

Wealth of Medicinal and Aromatic crops of North East India and their commercial exploitation

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Introduction: Medicinal and Aromatic Plants (MAPs) are emerging on the scene in Indian agriculture from three different perspectives.

- First, the traditional health care system under Ayurveda, Siddha and Unnani has become popular for holistic treatment, cost of treatment and least side effects. This may spurred the demand for medicinal plant products.
- Medicinal plants were being collected from the natural habitat and under minimal or no supervised environment. This over-exploitation of these plant species has led to the ultimate option for cultivation to cope up the increasing demand. Medicinal crops have better economic opportunities as against the traditional field crops and characterized by high value –low volume.

The Ministry of Environment and Forest, Govt. of India has identified and documented over 9,500 species of medicinal and aromatic plants that are significant for the pharmaceutical industries.

2000 to 2300 species are used in traditional medicines while at least 150 species are used commercially on a large scale (EXIM Bank, 1997). All plants have medicinal properties and these may be presence of essential oils or some other active ingredients. So, aromatic plants is the subset of medicinal plants.

Advantages of medicinal crops over traditional crops

- Medicinal crops provide better returns than traditional crops;
- Export demand
- Fetch better prices in the market
- Non-perishable in nature in processed or semi-processed conditions.
- Largely drought tolerant, and not easily grazed by animals;
- Have low incidence of pest and diseases;
- Could be raised as inter-crops, along with traditional crops, and also on degraded lands;
- Could provide scope of entrepreneurship development locally.
- Essentially industrial importance and cash crop.

Market scenario of MAP's products:

- Top ten exporting countries accounted for 85% of global export
- Leading importers are -

Importing countries	2001 (,000 USD)
Hong Kong	170477
USA	148216
Germany	74997
Japan	107007
France	63669
Korea Rep.	44418
Italy	40572
China	44027
Malaysia	30693
Singapore	26799
All countries	1031052

Source: Trade Analysis System of ITC, Geneva

- Indian herbal export valued at about Rs. 874 crores in 2001-2002 with average growth rate 15% the projected export to Rs. 1758 crores by 2006 –2007 and to Rs. 2674 crores by 2009-10.
- Indian export share in global market is 13%
- The global herbal market is estimated to be US\$ 62 billion.

Leading Export markets for India

US\$'000

Exports from India	1999	2000
World	44151	79454
USA	17681	31497
Japan	3578	4407
Germany	2581	3308
U K	1664	3995
Taiwan (PoC)	1585	4157
Italy	784	5561
France	1696	2019
Pakistan	1777	1690
Hong Kong	753	2086

Source: Trade Analysis System of ITC, Geneva

Importance of MAPs commercialization

“Commercialization is the best way of preservation”

Cultivation scenario in India:

- Out of 880 traded plants 538 plant species occur in wild and only 88 plant species are traded from cultivation sources.

Following traded medicinal and aromatic plants are cultivated in India-

Lawsonia inermis, Cassia senna, Acorus calamus, Alpinia galanga, Asparagus racemosus, Bacopa monierri, Chlorophytum borivillianum, Coptees teeta, Centella asiatica, Croton tiglium, Curcuma zediaria, Eclipta alba, Emblica officinalis, Garcinia indica, Gloriosa supraga, Kaemphferia galanga, Mimusops elengi, Piper longum, Plumbago indica, Rauwolfia serpentina, Santalum album, Solanum nigrum, Terminalia chebula, Terminalia bellerica, Tionpora cordifolia, Vetiveria zizaniodes, Withania somnifera, Adrographic panniculata, Azardirecta India, Aloe barbadensis, coleus barbutus, Pogostemon cablin, Cymbopogon sps. Swertia chirayata etc.

