MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 661

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This publication provides introductory information on starting a shade-tree nursery operation in Maryland. In this fact sheet we examine the factors that should be considered when planning a plant nursery for shade trees including site selection, water considerations, basic office and equipment needs, and the advantages and disadvantages of various growing methods for shade-tree production. Refer to Fact Sheet 660 *Starting a Nursery Enterprise: Introduction and Regulations* for an overview of the nursery business in Maryland and a summary of the main regulations that must be complied with to operate a plant nursery in Maryland.

Evaluating Land for Shade-Tree Production

A good evaluation of a parcel of land is difficult to achieve by merely walking or driving around it. Surveying the land from the air or viewing aerial photographs helps tremendously in evaluating a site. Seek information that could reveal potential unforeseen disasters, such as flooding, contamination from nearby dump sites, or previous chemical usage on the land. Ask neighbors what the land was used for in the past. This is important because after the land is purchased, the new owner may be liable for existing contamination. Neighboring lot owners may know if there are old buried fuel tanks or pesticide disposal sites on the land.

Determine how much of the land is useful for nursery production in its present condition. For in-ground tree production, soil that is at least 18 inches deep and generally free of rock is desirable. For container-tree production, a slope of no greater than 2 to 5 percent is best. If extensive grading, graveling, or surface and underground drainage tiles are required, the site may not be worth your effort or expense. Extensive brush clearing on the intended site will add to your cost of establishment. Many counties in Maryland also require that an engineer perform a site analysis if soil grading is necessary. The engineer's site analysis is submitted to the soil conservation agency in the county where your nursery will operate.

When examining land, normally you will find some areas more productive than others. For field production of trees and shrubs, deep, well-drained land should lie in contiguous areas for the most efficient operation of the nursery. Poorer sites on the land can be used for roadways and buildings. Evaluate whether the site would provide good production areas and suitable locations for an office and shipping and handling buildings.

Plan to gravel or pave in areas where heavy equipment will be used (roadways, shipping areas, and parking). Keep in mind that soil composition also affects roadways. A poorly drained area that is muddy in the spring may need extra grading to drain water away from the roads or require substantial gravel to keep roads usable. Although graveling or paving is expensive, the cost is offset by greater efficiency and dependability in handling plants; it ensures reentry in the areas after natural or artificial irrigation, and it can reduce soil erosion. Determine how far from existing paved roads you would have to gravel or pave to make the property accessible. If the distance is too great and the expense too high, then the land may not be the ideal site for your nursery.

It is important to determine if irrigation and natural rainfall will create erosion problems at the nursery site. This may require visiting the site during or following a heavy rainstorm. On a hilly location, you may have to design the nursery rows with grass buffer strips running parallel to the slope to prevent soil erosion. Hilly areas may also present problems with runoff from fertilizer and herbicide applications. If the land has streams located on it, then the State may have restrictions on how close you can grow plant material to the waterways. You may also be required to present a plan on how you will prevent runoff into the waterway.

Influence of Nematode Populations in Selecting a Site

When selecting a nursery location, there are two nematode pests, the corn cyst nematode and the soybean-cyst nematode, that are of concern for nursery operators. The presence of either of these two nematodes will affect where plant material can be shipped. Of the two nematodes, the more serious is the corn-cyst nematode. Presently, this nematode is restricted to parts of Cecil, Harford, Kent, and Queen Anne's Counties. A Federal quarantine prohibits movement of plants with soil unless the growing area has been surveyed by the Maryland Department of Agriculture (MDA) and found to be free of this nematode.

The second nematode, the soybean-cyst nematode, is found in Caroline, Charles, Dorchester, Kent, Queen Anne's, Somerset, Talbot, Wicomico, and Worcester Counties. A number of states have quarantines against this nematode, so if you plan interstate shipments of nursery plants, you must have the land surveyed.

To have a potential nursery location surveyed for these nematodes, call the Plant Protection Section of MDA in Annapolis at 410-841-5920. It is advisable to append a land purchase contract with a clause that states that the sale depends on negative corn-cyst or soybean-cyst nematode survey tests.

