

AROMATIC PLANT RESOURCES AT CSIR-IHBT

Volume-I

Rakesh Kumar
Sanatsujat Singh



सीएसआईआर—हिमालय जैवसंपदा प्रौद्योगिकी संस्थान
CSIR-Institute of Himalayan Bioresource Technology
पालमपुर—176 061 (हि.प्र.) / Palampur-176 061 (H.P.)



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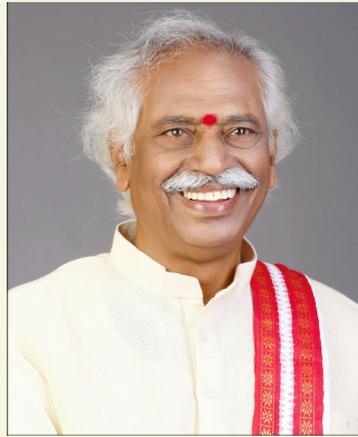
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FOREWORD



Aromatics of plant origin are the most preferred world over, and find use in food, flavour, cosmetic and pharmaceutical industries. The global market of essential oil and essential chemicals is approximately USD 7 billion, in which the total share of Asia Pacific is USD 1.5 billion. The essential oils market is projected to grow at a CAGR of 9.3% by 2025. America, China and India are the leading world producers, consumers and exporters of aromatic oil.

With the growing demand in the domestic and international market, aromatics holds vast potential. Cultivation of aromatic crops in mountains has a special advantage for the reason of quality oil production. Some of the desired aromatic crops for cultivation in hilly areas are lavender, rosemary, damask rose, wild marigold, rose geranium, jatamansi, chamomile, mints, lemon grass, and clary sage etc. CSIR-Institute of Himalayan Bioresource Technology has worked on research and development of medicinal and aromatic plants for last more than three decades, and has developed agro and process technologies, improved varieties of important aromatic crops.

The present book covers information on 26 aromatic plants, manufacturers and the current market prices of essential oil, list of traders of HP and India, and selected research publications of the institute. I believe that farmers, students and other stakeholders will benefit from this booklet and find it informative and useful.

Date: July 9, 2020

Sanjay Kumar
Director

Preface

Aromatic crops are the plants which contain secondary metabolites in the form of essential oils obtained by steam distillation which possesses odorous, volatiles, hydrophobic and low molecular weight characters. The essential oils are obtained from different plant parts viz., leaves, buds, flowers, stems, seeds, branches, bark, rhizomes and roots. CSIR-IHBT, is persistently performing a vital role in selecting desirable aromatic crops for cultivation in suitable regions and for improving the financial status of farmers. CSIR-IHBT deals with cultivation of aromatic plants, especially in unproductive, marginal waste lands including those affected by water scarcity, salinity or flood.

Cultivation of aromatic plant is thus a practical diversification process for many regional small-scale farmers because of huge demand, trade prospects and high income generating potential and also offers hope for enhancing the income of farmers. Encouraging farmers to cultivate essential oil crop through a diversification of their cropping pattern is the only sustainable approach to obtain natural raw matter for both industrial and domestic purposes and there is scope for farmers to utilize their marginal and problematic waste land for suitable aromatic crop cultivation.

CSIR-IHBT has also developed agrotechnologies for improving the quality parameters of variety of aromatic crops. Technical and scientific information generated by the Institute helped in getting complete agro and processing technologies of aromatic crops. Keeping in view the need of farming community and market demand, CSIR-IHBT has initiated AROMA mission program and several hectares of farmers' degraded land was brought under aromatic crop cultivation. So in this book an attempt has been made to compile information of some industrially important aromatic crops.

The authors express their deep sense of gratitude to the Director, CSIR-IHBT, Palampur, Dr. Sanjay Kumar for his encouragement to compile the information and motivation to bring out this publication. Thanks are due to colleagues of the institute for the help rendered during the course of book preparation. We are grateful to photographer, Mr. Pabitra Gain for designing cover page of this book. CSIR is duly acknowledged for the financial support to different R&D projects related to aromatic crops at CSIR-IHBT, Palampur, HP.

Date: July 9, 2020

**Rakesh Kumar
Sanatsujat Singh**

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Introduction

Aromatic plants are a special kind of plants used for their aroma and flavour. Many of them are also used for medicinal purposes. Aromatic plants are from a numerically large group of economically important plants. These are increasing demand for essential oils, aroma chemicals drugs and pharmaceuticals in the world market since two decades. Of more than 17000 native plant species found in India, 1500 contain essential oils. Only 65 of them have a large and consistent demand in the world trade, and are therefore cultivated. The most traded essential oils include mints, basil, citronella, lemongrass, geranium, and lavender. The extent of usage of essential oils is 55-60% for flavors in food industry, 15-21% for fragrances in perfumery/cosmetic industry, 10-20% as starting material for the isolation of components, 5-10% as active substances in pharmaceutical preparations and 2-5% for natural products. USA, France and Germany are in the forefront of essential oil trade. It is estimated that the annual turnover of perfumery, cosmetic and flavour industry exceeds US\$ 10 billion comprising more than 100 essential oils the world over. In India, area under aromatic plants is more than 3,00,000 ha with annual production of about 30,000 metric tonnes. Average productivity of essential oil crops is 75 kg per hectare. Considering the demand and export potential of aroma, and everyday use in every Indian families, it is necessary to study aroma scientifically and systematically. It produces secondary metabolites in the form of essential oils that contain odorous, volatiles, hydrophobic and low molecular weight characters. According to the market research report 2019, the global essential oil market demand was 226.9 kilotons and the global essential oil market size was USD 7.03 billion in 2018. The world market of essential oil is expected to increase up to 14.6 billion by the end of 2026 exhibiting a CAGR of 8.6% in the forecast period 2019-2026.

