

**ASPECTS OF GOOD AGRICULTURAL PRACTICES WITH REFERENCES TO
ENDANGERED SPECIES “GUGGUL” (*COMMIPHORA WIGHTII* ARN. BHANDARI)****Dr. Neelima Sharma*¹ and Ashish Bharillya²**¹Research Officer (Ay.) Regional Ayurveda Research Institute Jhansi.²Agronomist Sri vaidhyanath Ayurveda Bhawan, Jhansi.***Corresponding Author: Dr. Neelima Sharma**

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ABSTRACT

The plant *Commiphora wightii* (Arn.) Bhandari is a source of Indian bedellium, a oleo-gum resin obtained from incision of the bark.^[1] The resin is largely used in indigenous medicine as incense and as fixative in perfumery.^[2] It is very potent anti-arthritis, anti-obesity, anti-inflammatory and hypolipidaemic drug used in many Ayurvedic formulations.^[3,4,5,6,7,8,9] It is now classified as endangered by IUCN due to its overexploitation.^[10,11] Therefore in the present scenario when many of our indigenous medicinal plants are going in the list of endangered species, conservation and development of better agro techniques are the need of time. Moreover method and season of harvesting and post harvesting handling etc. are described in the full paper.

KEYWORDS: Resin, Indigenous, Antiobesity, Endangered, Harvesting.**INTRODUCTION**

Guggulu (*Commiphora wightii*) is a time tested very effective drug used in many antiarthritic, hypolipidaemic and anti obesity ayurvedic formulations i.e. Yograj guggulu, Mahayogaraj guggulu, Simhanada Guggulu, Kaishore Guggulu and many more.^[12,13,14] The unsustainable ways of harvesting and unrestricted marketing have led to the reduction in the population of guggulu and presently it is categorized under the endangered species by red data book.^[15,16,17] Reduction in the population and high demand leading to explore the ways of conservation and method of good agricultural practices such as agro techniques, harvesting method, post harvesting handling etc.

According to estimation the annual demand of guggulu is nearly 1000 tones, while the consumption of this drug is nearly 2300 tones used in various preparations of Indian system of medicine. The oleo resin of guggulu is imported nearly 500-1000 tones from Pakistan annually¹⁸. Therefore it is rational to conservation and cultivation of this endangered species with the study of good harvesting and post harvesting methods.^[19]

MATERIAL AND METHODS

Present study pertains the following points related to *guggulu*.

Part I: General aspects

1. Classification and Name

2. Origin and distribution
3. Production level and Major production areas in India
4. Description of the plants
5. Cultivars/ Varieties
6. Climatic requirements
7. Soil Requirements

Part II: Cultivation practices

1. Propagation
2. Soil Preparation
3. Planting
4. Manure and Fertilizer
5. Irrigation
6. Inter-culture & Intercropping
7. Plant Protection
8. Harvesting (Tapping and Collection)

Part III: Post-harvest handling

1. Grading, processing and Value addition
2. Adulterants
3. Yield
4. Packing & Storage

Part IV: Production Schedules**Part V: Utilizations**

1. Chemical constituents
2. Traditional medicinal use
3. Physical-Chemical Properties of Gum Guggul
4. General Properties of Guggul

Part I: General aspects***Commiphora mukul* (Stocks) Hook.**^[17,20]**Synonyms:** *Commiphora wightii* (Arn) Bhandari.^[17,20]***Commiphora roxburghii* (Stocks) Engl, Family:**
*Burseraceae,***Common names:** English: Myrrh tree, Mukul,**Indian bedellium,** Sanskrit: Guggulu,^[3]**Hindi:** Guggal.^[3]**Origin and distribution**

The genus: *Commiphora*, which has 165 species. Its origin in Africa and Asia and is widely distributed in tropical region of Northern Africa, Madagascar, Central Asia, Australia, Pacific Islands, India, Bangladesh and Pakistan.^[21,27,28] Four species occur in India. These are *C. wightii*, *C. agollochoa*, *C. stocksiana*, and *C. berryi*.^[22] The genuine guggulu gum is derived from *Commiphora wightii*. In India this species is distributed in the states of Rajasthan, Tamilnadu, Assam, Gujarat, Maharashtra, and Karnataka.^[23,24,25,26,28]

