Acacia nilotica: a multipurpose tree and source of Indian gum Arabic

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1. Introduction

Acacia is a genus of shrubs and trees belonging to the subfamily Mimosoideae of the family Fabaceae or Leguminosae. It is indigenously known as ‘Babul’ or ‘Kikar’ is moderate sized with a spreading crown tree and is broadly scattered in tropical and subtropical countries. It is indigenous to the Indian Sub-continent as also in Tropical Africa, Burma, Sri Lanka, Saudi Arabia, Egypt and in West and East Sudan. In India, natural babul forests are generally found in Maharashtra, Gujarat, Andhra Pradesh, Rajasthan, Haryana and Karnataka. However, scattered trees in groups occur naturally and also widely planted in almost all states and Union territories except north-eastern states, Kashmir and Kerala. A. nilotica is truly a multipurpose tree and extensively used in traditional agro-forestry system. In the present scenario of climate change, agro-forestry practices, emerging as a viable option for combating negative impacts of climate change (Singh et al., 2013). It is reported to be well nodulated with Rhizobium species (Dreyfus and Dommergues 1981). This nodulation behavior helps in biological nitrogen fixation which helps to meet the nitrogen requirement in nutrient-poor soils and application of nitrogen In addition, this species form symbiotic associations with naturally occurring soil fungi called vesicular arbuscular mycorrhizae (VAM) (Kaushik and Mandal 2005). This association assists the roots to exploit more soil volume and to gain improved access to available nutrients especially phosphorus under stress and also makes the unavailable forms of nutrients into utilizable forms (Bowen 1973). Its timber is valued by rural folks, its leaves and pod are used as fodder and gum has a number of uses.

Acacia nilotica is an imperative multipurpose plant that has been used broadly for the treatment of various diseases (Singh et al., 2009). Further, MPTs like Acacia nilotica, Butea monosperma, Terminalia arjuna, Albizia procera and Zizyphus mauritiana are an integral part of the rural agroforestry practices of the region and have tremendous importance in poverty alleviation and income generation (Jhariya et al., 2015). The tree has a special significance to resource-poor farmers, who have a long tradition of growing it on their farms along with crops (Jena 1991). Moreover,
gum produced from this resource is very valuable in pharmaceutical purpose, calico-printing, sizing paper, cloth and textiles and encapsulation etc.

2. Origin and distribution

*Acacia nilotica* (L.) Willd. ex Del. (*Mimosaceae*), known as prickly acacia in Australia, is native to the tropics and subtropics of Africa, the Middle East, and the Indian subcontinent. It is being a multipurpose and nitrogen fixer species is highly preferred by farmers and as a result, it is widely distributed in the field (Raj 2014). It is an imperative multipurpose plant (Kaur et al., 2005) that was introduced into Queensland from India in the late 1890s as an ornamental tree (Bolton 1989). It is a complex species with nine subspecies, of which six are native to the African tropics and three others are native to the Indian subcontinent. It is a species of Southern Tropical dry deciduous forests and Southern Tropical thorn forests as distinguished by Champion and Seth (1968).

3. Botanical description

It is a medium-sized 7 to 13 m tall with a stem diameter of 20 to 30 cm evergreen tree with a short trunk and having round spreading crown with feathery foliage. Bark is a rough dark brownish to nearly black in colour with longitudinally and deeply cracked figured. Leaves are from 2.5-5 cm long, bipinnate with spinescent stipules, pinnules narrowly oblong. Pods are flat shaped, 7.5-15.0 cm, contracted between the circular seeds. It is a relatively fast growing, drought resistant multipurpose legume with the ability of biological nitrogen fixation. In addition, its strong tap root system (Toky and Bisht 1992), long growing period of more than 300 days with four peaks of leaf flush (Beniwal et al., 1992), it can intensively exploit soil column for nutrients and moisture.

4. Phenology

*Acacia nilotica* germinates following rainfall in the wet season. Germination is aided when seeds are disturbed, e.g. by fire or by passing through the digestive system of animals. It flowers between March and June, with pods forming between July and December. Most leaf fall corresponds to this dry period between June and November. Seedpods drop from October to January. Pods are strongly constricted, white-grey, hairy and thick (Baravkar et al., 2008). Most flowers are functionally male with a few hermaphrodites. Most of the leaf fall occurs during the dry period when the tree bears green pods.

5. Habitat

*Acacia nilotica* is a tropical and subtropical genus with species abundant throughout Asia, Australia, Africa and America. *Acacia nilotica* occurs naturally and is imperative in traditional rural and agro-pastoral systems (Shittu 2010).

6. Environment and ecology

There is some evidence that *Acacia nilotica* is a weed in its native habitat e.g. South Africa (Holm et al., 1979), but in other areas it is planted for forestry or reclamation of degraded land (Puri and Khybri 1975). It grows well in two types of soils i.e. riverian alluvial soil and black cotton soil. It can withstand extremes of temperature (≥ 50°C) and conditions of drought however; adequate moisture is needed for full growth and development. Trees of all age classes are adversely affected by conditions of severe frost. The average annual rainfall varies from 250-1500 mm.

