



## Rosemary Farming: A Comprehensive Guide to Cultivation and Management

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Rosemary (*Rosemarinus officinalis*) is an aromatic evergreen shrub native to southern Europe and thrives in Mediterranean climates. Its cultivation is prominent in various regions, including India, where it is grown for its fragrant leaves. Historically, rosemary has symbolized remembrance, loyalty, and love, and was used in ancient Greece and Rome for mental clarity. The essential oil derived from rosemary is rich in beneficial compounds such as a-pinene, camphor, and 1,8 cineole, and serves multiple purposes including culinary applications, cosmetics, and traditional medicine. Propagation typically occurs through stem cuttings due to poor seed germination, and optimal cultivation practices include careful soil preparation, irrigation, and pest management. Intercropping with short-duration crops can enhance land use efficiency. The oil extraction process involves steam distillation, yielding around 1-2% oil from the herb, depending on growth conditions. Rosemary oil is prized for its applications in perfumery, flavoring, and folk medicine, as well as its antioxidant properties. Furthermore, it serves therapeutic roles in addressing various health concerns, demonstrating its multifaceted benefits in both culinary and medicinal fields.

### Introduction

Rosemary (*Rosemarinus officinalis*) is a sweet scented evergreen shrub which grows up to two meters in height. Leaves are narrow and resemble to curved pine needles. Rosemary is a native of southern Europe and grows wild on dry rocky hills in the Mediterranean region. It is cultivated across in Portugal, Spain and USA. In India, it is cultivated in gardens in cool climates for its pleasantly fragrant leaves. It is suitable for cultivation in the temperate Himalayas and Nilgiri hills which have dry to moderately moist climate. Rosemary has been regarded as the herb for remembrance. Mystically, it symbolizes loyalty, love and immortality. It was once believed to strengthen the heart as well as memory. The Greeks and the Romans prepared fragrant distilled water from the flowers and inhaled the odour so that the evils were destroyed from the mind and the memory no longer played tricks.

In ancient Greece, students preparing for examinations threaded sprigs of rosemary in their locks to induce dear thinking and a good memory. The rosemary oil is distilled from the aerial parts of *Rosemarinus officinalis* L. and is principally used in cooked dishes because of its antioxidant properties. Rosemarinus means "dew of the sea" in Latin. The Romans also called rosemary " the flower of the sea". In Greek and Roman times, the use of plants of rosemary was important in religious ceremonies and public festivities. The plant was regarded as symbol of fidelity. Rosemary oil is used in scenting of soaps, shampoos, and

other toiletries. It is also used in insecticides, deodorants and room sprays. The demand for rosemary oil is increasing regularly.

### Botany

Rosemary (*Rosemarinus officinalis*) is an aromatic, perennial shrub, belonging to the family Lamiaceae. The plant has whitish brown stem which bear opposite, leathery thick leaves, which are lustour and dark green above and downy white underneath. The flowers are of white or purple colour, situated in little clusters towards the ends of the branches. Calyx is two lipped, the upper with a single broad oval lobe, and the lower with two segmented triangular lobes. The corolla is two lipped with segment and a long style projecting from it. The fruit is an oval, 4-sectioned cremocarp.

### Soil and climate

Rosemary requires Mediterranean type of climate with moderately cool winter free from frost and mild summer (temperature not exceeding 35°C. Rosemary thrives best in a light, rather dry soil. In India, the hills of Uttarakhand, Himachal Pradesh, Jammu and Kashmir, North-eastern region, West Bengal, Arunachal Pradesh and Tamil Nadu with altitude of 1000-1500 m are ideally suited for the cultivation of rosemary.

### Cultivation

**Propagation:** Rosemary can be propagated by seeds, stem cuttings, layers, and division of roots. Propagation through seed is not suitable owing to very poor and late germination. Therefore, it is generally multiplied through stem cuttings. At least one-year-old plantation should be used for cuttings preparation. Terminal cuttings of 8-10 cm length are suitable for multiplication. Leaves of lower 2/3 portion of the cutting should be removed before planting. The cuttings are treated with 0.2% Carbendazim to control disease and 200 ppm IBA (4 hr) for quick root induction. The treated cuttings are grown in polythene bags, sphagnum moss ball or nursery beds (10 × 10 cm) in partial shade or mist chambers or glass house for rooting. Vermicompost and soil (1:2) is the best medium for growing the cuttings followed by mixture of sand and soil. Medium (soil of polythene bag or nursery bed) should be treated with 0.2% Chloropyrifos to control the termites. Planted cuttings are regularly watered. The optimum season for nursery preparation (raising the rooted cuttings) is February to March and October to November.

