

2A: LANDSCAPE GARDENING

2.1 Definition, Objectives and Scope

Definition

- Landscape gardening is the branch of horticulture, which deals with the art and knowledge of plantation by arranging them in such a manner with the existing plants and structures to beautify a place and maintain natural scenery.
- On the other hand, landscape gardening may be defined as using plants outdoor and indoor to fulfil aesthetic and functional purposes.
- Landscaping is an activity in which beauty and function may be determined by the customer.
- To one person, landscaping may mean a couple of fruit trees just plants on the property. To another customer, plants in the landscape must not only be carefully selected but also strategically arranged.
- A beautiful home or an institution with the well landscaped ground increases the property's value and increases the property's usefulness. In addition, it is a source of pride in the community, visitors, and passers-by.

Objectives of Landscape Gardening

Specific objectives should be attained or keep in mind to beautify a home and institution effectively by landscaping.

- To enhance the aesthetic appeal of an area.
- To increase the property value and make your property more attractive.
- To secure attractive ground.
- To blend concrete and architectural creations into the natural scenery.
- To provide privacy by shielding the general public from selected areas. Such as the backgrounds of homes, utility substations, and patios.
- To hide bad conditions in the area. For example, plants can be used to create a wall ground.
- To modify environmental factors.
- To create recreational grounds to provide places for relaxation and community interaction.
- To provide hobby activities for homeowners.
- To improve and conserve natural resources by reducing soil erosion.
- To reduce noise and environmental pollution. For example, plants in the landscape can be used to absorb noise.
- Reduce the heating and cooling cost.
- Create a green buffer zone to increase liveability of our communities.
- Enhance the beauty of area and create the focal point.

Scope of Landscape Gardening

- Gardening which was only an art and science in the earlier days has now emerged as a huge industry
- With the importance and need of gardening in **improving and conserving the environment being strongly.**
- Landscape gardening has expanded as a multi faceted industry encompassing activities such as propagating and rearing ornamental plants, landscaping and production of growing media, pots, machinery and accessories.
- Landscape gardening generates the huge employment in perfume industry, cosmetic industry.
- Landscape garden provide a worker based jobs as **arborist, lawn care technician, irrigation specialist.**
- Landscape gardening develops **entrepreneurship** in nursery management, garden designing, protected cultivation of crop plants.
- Floriculture is the part of landscape gardening which can **generate the self employment** like garland making, gajara making, flower bouquet, flower designs in ceremonies.
- Landscaping creates recreational grounds to provide places for **relaxation and community interaction** and simultaneously promoting activities that would **improve the environment.**
- Proper landscaping of commercial garden, polyhouse and greenhouse generate the more income which gives **economic strength to us.**
- **Horticultural Therapist:** These people can be employed by hospitals, nursing homes, prisons, schools and rehabilitation centres.
- **Business of nursery raising** of fruit plants, ornamental plant, aromatic and medicinal plants and bonsai by the plant material using various techniques.
- **Expert systems, communication, sensor technology and internet services etc.** Have significant application and scope in landscape gardening.

TERRARIUM

Introduction

- Terrarium provide optimum growing condition for plants which like a humid atmosphere, since the moisture given off by the leaves of the plants inside condenses and run back into the soil.
- Any type of bottle or glass box is suitable in which provided plant can be passed through the neck of bottle.
- When a landscape or garden developed inside a bottle is known as terrarium or bottle garden.
- The oldest terrarium bottle garden in existence to have been planted in 1960 and to have remained sealed from 1972 to 2013.
- For this purpose any type of bottle can be used in which provided plants can be passed through the neck of bottle, to develop garden inside generally.
- A transparent white glass bottle is used to develop a bottle garden, because through transparent glass proper light will pass inside the bottle, so that plants planted in the bottle can do their functions normally.
- If a dark colour glass bottle is used to develop bottle garden, then you should keep bottle in bright light to carry out inside plants, their function of life cycle.

How it works

- The plants planted inside the bottle or glass box do not require frequent watering, as the moisture developed inside the glass container from the transpiration of inside plants again become available to the plants for their functions.
- This way by keeping the plants in enclosed containers, drought is excluded and high humidity can be maintained.



Selection of Plants for Terrarium

- Choice of plants for terrarium is very limited, those plants should be selected which do not require pruning and with slow growing habits.
- As it is difficult to prune and remove plants from the terrarium.
- Select those plants in terrarium which have slow growing and small sized habit.
- Planting of flowering plants is not a good idea because once the flowers fade, they can look very dull. It is best to create a colourful effect by using plants with variegated leaves and to build an interesting group with contrasts of shape and texture.
- Some plants for terrarium are suggested below:

Adiantum Raddianum - Maiden hair fern, *Fittonia Verschaffeltii*.

Fittonia Verschaffeltii - "Nana" little snakeskin plant.

Adiantum Hispidulum - Australian maiden hair fern.

Selaginella Krassiana, *Chamaedora sp.*, *Ficus*, *Begonia*, *Tradescantia*, *Peperomia*

Acorus Gramineous "Variegatus". etc.

Tools and Equipment for Terrarium

The following tools and equipments are required for bottle garden development:

- 1) Glass bottle
- 2) Funnel
- 3) Circular paper
- 4) Sphagnum moss
- 5) Clay pellets
- 6) Peat-based potting mixture
- 7) Miniature trowel
- 8) Charcoal
- 9) Spoon
- 10) Fork
- 11) Spool
- 12) Sponge

Climatic Conditions for Terrarium

- The terrarium requires warm-filtered sunlight.
- A warm room is one keep at temperature of 15- 21°C, the range preferred by many popular house plants, but all plants can tolerate a slightly higher or lower level for a short time. A normal heating system prevents temperature falling below 15°C.
- A room receiving filtered sunlight may face south-north although a tall building or leafy tree outside the window.
- This type of arrangement of climate is known as mini climate in which a terrarium is properly grown.

Planting of Terrarium

- To plant a landscape garden in a bottle or glass container, select such type slow growing plants with variegated leaves, which do not require pruning, as it is difficult to prune and remove plants from the bottle.
- When you are going to plant a terrarium follow the following principles after selecting a suitable bottle or glass container for gardening.
- Cut a circular of paper the same size as the planting area of the terrarium selected for gardening and experiment the design of garden, until you are happy with it. Place the taller plants at the back and the low-growing ones in the foreground.
- Pour a 3 cm layer of clay pellets into the bottle through a funnel made of stiff paper.
- Add a handful of charcoal, and fill the bottle 5-7 cm of damp peat-based potting mixture.
- Build up the potting mixture at the back and use the spoon to smooth out the surface.
- Make a hole for plantation of first plant. Take a big sized plant and stick the fork into the root ball and lower it into the hole to plant it in the media of terrarium.
- Cover the root ball with potting mixture and firm down the mixture around it.
- Put another plant at the back and then add a small plant on front side to vary the outline.
- Leave about 3cm distance between them to allow room for growth.
- Finally, decorate any bare area with sphagnum moss, and pour a cup of water.
- You can cork the bottle or container and your terrarium becomes ready to display in the house.

Irrigation of Terrarium

- After planting of the terrarium, moist the surface of the soil carefully without disturbing the plants and other structures.
- It can be done by mist spraying on the plants and potting mixture of bottle garden.
- Now cork the bottle.

- Further watering of terrarium may not be necessary because the vapors given by the plants of terrarium are re-circulated and the garden becomes self-maintaining for their irrigation.
- Plants have been known to flourish in the terrarium for several months without extra water added from the time of planting.
- If the mouth of a bottle is open, spray a small cup of water or less in every month.

After care of Terrarium

- Keep the terrarium out of direct sunlight, but make sure that it is receiving good indirect light.
- Terrarium also need to be cleaned on regular intervals to remove the condensation of algae from the inside surface of bottle to receive proper light for photosynthesis and respiration.
- It can be easily done using small sponge attached to a bamboo stalk.
- Dead leaves or flowers from the bottle garden should be removed by cutting them with a piece of razor blade wire.
- If these dead leaves will not be removed, that can bring fungus on rotting inside the bottle garden and this will harm the terrarium plants.

Functions

- The terrarium commonly used as a form of decoration.
- It is very useful in area with little space like apartments.
- The bottle garden used in schools for the study of miniature of ecosystem.
- Terrarium can be used for conservation of some species in dry area because it has a less water and easy to maintain.



HANGING GARDEN

Introduction

- Hanging garden refer to flowering or foliage plants trailing in baskets hanging on any support.
- Delicate, light weighted trailing or cascading plants are highly suitable for hanging garden.
- Hanging garden are ideal for indoors as well as outdoors.
- They can be displayed in verandas, the entrance of the house, balconies as well as in roof gardening.
- Hanging garden are good material for interior decoration of a wedding hall, party plot or restaurant to give a live look.
- Hanging gardens look quite aesthetic in conservatories also.
- Hanging gardens generates the income of greenhouse growers and it provides an new start up business for garden professionals.
- After Second World War the concept of hanging garden developed in European countries. But 3000 year ago Babylon hanging garden reported in Babylon empire which developed by the queen Semiranis.

Containers

A) Characteristics of the container

The characteristics of container used as basket for hanging garden are:

- Clean, attractive and easy to handle.
- Light in weight but durable.
- Easy to hang.
- Side openings for plantation in the pot are preferable.
- Should have a drainage hole.
- Should have hooks to hang on a stand.

B) Types of containers

- A wire basket with three or four hooks for hanging is a good container.
- Wooden basket made up of water resistant wood.
- Fiber or plastic baskets with attached dish at bottom for collection of drained water are also available. Earthen pots in form of hangings are heavier and hence not suitable.
- For indoor purposes baskets of brass, copper and ceramic or glazed pottery look very elegant.



Media

- In the container of hanging garden, an inner lining of a thin gunny cloth is made over which about 2-3 cm thick sphagnum moss is spread.
- A single layer of Sphagnum moss can also be spread in the container.
- Compost is made up of equal parts of coco-peat, leaf-mould, garden loam, sand and manure is filled in the container for growing of plants.
- Some water absorbing crystals can also be added in the media.

Plant Selection

A) Characteristics of plants for hanging basket

- Gentle and light in weight
- Fast growing or proliferating.
- Spreading type or trailing or cascading habit.
- If flowering than those having profuse flowering habit.
- Easy to propagate.

B) Foliage Plants

- *Pothos, Phillodendron, Fittonia, Maranta, Tradescantia, Sedum, Pilea, Ferns, Asparagus, Portulacarea, etc.*

C) Flowering Plants

- Annuals: *Portulaca, Petunia, Alyssum, Dwarf marigold, Daisy, Dimorphotheca, Cuphea, etc.*
- Perennials: *Begonia, Geranium, Chrysanthemum, Orchids, Verbena, Vinca rosea, Zinnia linearis, etc*

Preparation of Hanging Garden

- Initially, sphagnum moss is dipped in water for 3-4 hour and thereafter it is squeezed lightly and spread inside the container.
- Compost is added in the container. Small plantlets are inserted through the side hole or openings of the container.
- Thereafter, compost is again added to 3cm height of the container and the young plants are sown. Remaining compost is added leaving 2-3 cm space from the brim of the container and is made firm.
- The planted hanging garden is dipped in a tub of water and hanged outdoors to allow the excess water to drain off before putting it back indoors.



Watering

- There is need of frequent watering in hanging baskets to maintain their freshness and elegant look.
- The hanging garden is watered thoroughly with fine rose can. Water can be poured slowly from the top, allowing enough time for the water to soak.

- Simple thing is to touch the soil and check the moisture before watering.
- Avoid the over watering to prevent water logging condition.

After Care

- Once in month liquid manuring should be done.
- Organic fertilizers like neem cake, castor cake, vermi-compost should be incorporated in the media at an interval of 6 months.
- Liquid fertilizers of NPK and micro-nutrients can be applied in small quantity as soil drench and as foliar spray.
- 1-2 g of NPK mix (19: 19: 19) dissolved in 1 liter of water can also be used.
- Aeration should be maintained in the media by taken the shallow tilling.
- Dried and decayed foliage and flowers should be removed at frequent intervals.

Functions

- Primarily hanging garden has great decorative and aesthetic value.
- Hanging garden can used in the decoration of events, ceremonies and functions.
- Hanging garden on walls and balconies creates a focal point.
- Grow in very limited place; it can be hang on the roof of any type of infrastructure.
- Hanging garden provide a healthier environments which create serenity.

2.3 OUTDOOR GARDEN:

PREPARATION AND IMPORTANCE OF LAWN AND TERRACE GARDEN.

Outdoor garden is a planned plot of land adjoining an any infrastructure that is used for cultivating new plants, flowers and fruits in trees and other forms of nature.



Lawn: Preparation and Importance

Introduction

- A lawn is an area where grass is grown as a green carpet for a landscape.
- It serves to enhance the beauty of the garden, be it larger or smaller.
- Proper lawn maintenance plays a crucial part in any landscape design.
- A beautiful well maintained lawn can make the entire landscape look good, whereas a lawn that is not maintained can completely ruin its beauty.
- The position of the lawn largely depends upon the layout of the garden in relation to the house. In general lawn should be wide open with access to direct sunshine, especially in front of a rockery and a water pool.