Production level and Major production areas in India

The Guggulu plant present in arid and semi arid climate and it is tolerant of poor soil.^[29,30] In India its plant found in arid, Rocky tracts of Rajasthan, Gujarat and Karnataka. According to *Ayurveda*, there are five type of *Guggulu* namely; *Krishnan* (black), *Pita* (Yellow), *Nila* (blue), *Kapisha* (light brown) and *Rakta* (blood red).^[3] In India Major *guggulu* producing centers are kutch forest division in Gujarat and Jodhpur forest division in Rajasthan. Due to increasing demand of Guggulu it has become imperative that steps should be taken for its scientific and rational use and conservation.^[18]

Description of the plants

The *Guggulu* plant is a Woody shrub or small tree. It is a slow growing plant and takes 8 to 10 years to reach to a height of 3 to 3.5 m with thin papery bark and branch are thorny. The branches are knotty, crooked aromatic and end in sharp spines. The bark is thin papery and peels in strips from the older parts of the stems. The branches are thorny. The leaves are simple or trifoliate, the leaflets ovate, 1–5 cm (0.39–1.97 in) long, 0.5–2.5 cm (0.20–0.98 in) broad, and irregularly toothed. It is gynodioecious, with some plants bearing bisexual and male flowers, and others with female flowers. The individual flowers are red to pink, with four small petals. Fruit is round, ovoid, up to 1cm long drops red, when ripe and the monocarps are yellow. When it is ripe, it splits into two celled stone. The ash colored bark comes off in flakes exposing the under bark which also peels off in thin papery tolls. The shrub defoliates in winter and reserves for guggulu gum extraction are high during April-May.^[31,32,33]

Cultivars/ Varieties

CIMAP (Central Institute of Medicinal and Aromatic Plants), Lucknow, has developed a good oleo-gum-resin-yielding cultivar called '*marusudha*'.^[34] Some studies by CIMAP also indicate the presence of high

guggulsterones in the cuttings obtained from *Mangaliaswas* area of Ajmer in Rajasthan and *Kottakhpat* area of *Bhuj* in Gujarat.^[35,36,37,38,39,40] The germplasm from Nakoda in Rajasthan also gives a good yield.

About 26 cultures designated by the name of the places from where they are collected are being evaluated at ICAR-DMAR Anand Gujarat, and variety named NRC-CW-1 and NRC-CW-2, which is the highest yielder, has been released for cultivation.

Climatic requirements

The plant has a wide adaptability and is found growing in it prefers arid and semi-arid climates. Its small leathery leaves and thick bark covered with a white waxy coat over the stems, help it to withstand desert conditions. It prefers a warm, dry climate for good yield of oleo-gum-resin.^[41]

Soil Requirements

The plants are occurs in naturally, preferring hard, rocky soils off arid tracts of North West India. It is also considered as a drought aria salinity resistant plant. It prefers loams to sandy loam soils with pH ranging between 7.5 to 9.0. Soils are coarse textured, well drained and calcareous soils are generally poor in organic carbon, nitrogen, high in potash ion, magnesium, zinc and copper, medium in phosphorus and calcium. Faster growth of the plants is observed in soil which has moisture retaining capacity. An average soil is suitable for cultivation.^[42,43,44]

Part II: Cultivation practices**Propagation**

Guggal can be propagated by seeds and vegetative both. In vegetative propagation through stem cuttings, air layering is successful in this plant.^[45]

By Seed

Seeds are the major propagation source in nature. In tropical countries, there are several problems with the production of quality planting stocks of important plant species, such as irregularity of seed supply due to irregular flowering and fruiting, short viability period of seeds, poor-quality seeds, and lack of seed storage and handling facilities. These problems have hampered the development of plantations. The plant guggal become endangered because of its slow growing nature, poor seed setting, lack of cultivation, poor seed and germination rate.

