

Cultivation of Palmarosa



ICAR – DIRECTORATE OF MEDICINAL AND AROMATIC PLANTS RESEARCH
BORIIVI, ANAND – 387 310, GUJARAT

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CONTENT

Forward

Preface

1	Name of the plant	7
2	Plant part employed in aromatic oil extraction	7
3	Characteristics of the plant	8
4	Major production areas	8
5	Characteristics of strain (s) for cultivation	8
6	Cultivation methods	9
7	Quality evaluation of essential oil	17
8	Comparative summary table of the characteristics of different cultivated varieties / strains	18
9	Cultivation calendar	18


FOREWORD

PALMAROSA is a tall perennial grass which contains a sweet smelling oil of rose like odour. It is a tropical plant and grows in warm humid areas and is used in perfumery, food flavouring and medicinal pharmaceutical industry. The oil is a very rich source of high grade geraniol (75- 90%) and the crop is regarded as the cheap source of geraniol. Moreover it is a hardy crop which can be grown on varied types of soil and climatic conditions. It can even tolerate drought and could be grown on marginal waste lands including saline/sodic/alkaline soils. Palmarosa grows wild in India, particularly in Madhya Pradesh, Maharashtra, and Andhra Pradesh. It is also found in lesser frequency in Karnataka, Tamilnadu and Uttar Pradesh. About 15 metric tonnes of Palmarosa oil is produced in India annually both from cultivated and natural resources.

As the demand for our aromatic industry is growing high, concerns are raising over the improved production and quality of raw materials used. Hence, I hope this extension bulletin will serve the Palmarosa farmers to increase the production by adopting the proper cultivation practices. I am happy that ICAR-DMAPR, Anand has taken appropriate step to publish this bulletin that would serve as a useful guide for the Palmarosa growers of our nation.

Anand

November 24, 2014


(Jitendra Kumar)

Cultivation of Palmarosa

(*Cymbopogon martinii* [Roxb.] Wats. Var. *motia* Burk.)



1. Name of the plant

- 1.1. Scientific name: *Cymbopogon martinii* [Roxb.] Wats. Var. *motia* Burk. (2n=20) (Family: Poaceae)
- 1.2. Local name: *Rosha* grass, *Rusha* ghas (Hindi); Rauns, Rosdo (Gujarati); Rohisha, Rohisa (Sanskrit)

2. Plant part used in aromatic oil extraction

Floral shoots and above ground parts of the plant are used for distillation of essential oil.

3. Characteristics of the plant

Palmarosa is an aromatic tall perennial grass, which contain a sweet-smelling oil of rose like odour in its flowering tops and foliage. It grows to a height of 1.5 - 2.5 m, roots are shallow and fibrous, culms erect and nodes swollen. Leaf sheath is glabrous, ligule membranous, blades linear and flat. Inflorescence is large compound panicle up to 80 cm, spatheate beneath racemes up to 1.5 cm. Racemes with several spikelets hermaphrodite, oblong, elliptic and awned. Mature seeds are brown, fine, hairy and easily disposed by air. It is a best natural source of geraniol (75-90%).

4. Major production areas

This plant is a native of India and it grows wild in forests of Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Uttar Pradesh and Odisha. It is also found in lesser frequency in Karnataka, Tamil Nadu and in some parts of Uttar Pradesh. There is now expansion in cultivated area which is spread over in the states of Uttar Pradesh, Andhra Pradesh, Rajasthan, Karnataka, Maharashtra, Madhya Pradesh, Gujarat and Tamil Nadu.

5. Characteristics of *Cymbopogon* varieties

Palmarosa (*C. martinii*) is one among 140 species of the genus *Cymbopogon* and it has two cultivable varieties;

1. *C. martinii* var. motia - Palmarosa
2. *C. martinii* var. sofia - Ginger grass

C. martinii var. motia yields an essential oil with high geraniol content (60-90%) which is also called as East Indian Geranium Oil or *Russa* Oil. It has dark green leaves, which are leathery, prominently mid ribbed, roundish at the base and form an obtuse to right angle with the stem. It is a diploid ($2n=20$) and the oil is rich in geraniol, geranyl acetate and linalool.

C. martinii var. *sofia* called as Ginger grass is also grown widely in India and it yields oil of lower geraniol content. It has a dense tufts and more luxuriant growth but with shorter inflorescence and curved leaf base attached at an acute angle to the stem. It is tetraploid

(2n=40). Its oil is known as Ginger Grass Oil is of inferior grade and fetches much less price than the Palmarosa oil. The oil contains less of geraniol and more of other components like perillyl alcohol, carnegol, carvon, dipentene etc.

Proper identification of the species is very important and expert advice can be taken to avoid mistakes in species identification. Government recognized herbariums can be used to verify the correct species. Cultivation of inappropriate species/varieties (eg. var. sofia) may deteriorate the oil yield and quality.