Site and Soil

- For the preparation of lawn firstly choose the proper site.
- After choosing the site the next important factor for consideration is the size and shape of the lawn.

- The preparation of site includes digging, levelling and enriching the soil with organic manures or by amending with fertile soil.
- If the soil is very heavy, coarse sand may be added by removing subsoil to a depth of 20 cm.
- The ideal soil pH should be 5.0 to 5.6. If it is very acidic 500 g/m² lime should be added and alkaline soil gypsum of the same quantity may be added.
- Provision of drainage for excess rain water should be made if the ground is not sloppy.

Levelling

- The site should be thoroughly levelled with spade, pebbles and weeds are handpicked.
- The soil is rolled with a roller.
- Weeds especially nut grass should not be allowed to grow and should be removed with roots for at least 2 to 3 times.

Selection of Lawn Grass and Types

Sr. No.	Botanical Name	Common name	Texture	Situation
1	<i>Cynodon dactylon</i>	Hariyali (or) Arugu (or) Doob grass	Medium fine	Suitable for open sunny location; drought resistant
2	<i>Stenotaphrum secundatum</i>	Buffalo grass	Coarse texture	Suitable for shady situation; requires frequent watering
3	<i>Sporobolus tremulus</i>	Chain grass (or) Upparugu	Fine	Suitable for saline soils and open sunny locations
4	<i>Poa annua</i>	Annual blue grass	Medium fine	Suitable for acid soils and suitable for higher elevations
5	<i>Pennisetum clandestinum</i>	Kikuyu grass	Rough	Grow well in acids soils, suitable for higher elevations.
6	<i>Zoisia japonica</i>	Japan grass	Coarse	Suitable for poor sandy soil; open sunny situation, slow in growth

7	<i>Z. matrella</i>	Manila grass	Medium	Suitable for open sunny situation
8	<i>Z. tenuifolia</i>	Korean grass or velvet grass or carpet grass	Fine	Suitable for open sunny situation
9	<i>Cynodon</i> sp.	Bermuda grass (or) Hyderabad grass	Fine	Suitable for open sunny situation, needs mowing
10	<i>Cynodon</i> sp.	Dwarf Bermuda	Medium	Suitable for open sunny situation
11	<i>Festuca</i> sp.	Fescue grass	Coarse	Shade tolerant, survive on inferior soils
12	<i>Paspalum vaginatum</i>	Paspalum grass	Medium	Suitable for open sunny situation

Methods of lawn making

1. Seeding

- The most popular grass suitable for seeding is "Doob" grass (*Cynodon dactylon*).
- It has the fast spreading mat forming habit, radially forms roots at the nodes, the foliage is dark green, narrow with parallel veins.
- A lawn from seed is thought of only when grass roots are not available.
- About 30 kg of seed is required for planting one hectare.
- The soil should be reduced to fine tilth and given a light rolling.
- The site should be divided into suitable small squares or rectangles, the seeds are mixed with double the quantity of finely sieved soil and should be sown in selected squares, rolled again and watered liberally with rose can.
- The seeds take four to five weeks for germination.
- Care should be taken not to flood the site.
- For the first few times, the grasses are cut with a scythe. Lawn mower may be used for easy maintenance and for its spreading.

2. Turfing

- The turfs are nothing but pieces of earth with compact grasses on them.
- These turfs should be cut uniformly in squares from a place where the grass is short, compact and free from weeds.

- These turfs should be placed on the prepared ground site, side by side and beaten down flat with a turf beater.
- The cavities in between should be filled with fine soil.
- The entire turfed area should be rolled and watered liberally.
- This is the most expensive way of lawn making.

3. Turf plastering

- The doob grass can be procured in large quantities free from weeds and chopped properly into small bits of 5-7 cm long.
- Two baskets of chopped grass pieces should be mixed well with one basket each of garden soil and fresh cow dung and a shovel full of wood ash with required quantity of water to form a thick pasty substance.
- This mixture is then spread uniformly on the surface of a previously wetted perfectly levelled ground to a thickness of at least 2.5cm and watering should be done with a rose can.
- The next day ground should be rolled and the grass should be allowed to spread.
- The grass will shoot up in a fortnight.
- To start cut with a scythe and after three months, use the lawn mower.

4. Dibbling roots

- This is the cheapest but time consuming method.
- Small pieces of grass roots should be dibbled 10 – 15 cm apart in a levelled ground when it is wet after rain.
- The roots spread and grow underground in the course of six months making a fairly compact lawn by frequent mowing, rolling and watering.

5. Astro Turf

- It is a synthetic lawn popularly used in developed countries in roof gardens as well as in play grounds.
- It dispenses the normal maintenance usually required for normal lawns.
- Constant sprinkling of water is one of the prime requisite to bind the synthetic fibre to provide a surface akin to a lawn carpet.





Bermuda grass



Paspalum vaginatum

After Care

- It includes rolling, mowing, watering and restoration of patchy places, which should be done regularly.
- Fertilizing the lawn thrice a year is adequate to maintain rich greenness. Application of urea or ammonium sulphate at the rate of 1 kg / 50 sq. m during February - March, June - July and October - November is quite beneficial. At times well decomposed compost at 10 kg / 10 sq. m area will be sufficient as top dressing.
- Weeds should be removed as soon as they appear, otherwise they spread, seed multiply and overpower the grass. Fill the gaps with grass roots and fine soil. In the absence of rain, watering is done regularly at weekly intervals.
- A mower should not be employed until a firm green sward has been formed. The grass is first cut with sickle and the surface is then rolled. Heavy roller should be used frequently but not when the ground is either too wet or dry.
- Mowing should be done at brief intervals and never allow to produce seed stalks.
- Avoid cutting the grass too short as this can damage the grass, inhibit a deeper root system from setting up and give rise to weeds.
- Different grasses have different heights at which they can grow best, so make sure you enquire about this from the vendor or your landscaping company.
- The ideal height of most grasses is 3 to 4 inches. Removing more than one-third of the grass leaf in a single cutting is not recommended.
- Mow only on dry grass and not when the grass is wet. Make sure you mower's blade is a new and sharp before starting a fresh moving session. To ensure smoothness make sure you change the mower's oil once or twice during mowing season.
- Once in a year rake the lawn before rain and top dress with rich mixture of decomposed manure and soil. This will accelerate the grass with new vigorous growth.
- The best time to water the lawn would be during the early hours of morning. Watering during this time will allow the water to reach the roots without evaporating. Mid afternoons may lead to water getting evaporated soon and

watering at night times can give rise to the possibilities of diseases. While watering, care should be taken to spread the water homogeneously across the lawn without over flooding or missing certain areas/spots. If the lawn is placed on heavy slopes make sure that the water does not run-off. Several applications of water would be necessary for such surfaces to ensure adequate penetration.

Plants suitable for planting in lawns as single specimen

A spacious lawn though beautiful will often be monotonous. So, to break the monotony, some beautiful tree or shrub is recommended as single specimen in the lawn.

Trees

1. *Amherstia nobilis*
2. *Callistemon lanceolatus*
3. *Magnolia grandiflora*
4. *Cupressus macrocarpa*
5. *Pinus longifolia*
6. *Thuja orientalis*
7. *Araucaria excelsa*

Shrubs and creepers

1. *Agave americana*
2. *Furcraea gigantea*
3. *Musa superba*
4. *Bougainvillea spectabilis*
5. *Cestrum nocturnum*
6. *Dombeya spectabilis*
7. *Hibiscus species*

Problems in Lawn

Problem	Symptoms	Control
Chlorosis	Grass turns yellow with the deficiency of magnesium and iron	Iron: Spray Ferrous sulphate 25 g dissolved in 10 litres of water per 100 sq. metre.
		Magnesium: Spray Magnesium sulphate 100 g in 10 litres of water per 100 sq. metre.
Dog urine	Dead grass in the lawn	Re-plant grass in a circular manner

Fertilizer burn	Grass browns especially in hot weather	Drench the lawn in injured areas to leach excess fertilizers deep into the soil.
Improper mowing	Lawns cut too closely turn yellowish and often look diseased or dried	Mow enough to remove not more than 1/3rd height of the grass at a time. Keep mower blades sharp.
Improper watering	Light sprinkling encourages shallow roots. Over watering causes diseases	Water the lawn to wet the soil about 10 to 15 cm depth.

Plant Protection

Pest	Symptoms	Control
Leafhoppers	Suck the juice from grass blades causing stripped white, then yellow and finally brown leaves.	Spray Dimethoate 2 ml/l
Nematodes	Affect the roots, lawn takes a bleached out appearance	Apply Furadan 40 g /sq.m

Importance of Lawn

Lawns are help to create a serene and beautiful landscape, lawn grass provides a great deal more than a lush outdoor carpet for your property. Believe it or not, lawn is North America's largest agricultural crop. Because it is so common place in the landscape, it is easy to overlook the many benefits of lawn. Here are some reasons why lawn is so important:

- **Business and economic improvement** -Lawns increase the value of a property by 15 to 20 per cent. They improve curb appeal. Real estate agents will tell you that homes with well-maintained landscapes and lawn sell quicker and for higher values. Property managers say that well-maintained landscapes increase tenant satisfaction and lower vacancy rates.
- **Climate control** - Lawn serves as a natural air-conditioner. On a hot day, compare the difference between standing on pavement and standing on lawn. The difference in temperature and comfort is measurable. The lawn on eight average-sized healthy front lawns has the cooling effect of 70 tons of air conditioning, enough for 16 average homes.
- **Dust filter** - Lawn traps dust and smoke particles from the air and acts as a filter for the air we breathe. This is particularly important in urban areas where dust

generated by cars and trucks can be trapped and washed down into the soil, preventing further movement.

- **Erosion control** - Grass offers a very efficient and inexpensive erosion control function. Lawn intercepts raindrops before they disturb the soil. Lawn promotes water percolation rather than runoff. Our streams and drainage infrastructure would be absolutely overwhelmed if not for lawn's water-retention capabilities. Our fertile soil would be lost if the lawn biomass was not so efficient at slowing water runoff.
- **Golf courses** - Millions of people play golf for exercise and relaxation. Lawn is an integral part of this enjoyable activity.
- **Environmental benefits** - Grass plants capture and use greenhouse gases, thereby counteracting climate change. Lawn also traps air pollution and generates much of the oxygen we breathe. A 50 x 50 feet lawn produces enough oxygen for a family of four to breathe for one year. Lawn also acts as a barrier that deters chemicals from entering the soil profile.
- **Injury reducer** - Well-maintained lawn areas serve as excellent sports surfaces. Lawn helps to absorb physical impact and reduce injuries. As a playing surface it is safer than artificial grass or bare soil. It provides traction and cushioning.
- **Garbage prevention** - Garbage is less likely to be thrown on a landscape that is well maintained.
- **Therapeutic benefits** - Gardens (including lawn) provide mental health benefits. The Horticultural Therapy Association exists to promote therapeutic benefits of green space as a technique for rehabilitation. No wonder so many people use landscape pictures as screen savers on computers. It has been shown that looking at images of landscapes and plants helps to reduce stress. Grassy areas in golf courses, cemeteries, parks and homes can create feelings of peacefulness and remind us that the earth is alive.
- **Noise reducer** - Grassy areas can decrease noise by eight to 10 decibels. This is especially important in an urban location.
- **Water filter** - Research over the last ten years has demonstrated that storm water runoff from a healthy lawn rarely occurs. Not only does grass slow down water and soil runoff, but it also protects surface water quality as it filters and cleans the water percolating into streams, drainage systems and aquifers.

TERRACE GARDEN

Introduction

- Gardening is the best hobby that relieves us from stress; it also gives good body exercise. But in this tight concrete jungle where do we get a place for gardening?
- City life gives us all the necessities we need for an easy living, so people are getting attracted to cities. Cities are crowded with all concrete buildings, cement roads, multiplexes etc. with full of pollution.
- It's hard to plant a tree around our house, trees and plants give fresh air, make our body and mind refresh.
- Going to a park or out of the city for fresh air is very tough in our busy schedules.
- So just think of our own garden, which gives you an amazing, beautiful garden with full greenery and beautiful flowers giving you fresh air, along with body exercise and a handful of fresh organic vegetables and fruits.
- We construct our house in less place, we cannot get enough place for gardening. So, what can we do to have our own garden, terrace gardening is a best solution.
- Terrace gardening could be a great idea. The terrace is the place where we get good air, sun, and water. So, lets the plants on our terrace, terrace gardening is not very expensive.
- Everyone in the family can spend some quality time in spending in our own garden may refresh mind and body.
- Terrace gardening gives amazing experience in gardening along with some hand grown fruits, vegetable with amazing sitting experience with fresh air.
- Apart from this, terrace gardening will protect our building from absorbing heat. Terrace gardens are very easy to maintain, we can grow all types of vegetables/fruits.
- Just need to some leisure time to take of plants, gardening gives you good body exercise that reduces our stress and increases the blood flow in the body.



Requirements for Terrace Gardening

Terrace garden is not very expensive, all required material getting in nurseries along with plants or seeds, containers, growing beds, pots, gardening equipment's, gardening soil or potting soil and organic manures, etc.