In Rajasthan and nearby arid regions flowers and seeds are constantly produced by guggal except in winter season. April May seeds are less viable compared to July to September seeds. Monsoon, season creates conducive atmosphere for germination. The temperature after monsoon ranges between 30 - 37°C maximum 20-25 °C minimum with high relative humidity.^[46,47,48,49]

By Cuttings

It can be successfully propagated vegetative by stem cuttings. Stem cuttings offer several advantages over seeds. They save time and labor, and produce genetically superior and uniform planting materials from superior parent stocks. Stem cuttings are also inexpensive and easier to practice than other vegetative - propagation methods, such as tissue culture. In addition, stem cuttings can continuously supply planting stocks throughout the year. Stem cuttings were collected from mature plants of *guggal* during March- April. High frequency of sprouting was observed in plantlets developed from 0.6-0.8 mm diameter stem cuttings and 30 cm long. Auxins triggered /enhanced rooting of cuttings; NAA (0.5 mg/L) and IBA (0.5 mg/L) were found to be the most effective. These cuttings were planted in plastic bags at a depth of 15 cm containing soil and manure in the ratio of 1:3 and then transferred in green-shade house. Proper soil moisture is necessary for better rooting. Treatment of stem cuttings is beneficial which enhances the rooting to nearly 70% as against 30% under normal conditions. The sprouting was achieved within one month. In July-August, (during the monsoon) the well developed plantlets were transplanted in the main field.. The plants are kept in nursery for 5- 6 months.^[50,51,52,53,54]

Soil Preparation

The soil is prepared well in advance of the rainy season by 2-3 ploughing and laid out into plots of convenient sizes.

Pits of the size 0.5X0.5X0.5 M, are dug at a spacing of 2 X 2 M. in row and plants. One hectare required approx. 2500 plants. The pits are filled with FYM and topsoil and mixed with Prorate 10 G or Neem oil cake to prevent any damage to the plants due to termite attack.^[18,55,56]

Planting

The rooted cutting are planted in pits during rainy season .As the plants grow, they are trained properly by cutting the side branches.^[18,55,56]

Manure and Fertilizer

Besides the basal dose of FYM (@ 5 Kg/Pit) provided in the pits, the plants may be provided with growth regulators like IBA (10 mg/liter) along with organic manures like hexameal @ 100 g/plant every month or NPK (nitrogen, phosphorus, potassium) @ 75:130:30 g/plant after every three months up to a period of one year, which helps in the better survival of plants. After one year, quarterly dose of compost or hexameal @ 100 g/plant is good for growth and survival of plants.^[18,55,56]

Irrigation

Providing light irrigation during summer season supports good growth of the plants.^[18,55,56]

Inter-culture & Intercropping

Inter-culture is confined to one weeding and hoeing in the early stage of growth. During rainy season, weeds

occur in the crop. The excessive weeds-check the nutrition supply to the plant. The weeding is beneficial in the month of September and December.

Guggal can be intercropped with crops like pearl millet and cluster bean. Experiments indicate a synergistic relationship between the intercropped species and guggal, resulting in better yield of pearl millet and cluster bean, while the quality and yield of guggal plantation remain unaffected. In Rajasthan, it is planted on the borders of the cultivated fields because of it's very slow growing nature. Presence of spine branches makes the field impenetrable.^[18,55,56]

Plant Protection

Major Insects

Guggal plants are attack by a leaf-eating caterpillar, white fly, which suck the sap of the leaves results of which the leaves turn yellow and finally drop off. Plants also are often affected by termites particularly in summer season. Termite causes severe damage to the plant by making holes through buried ends of the stem or root. The infested plants become dry showing yellow appearance' of leaves and eventually result in death of the plants.^[18,55,56]

Major disease

Leaf spot and bacterial disease leaf blight. Root rot is frequent in rainy season.^[18,55,56]

Control^[18,55,56]

1. During land preparation the pits are filled with FYM and top soil mixed with Chloropyriphos .5ml per litre of water to prevent termites.
2. To control leaf eating caterpillar and white fly spray 0.2% metocid aqueous solution.
3. To control diseases spray the crop with Blitox 4g with 0.1g of agromycin in 1 litre of water.

Harvesting (Tapping and Collection)^[56,57]

1. After achieving the physiological maturity (8-10 years) of plant the gum resin is tapped during Mid Dec. and Feb. because the flow of gum is more during winter and summer.
2. Plant attaining 7.5 cm diameter is suitable for tapping the gum resin.
3. It is done by giving an incision 10 cm long and Usually 1.5 cm deep circular incisions are made on the main branches and stems at uniform distance of 30 cm and at an angle of 60 manually.
4. Incision should not be deeper than bark.
5. It is done by sharp knife.
6. The knife should be dipped in an activator like guggal gum pest.
7. 2-4 incisions given per plant.
8. The yellowish white fragrant latex oozes out through the incision and slowly solidifies into vermicular pieces often forming big lump.
9. Gum is collect after 15-20 days of incision by manually or with spear.

