

## Nursery Field Production

(Revised 8-2009)

Mark Halcomb, UT Extension Area Nursery Specialist

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### THE NURSERY INDUSTRY OF MIDDLE TENNESSEE

The Nursery Industry of Middle Tennessee has been dubbed "The Cradle of the Plant Kingdom", "Nursery Capital of the South "and" Nursery Capital of the World". Whoever did the naming has never visited Apopka, Florida; Semmes, Alabama; Oregon or Boskoop Holland. The industry is 500 years old in Boskoop. The nursery industry of Middle Tennessee was about 125 years old in 2000.

Middle Tennessee does have a favorable climate, adequate rainfall, a unique topography, and a soil that will ball; which is all conducive to nursery production. Traditional nursery production in Tennessee is in the field. McMinnville is generally about 900 feet, while the plateau is generally about 1800 feet above sea level. Many unique micro-climates are created where the valley meets the plateau. Plants raised on the plateau can be shipped two zones north; greatly expanding our market.

"The Cradle of the Plant Kingdom" title was probably created to describe the large plant diversity that naturally occurs. The Tennessee Nursery Buyers Guide is a good indication of what is grown here. It currently lists 285 different plant genera, 606 species and 1368 selections (varieties & cultivars). A 200 acre nursery at random grows 71 different plant genera and 254 selections. Because they offer plants in different sizes, they have more than 800 entries in their catalog.

While Tennessee ships plants worldwide, 60 percent of the market is in the north and northeast. Approximately 47% of the U.S. population lives within 800 miles of Tennessee. Tennessee produces 70% of the nation's dogwoods. Franklin Co. will produce most of them; with 7 producers that plant dogwood seed by the ton. Dogwoods may account for \$40 million of Tennessee's annual sales.

The Tennessee Dept of Agriculture has certified nearly 40,000 acres of nursery stock in Tennessee; with 30,000 acres in the 6 Middle Tennessee counties of Coffee, DeKalb, Franklin,

Grundy, Warren and Van Buren. These six counties were responsible for \$76 million of Tennessee's \$117 million in gross sales (Tenn. Agr. Statistics—'93 Nursery Survey) Tennessee's nursery and floriculture industries total sales and services generated gross sales of \$480.5 million the same year. Tennessee had \$124 million in gross nursery sales according to the 2000 USDA Nursery Crops Survey. Calif had \$934, Oregon had \$508, Fla. had \$479, Michigan had \$166, N.C. had \$154, Ohio had \$107, Texas had \$101, NJ had \$90, Penn had \$86, Ala had \$86. Kentucky's Nursery Industry contributed \$60 million in 1998 to their state. Nationally, the nursery industry was worth \$47-50 billion in 1997.

## **GETTING STARTED**

The nursery industry is a very wonderful and exciting business. The production of plants for profit has the potential of providing many personal and financial rewards. However, as with many other farming enterprises that appear to be very simple on the surface, the nursery business is very complex and requires a great deal of knowledge and skill not only in production, but also in labor management and marketing.

Since nursery plants are agricultural crops, a great deal of risk is also involved from uncontrollable factors, such as the weather. Premature freezes, late freezes, flood, drought, wind, ice damage, insect, disease and theft are all potential problems. Producers generally experience some losses each year. Multiple locations at different elevations, irrigation, and genus diversification offer some protection.

**Nursery production is viewed by many as an alternative crop to failing traditional farm enterprises.** But a poor manager will be a poor nursery manager.

Many potential producers do not realize the skill and knowledge required to produce a quality nursery crop in the field. Another crucial item that is often under-estimated is the amount of money that is required to produce a salable plant.

Production of nursery stock is both an art and a science. Many skills are best developed through observation followed by practice, not only from reference books. If possible, work at a successful nursery to get a feel for the seasonal and day-to-day activities and production practices used.

A successful nursery producer needs knowledge of plants, soils, fertilizers, pesticides, irrigation, machinery, pruning, harvesting methods, overwintering techniques, packing and shipping practices, plumbing, electricity, etc. **It is not just casting seed to the wind and watching the trees and profits grow.**

Starting a field nursery requires large amounts of capital. Fixed costs include the price of the land, grading, road construction, and buildings.

Variable costs also can be quite high. A manager will be required as well as several laborers on large nurseries. Variable costs include fertilizer, lime, liners, and interest on operating capital. In 1987, \$5,000 to \$7,000 per acre were needed to establish nursery stock on existing

land. About \$2,000 to \$3,500 per acre was necessary to maintain crops each year until harvest.

Harvest does not normally begin until three to five years after initial planting. The break-even point occurs five to eight years after the first planting, with new plantings made each year.

In 1984, a McMinnville CPA figured that the average dollar value per acre per year of a nursery field operation was \$5721. In 1994, an experienced Warren County nursery producer said that, "A grower needs to turn \$2000 per acre per year to be successful."

With proper planning, plant selection, management and marketing; nursery field production can be highly profitable and rewarding. The market is there for the innovative marketer of high quality stock.

Beginning nursery producers can benefit from the resources and assistance provided by their Extension Service, the Small Business Admin., local and state nursery associations, the Natural Resources Conservation Service (NRCS), the Farm Service Agency, etc.

The Tenn. Dept. of Agr. (TDA) Plant Protection and Quarantine requires a \$200 annual certification. Contact the McMinnville office at 931-635-2783 or 931-815-9725 or the TDA Nashville office (615-837-5148) to learn how to contact your local TDA nursery inspector. A copy of the issued **plant certificate** (also referred to as a plant license) must accompany each wholesale plant shipment regardless of size as proof of being pest free following inspection. Various treatments are required to cross some state lines and some county lines because of quarantined pests.

One crucial item that is often under-estimated is the amount of money that is required to produce a salable plant. A thorough financial plan must be made prior to construction to see if capital is available to make the nursery a success. It is very important to know your own cost of production. If you simply set your selling prices from other producer's catalogs, you may be selling your plants below your cost.

There were many new entries into the industry during the late 80's and early 90's. Several never sold a plant. Some sold under current market prices trying to re-gain their investment. \$80 trees were sold for \$15. Most did not make it. Those that made it, threw themselves totally into it. They lived it, reading, visiting, attending educational seminars, networking with peers, etc. It also comes down to supply and demand. During shortages, by the time that a new producer can have product for sale, so can those that are established. Most present nurseries have a 20+ year market base.

The University of Tennessee Extension has management specialists available to help determine production costs of the various nursery crops. Labor is the most expensive item in the nursery, and can be the most challenging to manage. Producers list labor as their worse problem, even above weeds. Today's labor force speaks Spanish.

A **liner** is a young plant ready to be planted in a field or container. A liner may be 6 inches tall or 6 feet tall. It may cost 35 cents or \$35. It may have been produced from a seed, a rooted cutting, by grafting or from tissue culture.

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If new to the industry, invest time studying books, extension publications and trade magazines before deciding to invest money starting a nursery business, regardless how much you may love plants or think you know. Visit experienced successful nursery producers and observe their layout and inventory. Ask what they would do differently if they were starting all over. There is a separate document entitled "Reference books, trade magazines, and nursery associations".

[Refer to web site.](#)

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Occasionally, an individual requests information about growing nursery, but is interested in the production of annuals (or bedding plants), perennials or hanging baskets. These are floriculture or greenhouse crops. The word '**nursery**' obviously can mean different things to different people. Nursery generally refers to woody ornamentals: shrubs and trees; but groundcovers and several of the herbaceous plants are usually included as well.

**There are several DIFFERENT ASPECTS OF THE COMMERCIAL NURSERY INDUSTRY.**

The nursery industry is very **diverse**. **You could produce ornamental plants:**

By propagating **liners from seed** in beds or field rows **or from cuttings** stuck in ground beds, with or without a poly covered Quonset house over the beds to sell to other nurseries.

By propagating **budded tree liners** in field; such as pink dogwood, Bradford pear, etc., to other nurseries.

By propagating and growing **ground covers** such as ajuga, Wintercreeper Euonymus, ferns, ivies, daylilies, hosta, monkeygrass, pachyasandra, phlox, vinca, etc., and selling to retailers, landscapers, landscape contractors, re-wholesalers, etc., retail and wholesale.

By growing shrubs and trees **in the field, harvesting B&B (balled & burlapped)**. Must be more than 10 acres to cash flow, primarily because of the many pieces of specialized equipment required. Many of the flowering and shade trees are 5 year crops on average. Requires land, labor, money, experience, knowledge and specialized equipment.

By growing shrubs and trees in containers, up to 45 gallon. 5 to 10 acres. **Conventional container production** requires a dependable source of quality water (tested for irrigation suitability), such as a good well or stream, sufficient for approximately 200-250 irrigations per year, with 27,000 gallons required per acre per day (equals 1 acre inch), catch basins to avoid run-off leaving the property, overhead sprinklers with uniform distribution, a 4 inch gravel base or fabric, overwintering structures, knowledge and experience. Labor intensive. Can't leave.

[Refer to web site for a handout.](#)

**Pot-N-Pot Production** is the production of shrubs and trees in 5-25 gallon containers spaced 3x6 feet apart. Holes are augured, with an injection molded container sank up to its rim. This holder or socket pot may last 10 years. The plant is planted into a less expensive blow-molded container, which sits or nests in the holder pot.

Plants are overwintered in place, no overwintering structures required, no gravel, no blow over and little water, with no run-off. Spray stakes are placed 1 per container and are fed by a spaghetti tube from a 3/4 inch lateral running down each row. Cost estimates can run \$20,000 per acre to set up when nothing is present, or \$15-25 per 10 gallon pot. [Refer to web site.](#)

**You could be in the nursery industry involved in buying and selling  
or planting the plants that someone else produced:**

Set up a **Re-Wholesale lot** near a major city. Keep it well stocked with quality B&B and container plants. Could require several hundred thousands of dollars: land, equipment, overwintering houses, inventory, labor, utilities, etc.

**If you liked milking, open a Retail business, a garden center, but;** location, location, location. Buy all plants, locate on the right side of road when leaving town to facilitate stops on way home. Excellent quality, labor to care for and load, knowledgeable staff to answer questions, line of pesticides and hard items, overwintering houses, greenhouse to sell quality houseplants from, offer re-potting service, maintenance.

A **broker** sells and then buys from the producers. He prints a catalog, advertises and exhibits at trade shows. After a few years, you learn what plants are scarce, plentiful, difficult to produce, in demand, etc. Production can begin after the customers are found. A few nurseries started this way.

Large nurseries have **traveling sales** personnel or professional brokers on the road.

There are businesses that **design** landscapes, there are companies that **build and plant** what the designers design and there are companies that specialize only in the hard scapes and those that **maintain** the completed site. A very few companies do it all.

A good relationship with a few good, active designers could keep a small labor force busy just installing (planting) the plants.

A pickup truck, pruners, a rake and some knowledge can get someone started in **Landscape Maintenance**. Come to think of it, the knowledge part is optional. Anyone and everyone mows, so decide if you will. Mowing may get you in the door; sub it out later. But don't shear all plants into round or flat-top boxes. Learn selective pruning.

Additional thoughts ....

Nursery crops are **planted and harvested during the same season**, while dormant, Oct through March generally. **The nursery producer does not take the products to an elevator,**

**gin, warehouse, livestock barn and take the set price that is being paid that day. The nursery producer must decide and plant today, what will be offered for sale in 5 years, (assuming 2" caliper shade trees).**

The nursery producer must print business cards and a catalog, travel to and exhibit at nursery trade shows, have a fax, a computer, an office, secretary/bookkeeper, labor, etc., in order to attract **a buyer, who is not known, who may haggle for a lower price and then may never pay after delivery that the producer must arrange.** Every nursery suffers some annual losses from pests or weather. It is very difficult to collect from out of state buyers that do not plan to pay for the third load.