Varieties like IW-31243, IW-31245, PRC-1, Trishna, Tripta, Vaishnavi, Cim-Harsha have been released by different institutes in India.

6. Cultivation methods

6.1 Soil

Palmarosa can be grown in poor sandy loam to heavy fertile soils. A well drained loamy soil with pH 6 to 7 is ideal. Although it grows best on soils having neutral pH, it survives and gives economic yield on alkaline soils of pH up to 9. A rise in pH above 8.5 is found to decrease the plant growth and oil yield but has no adverse influence on the quality of oil produced. But, if the soil is not well drained after heavy irrigation, standing water during summer seasons can affect the growth of the grass.

6.2 Climate

Palmarosa grows well in warm humid areas with high temperature and, plenty of sunshine during its growing period. The ideal elevation for its cultivation is up to 300 m. Annual rainfall of 90-150 cm and a temperature of 15 to 35°C with ample sunshine is congenial for its cultivation. It is susceptible to frost and hence frost-prone areas are not suitable for its cultivation.

6.3 Propagation

The crop can be propagated by both seeds and slips. For commercial cultivation, the crop is propagated by seeds. It is always better to use fresh seeds that were harvested during the previous season, which are in good condition and free from pests.

By seedlings: The best method for large scale propagation is by raising seedlings in nursery and transplanting in the main field. Raised nursery beds of 5×1 m should be prepared with 50 cm height during mid May – June. Seed beds should be well pulverized and add 2 baskets of cow dung manure, 100 g calcium ammonium nitrate, 150 g super phosphate and 50 g muriate of potash in each bed. As seeds are very small and light in weight they are usually mixed with fine sand or soil in a ratio of 1:10 for even distribution and ease in sowing. Lines of 3 cm deep and 10



cm apart are made and the seeds are uniformly sown in lines and covered with soil and manure mixture. The beds are irrigated with rose can on alternate days. The seeds start germinating within 3-4 days and in about 4-6 weeks seedlings are ready for transplanting in the main field. About 2.5 to 3 kg seeds are enough to transplant one hectare of land.

By slips: Plants producing high yield and better quality oil are to be selected for taking slips. Clumps are trimmed from 20-25 cm above ground and dug out without injuring the roots. The individual slip or a group of 2-3 slips having enough healthy root system are separated just before planting to minimize drying and loss of the roots.



6.4 **Planting time:** Onset of monsoon (June end to August)

6.5 Land preparation

The land is ploughed 2-3 times to produce a fine tilth before the seedlings or slips are transplanted. It is then laid into beds after applying the required dose of manures and fertilizers.

6.6 Planting / transplanting

Seeds are sown or seedlings are transplanted during the onset of monsoon (June to August). Ensure correct spacing between plants and rows. Healthy and established seedlings or slips of 20-25 cm long are planted during the onset of monsoon (June end to August) in rows of 30-60 cm apart with plants spaced at 30-60 cm within the rows. In fertile areas, spacing should be increased. Planting may be done on ridges in areas receiving high rainfall to avoid waterlogging. Seedlings/slips are planted firmly but not very deep in to the soil. Transplanting is done usually in the evening hours to avoid transplantation shock. The plots are given light irrigation after transplanting. Gap filling should be done within 8-10 days of planting. It is advisable to plant two seedlings/slips per hill to avoid seedling mortality.

6.7 Crop nutrition

As the palmarosa grass is perennial and whole herb is the economic part, it is necessary to frequently replenish the soil. Farm yard manure / compost are applied at 10 t/ha before planting. The recommended dose of fertilizer to palmarosa is 100:50:50 kg/ha of N:P₂O₅:K₂O. Phosphate and potash fertilizers are applied in two split doses as basal and after first harvest, while nitrogen is applied in four equal splits as basal dose, one month after transplanting and two more doses after each harvest. NPK application should be repeated each year at the time of appearance of fresh leaves. Application of micronutrients like ferrous sulphate and manganese sulphate improve the plant growth, herbage and oil yield. However, it may be applied if soil is deficient of iron and manganese.

6.8 Irrigation

Water requirement depends up on the climatic conditions. With an ample supply of water, growth is luxuriant, but if drought prevails



the growth is arrested, leaves wither and the oil content gets reduced. The crop is highly sensitive to water logging, where the plant becomes stunted and dies at later stages and proper drainage should be provided to prevent water logging. In general, the field is to be irrigated at 10-14 days interval during summer. Apply mulches to conserve soil moisture. Irrigation should be discontinued 7-10 days before harvesting.

6.9 Intercultural operation

Keeping the crop weed free during early establishment period is essential to get good harvest. Manage weeds before they start competing with the main crop for nutrients and light. It needs 3-4 hoeing and weeding during the first year, which can be restricted to two in the subsequent years. Use of mulches not only maintains soil moisture but also inhibits weed growth.