10. Subsequently collection is done at the interval of 10-15 days.
11. Weather conditions influence the success of obtaining gum.

Part III: Post-harvest handling

Grading, processing and Value addition⁵⁸

The best grade of guggal is collected from the thick branches of tree. These lumps of guggul are translucent. Second grade guggal is usually mixed with brark, sand and is dull colored guggal. Third grade guggal is usually collected from the ground which is mixed with sand stones and other foreign matter. The final grading is done after getting clearness material. Interior grades are improved by sprinkling castor oil over the heaps of the guggal which impart a shining appearance.

The exuded resin is allowed to dry on the tree before it is collected. Collected resin is cleaned by sieving and hand picking to remove foreign matter, and packed in sacks for transfer to points of sale, either nationally or internationally. The collected gum is graded according to its purity.

Adulterants^[58,59]

The oleo gum - resin of *Commiphora mukul* is commonly adulterated with resin of *C. agallocha*, *C. stocksiana*, *C. berryi*, *C. pubesence*, *C. opobalasanum*,

C. stocksiana, and the similar looking oleo -gum-resin of other trees. In Indian market, the drug is also found adulterated with the pieces of bark, wood, sand stones etc.

Sr. No.	Botanical Name	Common Name
1.	<i>Albizzia lebbeck</i>	Siris
2.	<i>Butea monosperma</i>	Palas
3.	<i>Moinga oleifera</i>	Sahjan
4.	<i>Acacia nilotica</i>	Babool
5.	<i>Acacia catechu</i>	Kher
6.	<i>Sterculiaureus</i>	Kathira
7.	<i>Acacia Senegal</i>	Kikkar
8.	<i>Boswellia serrata</i>	Salai-guggulu,
9.	<i>Hymenodictyon orixens</i>	Bhaultan

Yield

Starting from sixth year the guggal gum yield increases from 200 gm to 400 gm per plant. The mature plant (8-10 years) total guggal gum yield comes to be 700-900 gm per plant corresponding to 1750 -2250 kg per ha @ 2500 plants per ha. Gum is dried in shade.

Packing & Storage

After collection, the oleo-gum resin is stored in airtight plastic container or corrugated box with polyethylene liners. Guggal gum is stored in dry and cool places.

Part IV: Production Schedules

Production Schedules of Guggal.

Sr. No		
1	Name of Medicinal Plant	<i>Commiphora mukul</i>
2	Family	Burseraceae
3	Plant Part	Tree yield an oleo gum-resin-guggulipid
4	Actual Ingredients	guggulsterone,
5	Habit and Habitat	A shrub or small tree, reported to be found in Karnataka, Rajasthan, Deccan and Gujarat.
6	Varieties	marusudha
7	Propagation methods	by cutting.
8	Planting Time	July -August
9	Spacing Plant Population /ha.	Row to Row-2M, Plant to Plant-2M 2500 Plants
8	Fertilizer doses	Application of 5 kg FYM and NPK (nitrogen, phosphorus, potassium) @ 75:130:30 g/plant bush per year.
9	Irrigation Schedule	Require moderate irrigation
10	Diseases, pests and their control	Plants are affected by leaf-eating caterpillar, white fly, Termite (white ants). Leaf spot and bacterial disease leaf blight, Root rot Control: Pits are filled with FYM and treated with Chloropyriphos .5ml per litre of water to protect the new plants from white ants.
11	Harvesting and yield	Plants attain (mature plant) normal height and girth after 8-10 years of growth when they are ready for tapping of the gum by shallow incision on the bark between December and March. Guggal gum yield 700-900 gm per plant in mature plant

PartV: Utilization**Chemical constituents**^[60-66]

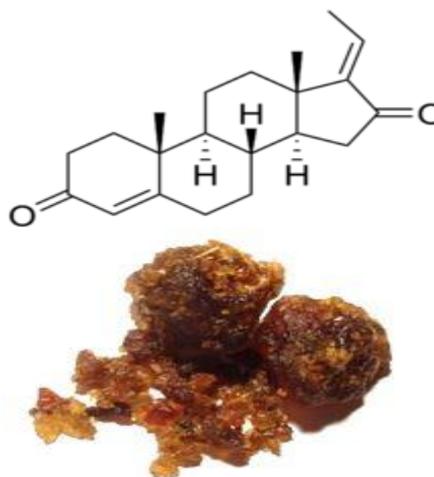
The gum resin contains 3.2% gum and 19.5%, mineral matter chiefly consisting of silicon dioxide, magnesium, calcium, iron, and aluminum. It also contains about 1.5% essential oil, which contains 6.5% myrcene and 11% dinarycene. A number of steroidshave also been isolated from guggul like Z-guggulsteroneandE-guggulsterol I, II, and III.^[60,61,62,63,64,65,66]

Over a hundred metabolites of various chemical compositions were reported from the leaves, stem, latex, root and fruit samples. High concentrations of quinic acid and myo-inositol were found in fruits and leaves.

