16

Nursery Production

Purpose and Expected Outcomes

This chapter is designed to discuss the nursery and its role in landscaping.

After studying this chapter, the student should be able to

1. Describe how a site for locating a nursery is selected.
2. List the categories of plants produced by a nursery business.
3. Discuss container and field nursery production systems.
4. List at least five plants in each of the categories of bedding plants, ground covers, ornamental grasses, trees, shrubs, and plants with underground modified structures.

Nurseries produce the plant materials used in the landscape. They also produce seedlings for gardens, fruit seedlings for orchards, and tree seedlings for forests and other uses. A good landscape design is only as good as the quality of materials used to implement it.

16.1 The Role of the Nurseryworker

The success of the landscape industry depends on the *nurseryworker*. The landscape designer depends on the nurseryworker to do the following:

1. *Supply the correct plants in terms of species, size, and other specified characteristics.* The nurseryperson should be knowledgeable about the species and be exact in labeling plants. It would be unfortunate to purchase seedlings that are supposed to produce red flowers only to find out midseason that they produce white flowers.
2. *Supply healthy plants.* The plant material provided should be high quality and free from diseases and insect pests. Plants grown in the field and potted plants should be free from weeds.

3. *Supply materials on a timely basis.* The materials should be ready when they are needed to avoid delays in completing the project.
4. *Deliver well-packaged plant materials.* Plants harvested with a ball of soil around the root should be properly packed. Cracked soil balls can seriously jeopardize the survival of plants in the landscape. Plants should be protected from bruising and damage to the bark.
5. Provide at least basic instructions for minimal care of the plants.

16.2 Location of the Nursery

Just as in locating a greenhouse, a nursery site should be selected after careful analysis, considering both economic and ecological factors. The ecological or environmental considerations include soil and climate. Since production is largely under open-air environments (i.e., not controlled like a greenhouse), the factors are more critical now than when considering the location of a greenhouse. These factors are discussed in detail in Chapter 12. Thus, discussions in this module are limited to certain aspects of these factors and how they specifically affect outdoor open nursery production. These factors are described in the following sections.

16.2.1 Climatic Considerations

Important climatic factors to consider in locating a nursery include temperature, rainfall, wind, light, and air pollution.

Temperature

Nurseries produce young plants or seedlings, which are more sensitive than older plants to changes in climatic conditions. Seedlings are generally intolerant of rapid changes in temperature. If a nursery is being considered for the West Coast of the United States (e.g., California) where winters are mild and the growing season longer, the need for winter protection of plants (overwintering) is not critical for container culture. On the other hand, an East Coast production enterprise should consider erecting structures for winter protection of plants in containers.

Rainfall

The rainfall pattern for an area should be well understood. Certain operations cannot be delayed in a nursery enterprise. Rainfall can be supplemented with irrigation if needed, but rains that come during field preparations (e.g., tillage and making beds) or planting time could be very problematic for an operation. Production schedules are delayed because, for example, the field may be too wet to prepare it for planting. Areas that are prone to unpredictable severe weather should be avoided. If seedlings are damaged by hail or storms, for example, the nursery is likely to take a loss in revenue because the plants may be too old to sell by the time the damage is corrected.

Wind

Nursery plants need to be sheltered from strong winds, which can topple plants in containers and damage young plants. Because plants in the nursery are meant to be around for only a short period of time before being marketed, spacing is closer than it should be in the landscape. Consequently, a delay in selling could make plants compete for space and become top heavy and prone to being blown down by even slight winds. Further, the containers used are generally relatively light to facilitate transportation, which contributes to their susceptibility to wind effects. To overcome this problem, a nursery should be located in an area where natural windbreaks occur; otherwise, artificial windbreaks must be installed.

Light

Unlike a greenhouse, in which supplemental lighting can be provided, field production relies solely on sunlight. Shade houses can be erected for plants that need such conditions. Unwanted shading sometimes is experienced where trees are used to provide shelter from the winds.

Air Pollution

A nursery should be located where it will not suffer from air pollution. If it has to be established in a heavily industrialized area, it should be located upwind to escape the pollutants emitted from the various industrial facilities.

16.2.2 SOIL FACTORS

Soil factors that affect the location of a nursery include drainage, topography, soil texture and structure, and soil fertility.

Drainage

The proposed site for a nursery should be naturally well drained. If it is not, artificial drainage is required, adding to production costs. Drainage is required for good aeration of the soil and to reduce the incidence of soilborne diseases. Well-drained soils allow rapid soil warming for early production in spring.

Topography

The terrain of the site has implications in drainage, soil erosion, ease of land preparation, and general ease of production operations. If the site is rolling, use of machinery is hampered and irrigation systems are more difficult to install and operate. It may become necessary to spend additional money to level or terrace the site to facilitate production operations. On a rolling site, low parts of the land are likely to experience drainage problems and be susceptible to frost damage.

