

Gum Production on Different Land Forms in Arid Western Rajasthan

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Abstract: *Acacia senegal* (L.) Willdenow or *Acacia seyal* (Fam. Leguminosae) is native to arid and semi-arid region of sub-Saharan Africa. In Indian sub-continent, species is exotic but has been well naturalized. *Acacia senegal* is an important tree species, the source of gum Arabic is found in the desert state of Rajasthan, especially in arid western Rajasthan. It's habitats in arid western Rajasthan included rocky hills, sandy plains, sandy hummock and sand dunes. It is commonly an under canopy tree which generally attains a height of 4.5 to 8.0 m. After repeated trials and error, ICAR-CAZRI, Jodhpur standardized the dose of Ethephon treatment of *A. senegal* trees for enhanced recovery of gum Arabic. The present study deals with CAZRI developed gum Arabic production technology coupled with gum Arabic production from different land forms in arid zone. From the data obtained through various experimentations *A. senegal* produces maximum average of (0.408g/ tree) gum Arabic on sand dunes followed by inter dunal area (0.316g/ tree). Minimum average of gum Arabic yield recorded in rocky gravelly land forms (0.12 g/tree). *Acacia senegal* can be source of additional income for the millions of people in arid and semi-arid regions of India, if it is explored scientifically for gum tapping through the technique developed by ICAR-Central Arid Zone Research Institute, Jodhpur, India.

Keywords: *Acacia senegal*, arid western Rajasthan, gum Arabic, Land forms

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I. Introduction

Acacia senegal is native to arid and semi-arid region of sub-Saharan Africa. In Indian sub-continent species is exotic but has been well naturalized. Chaimphon and Seth (1968) placed *A. senegal* (L.) Willdenow or *Acacia seyal* (Fam. Leguminosae) (FAO 1999) is under dry tropical thorn forest in their classification of Indian forests. This important species is found prominently in the desert state of Rajasthan, especially in arid western Rajasthan. It's habitat in arid western Rajasthan included rocky hills, sandy plains, sandy hummocks and sand dunes. It is also found in other parts of India viz., of south-east Punjab, Gujarat, Madhya Pradesh, Maharashtra and Haryana. In extreme western fringes of arid western Rajasthan the species forms important component of traditional agroforestry system (Tewari and Pareek 2015).

A. senegal is commonly under canopy trees which generally attains height of 4.7 to 8.1 m however, in most conducive environmental conditions it can attain height up to 14-15 m. Trunk may vary in diameter often attain a diameter of 29 -37 cm. Bark is grayish-white, although in some mature old trees it may be dark, scaly and thin. Powerful hooked thorns, 3-5 mm long, with enlarged bases appear at the nodes of the branches, usually in like 3s. They are sharp, with some pointing forwards and others backwards. Leaves bipinnate (3-8 pinnae), flowers yellowish –white and fragrant. Each flower has five deep lobes, 5 petals, a mass of short stamens and pistil inconspicuous. The pods are straight, flate, shortly stipitate and oblong, green when young, maturing to shining brown. Each pod contain 3-6 seeds which are smooth, flat, rather small, shiny dark brown. Seeds are also source of traditional folk vegetable. The species has wide ecological amplitude (Hocking 1993).

A. senegal is main tree component in rocky land forms of arid western Rajasthan. Rocky-semi-rocky land forms are spread over in 12% area of arid western Rajasthan which accounted to be 23,520 sq km. In such land forms *A. senegal* can be a source of income to the farmers' if they get some quantity of gum from the trees (Narian and Tewari, 2005). The species is known for it's edible high quality gum, commonly known as gum Arabic. Gum Arabic is "a dried exudates" obtained from the stems and branches of the species (FAO 1999). India has been a net importer ever since gum Arabic trade has got in its present shape in organized form. Imports, mainly from Sudan and Nigeria (the top gum Arabic producers), are needed to meet the country's requirements. Imports have increased from 4048 tons in 1992 to 26,098 tons in 2011 (UN Data 2011). India has the potential to produce independently a much higher quantum of gum Arabic because *A. senegal* trees are distributed abundantly throughout the arid and semi-arid tropics which constitute approximately 40% of the geographical area of the country. The most important issue is that this rich natural source of the country has left

mostly un-tapped because in traditional gum tapping method in which the tree trunks are blazed as various parts of the stem results in production of only 15-45 g gum Arabic/ tree, which is not economically viable and as well as harmful for tree health.

Ethephon (2-chloroethylphosphonic acid) is a synthetic compound of ethylene, phosphate and chloride ions. It is a commonly known as plant growth regulator. In plant increased rates of ethylene biosynthesis induced by stress activate various developmental responses and gum exudation may be considered as one such developmental response to stress (Hall and Smith 1995). The idea to use Ethephon as gum inducer came from the thought that if ethylene is supplied artificially to the tree via the application of Ethephon, the developmental response to stress could be accelerated, and, consequently, more gum exudates could be obtained. On the basis of this assumption, ICAR- Central Arid Zone Research Institute (ICAR-CAZRI), Jodhpur developed a technology to exude higher quantum of gum Arabic from abundantly distributed *A. senegal* trees in arid western Rajasthan. Paper describes CAZRI gum exudation technology and different experimentations carried out using this technology, and as well as extension and adoption of the technology by the stakeholders (Tewari and Pareek, 2012).