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## **WHAT SHOULD BE GROWN?**

Consider the question, "What plants can I sell and to whom can I sell them?" There are thousands of plants from which to choose. Not only must a producer choose what plants to grow, but a producer needs to be able to predict the market needs 3-10 years ahead, to allow lead time for the propagation and (growth) production of the mass numbers of plants.

A good marketing program could help create a demand for a particular plant but change comes very slow in the nursery and landscape industry. A general rule is to produce about 70% of the tried and true plants such as sugar maple, dogwoods, pin oak, 'Andorra' juniper, 'Manhattan' euonymus etc., and 30% of the plants that appear to have a bright future such as clethra, fothergilla, deciduous holly, serviceberry, sourwood, hostas, Japanese maples; and improved, disease resistant cultivars of redbud, dogwood, red maple, sweetgum, crabapple, hibiscus, hydrangea, crapemyrtle, magnolia, viburnum, etc.

To whom will the plants be sold? Generally, retail garden centers sell common varieties such as red azaleas and white dogwoods, (the tried and true plants); while landscapers sell named cultivars such as 'Cloud Nine' or 'Cherokee Brave' dogwood.

If the target audience is the landscape trade, then more emphasis should be placed on growing quality cultivar named plants. Landscapers are usually more knowledgeable of the desirable traits possessed by some of the selected cultivars.

Unfortunately, the ordinary home gardener's knowledge is generally limited to selecting pink or white dogwoods; or pink, white, or purple azaleas; and they usually are not as willing to pay for; or are uneducated to benefits such as disease resistance, better bloom, improved fall foliage color, etc., provided by the improved cultivars.

In order to learn what plants to grow, one could: 1) contact as many potential customers as possible and ask their opinion on what plants are in constant demand, short supply or have potential for their market; 2) observe the most commonly used plant material going into new landscapes; 3) broker (buy & sell without growing) while noting which plants are in constant demand, over planted, short supply, or which plants quality is difficult to find.



Once the crops to be grown have been selected; propagation, production and potential insect and disease information should be gathered. There is a large resource pool from which to draw general information on the production of nursery crops.

However, there are very few crops in the nursery industry that have written cookbook recipes for production. If available at all, the information is usually scattered in many different places and many contradictions will be found. After all, there is more than one way to propagate or produce a quality plant. That is one reason why no two nurseries are just alike.

It is best to concentrate on only one aspect of production (propagation, container, field, Pot-N-Pot) when first getting into the business. Consider buying liners until the business is running smoothly and only then consider producing some of your own liners, if thought to be advantageous. However, one could start a liner nursery and concentrate on that aspect of the business and sell liners rather than landscape size plants.

Marketing is an extremely important part of the nursery business and should be given equal status and attention to production. Marketing efforts should begin as soon as the commitment has been made to start a nursery business. Producers should begin to attend nursery meetings, trade shows, retail and landscape contractor meetings, during the first year of production, if not before.

Proximity to other nurseries can be an advantage. Through cooperative buying, marketing, shipping, and sharing of technology and equipment, costs can be reduced. A common practice among nurseries that are close, is to pool plants to make up shortfalls in numbers, sizes or species to fill orders.

There are three major areas in which nursery producers compete: price, quality and service (delivery). It is very difficult to compete with larger nurseries on production costs. Therefore, new competition must strive to produce higher quality plants and provide better service.

Another area in which smaller nurseries can compete is by doing something a little different in marketing or in inventory. Smaller nurseries can fill a niche market by producing specialty nursery crops. These are crops that are not in large enough demand to warrant high volume production or plants that require special skills and handling.

Some specialty nursery crops might include dwarf conifers, wildflowers, ferns, groundcovers, large container specimen plants for patios, native plants, bonsai, topiary, espaliers, rare or collector plants, new introductions, or crops which may require special seed handling, pruning, production, or propagation skills.

Remember that dealing in specialty plants requires a larger market area to reach potential buyers. This market is often accessed by mail order catalogs and classified ads in garden publications.

A well landscaped sales and office area should be included in the plan to show horticultural knowledge and appreciation and pride in the profession as well as exhibit plants for potential customers in an attractive display.

## **SITE EVALUATION of a POTENTIAL NEW NURSERY FIELD**

Desirable traits of a good nursery soil are: A deep, friable, well-drained (internally, as well as on the surface) silt loam with no fragipan; good moisture retention; the ability to release moisture to the crop; less than 5 percent slope, no erosion; no rocks; high in organic matter; ability to percolate or infiltrate moisture; good response to management, lime and fertilizer; a deep permeable root zone that is well aerated; never flooded and hold together when dug as a soil ball is essential. Soils that will not ball can be used to grow crops harvested bareroot.

It makes sense to purchase land with a high percentage of the better soils. Plant the crops that require good internal drainage on the better soils. A deep well drained soil with good water holding capacity and good response to management may grow a 2 inch caliper shade tree a year faster. Nursery producers must consider the capability of the soil and the availability of water for irrigation.

Steep slopes, wet areas, rock out-croppings, and shallow soils should be avoided. The steepness of the slope is important when considering tractor safety, potential irrigation practices, and potential soil erosion. Are there low areas which may create frost pockets where cold air settles? (Plant the more cold hardy species here.)

Check what the property taxes are for the proposed site. Are there any liens? Check the zoning restrictions; investigate future plans for the surrounding land. Build permanent structures and greenhouses far enough from the road to allow for future widening of the road; to avoid relocation expenses.

Will any heavy industries in the area pollute the air or water, adversely affecting plant growth? Check water which may wash on to the property. Could the water contain harmful pesticide residues, nematodes, or diseases? Pesticide residues and/or nematodes from upstream can be brought in with flood waters and spread out over a bottom field.

Existing buildings can be modified and be very useful; cheaper than building new ones at today's prices. But sometimes, it is better to tear down or move buildings rather than force them into an unworkable design.

It would be wise to learn and study the cropping history of the site for the previous ten years. A soybean history reflects the possibility of soybean cyst nematode, which is a quarantined pest. Soil or plants grown in soil infested with soybean cyst nematode cannot legally be moved. A nematode sample taken any month would determine their presence. A nematode is a microscopic, parasitic worm that attacks plant roots.

Members of the *Prunus* family, (peach, plum, and cherry) and also tomatoes, pepper, tobacco, and okra may increase a root knot nematode population. Root knot nematodes will attack most

of the major nursery crops in varying degrees. Sample the soil June through November, since these nematodes die during the colder months and their population does not rebuild until June. Contact your local Extension office for assistance in how to collect and where to send a sample of soil to be tested for the presence of nematodes, the type and population. At this writing samples can be sent to a commercial lab or out of state as Univ of Tenn no longer offers this service.

Inquire as to the herbicides used in the previous two years. Rates and method of application (broadcast vs. band) are important. Certain herbicides may persist, such as Atrazine, AAtrex, Scepter and Classic depending on rate, method of application, rainfall since application, and how recently it was applied. Persistent herbicides may damage roots of young nursery liners planted the following spring.

Soil maps (and possibly aerial photos & topographical maps) are available from the Natural Resources & Conservation Service (NRCS) (formerly SCS) office which is now part of the Farm Service Agency located in the county where the land is located. These are extremely valuable to determine if the soils will be suitable for nursery field production; if the soil will drain internally sufficiently well.

Soil maps indicate the soil type, soil depth, depth to bedrock or to a fragipan, response to lime and fertilizer, ability to drain, ability to supply moisture, and primary uses. This is extremely useful information. A list of the best soils and soils to avoid for several Middle Tennessee counties are presented in a document on the web. Obtain a map with the soil lines and symbols drawn on it. Compare the list to the soil list on the web site.

Survey the fields for problem weeds such as johnsongrass, bermudagrass, briars, thistle, nutsedge, ragweed, fescue, orchard-grass, sicklepod, etc. It is wise to eliminate perennial grasses and weeds prior to planting. Fescue fields converted to nursery crops are frequently infested with ragweed the first few years. Hay and pasture fields frequently have a population of grubworms. Several crops and especially dogwood liners have died following the first growing season from extensive root feeding of the grubs.

If the land is obtained in time, or if all of the acreage is not planted the first year, plan on building the soil by planting a Sorghum-sudangrass hybrid, such as Sudex, to be plowed into the soil to increase the organic matter content of the soil. Refer to the Soil Conservation section.

Land must be near major roads so the nursery stock can be hauled to market. It is convenient to load large plants directly onto a semi-trailer in the field, and avoid an extra move. Inspect bridges, curves, low tree branches and wires to avoid a last minute surprise.

## **NURSERY CROPS THAT FAVOR OR WILL TOLERATE MOIST SOIL CONDITIONS**

[Refer to web site.](#)

## **EQUIPMENT NEEDS and ESTIMATED COSTS (03-2003): *optional items are in italics***

While some nurseries may have and use every item listed below, some items could be borrowed

A **pick-up truck** and / or a **ton truck**. Consider 4-wheel drive, diesel.

A **55 or > hp tractor**; consider 4-wheel drive, cab - for soil prep, transplanting with larger transplanter, operate air blast sprayer, 8 to 12' rotary cutter, add front end loader perhaps.  
55 (PTO hp) 4-wheel drive, with cab and bucket \$37,500

A **35 hp tractor**; consider 4-wheel drive, cab — for operating smaller transplanter, air blast sprayer, 6' rotary cutter; front end loader optional.

A **20 to 35 hp tractor**; consider 4-wheel drive. Narrowness is primary importance for cultivation, mowing, sidedressing fertilizer, spraying between the rows. Should be no wider than 40" for use in 5' middles.

30 (gross hp) 4-wheel drive, JD 790, power steering \$11,200

If producing bareroot stock, a **high clearance, off-center tractor** is needed. A 1-bottom plow, narrow disc, fertilizer side-dressing buckets, an undercutter blade to root prune and lift bareroot are standard equipment.

For soil preparation prior to planting: plow, disk, chisel plow, Rotary Tiller, etc.

Narrow disk, cultivator, tiller, etc., to keep middles clean.

Back-pack sprayers

50 gallon sprayer: boom, handgun, spray arm mounted on front bumper to band spray; 1/4 quarter cut-off valve mounted on fender.

Multiple wagons or trailers to haul B&B from field. Must be strong, extra support, (3-axle), extra ply tires.

A clover seed drill

Misc. mechanic, electrical, plumbing tools; chains.

Assorted nursery hand tools: hoes, hand pruners, Loppers, pole pruner.

Enviromist mounted on a small tractor.

\$3,700

Mechanical lifting devices to load B&B balls.

Air blast sprayer, 3-point hitch, Jaccto J-400

\$5,000

Rotary cutters: a 3 to 4' for row middles; a 6 to 12' mower for roadways, field borders, etc.

Widths depend on width of row middles, tractor horsepower, acres involved, & capital available.

Rotary cutter, 3-4' \$ 700

Rotary cutter, 7' (choose a 7', 8' or 10' width) \$2,300

Rotary cutter, 10' \$4,900

Rotary tiller, 38-40" (several models vary in quality; \$1000, \$1500, \$1650, \$2600) \$1,650

Rotary tiller, 90" or 7.5' (quality varies with brands) \$3,600

Disc, narrow, sealed bearings, Rigsby Manuf.

