

LOSS OF *COMMIPHORA WIGHTII* (ARN.) BHANDARI IN INDIAN DESERT

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A B S T R A C T

Commiphora wightii (Arn.) Bhandari (Burseraceae), Indian Bdellium, the source of Guggul, once reported in abundance from arid regions of India, Pakistan, Iran & Saudi Arabia in old floras is now under critical threat. The present paper deals with its taxonomy, phenology, distribution and economic value alongwith causes of threat, scientific tapping of gum resin, yield and chemistry of guggul, propagation and conservation.

INTRODUCTION

Africa and Asia being the centre of origin of *Commiphora* Jacq. (Purseglove, 1975), members of the genus are widely distributed in tropical regions of Africa, Madagascar and Asia. It also extends to Australia and Pacific Islands (Good, 1974). Occurrence of *Commiphora* spp. in south-west Africa has also been confirmed by Van der Watt (1974). Out of about 185 species described so far, only three species are reported from India namely, *Commiphora caudata* (Wt. & Arn.) Engl., *C. berryi* (Arn.) Engl. and *C. wightii* (Arn.) Bhandari. While *C. wightii* occurs chiefly in Rajasthan and Gujarat, and poorly in Maharashtra and Karnataka, remaining two species are found in south and south-west India where these are grown as hedge plant.

Based on a collection of Robert Wight during his posting as a doctor at Bellary in Karnataka, Arnott in 1839 described the species *Balsamodendron wightii*, later transferred to the genus *Commiphora* by Bhandari in 1964.

The recent survey of field population, analysis of trade record and study of literature reveal that the species once distributed abundantly in a comparatively larger area of Rajasthan, Gujarat, Maharashtra and Karnataka, is now under critical threat and has become restricted to some pockets of Rajasthan and Gujarat only. Several factors are responsible for its quick decline in wild, however, the main reason being the indiscriminate and unscientific tapping to the gum-resin, the main source of Indian Bdellium.

TAXONOMY

Commiphora wightii (Arn.) Bhandari in Bull. Bot. Surv. India 6 : 327. 1964.
Balsamodendron wightii Arn. in Ann. Nat. Hist. 3 : 86. 1839. *B. mukul* Hook. ex Stock in Kew Journ. Bot. 1 : 258, t. 8. 1849. *Commiphora mukul* (Hook. ex Stock) Engl. in DC., Monogr. Phan. 4 : 12. 1883. Fig.1(A-C)

Local names : Bengali : Guggul; Gujarati : Gugara, Gugal; Hindi : Guggal; Marathi : Guggula; Sanskrit : Guggula, Koushikaha, Devadhupa; Tamil : Maishakshi gukkal; Telegu : Guggula, Gukkalu.

Extra Indian names : English : Indian Bdellium; Arab.: Moqle-arzagi; Pers.: Boe-jahudam.

Much branched shrubs up to 3 m high; branches knotty, ending in spines; bark shining, peels off in papery flakes from older branches, ash to yellowish white. Leaves highly aromatic, 1-3 foliolate; leaflets rhomboid-ovate, serrate at the apex, entire at the base, smooth, shining above and usually occur in rainy season. Flowers sessile, solitary or in group of 2 to 3, brownish red, unisexual. Calyx campanulate, glandular hairy; sepals 5, triangular. Petals 5, linear, reflexed. Stamens 8-10, alternately long and short. Ovary oblong-ovoid, attenuated into the style. Fruit a drupe, 6-8 mm in diam., ovoid-oblong, red when ripe and split into two.

Distribution : INDIA : Rajasthan, Gujarat, Maharashtra, Karnataka. PAKISTAN : Sind, Baluchistan and extended to SAUDI ARABIA.

