

## Chapter 1 Production of seedlings in nurseries

### 1. Concept of a nursery

The nursery industry is a growing sector that produces billions of plants each year, contributing significantly to forestry, horticulture, landscaping and floriculture. Given the continuous demand for plants, nurseries remain essential. Nurseries of various sizes and types can be found worldwide, and their success hinges on effective management to ensure sustainability and profitability.

#### A. Types of Nurseries

Nurseries that attempt to cover all activities often fail; therefore, new nurseries should define their scope of work according to their capabilities and experience. Nurseries can be classified by **ownership** into:

- **Public nurseries:** managed by governments, associations, or environmental organizations.
- **Private nurseries:** may be sole proprietorships, small partnerships, or companies with independent legal status.

Nurseries can also be classified by:

- Type of plants produced (native plants, ornamental plants, seedlings, bonsai, bulbs, etc.).
- Production method (in the ground or in containers).
- Size of plants produced (small seedlings, small containers, mature plants).

**However, the main types of nurseries are:**

- **Production Nurseries** Also known as propagation or wholesale nurseries, these specialize in producing and selling plants to retail nurseries, landscaping companies, or municipalities. Their success depends on:
  - Innovation: Introducing new varieties or modern production methods.
  - Specialization: Producing a limited number of varieties in large quantities to increase efficiency.
  - Market understanding: Anticipating demand and providing the required plants in a timely manner.
- **Growing-on Nurseries** These nurseries purchase small seedlings from production nurseries, then transplant them into larger containers and care for them for a period to

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increase their value. The primary focus is producing high-quality plants ready for sale, in terms of:

- Healthy and vigorous growth
- Cleanliness of the container and its freedom from weeds
- Appropriate labeling and supports when needed
- **Retail Nurseries** These nurseries purchase plants from production or growing nurseries and sell them directly to the consumer. Products include:
  - Seedlings, bulbs, potted plants, and bare-root plants
  - In addition to garden supplies such as pots, fertilizers, soil, and pesticides

### B. What to Grow

Plant selection is one of the most important factors in the success of a nursery. Some nursery managers focus more on their love of plants than on market demand, which is a mistake. Growing plants that are not in demand leads to losses, regardless of their quality. Therefore, decisions should be based on commercial demand rather than personal preference. The characteristics of the plants must also be taken into account, such as:

- The space they need (climbing or creeping plants require more space than slender trees).
- Growth rate (fast-growing plants must be sold quickly, while slow-growing plants can be kept for longer).
- The possibility of repotting into larger containers when necessary.
- The most important categories of plants produced in nurseries are:
  - Trees and shrubs (native or exotic, fruit-bearing or ornamental, climbing or ground cover).
  - Seasonal flowers and greens.
  - Ornamental plants grown in containers.
  - Foliage and indoor plants, including houseplants, hanging baskets, palms and ferns.
  - Medicinal and aromatic herbs.
  - Perennials and traditional garden plants.
  - Bulbs and tubers.
  - Aquatic plants.
  - Bonsai.

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### **2. Methods of plant production,**

Plant propagation methods form an important foundation in horticulture and plant production. They are used to increase the number of plants, preserve genetic traits and improve production. The main types of method are sexual and asexual (vegetative), and the most appropriate method depends on the plant species, production objective and available environmental conditions.

#### ⇔ **Firstly, sexual methods of producing plants.**

These methods rely on producing plants from seeds resulting from pollination and fertilisation. This method leads to genetic diversity among the resulting plants, which is important for plant breeding programmes and developing new varieties.

It is characterised by its low cost and ease of application; however, the resulting plants may take longer to reach the flowering or fruiting stage, and may not be completely identical to the parent plant in terms of characteristics.

#### ⇔ **Second: asexual (vegetative) methods of plant production.**

Asexual methods involve propagating plants without pollination or fertilisation. New plants are produced from vegetative parts, such as stems, roots or leaves. These methods produce genetically identical plants to the parent plant and are widely used in commercial nurseries to preserve desirable traits and accelerate production.

##### **a. Propagation by cuttings**

This method involves placing parts of the plant, such as stem, leaf or root cuttings, in a suitable medium to encourage root formation. It is one of the most widely used propagation methods due to its simplicity and low cost, and is employed for ornamental, fruit, and shade plants.

##### **b. Layering**

Layering involves bending a branch of the parent plant and partially burying it in the soil until roots form. The branch is then separated to become an independent plant. This method is used with plants that are difficult to propagate by cuttings, such as some trees and shrubs.

