

# Nursery Techniques for Medicinal and Aromatic Plants: A Review

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## ABSTRACT

Medicinal and aromatic plants (MAPs) have been valued for centuries for their therapeutic properties and aromatic compounds. Medicinal and aromatic plants (MAPs) play a crucial role in various industries, including pharmaceuticals, cosmetics, and culinary arts, due to their bioactive compounds and aromatic properties. However, the sustainable cultivation of these plants relies heavily on efficient nursery techniques to ensure healthy seedlings and robust growth. This review provides a comprehensive overview of nursery techniques explicitly tailored for MAPs, encompassing propagation methods, substrate selection, environmental conditions, and management practices. The review highlights the importance of selecting appropriate propagation methods, such as seed germination, cutting, and tissue culture, depending on species requirements. Substrate selection plays a critical role in seedling growth and development, with considerations for soil type, organic matter content, and amendments. Environmental factors such as light, temperature, and humidity are discussed in relation to their impact on nursery success. Additionally, effective management practices, including disease and pest management, nutrient monitoring, and irrigation scheduling, are emphasized for maintaining nursery health and productivity. By synthesizing existing knowledge and recent advancements, this review paper aims to guide practitioners and researchers in optimizing nursery practices for the successful cultivation of medicinal and aromatic plants.

**Key Words :-** Medicinal and aromatic plants, nursery techniques, propagation, substrate, environmental conditions, management practices

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## INTRODUCTION

Medicinal and aromatic plants (MAPs) have been valued for centuries for their therapeutic properties and aromatic compounds. Medicinal and aromatic plants (MAPs) play a crucial role in various industries, including pharmaceuticals, cosmetics, and culinary arts, due to their bioactive compounds and aromatic properties. However, the sustainable cultivation of these plants relies heavily on efficient nursery techniques to ensure healthy seedlings and robust growth. Conservation of medicinal and aromatic plants (MAPs) through nurseries is one of the significant promotional schemes promoted by the National Medicinal Plant Board (NMPB) and

various state medicinal plant boards to supply quality planting materials. A nursery is a managed site designed to produce quality planting materials grown under favourable conditions until they are ready for planting. Several MAP species are in great demand for domestic consumption as well as for commercial use by the herbal industry. MAP resource pools were plethoric in forests, but forest areas are destroying fast due to anthropogenic pressure. Accordingly, the elective way to create increasingly crude materials could be just through the development of restorative plants in farming fields. The importance of the cultivation of

medicinal and aromatic plants is increasing steadily due to the side effects of chemical and artificial medicines that are creating awareness among people worldwide. Conservation and improvement of threatened/endangered/ endemic species of medicinal and aromatic plants is becoming very important (Devi *et al.*, 2017). Nursery techniques enable efficient propagation of MAPs, allowing growers to produce large quantities of plants from seeds, cuttings, or other vegetative materials. This ensures a consistent and reliable supply of plant material for cultivation. Through nursery techniques such as seed banking and tissue culture, genetic diversity within MAP species can be preserved. This is crucial for maintaining the resilience of plant populations against environmental stressors and diseases. Nurseries provide controlled environments where optimal growing conditions can be maintained, leading to the production of high-quality plant stock. This is essential for ensuring that MAPs meet desired standards for medicinal or aromatic properties. Nursery techniques facilitate the selection and propagation of superior plant varieties with desirable traits such as high yield, disease resistance, or enhanced medicinal potency. This contributes to the continuous improvement of MAP cultivars.

## **METHODS OF PROPAGATION IN MEDICINAL AND AROMATIC PLANTS**

Two main propagation/production methods are used in medicinal and aromatic plants: "generative or sexual" and "vegetative or asexual" (Baydar, 2009; Schippmann *et al.*, 2006). In addition, "micropropagation" is also carried out using plant tissue and cell culture techniques (Sidhu, 2020).

### **Generative Propagation**

In generative propagation, the propagation material is the seed. Propagation by seed is both an economical and practical method. However, it also has some handicaps. Some plants produce very little seeds, while others produce no seeds at all. On the other hand, in some seeds, the germination rate is very low due to dormancy. Many medicinal and aromatic plants can be propagated by seed,

which is the generative propagation material. In particular, the propagation of annual and biennial herbaceous medicinal and aromatic plants is carried out by seeds. There are two different applications for propagation by seeds (Shaw *et al.*, 2020)

- 1- Sowing seeds directly into the field, which is the production area.
- 2- Obtaining seedlings before seeds and planting these seedlings in the production area.

Large seeds without germination problems can be planted directly in the field. In medicinal and aromatic plants, the sowing norm, sowing time, sowing method, seed quantity, sowing frequency and sowing depth vary greatly according to the plant type (Namdeo, 2018). Some information on the production of various medicinal and aromatic plants grown and propagated by seed and seedlings is summarized in Table 2 (Özgüven and Kirici, 1999; Gesch, 2013; Baydar, 2019; Boztas and Bayram, 2021; Sari, 2019; Ayran and Kan, 2022).

### **Seed Propagation:**

**Seed Collection and Storage:** Seeds are collected from mature plants during the appropriate season and stored under controlled conditions to maintain viability.