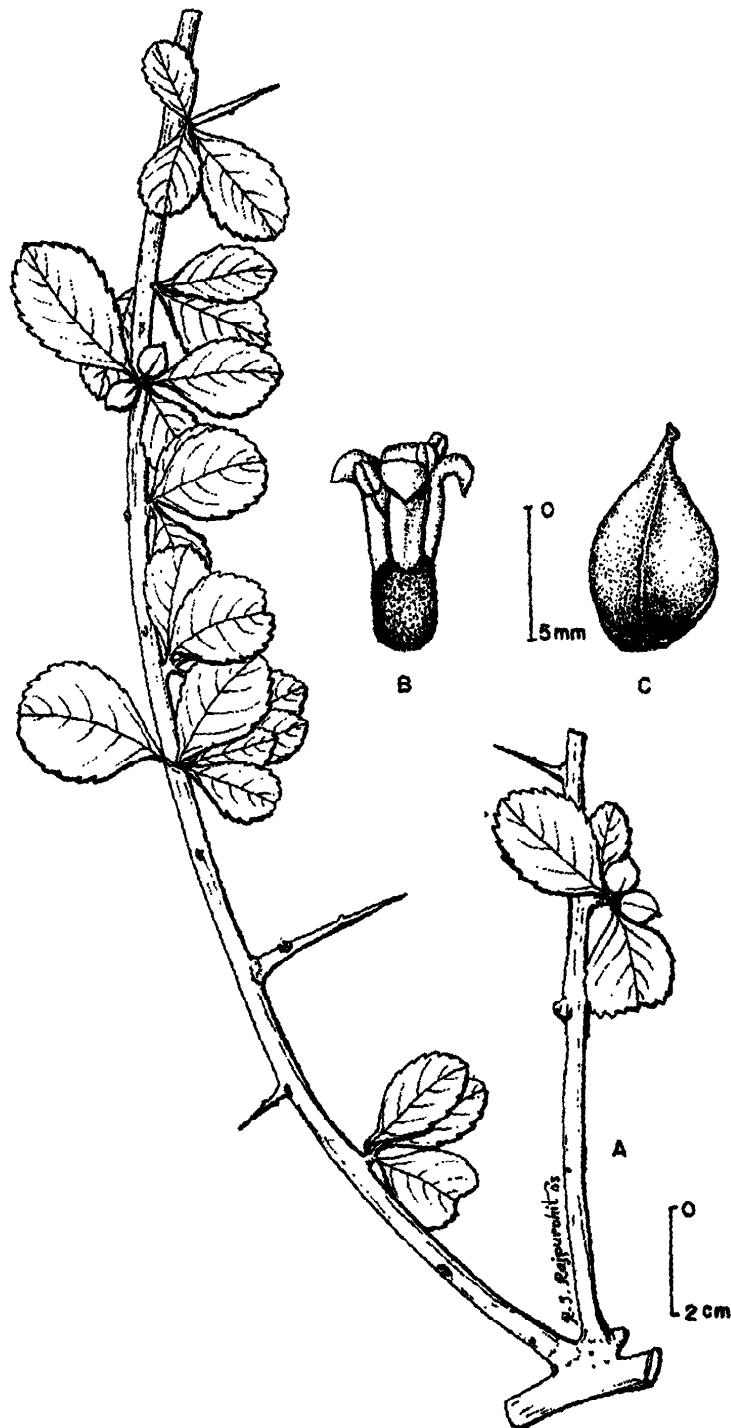


Fig.1(A-C). *Commiphora wightii* (Arn.) Bhandari
A. Twig; B. Flower; C. Fruit.

Habitat and Ecology : The open dry hills and piedmonts are the natural habitat of occurrence of this species. It also occurs in the rock-crevices and on rocky slopes in arid and semi-arid regions at altitudes 200-700 m, commonly receiving 100-700 mm rainfall annually and preferring sandy-loam soils where rain water is quickly drained away.

The most common associate of *Commiphora wightii* is *Euphorbia caducifolia*. The other associated species are *Acacia senegal*, *Anogeissus pendula*, *Bonnamia latifolia*, *Capparis decidua*, *Grewia tenax*, *Grewia flavescens*, *Maytenus emarginatus*, *Prosopis juliflora*, *Rhus mysorensis*, *Ziziphus nummularia* etc.

Fl. & Fr. : October to December.

Chromosome number : $2n = 26$ (Sobti & Singh, 1961).

UTILISATION

Commiphora wightii is the main source of Indian bdellium, a gum-resin used as an incense, fixation in perfumery and in medicine as astringent and antiseptic. It is also an important source of leaf fodder and is heavily browsed by goats and camel when there is acute shortage of fodder, in some areas it is being reduced to small shrubs or even ground hugging 'cushion'. Young branches are used as tooth-brushes and sometimes the whole plant is used by the villagers as fuel during scarcity.

