Branch stalk or twigs of plant is used a toothbrush to relieve toothache.

5.1. Pharmacological properties

It has several traditional uses and various researches indicate its uses as:

(a) Anti-inflammatory- Due to the presence of flavonoids and other bioactive compound it shows significant anti-inflammatory effects which is beneficial in management of arthritis and Skin disorders.

(b) Anti-oxidant- Phytochemical of *Sterculia urens* shows antioxidant activity, scavenging free radicals and protecting cells from oxidative damage. It is used to prevent various chronic diseases and delaying aging process.

(c) Gastro intestinal benefits- Gum Karaya has demulcent and laxative properties, therefore it is used in treatment of constipation and other digestive disorders. Bark decoction of tree is used in dysentery indicating its gastro protective effect.

(d) Wound healing- *Sterculia urens* is used for wound healing traditionally due to its antimicrobial and tissue repair properties. Its gum accelerates formation of granulation tissue and thus accelerates wound healing process.

(e) Respiratory support- It is prescribed in Ayurveda for cough and Asthma. Its expectorant and bronchodilator properties help in alleviating respiratory symptoms and improve lung function.

5.2. Uses of Gum Karaya

(a) Adhesives- It is used as a bulking laxative due to its ability to form a mucilaginous gel when in contact with water. Gum is used to limited extent as a wet end additive in papermaking in conjunctions with starches. It is widely used in industries due to its water absorption/ moisture absorption, gel and adhesive ability.

(b) Paper and pulp- Gum karaya is used for making special quality papers. It deflocculates the fibers and serves as binder for fibers. It gives light weight sheet with improved formation and strength.

(c) Leather and allied products- It is used as an ingredient of dressing composition in leather industry. It accelerates tannin action. It is also used in manufacture of collagen fiber material.

(d) Textile- The bark of tree can be stripped off the easily and yield a useful fiber suitable for making course cloths and ropes. In textile industries gum karaya is used as a binding material in powder form.

(e) Other industrial uses- It is used in Petroleum and gas producing industries in formulations of drilling liquids in removing calcareous deposits in the wells. It is added to time base drilling fluids to prevent water loss after reducing its viscosity by healing at 90˚ c for 10 hours. In formation of briquette (a block of compressed coal dust) low grade gum is used as binder.

(f) Medicinal uses- Karaya gum is used for constipation in liver disease and as a laxative. Application of powdered gum karaya has been found to stimulate granulation and heal stubborn bed sores. Its powder found to increased normal granulation tissue and good epidermal growth when applied on open wound. Gum is also used to treat throat infection.

(g) In Cosmetics- Gum has film forming properties which is useful in hail setting preparation of hail lotions and finger wave lotion for the beauty trade.

(h) In Food industry- It is used in beet sugar manufacturing by accelerating settling rates when applied in small dilute solution. It is found to improve the quality of juice by addition of gum. It serves as less sticky water absorber in meat products. It act as binder by absorbing moisture when added meat processing. Gum karaya is used as stabilizer by increasing water in salad dressing. In sauces, condiment bases, ketchups, sweet pickle and liquor, the gum acts as a stabilizer by increasing the viscosity.

(i) In Baking products- A mixture of Karaya and Arabic gum acts as an emulsifying agent. In biscuits preparation its mixture improve the appearance, symmetry, grain and tenderness while in bread preparation it increases the volume with improvement in softness, symmetry, taste, colour, etc. Gum Karaya can be used in making synthetic pulp for fruit juices due to its cold water swelling property.

(j) Other uses- Gum Karaya is used in linoleum, ice cream, jellies, varnishes, inks, rubber compositions, oil cloth, paper coating, polishes and engraving process. *Sterculia urens* is a useful plant for reclamation and afforestation work on bare rocky Land.

6. Study Objective

The conservation status of the species as well as its importance, uses and impacts are studied. Beside this seed parameters like the average seed size of *Sterculia urens* seeds will be carried out.

6.1. Problems associated with *Sterculia urens* & Conservation Approach

Due to its poor fruit set and self-incompatibility along with reduced germination of stored seeds, its propagation is difficult. Sometimes lack of awareness on advanced and scientific gum tapping methods leads to fatalities. Its young tree has gum producing ability at 42 cm girth at breast height and traditionally it is tapped brutally by tribals.