Some highly traded MAPs from wild harvests:-

Aconitum heterophyllum, Acyranthes aspera, Angelica glauca, Boerhavia diffusa, Berberis aristata, Boswellia serrata, Casisa absus, Commiphora wightii, Cyperus rotundus, Cyperus scariosus, Gymnema sylvestre, Hedychium spicatum, Holarrhena pubescens, Hyoscyamus niger, Mesua ferrea, Nardostachys grandiflora, Phyllanthus armorus, Picrorhiza kurrooa, Rhododendron anthopogon, Rubia cordifolia, Saraca asoka, Smilax glabra, Swertia chirayata, Taxus wallichiana, Terminalia arjuna, Valeriana wallichii, Aquilaria agallocha, Gardenia gummiphora, Cananga odorat, Paederia foetida, Adhatoda vasica, Eclipta elba, sterculia urens, Helicteres esora, Colchicum lutem, Dactyolrhiza hatagarea, Diplocyclos palmatus, Hemidesmus indicus, Strychnos mix-vomica, etc,

Top 10 traded Medicinal plants in India:-

,Emblica officinalis (Amla), *Asparagus racemosus* (Satwari), *Withania somnifera* (Aswagandha), *Saraca asoka* (Asok tree), *Aegle marmelos* (Bael), *Casia angustifolia* (Senna), *Adhatoda vasica* (Basaka), *Piper longum* (Pippali), *Bacopa monnieri* (Brahmi).

Top 10 traded Aromatic plants in India:-

Aquilaria agallocha (Eaglewood/ agarwood), *Pogostemon cablin* (Patchouli), *Mentha arvensis* (Menthol mint), *Vetiveria zizanioides* (Vetiver/ khus), *Cymbopogon winterianus* (Citronella), *Santalum album* (White sandalwood), *Pelagonium graveolens* (Rose geranium), *Rosa damascena* (Damask Rose), *Homolus lupulus* (hops), *Homalomena aromatica* (Sugandhamantri).

Factors affecting cultivation:

- * Lack of quality planting materials.
- * Shortage of appropriate Agro-Techniques.
- * Lack of market information
- * Lack of good agricultural practices (organic farming).
- * Lack of supporting from FI for cultivation and value addition.
- * No price parity with wild produce.

Prospect of commercial MAPs cultivation:

- Upward demand trends of MAPs products in global market.
- Decreasing areas for wild harvests.
- Increasing trends of prohibition on wild harvests. Indiscriminate wild harvests leading maximum species towards endanger categories.
- To ensure right quantity and quality to export at right time for maximum benefits.
- To save bio-diversity.
- Government's incentive to encourage cultivation

Altitude based MAPs for commercial cultivation:

Foot hills to 900 m MSL	1000 - 2000 m MSL	Above 2000 m MSL
<ol style="list-style-type: none">1. Sugandhamantri1.Amla2. Pippali3. Sarpagandha,4. Sandalwood,5. Agar6. Vetiver7. Patchouli8. Citronella9. Lemon grass10. Hilikha11. Bhomora12. Stevia13. Brahmi	<ol style="list-style-type: none">1.Damask Rose2. Costus3.Clary sage4. Rose scented Geranium5. Indian valeriana6. Tagetus minuta7. Evening primrose8. Bach9. Lavender/Lavendin10. Hops11. Pyrethrum	<ol style="list-style-type: none">1.Atees2.Texus3.Vatsnav (Aconitum ferox)4. Jatamansi5..Kutki6. Chirata7.Hops8. Pyrethrum.

Agro-Technologies of few selected MAPs for North East

Patchouli (*Pogostemon cablin*; Family- Lamiaceae)

Economic part: Herbs (Leaves and tender stems)

Variety : Indonesian type

Soil & Climate : Well drained, loamy soil rich in organic matter and no water stagnation. Soil pH 5.5 to 6.2.

Climate : Warm and humid climate with rainfall 1500 – 3000 mm per annum.

Temperature : Favourable temperature 24 – 28° C with a average Relative humidity 75% it grows successfully up to an altitude of 500m MSL.

Propagation : Terminal stem cuttings of shorter internodes are preferred.

Nursery preparation : Nursery with provision of shade and water supply should be prepared before cuttings are put. Rooting either in polybeg or directly in bed under shade. Pre and post monsoon are suitable period for raising of seedlings.