The gum guggul has been used medicinally for the last 3000 years in Ayurveda as a versatile indigenous drug which is highly efficacious in the treatment of rheumatism, obesity, neurological disorders, syphilitic diseases, scrofulous affections, urinary disorders, skin diseases, pyorrhoea, swollen gums, chronic tonsillitis and throat ulcer. It is also used as anti inflammatory uterine, stimulant diuretic and aphrodisiac. It is said to lower cholesterol and increase leucocytes in blood and induce phagocytosis. In general practice it is found useful in the form of an ointment in cleansing and stimulating indolent ulcers, and is a favourite in treatment of Delhi sores, specially when combined with Sulphur, Catechu and Borax. Guggul has stimulating properties, and is sometimes given internally especially in the treatment of

horses. It is also applied as a hot paste to incipient abscesses, as an absorbent. The paste of guggul applied locally in haemorrhoids. It is used externally and internally in muscular rheumatism, leprosy, piles, dysentery, gleet, scurvy, fistula, hysteria, anaemia and chronic diseases of the lungs (Watt, 1889).

The important Ayurvedic medicine prepared from “Guggul” are Amvatariras, Arogyawardhani vati, Chandraprabha vati, Gokshuradi guggul, Kaishore guggulu, Mahayograj guggul, Mehmudgar bati, Panchatika ghrit guggulu, Punarnawadi guggulu, Rasnadi guggulu, Saptavinshati guggulu, Sindhannad guggulu, Trayodashang guggulu, Trifala guggulu etc. It is said to be a substitute for African “Bdellium” obtained from *Commiphora myrrah* (Nees) Engl. (Anon., 1950; Bhandari, 1978).

POPULATION STATUS

The previous records in various Floras, scientific publications, authenticated notes in Forest Departments, study of herbarium specimens collected at different times and deposited in Indian herbaria support that the species was distributed over a larger area in Karnataka, Maharashtra, Gujarat and Rajasthan with slow but steady natural regeneration. Recent studies reveal it is now confined to a smaller area of Gujarat, in the districts of Kutch and Jamnagar. In Rajasthan, the distribution range of this species was almost all districts and more abundant in the western part viz. Jaisalmer, Barmer, Jalore, Jodhpur, Pali and Sirohi. This was the centre of Gum-Guggul collection in the past, but the wild population now is so severely fragmented and declined that for the last 10–15 years there had been no or very little yield of Gum-resin from this area. A thorough survey in 1982 recorded only 10–30 plants per hectare in this chief and dominated site of occurrence (Table-1). It has been estimated that within a period of 10 years or so, as a whole, the population has been shrunk to less than 50% with scattered and dissected subpopulations of few mature individuals in each. The populations have been threatened to such an extent that the species has figured in ‘Endangered’ category in the IUCN Red Data Book.

Table 1 : Plant density in various Forest areas in Rajasthan & Gujarat.

Locality	No. of plants per hectare	Average annual rainfall
A. Rajasthan :		
*1. Harji hill (Jalore Dt.)	30	350 mm
*2. Piedmonts of Lendra on Jaisalmer-Ramgarh road (Jaisalmer Dt.)	20	100 mm
*3. Falna Aravalli Range (Pali Dt.)	10	500 mm
4. Machia Protected area Kailana (Jodhpur Dt.)	8-12	300 mm
5. Mevanagar hills (Barmer Dt.)	10-15	80 mm
B. Gujarat :		
1. Kutch Dt. (Bhuj, Anjar & Nakhtrana)	70-110	350 mm
2. Dwarka (Jamnagar Dt.)		
a) Khatumba	150-200	
b) Positra	20-50	
c) Rajbara	15-50	
d) Murvasar	25-70	
e) Bett	30-60	

* Suresh Kumar & Vinod Shanker; 1982.