- **Dedication:** The basic key for terrace gardening is dedication. How much time spend to taking care of plants, gardening doesn't need hours of work, spend a minimum 1 hour a day to take care of plants. Plants need proper care.
- **Designing Idea for Terrace Gardening:** Prepare some simple design layout for combining container gardening, vertical gardening, raised bed gardening, and hanging containers and wall-mounted containers in a compact roof to utilize space efficiently.
- **Prepare the Roof for Terrace Gardening:** Prepare the roof for terrace gardening, waterproofing and draining system are main elements that you should take care of. Waterproofing can be done by covering the gardening area with a tarpaulin sheet or many professionals are available who do waterproofing of terrace. Check the strength of the terrace, if your roof can hold the weight of containers and bed, the house is built with a good amount of cement and sand it can hold a good amount of weight of the containers.
- **Raised Beds in Terrace Gardening:** Raised beds are the best alternative for garden beds. Raised beds are wider than the containers they come in wide square and rectangular shapes. Raised beds don't occupy much place, they can be placed adjacent to the walls of the terrace. Raised beds are a bit expensive, but yields of plant grown in raised beds are high compared to container grown plants. Raised beds are generally made of metals or wood, you can also construct a permanent raised bed with cement and concrete. Raised beds are available in hardware stores, nurseries, and online shops to purchase suitable ones as per your terrace space. Always place the raised beds slightly elevated from the terrace surface to protect the roof from root penetration and water leakages. Soil in raised beds will dry out quickly so watering should be done regularly.
- **Integrated Patches for Terrace Gardening:** Integrated patches are also used for growing vegetables, these patches help to grow plants on the surface of the terrace itself. These integrated patches are suitable of large terraces that are completely waterproof. Integrated patches are like normal garden beds, use garden soils with organic composts to grow plants in integrated patches.

Containers for Terrace Gardening

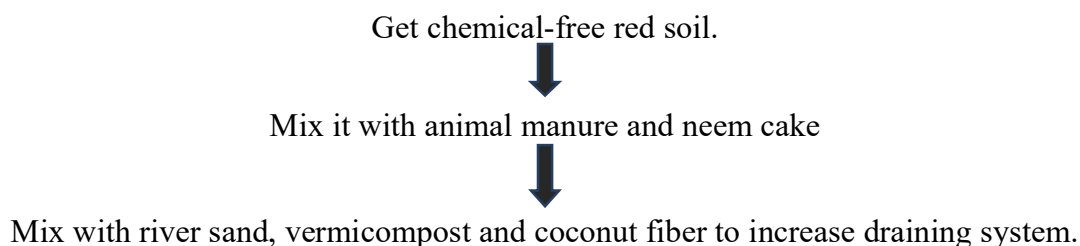
- Container is the best choice for terrace gardening.
- Use containers of any size and shape for terrace gardening.
- Avoid plastic containers; plastic container will break in the long run due to the heat.

- Use the containers made up of wood, metal, clay, terracotta, etc. In addition to this, use old paint boxes, vegetable or fruit crates, used glass or plastic bottles, sandboxes, old wheelbarrows, oil containers, etc. all types of recycled containers that can hold water and soil can be used for growing plants in terrace gardens.
- Grow bags, garbage bags, sugar bags, rice or wheat bags and cement bags are also used for growing plants.
- Select the size of the container depending on the plant size and growth.
- The entire container should have 2 to 3 draining holes. Cover the draining holes with fine net that stop dripping of soil and cover the bottom layer of containers with gravel to avoid water logging.
- Sandboxes: Sandboxes used for kids play are the best container to use in the terrace garden. Sandboxes are used for the growing leaf vegetable patch. Sandboxes provide wide place for plants to thrive.

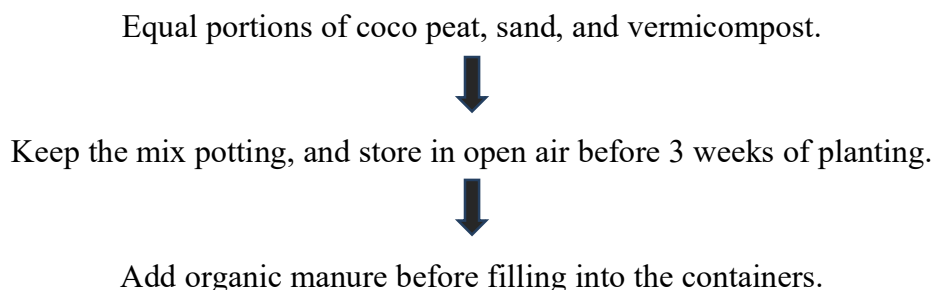
Soil/Media Requirement

- Soil is the key feature for growing a healthy plant.
- Don't opt chemical mixed soils, it may affect the yields.
- Soil used should provide all nutrients for proper growth of the plants.
- The premium potting mix is recommended for terrace gardening.
- Mix potting soil with compost, river sand and organic manure.
- Most of the plants grow in potting mix, some plants need different types of soil like lime and citrus plants need more acidic soil. So, change the compositions of soil as per the soil requirement.
- Get the potting mixes from the nurseries; if it is costly prepare them yourself.
- Buy some ingredients and create own compost and prepare homemade mix.

Preparation of Home Made Potting Mix for Terrace Gardening



Preparing the Soilless Potting Mix for Terrace Gardening



Prepare a Garden Layout

- Prepare designed layout as per our garden area considering the heat and light requirements.
- Place plants according to their resistant towards the sun.
- Place tender plants in shade areas, creepers in low wind areas. Place the containers in a convenient location so that you can water them easily.

Selection of Plants

- **Terrace Garden Vegetables:** With medium-sized pots or raised beds with fertile soil all other requirements in which grow all vegetables in the terrace garden like Tomatoes, Carrots, Onions, Potatoes, Beets, Capsicum, Radish, Chilies, Cucumbers, and Eggplants are easily grown. But all these vegetable plants need regular care like pinching, pruning, watering, and fertilizing should be done every week.



- **Fruit Trees for Terrace Gardening:** Select dwarf tree varieties of Orange, Guava, Lemon, Papaya, Mango, Sapodilla, Fig are best for terrace gardening.



- **Flowering plants for terrace Gardening:** Flowering plants like roses, Marie gold, Lilies, Jasmine, and *Hibiscus* can be grown. Also grow hyacinths, tulip bulbs and colorful primroses.



- **Herbs for terrace Gardening:** easily grown herbs in our terrace garden are mint, basil, curry leaf, celery, cilantro, chives, and garlic are suitable for terrace gardening.
- **Plants for Vertical Gardening:** Boston fern, Birds nest fern, rabbit foot fern, Pothos, lipstick plants, baby tears, etc. Vegetable for vertical garden are peas, cucumbers, pole beans, squashes, and pumpkins.
- **Leaf Vegetable for terrace Gardening:** Fenu Greek leaves, spinach coriander, Lettuce, Mustard leaves, Kale, Broccoli, and Lettuce, etc.

Seeds and Plantation for Terrace Gardening

- Get the necessary seeds and seedlings from nurseries, even seeds are available in stores.
- Go for good quality organic seeds, growth of the plants depends upon the quality of seeds.
- Follow the sowing procedure according labelled instruction on seed covers.
- Some seed should be grown in seed trays and then transplanted into the desired containers. Get one set of seed trays; seeds need regular observation till the sprout comes out.
- Select seeds that are depending upon season and climatic conditions. Some types of plants are tough to grow from seeds, in that cases get the seedling from nurseries.
- Some plants are directly grown from cuttings. We can get cuttings from neighbours or friends instead of purchasing.

- Start with a minimum number of easily grown plants; you can increase the number of plants from time to time.



Vertical Growing in Terrace Gardening

- Utilize vertical space on the walls of the terrace to increase the space for gardening, and vertical gardening increases the beauty of the terrace. Make a plan for vertical gardening, if you have walls, hang planters onto.
- In vertical gardening grow shrubs and vine vegetables like beans, gourds, etc. Vines get good support of walls but also save lots of space.
- For vertical gardening use some designed stands, pot holders, hangers and hanging pots etc. Train our veins of the plants on the walls on strings.
- Hanging pots and stands, pot holders are available in stores and nurseries.



Watering

- For terrace gardening, should have water resource near to your garden.
- Buy watering equipment like watering kettle or use a hose to water the plants in your terrace.
- We can also use buckets /mug and pour water plants in our terrace but carrying all over terrace can be a tough job.
- Use only water cans to water plants is recommended.
- If you don't get time water daily the implement drip irrigation in your garden.
- Many readymade watering systems and techniques are available which can fix them under professional advice.
- Use clean water for water, avoid chlorinated water for plants.

Fertilizers

- Plants grown in container and beds need feed regularly, especially in the growing period.
- Don't use chemical based fertilizers, only organic fertilizers are recommended.
- Use the mild liquid fertilizers and slow-release fertilizers.
- Natural composts like vegetable composts, fruit composts or tea composts are used as best feed. Top dress the soil with cow manure once in six months.

Pesticides

- Once we are ready with the garden, be ready to face the pests.
- Whatever precaution you take, plants are affected by the pests. Pesticides should be used to treat pests, but go for natural ones, don't use chemical fertilizers.
- Make a complete study on natural pesticide and their recipes are prepare yourself at home.
- Ginger oil, antiseptic soap spray, neem oil spray is good natural pesticide prepared at home to treat common pests.
- Plants affected with pests or diseases should be kept separately, as chance of spreading is more in terrace gardens.

Rain Water Harvesting

- Rainwater is a good source of nitrogen for plants. Make some provision in our terrace to collect the rainwater. Place the large container or buckets to collect rainwater and use it later.

Garden Cover and Wind Barriers

- In peak summer and peak winters, there is need to set up some shade for plants.
- Some plants are heat resistant and some plant cannot resist midday sun; garden covers are used; lightweight UV resistant covers should be used.
- But garden covers can be expensive; in that case you shade netting of low cost.

- Just cover some area of the terrace if you are running short of budget and place plants sensitive plants under shade.
- Garden cover used in winter to protect winter sensitive plants from frost.
- **Wind barriers:** Major problem faced by terrace grown plants is blowing winds.
- Winds can spoil the vines of the plants and break the young stems. In that case setting up wind barriers which is very expensive, if you are ready with the budget just set up barriers or fencing to protect the plants from strong winds.

Protecting Plants from Birds and Animals

- Terrace plants should be protected from birds and animals like rats and squirrels.
- Plants bearing Vegetable, seedling and fruits should be covered with mesh or wires to protect from birds.
- Take necessary steps for preventing rats and squirrels that damage raised beds, sown seeds and young plants.

Tips for Terrace Gardening

- Create a perfect theme; choose plants as per design, to create beautiful landscapes.
- Don't be more excited to grow all the plants at the first attempt. Make a list of the plants you are planning to grow and grow one by one and arrange them on the terrace according to the heat and light requirements.
- Be prepared with failure at initial stages, due to care, overwatering, overfeeding can lead to failures. Don't get disappointed, learn from mistakes.
- Wear gloves when working in your garden.
- Be prepared with all types of insects.
- The Internet is the best source to get complete information about plants, seeds, pests, and growing procedures.
- Choosing a right soil is very important, as soil supplies basic nutrients for plants. Mix the soil with sand and vermicompost to make it more fertile and well-drained.
- After the rainy season, add some mild organic fertilizers with essential nutrients. As the rains wash away the nutrients in the soil. Terrace gardening needs regular watering, in summer water the plants twice a day.

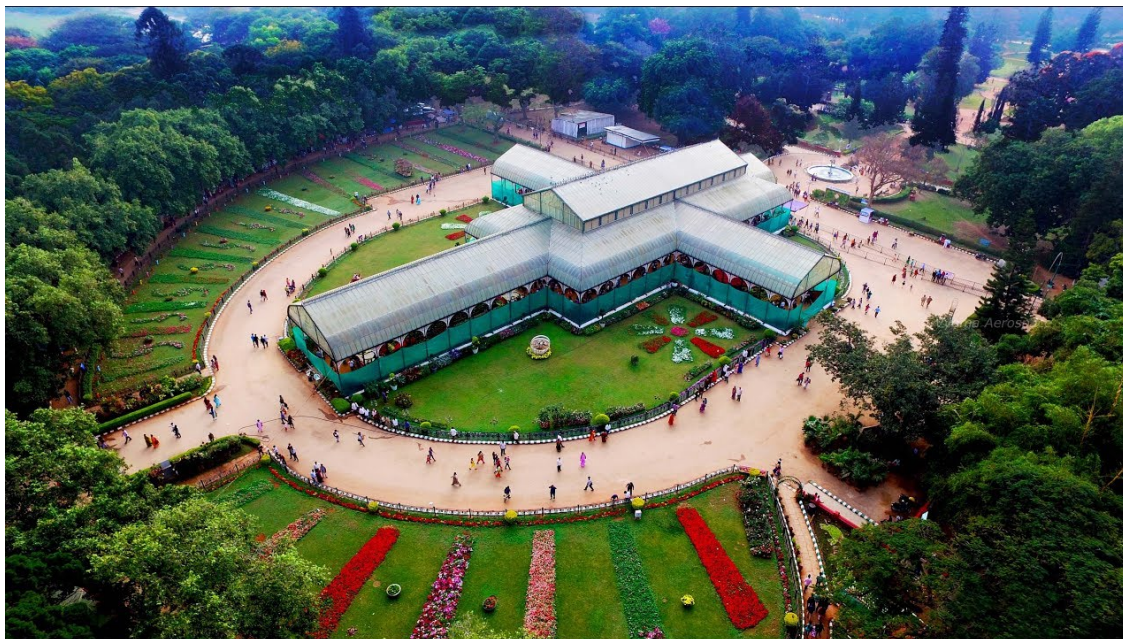
Importance of Terrace Gardening

- Terrace gardening is your personal space and you only have the access. You can harvest any product when required.
- Terrace gardening provides cooling effect to your building due to green plants.
- Growing plants on terrace may reduce carbon monoxide and good for the environment as well.
- Terrace gardening requires less maintenance.
- Your building looks beautiful with terrace gardening and provides an amazing view for others.