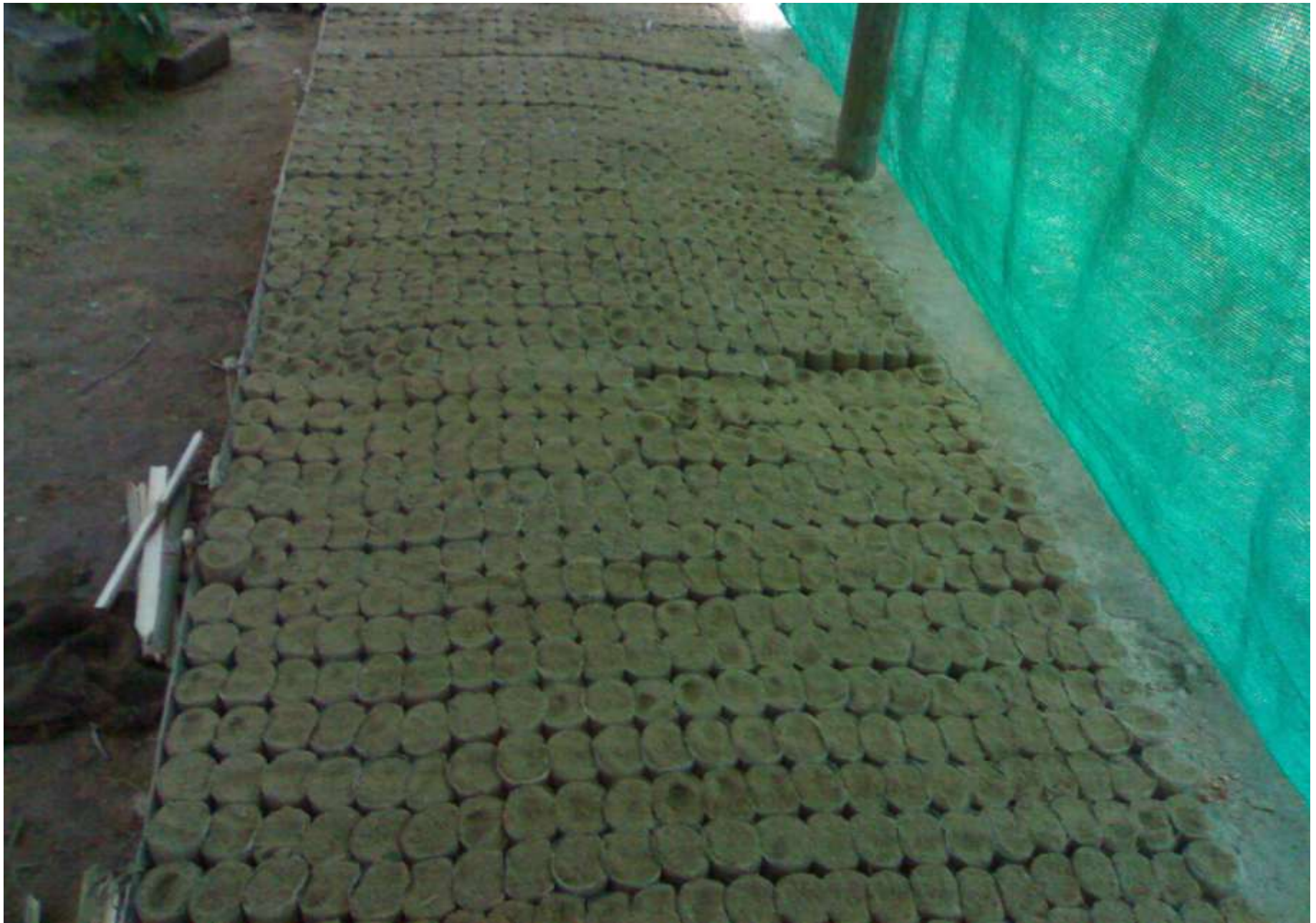
Removal method of excess leaves from cuttings



Patchouli Cutting preparation



Sorted patchouli cuttings – Ready to plant in bed or polybag for rooting



Polybag ready for planting of Patchouli cuttings



For faster rooting in winter



Rooted patchouli seedlings – ready to plant in field



A well laid-out field ready for Patchouli planting



Newly planted patchouli



Newly planted Patchouli (40cm x40cm, 4 lines/ bed & 5ft width bed)



Raking- Effective weed control means in patchouli



Cross raking



Patchouli- Mulched by Lemongrass spent materials



Partial harvest at 65 DAP in patchouli

Planting time : Rooted cuttings of 30-40 days old are ready to plant in field.

Rooting Media: Soil media for rooting is the mixture of sand : soil is (50 : 50).

Hardening of seedlings: Gradual reduction of water supply and shed for 7 – 10 days ahead of planting reduces field mortality of seedlings.

Time of planting: * For double harvest- October – November.

* For single harvest February –April.