6.2. Threat to species

Sterculia urens Roxb. exhibits significant medicinal value and is documented in ethno medicine. However, due to unscientific practice of gum excursion, due to high demand of species and lack of proper conservation studies it's population is decreasing drastically. It is very important for tribal economy. *Sterculia urens* population is in threat hence there is an urgent need to develop intense activity for conservation & management of this important species.

6.3. Conservation Strategies

(1) Beside studies on seed source variation (SSU) seed viability (SU) and seed germination (SG) there is a need for approaching programs to gain superior grade, healthy somatic embryo that can yield high frequency karaya plants in contrast to ordinary seeds using artificial methods. (2) Use of Micro grafting technique for propagation and development of gum yielding trees. (3) Genetic diversity analysis using molecular markers and micro propagation of an elite tree for the tree improvement programme. (4) *Sterculia urens* should be recommended by the ministry of forestry to tribal and farmers for agroforestry due to its potential for social forestry.

6.4. Export policy

Exporters are currently registered through Tribal co-operative marketing development Federation (TRIFED) under the Ministry of Tribal affairs, Govt of India, New Delhi. States Tribal development & Forest Development Corporation has right to purchase chewing gum in the respective states.

7. Material and Methods

Seeds of *Sterculia urens* were collected and after proper cleaning and drying they were stored for further analysis. Seed length, width and thickness were recorded for 100 seeds of each seed lot.

8. Result

Mean seed length was found as 9.74 mm and mean width of seed was found as 6.14 mm in the seed collected from Devli, Tonk, Rajasthan.

9. Conclusion and Discussion

The results indicate that seeds of *Sterculia urens* collected belong to average seed size. There is special need for conservation of this species as it is extremely useful from medicinal, ecological and economical point of view. The plant thrives well in Indian sub-continent and also has significant uses therefore need of conservation of this species should be the priority. the main problem associated with this species is good quality seeds and seed storage associated problems, therefore further studies should be conducted to resolve the seed storage and seed germination related problems in order to provide a good strategy to conserve this wealth of Indian deciduous forest.

Table 1. Seed size of *Sterculia urens*

S.No.	Location	GPS	Date of Collection	Mean Length (mm)	Mean Width (mm)
1.	**Devli, Tonk, Rajasthan**	N26˚03.511' E 76˚09.626'	10/6/2024	9.74±0.32	6.14±0.46

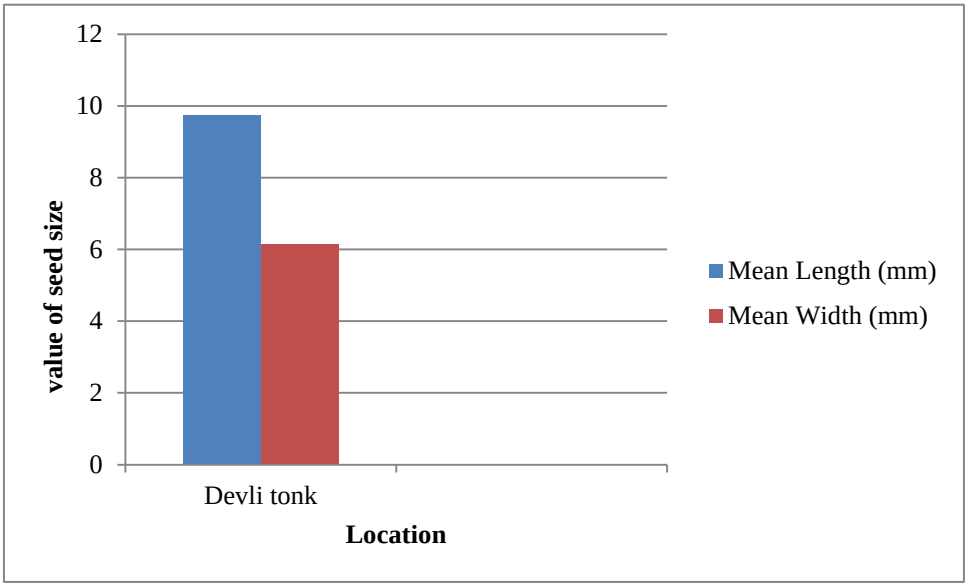

Figure 1. Seed size of *Sterculia urens*

Figure 2. Seed collection of *Sterculia urens*

Declarations

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Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

Consent for publication

The authors declare that they consented to the publication of this study.

Authors' contributions

All the authors took part in the literature review, analysis, and manuscript writing equally.

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