\$800

Depending on the size of liners planted: **1 to 3 transplanters** may be required: One for small liners with an 8" shoe opening; a larger model with a 12-18" shoe; and one that can handle the \$20 west coast liners with a 24" shoe. The shoe is the metal foot that opens a soil slit or furrow to receive the roots.

Transplanter, adj. opening 2-7", for 1 gal, (several local manufacturers)	\$1,635
<i>Transplanter, adj. opening 2-14", for 5 gal, (Refer to web site)</i>	\$3,885
Transplanter, stationary opening of 18",	\$4,685

Clover Drill (locally manuf.) Rigsby Manuf 931-686-2125 or Pack Manuf 931-473-1604 \$1,500

Vicon Fertilizer Distributor to broadcast or band, Rigsby Equip.931-668-7754 \$1,800

*Turning plow, used, 3 bottom* Approx. at auction sale \$1,500

Chisel plow, 7-8' wide, used Approx. at auction sale \$1,000

Disc, 10' wide, used Approx. at auction sale \$2,500

### **Mechanical harvest:**

To harvest bareroot, a side-band digger mounted on a 3-point hitch tool bar of a 65+hp tractor or behind a hi-clearance cultivating tractor. The side mounted digger can bareroot 6+ foot liners.

A mounted tree spade is a major purchase. A new producer might purchase a spade that will dig 20 to 24 inch balls during the 2<sup>nd</sup> or 3<sup>rd</sup> year of production and another spade that will dig 24 to 28 inch balls during the 3<sup>rd</sup> or 4<sup>th</sup> year. Reconditioned spades may be purchased for 60% of a new price with a full warranty. A skid steer or articulating loader is the preferred vehicle for mounting, but spades for a 3-point hitch are available for 45 hp tractors and larger. They are much slower and more cumbersome to operate, requiring wider plant spacing or more culls are created by the damage caused. A 3-pt. 30" spade might be \$10,000 mounted.

A Caretree 32" spade mounted on a Bobcat complete, cost approximately \$40,000. A truck and trailer will be required to haul it between farms or for service. Approximate costs of different items, as of Nov, 2001:

- a Caretree spade to dig 20" balls – \$6,100
- a Caretree spade to dig 24" balls – \$7,600
- a Caretree spade to dig 30" balls – \$8,800
- a Caretree spade to dig 32" balls – \$9,700

A Bobcat skid steer, with tracks -\$2500; rear stabilizer-\$1300; bucket & or forks to load with.

Contact Caretree Systems at 1-800-227-3873 \$27,000

A John Deere skid steer, with tracks, rear stabilizer, bucket & forks \$24,150

## **LAYOUT OF A NEW FIELD**

Surprisingly, roadways, field borders, fence rows, wooded areas, and areas too steep to cultivate can easily account for 30-40% of a nursery field in middle Tennessee, leaving only 60-70% of the space available for production.

Run rows across the slope to reduce the speed of water run-off and resulting erosion whenever possible. The NRCS may be able to assist in laying the rows out on contour, but contact them early to avoid delays in planting.

A field is divided into blocks, separated by 10-12 foot wide grassed roadways. Primary roads in a nursery field need to be 15-20 feet wide. Roadways are used by trucks, tractors, and harvesting machines to perform the various maintenance, planting and harvesting tasks.

The number of rows in a block is affected by:

1. The distance that one prefers to carry heavy balls out of the block. Trees from the middle row of a 9 row block must be carried across 4 rows to the nearest roadway to be loaded. A ball may weigh 100 pounds or more. Labor must also be careful not to step in previously dug holes.
2. The distance an air blast sprayer can effectively penetrate foliage to control insects and diseases. Ten or 12 rows of shade trees might be effectively sprayed, while only 6-8 rows of needle evergreens (pine, hemlock, arborvitae, etc.) could be effectively sprayed. Thorough coverage is required to control spider mites on a dense, sheared 6 foot hemlock. While the spray mist may be seen traveling 50 feet or more, it may not penetrate the back sides of the hemlock in the fourth row over. The miticide must be blown through the foliage.
3. Steeper slopes require additional and wider sod strips (roadways) to reduce the speed of run-off water and to catch (filter) soil particles from the blocks above.

## **PLANT SPACING**

Nursery plants, like all commodities, become scarce or too plentiful from time to time. Following good demand, the supply dwindles until supply catches up; then the demand may diminish, creating an oversupply. Frequently, new producers with little knowledge and experience enter the industry during those reduced supply periods. Too much planting can lead to an oversupply in 3-5 years. When new producers can't find a market and can't sell their products easily, they tend to dump their products very cheaply and get out.

Large quantities of plants dumped on the market at a low price cheapens the product and hurts the entire nursery industry for everyone for many years. Buyers tend to suspect that the regular price was inflated all along, while it could actually have been a break-even price.

The most common and one of the most expensive mistakes new nursery producers make is planting liners too close together in very narrow rows. Many are unable to get their equipment down the middles by the third summer. The field becomes over-grown with weeds and is often abandoned. Evergreen plants, such as hemlock and Foster holly develop a narrow base due to the lack of sunlight reaching the lower branches. Over-population drastically affects quality.

New producers frequently plant close on purpose, believing more plants per acre will equate to a greater profit. They plan to maintain the unwanted vegetation in the middles with a tiller or lawn mower. They also plan to dig every other plant early which would allow additional space for the remaining half. Good ideas, but I have witnessed more failures than successes.

New producers frequently have a full time job, may not have nursery experience, lose motivation during the heat of the summer, every other plant may not become salable, and the new producer may not find a market for his inventory.

All plants do not grow equally with straight, full, well branched trunks and canopies. Some plants will be unsalable. Crowded plants compete for moisture, nutrients and sunlight; creating more low quality plants. A chain saw may be the only remedy after a point.

Inexperienced, new producers assume that the more trees planted per acre will naturally equate into more profit per acre; that they will produce only salable plants, with good heads (no culls), that can be harvested row run with no injury, that the market will be good when they get there and that a buyer is waiting for what they have, whose check will be good.

A new producer does not know when or to whom the plants will be sold. If sales don't do well, a wider spacing will allow the plants to survive another year or two until sold without jeopardizing quality.

Close spacing also makes weed control, mechanical harvest, disease and insect control more difficult. If mechanical digging is attempted in narrow rows, the machine must move slowly down the row. When the tree is selected, the driver must pivot the machine. He may scrape two trees behind the machine in this operation. While digging one, 1-3 adjacent plants may be damaged. Narrow row, side mount diggers are on the market today helping to avoid this problem. They are manufactured locally.

The anticipated plant size to be dug, any intermediate harvests, and the type of harvest (hand or mechanical) are the primary considerations to determine in-the-row spacing. A general rule is to plant trees 3 feet apart for each inch of anticipated trunk diameter. For 2-inch trees sold balled and burlapped, the in-the-row spacing should be 5 to 6 feet, with 9 to 12 feet between rows. Middles should be at least 4 feet wider than the widest piece of equipment to be used in the middles.

A popular practice within the industry to conserve space is to plant short term crops between long term crops that are planted in wide middles. A row of flowering shrubs can be planted between two rows of Southern Magnolia for example.

Don't plant within 50 feet of a wood line, due to sunlight and root competition. Don't plant too close to a fence, brush pile, or building that will prevent a tractor from being able to work.

If land is not limited the first few years, space wider. This will be better for the plants, allow faster machine work, and could allow present equipment to be utilized without the costly expense of buying new narrow equipment.

Wider spaced plants will not be shaded and will have longer and stronger lower side branches. Therefore, a normal shape will be achieved. Also, it will be easier for labor to walk around a plant when they prune, shear, spray or dig.

"Remember, it is not how many you plant per acre, but how many you sell". . . and collect for that leads to success, according to Dr. Carl Whitcomb. Over-crowding of trees or shrubs results in poor form and low quality. These plants will be unsalable to the discriminating buyer.

## **A PLANT SPACING CHART**

[Refer to web site.](#)

This chart gives the number of plants per acre, at various spacings. It assumes no roadways, which are essential. For example, a 6' middle and a 4' in-row spacing allows 1,815 plants per acre. A 7' middle with 6' between plants allows 1,037 plants per acre.

## **FERTILITY BEFORE PLANTING**

Soil test to learn the pH (degree of soil acidity or alkalinity), available phosphorus (P), and potassium, (K). The University of Tennessee Extension soil lab charges \$7.00 for this basic test and the results are returned within 7-10 days.

Contact your local county extension office for assistance in soil sampling, mailing boxes and instruction sheets. But you may print your own forms and instruction sheets at <http://soilplantandpest.utk.edu/> Quart ziplock bags may be used and eliminate a trip. Label the bag with a waterproof marker, perhaps onto masking tape.

Artificially drying wet soil samples messes up the soil chemistry and makes the results invalid. Dry by spreading out on newspaper overnight and crumbling it up before it dries too hard. Proper soil sampling and testing will provide a recommendation that will save money by:

1. avoiding excessive and wasteful use of fertilizers,
2. adjusting the soil pH for optimum growth of the intended ornamental crop. If the pH is already too high for the specified crop, suggestions will be made as to ornamental crops that can tolerate or benefit from the higher pH. [Refer to web site for a list of ornamental crops that can tolerate an acidic \(low pH\) or an alkaline \(high pH\) soil.](#)
3. maximizing plant growth.



Sample blocks before they are replanted. Soil samples can be collected any month of the year, when time is available. Samples can be taken during the summer or fall, from blocks that will be cleared during the winter.

Broadcast the recommended lime, phosphate and potassium anytime prior to planting. Rates of fertilizer nutrients will be provided as pounds per acre; rates for lime will be as tons per acre. This is much better for the crop than side dressing all of the nutrients. Bulk blended phosphate and potash is cheaper than a complete bagged fertilizer containing nitrogen, phosphate, and potash and can be spread by the fertilizer dealer or the producer with a dealer provided buggy. Dealer provided buggies are also available for the producer to spread small quantities of lime with a tractor.

It is much easier and more beneficial to the crop to apply fertilizer to a field prior to planting than after the fact. Some elements move very slowly in the soil, such as calcium, sulfur, phosphorus and potassium. These elements should be incorporated. If levels of these nutrients are brought up to a high level, all that may be required for the next few years will be a nitrogen source.

Incorporate these fertilizers to a depth of 6 to 10 inches. The major objective is to provide the optimum nutrients to establish a good root system. If the roots are healthy, the top will grow.

The amount of fertilizer required depends on the amount of nutrients that are already present in the soil. If the soil test indicates a low level of available phosphorus or potassium, add about 150 pounds each of actual phosphate and potash per acre. If a 0-20-20 analysis fertilizer is used, 750 pounds of actual fertilizer would be required (150 lbs/acre divided by 0.20). If the test shows a medium level of these nutrients then half as much fertilizer would be required.

The amount of sulfur or lime required to adjust pH depends on the current pH, the particular soils' buffering capacity, and the pH requirements of the plant to be grown. Producers should test for calcium and magnesium to see if levels are adequate and if a proper balance exists between the two. Too much of either one of these elements may inhibit the uptake of the other resulting in a deficiency.

Research on hemlocks has shown that a ratio greater than 10:1 (calcium to magnesium) may cause a magnesium deficiency. It is important to specify the crop being grown so that proper recommendations can be made.