Spacing : 40 X 40 cm

Plant population: About 6000 per ha including mortality.

Method of planting: Raised bed (initially 4-6”), 5 feet wide and convenient in length and side drain of spade width.

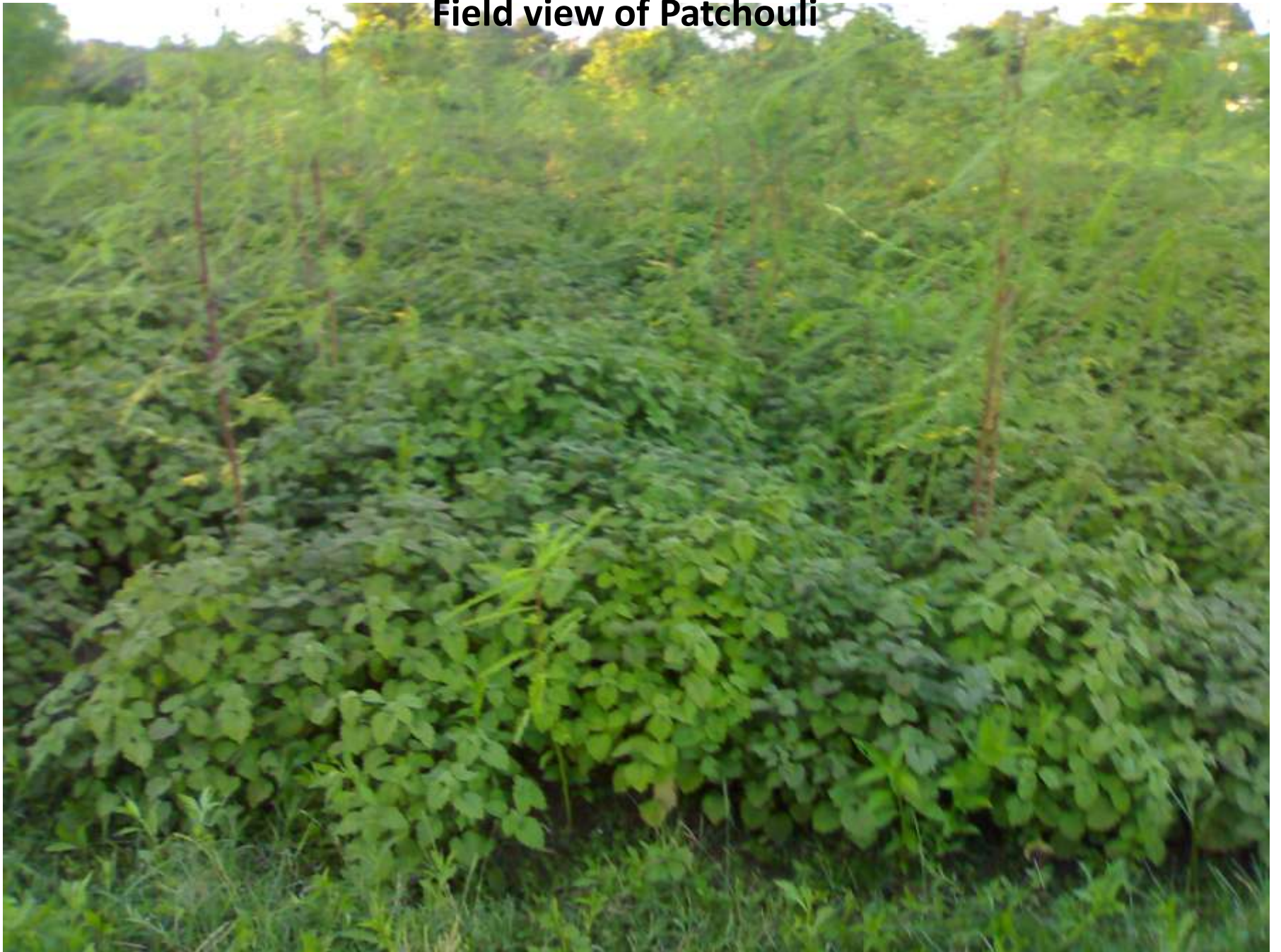
Detopping: Removal of tips after 30-35 encourages lateral branching.

Mulching: Mulching with dry and chopped herbs after 1st weeding is beneficial in respects of moisture retention, weeds suppression, regulates soil temperature, increases soil microbial activities and add organic matter on decomposition and finally loosen soil strata desirable for arable crop .