Soil Texture and Structure

Field production of seedlings for sale requires that plants be dug up at some point. If bare-root production is intended, a soil with loose structure (sand or loam) is preferred. For balled and burlapped production, the soil should be cohesive enough to form a ball around the roots. A properly textured soil also drains well, holds moisture at a desirable level, and is easy to work and well aerated.

Soil Fertility

The soil must be fertilized sooner or later for optimal production. However, the site should have some native fertility and be responsive to fertilization. The higher the soil quality (in terms of organic matter content, pH, and nutrition), the fewer the initial amendments.

16.2.3 NURSERY STRUCTURES

The type of structures needed depends on the region in which the nursery is located. As previously indicated, an area's climate may require the provision of overwintering facilities. Some plants may need shelter from intense sunlight, necessitating the construction of shade houses. Because some greenhouse-type production may be necessary to successfully produce certain types of plants, nurseries may construct greenhouses. For propagation, a cold frame or hotbed may be required at a nursery site.

A variety of storage facilities are needed on-site. Storage is needed for supplies, including seed, chemicals (e.g., fertilizers and pesticides), equipment, and temporarily for planting materials awaiting shipment. These facilities are in addition to basic ones

such as preparation rooms (for mixing and potting), propagation houses, and other administrative rooms.

16.2.4 ECONOMIC CONSIDERATIONS

For profitability, several economic considerations should be taken into account in deciding on the best place to locate a nursery. These include:

1. *Markets.* Nursery products may be transported to near or far markets. These products are generally bulky, whether container or field grown. Nurseries should be located near highways, if possible, to make them readily accessible to customers. Whereas some nurseries serve local markets, others serve clients out of state and long distances from the production sites. If the operation is large, the company may consider operating its own transportation system. Sometimes nurseries deliver large plants in mechanical augers after digging. This undertaking is economical only if the nursery is located close to the market or clients.
2. *Land.* Virgin land costs more to develop into a usable site than an area that has previously been in cultivation. It is advantageous to acquire a large piece of land and expand the operation as time goes by. Land near metropolitan areas may be expensive. Land in rural areas may be cheaper, but transporting materials and products to and from the nursery and markets would be costly.
3. *Labor.* Nursery production is seasonal in terms of labor needs. Container production is more labor intensive than field production. A limited number of permanent staff should be employed, with a seasonal labor pool readily available.

16.3 CONTAINER NURSERY PRODUCTION

Container nursery production is done on a large scale in many states, especially Florida, Michigan, Pennsylvania, Virginia, and Ohio. In container nursery operations, plants are grown and marketed in containers that differ in sizes and types according to the species and marketable size desired (Figure 16–1). Containers were discussed in Chapter 12. Similarly, the media ingredients and mixes discussed for greenhouse production apply here. The conditions described for successful container culture are also the same for the nursery operation.

Seeds and cuttings (Chapter 10) may be used for propagation. Nurseries may maintain blocks of parent stock in the field, which are plants used as a source of materials for propagation. Parent stock may be maintained less expensively in containers than in fields. These stock plants must be well maintained to produce healthy planting materials.

FIGURE 16–1 Container-grown tree seedling. *(Source: © George Acquaah)*

16.3.1 ADVANTAGES AND DISADVANTAGES

Container nursery production has certain advantages and disadvantages over field nursery production. Some of these are as follows:

Advantages

1. The seedlings are easier to market, being already "packaged" in independent containers.
2. The growing season can be extended by starting the material indoors ahead of the growing season.
3. Containerized plants are easier to transport.
4. Containerized seedlings are easier to transplant with minimal transplanting shock because the plant roots are intact.

Disadvantages

1. Container production requires more intense management.
2. Plant roots are more exposed to rapid fluctuations and greater extremes in temperature than plants in the ground in the field nursery. There is little environmental buffering against the environmental conditions because of the large surface-area-to-volume ratio.

16.3.2 CONTAINERS

Containers differ in shapes and sizes, according to root morphology and the marketable size of the plant species being produced. In greenhouses, pots are usually arranged on benches (and sometimes on the floor) during production. In container nurseries, container beds are created such that plants of similar size that require the same cultural conditions are grouped together during production. These beds vary in design and size depending on the sizes of pots, spacing, shade house and overwintering facility installed, and irrigation system used.

16.3.3 MEDIA FOR CONTAINERS

Container media composition was discussed in detail in Chapter 4. Factors to consider in developing media for container nurseries include the plant marketing size and form, and the need to stably support the plant in an erect position in an open environment without toppling. The container medium should be suited to the irrigation method to be used. Also, the cost of transportation to markets should be factored into media composition. The medium composition should be developed for specific production systems, rather than developing a universal mix.