THREATS

Over-tapping for the valuable oleo-resin called guggul, often through faulty technique, loss of habitat and abrupt climate change, less number of viable seed formation and slow germination of seeds are the main threats to the species. Among these, the destruction of population is greater and quicker due to unplanned tapping for oleo-resin. Normally a plant at an average can produce 1.5-2 pounds of gum-resin annually. But, the high demand in market and less production encourages over-exploitation through application of chemicals on the incision in need of more extraction which, however, leads to less production in successive seasons and often cause premature death of the plant. Another factor of threat is the tapping season. Normally the winter is the best season for tapping of the oleo-resin which is incidentally the flowering season of the species also. The unplanned and faulty tapping in this season plays the role of hindrance factor in natural flowering as well as fruit setting and thereby adversely affect the natural regeneration process. Gradual climatic change, especially limited winter rains also adversely affect the growth and the seed production/germination in natural habitat.

Some other factors for threat are :

(i) The villagers often allow their cattle to graze over this species especially during the recurring drought or when common fodder plants are almost fully consumed. (ii) In the scarcity for fuel wood, the branches are used by the villagers for fuel; and (iii) Sometimes the roots of the young plants are attacked by termite (*Odonto termes obesus*) in drier months. The termite infected plants start drying with yellow wilting leaves and ultimately die.

TAPPING AND COLLECTION OF GUGGUL

The tapping is done from December to February (Bhatt & Dixit, 1974). Plants of at least five years of age are suitable for gum tapping. Circular cuts are made at uniform distance of 30 cm apart at an angle of 60° with the stem (Atal & al., 1975). Incision should be up to 1.0-1.5 cm deep only. Slightly deeper and closer incision may affect the yield of resin in the following years or even cause the premature death of the plant. Mist in the night and bright sunny days are the important factor to yield more resin. The yellow, fragrant latex oozes out through the wounds which slowly hardens into vermicular pieces to form the oleo-gum resin

(Guggul). The resin is ready for collection after 10-15 days and gum is collected right up to the end of May or June.

Application in various kinds of paste and mixture are applied over incisions to increase the yield (Atal & al., 1975). It includes the paste made from the urine of horse or wild ass with oleo-gum resin and copper sulphate. The application of this paste reported to increase the yield 3-4 times, but repeated application might decrease the yield and life of the plant. Muthana & Subbayyan (1973) reported increased yield of gum resin by making more and closer incision as deep as the cambium layer.

Application of Ethephon also increases the gum yield up to 20-22 times of normal, but it also kills the plant.

YIELD AND QUALITY OF GUGGUL IN TRADE

A healthy mature plant yields 200-600 gm of dry resin in one season. An estimate of total production of gum guggul is not possible, because contractors do not report to the forest department the actual quantity of resin collected. The decrease in number of plants in chief zone of its distribution has also affected the yield of guggul (Table 2).

According to Tajudin (1995) India used to produce guggul up to 500 tons per annum in early 60's which was reduced to around 5 quintal per annum in the year 2001-02. The above figure support that there was substantial increase of production of gum-resin during 1991-94 because of indiscriminate tapping and applications of chemicals for more yield, which adversely affected the plant population and drastically decreased the yield during 1995-2002.

Table 2 : Showing loss of production of Gum Guggal.

Name of range	Year	Yield of Gum in Quintal
Jodhpur Div. (Rajasthan) :		
1. Jalore	1963-64	50.80
	1964-65	25.04
	1965-66	20.30

Name of range	Year	Yield of Gum in Quintal
2. Bhinmal	1963-64	13.20
	1964-65	14.20
	1965-66	06.00
Kutch Div. (Gujarat) :		
1. Nakhtrana	1963-64	304.81
2. Bhuj	1964-65	109.73
	1970-71	57.00
3. Anjar	1965-66	40-60

*Table 3 : Gum Guggul production in Gujarat during last ten years : **

Years	Weight (in Quintal)
1991-92	54.05
1992-93	84.66
1993- 94	107.999
1994-95	74.177
1995-96	41.516
1996-97	28.169
1997-98	28.115
1998-99	24.175
1999-00	8.029
2000-01	8.047
2001-02	5.810
2002-03 (up to January)	18.640

* Source : Gujarat State Forest Development Corporation Ltd.

Three grades of guggul are available in market; these are :

1. The best quality or first grade is one which has been collected from the trunk and from thick branches and is free from adhering bark and sand. This quality is translucent in appearance.
2. Second grade is usually dull in colour and mixed with bark and sand.
3. The third grade is most inferior one collected from the ground and contains much extraneous matter.