**Preparation of field:** For field preparation one-two ploughing with mould board plough followed by 2-3 harrowing and planking are required to get a fine tilth. Farm yard manure, compost and basal doses of N, P, K may be mixed with the soil during final harrowing or using cultivator. Suitable layout is prepared as per the field condition and available irrigation facilities.

**Manures and fertilizers:** The quantity of manures and fertilizers should be applied on soil test basis considering various factors like basic fertility of soil, organic content, soil texture, moisture supply, soil pH etc. Under hill conditions of Uttarakhand, farm yard manure @ 5 t/ha or Vermi-compost @ 2.5 t/ha, 75 kg N/ha, 40 kg P/ha and 40 kg/ha K are required. Fertilizers should be applied in three equal doses (i) at the time of transplanting. (i) after 120 days of transplanting and (in) after first harvest of the crop. Since, rosemary crop can be harvested 3-4 times in a year, frequent fertilizer applications are essential to obtain good biomass yield.

**Transplantation:** Rooted cuttings from the nursery are transplanted in rows at a distance of 50 cm plant to plant and 50 cm row to row in the month of November or February. The plots are irrigated soon after transplanting.

**Interculture operations:** Rosemary crop requires weed free conditions particularly in the initial stages of establishment. In large areas, weeding can be done both manually or mechanically. Power tiller can be used for hoeing. In terraces or small fields it can be done manually by khurpi. 4-5 hand weedings/year are required to obtain good crop in hill conditions of Uttarakhand.

**Irrigation and Drainage:** The crop initially requires frequent irrigations to establish rooted cuttings. Thereafter, water requirement of rosemary is comparatively low. However, irrigations are required as the crop passes through dry period. About 2-3 irrigations are sufficient during dry months for good herbage and oil yield. Proper drainage in the field is very essential to drain out the excessive rainwater from the plantation.

**Pests and Diseases:** Pests and diseases are not common in rosemary. It is observed some times that the rosemary plantation is affected by *Rhizoctonia solani*, a soil borne fungus causing leaf blight disease during rainy season in valley areas of Uttarakhand. Two - three sprays of 0.2% solution of Diethane Z-78, Ridomil or Carbendazim at 15-20 days interval is an effective control measure during rainy season.

**Intercropping:** Land use efficiency can be increased significantly by including certain intercrops with rosemary. Rosemary is a multi cut (3-4 harvests/year) perennial crop therefore, in early stages of development of a new plantation and after harvesting the crop, sufficient space available in the field can be utilized to grow short duration crops as intercrops (Table- 1). The promising crops which can be included as intercrop in rosemary plantation are mentioned below in Table- 1.

**Table-1: Suitable Intercrops for Rosemary**

Intercrop	Sowing Time	Harvesting Time
Radish	November	December (last week)
Cauliflower	November	February
Cabbage	November	March
Onion	November	April
Garlic	November	May
Sweet Pea	November	March/April
French Bean	June	July/August
Capsicum	June	August/September
Lady Finger	May	July/August

**Harvesting:** The crop is harvested in the months of June and November. The plants are harvested about 6 inches above the ground with sharp sickles and with minimum pulls or with mechanical harvesters. Harvesting of the crop is preferred on clear sunny days and generally rainy days are avoided. Dry condition of soil prior to harvesting is beneficial as it increases oil recovery. The first harvest is generally obtained after 8 months of transplanting, while the subsequent harvests are performed at 5-8 months interval. The crop gives relatively low yield during the first year and the optimum yield is obtained during second and third year. Under hill conditions, the first harvest is obtained in the month of June while second harvest can be obtained in November. A well maintained rosemary crop can give economic yields up-to 10 years.

**Distillation:** Essential oil is obtained by hydro-steam or steam distillation of the herb. The herbage can also be shade dried, stored and distilled at convenience without any loss of oil. In modern method, steam produced directly or indirectly, is used at 2 or 3 atmospheric pressure and herb is distilled for about 2-3 hours.

**Oil content, Herb and Oil yield:** Under laboratory conditions the fresh biomass yield about 1.2% oil and shade dried leaves yield 2.5% oil. But in commercial distillation units, oil content is about 0.8-1.0% in fresh and 1.8-2.0% in dry herb. In Uttarakhand hills fresh herb yield ranges between 300 - 350 q/ha/year in 3 years old crop which upon distillation yields 300-350 liters of essential oil.

**Table-2: Herb and Oil Yield of Rosemary**

Harvest	Herb Yield (q/ha)	Oil Yield (l/ha)
I year	50	50
II year	160	160
III year	350	350



**Storage of oil:** The distilled oil is decanted and filtered through cotton to remove extraneous matter and bulk of water. It is then treated with anhydrous sodium sulphate (20-30 g/liter) to remove the water traces and filtered, filled in airtight aluminium/stainless steel containers and stored in shade and cool place. Moisture, air and sunlight affects the quality of oil during storage.