Cultivation of aromatic plant is thus a feasible diversification enterprise for many small-scale farmers as demand is high, trade opportunities are increasing and the income generating potential is good. Cultivation of aromatic crops offers hope for enhancing the income of farmers. Encouraging farmers to cultivate aromatic crops through diversification of their cropping pattern, is the only practical and sustainable way to obtain naturally derived raw matter for both industrial and domestic purposes and that there is scope for farmers to improve the cultivation of aromatic plants on marginal and problematic soil. CSIR-IHBT deals with cultivation of aromatic plants, especially in unproductive, marginal waste lands including those affected by water scarcity, drought, salinity or flood. So in this book an effort has been made to compile the information of some industrially important aromatic crops i.e. *Rosa damascena*, *Tagetes minuta*, *Matricaria chamomilla*, *Rosmarinus officinalis*, *Lavandula officinalis*, *L. hybrida*, *Salvia officinalis*, *S. sclarea*, *Pelargonium graveolens*, *Cymbopogon flexuosus*, *C. martini*, *Ocimum basilicum*, *Origanum vulgare* and *O. marjorana* etc.



**AROMATIC PLANT
RESOURCES AT CSIR-IHBT**

Wild marigold (*Tagetes minuta* L.)

Family	Asteraceae
Common name	Jangli gaindha
Major components:	(Z)- β -ocimene, dihydro-tagetone, (Z)- and (E)-tagetones
Altitudes:	1000 to 2500 m amsl
Suitable region:	Moist, temperate regions
Uses:	Essential oil is used in perfumery and in flavour industry. The oil and its absolute are used for compounding of high grade perfumes in flavour and food products and for the synthesis of value added aroma chemicals.
Harvesting:	October-November
Biomass yield (t/ha)	12-15
Average oil content (%)	0.30 (\pm 0.05)
Essential oil yield (kg/ha)	36-45

CSIR-IHBT Varieties



Himgold:

Biomass yield (t/ha) 12-15; E. Oil (%) 0.25-0.30



Him Swarnima:

Biomass yield (t/ha) 18-23 E. Oil (%) 0.30-0.34

Family

Common

Major com

Altitudes:

Suitable regi

Uses:

temperate and sub tropical regions.

It is used in flavouring, perfumery, cosmetic, aromatic, pharmaceutical

Muskbala (*Valeriana jatamansi* Jones)

CSIR-IHBT Varieties

Family	Valerianaceae
Common name	Muskbala
Major components:	Patchouli alcohol
Altitudes:	1200 m to 3500 m amsl
Suitable region:	Temperate region
Uses:	It is used for curing obesity, nervous disorders, epilepsy, insanity, snake poisoning, eye trouble, failing reflexes, spastic disorders and skin diseases. Rhizome extract shows antimicrobial, anti-inflammatory, insecticidal, antiviral, anti-leishmanial and antioxidant properties.
Harvesting:	November -December (After second year)
Root yield (t/ha)	1.0
Average oil content (%)	0.4 - 0.5
Essential oil yield (kg/ha)	15



Himbala:

Root yield (t/ha) 1.0 to 1.2; E. Oil (%) 0.4-0.5



Him Surbhit:

Root yield (t/ha) 3.4 to 4.5; E. Oil (%) 0.29-0.31

Rosemary (*Rosmarinus officinalis* L.)

Family	Lamiaceae
Common name	Rosemary
Major components:	α -pinene, β -pinene, camphene
Altitudes:	1200 to 3500 m amsl
Suitable region:	Sub tropical to temperate region
Uses:	It is used as a culinary condiment, to boost the immune and circulatory system. It is used for improving memory, indigestion (dyspepsia), arthritis-related joint pain, and hair loss. In foods, it is used as a spice, leaves are used in foods, and the oil is used in beverages. Rosemary is a rich source of antioxidant and anti-inflammatory compounds.
Harvesting:	July-August (second year onwards)
Biomass yield (t/ha)	10 -12
Average oil content (%)	0.8-1.0
Essential oil yield (kg/ha)	80-120

CSIR-IHBT Selections



IHBT/RM-1:
Biomass yield (t/ha) 10 to 12; E. Oil (%) 0.8-1.0



IHBT/ RM-2:
Biomass yield (t/ha) 8 to 10; E. Oil (%) 0.6-0.8

Lavender (*Lavandula officinalis* L.)