- You can use rainwater for growing plants.
- Terrace gardening is a stress buster.
- It can also reduce daily spending cost on vegetables or fruits or herbs.

2.4 IMPORTANT AESTHETIC GARDENS OF INDIA: LALBAGH BOTANICAL GARDEN, BENGALORE

Introduction



- ❖ Lalbagh Botanical Garden is one of India's most famous botanical gardens, located in Bengaluru, Karnataka.
- ❖ It was originally commissioned by Hyder Ali in 1760 and later expanded and developed by his son, Tipu Sultan, who introduced many exotic plant species from different parts of the world.
- ❖ The garden spread over approximately 240 acres, is home to more than 1,800 species of plants, including rare trees, medicinal plants, ornamental flowers, and economically important species.
- ❖ Lalbagh is renowned for its rich biodiversity, beautifully landscaped lawns, serene lakes and the iconic Glass House, which was inspired by London's Crystal Palace and hosts the famous annual flower shows.
- ❖ The garden also serves as an important center for botanical research, plant conservation, education and environmental awareness.
- ❖ Today, Lalbagh Botanical Garden is recognized as a significant botanical, historical, and tourist landmark, attracting researchers, students, nature lovers, and visitors from around the world.

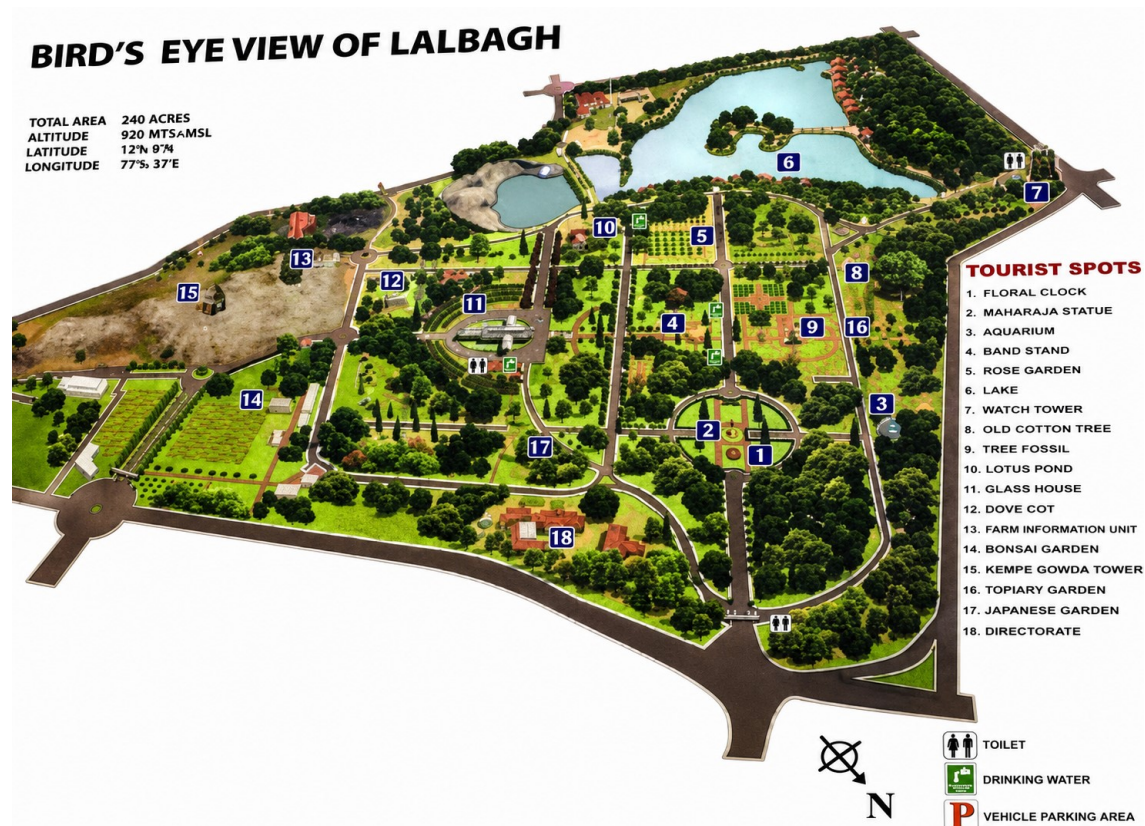
History of Lalbagh Botanical Garden

- ❖ Lalbagh Botanical Garden has a rich historical legacy that reflects the evolution of botanical science, horticulture, and plant conservation in India.

- ❖ The garden was established in 1760 by Hyder Ali, the ruler of the Kingdom of Mysore, who envisioned the creation of a royal garden inspired by the famous Mughal gardens.
- ❖ His primary objective was to cultivate economically valuable, medicinal, and ornamental plant species collected from different parts of India and abroad.
- ❖ After Hyder Ali's death, his son Tipu Sultan significantly expanded the garden by introducing numerous exotic plant species from countries such as Persia, Afghanistan, Mauritius, France, and other tropical regions through an extensive network of traders and diplomats.
- ❖ This transformed Lalbagh into one of the earliest centres for the introduction and acclimatization of exotic plants in southern India.
- ❖ Following the fall of Tipu Sultan in 1799, the administration of Lalbagh came under the British Government.
- ❖ During the nineteenth century, the garden underwent systematic scientific development under the supervision of British horticulturists and botanists, particularly John Cameron, who served as Superintendent from 1874 to 1908.
- ❖ Cameron reorganized the garden according to modern botanical principles, expanded its living plant collections, established nurseries, improved irrigation systems, and promoted research in economic botany and horticulture.
- ❖ One of the most significant milestones during this period was the construction of the iconic Glass House in 1889, inspired by London's Crystal Palace, which became a landmark for horticultural exhibitions and continues to host the renowned annual flower shows.
- ❖ During the twentieth century, Lalbagh evolved from a royal pleasure garden into a nationally important botanical institution dedicated to plant conservation, botanical research, education, and public awareness.
- ❖ After independence the garden managed and maintained by Directorate of Horticulture, Government of Karnataka.

Design and Layout of the Garden

- ❖ Lalbagh Botanical Garden has multiple entry gates strategically located around its perimeter to provide convenient access from different parts of Bengaluru.
- ❖ The four principal entrances are the Main Gate (Lalbagh Road Gate), West Gate (Siddaiah Road Gate), Double Road Gate (K.H. Road Gate), and East Gate (Jayanagar Gate).
- ❖ Each gate is connected to internal pathways that lead visitors to important attractions such as the Glass House, Lalbagh Lake, Peninsular Gneiss, Rose Garden, Bonsai Garden and other thematic plant collections.



- ❖ These entrances are designed to efficiently manage visitor movement while preserving the garden's ecological integrity and landscape.
- ❖ The gates are equipped with ticketing facilities, security arrangements, visitor information boards, and accessibility features to ensure a safe and organized experience.
- ❖ Their strategic placement allows easy access for tourists, students, researchers, and local residents, while supporting the garden's roles in botanical research, environmental education, biodiversity conservation, and public recreation.

Attractions of Lalbagh Botanical Garden, Bengaluru

1. Floral Clock

- ❖ The Floral Clock is one of the most attractive ornamental features of Lalbagh Botanical Garden.
- ❖ It is a fully functional clock constructed using colourful seasonal flowering plants and ornamental foliage.
- ❖ Installed in 1983, the clock mechanism was donated by Hindustan Machine Tools (HMT), Bengaluru.
- ❖ The floral display is redesigned periodically according to seasonal flowering patterns, making it an excellent example of carpet bedding and landscape gardening.

- ❖ The Floral Clock attracts thousands of visitors every year and serves as an educational model for horticulture students.

2. Maharaja Chamarajendra Wodeyar Statue

- ❖ The bronze equestrian statue of Maharaja Chamarajendra Wodeyar, is an important historical monument inside Lalbagh Botanical Garden.
- ❖ Maharaja Chamarajendra Wodeyar was one of the progressive rulers of the Mysore Kingdom who strongly promoted horticulture, education, and scientific development.
- ❖ The statue symbolizes the royal patronage that contributed significantly to the growth and expansion of Lalbagh Botanical Garden and serves as a reminder of Mysore's rich horticultural heritage.

3. Aquarium

- ❖ The Aquarium at Lalbagh Botanical Garden exhibits a diverse collection of freshwater ornamental fish species.
- ❖ It provides educational opportunities for students and visitors to understand fish diversity, aquatic ecosystems, and ornamental fish culture.
- ❖ The aquarium promotes awareness about aquatic biodiversity and conservation while enhancing the recreational value of the botanical garden.

4. Band Stand

- ❖ The Band Stand is a historic open-air pavilion constructed during the British colonial period.
- ❖ It was originally built as a platform where military brass bands performed musical concerts for the public during weekends and ceremonial occasions.
- ❖ The structure reflects European landscape architecture and remains an important heritage monument representing the cultural history of Lalbagh Botanical Garden.

5. Rose Garden

- ❖ The Rose Garden contains an extensive collection of rose cultivars, including Hybrid Tea Roses, Floribunda Roses, Miniature Roses, Climbing Roses, and Heritage Roses.
- ❖ It displays a remarkable diversity of colours, fragrances, and flower forms.
- ❖ During the annual Flower Shows, the Rose Garden becomes one of the most attractive sections of Lalbagh and serves as an excellent resource for horticultural education, plant breeding, and ornamental landscaping.

6. Lalbagh Lake

- ❖ The Lalbagh Lake is a natural freshwater lake situated within the botanical garden.
- ❖ It supports aquatic plants, fishes, migratory birds, amphibians, and numerous other organisms, thereby contributing significantly to biodiversity conservation.
- ❖ The lake also plays an important role in groundwater recharge, rainwater conservation, and microclimate regulation while providing visitors with opportunities for bird watching and nature photography.

7. Glass House

- ❖ The Glass House is the most iconic structure of Lalbagh Botanical Garden.

- ❖ Constructed in 1889 under the supervision of John Cameron, it was inspired by the famous Crystal Palace in London.
- ❖ Built with iron and glass, the structure hosts the internationally renowned Flower Shows held every year during Republic Day (26 January) and Independence Day (15 August).
- ❖ It represents one of the finest examples of Victorian greenhouse architecture in India.

8. Lalbagh Rock (Peninsular Gneiss)

- ❖ The Lalbagh Rock is one of the oldest geological formations on Earth, with an estimated age of nearly 3 billion years.
- ❖ It belongs to the Peninsular Gneissic Complex and has been declared a National Geological Monument by the Geological Survey of India.
- ❖ The rock provides valuable information about the geological evolution of the Indian Peninsula and serves as an important educational site for geology and earth science students.

9. Kempegowda Watch Tower

- ❖ The Kempegowda Watch Tower stands on the summit of Lalbagh Rock and is one of the four historical boundary towers constructed to mark the limits of the old city of Bengaluru.
- ❖ The tower is named after Nadaprabhu Kempegowda, the founder of Bengaluru.
- ❖ It offers panoramic views of the city and represents the historical significance of Bengaluru's early urban planning.

10. Bonsai Garden

- ❖ The Bonsai Garden houses an impressive collection of miniature trees cultivated using traditional bonsai techniques.
- ❖ The collection includes species such as Ficus, Tamarind, Bougainvillea, and Juniper.
- ❖ The garden demonstrates the art of dwarfing trees while maintaining their natural appearance and provides valuable educational opportunities for students of horticulture and ornamental gardening.

11. Topiary Garden

- ❖ The Topiary Garden showcases ornamental shrubs that have been artistically pruned into various geometric shapes, animals, and decorative forms.
- ❖ It demonstrates the horticultural skill involved in topiary art and illustrates the importance of pruning, plant training, and landscape aesthetics.
- ❖ The garden is one of the favourite attractions for both students and tourists.

12. Dovecote

- ❖ The Dovecote is a historic pigeon house located within Lalbagh Botanical Garden.
- ❖ Constructed during the late nineteenth century, it was designed to provide shelter and nesting spaces for pigeons.
- ❖ The structure reflects traditional landscape architecture where bird houses were integrated into public gardens for ecological and aesthetic purposes.
- ❖ Today, it remains an important heritage feature of Lalbagh.

13. Tree Fossil (Petrified Wood)

- ❖ The Tree Fossil, also known as Petrified Wood, is one of the scientifically important exhibits of Lalbagh Botanical Garden.
- ❖ It represents ancient wood that has been transformed into stone through the process of mineralization over millions of years.
- ❖ The fossil provides valuable information about prehistoric vegetation, palaeoclimate, and fossilization processes, making it an important educational resource for students of palaeobotany and geology.