**Seed Pretreatment Techniques:** Some MAP seeds require pretreatment methods such as scarification, stratification, or soaking to enhance germination rates.

**Seed Sowing and Germination:** Seeds are sown in seed trays, pots, or directly in the field under optimal environmental conditions to promote germination and seedling establishment.

**Sowing seeds in the nursery:** The first factor to be considered when sowing seeds in the nursery is the setting of the sowing time. If the seed to be sown has a germination barrier, this barrier is removed by various methods. Sowing should be done a few months before the time of planting the seedlings in the field. After the seeds are placed in the seedling soil homogeneously, a few inches of burnt barn manure or peat is sprinkled on it and the soil surface is pressed with a suitable tool (cylinder).

Work to be done during seedling development after planting (<http://eagri.org/eagri50/AGRO101/lec11.pdf>):

- 1- Regular irrigation,
- 2- Weed control,
- 3- Struggle with diseases and pests,
- 4- Seedlings that do not develop well should be removed.

### **Vegetative Propagation**

Plant cuttings for reproduction should be prepared approximately 7.5-15 cm long (Chauhan *et al.*, 2021). Different applications can be made to accelerate rooting in prepared cuttings (Baydar, 2009). Treating shoot cuttings with hormones increasing the temperature in the rooting medium increasing the carbon dioxide level in the environment increasing the C/N ratio in shoots preferring semi-woody and soft shoots removing buds on shoots. IBA and NAA are used to accelerate rooting. It is subjected to hormone application at different concentrations according to the type, variety, morphological structure and physiological characteristics of the shoot cutting to be rooted.

**Cutting Propagation:** Stem, leaf, or root cuttings are taken from parent plants and treated with rooting hormones before being planted in a suitable substrate to develop roots and establish new plants.

**Division:** Rhizomes, tubers, or bulbs of MAPs that produce clumps or clusters are divided into sections, each containing viable buds or growth points, and replanted to produce new plants.

**Layering:** Branches or stems of certain MAPs are bent or buried in the soil while still attached to the parent plant, encouraging the development of roots at the point of contact with the soil.

### **Micropropagation**

Micropropagation is the process of vegetative reproduction from plant tissues or seeds (Sidhu, 2010). Secondary metabolite sources from some medicinal and aromatic plants with economic and industrial value are produced by tissue and cell culture techniques under controlled conditions as an alternative way to traditional agricultural

activities. In this method, the part called explant (a single cell, embryo, meristem, callus, anther, etc.) taken from various parts of the plant is sterilized and cultured in a sterile and closed nutrient medium at appropriate light and temperature (Özkaynak and Samanci, 2005; Sidhu, 2010). The most important thing to be considered in tissue cultures is sterilization. The success of tissue culture largely depends on it.

In micropropagation, propagation is made by using shoot tip, bud and node cultures. In the micropropagation method:

- 1- Sterilization of explant/plant material
- 2- Planting the explant into the starting medium
- 3- Sprout reproduction
- 4- Rooting
- 5- *In vitro* plants have adapted to the external environment = acclimatization stages (Kocaçaliskan, 2017).

### **Nursery Design and Infrastructure for Medicinal and Aromatic Plants Cultivation**

Designing an appropriate nursery and setting up the necessary infrastructure is critical for the successful cultivation of medicinal and aromatic plants (MAPs). Key considerations for nursery design and infrastructure:

**Site Selection:** Choose a site with suitable soil conditions, adequate sunlight exposure, and good drainage. Proximity to a water source for irrigation is important. Consider environmental factors such as prevailing winds and microclimates that may affect plant growth.

**Nursery Layout:** Plan the layout to maximize space utilization and efficiency in plant handling and management. Allocate separate areas for different nursery activities such as propagation, seedling raising, and plant acclimatization. Ensure easy access for workers and equipment to minimize labour and transportation costs.

**Shade Structures:** Install shade structures such as shade netting or greenhouse tunnels to provide optimal light levels and protect young plants from excessive sunlight. Shade structures should be

adjustable to regulate light intensity and create suitable microclimates for different plant species.

**Irrigation Systems:** Implement efficient irrigation systems such as drip irrigation or sprinklers to deliver water directly to plants' root zones while minimizing water wastage. Consider water quality and filtration systems to prevent irrigation equipment clogging and ensure consistent water supply.

**Pest and Disease Management Infrastructure:** Set up measures to prevent and control pests and diseases, such as installing screens or nets to exclude insects and using biological control agents. Designate quarantine areas for inspecting incoming plant material to prevent the introduction of pests and diseases into the nursery.

**Management Practices:**

Effective management practices are essential for maintaining nursery health and productivity. Disease and pest management strategies such as sanitation, biocontrol agents, and integrated pest management (IPM) approaches are crucial for preventing outbreaks and minimizing crop losses. Furthermore, regular monitoring of nutrient levels, irrigation schedules, and growth parameters allows growers to adjust management practices accordingly and optimize plant health.

**Crop Rotation and Companion Planting:** Practice crop rotation to prevent soil depletion and reduce the buildup of pests and diseases. Use companion planting techniques to enhance biodiversity, repel pests, and improve soil health. For example, planting aromatic herbs like marigolds or basil alongside MAPs can deter pests and attract beneficial insects.