A field view of full grown Patchouli crop

Field view of Patchouli



Manures and fertilizers: FYM: 4.0 – 5.0 tons per ha during final land preparation along with P & K @ 100 kg, 50 kg per ha as basal application. 160 N in 4 splits as top dressing.

Cultural practices: Compaction of surface soil particularly around root zone is avoided. Soil loosening after harvest is recommended.

Irrigation : Sprinkler / furrow irrigations are advocated during winter season. Surface drainage is very important in high rainfall areas.

Weed control: Mechanical weed control with forking at 12-15 and 25-30 days after planting followed by mulching is enough for patchouli cropping.

Partial harvest: Partly harvesting of matured main stem at 60 – 65 days after planting is helpful in development of stable crop canopy.

Harvesting: Selective harvesting method is advocated. Branches having 5-7 pairs of leaves, showing 1-2 pairs leaves yellowing appearance becomes ready to harvest. Young branches are allowed to intact with the plant. In general 1st harvest is in 110-120 DAP(April-May) and second harvest at 50-60 days (July-August) interval. Level harvest is economic in single harvesting crop.

Harvesting time: Morning and evening hours. Avoid scorch sunny and rainy hours.



Thinned portioned- Harvesting done by 'Selection Method'



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Patchouli- Profitable even in single harvest (110-120 days)



Patchouli - As single harvest crop



Drying of leaves: Fresh herbs should be spread over bamboo mats or on tarpaulin under shade for 7 – 10 days. Thickness 2 inches. Turning of herbs once in a day avoid fermentation and promote uniform drying.

Drying structure: Rain protected shed of size 30 ft X 15 ft x 12 ft with four tier bamboo rack is enough for 1 ha patchouli cropping.

Storing of dry leaves: Dried leaves packed in gunny bag is stored for minimum 3 months before distillation for curing purpose.

Oil recovery: 3.0% in commercial unit.

Yield : Dry herb 50-60 q / ha/ cropping cycle

Oil yield: 150-180 kg per ha/ cropping cycle.

Price: Presently Rs. 2500/ per kg oil.

Plant protection: Fungal disease – soil application with PCNB or Brassicol @ 5 kg/ ha or 1% Bordeaux mixture.

Insect – Leaf roller : Decis @ 0.5 ml/lit water

Miriad bug: Dimethoate 30 EC or Monocrotophos @ 1ml/ lit water

Mite: Kelthene may be sprayed.

Nematode: Furadan granule @ 2.5 gm per plant.



Patchouli fresh herb- way to drying shed



Patchouli drying shade – 3 tier system



Patchouli oil



Patchouli – Mite infected leaves

LEMONGRASS (*Cymbopogon flexuosus*, Family: Poaceae)



Lemongrass (Krishna)

Variety : Krishna and CKP-25

Economic parts : Fresh herbs.

End product : Lemongrass oil (Aromatic)

Uses : Oil is the source of Citrol which is used as a basic raw material for isolation of Citrol and thereafter Alpha and Beta-ionone used for synthesis of a number of useful aromatic compounds and Vitamin-A. This is thus used as substitutes of 'cod liver oil.

Soil: Well drained deep loam to sandy loam and loamy soil , rich in organic matter, upland situations and irrespective of surface topography (var. Krishna)



Lemongrass Variety- CKP-25



Ground level harvesting of Lemongrass (Var- Krishna)

Krishna- 25 days after harvesting at 'Ground Level'



Climate: Warm and humid climate, up to 1000m altitude from MSL receiving well distributed medium to heavy rainfall.

Propagation : Vegetatively by means of slips.

Planting material required: 50,000 slips per ha.

Land preparation: Medium range of land preparation or as zero tillage crop in slopes.

Gestation period: 5 months.

Crop cycle : 4 years

Cropping option : As irrigated and rain fed crops.

Planting time : April – October.

Spacing : 45 cm x 45 cm. In case forest virgin and fertile soils 60 x 45cm.

Ground level harvesting of Lemongrass - a productive method



Planting method : Row to row in triangular fashion.

Manures: Mix well 4.0 – 5.0 ton FYM / compost per ha during land preparation followed by mulching of agricultural wastes.

Irrigation: One light irrigation just after planting is beneficial.