### **OPTIMUM SOIL pH RANGES OF COMMON NURSERY CROPS**

[Refer to web site.](#)

A discussion concerning the importance of pH and a list of the commonly grown ornamental's preferred pH ranges is provided as a separate handout at the web site.

### **GENERAL LINER CARE**

**Liners** — The word 'liner' is a common nursery term applied to a plant which is ready to be "lined out" in the field or planted into a container for further growth. A liner could have been

produced as a cutting (asexual propagation) or as a seedling (sexual propagation); bed grown or field grown; bareroot or potted; 6 inches to 6 feet tall.

The heart of any liner is the root system. A large healthy fibrous, well branched root system is essential. A good top is also important, and it should be straight, stocky, well branched, etc. A top cannot live without good roots. The term 'mop head' is a good description of what a desirable fibrous root system should look like.

The roots of a 2 year old liner are enhanced greatly by a procedure called 'root pruning' practiced by some nurseries in November or December of the first year. The roots are undercut by a spade or blade. The resulting root growth is much more branched and the plant has a better chance for successful establishment in the landscape or as a liner to be grown-on.

A reliable source of quality liners is essential. Some nurseries specialize in the production of liners. Many field nurseries grow some of their own liners. They may do this to produce better quality than they are able to buy, to grow new or scarce cultivars not yet available in sufficient numbers, to sell for added income, or to have the liners available on short notice in order to transplant into the field when the soil moisture conditions become favorable.

**Liner care during harvesting** — A liner has many opportunities to dry out from the time it is lifted from the soil, until it is planted back into the soil (or container). The smallest roots will dry out first and are the most important to the plant for taking in moisture and nutrients. A plant must regenerate those tiny root hairs before moisture and nutrients can be pulled from the soil following transplanting. The larger primary roots do not function in absorption, but are certainly important. Loss of root hairs delays plant growth.

Liners that are being bare rooted from a row or a bed can be damaged quickly by the drying action of sunlight and wind. As the digging operation progresses, strive to keep the roots covered, and put them in storage as soon as possible. Cover the roots when transporting. Moisten the roots as often as is necessary to avoid drying. Do it!!

**Care of bareroot liners upon arrival** — Small liners will arrive in boxes. Open the boxes immediately and inspect the plants for moisture, heat, ice and count. It is okay to tell the shipper that the plants arrived in good condition, or ask questions about how to handle the.

If there is a problem, now is the time to tell the supplier, not months later. Having a digital camera to document a problem and send photos electronically is a great idea.

Do not allow roots to dry out, heat or freeze. If unable to plant immediately, it is best to keep the plants in the same box, perhaps checking to assure that the sphagnum is still moist and has not shifted in transit. The sphagnum should be moist but not too wet. The excelsior, made from pine shavings, is there to keep the tops of the plants dry.

Close the box back up and store it in a cool place, away from sunlight and heat, ideally at 33-38 degrees F. If cold storage is unavailable, store in a basement or cellar if available. Plant as soon as possible.

Problems transplanting broadleaf evergreens and some conifers usually stem from desiccation (drying out) of the stock after transplanting. Strong drying winds following the transplant can contribute greatly to this problem.

**Liners can be Stored Outside in Trenches** — Bareroot tree liners can be stored outside in mild climates, as long as the roots are completely covered (6 to 8 inches) in moist sawdust; and the tops protected from strong winds. The trenches can be dug ahead of time with a back-hoe.

Select a sunny slope and dig the trenches approximately 24 inches deep. Try to maintain a constant depth. The goal will be that water will not be trapped, not stand and that the slope will allow excess water to move to the lower end. Don't use the lower end.

Sawdust is easier than soil to use. The soil would probably be too, too wet to handle when liners need to be added to the trenches. It might be chunky and leave air spaces around the roots, allowing them to dry out. The sawdust would shovel and fill the spaces between the roots, regardless of how wet it might be. Liners would pull out of the sawdust easier than from soil. A wet soil might hold too much moisture during a wet winter and set up a root rot.

**Grade & plant by size** — Regardless of the source, liners should be graded and planted by size for appearance and uniform growth and harvesting. Inferior liners should be discarded or returned to the source. The best liners will generally produce the best plants with less effort and provide the highest profits.

**Do not over prune liner roots** — Some root pruning is almost always necessary, but don't over prune. All cuts should be made cleanly with a sharp instrument. Periodically wipe the blade with alcohol, a 10 percent solution of household bleach or Lysol. Extra long roots should be shortened to stimulate branching and facilitate planting. Avoid cutting too many fibrous roots off.

After all, **roots are the heart of a liner**. Roots can grow a top, but a top without roots is dead. If the root mass is too large to be planted with the present transplanter, then buy or borrow a larger transplanter rather than cut too many roots off and risk death.

**Root dip** — Many producers feel that dipping liner roots into a water-holding hydrophilic polymer such as Terrasorb prior to transplanting helps insure survival if it does not rain.

Dipping roots into a solution of chlorpyrifos (Dursban) to kill or prevent borers in the lower trunks later is a waste of time and possibly dangerous to the roots and to Worker Protection issues.

Dipping *Malus* roots into a solution of Orthene to kill any Woolly Apple Aphids present is a good idea. Wash roots first to remove 99% of the soil. Soil might prevent Orthene from contacting all of the aphids. Pressure may be required; but don't remove the root/skin surface. Submerge the roots for 30 seconds; no more than 1 minute. Design a drip recovery tray to re-cycle the solution. Observe precautions for Worker Safety Standards; protective clothing, etc.

Mix 1 pound of Orthene 75% WP in 100 gallons; 0.5 lb in 50 gal; or 0.25 lb in 25 gal.

**Planting Window (time)** — It is best to bareroot and transplant while dormant (Oct to March). Plants transplanted in the fall will survive a dry summer much better (with less irrigation) than spring planted. Our falls generally allow limited root growth. January can be better than March. We worry about the winter freezing and thawing action, heaving the liners out of the ground. There is a gamble, but the benefit outweighs it. Field produced bareroot liners will be scarce in the early fall, until harvest catches up with demand. Potted and plug liners are available. Keep in mind that liners held in cold storage for several weeks will take longer to show signs of life after they have been exposed to spring temperatures.

### **Sweating Nursery Stock to Break Dormancy**

Most tree and shrub genera can be stored bareroot all winter under refrigeration and develop normally once transplanted. However, there are a few plant genera, which become deeply dormant during refrigerated storage. These must be forced out of dormancy before they are planted, or they will simply remain dormant after planting, and eventually die. Conifers should never be sweated.

Sweating is the process that forces bud break and active growth. The main goals are to rehydrate the root systems and to increase the humidity and temperature surrounding the plants. These conditions force growth to start.

Sweating plants is relatively easy. There are two methods commonly used. The first method merely involves potting the plants and placing them in a poly covered overwintering house. The warm, humid polyhouse environment meets the needs of the plants to bring them out of dormancy.

The other method can be done in a bareroot barn, garage or out building where the temperature can be maintained between (50) 60 and 70 degrees. (Sources varied)

Lay one or two layers of moistened burlap, straw or similar material on the floor. Soak the roots for several hours. Shake off the excess moisture and lay the plants on the prepared area. Avoid excess moisture, as a mold could grow and might any way (probably harmless).

Completely cover the plants with several layers of damp burlap, straw or similar material. Cover the pile with a tarp or a sheet of poly and seal around the edges to begin the process.

Check the plants daily to see if the dormant buds have begun to swell and break open (bud break). Also check for moisture and mold. Spray 1.25 teaspoons Cleary's 3336F in 1 gallon of water over the mold (roots and foliage) as a precaution.

Sweating and transplanting outside must be timed for late April in Middle Tennessee. Sweating only requires 3 to 4 days. What happens to the plants next is critical. Once the buds begin to swell, nothing must interfere with the natural progression. Remaining in the bareroot barn will cause what was started to stop. You cannot sweat a group of plants in February and keep them in the barn until March or April. Nor can you sweat a group of plants in February and plant them

out immediately. The new sprouts would be killed back by the cold temperatures. Sweated plants may be potted and grown in a polyhouse until weather conditions allow moving the plants outside.

Several large bareroot nurseries that ship nationally (perhaps worldwide) recommend sweating in their catalog. They agree on the procedure, but vary as to the plant genera that would benefit.

They collectively listed *Acer* (maple), *Amelanchier* (serviceberry), *Betula* (birch), *Berberis* (barberry), *Campsis* (trumpet vine), *Carpinus* (hornbeam), *Carya* (hickory), *Celtis* (hackberry), *Cotoneaster* (spreading cotoneaster), *Crataegus* (hawthorn), *Fraxinus* (ash), *Liquidambar* (sweet gum), *Malus* (apple and crabapple), *Morus* (mulberry), *Nyssa sylvatica* (black gum), *Pyrus* (pear), *Quercus* (oak), *Rosa* (rose), *Salix* (weeping willow specified), *Sorbus* (European mountain ash), *Syringa* (lilac), *Taxodium* (cypress), and *Tilia* (linden). Locust was also listed. I assume they meant the genus *Robinia* and not the genus *Gleditsia* (Honeylocust). No one nursery listed all of these.

Hackberry and Hawthorn are the two genera that I assume would benefit in our area. In the past, complaints of liners slow to leaf out have been blamed on leaving them in the bareroot barn too long or planting in the wrong moon sign. After asking several producers, I was told of 'Winter King' Hawthorn liners that stood dormant most of their first summer, with some slowly leafing out periodically and some leafing out very weakly the second spring.

Plant genera that require sweating cannot be planted outside early. Sort of a kick in the pants. Sweating plants is an easy way to ensure bud break on some plant genera that have difficulty breaking dormancy after cold storage. The sweating process and planting must be delayed until outside conditions are right.

Note: Depending on the time of year and temperatures in transit, plants may break dormancy while in transit from Oregon. If this happens plants are ready to plant and grow and should not be refrigerated again for any extended period.

## **PLANTING PROCEDURE**

When planting 6" to 6' liners, 2 to 3 different transplanters will be required to open a slit in the soil wide enough. A transplanter that will open a slit up to 7" will allow small bareroot, plugs and gallon containers to be planted. This may be a 2 seat model.

A larger transplanter will be required to plant 2 to 5 gal. liners, requiring a slit up to 14" wide. Another transplanter will be required for the 6' west coast liners that require a 24" slit. Labor is required to stand on these models. High quality planters are locally built.

If a bareroot liner is held too long in the transplanter, the roots will drag and develop a one sided root system, referred as a 'J' root. It will not grow as well as those that have roots in all directions. Conscientious workers are needed on the transplanter to obtain the correct in-row

spacing and depth. The tractor driver must be alert to maintain straight rows. Several workers will walk behind the planter to lift, straighten and stomp the soil around the root systems. If labor is short, those on the transplanter will have double duty, but it can be a welcome break. This may be most important step.

A hi-clearance cultivating tractor with 2 coulters under the belly is normally used next to throw loose soil to the row of just planted small liners. This can contribute too much soil over the roots, but is an age old practice.

**Do Not plant too deep** — Planting too deep is a major cause of plant stress, root loss, plant decline and plant death, in the field, in containers and in the landscape. It is frequently done on purpose in the field. Reasons given include: didn't want the wind to blow them over, wanted roots closer to good moisture, wanted to hide the bud union or cut-back crook. These are all invalid.

Being too deep can be harmful to all plants, but dogwoods, hemlocks, white pines, and yews are especially sensitive. All plants (liners also) should always be planted at the same depth at which they were previously grown in the field or container, including when going into the landscape. Roots can't get enough oxygen when they are deeper than they should be, and they die off fast or slow, depending on the amount of oxygen. New roots try to grow.