Water Issues for Maryland Nursery Operators

A properly designed, installed, and controlled irrigation system is a necessity for a nursery operation; therefore, a good water source is an important consideration in locating a tree nursery business. Although Maryland is in a humid climate, there may be several weeks of little or no rainfall during the hot summer months. The survival and growth of shade trees are affected by low moisture levels, particularly those grown in containers. Container-grown plants need watering on a frequent, if not daily, basis. Field-grown trees usually benefit from irrigation, and producing steady growth to reach market size earlier.

Quantity

Water is lost daily that must be replaced by rainfall or irrigation. The quantity of water needed depends on the crop, the acreage, and the method of irrigation. Overhead sprinklers distribute water over all the ground, whereas trickle, or microirrigation, methods deliver water to individual plants. The amount of water required by these methods differs considerably. Some water is also lost in irrigated fields during water application. A novice grower should seek professional help when planning an irrigation

system. The following paragraphs discuss some of the factors to consider.

Evapotranspiration. Evapotranspiration (ET) is the loss of water from the soil by evaporation and by the absorption (transpiration) of water through plant leaves. The ET rate for field-grown trees can be 0.2 to 0.3 inch per day. In container-grown plants, the rootball is confined to a small soil mass, which retains less water, so a larger amount of water (as much as 0.5 inch per day) must be applied to the container to compensate for water lost through ET. One inch of water over 1 acre of ground requires 27,610 gallons. A rough estimate of the number of gallons of water it would take to replace the amount lost as a result of ET can be made using this figure. For example, if 0.25 inch of water is lost through ET in 1 acre of field-grown trees each day, then 25 percent of 27,610 gallons must be replaced, or 6,902.5 gallons.

Irrigation systems. Overhead sprinklers cover the entire ground surface. During the summer, 25 percent of the water pumped may be lost by evaporation directly into the air or off of the wet foliage. Consequently, only 75 percent of the water pumped would reach the plants, and the 1 inch of pumped water is reduced to 0.75 inch actually absorbed. Given that 1 inch of water over 1 acre of land is equal to 27,160 gallons of water, to net 1 inch of water over 1 acre by using overhead sprinklers, 36,213 gallons would have to be pumped (27,610 ÷ 0.75). In terms of application, a pump moving 100 gallons per minute would require 6 hours to apply 1 inch of water. A pump moving 75 gallons per minute would take 8 hours to distribute 1 inch of water over an acre.

Trickle, or microirrigation, systems deliver water directly to the container or the root zone in fields without broadcasting the water. Studies have shown that using microirrigation can reduce water use by 90 percent. For example, putting 1 inch of water into a container by trickle irrigation when the container's surface covers only 10 percent of the ground surface allotted to the tree reduces water use by 90 percent. This is significant when compared with an overhead sprinkler that disperses 1 inch of water onto 100 percent of the surface—both the container surface and the surrounding ground. Trickle irrigation has great prospects for use with larger containers because the containers are usually spaced apart to allow room for the trees' tops to grow.

Quality

Water quality is important in two ways. Trickle irrigation systems require fairly clean water because the openings on the emission devices are small. Dirt and organic particles must be filtered out. In some situations, chemical activity in the water will cause particles to form that will clog the openings. A water test at an agricultural testing laboratory is recommended. Water chemistry can be complex. The water pH affects nutrient availability and the chemical interactions that can occur in the soil. The useful life of pesticides can be affected by the water pH. Check with other local growers for any known water problems before purchasing property.

Sources

Water can come from a river, stream, spring, pond, well, municipal supply, or any combination of these. The nursery location largely determines the source of water that will be available. The quantity and quality are also variable across the State. In a few areas of the Eastern Shore, a relatively shallow well will yield as much as 600 to 1,000 gallons per minute. In much of the State, however, 50 gallons per minute or even 15 gallons per minute is considered good. Streams and rivers may have abundant water but they are not always located near the business and are therefore not accessible. Adjacent property owners are entitled to use a share of surface water flowing on or adjacent to their property. Quantity and distance will affect the decision on whether to use such a water supply. Pond development may also be limited by the lack of a good pond site or by lack of a continuous water source, spring or stream. Changing regulations concerning wetlands and pond development must be reviewed before any plans are made.