Harvest method: ‘Ground level harvesting’ is advantageous to top harvest.

Harvesting: 4 -5 harvests in a year and 20 times harvesting in 4 years.

Production: Fresh herbs 50 - 80 MT/ ha/ year depending on type of variety.

Oil extraction: By Hydro-steam distillation process.

Oil recovery: 0.5 – 0.7% on fresh weight basis depending on variety.

Oil production: 350 - 400 kg per hectare annually.

Oil price: Presently 400/kg

Chopping increases oil recovery



CITRONELLA (*Cymbopogon winterinanus*, Family: Poaceae)



Full grown Citronella following GLH Technique

Soil: Well drained deep loam to sandy loam and loamy soil rich in organic matter and prefers upland conditions.

Climate: Warm and humid climate, upto 1000m altitude from MSL receiving well distributed medium to heavy rainfall.

Propagation: Vegetative means by separation of slips.

Planting material required: 50,000 slips per hectare

Land preparation: Requires medium range of land preparation.

Gestation period: 5 months.

Crop cycle: 3 years

Cropping option : As irrigated and rainfed crops.

Planting time: April – October.

Spacing: 45 x 45 cm. In case of forest virgin and fertile soils 60 x 45cm.

Planting method : Row to row in triangular fashion.

Manures: Mix well 4.0-5.0 ton FYM / compost per ha during land preparation followed by mulching of agricultural wastes. Organic practices gives better results.

Irrigation: One light irrigation just after planting is beneficial.

Harvesting: 'Ground level harvesting' is advantageous to top harvest. .

Production: Fresh herbs 60 MT per hectare in a year.

Oil extraction: By Hydro-steam distillation process.

Oil production: 350 – 375 kg oil per ha annually at 0.6% oil recovery.

Oil price: Rs. 350/ - 380/ per kg

VETIVER (*Vetiveria zizaniodes*, Family: Poaceae)



Global status : Globally about 300MT vetiver oil is produced and India's share is only 20-25 MT. The north type of vetiver cultivated in NER is considered as best quality in world market and vetiverol content in oil is comparatively higher and low in caryophyllene content.

Variety : KS-1 (North type)

Economic parts : Roots.

End product : Vetiver oil (Aromatic)

Uses : Perfumery, cosmetic, food flavour.

Soil : Flood affected sandy and sandy loam.

Climate : Warm and humid.

Propagation : Vegetative means by slips.

Required planting material: 50,000 slips per hectare.

Land preparation: Requires medium range of land preparation.

Gestation period: 18 months.

Vetiver Roots



- Crop cycle** : 15-18 months.
- Cropping option** : Rainfed crop and soil ameliorants .
- Planting time** : April – October.
- Spacing** : Normal planting distance is 45 cm x 45 cm.
- Manures** : Mix well 4.5- 6.0 ton FYM / compost per hectare during land preparation followed by mulching of organic wastes.
- Harvesting** : By digging out of roots, cleaned and dried under shade.
- Production** : Dry root 3.5 - 4.5 MT per hectare .
- Oil recovery** : 0.5% on dry weight of roots.
- Oil extraction** : By Hydro-steam or simple hydro-distillation method.
- Oil production** : 17 – 24 kg per hectare.
- Oil Price** : Rs. 9000/ -10000/ per kg

SUGANDHMANTRI / GONDHI (*Homalomena aromatica*, Family: Araceae)



Field view of Sugandhmantri

Area for cultivation: Assam, Lower altitude of Arunachal Pradesh, Nagaland, Meghalaya and Tripura.

Economic parts : Rhizome.

End product : Sugandhmantri oil (Aromatic)

Uses : Perfumery, cosmetic and scenting of incense stick.

Soil : Sandy loam to loamy soils and soil reaction in acidic range

Climate : Warm and humid.

Propagation : Through rhizome cuttings.

Required planting material: 50,000 cuttings per hectare.

Land preparation : Medium to zero tillage.

Gestation period : 24 months.

Crop cycle : 22-24 months.

Cropping option : As rainfed crop under crop in existing fruit orchard and natural forest.

Planting time : April – June.