It is not always done on purpose; erosion can wash soil into low spots; cultivation can throw loose soil to the roots and it will build over time. On a disk, replace the blade that throws soil with a smaller diameter disk blade. Pull excess soil back with a hoe and fingers.

A block of plants may not grow off the way they should; with some severe stunting, some green, some off color, some healthy, some with dead terminals, and some just dead. Dig down around a few plants and see how much soil is on top of the roots. Any more than a half inch or so should probably be removed. Not an easy task, but cheaper than plant loss.

The plants that survive are able to grow a replacement root system in the upper soil. There are a few plant genera that can tolerate having their roots deeper than normal, those that can tolerate moist sites.

Be sure that the root flare or collar is level with the soil surface or slightly higher to allow for settling.

**Handling Potted Liners** — *Plug liners will be considered as potted or container produced liners in this article.*

Potted liners are great, but management must handle them correctly. I encourage their use. Nursery producers favor planting potted liners in the fall because bareroot liners are generally not available until they become dormant in November.

Fall planted liners receive a major advantage that spring planted liners do not receive. Some root growth will likely occur in the fall. This allows a head start, with a better chance to tolerate a drought the following summer.

Potted liners should receive special attention when they first arrive and throughout their stay until planted, and also for the next few months for moisture. Check the moisture of the media of several containers while unloading. More than likely, the liners should be placed in the shade and irrigated as soon as possible. This will help settle things after being tossed about.

Potted liners are normally watered daily during the growing season. Check the plants daily and water as needed.

Daily watering will be required if it is above 80 degrees. Cloudy or temperatures in the 60's or 70's may allow every other day watering. Don't neglect your responsibility to provide good care. A lack of water for only a day or two can cause death, but over-watering can cause root rot.

Potted liners may arrive in a high state of growth, from a warmer climate, just when our weather is turning much cooler.

Protect the plants from a premature freeze. The tips may be killed or the bark just above the soil may be split by sudden freezes that occur before the plants become acclimated. Roots sitting above the ground in containers may be killed by 25 degrees.

If irrigation is not possible in the field, consider vigorously shaking as much media away from the roots as possible, by opening the root ball from the bottom. Plan to water the plants by hand immediately after transplanting and every week until normal rainfall takes over.

Potted liners should be watered very well the morning prior to planting. The plants should be planted at the same depth that they have been grown. It is harmful to plant deeper, even if it is dry and there is moisture deeper. Any encircling roots or extra roots in the bottom should be ripped off. The rootball may benefit by being opened from the bottom to rip some roots apart. Do not be concerned that containers treated with SpinOut will not have visible roots. The copper ingredient prevented root encircling.

No more than a quarter inch of soil should cover the container media, but it is critical that the artificial media not be exposed to the air, as moisture will wick up and dehydrate the roots. Immediately after transplanting, turn the irrigation on to settle the soil around the rootball; whether overhead or drip. Check the moisture of the artificial media twice a week and irrigate as needed. A dry soil will pull moisture from the artificial media and the roots will die quickly. After some rooting occurs, check the plants weekly. Don't just look from the truck seat; stick a finger into the media or around it. Cover the hole with soil and wipe your hands on your britches.

**Avoid top pruning** — Avoid over pruning first year liners. Do not remove all of the lower branches. Foliage is required to feed the plant and the roots. While this has been a standard nursery practice for some, research has now proven the benefits of waiting. It may difficult, but

just walk away. The more foliage the better to help manufacture food to send to the roots to grow and establish a root system.

Long branches can be shortened if they would interfere with cultural activities. Preserving the shoots will help ensure that the tree produces adequate carbohydrates for proper trunk taper. They can be removed after two or three years.

Only top a very tall, leggy liner. New, straight leaders are difficult to re-establish. Topping generally induces branching for a distance of 18 inches below the cut. It is not necessary to top all of the trees that are commonly topped.

Research conducted over the past 30 years indicates that you should avoid top pruning during the initial planting. Remove only damaged parts. After planting, the primary objective is to encourage the tree to become root-established as soon as possible. Dr. Carl Whitcomb's research suggests that shoot pruning decreases root growth. Top pruning stunts root development in favor of shoot growth, which in turn uses more carbohydrate reserves.

Wait 1 to 2 years before cutting a plant back to the ground to grow a straight trunk. The presence of lower foliage and branches builds caliper.

**Use a Liner Row to conserve space**, fertilizer, herbicides, chopping time, irrigation water, time and labor. Young liners are planted 1 or 2 per foot of row. Use a liner row when you have more liners than space, or when the roots are small and poorly developed. A high mortality rate when spaced out normally ties up a lot of ground for several years. A liner row is an excellent place to grow a larger root system for 1 to 2 years. Irrigation is essential to the success of a liner row. Drip is preferred.

**Irrigation** — New transplants should be watered-in immediately after planting. Supplemental irrigation during brief droughts is necessary to ensure survival and optimum growth.

**Chemical Weed Control** — Most of the commonly used preemergence herbicide labels recommend delaying application to freshly planted fields until after a good settling rain. The fear is that injury could occur if a new planting is immediately sprayed with a preemergence herbicide, followed by a rain that might carry the chemical to the roots through the fluffy, loose soil. Refer to the field weed control handout on the web page. Preemergence and postemergence herbicide tables also list the herbicides that are labeled for the commonly produced ornamentals. Those tables are also on the web under weed control. [Link to](#)

**Staking** — Tall and weak stemmed tree liners must be staked, to prevent them from damaging themselves during high winds. But remember that movement of the trunk builds stem strength.

The goal is to grow shade trees with strong, straight trunks, with good caliper and taper. Most producers desire to grow quality shade trees and are very willing to stake each one. In one respect, that is very good. But the rigid staking that is practiced adds cost and prevents all movement of the tree. Many producers try to help their liners stand vertical by planting the roots deeper than they should, which is addressed in the planting section.



The current standard nursery practice is to secure shade tree liners very tightly to a stake, using various sorts of twine or plastic strips, or a Max-Tapener, periodically, throughout the growing season. Rigid staking is extremely labor intensive, requiring labor to re-tie broken ties several times during the first growing season. Stakes are normally removed after the first growing season.

The (6 to 7 foot) shade tree liners that we purchase from west coast nurseries don't always require staking. Certainly not rigid staking. They would benefit from some assistance in standing vertical during wind gusts during their first spring. High winds might blow some liners over, and prevent roots from establishing.

Bamboo canes, wooden stakes or metal stakes are expensive. While bamboo is less expensive to purchase, the portion in the ground rots and the canes loose about 10 inches of their length each season. They can be used 1 to 2 years. Metal stakes (5/16" galvanized) will last many years, but at a high initial investment.

Staking itself is not the problem. The problem is the restrictive method currently being used. This article is not against offering support where and when needed. We need a better method to keep shade tree liners vertical, while allowing movement. We need to keep the trees from being whipped to death in high winds.

Producers should consider alternative methods of support, practice less rigid staking and demand and purchase shade tree liners that can hold themselves upright without having to be rigidly staked.

I have seen weak stemmed ornamental cherries with heavy heads, being severely whipped by high winds, probably in May. They were about 6 feet tall and 3/4 inch caliper. Their first branch was 4 feet above the ground. They were well branched, with a very heavy head, with lots of foliage. They had already torn loose from some heavy 6 foot canes they had been tied to. I observed several bending over and touching the ground with their foliage, during strong wind gusts. The lower stem was vertical. The roots were well anchored. The stems were flexible (weak) enough that they were bending that much. But every now and then, one would break. Half of the plants eventually broke because labor did not re-tie them to their stakes.

A binding poly tube gained favor in the early 2000's from Timm Enterprises, 888-769-8466.

The rigid staking of young trees tends to promote growth in the upper portion of the stem to the detriment of the basal portion. In research trials in Maryland by Dr. Stanton Gill, unstaked trees exposed to the stress of moderate, multidirectional winds produced stems that supported their heads under the stress of normal wind action. Rigidly staked trees grew taller but produced stems of less caliper and less taper. Shade trees are sold by caliper, not height. The rigid staking of young trees slows down the objective of increasing caliper.

Top heavy liners, such as weeping cherry and mulberry, must be assisted in remaining vertical their first year in the field. The rigid staking of a small percentage of shade tree liners may be

necessary as well, but staking every single liner may not be necessary. There may be other ways of accomplishing the goal. Research has proven that the presence of lower leaves and branches helps to increase the stem caliper.

Fiberglass stakes appear to meet the requirements of stability while providing more movement than any other type. No one knows how long they will last or if there will be issues with handling them when they age.

Frequently there is a need to provide support for the upper part of shade trees the 2<sup>nd</sup> or 3<sup>rd</sup> year when the stake is removed after the 1<sup>st</sup> year. Some producers will remove the cane after the 1<sup>st</sup> year and merely slide it up into the top of the tree to support it. Have observed pads made from pieces of slit drip tape to pad or cushion the lower part of the cane where it might cause a wound from movement.

#### **Sources of stakes:**

There are several sources of bamboo, fiberglass and metal stakes. [Refer to web site for sources.](#)

#### **IRRIGATION**

[Refer to web site for sources](#)

Irrigation is the redistribution of previous precipitation. Water is taken from storage, pressurized with a pump for delivery through pipe and spread with sprinklers. (A lake, pond, stream or well is considered storage.) Uniformity of coverage is important. Therefore, the design should take into account all factors that affect coverage characteristics. This includes pumps, pipes, fittings, topography and sprinklers.

Irrigation is needed when rainfall is insufficient. If production with irrigation is about the same as it would be with good rainfall, then irrigation is providing insurance. If production with irrigation can be increased to a point higher than that achieved under average moisture conditions then irrigation can function as a production tool.

Three resources must be available before irrigation can be successful. These are water, time and capital. As mentioned above, there must be an adequate supply of water. One acre inch requires approximately 27,000 gallons. Run an irrigation suitability test (\$28-50) on any water considered for irrigation use, before using it.

Time is required to determine when to irrigate, to move the set-ups, to check for leaks, and make repairs, etc. Mechanization in irrigation has helped to reduce the man-hour requirements, but the cost to irrigate can be substantial.

The initial investment may approach the value of the land. The annual cost could be as great as all the other inputs to produce the crop. However, irrigation has proven to be a necessary production tool for liner production, to insure the survival of liners during their first year in the field, and for high value crops.

In general, the rate of application (inches per hour) increases as the sprinkler size increases. The application rate can be increased until it approaches the infiltration rate of the soil. This can be accomplished with larger sprinklers or by placing sprinklers closer together.

The usual spacing of sprinklers in a solid set arrangement is about 50% of the diameter that the sprinkler wets (wetted diameter). They may be slightly closer (40%) along the lateral and slightly further apart (60%) between laterals.

The hand-moved lateral is lower in cost but higher in labor requirements. It can be used in a wide variety of land and crop conditions.

Traveling guns offer a degree of mechanization over the hand-moved systems. This reduces labor but increases the energy requirements. Travel lanes of sod must be provided. Each lane needs a minimum width of eight feet travel space. The lanes are separated by 100-350 feet of irrigated land depending upon sprinkler size.

Drip (trickle) irrigation is the frequent, slow application of water to the soil. This is done through mechanical devices called emitters that are located at selected points along water delivery lines. Most drip lines are placed on the soil surface but they can be buried at shallow depths for protection from rodents and cultivation equipment.