Family	Lamiaceae
Common name	Lavender
Major components:	Linalool, Linalyl acetate
Altitudes:	1500 to 2500 m amsl
Suitable region:	Temperate region
Uses:	It is used as a flavor component in foods and beverages industry. In manufacturing industry it is used in pharmaceutical products and as a fragrance ingredient in soaps, cosmetics, perfumes, potpourri, and decorations. It contains essential oil that has sedating effects and might relax certain muscles. Treats anxiety, depression, headache, insomnia, and skin infections.
Harvesting:	May -August (second year onwards)
Flower yield (t/ha)	4-5
Average oil content (%)	0.8-1.0
Essential oil yield (kg/ha)	40-50

CSIR-IHBT Selection



IHBT/LO-1

Flower yield (t/ha) 4.5-5.5; E. Oil (%) 0.8-1.0



Lavandin (*Lavandula hybrida* Rev.)

Family	Lamiaceae
Common name	Lavandin
Major components:	Linalool and linalyl acetate
Altitudes:	1200 to 2000 m amsl
Suitable region:	Sub tropical and sub temperate region
Uses:	It is used in pharmaceutical and fragrance industry. It repels insect pests and act as antiseptic, which makes it an excellent cleaner. The aroma itself is relaxing and helps relieve body aches and stress.
Harvesting:	May -August (second year onwards)
Flower yield (t/ha)	8-12
Average oil content (%)	1.0
Essential oil yield (kg/ha)	80-120

CSIR-IHBT Selection



IHBT/LH-1:

Flower yield (t/ha) 4.5 to 5.5; E. Oil (%) 0.8-1.0

Rose geranium (*Pelargonium graveolens* L.)

Family	Geraniaceae
Common name	Rose geranium
Major components:	Citronellol, geraniol, linalool
Altitudes:	500 to 2400 m amsl
Suitable region:	Sub tropical, cold and dry climate
Uses:	Essential oil is used in flavour, pharmaceutical and fragrance industry. It is used in the treatment of dysentery, haemorrhoids, inflammation, heavy menstrual flows and even cancer. Also used to treats diabetes, diarrhoea, gallbladder problems, gastric ulcers, jaundice, liver problems, sterility and urinary stones with this oil.
Harvesting:	May-June (2-3 cuts/year)
Biomass yield (t/ha)	20-25
Average oil content (%)	0.15 - 0.20
Essential oil yield (kg/ha)	25-30

CSIR-IHBT Selection



IHBT/PG-1

Biomass yield (t/ha) 25-30; E. Oil (%) 0.15-0.20

Chamomile (*Matricaria chamomilla* L.)

CSIR-IHBT Selection

Family	Asteraceae
Common name	Chamomile
Major components:	Bisabolol oxides A and B, α -bisabolol, and chamazulene
Altitudes:	Upto 1500 m amsl
Suitable region:	Tropical, subtropical to sub temperate Asia
Uses:	Flowers and oil are used in herbal tea, cosmetics, perfumery, pharmaceutical and aromatherapy industries. It is used in health disorders treats insomnia, anxiety, and depression. Used in flavor industry for making herbal tea.
Harvesting:	April-May
Fresh flower yield (t/ha)	5 - 7
Dry flower yield (t/ha)	1.0 -1.5
Average oil content (%)	0.8- 1.0
Essential oil yield (kg/ha)	7-8



IHBT/MC-1

Dry flower yield (t/ha) 1.2 to 1.5; E. Oil (%) 0.8



Palmarosa (*Cymbopogon martinii* Roxb. W. Watson)

Family	Poaceae
Common name	Rosa grass
Major components:	Geraniol, geranyl acetate
Altitudes:	300 to 1500 m amsl
Suitable region:	Tropical and subtropical regions
Uses:	Essential oil is used in perfumery, flavour and fragrance industry. It has many therapeutic uses, most frequently used for skin problems like eczema and psoriasis, as well as boils, abscesses and acne. Improves digestion, reduces fever, treats dehydration and cures bacterial and urinary tract infections.
Harvesting:	October-November
Fresh herb yield (t/ha)	50-60
Average oil content (%)	0.25
Essential oil yield (kg/ha)	120-130 (Irrigated conditions) 75-80 (Rainfed conditions)

CSIR-IHBT Selection



IHBT/CM-1

Biomass yield (t/ha) 1.2-1.5; E. Oil (%) 0.25

Wild mint (*Mentha arvensis* L.)

Family	Lamiaceae
Common name	Jangli pudina
Major components:	Menthol
Altitudes:	1200 to 2000 m amsl
Suitable region:	Tropical and subtropical regions
Uses:	It is used as a food seasoner, household remedy, and industrial purposes. It is traditionally used in hypertension and in patients with ischemic heart disease. Juice of leaves is given in diarrhea and dysentery. The leaves medicinally used for stomach problems and allergy.
Harvesting:	June
Fresh herb yield (t/ha)	15-25
Average oil content (%)	0.5 -0.7
Essential oil yield (kg/ha)	100-150

CSIR-IHBT Selection



IHBT/MA-1:
Fresh herb yield (t/ha) 1.8-2.5; E. Oil (%) 0.6-0.8

Sweet basil (*Ocimum basilicum* L.)