Municipal water systems may cross the property and may be an option for a source. Municipal water is clean and available at a good working pressure. Although it can be costly, municipal water is good alternative when a water-conserving irrigation system is in use. However, there may be some restrictions on use during a drought.

Runoff

Close monitoring of water runoff is essential because pesticides and fertilizers must stay out of the ground water and any surface streams or rivers. To avoid problems, many nurseries use ponds to collect and then reuse (recycle) the water. Recycled water is treated with chlorine or bromine to kill disease organisms. Irrigation systems must be designed to apply water efficiently to avoid runoff.

Nursery operators must develop a water management plan for their property. A grower can keep runoff to a minimum by careful design of the irrigation system and careful handling of rainwater runoff. Culturally, the grower can use contour planting, grass strips, and waterways to control runoff. Excessive use of overhead sprinkler irrigation should be avoided. Where possible, trickle, or microirrigation, systems should be used to deliver water to the crop only.

Local Cooperative Extension Service offices can help design a nutrient management program to reduce the chance of nitrogen and phosphorus runoff contamination into surrounding streams and ground water. This is a volunteer program that can be requested by contacting your county Extension agent.

Estimating Investment Costs for a Nursery Operation

Many nursery operators in the State start with a landscape business or a small greenhouse operation. Over a number of years, they purchase additional land for growing and purchase pieces of equipment as capital becomes available. This may seem an easier method of entering a capital-intense operation such as a nursery. With this type of gradual expansion, however, a long-term plan is essential. Otherwise, a nursery can become a series of expensive learning experiences.

After zoning regulations and operational regulations have been studied, water availability has been considered, and land, market, and labor availability have been examined, it is time to design a central facility and evaluate general equipment needs for operating a shade-tree nursery.

Central Facilities

All nurseries require certain buildings and equipment, regardless of growing methods. This includes an office for keeping records, taking and placing orders, and scheduling. The office needs space for at least one computer, files, and desks for secretarial or accounting support staff. A room 20 feet by 20 feet should be adequate for a small operation. The office must be designed to meet the Worker's Disability Act. You will need to provide workers and customers with two restrooms. Include a shower and locker room for workers. All of the buildings should be insulated, and the office, restrooms, and lunchroom should be heated and air conditioned. A machine shop with storage (approximately 25 feet by 40 feet) is required to maintain your equipment.

Depending on the nursery site, there may be improvements that you will have to perform before constructing your office, storage buildings, and parking lots. There will be costs associated with clearing the land, grading, drainage provisions, and graveling or paving areas.

In field production of shade trees, the best land should be utilized for growing. The poorer soil sites should be used for office and service buildings, parking lots, shipping and receiving areas, and holding areas for harvested trees. A physical layout of the nursery should be developed before any equipment is purchased or building constructed.

In developing the proposed layout of the nursery, you will need to plan for the following: the number and size of buildings, shipping and receiving areas, equipment for shipping and

receiving, roadways, irrigation supply lines, customer parking, employee parking, storage areas, and placement of utilities. In planning equipment needs, allow for future building additions as your business grows. Also, keep in mind that equipment must be repaired and stored to get the maximum use for your expenditure. Additional equipment will be needed if you grow in containers, root-containment bags, or "pot-in-pot."

General Equipment Needed for Shade-Tree Production

When creating a new nursery, there may not be enough money to purchase all of the equipment and buildings necessary for efficient production. These items should still be included in the physical layout, or "master plan," of the nursery. The items can be acquired as needed and as cash-flow increases. Some county zoning boards require a 10-year plan of development for a nursery. Even in a county that does not require this, it makes good business sense. A year-by-year plan for acquisition of equipment and building, as well as placement in the nursery operation, is essential. The worksheet provided on page 8 lists the facilities and equipment necessary for a shade-tree nursery operation with spaces for approximating costs.

Examine which phone systems provide the best service at the least cost, yet allow expansion to accommodate business growth. Basic telephone service, an answering machine, and a FAX machine are necessary from the beginning. Many computers can have a FAX board installed, which would cut the cost of purchasing another piece of office equipment.