**Advantages of Drip Irrigation:**

1. Reduces water volume needed
2. Water placement to roots
3. Less energy for pumping
4. Promotes even soil moisture
5. No wind interference
6. Easily automated
7. Can inject chemicals
8. Can work while watering
9. Low labor once installed
10. Adaptable to various spacings.

**Disadvantages of Drip Irrigation:**

1. Clean water is required to prevent clogging
2. High initial labor for assembly and layout
3. Above ground damage by equipment
4. Insect and rodent damage
5. Roots may seek emitter openings
6. Time to check for clogged emitters and rodent damage.

*Pumps:* There are pumps for all needs. It is important to match the pump to the job. The manufacturer can provide test information on their pumps upon request. Look for gpm, psi and efficiency. The highest efficiency is around 75 percent. High efficiency conserves fuel.

The most frequently used type of pump for irrigation is the centrifugal pump. This pump can be obtained in a wide range of gpm and psi. The horsepower match to the pumping requirement (efficiency) is important. Electric motors need to be sized about 5% more than the pump. Internal combustion engines should have about 25% more power than required by the pump.

*Pipes:* Sizing pipe is important. Water moving through a pipe loses some pressure due to friction. Care must be taken to prevent excessive pressure loss. A good rule-of-thumb is to select a pipe large enough to keep the pressure loss in 100 feet of pipe less than 1 psi (1 psi = 2.3 feet).

## PRUNING

Most pruning cuts are best made by a sharp pair of hand pruners. The by-pass or scissor type is preferred over the anvil type. A knife has the tendency to remove too much tissue, as if the goal were to shave all evidence of the branch away. Recent research has shown that the regenerative cells are in the shoulder area that a knife removes. Don't leave a 2 inch stub, but leave the branch collar or shoulder area. When removing a branch from the main trunk, for example, the cut will be nearly perpendicular to the branch; not parallel with the trunk. Leaving the regenerative cells will shorten the healing time.

Pruning is a necessary management tool used to produce quality landscape specimens. Pruning must be done throughout the production cycle. Producers must exercise caution to prevent over-pruning in some instances.

The months of February, March and probably most of April are excellent months to prune all nursery plants in the field or container. The rapid spring growth that will soon follow will heal the wounds faster than at any other time of year. It is also easy to see the limb structure on deciduous plants and leaders on trees before the foliage hides it. Always use sharp tools.

Research in the last 30 years has changed how we should prune plants.

1. Avoid making cuts too close to the trunk of a tree or shrub. When cutting branches from the trunk, leave the branch collar. The branch collar is the swollen area at the base of the branch, sometimes with a bark ridge. The cells that regenerate the healing are located here. Closer removal can result in delayed healing. In much older trees, removing the branch collar with the limb usually causes decay and poor healing. Hand pruners should be used and not a knife.
2. Avoid over pruning first year liners. Don't remove all of the lower branches immediately. Foliage is required to feed the plant and the roots. While this has been a standard nursery practice for some, research has now proven the benefits of waiting. It may be difficult, but just walk away. Long branches can be shortened if they would interfere with cultural activities. Preserving the shoots will help ensure that the tree produces adequate carbohydrates for proper trunk taper. They can be removed after two or three years. Remove any low branch from the trunk before it reaches an inch in diameter.
3. It is not necessary to top all of the tree liners that are commonly topped. Only top a very tall, leggy liner, to induce branching in the next 18 inches below the cut. New, straight leaders are difficult to re-establish.

Research conducted over the past 30 years indicates that you should avoid top pruning during the initial planting. Remove only damaged parts. After planting, the primary objective is to encourage the tree to become root-established as soon as possible. Dr. Carl Whitcomb's research suggests that shoot pruning decreases root growth. Top pruning stunts root development in favor of shoot growth, which in turn uses more carbohydrate reserves.

4. Spindly or whippy tree liners should not have lower foliage or branches removed until they strengthen themselves and build some caliper. Movement of the stem builds stem strength. Avoid rigid staking, if possible. Staking is expensive but sometimes necessary. Be inventive, there's more than one way to stake a young tree liner. See if you can think of an economical way to prevent the wind from breaking the trunk as it whips a limber top around, to allow some movement of the stem, with less labor than the one stake per tree method.

**Pruning trees during production** – Strive to maintain or re-establish a straight central leader in all trees, except the multiple-stemmed shrubby ones. Remove any suckers, epicormic shoots and crossover branches. It is difficult to maintain a central leader higher than 6 to 8 feet in most of the flowering trees.

The number of salable trees can be greatly increased with timely, frequent attention to reestablish leaders, especially on red maple. The shoot boring caterpillar that destroys the terminal and being opposite budded makes the red maple the greatest challenge. Time must be devoted to this. It cannot be delayed or done from the tractor seat.

Trees should be limbed up gradually, a little each year as caliper increases. This will produce a well balanced tree at any size. Caliper is increased by leaving foliage and small branches on the lower stem of young trees the first couple of years in the field. Branches can be shorten so they will not interfere with hoeing or cultivation practices. Remove any branch before it becomes half the diameter of the trunk to avoid a wound that will require too long to close.

Growth can be directed by selecting a bud growing into the direction that growth is needed. Cut back to and leave the selected bud. On leaders, select a strong bud on the southwest side, so the prevailing wind can assist.

The market decides how high the first limb should be above the ground. Homeowners generally prefer full-headed, low-branched trees (4'), while cities want higher branched trees (6') for traffic visibility. It would not bother a horticulturist to purchase a tree with branches limbed up to 4' and to prune it up to 6' after planting it. But producers inform me that their customers would not purchase a tree with fresh cuts. We need a little education on this.

A pole pruner can be used to maintain or re-establish leaders in shade trees. Consider building a platform with a safety railing on a narrow trailer to work from. Even though two people are required, the work can be done safely, more effectively and more efficiently. Working from the ground with long poles is tiring and impossible to cut close to a bud. Self-propelled scaffolds are used in European nurseries.

When selecting new leaders, select a strong bud. Some use a bud clip, an index card or 4 revolutions of masking tape to pull an upper branch vertical. The tape and card disintegrate in the weather. Cutting too close to a bud will cause it to dry out and die. Leave a little less than a quarter of an inch of stem.

When trimming lateral branches to thicken the canopy, the direction of the new growth can be controlled by leaving a strong bud pointing in the desired direction. Remove branches that form a narrow crotch angle, because they are weak and cause a split years later. (Redbud is an exception.) Select branches that form a 45 degree angle.

Maples are difficult to grow with a straight central leader, because they have opposite buds. Anytime the bud of the central leader is damaged, a fork develops rapidly, producing two leaders and a poor quality tree, or a cull. Unfortunately, the central leader is damaged frequently by a shoot boring caterpillar in April, by birds, deer browsing, wind, and occasionally by a producer cutting the top out, trying to stimulate (develop) scaffold branches where none existed.

One of the forks must be removed as soon as it is noticed. Leave the straightest, and healthiest, or the branch on the southwest side (prevailing wind side). If it is caught in the bud stage (prior to the buds in question growing), merely cut the damaged leader back just above the buds and remove one of the buds. A careful worker can usually accomplish this with one diagonal cut made through the stem with a hand pruner, removing one bud with the stem portion being cut off.

Pruning plants correctly each year can produce quality shade trees. Some summer pruning is also required. Effort and labor can be reduced by using timely pruning practices. Many pruning tasks can be performed when the ground is too wet to support machinery to perform other tasks.

Spray a labeled thiophanate methyl product such as Cleary's 3336 fungicide onto tree trunks following a major limbing-up job, and do it before the wounds dry to avoid possible infection by one of several potential canker diseases. I occasionally see some extremely high infection percentages that Cleary's could avoid. (20 fluid ounces of Cleary's 3336 Flowable per 100 gallons of water; or 1 Tablespoon + 0.75 teaspoon per 3 gallons; 1 Tablespoon + 2 teaspoons per 4 gallons).

When a cull is found and you know it will always be a cull, remove it; otherwise laborers may continue to fertilize and prune it. Don't waste more time with it. Removing it allows other plants to benefit from the moisture it would consume. Don't risk damaging your reputation by selling a cull.

### **Straighten Young Trees by Flexing**

It might be good to perform flexing on crooked tree transplants before staking them. Try flexing crooked transplants even after the stake has been removed if they are flexible enough. Flexing is generally practiced on shade tree transplants during their first or second year in the field; on trunks that are ½ to 1 inch in diameter.

Crooked stems are merely bent straight and a little more, using 2 hands, repeatedly until the stem remains straight. Care must be taken not to break the stem, but a little experience teaches how much pressure to use and when to quit.

This bending in the opposite direction will break a few internal cells. One treatment will help most, but a second treatment a few days later is best and necessary for some. Flexing is an old practice that seems to have fallen by the wayside but still works. There has been little written about it; however one grower remembers that his Dad practiced it years ago. An Oregon liner producer is currently promoting flexing to their customers with an audio tape. It is an excellent procedure.

While some staking seems to be essential, tree movement builds stem strength. Rigid staking prevents movement. The new fiberglass stakes may provide more movement than steel. Bamboo seems to be the most rigid.

I still prefer a 5 foot lightly branched tree liner rather than a fishing pole that cannot hold its head up. A 5 foot liner with good caliper will not have to be topped or staked.

**Shaping shrubs first few years** – Multiple shearings a year can be performed with manual or powered hedge shears to produce a thicker head on most species. Pruning encourages more branching in order to produce a fuller, denser plant.

Broadleaf evergreens with small leaves, such as hollies and boxwood; needle or narrow-leaved evergreens, such as arborvitae and cypress; and deciduous shrubs such as barberry should be sheared into round balls the first few years.

The upright growing shrubs are exceptions. Nellie R. Stevens Holly, Foster holly, the upright junipers and arborvitae will be shaped pyramidal. Central leaders should be encouraged in the upright hollies. They should not be sheared flat across their top. The secret to a quality Foster Holly seems to be multiple shearings each year, after the first or second year of growth.

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On plants budded the previous fall, once the bud is observed to be alive in the spring, the understock top is cut off. On Bradford pears for example, the callery pear understock top is cut off, and the Bradford bud is fitted with a Gro-straight to prevent a crooked trunk or "dogleg". The numerous tops must be removed from the field because of the many thorns on the rootstock. The thorns are capable of causing flat tires. The thorny tops use to be removed by hand or with pitch forks.

Technology has accelerated some tasks. Some producers have adapted silage choppers to cut the callery pear top off high and grind the top and thorns up in one pass. Then the final cut is made precisely above the bud with sharp hand pruners or tractor pto generated pneumatic hand pruners, which reduce fatigue and increase speed, but stooping is still required.

**Cut-backs** — A common practice is to grow seedling shade trees in the field for 1 to 2 years spaced to B&B. Oak seedlings are cut 2-3 inches above the soil; while maples are cut 1-2 inches above the soil in March. The established root systems are able to grow new trunks fast

and straight. They are referred to as "cut-backs". Five to seven foot stakes are generally used to protect the tender growth after the strongest sucker is selected.

## **ANNUAL MAINTENANCE FERTILIZATION**

The standard nursery practice is to band or sidedress the annual maintenance fertilizer applications to avoid excessive stimulation of weed growth between rows. The rates will be provided as per acre but please realize the sidedressed band is the suspected root zone. An acre is still an acre, but a sidedressed acre when banding with a Vicon could be 3 feet by 14,520 feet to equal an acre of 43,560 sq ft. This assumes the Vicon is applying an 18 inch band on both sides of the row of larger plants.