7. Source of babul gum

Gum trees are economically important and found in tropical moist and dry deciduous forests, produce a significant quantity of gum, which are widely used as industrial, food and medicinal purposes in India (Das 2014). India is a rich diversity centre of medicinal and aromatic plants and plays an important role in supporting health care system in India (Painkra et al., 2015). The major commercially important gums in good quantity are sourced from the central Indian forests, comprising of Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Orissa, Jharkhand and Bihar and to some extent Gujarat and Rajasthan. These central India forms one of the major ecosystems of the Indian subcontinent and constitutes a large tract of tropical dry deciduous and tropical moist deciduous forest type (Raj and Toppo 2014; Toppo et al., 2014). *Acacia nilotica* gum is known as ‘Indian gum Arabic’. It exudes from the wounds in bark. It generally exudes during March-May. It occurs in the form of rounded or ovoid teardrop shape up to 1 cm and color varies from pale-yellow to brown or almost black (Raj 2015).

8. Gum production by improved techniques

Traditionally trees are tapped by blazing, stripping of the bark or making deep cuts in the base of the tree with axe and in the process plants get injured at various points and produce only few quantity of gum (Tadesse et al., 2007; Moola Ram et al., 2013). Therefore after recognizing these problems, there is an urgent need to employing improved scientific tapping techniques i.e. application of ethephon. Trees are tapped to increase gum yield by making incisions in the bark or treating with stress hormone ethylene or ethylene-releasing compounds such as ethephon (2-chloroethylphosphonic acid). Ethephon is used to stimulate latex flow in Para rubber (*Hevea brasiliensis*), resin enhancement in pines (Peters et al., 1978), gum production in *Acacia senegal* (Bhatt and Mohan Ram, 1990), *Acacia nilotica* (Das 2014), *Anogeissus latifolia* (Bhatt 1987), *Azadirachta indica* (Nair et al., 1980, 1985). It also increases gumresinosis in *Mangifera indica* (Bhatt and Shah, 1985) and *Commiphora wightii* (Bhatt et al., 1989). However, gum tapping using scientific methods of gum exudation not only maintain the life span of the tree but also yields good quality gum of high international value.

9. Physico-chemical property of gum

Physico-chemical characterization of gums therefore is an essential step towards establishing their suitability for industrial application. The physico-chemical properties of a compound are the measurable physical and chemical characteristics by which the compound may interact with other systems, and these
characteristics collectively determine the quality, applicability or end-use of the compound (Yusuf 2011). In plant gums, these properties are directly influenced by the botanical type, age, location, nature of the growing soils and the climatic conditions around the resource gum tree (FAO 1995; Chikamai 1997; Idris et al., 1998; NGARA 2005). Its physico-chemical properties comprises of 13% moisture, 38% solubility, 300-320°C melting temperature, 3.54% ash, 0.4% nitrogen, 2.71% protein, 78.15% total soluble fibre, 0.70g/100g Ca, 0.30g/100g Mg, 0.004g/100g Fe, 0.016g/100g Na and 0.78g/100g K. The gum of Acacia nilotica has a higher molecular weight (Mw, 2.3 x 10^6) than Acacia senegal (Mw 600,000). The gum contains galactose, L-arabinose, L-rhamnose, and four aldobiouroncids. It contains a high percentage of phenolic constituents consisting of m-digalic acid, gallic acid, its methyl and ethyl esters, protocatechuic and ellagic acids, leucocyanidin, m-digalic dimer 3,4,5,7-tetrahydroxy flavan-3-ol, oligomer 3,4,7-trihydroxy flavan 3,4-diol and 3,4,5,7-tetrahydroxy flavan-3-ol and (-) epicatechin. Fruit also contains mucilage and saponins. Also is rich in phenolics consisting of condensed tannins and phlobin, gallic acid, protocatechuic acid pyrocatechol, (+) catechin, (-) epigallocatechin-5,7-digallate, apigenin, 6,8-bis-D-glucoside, and rutin (Seigler, 2003).

10. Role of gum in livelihood

Gum is a one of the important non-timber forest produce (NTFP) and viable income sources for thousands of forest dwellers, especially tribals in India. Gum production is a pillar of family economy and considered as an income-generating source that requires only a low input of work after the rainy season. Exploiting Babul tree for gum tapping will help farmers to strengthen their socioeconomic conditions as well as to help conserve environment and biodiversity too (Raj 2015). Conserving biodiversity and eliminating poverty are linked global challenges. The poor, particularly the rural poor, depend on nature for many elements of their livelihoods, including food, fuel, shelter and medicines (Jhariya and Raj 2014). As per Abtew et al. (2014) gum and resin income contributes to 14%–23% of the small-scale producers’ household income in the dryland of Ethiopia and Sudan. Therefore, it represents important sources of livelihoods of the local community, employment and foreign exchange earnings (Chikamai and Casadei 2005). In addition to the wider industrial applications in developed countries, the products are consumed locally as traditional medicines, foods and beverages, and are used in religious and cultural rituals (Chikamai et al., 2009).

11. Conclusion

Acacia nilotica has been known since ancient time and it is widely distributed, as well as cultivated in agricultural fields in the Indian subcontinent. It is a leguminous tree which provides the nutrients to the plant through biological nitrogen fixation and having a multiple use such as for fodder, fuel wood, for making hedges because it’s thorns and for making agricultural implements. Apart from this A. nilotica is a good gum yielding tree and having therapeutic ingredients to prevent, mitigate or treat many diseases or conditions. So it is one of the important sources for strengthening the socio-economic status for the rural people.

Conflict of interest statement

We declare that we have no conflict of interest.

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