Guggal is sought for its gummy resin, which is harvested from the plant's bark through the process of tapping. It is completely soluble in most of the organic solvent and in castor oil drying and turpentine oil. It mixes with stearic acid, vegetable waxes and resins.

In India and Pakistan, guggal is cultivated commercially. The resin of guggal known as *gum guggulu*, has a fragrance similar to that of myrrh and is commonly used in incense and perfumes. It is the same product that was known in Hebrew, ancient Greek and Latin sources as bdellium.

The gum can be purchased in a loosely packed form called *dhoop*, an incense from India, which is burned over hot coals. This produces a fragrant, dense smoke. The burning coals which let out the smoke are then carried around to different rooms and held in all corners for a few seconds. This is said to drive away evil spirits as well as remove the evil eye from the home and its family member.

**Chemical structure of guggulsterone, & constituent of gum guggal**

The extract of gum guggal, called gugulipid, guggulipid, or guglipid, has been used in Unani and Ayurvedic medicine, for nearly 3,000 years in India. One chemical ingredient in the extract is the steroid guggulsterone which acts as an antagonist of the farnesoid X receptor, once believed to result in decreased cholesterol synthesis in the liver. However, several studies have been published that indicate no overall reduction in total cholesterol occurs using various dosages of guggal sterone and levels of low-density lipoprotein ("bad cholesterol") increased in many people.

The essential oil (0.38%), obtained by steam distillation of oleo - resin of guggal is composed of chiefly terpermes like myrcene (64%), dimyrcene (11%) polymyrcene and cryophylene.

Physico-Chemical Properties of Gum Guggal

Properties	Information
Physical State	Viscous, moist; dry powder or granules
Odor	Fragrant; acrid
Taste	Bitter
Feel	Astringent, thermogenic
Color	Off-white or pale yellow; dusty (brown.)
Solubility	In water \geq 60% w/w , In alcohol \geq 40% w/w, In petroleum ether, ethyl acetatecastor oil, drying oils, andturpentine.
pH (1% w/v solution)	5 to 7
Loss upon drying at 105 °C	\leq 5% w/w
Moisture content by K.F.	\leq 5% w/w
Ash content	\leq 5% w/w
Sulphated ash content	\leq 5% w/w
Gugulipid concentrationsin ethyl acetate extract Guggulsterones by HPLC	\geq 2.5%
Assay of guggulsterones by HPLC and HPTLC	\geq 3%
Heavy metalsconcentration	\geq 20 ppm
Total bacterial count(CFU/g)	\leq 800
Total fungal count (CFU/g)	\leq 500
Microbial pathogens	None

The oleoresin “burns in fire, melts in the sun, and forms a milky emulsion with hot water”. It mixes well with vegetable waxes, stearic acids, and resin.

Quality Requirements

- The dried gum-resin has a bitter aromatic taste and balsamic odour
- The colour of guggul varies from transparent golden brown to dark brown.
- It is soluble in most organic solvents.
- It burns readily and diffuses a pleasant odour.

CONCLUSION

Guggal has been a key component in ancient Indian Ayurvedic system of medicine. However, because of its overuse, it has become so scarce in its two habitats in India i.e Gujarat and Rajasthan . That the World Conservation Union (IUCN) has enlisted it in its Red Data List of endangered species.^[15,16,17] The gum guggal, has been used in Unani and Ayurvedic medicine, for nearly 3,000 years in India. All the above description proves its utility in the Indian system of medicine for its antiarthritic, hypolipidaemic and cholesterol lowering properties.^[68-75] Paper described the data related to cultivation, conservation and chemical composition of a very important drug *Commiphora mukul* (Stocks)Hook. Elaborated compilation will prove helpful to the researchers and students.

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