**Physicochemical properties of oil:** The essential oil of rosemary is a colourless or slightly greenish yellow liquid with camphoraceous dour, penetrating with sharp, aggressive top note. The physicochemical characteristics of rosemary oil is presented in Table-3. Specific gravity of oil is lower with higher percentage of monoterpenes. The optical rotation mostly depends on the rotation of  $\alpha$ -pinene, camphene, camphor and 1,8 cineole. It ranges  $+0^{\circ}43'$  to  $13^{\circ}10'$ . The refractive index is dependent on total monoterpene content and its oxygenated derivatives. Higher the monoterpene content, higher is the value of refractive index. Reverse is true with their oxygenated derivatives. Solubility in ethanol is inversely related to the total amount of hydrocarbon. Alcohol number is calculated as borneol and ester number corresponds to the amount of monoterpene acetate i.e. bornyl acetate.

**Table-3: Physicochemical Properties of Rosemary Essential Oil**

Properties	Range
Colour	Colourless to greenish yellow
Odour	Camphoraceous
Sp. gravity at 15°C	0.894 - 0.913
Optical rotation	$+0^{\circ}43'$ to $13^{\circ}10'$
Ref. Index at 20°C	1.466 - 1.468
Solubility in ethanol	1 to 2 vol of 70% alcohol (v/v)
Ester No	1.8 – 7
Alcohol No	8.4 - 14.3
Acid No	0 - 0.3

**Chemical constituents:** The oil is characterized by fairly high concentration of monoterpene hydrocarbons and oxygenated monoterpenes. Sesquiterpenes, aliphatic compounds and benzenoid compounds are very poor in the oil. Major constituents (Table-4) of the oil are 1,8 cineol, camphor,  $\alpha$ -pinene, camphene, B-pinene, verbenone, limonene, borneol,  $\alpha$ -terpineol and bornyl acetate. Other minor and trace constituents are eugenol, methyl eugenol,  $\gamma$ -terpinene, Cis-3- hexanol,  $\alpha$ - thujene, 1 octan-3-ol, Sabinene,  $\alpha$ -phellandrene, P-cymene, B-phellandrene, cis-sabinene-hydrate, trans-sabinene-hydrate, terpinolene, B-caryophyllene,  $\alpha$ -humulene, caryophyllene oxide etc.

**Table-4: Major Chemical Components of Rosemary Oil**

Compounds	Area % (North India)	Area % (South India)
$\alpha$ -pinene	9.94 - 13.02	11.7
Camphene	5.83 - 6.34	5.5
$\beta$ -pinene	3.26 - 4.86	2.7
Limonene	3.08	2.1
1,8-cineole	22.02 - 24.88	26.4
Linalool	1.24	1.2
Camphor	22.68 - 26.95	26.5
Borneol	0.83 - 2.05	1.7
Terpinen-4-ol	0.83 - 3.60	1.3
$\alpha$ -terpineol	2.68 - 5.51	2.3
Verbenone	3.84 - 7.24	7.0
Bornyl acetate	3.97	1.2

The composition of oil is influenced by several factors. These are genotype, crop stage, leaf stage, location of cultivation, season of harvesting, distillation method, storage conditions and duration etc. Knowledge of these factors is therefore essential to harvest good quality oil.

### Uses

**Cosmetics/perfumery:** Rosemary oil finds wide uses in perfumery. It is used in scenting soaps, shampoos, insecticides, deodorants, room sprays and toiletries. It is also used widely in combination with other essential oils eg, pine needle, lavender and citrus oils.

**Flavour:** Oil is used in meat, meat products, sausages, seasonings, processed vegetables, snacks and baked foods. Oil is used in alcoholic and non-alcoholic beverages, frozen dairy desserts, candy, gelatins and puddings. Oleoresin of rosemary is also used in the flavor industry.

**Folk medicine:** It has been used since ancient times in Europe as a tonic, stimulant and carminative and in treating dyspepsia, stomach pains, headaches, colds and nervous tensions. An infusion of a mixture of rosemary herb and borax is used for controlling baldness and dandruff.

**Pharmaceuticals:** The oil is used in some pharmaceutical products including a number of stomach disorders and in some health foods. The oil finds use in different compositions in hair tonics and for treating scalps. It can kill about 90-100% of mosquito and larvae of *Culex quinquefasciatus*. In addition to above, it is a rich source of vitamin 'A' and 'C', phosphorus, iron, magnesium and zine. It also has antioxidant properties. A strong infusion makes an antiseptic mouthwash and gargle. The essential oil also finds use in treatment of arthritis and to sootheaching muscles.

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