6.10 Plant protection

Palmarosa is a hardy crop and is resistant to many pests. Pest and disease problems should be managed by using botanical pesticides made from locally available resources or registered product from reputed manufacturer or institution. Use chemical pesticides as last option and maintain sufficient time between applications and harvest (pre harvest interval / safe waiting period) so that the chemical cannot be detected in the harvested plant material.

a. Insect pests

Sucking pests

1. **Aphids:** Adults and nymphs of *Aphis gossypii* suck sap from inflorescence. The infestation is maximum during January-April.
2. **Thrips:** Adults and nymphs of thrips (*Haplothrips sp.*) are yellowish brown in colour. They damage young shoot tips, leaves and floral parts affecting seed setting. Attack is more severe during February-April and July-August months.

Management: These sucking pests can be managed by spraying Azadirachtin 1% (10,000 ppm) @ 5 ml/l

White grub: Grubs of *Holotrichia consanguinea* feed on roots of palmarosa. Grub is dirty white to brown coloured and severe infestation occur during June – November months.

Management: Flooding with irrigation water kills the grubs

Termite: *Microtermis sp.* is the major termite attacking palmarosa. Whitish coloured adults damage the crop throughout the year. Newly planted seedlings are more vulnerable and termites eat the fibrous roots leading to death of plants.

Management: Flooding the soil with irrigation water. In severe cases, add Chlorpyrifos 20 EC in irrigation water and use for flooding.

b. Diseases

Ellisiella blight: It is one of the serious disease of palmarosa caused by *Ellisiella caudate*. This disease appears in epiphytic form during rainy season and causes considerable loss in production of leaves and essential oil. Initially, small grey necrotic spots appear symptom on the surface of infected leaves. In severe cases lesions get enlarged and coalesce resulting in premature drying of infected leaves. Fungus sporulates on dried necrotic lesions.

Management: Disease can be effectively managed by foliar spraying of Bordeaux mixture 1% at 15 days interval.

Curvularia blotch: This disease is caused by *Curvularia andrographis* and *C. trifolii*. Disease occurs in epiphytotic form during August and October. Small eye shaped, orange / brick red necrotic lesions appear and coalesce together resulting in premature drying of leaves.

Management: Foliar application of Bordeaux mixture 1% or Mancozeb @ 0.3% at 15 days interval at initial stages of infection effectively controls the disease.

6.11 Harvesting



Harvest palmarosa at the right stage to get high oil yield. The essential oil is present in all parts of the grass, viz. inflorescence, leaves and stems of which the inflorescence contains the major portion. Hence, the crop should be harvested at full flowering to

seed production stage in order to obtain maximum and good quality oil. Harvesting is usually done with a sickle at 15-20 cm above the ground surface. Harvest the crop in dry weather or during the hot hours of the day and do not harvest the crop when it is raining, or early in the morning when there is dew on the ground.

The number of harvests depends upon the climatic condition of the place, where it is grown. Generally during the first year, only one harvesting can be done during October-November, whereas 3-4 harvests can be obtained during the subsequent years. The crop remains productive up to 4-5 years depending upon the management practices followed. However, both herbage and oil yield start decreasing from the fourth year onwards. It is, therefore, recommended to keep the crop for only 4-5 years.

6.12 Processing

Post harvest processing is usually the most critical stage in determining the end quality of the Palmarosa. Immediately after harvesting, transport the plant part for further processing.

To obtain maximum yield of essential oil and to facilitate easy release of oil, harvested and cleaned palmarosa grass is chopped into 5-10 cm length (communion). Chopping the grass has further advantages that more grass can be filled into the still and even packing is facilitated. For economical



production of the oil, it is advisable that the harvested material is allowed to wilt in shade for 24-48 hours. From quality point of view, the grass should be distilled as fresh as possible. Oil obtained from dry or fermented grass is of inferior quality.

Palmarosa can be distilled either by hydro-distillation or steam distillation methods. Steam distillation results in maximum yield of better quality oil. Distillation unit should be clean, rust free and free



of any other odour. The oil, being lighter than water and insoluble, floats on the top of the separator and is continuously drawn off. The oil is then decanted and filtered. The distilled oil is treated with anhydrous sodium sulphate or common salt at the rate of 20 g per litre to remove the moisture. The oil should be stored in sealed amber coloured glass bottles or containers made of stainless steel, galvanised tanks, aluminium containers and stored in a cool and dry place. All processing activities should be documented in a diary.