Family	Lamiaceae
Common name	Tulsi, Sweet basil
Major components:	Methyl chavicol, linalool, citral
Altitudes:	100 to 1600 m amsl
Suitable region:	Tropical to sub tropical regions
Uses:	Its oil is used in pharmaceutical, perfumery industry and aroma therapy. In folk and medicine it is used to prevent and treat diabetics, cardiovascular disorders, kidney malfunctions, headaches, coughs, diarrhea, pains, treatment of insect stings, snake bites, skin infections, and as sedative.
Harvesting:	3 months after planting at full bloom stage
Fresh herb yield (t/ha)	15-20
Average oil content (%)	0.5-0.6
Essential oil yield (kg/ha)	100-125

CSIR-IHBT Selection



IHBT/OB-1:

Fresh herb yield (t/ha) 1.8 to 2.5; E. Oil (%) 0.6-0.8

Clary sage (*Salvia sclarea* L.)

Family	Lamiaceae
Common name	Clary sage
Major components:	Linalool, linalyl acetate, neryl acetate
Altitudes:	1000 to 2500 m amsl
Suitable region:	Dry temperate and subtropical regions
Uses:	It is used for medicinal purposes and as a spice. Clary sage oil has antidepressant, anti-inflammatory effects and antibacterial effects. It improves digestion, relief stress and improves circulation. It is also regarded as a tonic, calming herb that helps relieve period pain and pre-menstrual problems.
Harvesting:	July-August
Fresh inflorescence yield (t/ha)	4-5
Average oil content (%)	0.1-0.2
Essential oil yield (kg/ha)	10-12

CSIR-IHBT Selection



IHBT/SC-1:
Biomass yield (t/ha) 5.5; E. Oil (%) 0.15



Thimsingli (*Dracocephalum heterophyllum* Benth.)

CSIR-IHBT Varieties

Family	Lamiaceae
Common name	Thimsingli
Major components:	Cis & trans rose oxide, citronellol
Altitudes:	3000 to 5200 m amsl
Suitable region:	Sub- temperate region and high altitude regions
Uses:	It is an aromatic herb, used for its essential oil present in aerial parts of the plant. The decoction of dried flowers and leaves are used for cold, cough and head ache. Its essential oil is nowadays used in pharmaceutical, sanitary, cosmetic, agricultural and food industries.
Harvesting:	September -October (First year onward)
Fresh rhizome yield (t/ha)	5
Average oil content (%)	0.17-0.25
Essential oil yield (kg/ha)	10-12



Himsurbh:

Biomass yield (t/ha) 4-5; E. Oil (%) 0.17-0.20



Him Sugandh:

Biomass yield (t/ha) 4.5-5.1; E. Oil (%) 0.20-0.22

Vacha (*Acorus calamus* L.)

Family	Acoraceae
Common name	Vacha
Major components:	β -asarone
Altitudes:	Up to 2200 m amsl
Suitable region:	Moist land, tropical, sub tropical, sub temperate
Uses:	The scented leaves and rhizomes of vacha have been traditionally used as a medicine and the dried and powdered rhizome has a spicy flavour and is used as a substitute for ginger, cinnamon and nutmeg for its odor.
Harvesting:	18- 24 months after plantation, November-December
Fresh rhizome yield (t/ha)	8 - 9
Average oil content (%)	0.5-1.5
Essential oil yield (kg/ha)	40-50

CSIR-IHBT Selection



IHBT/AC-1:

Low β -asarone content

Fresh rhizome yield (t/ha) 10-12; E. Oil (%) 1.0 to 1.5



Sea wormwood (*Artemisia maritima* L.)

Family	Asteraceae
Common name	Nurcha, Senski
Major component:	1,8 cineole
Altitudes:	2500 to 4000 m amsl
Suitable region:	Dry temperate region
Uses:	This plant is traditionally used as an insect repellent.
Harvesting:	September-October (Perennial crop)
Biomass yield (t/ha)	2.8 - 3.4
Average oil content (%)	0.3 -0.5
Essential oil yield (kg/ha)	8.4 -10.2

CSIR-IHBT Variety



Him Devsugandh:
Biomass yield (t/ha) 2.8-3.4; E. Oil (%) 0.22 - 0.23



Lemongrass (*Cymbopogon flexuosus* Nees ex Steud. W. Watson)

CSIR-IHBT Selection

Family	Poaceae
Common name	Lemon grass
Major component:	Citral
Altitudes:	500 to 900 m amsl
Suitable region:	Tropical and subtropical regions
Uses:	Perennial aromatic grass used in perfumery and aroma industry. In food and beverages, it is used as a flavoring agent its leaves are commonly used for flavoring in herbal teas. In manufacturing industry, it is used as a fragrance in deodorants, soaps, and cosmetics.
Harvesting:	3-4 times in year
Fresh biomass yield (t/ha)	20- 25 (From 3-4 harvests/year)
Average oil content (%)	0.5
Essential oil yield (kg/ha)	100-125



IHBT/LM-1:
Biomass yield (t/ha) 25-30; E. Oil (%) 0.55 to 0.60

Lemon balm (*Melissa officinalis* L.)