14. Lotus Pond

- ❖ The Lotus Pond is a beautiful water feature containing lotus and other aquatic plants.
- ❖ It enhances the scenic beauty of the garden while providing habitat for aquatic insects, amphibians, and birds.
- ❖ The pond also serves as a demonstration site for the cultivation and ecological importance of aquatic ornamental plants.

15. Japanese Garden

- ❖ The Japanese Garden is designed according to the traditional principles of Japanese landscape architecture.
- ❖ It incorporates rocks, water features, ornamental plants, pathways, and open spaces to create a peaceful and harmonious environment.
- ❖ The garden symbolizes simplicity, balance, and natural beauty while introducing visitors to international landscape gardening styles.

16. Silk Cotton Tree

- ❖ The Silk Cotton Tree (*Bombax ceiba*) is one of the remarkable tree species found in Lalbagh Botanical Garden.
- ❖ During the flowering season, the tree produces large bright red flowers that attract birds, bees, and other pollinators. It is an important indigenous tree species known for its ecological value, medicinal uses, and striking ornamental appearance.

17. Directorate of Horticulture

- ❖ The Directorate of Horticulture located within Lalbagh Botanical Garden serves as the headquarters of the Department of Horticulture, Government of Karnataka.
- ❖ It is responsible for planning, administration, research, training, and implementation of horticultural development programmes throughout the state.
- ❖ The Directorate also supervises the maintenance and scientific management of Lalbagh Botanical Garden.

18. Nursery and Plant Collection Areas

- ❖ The Nursery and Plant Collection Areas form the scientific foundation of Lalbagh Botanical Garden.
- ❖ These sections are responsible for the propagation, conservation, and maintenance of thousands of indigenous and exotic plant species.
- ❖ The nursery produces ornamental plants, medicinal plants, fruit trees, palms, bamboos, orchids, and flowering plants for research, education, landscape development, and public distribution.

- ❖ These areas play a vital role in plant conservation, biodiversity preservation, and horticultural education.

Importance of Lalbagh Botanical Garden, Bengaluru

- ❖ Lalbagh Botanical Garden is one of India's most significant botanical institutions, conserving a remarkable collection of indigenous and exotic plant species from different parts of the world. The garden contains thousands of species of trees, shrubs, herbs, climbers, palms, bamboos, orchids, and medicinal plants.
- ❖ Lalbagh Botanical Garden is regarded as the centre of horticultural excellence in Karnataka. It has played a pioneering role in introducing, acclimatizing, propagating, and popularizing numerous ornamental, fruit, vegetable, and flowering plants. The garden serves as a demonstration centre for nursery management, landscape gardening, floriculture, bonsai cultivation, topiary, and greenhouse management.
- ❖ Lalbagh serves as an outdoor laboratory for students of Botany, Horticulture, Forestry, Agriculture, Environmental Science, and Landscape Architecture.
- ❖ The garden provides valuable research material for scientists and scholars working in plant taxonomy, ecology, horticulture, plant physiology, biotechnology, ethnobotany, and conservation biology. Its diverse plant collections are extensively used for scientific studies, germplasm evaluation, species documentation, and climate adaptation research.
- ❖ Lalbagh Botanical Garden plays an important role in the ex-situ conservation of rare, endangered, threatened, and economically important plant species. The garden maintains living collections of valuable germplasm that help safeguard plant diversity against habitat destruction and environmental changes.
- ❖ The garden functions as an important urban green ecosystem that supports a rich diversity of plants, birds, butterflies, insects, reptiles, fishes, and microorganisms.
- ❖ Lalbagh helps improve the urban environment by reducing pollution, controlling dust, moderating local temperature, increasing humidity, and minimizing noise pollution. Its extensive tree cover acts as a carbon sink and contributes to climate change mitigation.
- ❖ Lalbagh Botanical Garden is one of the oldest botanical gardens in India, established during the eighteenth century by Hyder Ali and later expanded by Tipu Sultan and the British administration. Over the centuries, it has become an important symbol of Bengaluru's cultural and scientific heritage. Historic structures such as the Glass House, Kempegowda Watch Tower, Dovecote and Band Stand preserve the historical legacy of the garden.
- ❖ Lalbagh contributes to the economy by promoting horticulture, floriculture, nursery industries, landscaping, ecotourism, and plant-based businesses. The annual flower shows attract thousands of visitors, generating revenue through tourism. The garden also supplies quality planting materials and provides technical guidance that supports commercial horticulture and employment generation.

- ❖ Lalbagh Botanical Garden is one of the most visited tourist destinations in Bengaluru. The internationally renowned Flower Shows held during Republic Day and Independence Day celebrate India's rich horticultural heritage and attract visitors from across the country.
- ❖ The garden hosts cultural programmes, educational exhibitions, and public awareness campaigns, making it an important centre for cultural exchange, tourism, and environmental education.



LEAD BOTANICAL GARDEN, SHIVAJI UNIVERSITY, KOLHAPUR

Introduction



- ❖ The Lead Botanical Garden (LBG) of Shivaji University, Kolhapur, is one of India's premier botanical gardens dedicated to the conservation, research, and sustainable utilization of plant biodiversity.
- ❖ Situated within the lush 850 acre university campus at the foothills of the Western Ghats, the garden serves as an important centre for the ex-situ conservation of rare, endemic, and threatened plant species, particularly those native to the Western Ghats.
- ❖ The Department of Botany initiated the development of the botanical garden in 1985, and with financial support from the Ministry of Environment, Forest and Climate Change (formerly MoEF), it expanded significantly.
- ❖ In recognition of its outstanding contribution to plant conservation, it became the first Botanical Garden in India to be designated as the "Lead Botanical Garden for Western India."
- ❖ Today, the garden extends over approximately 42 acres and houses 1000+ of plant species, including more than 150 endemic species and several critically endangered plants.

- ❖ The garden equipped with facilities such as an arboretum, orchidarium, fernery, palmetum, medicinal plant garden, aquatic plant section, nurseries, tissue culture laboratory and germplasm banks.
- ❖ The garden developed under the guidance of Prof. (Dr.) S. R. Yadav with valuable contributions of faculty members, researchers and gardeners.
- ❖ Lead Botanical Garden plays a vital role in biodiversity conservation, botanical research, education, environmental awareness, and the restoration of threatened plant species.
- ❖ It is an invaluable resource for students, researchers, conservationists and visitors, promoting scientific knowledge and the sustainable management of India's rich plant diversity.

History

- ❖ The history of the Lead Botanical Garden (LBG) at Shivaji University, Kolhapur, began with the establishment of the Department of Botany in 1964.
- ❖ Initially, the department was allotted 6 acres of land where only limited plantation activities were carried out because of inadequate financial support.
- ❖ As a result, a well-developed botanical garden could not be established during the early years.
- ❖ In 1985, the Department of Botany requested an additional 6 acres of land, which was granted by the university authorities.
- ❖ This marked the beginning of the systematic development of the botanical garden.
- ❖ Over the next four to five years, continuous plantation, introduction of diverse plant species and regular maintenance gradually transformed the area into a well-recognized botanical garden.
- ❖ A major turning point came in 1996, when the Ministry of Environment and Forests (MoEF), Government of India, provided financial assistance for developing the garden's infrastructure.
- ❖ This support enabled the establishment of nurseries, irrigation systems, propagation facilities, and conservation units. Plant species, particularly rare, endemic, and threatened species from the Western Ghats, were collected and introduced into the garden.
- ❖ By 2005, the garden had conserved more than 150 endemic plant species, making it an important centre for biodiversity conservation and botanical research.
- ❖ Additional support from the Department of Biotechnology (DBT), Government of India, further strengthened research on biodiversity, bioprospecting, micropropagation and the conservation of critically endangered plant species of the Western Ghats.
- ❖ In 2005, an expert committee appointed by the Ministry of Environment and Forests evaluated the achievements and infrastructure of the garden.
- ❖ Based on its outstanding work in plant conservation and research, the committee recommended the garden for recognition as a Lead Botanical Garden.

- ❖ Consequently, the botanical garden of Shivaji University became the first botanical garden in India to be designated as the "Lead Botanical Garden for Western India."
- ❖ The university also allotted an additional 30 acres of land, expanding the garden to approximately 42 acres.
- ❖ Today, the Lead Botanical Garden serves as a national centre for the ex-situ conservation of rare, endemic, and threatened plant species, while promoting education, research, environmental awareness, and the sustainable utilization of plant biodiversity.

Main Attractions

The Lead Botanical Garden (LBG) at Shivaji University, Kolhapur, is spread over approximately 42 acres and is one of India's leading centres for the ex-situ conservation of plant diversity. The garden is divided into several specialized sections, each designed for conservation, research, education, and the propagation of different groups of plants.



- ❖ **Fernery:** A dedicated section containing 63 species of ferns and fern allies, representing primitive vascular plants from different habitats.
- ❖ **Rhizomatous, Cormatous, Tuberous and Bulbous Plant Section:** This section conserves 40+ species possessing underground storage organs such as rhizomes, corms, tubers, and bulbs, many of which have ornamental and medicinal importance.
- ❖ **Pinetum:** A collection 22 species of coniferous plants, including various species of pines and related gymnosperms, maintained for education and conservation. The Pinetum section includes petrified fossil (Mesembryoxylon mahabalai, 2 million years old).

- ❖ **Orchidarium:** Houses a diverse collection of native and exotic orchids, showcasing their remarkable floral diversity and ecological significance.
- ❖ **Aquatic Plant Section:** Displays freshwater aquatic plants, including the famous *Victoria amazonica* (Giant Water Lily), one of the major attractions of the garden.
- ❖ **Medicinal Plant Garden:** Contains numerous medicinal plant species used in traditional Indian systems of medicine, supporting research and public awareness.
- ❖ **Palmetum:** A specialized collection of 65+ indigenous and exotic palm species, representing one of the important palm conservation collections in the region.
- ❖ **Arboretum:** A large living collection of tree species, including rare, endemic, and economically important trees from the Western Ghats and other parts of India.
- ❖ **Rare, Endangered, Threatened (RET) and Endemic Plant Arboretum:** Conserves threatened and endemic plant species of the Western Ghats and Andaman & Nicobar Islands as part of ex-situ conservation programmes.
- ❖ **Plant Groves:** Thematic plantations of economically, ecologically, and culturally important plant groups established for educational and conservation purposes. The groves includes 35 varieties of Mango, 10+ species of *Garcinia* and 10 species of *Ficus*
- ❖ **Climber Section:** Features a wide variety of climbing plants and lianas, demonstrating their diversity and ecological adaptations.
- ❖ **Indigenous, Threatened and Endemic Plant Nurseries:** Nurseries dedicated to the propagation and multiplication of native and threatened plant species for conservation and restoration programmes.
- ❖ **Mangrove Nursery:** Maintains mangrove species for conservation, research, and awareness regarding coastal ecosystems.
- ❖ **Germplasm Banks (Field Gene Banks):** Conserves valuable genetic resources of plant groups such as *Barleria*, *Flemingia*, *Crinum*, *Pancratium*, *Drimia*, *Dipcadi*, *Aponogeton* and *Chlorophytum*, ensuring long-term preservation of plant diversity.

Importance

- ❖ The Lead Botanical Garden (LBG) of Shivaji University, Kolhapur, is one of India's most important botanical gardens for the conservation, research, and sustainable utilization of plant biodiversity.
- ❖ It plays a vital role in the ex-situ conservation of rare, endemic, and threatened (RET) plant species of the Western Ghats by maintaining living collections, seed banks, germplasm banks, and tissue culture facilities.
- ❖ The garden serves as a valuable resource for teaching and research in taxonomy, ecology, biotechnology, plant conservation, and restoration biology.
- ❖ It supports the multiplication and reintroduction of endangered plant species into their natural habitats and promotes scientific studies on biodiversity and climate change.
- ❖ The Lead Botanical Garden also creates environmental awareness among students, researchers, farmers and the general public through educational programmes and guided visits.

- ❖ As the first Lead Botanical Garden for Western India recognized by the Ministry of Environment, Forest and Climate Change (MoEFCC), it has become a national centre for plant conservation and biodiversity research.
- ❖ By preserving the rich flora of the Western Ghats and promoting sustainable use of plant resources, the garden makes a significant contribution to ecological conservation, scientific advancement, and environmental education.



2b – Nursery Development

Objectives and Scope of Nursery

Introduction

- ✚ A nursery is a specialized place where young plants are propagated, grown and cared for until they become healthy enough for transplanting to fields, gardens, orchards, forests or landscapes.
- ✚ It plays a vital role in agriculture, horticulture, forestry, floriculture and environmental conservation by producing high-quality, disease-free and vigorous planting materials.
- ✚ In a nursery, plants are raised from seeds, cuttings, grafts, buds, layers or tissue culture under controlled environmental conditions that ensure proper germination, growth and survival.
- ✚ Nursery development includes activities such as soil preparation, sowing, watering, fertilization, weed control, pest and disease management, pruning, shading and hardening of seedlings before transplantation.
- ✚ A well-managed nursery ensures the continuous availability of healthy and genetically superior plants, resulting in higher crop productivity, uniform plant growth and better economic returns.
- ✚ Nurseries also contribute significantly to afforestation, biodiversity conservation, urban landscaping and the beautification of public and private spaces.
- ✚ Thus, a nursery serves as the foundation for successful plant cultivation and sustainable agricultural and horticultural development.