6.13 Expected yield

Herbage yield and essential oil content of palmarosa depend upon many factors such as soil and climatic conditions, crop nutrition, management practices, harvesting time, maturity stage of grass, extent of wilting and distillation process. Fresh herbage yield of 30-40 tonnes can be obtained per hectare per year. An oil yield of about 220-250 kg/ha may be obtained from second year onwards from an irrigated crop. Oil yield is low in first year and it increases during 2-4 years of planting but gradually decreases thereafter. All parts of the plant contain essential oil, the maximum being present

in inflorescence and the least in stem. On an average, oil content in various plant parts is as follows:

Plant part	Essential oil content (%)
Whole plant	0.1-0.4
Stalks	0.01-0.03
Inflorescence	0.45-0.52
Leaves	0.16-0.25

7. Quality evaluation of essential oil

According to IS-526-1988, palmarosa oil should have the following specifications

Colour and appearance	:	Light yellow to yellow
Odour	:	Rosaceous, with a characteristic grassy background
Specific gravity at 27° C	:	0.8762 to 0.8882
Optical rotation	:	(-) 2° to 2°
Refractive index at 77° C	:	1.4702 to 1.4747
Acid value, max	:	3
Ester value after acetylation	:	266 to 280
Total alcohols, calculated as geraniol, per cent by mass (using about 1 g of the material)	:	90.0
Solubility	:	Soluble in 2 volumes of ethanol (70% by volume)

7.1 Gas Liquid Chromatography composition of palmarosa oil:

The constituents of palmarosa essential oil are geraniol (70-85%), geranyl acetate (8-12%), linalool (2.4%), β -caryophyllene (1.3%), geranyl formate (1.5%), geranyl butyrate (1%), nerol (0.22%), 6,7 geranyl epoxide (0.5%), 2,3 geranyl epoxide (0.2%), geranyl hexanoate (0.5%), geranyl octanoate (0.5%), limonene (0.5%), prenyl-isovalerance (0.4%), amyl hexanoate (0.3%), neryl formate (0.2%), and trace amounts of β - pinene, myrcene, D-hexanol, geranial, prenyl otonoate, caryophyllene epoxide, p-menthal etc.

8. Comparative summary table of the characteristics of different cultivated varieties / strains

PRC-1	:	Oil yield 80 kg/ha/harvest; geraniol 75-80%
Trishna	:	Oil yield 77 kg/ha/harvest; geraniol 78-82%, suitable for north Indian plains
Tripta	:	Oil content 0.7-1.0%, dwarf, early maturing
Vaishnavi	:	Oil yield 165 kg/ha/ harvest; geraniol 78-82%, self pollinating variety
Cim-Harsha	:	Herb yield 300 q / ha, oil yield 243.34 kg/ha; geraniol 89.5%

9. Cultivation calendar

Major activity	Month	Activity details
Nursery raising	April end - Mid May	Seeds mixed with sand in 1:10 ratio, sow in raised nursery bed in lines of 3 cm deep at 10 cm apart.
Land preparation	May - June	2-3 deep ploughing & harrowing
Manure and fertilizer application	May - June	Application of FYM 10 t/ha and fertilizers at 25 kg N, 50 kg P ₂ O ₅ and 40 kg K ₂ O/ha as basal dose

Major activity	Month	Activity details
Plantation	June - July	Planting / transplanting of healthy and established seedlings / slips of 4-6 weeks at a spacing of 30-60 × 30-60 cm
Irrigation	June - July	One irrigation immediately after transplanting and subsequent irrigations at 10-15 days interval should be given
Fertilizer application	June - July	Application of first top dressing nitrogen 25 kg/ha at one month after transplanting
Intercultural operations	August-September	Two weeding cum hoeing operations are recommended at 40 days after transplanting and another at 30-40 days after first weeding
First harvest	October - November	Harvest the plants at full blooming stage by cutting the clumps at 10-15 cm from the ground level
Intercultural operations	October - November	Weeding, hoeing and earthing up
Irrigation and fertilizer application	October - November	Irrigation should be given after harvesting. Application of second top dressing of nitrogen 25 kg/ha should be done after first harvest
Second harvest	February - March	Harvest the plants at full blooming stage by cutting the clumps at 10-15 cm from the ground level
Irrigation and fertilizer application	February - March	Irrigation should be given after harvesting. Application of third top dressing of nitrogen 25 kg/ha should be done after first harvest

Major activity	Month	Activity details
Third harvest	May - June	Harvest the plants at full blooming stage by cutting the clumps at 10-15 cm from the ground level
Irrigation and fertilizer application	May - June	Irrigation should be given after harvesting. Application of third top dressing of nitrogen 25 kg/ha should be done after first harvest
<p>Palmarosa is a perennial grass which can be harvested at 1-2 times during the first year and 3-4 times from second year onwards. As this crop can be maintained for 5-8 years, the above mentioned schedule starting from irrigation shall be followed for the remaining period with suitable alterations.</p>		



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