Family	Lamiaceae
Common name	Lemon balm
Major component:	Citral, citronellal
Altitudes:	500 to 2400 m amsl
Suitable region:	Tropical and temperate regions
Uses:	It is used to give fragrance to different food and beverage products. The leaves are used as herbal tea for colds, gastrointestinal disorders, fever, headache, rheumatism, insomnia and calming nerves.
Harvesting:	June-August (Perennial crop)
Dry herb yield (t/ha)	4-6
Average oil content (%)	0.1 -0.3
Essential oil yield (kg/ha)	4-6

CSIR-IHBT Selection



IHBT/MO-1:

Dry herb yield (t/ha) 5.5-7; E. Oil (%) 0.20-0.25

Oregano (*Origanum vulgare* L.)

Family	Lamiaceae
Common name	Oregano
Major component:	Carvacrol, thymol
Altitudes:	200 to 1700 m amsl
Suitable region:	Tropical and temperate regions
Uses:	Oregano is a culinary herb, used for the flavor of its leaves. It is used in the treatment of colds, influenza, mild feverish illnesses, indigestion, stomach upsets and painful menstruation. Its essential oil is used as a dietary supplement
Harvesting:	June-August (Perennial crop)
Fresh herb yield (t/ha)	5-7
Average oil content (%)	0.2 to 1.3
Essential oil yield (kg/ha)	10 to 14

CSIR-IHBT Selection



IHBT/OV-1:

Fresh herb yield (t/ha) 7; E. Oil (kg/ha) 12

Marjoram (*Origanum majorana* L.)

Family	Lamiaceae
Common name	Marjoram
Major component:	Terpinene 4-ol, cis-sabinene hydrate
Altitudes:	400 to 1800 m amsl
Suitable region:	Tropical and temperate regions
Uses:	Marjoram herb and oil are used as flavoring in foods. It is commonly used for runny nose, coughs, colds, infections, and various digestion problems
Harvesting:	May-June
Herb yield (t/ha)	2.5-3.5
Average oil content (%)	0.5-1.5
Essential oil yield (kg/ha)	12.5-17.5

CSIR-IHBT Selection



IHBT/OM-1:

Herb yield (t/ha) 2.8-3.5; E. Oil (%) 0.8-1.3

Catmint (*Nepeta cataria* L.)

Family	Lamiaceae
Common name	Catmint
Major components:	Nepetalactone, 1,8-cineole
Altitudes:	300 to 1800 m amsl
Suitable region:	Tropical to sub tropical regions
Uses:	Suitable for treating colds, flu and fevers in children. It is used as mosquito and fly repellent
Harvesting:	August when the plant is in full bloom
Dry herb yield (t/ha)	4.4-5.0
Average oil content (%)	1.5- 2.5
Essential oil yield (kg/ha)	66-75

CSIR-IHBT Selection



IHBT/NC-1:

Dry herb yield (t/ha) 5.0-5.5; E. Oil (%) 1.8

Hyssop (*Hyssopus officinalis* L.)

Family	Lamiaceae
Common name	Juffa
Major components:	Isopinocamphone, pinocamphone, β -pinene
Altitudes:	300 to 1800 m amsl
Suitable region:	Tropical to sub tropical regions
Uses:	In perfumery and cosmetics, foods, beverages, and pharmaceuticals products, stimulant, carminative and expectorant and is used in colds, coughs, congestion and lung complaints.
Harvesting:	At full bloom
Herb yield (t/ha)	15-25
Average oil content (%)	0.13-0.26
Essential oil yield (kg/ha)	7-19

CSIR-IHBT Selection



IHBT/HF-1:
Herb yield (t/ha) 20; E. Oil (%) 0.18-0.25

Sage (*Salvia officinalis* L.)

CSIR-IHBT Selection

Family	Lamiaceae
Common name	Sage
Major component:	Carvacrol, thymol
Altitudes:	1200 to 2500 m amsl
Suitable region:	Temperate and subtropical regions
Uses:	It is used to treat mild dyspepsia, age-related cognitive disorders, and inflammations in the throat and skin. It is used for digestive problems, including loss of appetite, and stomach disorders .
Harvesting:	June- July
Fresh herb yield (t/ha)	5-7
Average oil content (%)	0.7-1.0
Essential oil yield (kg/ha)	8-20



IHBT/SO-1:
Fresh herb yield (t/ha) 8; E. Oil (%) 1.0

Jangli haldi (*Curcuma aromatica* Salisb.)

Family	Zingiberaceae
Common name	Jangli haldi
Major component:	1,8 cineole, iso bournyl
Altitudes:	1000 to 2500 m amsl
Suitable region:	Sub tropical and temperate
Uses:	Possesses antifungal, antimicrobial, mosquito repellent, and anti-inflammatory activities. Essential oil is used for treating cervix cancer at early stage.
Harvesting:	After two years
Fresh rhizome yield (t/ha)	60
Average oil content (%)	2.4
Essential oil yield (kg/ha)	150-200

CSIR-IHBT Variety



Himhaldi:

Fresh rhizome yield (t/ha) 60; E. Oil (%) 2.4



Kapoorkachri (*Hedychium spicatum* Buch. Ham. ex Smith.)