##### **c. Propagation by grafting**

This method involves attaching a plant part, known as the scion, to another plant, known as the rootstock. The aim is to combine the desirable traits of both parts, such as disease resistance

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and growth strength. Grafting is widely used with fruit trees to improve both production and fruit quality.

### **d. Propagation by budding**

Budding is a special type of grafting where a single bud from the desired plant is inserted under the bark of the rootstock. This method is economical in terms of plant material and produces quick results with many horticultural plants.

### **e. Propagation by division**

This method involves dividing the parent plant into several parts, each of which contains roots and buds capable of growth. It is often used with perennial and herbaceous plants, and is quick and simple.

### **f. Propagation by tissue culture (micropropagation)**

Micropropagation is one of the newest asexual methods. It produces large numbers of plants from very small parts in a laboratory under sterile conditions. It is used to produce disease-free plants quickly, but requires advanced techniques and is expensive.

## **3. Techniques for producing clumps**

The production of clumps is an important method of asexual propagation, used to produce genetically identical plants from strong parent plants. These techniques rely on plant parts that produce closely related groups of plants, such as side shoots, side buds, bulbs, corms or root crowns.

### **3.1. Division**

This involves separating a plant cluster, or more than one part of a mature plant, into several parts so that each part has roots and shoots that can grow as an independent plant. This method is often used with perennial and herbaceous plants that form a large mass over time. Division is usually carried out when the plant is dormant or before the growing season begins, to ensure successful planting. Examples: **Crowns:** Sansevieria, iris and daylilies can be divided into more than one crown. **Perennials:** It is advisable to discard the centre of the clump and use the stronger parts from the edges.

#### **A. Stolons and runners**

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Some plants produce horizontal stems on the soil surface, known as stolons or runners. These form new plants at the points where they touch the ground. These small plants, known as plantlets, can be separated once they have developed a root system, after which they can be planted in a new medium. Alternatively, they can be left to develop while still attached to the original plant, before being cut off later. Examples: Strawberry, Spider plant These are two common types of plant propagated in this way.

### **B. Offsets (basal shoots/seedlings)**

Some plants produce small seedlings or shoots around the base of the parent plant, known as offsets. These shoots can be separated once their roots have developed slightly and then planted independently. Examples: Date palm, Haworthia and Bromeliads, Cacti and succulents (many species produce offsets)

### **C. Separating bulbs and rhizomes**

Plants that produce bulbs or rhizomes can be divided into clumps that emerge next to the original plant at the end of the growing season. These clumps can be collected and replanted to increase the number of plants.

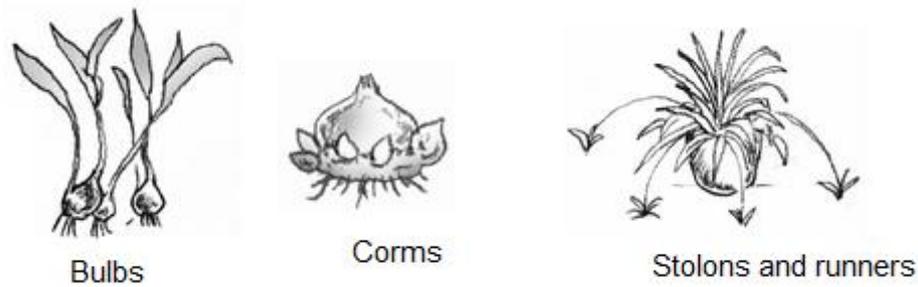
Bulbs such as tulips, daffodils, hyacinths and lilies produce new bulbs next to the original ones and should be separated every few years to improve flowering and plant quality.

Corms, such as those found in crocuses, gladioli and freesias, form small cormlets around the large corm and are separated after a period of growth.

### **D. tuber**

A tuber is a part of a plant's stem which stores food in the form of starch. If a tuber falls into the soil, it can grow into a new plant that is genetically identical to the original. This type of reproduction is common in plants such as potatoes, where tubers are used to quickly reproduce the plant and ensure the continuation of the species without the need for seeds. The importance of tuber propagation lies in its ability to produce genetically identical plants and to provide a means of survival in difficult environmental conditions.

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**Fig.1.** producing clumps wide Division.

### E. Tissue culture

This method is used to produce large quantities of plants in a short period of time, particularly when disease-free specimens are required. It is an advanced method used in specialised nurseries.