II. Material and Methods

The technology

After repeated trials and error, ICAR-CAZRI, Jodhpur standardized the dose of Ethephon treatment of *A. senegal* trees for enhanced recovery of gum Arabic. It was found that Ethephon solution containing 780 mg active ingredient/4 ml was found optimum dose for maximum yield of gum Arabic. The standardized Ethephon solution for gum Arabic production is giving the name- CAZRI gum inducer. Application of CAZRI gum inducer on *A. senegal* trees was done as follows.

A 50° downward slanted hole of 14- 16 mm in diameter and about 4 cm deep was made on the tree trunk (35-50 cm above the ground) using a hand or electrical drill. This technique was used to ensure that maximum amount of the applied CAZRI gum inducer was utilized by the tree for the process of gum exudation. One 4-ml dose of CAZRI gum inducer is applied. After the treatment, the hole was covered with moistened clay/ natural bee wax. Whole procedure of ethephon-induced gum Arabic exudation technique is shown in Fig. 1. In this method Ethephon which is directly injected into the tree trunk reaches rapidly in plant tissues involved in gum production (Ram *et. al*, 2012).

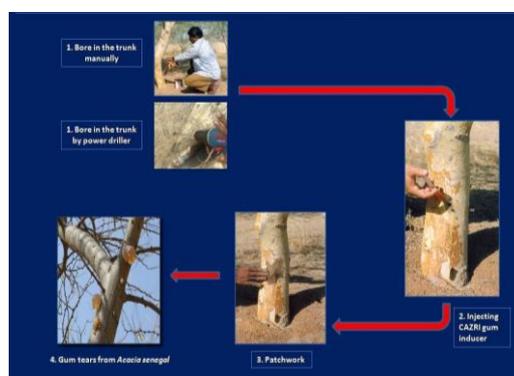


Fig. 1 Step by step procedure for application of CAZRI gum inducer to for gum Arabic production from *A. senegal*

Gum Arabic production from different land forms in arid zone

In arid western Rajasthan, different types of land forms are found. Arid western Rajasthan is spread over approximately 196000 sq km, which is better known as *Thar Desert*. *A. senegal* is wide spread on different land forms. Of the total geographical area of arid western Rajasthan 47.9 % is under different intensities of dunes and inter-dunal planes. Sandy planes are spread over in 27.9 % area. Rocky-gravelly areas are spread over in 11.6 %. Rest 12.6% area is under other different land forms in which *A. senegal* is not found at all. A study was conducted in 2014 on five major land formations of arid zone in five villages of Chouhatan tehsil and Barmer tehsil of Barmer district, and Shergarh tehsil of Jodhpur district. The selection of villages was done on the basis of dominant land form in a particular village (Binjarad, dominant formation sand dunes; Jakhada, dominant formation was inter dunal areas ; Chatarpura dominant formation was rocky-gravelly land; Sura and Bayatu, dominant formation was sandy plain. In each land form, 25 trees of more or less same girth class were marked and treated with CAZRI gum inducer and information on gum production was collected from the stakeholders at the end of June (at the start of rainy season).

III. Results and Discussion

Gum exudations started five- ten days after treatment of sand dunes and inter dunal areas. In case of sandy plain formation, gum exudation started after seven days of treatment, and in case of inter dunal areas, gum exudation initiated 10 days after the treatment. Gum exudation process started after 13- 14 days in case of rocky- gravelly land form. Gum Arabic production was found maximum on sand dunes followed by inter dunal areas (Fig. 2). Minimum gum Arabic production was recorded in rocky- gravelly land form. Though low gum yield in rocky-gravelly areas was in expected line however, it was very interesting that production of gums on sandy plains and inter dunal areas was 21.9% and 61.3% lower than gum yield on the sand dunes. This indicated that maximum gum Arabic can be harvested from the *A. senegal* trees growing on sand dunes. About five decades back, Kaul and Chitinis (1964) while working with traditional methods of gum harvesting through blazing the tree also