Tree seedlings remain longer in the containers. The medium should be stable enough to support proper growth and development throughout the production period. Container medium volume generally decreases with time as the soil medium's physical conditions are altered by the force exerted by root penetration, soil compaction, shrinkage, and erosion from the impact of irrigation and natural precipitation.

Over time, the particle size distribution, soil porosity and air space, and water-holding capacity change. Particle size alteration is due in part to microbial action through decomposition of the organic component, resulting in the decrease in soil volume. Media that incorporate sand are prone to the migration of smaller particles to the bottom of the pot, and may clog the drainage hole and thereby reduce aeration and increase the potential for waterlogging. The particle size distribution also influences the root distribution in the container. Plant roots would tend to concentrate in the top of the container if aeration is reduced. Water saturation in the container predisposes the plants to root infections like *Pythium* and *Phytophthora*.

The root zone of containerized plants is subject to rapid environmental fluctuations. First, the container surface-area-to-soil volume is high and thereby provides little buffering

of environmental fluctuations. Further, the container sidewalls are exposed to direct solar radiation, making the container soil temperature about 15°C higher than the air temperature. However, in winter, night temperature of the container soil could be lower than the air temperature as a result of rapid heat loss from the container surfaces; this could lead to root injury.

16.3.4 SITE PREPARATION

The site is leveled in one of two basic ways (Figure 16–2). In one design, the center of the bed is raised so that excess irrigation water flows away to the edges of the bed. This design may be undesirable because it compels workers to walk through mud to get to the bed. In the other design, the slope is toward the center of the bed. The bed is covered with natural materials, such as gravel or crushed sea shells, or artificial materials, such as black ground cloth or black polyethylene. Black cloth is made of durable natural materials. The problem with gravel and shells is that they allow weeds to grow through, and plant roots may also grow through drainage holes in the pots and through the gravel layer into the ground, making moving plants around problematic.

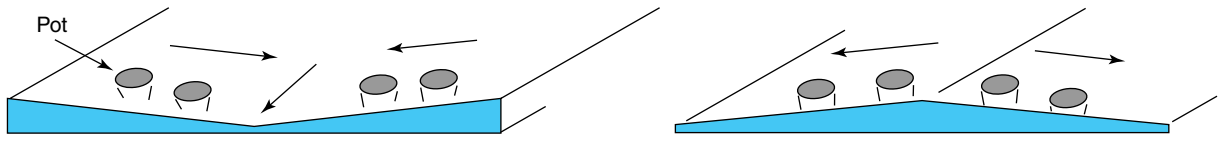
16.3.5 PROTECTION FROM COLD INJURY

Tropical and subtropical plants are more susceptible to cold injury. Two basic cold injuries are recognized (see also Chapter 4). Chilling injury results from cold temperatures above freezing, while freezing injury causes freezing injury.

1. *Chilling injury* Characteristic symptoms of chilling injury are not very different from drought injury, root rot diseases, chemical injury, heat stress, and light stress. They include the following:
   - Surface lesions, pitting, large sunken areas and discoloration
   - Water-soaked tissues (as cells rupture to release content solutes into intercellular spaces); Wilting and browning.
   - Internal discoloration of pulp, pith, and seed
   - Accelerated rate of senescence
   - Slowed growth
2. *Freezing injury*
   - Desiccation or burning of foliage
   - Water-soaked areas, resulting in necrotic spots on the plant

Container plant roots are less resistant to cold than field roots because they are less protected than roots in the ground. The ground is warmer in winter than the soil in pots. Thus, in container culture, plants need protection from the cold. One way to provide winter protection is to crowd plants together and wrap the pots in black plastic. In place of plastic, an outer border of containers filled with growing media can be used. White polyethylene-glazed overwintering houses are widely used for winter protection of plants in nurseries.

One strategy of growing container plants with winter protection is called the *double pot* (pot-in-pot) *production system*, whereby larger pots (*holder pots*) are placed



(a) Water drains into center of center-depressed plot (b) Water drains away from center-elevated bed

FIGURE 16–2 Ways of leveling a field nursery for pot culture: (a) water is drained from the sides of the field into a central channel, (b) water is drained into channels on both sides of the field.

FIGURE 16–3 Using holder pots in a field nursery. *(Source: © George Acquaah)*

in holes in the ground and buried up to their lips. Tree seedlings may also be grown in pots placed in raised beds containing soil and wood chipping (Figure 16–3). These pots then become holes in which containerized plants are grown through the season. The use of holder pots eliminates the need for additional winter protection. However, this year-round insulation may expose plant roots to high temperatures during the summer season.