Office and field equipment do not need to be purchased new. Money can be saved by checking with used office equipment stores and visiting farm auctions for purchasing field equipment. If you are not mechanically inclined, have a mechanic evaluate field equipment before purchasing. Cost of equipment varies widely—check with local suppliers for an approximate price, and enter these cost estimates on the worksheet. Manufacturers' suggested useful life also ranges widely. When checking on prices of equipment, divide the cost by the projected life of the equipment for an accurate cost comparison. A more expensive piece of equipment that gives a longer life may provide a savings when projected over several years. Also check on availability and cost of replacement parts for equipment. Although the worksheet on page 8 lists the general equipment needed for a shade-tree nursery operation, additional equipment may be necessary to customize a nursery.

Production Methods for Growing Shade Trees

There are several methods for producing trees and shrubs. This section provides general information on the following methods for growing shade trees, including a few of the advantages and disadvantages of each method:

- in ground, in the field;
- in ground, in root-containment bags;
- above ground, in plastic or fiber pots; and
- in ground, "pot-in-pot"(in plastic pots placed in a second plastic pot).

In Ground, in the Field

Planting trees into prepared field soil is one of the oldest methods of shade-tree production. This is still the least expensive means to produce quality shade trees in Maryland. Because both bare-root and balled-in-burlap plants are most effectively dug and transplanted in the spring or fall, the length of time that a nursery can offer trees for sale is limited. Such techniques as the use of shaded holding areas, larger diameter tree-spade rootballs, overhead irrigation systems designed for large trees, and heeling-in mulch have done much to extend the selling time for field-dug trees.

Advantages. Growing trees in the ground is generally the least expensive method if the soil is productive and drains well. Use of field trickle irrigation can shorten the time it takes to produce a desired caliber tree. When field-grown rootballs are transplanted into landscapes with similar soil textures, the rate of successful transplantation is high.

Disadvantages. Each time a tree is harvested from a field, a significant amount of soil is removed. If this soil is not replaced, the field is losing soil that, over time, may reduce its productive capacity. Rootballs from field-produced trees are quite heavy. This may influence sales to homeowners who are planting trees without the aid of a landscape company. The weight factor must also be considered if the trees must be shipped and freight paid on the net weight. Optimum harvest time is limited to spring and fall. Summer harvesting requires using larger rootballs and extensive watering before and after transplantation.

In Ground, in Root-Containment Bags

In 1982, the root-containment bag system became available for production of trees and shrubs. It essentially combined the advantages of growing a plant in a container with the buffer, safety, and simplicity of producing plants in the field. Root-containment bags consist of a porous fabric container that allows plant roots to penetrate the fabric as they extend outward. As the roots grow in diameter, they are restricted by the physical strength and resistance to expansion of the unique fabric. The physical restriction of the fabric causes the root system to branch inside the fabric bag. Difficult-to-transplant trees or trees harvested at less than optimum times during the season generally transplant well when grown with this method.

Advantages. With this system, trees can be dug and transplanted over longer periods of the season than tree-spade or hand-dug trees. The rootball is often smaller and weighs than a burlap plant, so shipping is cheaper. The rootball bottom is flat for easier display and handling. Digging up most tree species grown in root-containment bags is relatively easy and may reduce the need for using tree spades for tree harvesting.

Disadvantages. Installation of the root-containment bag slows the planting of liner trees in the nursery row. Transplanting machines are being developed to speed up this process. Root-containment bags purchased add to the cost of producing a marketable tree. Root-containment bag systems also require a trickle irrigation system to supply adequate water. Because many fibrous roots are retained in harvesting the rootball, the plants must be kept moist and not allowed to dry out while being stored in holding areas. When selling trees grown in root-containment bags, the seller must explain to the buyer that the bag must be torn off the rootball before planting into the landscape.

Above Ground, in Plastic or Fiber Pots

Growing trees in plastic or fiber pots filled with porous, soilless media is becoming extremely popular in the nursery business. With this method, a nursery can grow quality plants and maximize growth by controlling the amounts of nutrients and water provided.

Advantages. Plants in full leaf and sometimes in flower can be marketed at times of the year when field-dug plant material cannot. The container provides a neat package that is easily displayed, handled, and transported in the bed of a truck or back seat of a car.