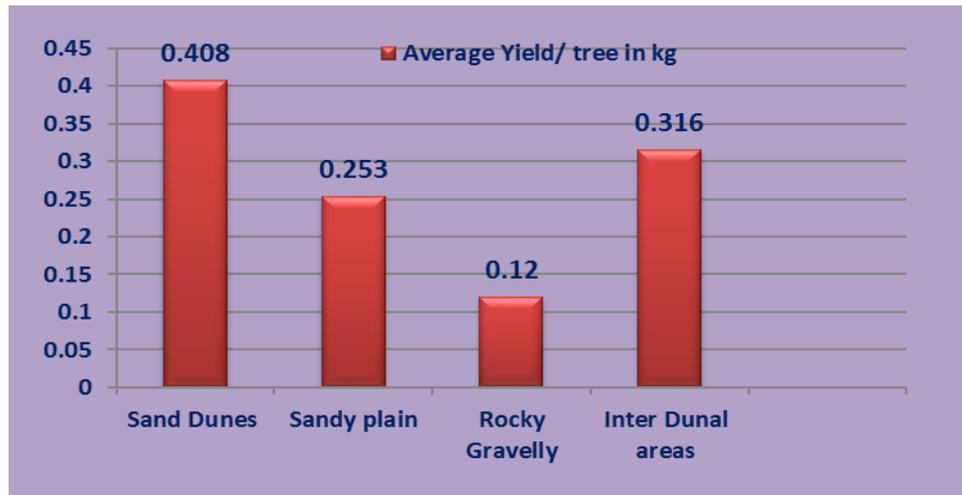


Fig.2. Gum Arabic production in different land forms of arid zone

found that *A. senegal* produces maximum average of (0.408g/ tree) gum Arabic on sand dunes followed by inter dunal area (0.316g/ tree). Minimum average (0.12 g/tree) of gum Arabic yield recorded in rocky gravelly land forms (Fig. 3). However, we have observed in rocky landform by irrigating *A. senegal* trees gum Arabic production was increased coupled with manuring + irrigation practices (Tewari *et. al.* 2017). Sand dunes also contain moisture below 25 cm after rainfall up to winter season and even in summer season moisture is available below 50 cm (Kaul and Chitinis, 1964). This may perhaps major reason for higher gum Arabic production from *A. senegal* tree on sand dunes.

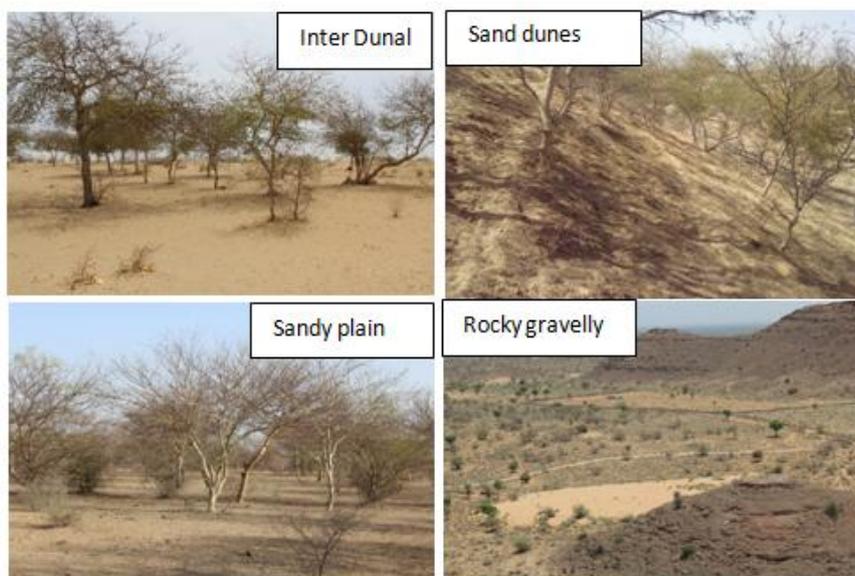


Fig.3. Different land forms (Inter dunal, Sand dunes, Sandy plain and Rocky gravelly) of arid zone with *Acacia senegal* tree found abundantly

IV. Conclusion

In case of traditional method by blazing the tree stems, in one hand the gum production is very low (30-40 g/tree) and on the other trees are injured to very high extent, which even some time causes large scale mortality. Results obtained during the present course of experimentations indicated that gum Arabic exudation after treatment of CAZRI gum inducer continued up to one month or little more. Results of our experimentations indicated that maximum gum Arabic was exuded on sand dunes followed by internal dunal areas (Fig.4).

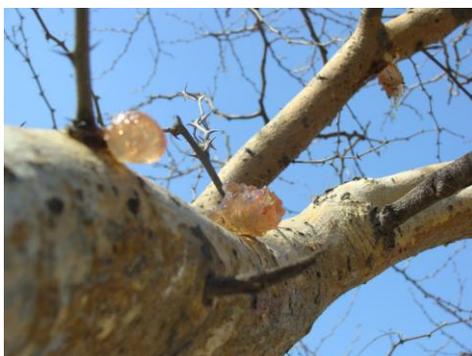


Fig.4. Gum Arabic exuded from *Acacia senegal* treated by CAZRI gum inducer

Gum Arabic is a commercially important commodity which is used in food industries, dairy products, bakery products, flavour fixative, beverages and in pharmaceutical industry for processing many preparations. The market cost of pure gum Arabic in India ranged from Rupees 1200-1500/ kg (18.46 – 23.07 US \$/ kg). It has many others application ranging from cosmetics to textile. Chikemi (1997) stated that gum Arabic plays an important role in rural life, providing an additional income to rural families especially in years when productions of crops fail. If CAZRI gum inducing technology is applied appropriately coupled with various land forms, the species can be source of income it millions of people in Indian arid and semi-arid regions. The researches described in this paper if adopted precisely in target area, the technology has potential to change scenario of gum Arabic production of India.

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