Sugandhmantri Rhizome - The economic part



Mature rhizome

Spacing	: 45 cm x 45 cm.
Manures	: Mix well 5 – 6 ton FYM / compost per hectare during land preparation followed by mulching of organic wastes especially rice husk.
Harvesting	: By digging out of rhizome in winter, cleaned and smoke dried.
Production	: Dry rhizome 40 – 45 q per hectare.
Oil extraction	: By steam distillation process from dry and crashed rhizome.
Oil recovery	: 1.0% on dry weight of rhizomes.
Oil production	: 40 – 45 kg per hectare.
Oil price	: 5000/ -5500/ per kg
Dry rhizome	: Smoked dry rhizomes @ 30/ - 35/ per kg

AGAR (*Aquilaria agallocha*, Family- Thymelaeaceae)



Agar plantation

Area for cultivation: Assam, Lower altitude of Arunachal Pradesh, Nagaland, Meghalaya, Manipur, Mizoram and Tripura.

Economic parts : Infected wood.

End product : Agar wood and oil (medicinal and aromatic)

Uses : Perfumery, attar, ideal fixative, scenting of incense stick and cardio-tonic.

Soil : Sandy loam, loamy, hard and rocky soils of acidic reaction in upland situation.

Climate : Warm and humid.

Propagation : Seeds

Land preparation: Zero tillage.

Gestation period: 15-20 years.

Cropping option : As rainfed tree crop suitable for multistoried cropping and as shade tree in tea garden, mixed forest plantations.
Suitable secondary host for Sandalwood.



Agar formation is on

INSECT (*Zeuzera conferta*) BORES LIVING AGAR TREE

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Planting time : April – June.

Spacing : 4m x 4m.

Required planting material: 625 tree / ha.

Planting method : Pit method

Manures : Mix well 10-15 kg FYM / compost per pit before planting followed by mulching of organic wastes in circular fashion.

Plant protection : Spraying of pesticides are restricted after 7th year onwards.

Harvesting : Partial harvesting and encourage coppicing.



Agaru formation



Agaru- The Wood of God



Infected agar chips

WHITE SANDALWOOD OR INDIAN SANDALWOOD

(*Santalum album*, Family- Santalaceae)



Sandalwood plantation in Sonitpur, Assam

Area for cultivation: Assam, Lower altitude of Arunachal Pradesh, Nagaland, Meghalaya, Manipur, Mizoram, Sikkim and Tripura upto 900m from MSL.

Economic parts : Heartwood.

End product : Sandalwood powder and oil (medicinal and aromatic)

Uses : Perfumery, attar, fixative, scenting of incense stick and skin care and aromatherapy.

Soil : Sandy loam, hard and rocky soils.

Climate : Warm, humid and low rainfall.

Propagation : Seeds and root cuttings

Spacing : Planting distance is 4m x 4m.

Required planting material: 625 saplings per hectare.

Land preparation: Zero tillage.

Gestation period : 20 years..

Cropping option : As rainfed tree crop suitable for multistoried cropping and as shade tree in tea garden, mixed forest plantations.

Planting time : April – June. Simultaneous planting of host plant.

Planting method : Pit method.

