

Review Article

Acacia nilotica: A Multipurpose Tree Species for Climate Resilience

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ABSTRACT

Acacia nilotica is truly multipurpose nitrogen fixing leguminous tree in India commonly called as babul. Its timber is valued by rural folks, leaves and pod are used as fodder and gum has a number of uses. *Acacia nilotica* is an agroforestry and urban forestry tree species, which provide fruits, timber, fodder, gums and other services such shade, beauty, soil improvement and is used for climate change mitigation. It tolerates extremes of temperature and moisture. It is suited for planting on marginal lands and can survive both drought and flooded conditions. The main advantage of this genus is its fast biological nitrogen fixation, ability to establish on nitrogen-deficient and drought prone soils and suitability for agroforestry systems. This article briefly reviews ecological and economic importance of *Acacia nilotica* with plant description. This is an attempt to compile and document information on different aspect of *Acacia nilotica*.

Keywords

Acacia nilotica,
Leguminous tree,
Nitrogen fixation,
Agroforestry

Introduction

Multipurpose trees are defined as all woody perennials that are purposefully grown to provide more than one significant contribution to the production and/or service functions of a land-use system. They are so classified according to the attributes of the plant species as well as to the plant's functional role in the agroforestry technology under consideration [1]. *Acacia* is a genus of shrubs and trees belonging to the subfamily Mimosoideae [2,3], of the family Fabaceae or Leguminosae, [4,5] first described by the Swedish botanist Carl Linnaeus (1773). 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. *Acacia 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 [6]. *Acacia nilotica* known as babul is the most important tree of the dried parts of India. Almost all its parts are used in different aspects including root, bark, leaves, flower, gum, pods etc. [7,8]. The bark of babul tree contains tannin made up of strong and astringent acid (gallic acid) and used in tanning and dyeing, inks and pharmaceuticals [9,3].

Botanical Description

Acacia nilotica (L.) Del. syn. *Acacia Arabica* (Lam.) Willd. (Mimosaceae) is an imperative multipurpose plant [10]. *Acacia nilotica* occurs naturally and is imperative in traditional rural and agro-pastoral systems [11]. It is a tree 5–20 m high with a dense spheric crown, stems and branches usually dark to black coloured, fissured bark, grey-pinkish slash, exuding a reddish low quality gum. The tree has thin, straight, light grey spines in axillary pairs, usually in 3 to 12 pairs, 5 to 7.5 cm (3 in) long in young trees, mature trees commonly without thorns. Flowers in globulous heads 1.2–1.5 cm in diameter of a bright golden-yellow colour set up either axillary or whorly on peduncles 2–3 cm long located at the end of the branches. Pods are strongly constricted, white-grey, hairy and thick [12]. Pod shortly stalked, 3 or 4 inches long by about $\frac{3}{4}$ wide, more or less constricted between the 2-6 seeds, flat except over the seeds, smooth, pale membranous, with a strong fibrous marginal rib and fainter transverse reticulating veins. Seeds with a long funicle slightly dilated at the hilum, roundish in outline [13] and persistently grey downy. [14] It is very bitter to taste. [7,8,15]. The species can withstand extremely hot temperature (>50°C) and can also endure floods. The species is sensitive to frost when it is young [16]. Trees can flower and fruit two to three years after germination, but after high rainfall it is more quickly, usually between March and June [17]. The bark has a

tinge of orange and/or green (young tree), but older trees have dark, rough bark and tend to lose their thorns [18]. The gum exudes from the cuts in the bark in form of ovoid tears. The tears are glossy and marked with minute fissures and are brittle in nature. The colour of the gum varies from pale yellow to black. It is soluble in water [4,7].

Distribution

Acacia nilotica (L.) Wild. ex Del. (Mimosaceae), known as prickly acacia in Australia. 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. *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. The largest tracts are found in Sind.

It is distributed throughout the greater part of India in forest areas, roadsides, farmlands, tank foreshores, agricultural fields, village grazing lands, wastelands, bunds, along the national highways and railway lines. Mostly it occurs as an isolated tree and rarely found in patches to a limited extent in forests. Further, MPTs like *Acacia nilotica*, *Butea mono sperma*, *Terminalia arjuna*, *Albizia procera* and *Zizyphus mauritiana* are an integral part of the rural agro forestry practices of the region and have tremendous importance in poverty alleviation and income generation [19].

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). [20]

Ecological Importance

Climate change affects agricultural production and leads to the reduction in household incomes. In this context, the use of *Acacia nilotica* in agroforestry systems can help farmers to climate change adaptation. For instance, *Acacia nilotica* was found to have significant effects on amending soil, improving crops growth and yield performance in Saudi Arabia [21]. In addition to that, *Acacia nilotica* is leguminous plant, which is nitrogen-fixing species and found to enhance biomass production of a given ecosystem therefore carbon dioxide sequestration [22]. Leguminous species are the provider of nitrogen to the non-nitrogen fixing species, which is vital for the productivity of ecosystems therefore more carbon storage. Approximately the lifespan of *Acacia nilotica* is 40 year periods [23]. *Acacia nilotica* is reported to be well nodulated with Rhizobium species [24]. This nodulation behaviour help in biological nitrogen fixation which help to meet the nitrogen requirement in nutrient-poor soils. In addition, this species form symbiotic associations with naturally occurring soil fungi called vesicular arbuscular mycorrhizae (VAM) [25]. 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 [26].

Economic Importance

Acacias are established as very important economic plants since early times as source of tannins, gums, timber, fuel and fodder. They have significant pharmacological and toxicological effects In Africa and the Indian subcontinent; *Acacia nilotica* is extensively used as a browse, timber and firewood species [27,2,3]. The bark and seeds are used

as a source of tannins[28,3]. The species is also used for medicinal purposes. Bark of *Acacia nilotica* has been used for treating hemorrhages, colds, diarrhea tuberculosis and leprosy while the roots have been used as an aphrodisiac and the flowers for treating syphilis lesions [3]. The dark brown wood is strong, durable, nearly twice as hard as teak, very shock resistant and is used for construction, tool handles and carts. It has a high calorific value of 4950 kcal/kg, making excellent fuel wood and quality charcoal. It burns slow with little smoke when dry. It has a25% more shock resisting ability than teak. At the time of tree felling total wood production was estimated 167 Mg ha⁻¹ that included 45 m³ marketable timbers [29]. 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 [30].

***Acacia nilotica* - Resilience relieve plant**

Acacia nilotica belongs to the economically and ecologically important family Leguminosae or Fabaceae. *Acacia nilotica* is an imperative multipurpose tree diverse societal benefit. For instance, the products derived from *Acacia nilotica* such as gum, fuel, fodder and drugs can be used to fight societal poverty and adapt to climate change in the rural areas. For example, *Acacia nilotica* is used as green manure in order to improve soil fertility, which could be a climate change adaptation option. This presents an opportunity for food security and poverty reduction. This goes with the sustainable development's goals [31].

Conservation and management of natural *Acacia nilotica* populations is essential in environment stabilization and fighting against drought. *Acacia nilotica* is a multipurpose tree species, which is widely distributed and

used in agroforestry and urban forestry for various services. This tree is part of an economic dynamic and in the strategies of resilience in the face of different threats from the population and provides a considerable opportunity for climate adaptation. Therefore, we recommend that *Acacia nilotica* should be included in planting programmes for strengthening the socio-economic status for the rural people and for ecological benefits, which can be a climate change response.

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