**Irrigation Management:** Implement efficient irrigation systems to provide consistent moisture to MAPs while avoiding waterlogging or drought stress. Monitor soil moisture levels regularly and adjust irrigation schedules based on plant requirements and weather conditions.

**Nutrient Management:** Conduct soil tests to assess nutrient levels and pH, and apply organic amendments or balanced fertilizers as needed to

maintain soil fertility. Use compost, organic mulches, or cover crops to improve soil structure, retain moisture, and enhance nutrient cycling.

**Weed Control:** To control weeds in MAP fields and nurseries, employ mechanical methods such as hoeing or hand weeding. Mulching with organic materials can suppress weed growth while conserving soil moisture and regulating soil temperature.

**Pruning and Training:** Prune MAP plants to promote bushier growth, increase airflow, and enhance light penetration, which can improve plant vigor and yield. Train climbing or vining MAPs onto trellises or supports to maximize space utilization and facilitate harvesting.

**Disease and Pest Management:** Monitor MAP crops regularly for signs of pests and diseases, and take prompt action to control outbreaks using integrated pest management (IPM) strategies. Utilize cultural practices such as crop rotation, sanitation, and the use of resistant varieties to minimize pest and disease pressure.

**Harvesting and Post-Harvest Handling:** Time harvests coincide with peak levels of active compounds in MAP plants, which vary depending on species and plant parts. Handle harvested material carefully to minimize damage and degradation of quality, and employ appropriate drying, processing, and storage techniques to maintain potency and shelf life.

**Record Keeping and Monitoring:** Maintain detailed records of cultivation practices, including planting dates, crop rotations, pest and disease management activities, and harvest yields. Regularly monitor plant health, growth, and environmental conditions to identify issues early and make informed management decisions.

**Environmental Conditions:**

Environmental factors, including light, temperature, humidity, and air circulation, play critical roles in nursery management. Controlled environment nurseries equipped with climate control systems enable growers to manipulate these factors to mimic optimal growing conditions

for specific MAP species. Additionally, shading structures and misting systems are utilized to mitigate stress and promote uniform growth, particularly during the critical establishment phase. Also Depending on climatic conditions, consider installing environmental control systems such as heaters, fans, and evaporative cooling systems to maintain optimal temperature and humidity levels. Use shade and ventilation systems to regulate temperature and airflow within the nursery.

**Here are a few case studies showcasing successful nursery establishment for medicinal and aromatic plants (MAPs):**

**1. Medicinal Plant Propagation Center, Kerala, India:**

Recognizing the rich biodiversity of medicinal plants in Kerala, India, a nonprofit organization established a propagation centre to conserve and propagate endangered medicinal plant species. The propagation centre focused on collecting seeds and vegetative materials from wild populations of endangered medicinal plants and propagating them through seed germination and tissue culture techniques. The centre collaborated with local communities and government agencies to identify priority species for conservation and propagation. It also conducted training programs on sustainable harvesting and cultivation practices for local farmers and herbal practitioners.

**Outcome:** The medicinal plant propagation centre successfully propagated several endangered medicinal plant species, contributing to their conservation and sustainable utilization. It also facilitated the establishment of community-based nurseries for medicinal plant cultivation, providing economic opportunities for local communities while promoting biodiversity conservation.

**2. Organic Herb Nursery, California, USA:**

An organic herb farm in California recognized the need for locally adapted, organic herb seedlings to support sustainable agriculture in the region. The farm established an organic herb nursery focusing on diverse culinary and medicinal herbs, including basil, thyme, and sage. The nursery implemented organic growing practices, utilizing compost-based

potting mixes and natural pest control methods. It also offered educational workshops on herb cultivation and sustainable gardening practices.

**Outcome:** The organic herb nursery gained popularity among local farmers, gardeners, and chefs seeking high-quality, organically grown herb seedlings. Its commitment to sustainability and education contributed to community engagement and awareness of organic farming practices.

**CONCLUSION**

The present paper discusses the development of a participatory approach to promote medicinal and aromatic plant (MAP) cultivation as a tool for biodiversity conservation and livelihood enhancement. Medicinal and aromatic plants (MAPs) are gaining popularity globally as a source of raw materials for pharmaceuticals and traditional healthcare systems. Therefore, approaches for cultivation, sustainable harvesting, and protection against existing threats should be developed for the conservation of MAPs and livelihood enhancement of local communities in the Indian region. Nursery techniques tailored for medicinal and aromatic plants are fundamental for ensuring the availability of healthy planting material and facilitating sustainable cultivation practices. This review highlights the importance of adopting appropriate propagation methods, substrate selection, environmental controls, and management practices to maximize the success of MAP nurseries. Future research endeavours should focus on developing innovative techniques and technologies to address emerging challenges and enhance the efficiency and sustainability of MAP cultivation. These case studies demonstrate the diverse approaches to establishing successful nurseries for MAPs, emphasizing the importance of tailored propagation techniques, sustainable practices, and community engagement in achieving positive outcomes for both conservation and economic development.

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