### 4. The growing medium

A growing medium is a material through which plant roots grow, extracting the water and nutrients necessary for growth. Selecting the appropriate medium is crucial for the management of nurseries and the cultivation of healthy plants, particularly in controlled environments such as containers or greenhouses.

#### A. Types of Growing Media

- ◆ **Soil-based media:** This contains natural soil as its main component.
- ◆ **Organic media (common in nurseries):** Based on organic materials such as peat, coconut coir and compost, with inorganic components added to improve its properties.

#### B. Functions and importance of the growing medium

A good growing medium performs four essential functions for plant growth:

- › **Physical support for the plant** It provides the root system with a place to grow and keeps the plant upright. It must be consistent and lightweight but strong enough to support the plant.
- › **Aeration** Roots need oxygen to breathe and grow. Air spaces in the medium allow for gas exchange (oxygen and carbon dioxide).

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- › **Water Retention** The medium must retain water so that the roots can absorb it. Small pores (micropores) absorb and retain water, while large pores aid in drainage.
- › **Nutrient Retention** Nutrients that are important to the plant are usually present in the medium or added to it later. The medium's ability to retain nutrient ions is called “cation exchange capacity” (CEC) and is an important indicator of medium quality.

### C. properties of the medium

#### › physical properties of the medium:

- ◆ **Water retention capacity:** The ability of the medium to retain the water needed by plants.
- ◆ **Porosity:** The balance between air and water within the medium.
- ◆ **Bulk density:** The weight of the medium per unit volume. it should be light and easy to handle, yet dense enough to support the plant.

#### › Chemical and biological properties:

- ◆ **PH:** Affects the availability of nutrients in the medium.
- ◆ **CEC (cation exchange capacity):** Reflects the medium's ability to retain and supply nutrients.
- ◆ **Biological aspect:** Some media may contain microbes that are either beneficial or harmful; therefore, the medium is sometimes treated to ensure it is free of pathogens.

### D. Common components of growing mediums:

#### › Organic medium:

- ◆ **Coconut coir:** It retains moisture well and allows for aeration. It is also organic and biodegradable.
- ◆ **Disadvantages:** It may contain salt or harmful substances if it is not washed thoroughly before use.
- ◆ **Expanded clay aggregate (LECA):** Relatively heavy; allows good water flow; reusable; does not retain much water.
- ◆ Peat moss has high water retention, but it is acidic and may promote disease if not treated.
- ◆ **Rice hulls:** Improves aeration and retains moisture, but works best when mixed with other media.
- ◆ **Pine bark:** Retains air and water, but can make the medium acidic and may float in certain systems.

#### › Inorganic media

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- ◆ **Mineral wool/rockwool:** A common hydroponic material, it retains moisture and allows for aeration. However, it is not biodegradable and may require pH adjustment.
- ◆ **Perlite:** It is lightweight and retains oxygen well, but it may wash out or float in water systems.
- ◆ **Vermiculite:** It absorbs water well and has the ability to exchange nutrients, but it may retain too much water.
- ◆ **Gravel and sand:** These old materials are used in agriculture and help with aeration, but they do not retain much water.
- ◆ **Lava rock and pumice:** They have good porosity and excellent aeration, but can be heavy.
- ◆ **Recycled glass stones (Growstones):** They have a porous surface and good aeration, but they can pull roots too tightly.

### 5. The container

In plant nurseries, containers are the pots or containers in which plants are grown and kept during their growth stages, before being transferred to the ground or a larger container. They are used to control the root environment and provide a suitable, balanced growing medium.

#### A. Types of containers used in nurseries

There are several types of container designed to suit different production needs:

##### a. High-density plastic containers:

- These are typically used for long-term cultivation within the nursery.
- They are strong and durable and can withstand different environments.
- They prevent rapid decomposition and support root growth for several seasons.

##### b. Fibre/cellulose containers

- These are suitable for short-term cultivation, temporary storage or transferring to another location after root growth.
- They decompose quickly, so are not used for long-term plant preservation.

##### c. Square or vertical-sided containers

- Their design helps prevent roots from circling inside the container.
- This encourages the roots to grow vertically rather than in circles, improving the quality of the plant after transplanting.

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### d. Containers with ventilation and drainage holes

- These allow excess water to drain away and provide good ventilation for the roots.
- They also reduce the risk of root rot caused by moisture build-up.