Family	Zingiberaceae
Common name	Spiked ginger lily, Kapoorkachri
Major component:	β -pinene, 1,8-cineole, β -eudesmol
Altitudes:	1000 to 2800 m amsl
Suitable region:	Subtropical and temperate region
Uses:	Rhizomes used in colic, enteric fever, asthma and bronchitis, eye disorder, liver complaints, urinary disorders, gastric disorder, vomiting, cuts and wounds, rheumatism, and inflammation. Its essential oil is having antioxidant, antifungal, hypoglycemic cytotoxic, tranquilizer, CNS depressant properties.
Harvesting:	After two years
Fresh rhizome yield (t/ha)	12
Average oil content (%)	0.50
Essential oil yield (kg/ha)	60

CSIR-IHBT Variety



Himkachari:

Fresh rhizome yield (t/ha) 12-15; E. Oil (%) 0.50

Parsley (*Petroselinum crispum* Mill. Fuss)

Family	Apiaceae
Common name	Parsley
Major component:	Apiol, myristicin
Altitudes:	800 to 2500 m.
Suitable region:	Subtropical, tropical and temperate regions
Uses:	Used as diuretic, have antimicrobial, antiseptic, antispasmodic properties. Treats gastrointestinal disorders, inflammation, halitosis, kidney stones, and amenorrhea. Rich source of folic acid, vitamin K, vitamin C, and vitamin A
Harvesting:	75 days after sowing (3 cuts per year)
Fresh herb yield (t/ha)	40-60
Average oil content (%)	0.04-0.19
Essential oil yield (kg/ha)	24

CSIR-IHBT Selection



IHBT/PC-1:

Fresh herb yield (t/ha) 55-60; E. Oil (%) 0.15

Thyme (*Thymus vulgaris* L.)

Family	Lamiaceae
Common name	Thyme
Major component:	Thymol and γ -terpinene
Altitudes:	1000 to 2500 m.
Suitable region:	Tropical and temperate regions
Uses:	Used as expectorant, gastroenteric and bronchopulmonary, have antimicrobial, antibroncholytic, antispasmodic, anthelmintic, carminative, and diuretic properties.
Harvesting:	Starts in late spring to early autumn (3 harvest per year).
Fresh herb yield (t/ha)	5-6
Dry herb yield (t/ha)	1.5-2.5
Average oil content (%)	1.25
Essential oil yield (kg/ha)	6.25-7.50

CSIR-IHBT Selection



IHBT/TV-1:
Fresh herb yield (t/ha) 6.5; E. Oil (%) 1.25

Manufacturer of essential oil, phytochemicals, crude extract, herb traders & growers in Himachal Pradesh

- | | | |
|----|--|--|
| 1 | Mr. Surender Mohan, M/S Hari Industries, Baggi, Distt. Mandi–
175027, (H.P.) Tel: (O) 245232, ® 245252. Fax No. 01905 245132 | Mfr. Essential Oil & Herb Extracts & Oleoresin |
| 2 | Mr. Jitender Sodhi, Ayush Herbs, Phase I, Ind. Area, Nagrota Bagwan,
Kangra, Tel. 01892 252099, 252109. | Mfr. Phytochemicals, Herbs Extracts & Herbal
Medicine |
| 3 | Manoj Nayer, M/S Namiex chemicals (P) Ltd, Lodhwan, Nurpur, Distt.
Kangra. (H.P.) Tel: 0186 226308. | Phytochemicals |
| 4 | Mr. R.N. Kapoor, Grassroot Industries, Plot No. 4, Phase III, I Area,
Mandi. Ph. No.223124, 223224, 222624. | Essential Oil |
| 5 | Dr. Bimal Chander, M/s Kanha Aromatica, Vill. & P.O. Seobagh, Distt.
Kullu (H.P.) Tel. Off. 222621 ® 222376. | Essential Oil |
| 6 | Mr. Rajender Mohan, M/S Hitesh Aromatics, Vill. Nalsar, P.O. Baggi –
175027, Distt. Mandi (H.P.) Tel: (O) 245288 ® 245241 | Essential Oil |
| 7 | Mr. Kailash Sharma, M/S Himalyan Lap Aromatics, Arsu, Distt. Kullu
(H.P.) | Essential Oil |
| 8 | Mr. Hans Raj Rana, M/s Mahamaya Traders, Vill. Salahar, P.O.
Devdhar, Distt. Mandi – 175029 (H.P.) Tel: (O) 01907 250219 ®
250020. Fax: 01907 250442 | Cultivator large scale Crop of Medicinal &
Aromatic Plants. |
| 9 | Dr. Lal Singh, Director, Himalyan Research Group, Umesh Bhawan,
Chotta Shimla, Shimla – 171 002. Tel. (O) 0177 226 820 ® 220520. | Cultivator & N.G.O. |
| 10 | Mr. Govind Goswami, Naina Aromatics Industry, Sakroha, Distt. Mandi
(H.P.), Ph. 01905 247203 | Essential Oil& Herb Extract |
| 11 | Manoj Gupta, M/s Himalyan Herbal Extracts, Vill. Tawan, P/O Dhawan,
Distt. Mandi (H.P.)Tel. (M) 098160 45334, (o) 245232 | Essential Oil& Herb Extract |