A sidedressed band could be 12 inches wide on both sides of the same row (43,560 divided by 2 ft per row; or 21,780 row feet would equal an acre).

If you have ever fertilized an acre of pasture or bare ground with 400 pounds of 13-13-13 for example, you will only see fertilizer prills or granules 3 to 6 inches apart. Nursery producers expect to see a constant flow, probably because they began using 'Old Black Joe' in the 1940's that had a very low analysis. A broadcast rate and a sidedress rate of 400 pounds per acre is the same. The prills should be the same density or distance apart. We did not reduce the pounds per acre when fertilizers became more concentrated or higher analysis.

We assumed if it did not kill the crop then more was better. We sell by size, bigger brings more money. But our crops were not showing visual symptoms on the foliage that we recognized. We may have burnt roots without foliar symptoms. I do know that during years of research completed at local nurseries, higher rates than we currently recommend did not grow bigger plants. Higher rates produced plants of the same size or slightly smaller in height and caliper. Rates higher than recommended rates merely wasted fertilizer, money and labor to apply more.

Root growth begins earlier in the spring than shoot growth. For established plants in the nursery field, maintenance fertilizer applications should be applied 4 to 6 weeks prior to bud break in the spring. To get the maximum benefit from the fertilizer it is very important to make the annual maintenance fertilizer application by mid to late February, and then repeated mid to late June.

Rates are calculated on the amount of nitrogen. If the available phosphorus and potassium tested high on the soil test, or if more was broadcast to bring it up to the high level, according to the soil test recommendation, then actually, only a nitrogen source is required for the next few years of production.

But the normal nursery sidedressing equipment cannot be adjusted to (apply such small amounts) only apply the recommended 150 pounds Ammonium nitrate (34-0-0) per acre. The average sidedressing equipment will apply too much 34-0-0 and damage small plants. A nitrogen fertilizer with some phosphate and potash added to dilute the caustic action of the nitrogen would be safer. If 20-10-10 is available and is used as the nitrogen source, 250 pounds of actual fertilizer would be required per acre at each application, on shade trees. (50 pounds divided by 0.20)



Sidedress all recent transplants<sup>1</sup>, all shrubs, all conifers, dogwoods, *Malus* and *Pyrus*<sup>2</sup> with no more than 50 pounds of actual nitrogen per acre at each application in February and June. This equals 250 pounds of 20-10-10 per acre at each application (or 150 lbs. of 34-0-0).

A general recommendation is to apply 75 pounds of actual nitrogen per acre to shade trees twice a year after they receive the initial 50 lb. rate. This represents a total of 150 pounds of actual nitrogen per year. [Refer to web site for Rates per plant based on size or age.](#)

**50 lbs of Actual Nitrogen supplied by:**

	lbs/acre	Cups/100 row ft.
34-0-0	150	0.75
20-10-10	250	1.50
15-15-15	333	2.0
13-13-13	385	2.0

**75 lbs of Actual Nitrogen supplied by:**

	lbs/acre	Cups/100 row ft.
34-0-0	225	1.25
20-10-10	375	2.00
15-15-15	500	2.75
13-13-13	575	3.0

**Note:** It is known that the standard nursery practice applies 2 to 3 times this amount. But research has found no growth benefit for applying more than these recommended rates.

Never fertilize after August 1<sup>st</sup>, except liquid. Stop liquid applications by Sept. 15. Some gambling bareroot producers will push the limit, trying for a larger grade by sidedressing after

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<sup>1</sup> High nitrogen rates could force excessive top growth that cannot be supported by a limited root system.

<sup>2</sup> Lower rates are recommended to reduce the severity of fireblight. Rates can be increased to 75 lbs for *Malus* and *Pyrus* for the June application if you think they need it.

August 1. An early killing freeze can kill the crop to the ground; with the producer losing everything.

New fall and winter plantings can be sidedressed in mid to late February, as recommended above. Plantings made after February can be sidedressed two weeks later.

## **SOIL CONSERVATION, IMPROVEMENT & STABILIZATION**

Nursery producers should take every opportunity to conserve and build their soil, which provides their livelihood. Over a period of time, soil structure deteriorates as a result of losing topsoil with the rootballs and running harvesting equipment when the soil is too wet. Poor soil structure then results in reduced growth.

Run rows across the slope (on the contour) whenever possible to reduce erosion. Band preemergence herbicides rather than broadcast them. Mow the middles rather than disc the middles. Disc rather than till the middles, as a tiller destroys soil structure more than a disc.

Never work (plow, disc, cultivate) the soil when it's too wet as this also destroys soil structure. It will dry hard as a brick. Broadcast most of the phosphate and potash fertilizer.

More and wider grass strips are required on slopes. The proper use of grass strips or grass roadways between blocks can reduce erosion by as much as 45-50%.

Roadways, travel lanes, grassed strips and waterways, etc. should be planted in the infected fescue. Probably nothing is better than fescue for these non-crop areas, but nothing is worse than fescue in the row where it reduces plant growth. Large pasture no-till drills can be used to establish fescue without plowing and disking mid February to mid March or mid August to mid September.

### Crimson Red Clover

Drill Crimson red clover August 1 - October 15 in the middles all years except the first, if the liners are small. The clover may shade out small liners the following spring. Also avoid clover where plants will be cut-back to within a few inches of the soil. Small seed drills are available to keep the seed out of the rows where competition for moisture and nutrients could occur.

UT Extension recommends 15 lbs per full acre for cover, 20 lbs for forage. Clover is not drilled broadcast, but only in the middles. So if the middles are 6 ft wide and the drill is 3 ft wide, then 2 acres will be driven over to actually drill 1 acre minus roadways.

Be sure to inoculate the seed each time with the proper clover inoculate, so that the clover roots will be able to fix nitrogen from the atmosphere in their root nodules. The black powder inoculate is the nitrogen fixing bacteria that does the job. An estimated 30-40 pounds of actual nitrogen per acre per year can be received with 6 foot middles.

Benefits include: erosion reduction, grass and weed growth suppression in the middles through June, and support for traffic when the ground might otherwise be too soft. Eventually, after

incorporation, the clover improves the soil structure, increases the organic matter, soil nitrogen, and the moisture holding ability of the soil.

Note: A cover crop does not have to be plowed into the soil while in full bloom in order to provide the maximum benefit to the soil. The clover can be allowed to produce seed in May, die down naturally in June, and provide maximum benefits whenever it is incorporated into the soil. Don't work the seed too deep.

Clover should not be planted if there is a known nematode population present, as the nematode population could maintain itself on the clover roots.

A preemergence herbicide can be banded down the row to keep it clean. Spraying preemergence herbicides over the top of 4 inch Crimson Clover should not injure the clover.

Alternative Winter Cover Crops for Row Middles — Crimson Red Clover has been the standard for many years, but rye or wheat are effective substitutes. Rye or wheat could be seeded in Sept-Oct and die with hot weather much like the clover. I am not recommending either, except for trial purposes. We do advise against annual ryegrass and perennial ryegrass as being too aggressive and perhaps more difficult to kill before the next growing season.

Rye and wheat are annual crops that die after producing seed. Mowing prior to heading will thicken the foliage. Mowing or cultivation during late heading, but prior to seed maturation, will allow little regrowth and the plants will eventually die.

The postemergence grass herbicides (Envoy, Fusilade & Segment) will kill them as well. The standing dead plants would serve as an effective mulch, delaying weed seed germination within the middles, just like crimson clover.

Rye or wheat could be an effective substitute for clover: foot and vehicular traffic will be supported, erosion reduced, weed growth suppressed if thick, organic matter will be added to the soil eventually, and wildlife may prefer this over the nursery crop.

Rye or wheat can be seeded later than clover but will not generate the 30-40 pounds of actual nitrogen per acre that inoculated clover would. The seeding rate is 1.5 bushels per solid acre. The seeding rate should be adjusted for the width of the drill and the width of the middle. Will your clover seed drill handle the rye or wheat seed? Some will, some will not.

Try some or stick with the tried and proven Crimson Clover. It will be hard to beat. This has not been researched adequately for anyone to bet the farm.

Fescue or orchardgrass should be considered if a permanent grass is desired in the middles. Nothing will stunt an ornamental worse than fescue in the root zone area. But nothing holds the soil together any better in roadways and slopes to reduce erosion than fescue. The fungus-free tall fescue is suggested for the middles, because it is not as competitive as the infected fescue. Use the infected fescue on the roadways and grass strips.

Green Manure crops can be grown in vacant blocks during the summer to build the organic matter up in the soil. A green manure crop, such as a Sorghum-Sudangrass Hybrid (i.e. Sudex) can be grown. It is a good choice because it will not feed any nematodes and supplies a tremendously large volume of organic matter.

A first cutting could be cut for hay, (if needed) with the remaining cuttings left to be plowed into the soil in the fall. Frequent cuttings, an early August plowing, and 2-300 pounds of 34-0-0 broadcast per acre will speed decomposition and reduce spring transplanting problems.

**Plant Growth Patterns** — Plant hormones trigger when root, shoot and stem growth occurs and stops. These growth periods are referred to as episodes. There are not enough nutrients (food, energy and essential elements) available at one time to allow all plant parts to grow at the same time. Hormones regulate the growth pattern by switching growth activity from one area to another.

Roots have two growth episodes per year; spring and fall. As the spring root growth peaks, it helps drive shoot growth. Root growth declines as the shoots rapidly expand. Shoot expansion leads to an availability of nutrients down the stem and increases stem (caliper) growth. When stem growth begins to decline, hormonal activity signals root growth to increase again.

**Caliper or stem diameter only increases in late summer to early fall.** Trees measured during an early summer inventory will gain additional caliper by fall. Each part of the plant signals for growth materials as sunlight, moisture, temperature and food supplies change. This pattern of episodic growth keeps plant growth balanced.

## **HARVESTING BALLED & BURLAPPED (B&B) PLANTS**

Field nursery stock is usually dug while dormant. Deciduous trees transplant more successfully after going dormant. Trees transplanted while still dormant initiate and develop roots that supply new spring leaves and stems with moisture.

Harvesting conventionally-grown field nursery stock requires a mechanized tree spade or labor experienced in hand digging. Tree spades can be purchased in a variety of sizes which will dig balls from 15 inches up to 42 inches and larger. Machines and estimated costs are listed in the Equipment Section of this document.

The size of the root ball should be in proportion to the diameter or caliper of the trunk. Spades are normally mounted on the front of a skid-steer machine, but can be mounted on the rear of a regular wheel farm tractor, but with less maneuverability.

The nursery industry measures caliper 6 inches above the soil. Foresters measure caliper 4.5 feet above the soil and refer to it as D.B.H. (Diameter at Breast Height).

The American Nursery & Landscape Association (ANLA), <http://www.anla.org/> formerly the American Association of Nurserymen (AAN) has sizing guidelines establishing standards for the nursery industry. Landscape contractors and retail nurseries expect root ball sizes to be within the guidelines of the ANLA (AAN). Call the ANLA at 202-789-2900 or American Nurseryman

Publishing (item H-287; 800-621-5727) to order a copy of the “American Standard for Nursery Stock” for about \$15 plus shipping. [Refer to web site.](#)

For example, a 1.25 inch caliper shade tree requires a minimum of an 18 inch rootball;

- 1.50 inch – 20 inch diameter root ball
- 2.00 inch – 24 inch diameter root ball
- 2.50 inch – 28 inch diameter root ball
- 3.00 inch – 32 inch diameter root ball

Mechanical tree harvest is straight forward. The digging crew will first protect the trunks by wrapping burlap, felt, fabric or feed sacks (misprints) around the lower trunks. One machine can keep 3 to 5 laborers busy. Second, wire baskets are lined with a piece of burlap and placed where the rootballs will be worked, usually in a grassy roadway.