Objectives

- ✚ The primary objective of a nursery is to produce healthy, vigorous, and high-quality planting material for agriculture, horticulture, forestry, landscaping and ornamental gardening. A nursery provides controlled environmental conditions that promote proper seed germination, root development, and vegetative growth, ensuring that seedlings develop into strong and healthy plants capable of surviving after transplantation. The production of disease-free and genetically superior plants helps improve crop productivity, quality, and profitability.
- ✚ Another important objective of a nursery is the mass multiplication of plants through both sexual and asexual methods of propagation. Plants can be raised from seeds or propagated vegetatively by cuttings, grafting, budding, layering, and tissue culture. Vegetative propagation helps preserve desirable characteristics of superior cultivars, while seed propagation is useful for producing rootstocks and maintaining genetic diversity. This ensures the continuous supply of planting material throughout the year.
- ✚ Nurseries aim to produce uniform and true-to-type plants with desirable genetic characteristics. Proper selection of mother plants and standardized propagation techniques ensure that seedlings possess desirable traits such as high yield,

superior fruit quality, disease resistance, drought tolerance and adaptability to local environmental conditions.

- ✚ An important objective of nursery is to reduce the mortality rate of young plants by providing optimum growing conditions. Adequate irrigation, balanced nutrition, proper spacing, shading, ventilation, and timely pest and disease control help seedlings establish strong root systems and healthy shoots. Hardening practices gradually expose seedlings to natural environmental conditions, improving their ability to withstand transplanting stress and adverse climatic conditions.
- ✚ Nurseries also serve as centres for the conservation and multiplication of valuable, rare, endangered and indigenous plant species. By propagating these plants under controlled conditions, nurseries contribute significantly to biodiversity conservation, ecological restoration, afforestation programmes and the preservation of plant genetic resources for future generations.
- ✚ Another major objective is to ensure the timely availability of planting materials according to seasonal requirements. Farmers, gardeners, commercial growers, and government agencies depend on nurseries for the regular supply of seedlings, saplings, ornamental plants, fruit trees, medicinal plants and forest species. Continuous production enables timely planting, resulting in better crop establishment and increased agricultural productivity.
- ✚ Nurseries play a vital role in supporting research, education and training. Educational institutions, research organizations and agricultural universities use nurseries for conducting experiments on plant breeding, propagation techniques, nutrient management, pest and disease control and the evaluation of new crop varieties. Students receive practical training in nursery establishment, plant propagation, nursery management, and scientific cultivation practices.
- ✚ The nursery also aims to improve economic development by generating employment opportunities and supporting the horticultural industry. Commercial nurseries produce ornamental plants, flowering plants, fruit trees, vegetable seedlings, medicinal plants and indoor plants for domestic and international markets. This creates income for nursery owners, skilled workers and rural communities while contributing to the economy.

Scope

- ✚ The scope of a nursery is vast and extends across agriculture, horticulture, forestry, floriculture, landscaping, environmental conservation, research and commercial plant production.
- ✚ A nursery serves as the foundation for the successful cultivation of plants by producing healthy, vigorous, disease-free, and genetically superior planting materials. With the increasing demand for food, fruits, vegetables, ornamental plants, medicinal plants and forest species, the importance and scope of nurseries have expanded significantly. Modern nurseries not only produce planting material

but also support sustainable agriculture, biodiversity conservation and rural economic development.

- ✚ In agriculture, nurseries play a crucial role in producing healthy seedlings of vegetable crops, cereals, pulses, oilseeds and plantation crops. Raising seedlings under controlled conditions ensures better germination, vigorous growth and higher survival rates after transplantation. Healthy nursery grown seedlings establish quickly in the field, resulting in increased crop productivity, better quality produce and improved resistance to pests, diseases and environmental stress.
- ✚ The scope of nurseries in horticulture is extensive because they provide quality planting materials for fruit crops, vegetable crops, spices, plantation crops, medicinal plants, aromatic plants and ornamental species. Commercial orchards depend on nurseries for grafted, budded and tissue-cultured plants that possess desirable characteristics such as high yield, superior fruit quality, disease resistance and uniform growth. Nurseries also support the cultivation of high-value horticultural crops for domestic consumption and export markets.
- ✚ In floriculture, nurseries are essential for the production of flowering plants, cut flowers, foliage plants, indoor plants, hanging baskets, bonsai, succulents, cacti and ornamental shrubs. They supply planting materials to flower growers, landscape designers, parks, hotels, educational institutions, and home gardeners. The increasing demand for ornamental plants has greatly expanded the commercial scope of floriculture nurseries.
- ✚ Forestry is another major area where nurseries have significant importance. Forest nurseries produce seedlings of timber, fuelwood, fodder, bamboo and other economically important tree species required for afforestation, reforestation, social forestry, agroforestry and watershed management programmes. These nurseries contribute to increasing forest cover, conserving natural resources, preventing soil erosion, improving water conservation and mitigating climate change through large-scale tree plantation.
- ✚ Nurseries also play an important role in medicinal and aromatic plant cultivation. The growing demand for herbal medicines, nutraceuticals, cosmetics and essential oils has increased the need for quality planting materials of medicinal species. Nurseries ensure the availability of authentic, disease-free, and genetically pure medicinal plants for pharmaceutical industries, herbal gardens, research institutions, and commercial cultivation.
- ✚ The scope of nurseries extends to environmental conservation and ecological restoration. They produce seedlings required for urban greening, roadside plantations, riverbank stabilization, biodiversity parks, wildlife habitats, ecological restoration projects and climate-resilient landscapes. By supplying millions of plants every year, nurseries help improve air quality, reduce atmospheric carbon dioxide, conserve biodiversity, enhance soil fertility and restore degraded ecosystems.

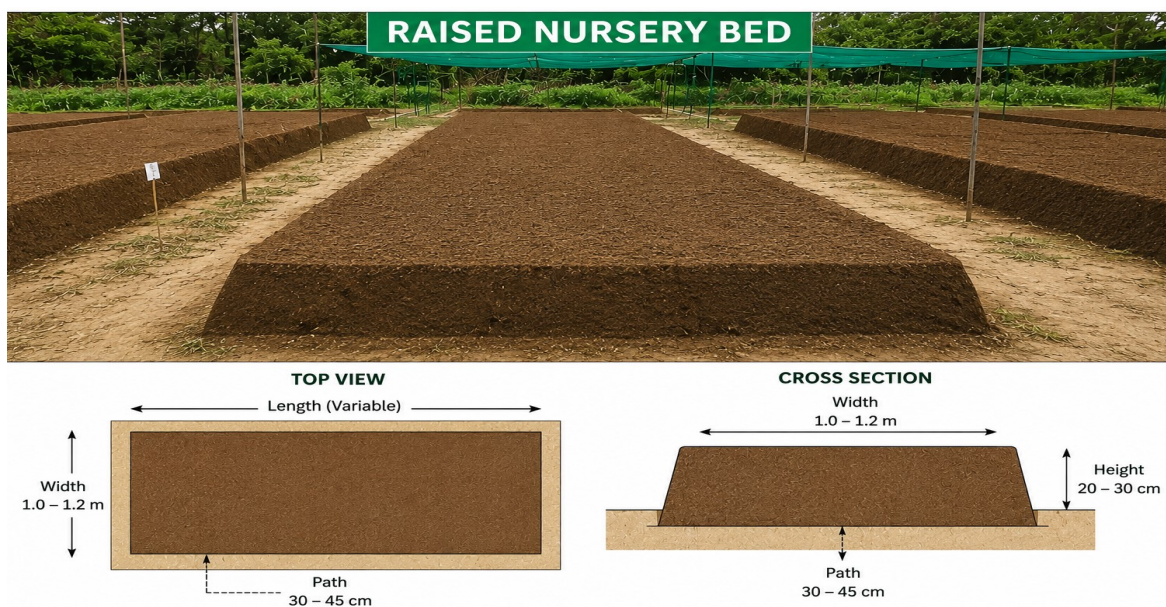
- ✚ Research and educational institutions also benefit greatly from nurseries. Universities, botanical gardens, agricultural colleges and research centres use nurseries for plant breeding, crop improvement, conservation of germplasm, evaluation of new varieties, tissue culture studies, propagation research and training programmes. Students gain practical knowledge of nursery establishment, plant propagation, nursery management, and modern cultivation techniques through hands-on learning.
- ✚ The commercial scope of nurseries has expanded rapidly with the growth of urbanization and the horticulture industry. Commercial nurseries produce and market fruit plants, ornamental plants, vegetable seedlings, indoor plants, landscaping materials, medicinal plants, tissue-cultured plants and nursery accessories. Many nurseries also provide consultancy services, garden design, landscape maintenance, plant rental, online plant sales and home delivery, creating profitable business opportunities and employment.
- ✚ Modern nurseries increasingly adopt advanced technologies such as protected cultivation, polyhouses, greenhouses, mist chambers, shade-net houses, automated irrigation systems, hydroponics, aeroponics, and tissue culture. These technologies enable year-round production of high-quality planting materials, efficient resource utilization, reduced production costs and better adaptation to changing climatic conditions.
- ✚ Overall, the scope of a nursery is continuously expanding due to the increasing demand for quality planting materials, sustainable agricultural practices, environmental protection, urban landscaping and commercial horticulture. A well-managed nursery supports food security, biodiversity conservation, climate change mitigation, scientific research, employment generation and economic development. Thus, nurseries have become an indispensable component of modern agriculture, horticulture, forestry and environmental management.

Types of Nursery Beds and Preparation of Nursery Beds

Types of Nursery Beds

- ✚ A nursery bed is a specially prepared area where seeds are sown and seedlings are raised under controlled environmental conditions until they become strong enough for transplanting into the main field or permanent growing site.
- ✚ The selection of an appropriate nursery bed depends on several factors, including soil type, climate, rainfall, irrigation facilities, crop species and nursery management practices.
- ✚ Properly designed nursery beds ensure uniform seed germination, healthy root development, efficient water management, and protection of seedlings from diseases and adverse environmental conditions.
- ✚ Based on their design and purpose, nursery beds are commonly classified as raised beds, flat beds, sunken beds and container beds.

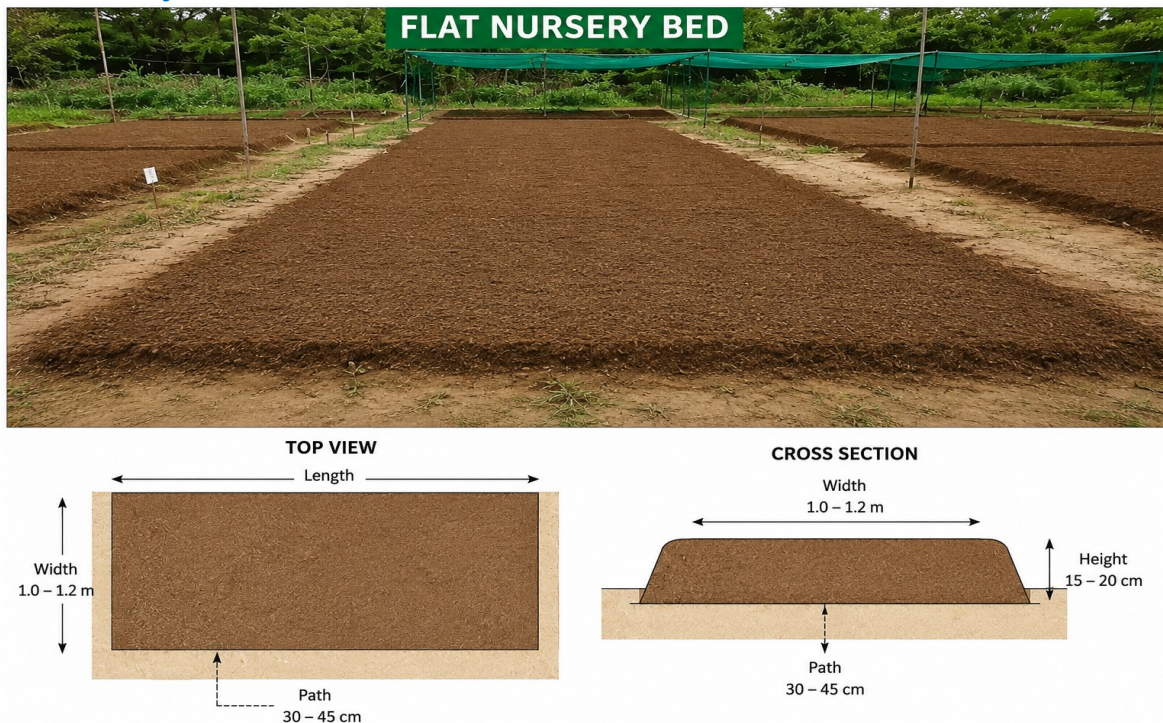
Raised Nursery Bed



- ✚ A raised nursery bed is constructed approximately **15–30 cm above the natural ground level** and is considered the most widely used nursery bed in horticulture, forestry and ornamental plant production.
- ✚ The bed is generally **1.0–1.2 m wide**, while its length varies depending on the available space and the number of seedlings required.
- ✚ Narrow pathways of about **30–50 cm** are maintained between beds to facilitate irrigation, weeding and other intercultural operations.
- ✚ The soil is thoroughly prepared by incorporating well-decomposed farmyard manure or compost to improve fertility and structure.