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|-----------|--|--|
| 12 | Mr. Vikas Gupta, M/S Sant Bhamas Enterprises, Baggi – 175027,
Distt. Mandi (H.P.) Tel: 098170 64799 @ 45334 | Mfr. & Exporter Essential Oil & Herb Extract |
| 13 | M/S Mediroma Nirgalits International, H. 40, Industrial Area Shamshi,
Distt. Kullu (H.P.)-175126.Tel; 01902-267221 | Essential Oil and Aromatherapy |
| 14 | Mr. Madan Awasthi, Awasthi Cottage, Manali, Distt. Kullu (H.P.) Tel:
(O) 278311 @ 253035 | Cultivator |
| 15 | Mr. K.G. Butail, Vill. Sungal, P.O. Sungal Tea Estate, Palampur (H.P.) –
176061. Phone. 01894 230456. | Cultivator & Mfr. Essential Oil |
| 16 | Mr. Shiv Bhushan, Una, Distt. Una (H.P.) | Essential Oil R.T. Aromatics E.O. Pvt, Ltd, |
| 17 | Mr. B.M. Sood, Himachal Pharmaceutical, Ind. Area Kandaruri,
176402. Distt. Kangra 01893 244414 , 244814 | Phytochemicals |
| 18 | M/s Natraj Industries, V & P.O. Badhu, Distt. Mandi (H.P.) 01907
274033 | Essential oil |
| 19 | Mr. Vijay Kumar Sharma, Mountainous Herb (P) Ltd, Plot No. 4, Phase
III, 1 Area Rati. Distt. Mandi (H.P.) Tel. No. 221772 | Essential Oil |

Indian market price list of different essential oils

S.No.	Product (oils)	Price (Rs/kg)
1	Ajwain oil	800-1100
2	Angelica root oil	45000-48000
3	Anise oil	2400-2600
4	Basil oil	650-850
5	Betel leaf oil	35000-40000
7	Black pepper oil	6000-6500
7	Cajuput oil	2200-2800
8	<i>Acorus calamus</i> oil	6000-6500
9	Camphor oil	450-550
10	Caraway oil	7000-7500
11	Cardamom oil	30000-35000
12	Carrot seed oil	4800-5200
13	Cassia oil	3000-3500
14	Cedarwood oil	750-950
15	Celery seed oil	5200-5600
16	Chamomile blue oil	35000-40000
17	Cinnamon leaf oil	1800-2000
18	Citronella oil	1800-2000
19	Clove bud oil	2000-2400
20	Coriander seed oil	14000-15000
21	Cubeb oil	30000-35000
22	Cumin seed oil	3000-3500
23	Curry leaf oil	7000-7500
24	Cypriol oil	14000-16000
25	Davana oil	30000-35000
26	Dill seed oil	1800-2000
27	<i>Eucalyptus citrodora</i> oil	1600-2000
28	<i>Eucalyptus globulous</i> oil	1800-2000
29	Fennel seed oil	2800-3000
30	<i>Galangal alpine</i> oil	45000-48000
31	<i>Galangal kaemperia</i> oil	35000-38000
32	<i>Galangal offinarum</i> oil	38000-42000
33	Geranium oil	20000-22000
34	Ginger oil	7000-7500
35	Ginger grass oil	2500-3000
36	Hedychium oil	2000-4500
37	Jamrosa oil	2000-2200
38	Juniper berry oil	4000-4500

39	Lemon grass oil	1300-1500
40	Lime oil (distilled)	2000-2200
41	Mace oil	5500-6500
42	Mandarin oil	1800-2000
43	Marjoram oil	7800-8200
44	<i>Mentha arvensis</i> (de-mentholised) oil	1000-1075
45	<i>Mentha arvensis</i> (shivalik) oil	1400-1500
46	<i>Mentha citrata</i> oil	1400-1700
47	<i>Mentha piperata</i> oil	2400-2600
48	<i>Mentha spicata</i> oil	1500-1700
49	Nutmeg oil	2500-3000
50	Olibanum oil	2800-3200
51	Orange oil	1500-1800
52	Palmarosa oil	2800-3200
53	Patchouli oil	4800-5400
54	Black pepper oil	4500-5000
55	Pine oil	450-550
56	Sandal wood oil	110000-115000
57	Spikenard oil	40000-45000
58	Sugandh kokila oil	2800-3200
59	Sugandh mantra oil	30000-34000
60	Tagetes oil (Plain region)	3800-4200
61	Tagetes oil (Hilly region)	7500-8000
62	Thuja oil	6500-7000
63	Tomar seed oil	4500-5000
64	<i>Ocimum sanctum</i> oil	10000-11000
65	Turmeric oil	2200-2400
66	Valerian oil	26000-28000
67	Vetiver oil (Ruh khus)	40000-45000