16.4 Field Nursery

Methods of cold protection include sprinkling with water. A disadvantage of sprinkling is that the ice formed may weigh down plant limbs, breaking some of them, eventually. To reduce this incidence, container plants may be positioned on their sides prior to sprinkling. Fog application retards the loss of heat from soil and plant surfaces. This treatment is more effective in an enclosed structure such as a greenhouse. Some producers use erected structures like wind tunnels or cold frames. Cold injury to container plant roots may not be detected until it manifests later in the warmer season as high-temperature stress.

A fundamental difference between container and field nurseries is that in field nurseries plants are grown to the desired size in ground beds (e.g., Christmas tree farms). This system is often used for producing shade trees (e.g., red maple, pin oak, green ash, honey locust, white ash, and red oak), flowering trees (e.g., crab apple, redbud, flowering plum, and flowering dogwood), and evergreen and deciduous shrubs.

The soil is broken up and prepared for planting by plowing and harrowing. The land is divided into sections, with turfgrass-covered access ways between sections. Planting materials may be cuttings or grafted plants or from tissue culture. Trees are planted in rows under two basic systems, which differ according to how they are harvested for the market.

16.4.1 TYPES OF PRODUCTION

The method of harvesting plants distinguishes the production systems in field nursery production into two distinct types—bare roots, and balled and burlapped.

Bare-Root Trees

Bare Root
A tree or shrub seedling that is offered for sale without soil around its roots.

Bare-root trees are dug up without soil around the roots (Figure 16–4); they do not store well and are prone to transplanting shock. This system is suited to small trees and shrubs. Bare-root plants are lighter and easier to transport than balled and burlapped trees.

FIGURE 16–4 A bare-root tree seedling. *(Source: © George Acquaah)*

FIGURE 16–5 Balled and burlapped tree seedling. *(Source: © George Acquaah)*

Balled and Burlapped Trees

Balled and burlapped systems require plants to be planted in the ground and dug with a ball of soil around the roots (Figure 16–5). Mechanical harvesters (hydraulic augers or tree spades) are used for this purpose. The ball of soil is wrapped with burlap material and tied. If they are not needed immediately, balled and burlapped plants can be stored for a period of time. Harvesting by tree spade can severely prune roots, jeopardizing their establishment in the field. Balled and burlapped plants are best harvested when the soil is moist.

Balled and Burlapped
A tree or shrub seedling that is offered for sale with a ball of soil around its roots and wrapped in burlap.

16.4.2 IRRIGATION AND FERTILIZATION

Overhead sprinklers are commonly used in container nurseries. If there is the need, sprinklers are convenient to use for protection during a cold spell. The major drawback of this method of irrigation in container nurseries is that water application is very inefficient, involving significant water runoff loss. It is estimated that the average efficiency of overhead sprinkler systems in the container nursery is only about 25 percent. Plants may be grouped according to water needs and more closely together to reduce water waste. Also, the nursery ground may be lined with plastic or some impervious material to collect and pond the surface runoff for recycling. This strategy is implemented at additional production cost. Some producers use microirrigation in some instances.

16.5 RETAIL NURSERY

A retail nursery or garden nursery represents the retail outlet of the nursery industry. Garden centers sell nursery products (planting materials) and production materials (pesticides, simple tools, fertilizers, garden or landscape furniture, and various horticultural literature). The personnel at these facilities include a manager for administrative and general oversight purposes and a plant technician who is knowledgeable in a variety of plant problems and capable of advising customers. A garden center may employ a landscape designer who can design small-scale projects for homeowners.

SUMMARY

Nurseries are depended on to provide planting materials for the landscape. The plants they specialize in are perennials—shrubs, trees, and fruit trees. The site for the nursery should be carefully selected, following the guidelines utilized in selecting a greenhouse site. The site may require some preplanting preparation, including leveling and installation of drainage systems to ensure good drainage. Greenhouse-type structures are often erected for certain production operations and for protecting plants in adverse weather.

The two basic nursery production types are container and field. In container production, the prepared ground is covered with gravel or another suitable natural material or artificial materials such as black ground cloths. Plants produced in the field are marketed as either bare-root or balled and burlapped plants.

REFERENCES AND SUGGESTED READING

Schroeder, C. B., E. D. Seagle, L. R. Felton, L. M. Ruter, W. M. Kelly, and G. Krewer. 1997. *Introduction to horticulture: Science and technology*, 2d ed. Danville, Il: Interstate Publishers, Inc.

OUTCOMES ASSESSMENT

1. Describe the role of the nursery in modern horticultural industry.
2. Compare and contrast bare-root and balled and burlapped tree seedlings as landscape planting materials.
3. Discuss the incidence of cold injury in container nursery production.
4. What are the advantages and disadvantages of container production?