### B. The importance of choosing the right container

The type of container you choose is very important because it affects several aspects, including:

- ◆ **Root system:** If the container is too small or unsuitable, the roots may become twisted, which reduces the plant's ability to absorb water and nutrients after transplanting.
- ◆ **Planting duration:** Strong plastic containers are ideal for plants that will remain in the container long term. Lightweight containers, such as fibre containers, are only useful for short-term planting or transportation.
- ◆ **Water drainage and air availability:** Drainage holes are necessary to prevent water collecting around the roots, which weakens the plant.

### C. How to improve container performance

- ⇔ **The quality of containers and the growing environment can be improved by:** Choosing an appropriately sized container for the type of plant. It is also important to ensure there are adequate drainage holes. Use a good growing medium (substrate) that allows water to drain while retaining moisture.
- ⇔ **Model for using containers in commercial production:** In commercial nurseries, production can be entirely container-based, with the plant being grown in the container from start to finish. Alternatively, the plant can start in the ground and be transferred to a container later on to grow until the final sale or transport stage. The factors influencing the choice between these two methods include market size, plant type and expected production duration.

## 6. Cultivation practices

### A. Selecting and preparing the land

When selecting agricultural land for growing vegetables, it is important to consider that they require a large amount of water, so the necessary water for irrigation must be provided. Avoid sloping land as this causes soil erosion. Focus on the physical structure of the soil, which should be well-drained, loose and rich in organic matter. Then, clear the area of debris and weeds. Next, mark out specific planting lines. Make holes for the plant clusters and add primary fertilisers to them. Create parallel ridges to prevent soil erosion.

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### B. Buying seeds

There are three types of seeds available on the market: fixed hybrids and composites. The choice of seeds depends on various factors, such as market demand, production characteristics, shelf life, tolerance to climate and resistance to pests and diseases.

### C. Cultivation methods

- ◆ Direct sowing: Seeds are sown directly in their final location, with weak plants subsequently being thinned out.
- ◆ Nursery cultivation: Seedlings are grown in a protected environment before being transferred to the field.

### D. Planting and care

- › **Repiquage (transplanting)** We select the strongest plants from the nursery to transplant to the field. A hole is dug and the seedling is carefully placed so that the neck is level, then soil is added and pressed down around it. After planting, the seedlings are watered generously. This process is usually done during the cooler parts of the day to prevent stress.
- › **Irrigation:** Regular irrigation is important, especially during dry periods. Farmers choose the irrigation method according to their capabilities and the topography. Irrigation should be balanced (sometimes daily during critical growth periods).
- › Maintenance work:
  - ◆ **Binage:** Loosening the topsoil to break up the crust and reduce water evaporation.
  - ◆ **Sarclage:** Removing competing weeds.
  - ◆ **Buttage:** Replacing soil around the roots of plants as needed.

### E. Fertilisation

Fertilisation is recommended in two stages:

- › In the nursery: Add 0.5–1 kg of organic fertiliser or turkey manure per m<sup>2</sup> to the hills before planting.
- › In the field: Use organic fertiliser such as natural manure or compound fertiliser according to the needs of each crop. Liquid or foliar fertiliser can also be added to stimulate growth at specific stages.

### F. Crop protection (protection des cultures)

Pests and diseases include fungi, viruses and bacteria, nematodes, spiders and whiteflies. The most important methods of combating them are:

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- ◆ Preventive treatment with appropriate pesticides
- ◆ Use broad-spectrum pesticides weekly until the flowers open.
- ◆ Treatment of nematodes by treating the soil before planting.
- ◆ Cultural, biological, chemical or integrated control methods can be used, depending on the circumstances.
- ◆ The quantities and types recommended vary depending on the type of vegetable (e.g. tomatoes, peppers or onions) and are applied during the growth stages.

### **7. Controlling shoot growth and root growth**

The growth of plants' aerial parts (such as stems and leaves) and root systems is regulated by hormones called phytohormones (such as auxins, gibberellins and cytokinins). These hormones maintain a balance between the two to ensure harmonious development. This balance is important because the leaves transpire (lose water), while the roots absorb water from the soil. To reduce water stress and prevent wilting, the leaf surface area can be reduced at the time of planting by removing some leaves, which decreases water loss through evaporation and helps the plant to recover.