Selected Publications of CSIR-IHBT

1. Walia, S., Mukhia, S., Bhatt, V., Kumar, R., Kumar, R. 2020. Variability in chemical composition and antimicrobial activity of *Tagetes minuta* L. essential oil collected from different locations of Himalayas. *Industrial Crops and Products* 150:112449.
2. Mahajan, M., Pal, P.K., 2020. Flower yield and chemical composition of essential oil from *Rosa damascena* under foliar application of Ca (NO₃)₂ and seasonal variation. *Acta Physiologiae Plantarum* 42(23):1-13.
3. Dhiman, B., Sharma, P., Shivani, Pal, P.K. 2020. Biology, chemical diversity, agronomy, conservation and industrial importance of *Valeriana jatamansi*: A natural sedative. *Journal of Applied Research on Medicinal and Aromatic Plants*. doi:10.1016/j.jarmap.2020.100243
4. Thakur, M., Sharma, U., Kumar, R. 2019. Effect of shade level and mulch type on growth, yield and essential oil composition of damask rose (*Rosa damascena* Mill.) under mid hill conditions of Western Himalayas. *PLoS ONE* 14(4):e0214672.
5. Walia, S., Rana, A., Singh, A., Sharma, M., Edward Reddy, S.G., Kumar, R. 2019. Influence of harvesting time on essential oil content, chemical composition and pesticidal activity of *Artemisia maritima* growing wild in the cold desert region of Western Himalayas. *Journal of Essential Oil bearing plants* 22(2):396-407.
6. Thakur, M., Sharma, S., Sharma, U., Kumar, R. 2019. Study on effect of pruning time on growth, yield and quality of scented rose (*Rosa damascena* Mill.) varieties under acidic conditions of western Himalayas. *JARMAP*. DOI: 10.1016/j.jarmap.2019.100202
7. Kaundal, M., Bhatt, V., Kumar, R. 2018. Elevated CO₂ and temperature effect on essential oil content and composition of *Valeriana jatamansi* Jones. With organic manure application in a Western Himalayan region. *Journal of Essential Oil Bearing Plants* 21(4):1041-1050.
8. Rathore, S., Walia, S., Kumar, R. 2018. Biomass and essential oil of *Tagetes minuta* influenced by pinching and harvesting stage under high precipitation conditions in the western Himalayas. *Journal of Essential Oil Research* 30(5):360-368.
9. Koundal, R., Dolma, S.K., Chand, G., Agnihotri, V.K., Reddy, S.G.E. 2018. Chemical composition and insecticidal properties of essential oils against diamondback moth, *Plutella xylostella* (L.). *Toxin Reviews* 2018:1-11.
10. Kumar, R., Sharma, S., Sharma, S., Sharma, M., Kumar, N. 2018. Influence of flower to water ratio and distillation time of damask rose (*Rosa damascena* Mill.) flowers on essential oil content and composition in the western Himalayas. *Journal of Essential Oil Research* 30(5):353-359.

11. Thakur, M., Kumar R. 2018. Agro-meteorological indices of aromatic rose (*Rosa damascena* Mill.) influenced by pruning time in the western Himalayas. *Journal of Agrometeorology* 20(1):31-35.
12. Sharma, S., Kumar, R. 2017. Influence of harvesting stage and distillation time of damask rose (*Rosa damascena* Mill.) flowers on essential oil content and composition in the western Himalayas. *Journal of Essential Oil Bearing Plants* 21(1):92-102.
13. Kumar, R., Kaundal, M., Sharma, S., Thakur, M., Kumar, N., Kaur, T., Vyas, D., Kumar, S. 2017. Effect of elevated [CO₂] and temperature on growth, physiology and essential oil composition of *Salvia sclarea* in the western Himalayas. *Journal of Applied Research on Medicinal and Aromatic Plants* 6:22-30.
14. Kumar, R., Sharma S., Sood, S., Kaundal, M., Agnihotri, V.K. 2017. Effect of manures and inorganic fertilizers on growth, yield, essential oil of damask rose (*Rosa damascena* Mill.) and chemical properties of soil in western Himalayas. *Journal of Plant Nutrition* 40(11):1604-1615.
15. Walia, S., Kumar, R. 2017. Development of the nondestructive leaf area estimation model for valeriana (*Valeriana jatamansi* Jones). *Communication in Soil Science and Plant Analysis* 48(1):83-91.
16. Kumar, R., Sharma, S., Sharma, S., Kumari, A., Kumar, D., Nadda, G., Padwad, Y., Ogra, R.K. and Kumar, N. 2016. Chemical compositions, cytotoxicity, and insecticidal activities of *Acorus calamus* accessions from the western Himalaya. *Industrial Crops and Products*. 94:520-527.
17. Kumar, R., Sharma S., Sharma S., and Kumar, N. 2016. Drying methods and distillation time affects essential oil content and chemical compositions of *Acorus calamus* L. in the western Himalayas. *Journal of Applied Research on Medicinal and Aromatic Plants*. 3(3):136-141.
18. Pal, P.K., Mahajan, M. 2017. Pruning System and Foliar Application of MgSO₄ Alter Yield and Secondary Metabolite Profile of *Rosa damascena* under Rainfed Acidic Conditions. *Frontier in Plant Sciences* 8:507.



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