Disadvantages. The length of time a tree can be grown in a container is limited. Depending on its species, a tree may completely fill a container with its roots. The roots that reach the outside wall of the container will tend to circle the pot. Trees with circling roots often do not establish well into landscape sites unless the root system is modified to encourage branching. When the tree reaches a certain size, it must be sold, shifted into a larger container, or thrown away. New plant-pot designs using vertical ridges, air-slit, rectangular shapes, stair-step shapes, and other innovative designs are helping to improve circling-root problems. Coating plastic pots with copper is also being used effectively to reduce circling-root problems.

Growing trees in containers requires regular irrigation. Failure in irrigation systems can rapidly cause death of trees. Trickle irrigation is the most efficient way to irrigate container-grown trees. More fertilizer is required to grow container-grown trees than field-grown trees.

In Ground, "Pot-in-Pot"

This is a modified method of growing trees in plastic pots. Pot-in-pot involves planting a tree in one container with a shoulder lip. Using a soil auger, a hole is drilled into the ground that is the depth and width of the pot. A second pot, similar in size to the one in which the tree is planted, is placed in the ground. The first pot is slipped into the second pot. The pot with the tree in it is held suspended off the bottom of the second pot by the shoulder lip. A trickle irrigation system supplies the water and nutrients.

Advantages. The tree is more stable and not as susceptible as above-ground container-grown trees to being blown over by the wind. The rootball is below soil grade and is not exposed to root-killing temperatures. When the pot is removed from the in-ground pot, the outside of the pot is relatively clean and ready to market to the customer.

Disadvantages. The purchase of the second pot that is inserted into the ground increases costs. This pot does remain in the ground after the tree in the first pot is harvested and can be reused for additional pot-in-pot plantings. Trees with aggressive root systems will develop roots through the first pot's drain holes and will root through the drain holes of the in-ground pot. This can make harvesting difficult. Using a barrier cloth in the in-ground pot can prevent this rooting problem. Two other disadvantages of growing trees in plastic pots is that large trees are still susceptible to being blown over by the wind and the rootball for many species must be protected against low, root-killing temperatures.

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Equipment Needed for a Shade-Tree Nursery

Item	Approximate cost
Buildings	
Central office (10 ft × 20 ft)*	_____
Employee building (10 ft × 15 ft)* including	_____
• Bathrooms with access for disabled persons	_____
• Locker room	_____
• First aid and safety equipment	_____
Tool storage (10 ft × 10 ft)*	_____
Tractor and implement storage (20 ft × 40 ft)*	_____
Miscellaneous storage (20 ft × 20 ft)*	_____
Equipment repair (20 ft × 20 ft)*	_____
Pesticide storage (10 ft × 10 ft; check with MDA for specifications)*	_____
Vehicles	
Tractor (for general use) 50 horsepower (HP)	_____
Tractor (for field plowing and larger implements and planters) 100 HP	_____
Wagons (for transporting nursery stock from the field to loading area)	_____
Flatbed truck (for transporting nursery plants)	_____
Pickup truck (for light hauling)	_____
Other Equipment	
Office equipment	
• Telephone	_____
• FAX machine	_____
• Desk(s)	_____
• Computer	_____
• File cabinets	_____
• Bathroom	_____
• Copier	_____
	_____
Planting equipment	
• Plow	
• Chisel plow	_____
• Disk	_____
• Harrow	_____
• Cultivator	_____
• Tree planter	_____
	_____
Fertilizer (Cyclone type)	_____
Pesticide equipment	
• 100-gallon sprayer	
• Boom sprayer (for applying herbicides)	_____
• Backpack sprayer (for spot treating for insect and disease management)	_____
	_____
Maintenance equipment	
• Mower (48 inches)	
• Hand tools (pruners, saws, shovels)	_____
	_____
Harvesting equipment and supplies	
• Adjustable 28/36/42-inch tree spade	
• Pallets for loading stock	_____
• Wire baskets and burlap	_____
	_____
Miscellaneous	
Tree holding facility (a shaded structure with irrigation for holding harvested plants)	_____
Loading ramp (for shipping and receiving of nursery stock)	_____
Front-end loader	_____
Tree sling on forklift	_____
Skidloader	_____
Total estimated costs	_____

*Minimum suggested sizes.

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