The Gujarat State Forest Department are paying about Rs.50,32 and 15 per kg. for the different grade of gum-guggul to the collectors.

*Table 4 : Total Revenue earned during last ten years by Gujarat Forest Department * :*

Year	Revenue (in rupees)
1991-92	3,55,316
1992-93	6,68,096
1993- 94	2,98,542
1994-95	2,86,421
1995-96	8,79,501
1996-97	1,84,000
1997-98	3,48,000
1998-99	1,09,000
1999-00	48,000
2000-01	84,000
2001-02	95,000
2002-03 (upto January)	2,38,000

* Source : Gujarat State Forest Development Corporation Ltd.

CHEMISTRY

Gum guggul contain 61% resin, 29.3% gum, 6.1% water, 0.6% volatile oil and 3.2% foreign matter. Different chemical compound isolated from gum guggul are (Anon., 1950) :

Fraction of Guggul	Isolated Chemical Compound
Oleo fraction	<ol style="list-style-type: none"> 1. Myrcene 2. Dimyrcene 3. Polymyrcene compound
Gum fraction A	<ol style="list-style-type: none"> 1. α - arabinose 2. D - galactose 3. L - fucose (L - arabinose : D - galactose ratio = 1 : 3)
Gum fraction B	6-D (4-D-methyl- β -D-glucopyranosyluronic acid)-D-glactopyranose.
Resin fraction	<ol style="list-style-type: none"> 1. Guggul sterol - I: $C_{27}H_{44}O_4$, (M.P. 225-228°C) 2. Guggul sterol - II : $C_{27}H_{46}O_3$ ' (M.P. 231-233°C) 3. Guggul sterol - III : $C_{27}H_{46}O_3$ ' (M.P. 181-183°C) 4. Guggul sterol - IV : Cholestane 5α-ol-3, 6-dione 5. Guggul sterol - V : Cholestane-3, 5α-diol-6-β-acetate 6. Guggul sterol - Z : M.P. 192-193°C 7. Guggul sterol - E : M.P. 168-170°C 8. Nonadecan - 1,2,3,4-tetrol 9. Diterpene alcohol : $C_{20}H_{34}O$ (M.P. 37-38°C) 10. Octadecan - 1,2,3,4-tetrol

Seed production and natural germination :

The plant produces seeds twice in a year, first after the monsoon and second after the winter rains. An average 300-500 seeds per plant have been observed after monsoon season. The rate of seed production is very less in winter than that of rainy season as the winter rain is not so frequent. Self seedling is rare but occur.

CULTIVATION

1. By Seeds :

Seeds collected from wild are easily germinated in experimental plots. Seeds treated by soaking in hot water or in acid or after rubbing with sand paper and grown in polythene bags show germination rate over 70-80 percent.

2. Vegetative propagation :

Multiplication through hard wood cutting show very satisfactory results and sometimes roots are induced without any treatment of growth hormone. Stem cuttings of 1-3 cm in diam. and 25-30 cm long are very suitable for vegetative propagation. These cuttings are planted in polythene bags containing 1 : 1 garden soil and sand and kept in natural condition and watered regularly, resulting 60-80% sprouting in 20-25 days.

A systematic cultivation of guggul for its medicinal value is being done in many places in India for the last two decades. In Rajasthan, at Mangaliawas near Ajmer, Guggul is cultivated extensively by cutting (Bhatt & Dixit, 1974) and established Guggul herbal farm. Recently some more commercial 'Guggul' plantations are coming up in many places in Rajasthan. The forest Department of Gujarat has started the cultivation of guggul by transplanting the cuttings and sowing the seeds in many parts, since 1974. In 1995 about 1400 cuttings have been sown in Khatumba block of Dwarka forest range.

CONSERVATION AND MANAGEMENT

(a) Conservation measures taken :

1. Introduction of the species in natural habitats by Gujarat state forest department, Dwarka range

2. Alternatively tapping of plant in forest area of Dwarka and Kutch.

(b) Conservation measures proposed :

1. To introduce the species in the protected areas of nearly similar habitat and climate.
2. To maintain its germplasm by keeping its seeds in seed bank and replacing them by fresh collection every year as its seeds have low viability.
3. To attempt for its regeneration and re-introduction in its original habitat and introduction in habitats with identical ecological condition.

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