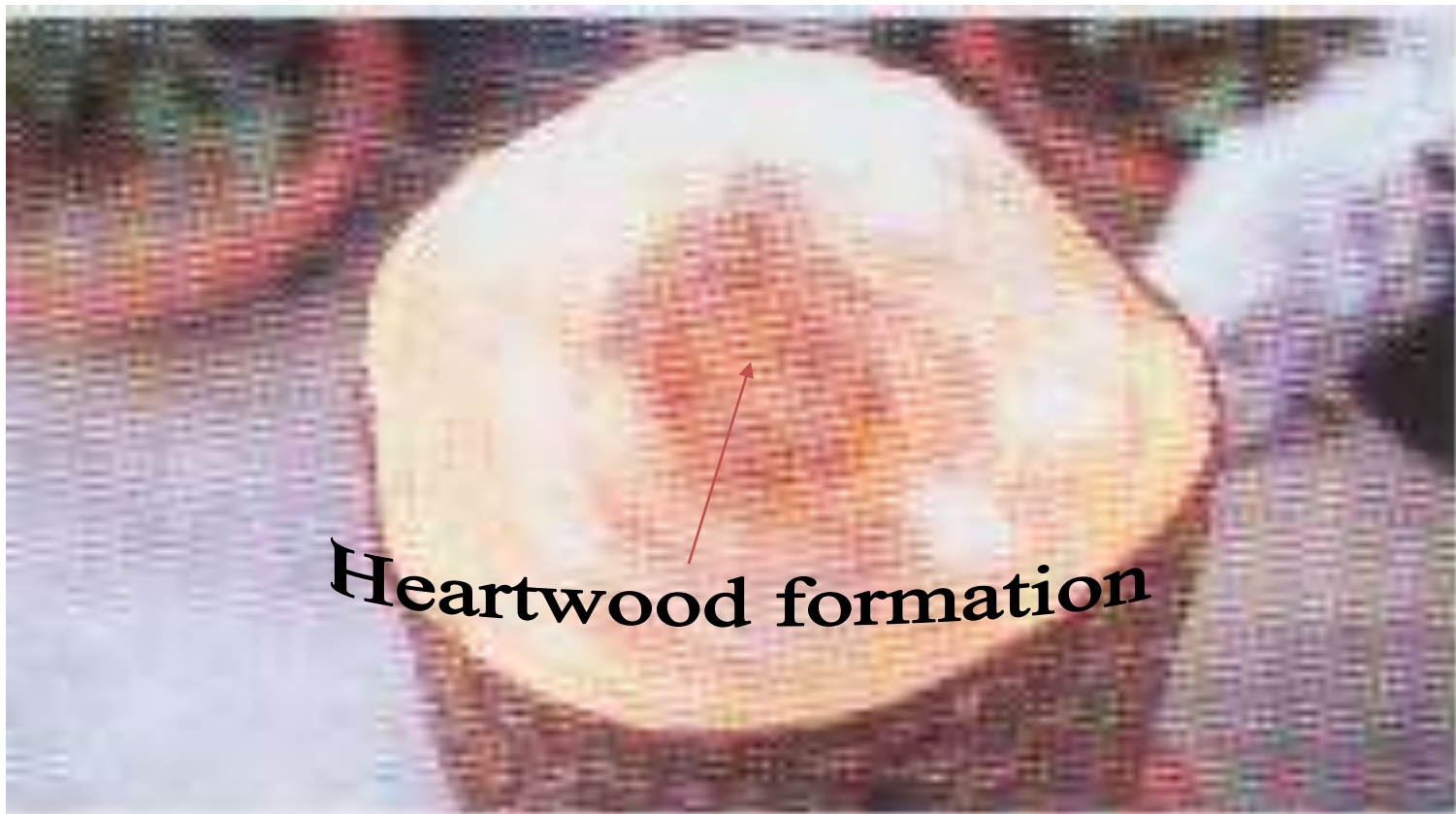
Manures : Mix well 10-15 kg FYM / compost per pit before planting followed by mulching of organic wastes in circular fashion.

Plant protection : Periodic spraying mixture of insecticides and fungicide upto 5-6th year prevent the dreaded spike disease.

Harvesting : Harvesting done by complete uprooting of tree and separation of heart wood.

Yield : Heartwood 20 kg/ tree in 20 year old tree.

Price: Heartwood @ 2500 – 3000 per kg and oil @ 70000/ per kg.



SARPAGANDHA

(*Rauvolfia serpentina*, Family: Apocynaceae)



Sarpaganda – A highly medicinal plant

- Variety** : Local type
- Economic parts** : Dry roots
- Uses** : As anti-hypertension in Indian system of medicine.
- Soil** : Well drained deep loam to sandy loam and loamy soil , rich in organic matter and prefers upland conditions.
- Climate** : Warm and humid climate, up to 500m altitude from MSL receiving well distributed medium to heavy rainfall.
- Propagation** : Through seeds, root and stem cuttings
- Spacing** : 45 cm x 30cm Spacing
- Required planting material:** 75,000 sapling.
- Land preparation:** Medium range of land preparation and even as zero tillage .
- Gestation period:** 24 months.
- Crop cycle** : 22-24 months

- Cropping option** : As rainfed under crop in existing fruit orchard and natural forest.
- Planting time** : April – June.
- Manures** : Mix well 4.5- 6.0 ton FYM / compost per hectare during land preparation followed by mulching of agricultural wastes and leaf litter.
- Harvesting** : Dig out roots, clean, wash, grading and dry.
- Production** : Dry roots 2.0T / ha in 2 years.
- Price** : Presently Rs. 200/ -250/ per kg of dry roots.