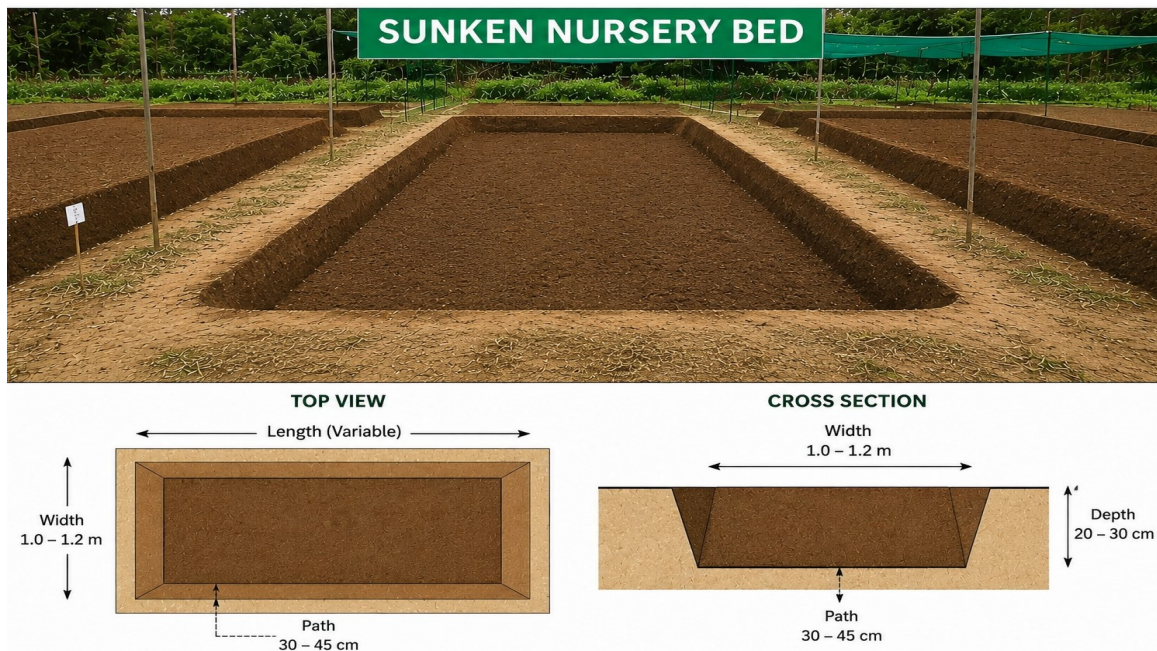
- ✚ Raised beds provide excellent drainage, prevent water stagnation, improve soil aeration, and encourage healthy root development.
- ✚ They are especially suitable for areas receiving heavy rainfall or having clayey soils where waterlogging is a major concern.
- ✚ Although raised beds require comparatively more labour and frequent irrigation during dry periods, they significantly reduce the incidence of damping-off disease and produce vigorous seedlings.
- ✚ Vegetable crops such as tomato, chilli, brinjal, cabbage and cauliflower, as well as ornamental and forestry species are commonly raised on raised nursery beds.

Flat Nursery Bed



- ✚ A flat nursery bed is prepared at the same level as the surrounding ground surface without any elevation or depression.
- ✚ It is commonly adopted in regions where the soil has good natural drainage and rainfall is moderate. The dimensions of the bed are usually similar to those of raised beds, with a width of about **1–1.2m**.
- ✚ Flat beds require less labour for preparation and help conserve soil moisture more effectively than raised beds, making them suitable for areas with limited irrigation.
- ✚ However, during periods of heavy rainfall, excess water may accumulate on the bed surface, leading to poor aeration and increased susceptibility to fungal diseases.
- ✚ Flat nursery beds are therefore recommended only where drainage conditions are favourable. They are widely used for raising onion seedlings, cereal crops, fodder crops and several ornamental plant species.

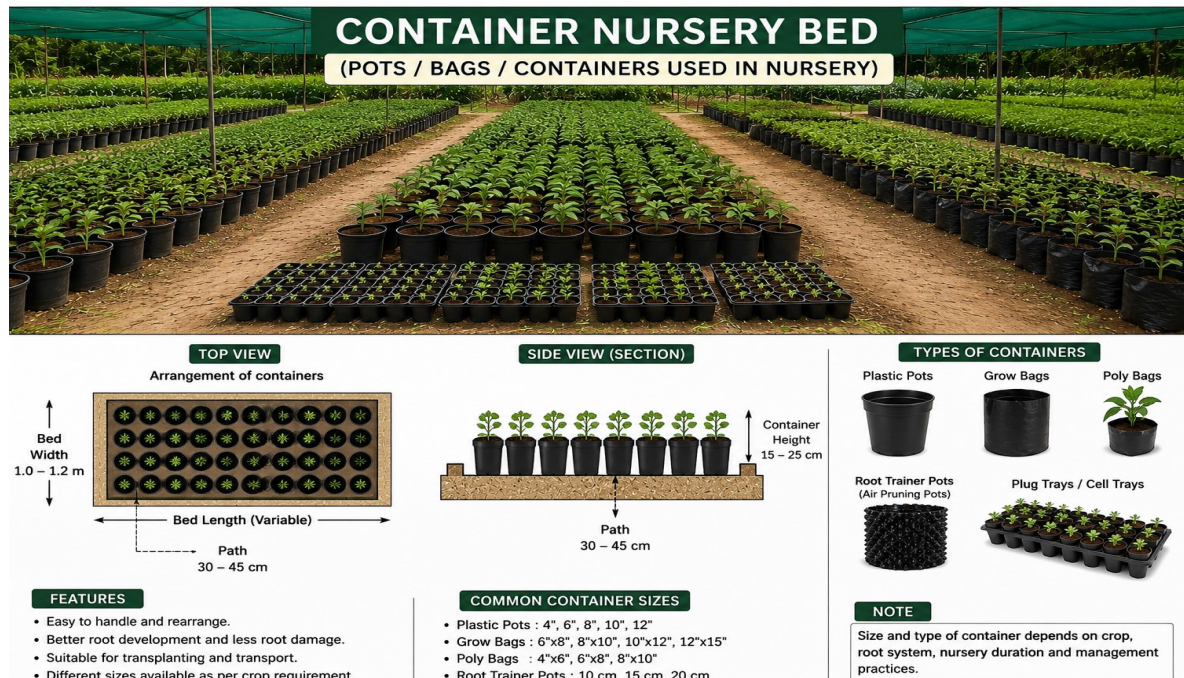
Sunken Nursery Bed



- ✚ A sunken nursery bed is constructed **10–20cm below the ground level** to maximize soil moisture conservation.
- ✚ This type of nursery bed is mainly recommended for arid and semi-arid regions where water availability is limited and evaporation losses are high.
- ✚ The depressed structure allows irrigation water and rainfall to remain within the bed for a longer period, thereby reducing the frequency of irrigation.
- ✚ The soil remains moist for an extended duration, promoting continuous seed germination and seedling growth under dry conditions.
- ✚ However, sunken beds are not suitable for regions receiving heavy rainfall because excessive water accumulation may cause waterlogging, poor root aeration and the development of soil-borne diseases.
- ✚ Crops such as onion, leafy vegetables, and fodder grasses are commonly grown in sunken nursery beds in drought-prone areas.

Container Nursery Bed

- ✚ Container nursery beds involve raising seedlings individually in containers such as **polybags, plastic pots, root trainers, plug trays (pro trays), seedling trays, biodegradable pots, or paper pots** instead of sowing them directly in the soil.
- ✚ The containers are filled with a sterilized growing medium consisting of soil, sand, cocopeat, vermicompost, compost or other suitable substrates.
- ✚ Container nursery production provides complete control over the growing environment, resulting in uniform germination, better root development and minimal transplanting shock because the root system remains undisturbed during transplantation.



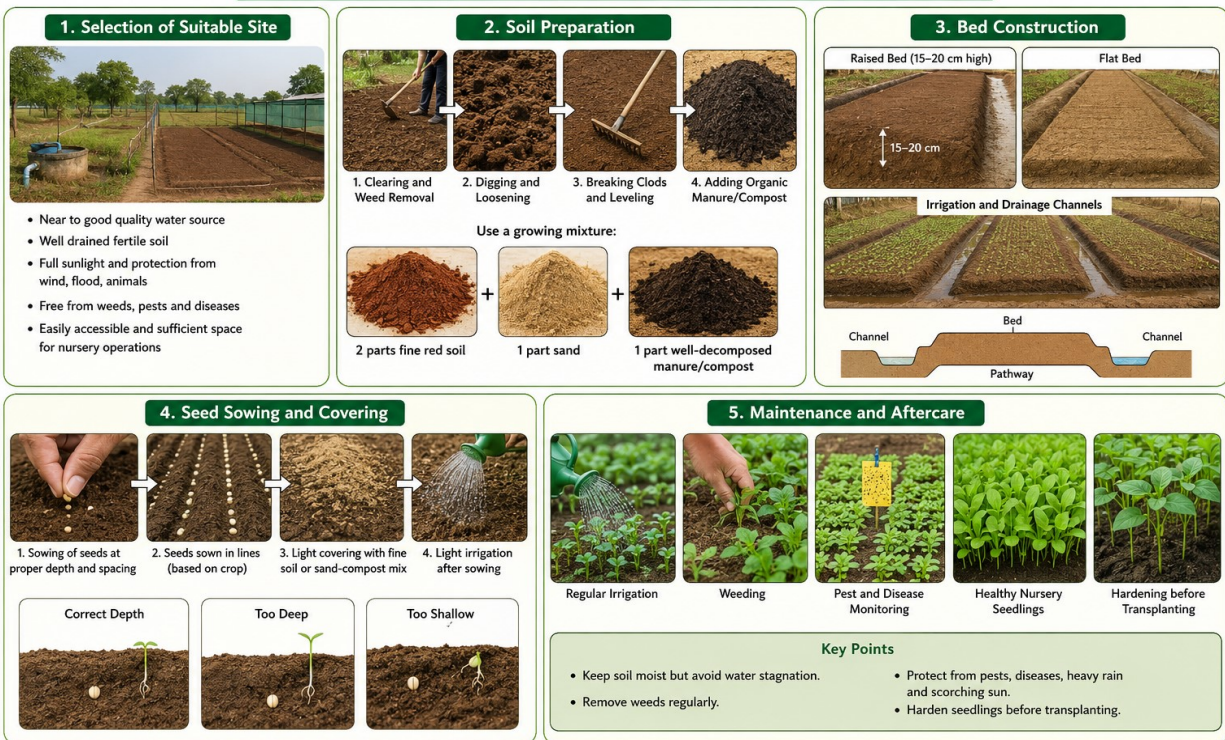
- ✚ It also reduces disease incidence through the use of sterilized media and allows efficient nutrient and water management.
- ✚ Container nursery systems are widely used in commercial horticulture, forestry, tissue culture hardening units, medicinal plant nurseries, ornamental plant production and modern vegetable seedling production.
- ✚ Although the initial investment and maintenance costs are comparatively higher, container-grown seedlings generally exhibit higher survival rates, faster establishment, and superior growth after transplanting.

Preparation of Nursery Beds

Introduction

- ✚ Preparation of nursery beds is an important step in nursery management because the quality of the nursery bed directly affects seed germination, seedling growth and subsequent establishment of plants.
- ✚ A well-prepared nursery bed should provide suitable conditions such as adequate moisture, good aeration, proper drainage, sufficient nutrients and a fine soil structure for developing seedlings.
- ✚ Nursery beds are prepared according to the type of crop, season, soil condition and method of irrigation.
- ✚ Proper preparation helps in obtaining healthy, uniform and vigorous seedlings while reducing problems such as water stagnation, poor germination, weed growth and disease incidence.
- ✚ The major steps involved in the preparation of nursery beds are selection of a suitable site, soil preparation, bed construction, seed sowing and covering, and maintenance and aftercare.

PREPARATION OF NURSERY BEDS – 5 KEY STEPS



Selection of Suitable Site

- ✚ Selection of a suitable site is the first and most important step in nursery bed preparation.
- ✚ The site should be easily accessible and preferably located near a reliable source of good-quality irrigation water.
- ✚ It should receive adequate sunlight and should have good natural drainage to prevent water stagnation.
- ✚ A fertile, loose and well-drained soil is preferred for raising healthy seedlings.
- ✚ The site should be protected from strong winds, flooding, animals and other sources of physical damage.
- ✚ It should also be free from perennial weeds, pests and diseases as far as possible.
- ✚ The selected site should have sufficient space for preparing beds, irrigation channels, pathways and other nursery operations.
- ✚ Proper site selection ensures favourable conditions for uniform germination and healthy seedling development.