### **8. Transplanting seedlings**

There is no standard size for transplanting seedlings as this depends on factors such as the type of plant, soil conditions, the presence of pests and weeds, and the method of irrigation. Some seedlings may appear small, but if their roots are strong, they will thrive after transplanting. In fact, most flower seedlings grow well when transplanted while still small because root strength is more important than the size of the aerial part.

We determine whether seedlings are ready for planting by checking whether they can be easily pulled out of the cell without causing any damage. This indicates that they have grown sufficient roots without restriction. Some varieties are sensitive to root disturbance and require special care. Delicate seedlings, such as lysianthus, are removed using tools to avoid damage and protect the investment in them.

#### **a. Factors affecting seedling size**

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- › Pest and weed pressure: Larger seedlings are better able to withstand snail damage and competition for light and space.
- › Soil type and irrigation: Seedlings with strong roots and regular irrigation (such as drip irrigation or manual watering) are required for clay or poor soils and dry sands.

### **b. Preparing seedlings for planting**

It is important to acclimatise seedlings to outdoor conditions gradually before planting, in order to minimise transplant shock. This involves exposing them to sunlight, wind and gradual temperature changes to encourage the development of strong stems and leaves.

The timing of planting depends on the weather (avoid frost and fluctuating temperatures), the soil temperature (e.g.  $\geq 60^{\circ}\text{F}$  for heat-loving plants) and the presence of 'volunteer' plants sprouting in the field, which indicates readiness.

### **c. Soil preparation**

Test the soil first to understand its nutrient level and pH. Improve it with materials such as compost, humic acid, gypsum and balanced fertilisers to support good soil structure.

### **d. Practical planting steps**

Prepare the planting beds and cover the soil to kill weeds and equalise the temperature; then remove the cover before planting. Use systems such as drip irrigation to maintain uniform moisture levels. Water the seedlings before and after planting and plant during the coolest times of day to minimise heat shock.

### **e. Post-planting problems**

can be addressed by Various problems can occur after planting, such as yellowing leaves, wilting and damping off. These issues can be caused by incorrect watering, nutrient deficiencies or other factors, and can be resolved by adjusting watering, protecting seedlings or amending the soil.

## **9. Plant conservation**

Crop protection involves safeguarding plants against threats to their growth, quality and productivity, including pests (such as insects and weeds), fungal and bacterial diseases, and adverse environmental conditions like drought or frost.

### **a. The importance of crop protection**

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- ◆ Increased productivity: Protecting plants increases yields and ensures a healthy, high-quality harvest.
- ◆ Reduced losses: It reduces losses caused by diseases and pests that can destroy crops.
- ◆ Environmental protection: Choosing the right methods can reduce the excessive use of harmful pesticides.
- ◆ Cost reduction: Improves the use of resources such as water, land and labour.

### b. Essential elements for crop protection:

⇔ **Prevention before infection** Choose varieties that are resistant to pests and diseases. Apply good soil preparation, irrigation and maintenance techniques before planting. Example: Seed treatment: seeds are treated with substances that protect them from pests and diseases before they enter the soil. This increases their success rate of germination and growth.

#### ⇔ **Methods of crop protection**

- › **Mechanical and cultural protection** Good ploughing and soil loosening helps to remove debris that may harbour pests. Crop rotation: planting a different type of plant in the same soil each season to break the life cycle of some pests.
- › **Careful chemical protection** Use pesticides (insecticides, fungicides and herbicides) only when necessary, exercising caution and following technical guidelines to ensure effectiveness and minimise damage. These materials should only be used after monitoring the field and determining the actual presence of an infestation.
- › **Biological and alternative protection** Use of natural enemies

### **10. Plant production scheduling**

Seedling production involves preparing young plants (seedlings) in a nursery before transferring them to fields or orchards. The aim is to produce a sufficient number of healthy, strong seedlings of the right quality at the right time to meet the needs of the target crop.

The production of seedlings is organised by setting key dates for sowing, transplanting to larger containers or the nursery bed, and preparing for the final transfer to the field. Germination, feeding and transfer schedules are organised according to the plant's growth cycle, ensuring that the seedlings are ready for planting in the main field. During the growth period, seedlings are cared for through regular watering, weed control, providing necessary nutrients and preventing

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diseases and pests. This is all done within a specific schedule to enable weekly monitoring of development and recording of data, so that the production programme can be adjusted when necessary. This systematic approach achieves the following:

- reduction of losses
- strong, healthy seedlings arriving at the right time
- improved production quality
- effective management of resources such as labour, water, and planting beds