Soil Preparation

- ✚ Soil preparation involves making the soil loose, friable, fertile and suitable for seed germination and root development.
- ✚ The selected area should first be cleared of weeds, stones, crop residues and other unwanted materials.
- ✚ The soil is then thoroughly dug or ploughed and broken into fine particles.
- ✚ Clods should be removed and the soil should be properly levelled.
- ✚ Well-decomposed organic manure or compost can be incorporated into the soil to improve its fertility, structure, water-holding capacity and microbial activity.

- ✚ A suitable growing mixture may consist of **two parts fine red soil, one part sand and one part well-decomposed manure**, depending on the crop and local soil conditions.
- ✚ Soil preparation should also ensure adequate drainage and good aeration, which are essential for healthy root development.

Bed Construction

- ✚ After soil preparation, nursery beds are constructed according to the season, crop and irrigation requirement.
- ✚ **Raised beds, generally about 15–20 cm high, are recommended during the rainy season** because they provide better drainage and help prevent water stagnation.
- ✚ **Flat beds** can be used during dry seasons because they remain level with the surrounding ground and facilitate moisture conservation and irrigation.
- ✚ Beds should be prepared with convenient dimensions so that sowing, weeding, irrigation and other management operations can be carried out easily.
- ✚ Proper irrigation and drainage channels should be provided around the beds for efficient water management and easy movement within the nursery. The bed surface should be fine, level and free from large soil clods before sowing.

Seed Sowing and Covering

- ✚ Seeds should be sown only after the nursery bed has been properly prepared and adequately moistened.
- ✚ The method of sowing depends on the size of the seed and the crop.
- ✚ Small seeds are generally broadcast or sown in shallow lines, whereas larger seeds can be placed individually at appropriate spacing and depth.
- ✚ Seeds should be sown at a **crop-specific depth and spacing** because excessive depth may delay or reduce germination, while shallow sowing may expose seeds to drying or other damage.
- ✚ After sowing, the seeds should be covered lightly with fine soil, sand or a suitable sand-compost mixture.
- ✚ The covering should be loose enough to allow the emergence of seedlings.
- ✚ Light irrigation should be provided after sowing without disturbing the seeds or causing soil erosion.

Maintenance and After Care

- ✚ Maintenance and aftercare are essential for obtaining healthy and vigorous nursery seedlings.
- ✚ The beds should be irrigated regularly according to the crop and prevailing weather conditions, while avoiding excessive irrigation and water stagnation.
- ✚ Weeds should be removed regularly because they compete with seedlings for water, nutrients, light and space.
- ✚ The nursery should be regularly inspected for insect pests, diseases and other problems, and suitable control measures should be adopted when necessary.
- ✚ Proper drainage should be maintained, particularly during rainy periods.
- ✚ Seedlings may also require thinning, gap filling, protection from excessive sunlight or rain, and gradual hardening before transplantation.
- ✚ Proper maintenance and aftercare produce uniform, healthy and well-developed seedlings that can withstand transplanting shock and establish successfully in the main field.

Techniques of Seedling Raising

Introduction

- Seedling raising refers to the process of growing young plants from seeds under suitable and carefully controlled conditions until they attain sufficient size, vigour and physiological maturity for transplanting or establishment in the field.
- It is an important operation in nursery management and commercial horticulture because the early stages of plant growth are highly sensitive to environmental conditions such as temperature, moisture, light, nutrients, pests, and diseases.
- Proper seedling-raising techniques help in obtaining **healthy, uniform, vigorous, and disease-free seedlings** with a well-developed root and shoot system.
- The technique selected for raising seedlings depends on the **type of crop, seed size, germination behaviour, climatic conditions, availability of water, nursery facilities, labour, cost and purpose of production**.
- Seedlings may be raised directly in the field or nursery beds, in containers, trays, protected structures, hydroponic systems or specialized pro-trays.
- Each method has its own advantages and limitations.
- The major techniques of seedling raising are given below.



Direct Sowing

- Direct sowing is one of the simplest methods of seedling establishment in which seeds are sown directly at the place where the crop is intended to grow.
- The seeds are not first raised in a separate nursery and subsequently transplanted.

- ✚ The land is properly prepared, and seeds are placed at the required depth and spacing according to the crop.
- ✚ Before sowing, the soil should be **well pulverized, free from weeds, properly levelled, and adequately moist**.
- ✚ Good-quality and viable seeds are selected.
- ✚ Seeds may be treated with suitable fungicides or bio-agents before sowing to protect young seedlings from seed-borne and soil-borne diseases.
- ✚ Depending on the crop, seeds may be sown by broadcasting, line sowing, dibbling or using a seed drill.
- ✚ After sowing, light irrigation is provided to maintain adequate moisture for germination.
- ✚ Excess irrigation should be avoided because waterlogging can cause seed rotting and poor germination.
- ✚ Emerging seedlings should be protected from weeds, pests, diseases and extreme environmental conditions.
- ✚ Thinning may be carried out where seedlings are overcrowded.

Advantages

- ✚ Direct sowing reduces transplanting shock, saves labour and nursery infrastructure, and is suitable for crops having large seeds or crops that do not tolerate transplanting well.

Examples

- ✚ Carrot, radish, turnip, pea, bean, groundnut, okra and many root crops are commonly established through direct sowing.

Sowing in Containers

- ✚ Sowing in containers involves raising individual seedlings in separate containers such as **earthen pots, plastic pots, polybags, root trainers, paper pots, or other suitable nursery containers**.
- ✚ This method is particularly useful for crops and ornamental plants that require careful management during the early stages of growth.
- ✚ Containers are first cleaned and provided with drainage holes.
- ✚ A suitable growing medium is filled into the containers.
- ✚ The medium should be **porous, well-drained, fertile, lightweight and free from harmful pathogens and weed seeds**.
- ✚ A mixture of soil, sand and well-decomposed organic manure or other suitable nursery media may be used depending on the crop.
- ✚ One or more seeds are sown at an appropriate depth and covered lightly with the growing medium.
- ✚ Containers are placed in a suitable nursery area where adequate light, temperature, moisture, and ventilation are available.
- ✚ Irrigation should be gentle so that seeds are not displaced.
- ✚ Once seedlings emerge, excess seedlings may be removed to maintain one healthy seedling per container.

- ✚ As the seedlings grow, they develop their own root system within the container.
- ✚ When they reach the appropriate transplanting stage, they can be carefully removed along with the root ball and transplanted into the field or larger containers.

Advantages

- ✚ Container raising provides better control over individual seedlings, reduces root disturbance during transplanting, allows easy transportation, and is useful for plants requiring a longer nursery period.

Examples

- ✚ Fruit plants, ornamental plants, vegetable seedlings, forest plants and many perennial crops can be raised in containers.

Seedling Raising in Trays

- ✚ Seedling raising in trays is a modern nursery technique in which seeds are sown in specially designed **seedling trays**.
- ✚ Trays may be made of plastic, thermocol, or other suitable materials.
- ✚ A suitable sterile or partially sterile growing medium is filled into the tray.
- ✚ Common media include **cocopeat, vermiculite, perlite, compost, or suitable combinations of these materials**.
- ✚ Seeds are placed in the tray at the recommended depth and covered lightly with the medium.
- ✚ The trays are kept in a nursery under suitable environmental conditions.
- ✚ Fine irrigation, preferably through a sprinkler or misting system, is used to maintain uniform moisture.
- ✚ Adequate light, temperature, humidity and ventilation are maintained for proper germination and seedling growth.

Advantages

- ✚ The major advantage of tray raising is the tray easily transportable and requires less water.
- ✚ Tray-raised seedlings can be transported easily and transplanted with minimum disturbance to the roots.

Examples

- ✚ Tomato, chilli, brinjal, cabbage, cauliflower, capsicum, cucumber, watermelon, muskmelon, and many vegetable crops are commonly raised in trays.

Raising Seedlings under Protected Structures

- ✚ Protected nursery production involves raising seedlings under structures that provide partial or complete protection from unfavourable environmental conditions.
- ✚ Common protected structures include **greenhouses, polyhouses, shade-net houses, net houses, low tunnels, mist chambers and other controlled nursery structures**.

- ✚ The main objective is to create a favourable microclimate for seed germination and seedling growth.
- ✚ Factors such as **temperature, relative humidity, light intensity, irrigation, ventilation and pest entry** can be managed more effectively than in an open nursery.
- ✚ Seeds are generally sown in trays, containers or raised nursery beds inside the protected structure.
- ✚ Controlled irrigation systems such as misting or micro-sprinklers may be used.
- ✚ Proper ventilation is essential because excessive humidity and poor air circulation can encourage fungal and bacterial diseases.
- ✚ Protected structures are especially useful for raising seedlings during adverse weather conditions such as excessive rainfall, high temperature, low temperature, strong winds or excessive solar radiation.
- ✚ They also help in producing uniform and high-quality planting material throughout the year.

Advantages

- ✚ Better germination, protection from environmental stress, reduced pest and disease incidence, efficient water use, uniform growth and production of high-quality seedlings.

Limitations

- ✚ Initial investment is comparatively high, and proper management of temperature, humidity, ventilation and sanitation is essential.

Hydroponic Seedling Raising

- ✚ Hydroponic seedling raising is a technique in which seedlings are grown **without conventional soil**, using a nutrient solution or an inert growing medium supplied with a balanced nutrient solution.
- ✚ The method provides precise control over water and nutrient availability.
- ✚ Seeds may be germinated in materials such as **rockwool, cocopeat, perlite, vermiculite or other inert substrates**.
- ✚ After germination, the seedlings receive water containing essential mineral nutrients in suitable concentrations.
- ✚ The root system obtains nutrients directly from the nutrient solution or from the moist growing medium.
- ✚ Hydroponic systems can provide accurate management of **water, nutrients, pH, electrical conductivity (EC), oxygen availability and root-zone conditions**.
- ✚ Because the growing medium is generally free from many soil-borne pathogens, the risk of certain soil-related diseases can be reduced when proper sanitation is maintained.
- ✚ Hydroponically raised seedlings generally have a **clean and well-developed root system** and can be transplanted into hydroponic systems, protected cultivation systems, or suitable field conditions after hardening.

Advantages

- ✚ Efficient use of water and nutrients, better control of root-zone conditions, uniform growth, reduced dependence on soil, and suitability for modern protected cultivation.

Limitations

- ✚ Requires technical knowledge, proper nutrient management, suitable equipment, and regular monitoring of pH and EC.

Raising Seedlings in Seedbeds with Mulching

- ✚ In this method, seedlings are raised on specially prepared nursery beds, and the soil surface is covered with a suitable mulch material.
- ✚ Seedbeds may be **raised, flat or sunken**, depending on soil type, drainage, rainfall and crop requirements.
- ✚ The nursery bed is prepared by loosening and finely pulverizing the soil.
- ✚ Well-decomposed organic manure and required nutrients may be incorporated before sowing.
- ✚ Seeds are generally sown in lines at suitable spacing and depth.
- ✚ After sowing, a thin layer of mulch such as **straw, dry grass, leaves, or other suitable organic material** may be applied over the seedbed.
- ✚ Mulching helps maintain **soil moisture and temperature**, protects seeds from direct solar radiation and heavy rainfall, and reduces the formation of a hard soil crust.
- ✚ It also helps improve seed germination under suitable conditions.
- ✚ The mulch should be removed or reduced once seedlings emerge sufficiently so that adequate light and air reach the young plants.
- ✚ Proper irrigation should be provided, and the nursery should be kept free from weeds.
- ✚ Seedlings are carefully lifted when they reach the appropriate transplanting stage.

Advantages

- ✚ Better moisture conservation, protection of seeds and young seedlings, improved germination, reduced evaporation and suppression of some weeds.

Limitations

- ✚ Excessive or poorly managed mulch may restrict aeration, increase humidity, or encourage pests and diseases.

Pro-Tray Method

- ✚ The pro-tray method is a specialized and highly efficient technique of seedling production in which seedlings are raised in **plastic pro-trays containing individual cells**.
- ✚ It is widely used in commercial vegetable nurseries because it produces uniform and healthy seedlings suitable for mechanical or careful transplanting.

- ✚ A suitable growing medium, commonly **cocopeat or a cocopeat-based mixture**, is filled into each cell of the pro-tray.
- ✚ A single seed is placed in each cell at the recommended depth and covered lightly with the growing medium.
- ✚ The trays are kept under suitable environmental conditions, often inside a protected nursery.
- ✚ Fine irrigation or mist irrigation is used to maintain uniform moisture.
- ✚ Depending on the crop and nursery system, soluble fertilizers or nutrient solutions are supplied at appropriate stages.
- ✚ The seedlings are monitored regularly for **germination, root development, nutrient deficiency, pests and diseases**.
- ✚ The major feature of the pro-tray method is the development of a **compact and healthy root plug** in each cell.
- ✚ During transplanting, the seedling can be removed along with the root plug, resulting in minimum root damage and transplanting shock.
- ✚ Proper hardening before transplanting improves survival and establishment in the field.

Advantages

- ✚ Produces uniform and vigorous seedlings, requires less seed, provides better root development, minimizes transplanting shock, saves water and growing media, easy handling and transportation, suitable for commercial nursery production, allows efficient use of nursery space.

Examples

- ✚ Tomato, chilli, brinjal, cabbage, cauliflower, capsicum, cucumber, watermelon, muskmelon, and several other vegetable crops are commonly raised by the pro-tray method.