The tree spade is guided into position around the tree trunk to be dug. Large spades are forced hydraulically into the ground pruning side roots and tap roots. The entire soil ball, root system and spades are lifted. Any root escapes are cut with loppers. The machine carries the plant out of the block to the roadway and over a burlap-lined wire basket. The root ball is lowered into the basket and the spades removed one at a time, slowly.

Two to three workers will be required to tightly wrap and pin the burlap around the rootball, lace it across the top of the basket and tighten the wire. The branches will be tied up to reduce damage. When completed, each plant is prepared as a very neat package. The burlap and the basket prevent the soil from falling apart and breaking roots. Wet rootballs cannot pancake in transit as they once did occasionally. The plant can be moved to a holding area or shipped immediately to the buyer from the field (farm fresh). Hand dug balls are frequently placed back in their hole to maintain moisture and reduce cold injury. Once dug, rootballs should not be allowed to freeze or dry out

There are contract diggers available to dig local or out of state. Once shown the tagged plants to be dug, they will dig and furnish all supplies (twine, pinning nails, burlap, trunk wraps, wire baskets, etc). When they are finished, the plants will be ready to be loaded and shipped. Some average custom rate examples follow:

<u>by Machine:</u>	(02-2008)	<u>Hand digging:</u>	(03-2003)
24"	= \$12	14"	\$2.00
28"	= \$14	15"	2.05
		16"	2.25
		18"	3.25
		20"	4.00
		22"	5.00
		24"	6.25

Prices subject to change

**Summer Digging** — Plants may be dug out of season because of customer demand. New growth must be hardened-off before they are dug. Anti-transpirants (Vapor Gard, Wilt Pruf) may be applied 2-3 days prior to digging to minimize moisture loss. Trees are best harvested in early morning and moved to a shady area beneath an irrigation sprinkler.

Plants should be hardened-off for 1-2 weeks prior to being shipped to the buyer. The hand stripping of foliage (only after buds have formed) is a drastic, but effective and proven way to move a plant out of season, safely.

The **root-control bag or ‘Gro Bag’** is a recent innovation in the production field, to allow year round harvest. Liners are planted in root-control bags placed in the ground. Natural field soil is used. Roots grow through the bag and then are pinched off by the fabric as they increase in size. New roots proliferate inside the bag. "Gro Bags" can be used successfully in sandy or clay soils, which might not hold a ball of soil otherwise. The bag must be peeled off the rootball, however, requiring great effort; eliminating all of the roots that escaped the bag. The root control bag has not been widely accepted and is not used in Middle Tennessee.

**Rootball Weights**

[Refer to web site.](#)

**Estimated Number of Rootballs that will Load a Trailer** (will vary with trailer length<sup>3</sup> and type of plants) Have included the estimated ranges of three experienced nursery producers and shippers.

Ball size	# of rootballs/trailer	Ball size	# of rootballs/trailer
12"	550 - 650	30"	75 - 80
14"	500 - 525	32"	50 - 60
16"	400 - 450	36"	30 - 40
18"	350 - 400	40"	25 - 26
20"	200 - 300	42"	20 - 22
22"	120 - 200	48"	14 - 16
24"	90 - 125	50"	8 - 10
28"	75 - 90	60"	6 - 8

**HARVESTING BARERoot PLANTS FROM FIELD**

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<sup>3</sup> Most semi-trailers will be 45 to 48 feet long, 96 to 102 inches wide and 4.5 to 5 feet high above the ground. The truck, trailer and load must not exceed a maximum of 80,000 pounds. Most rigs will weigh 30 to 33,000 pounds empty. Most loads of nursery plants leave Warren Co. weighing 72 to 77,000 pounds. The plants would weigh about 44,000 pounds.

Seedling producers routinely grow the following seedlings by planting the seed in rows in the field and harvesting them 1 to 2 years later bareroot. Maple, oak, dogwood, callery pear, redbud, river birch, catalpa, persimmon, ash, black walnut, sweetgum, tulip popular, southern magnolia, sycamore, etc.

They will be graded and sold to someone to pot or to space out to harvest as B&B plants several years later. One year old dogwood seedlings are budded in the seedling row and grown another year before being barerooted. They will be 18 to 48 inches tall depending on the cultivar, moisture, fertility, etc.

Some of the above 1 to 2 year old seedling types of plants may be planted in rows, spaced 6 to 12 inches apart within the row and budded in the row several months later; such as callery pear, redbud, ash, and sweetgum. They will be harvested about 1 year after being budded. The pear and ash may be referred to as whips and are also called liners at this point.

While small numbers of these seedlings or liners or seedling liners or budded liners can be spaded out with a spade, mechanical devices are generally used. Labor may prefer to hand spade a small order out, especially if too wet for the equipment.

Bareroot diggers are basically 'U' shaped metal blades that undercut the root systems. They are pulled by tractors. Undercutter blades are available in different sizes, capable of harvesting different size liners, and requiring different size tractors. Bigger the blade, bigger the tractor required to dig a bigger plant.

A kicker is bolted onto the bottom part of the blade to lift and separate the root system from the soil. The kicker may be a metal wedge or 3 metal rods used to create the lift. More expensive models are available with a shaker. This is accomplished with an off-center cam powered by the pto. A great deal more horsepower is required. The vibration tends to loosen bolts on the digger and tractor, but reduces labor.

The very first bareroot digger was pulled by several teams of mules. That same implement was modified to fit the 3-point hitch of the International Super A and 140 hi-clearance, off-set cultivating tractors. The tractor straddled the plants (row). The tractor's belly clearance limited the size liners that could be mechanically barerooted. This method is still very common. Producers wrap and pad the tractor parts that rub the plants during the process with burlap and intertube rubber to reduce plant bruising and scraps.

More recently, with greater horsepower available, a 'U' blade has been welded onto the end of a tool bar which is 3-point hitch mounted. This allows and limits the tractor to only harvest the outside row. Once labor picks these liners up, the tractor can then run the next row, which is now the outside row. This device can not harvest an inside row, until it becomes an outside row.

While the lifting and shaking greatly reduces the amount of energy that labor must exert, the pulling and shaking that labor must still do makes this a very strenuous, labor intensive task. Labor will pick up 1 to several plants at a time and slap the root systems against their boot to remove as much of the soil as possible. They then throw the liners into piles. The liners are loaded onto wagons occasionally and kept tarped. They are hauled and stacked in the bareroot

barn. They will be graded, counted and tied into bundles the next day that labor cannot work outside, or during evening hours.

Plants are barerooted while dormant. Some producers may harvest a portion of each species in order to begin filling orders quicker. Additional digging is done as the weather and soil conditions allow. Extreme wetness prevents bareroot harvesting. Tractors rut the fields, get stuck and the soil will not fall away from the roots.

## **FIELD NURSERY TASK CALENDAR**

[Refer to web site.](#)

## **INSECTS and DISEASES**

[Refer to web site.](#)

Refer to the Task Calendar above regarding annual pest problems.

UT Extension Publication #1589 "*Commercial Insect and Mite Control for Trees, Shrubs and Flowers*" is available at <http://www.utextension.utk.edu/publications/pbfiles/PB1589.pdf>

Link to UT Extension publications for fact sheets on various pests

<http://www.utextension.utk.edu/publications/default.htm>

Link to Drs. Alan Windham & Frank Hale's world renowned monthly Ornamental Pest & Disease Update, with great color images of the most current problems; and what to expect.

<http://soilplantandpest.utk.edu/publications/ornamentalnwsltr.html>

The presence of quarantined pests, such as Japanese beetles (JB) or the imported fire ants (IFA) complicate production and shipping. Check with your local TDA nursery inspector to learn the requirements. Action is required in order for other states to accept the product. Our Dept. of Agr. did not create the requirements, but must enforce them to guarantee our market.

Throughout the production season, producers need to be alert for insect, disease and weed problems. Insect and disease problems can usually be controlled with little plant damage when detected early. Producers or hired scouts need to check leaves, stems and roots. Roots of slow growing or slightly off-color plants should be examined for grub feeding damage, root rot, or being too deep.

A few species with routine annual problems should be routinely sprayed on a preventive basis. Examples would be dogwood borers and black knot on plum. High-quality ornamentals must be free of insects, disease and their disfiguring symptoms.

## **Borer Prevention in Dogwood, Ash, Maple, & Oak**

[Refer to web site.](#)

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## **PESTICIDES**



**Pesticide** - The catch-all term for all of the chemicals that kill plants, insects, mites, fungi, bacteria, nematodes, etc, etc.

**Fungicide** - A chemical that kills fungi.

**Herbicide** - A chemical that kills plants, not necessarily just weeds.

A **preemergence herbicide** - A chemical that kills a germinating seedling before (pre) it emerges out of the ground, such as Surflan.

A **postemergence herbicide** - A chemical that kills a plant after (post) it has emerged out of the ground, such as Roundup.

**Insecticide** - A chemical that kills insects.

**Miticide** - A chemical that kills mites.

**Nematicide** - A chemical that kills nematodes.

RUP = **Restricted Use Pesticide**. Requires certification from Tenn Dept of Agr. Contact local UT Extension office

REI = **Restricted Entry Interval**. The number of hours that legally must pass before labor is allowed to return to the area sprayed.

The various **formulations** that Pesticides come in:

A	= aerosol
D	= dust
DF	= dry flowable
E	= emulsifiable
EC	= emulsifiable concentrate
F	= flowable
G	= granular
L	= liquid
RTU	= ready to use
S	= soluble
T/O	= Turf and Ornamental
WDG	= water dispersible granule
WP	= wettable powder
WSG	= water soluble granule
WSP	= water soluble packet

**Backflow prevention devices** must be installed to prevent pesticides from entering the water supply if a negative pressure happens. Avoid a cross connection that could allow a pesticide to enter the water supply if a negative pressure occurred. Never submerge a garden hose into a spray tank when filling, even if present.

**Pesticide Storage** – Pesticides should be stored in a secure facility, convenient to the mixing area, insulated and heated to keep liquids from freezing and powders dry. The water source should have a backflow prevention device. Mixing should be located a safe distance downhill from the well head to avoid contamination in case of a spill. It should be reasonably fireproof, with lights and an exhaust fan would be nice. Sit containers in plastic containers to catch any leaks.

[PowerPoint in pdf of examples](#)

**Pesticide Compatibility** – Pesticide manufacturers are less helpful today concerning the compatibility of different pesticides than 20 years ago due to liability issues. Compatibility charts are no longer printed. Compatibility information is now usually limited to ones own products. Always follow the mixing directions. If the compatibility is unknown, it might be best to apply the products separately, or ask Extension, the dealer or company rep.

**The Jar Test** can also be used to determine compatibility:

1. Add 3 1/3 cups (800 ml) of the same water as when actually spraying to a glass jar if 20 gallons of spray material is planned per sprayed acre.
2. Add each herbicide at the rate of 1 teaspoon (5 ml) for each pint of product recommended or intended.
3. Add the components in the WALE Method sequence, gently stirring between additions.
4. Cap jar and invert 10 cycles. Allow to stand for 15 minutes.
5. Evaluate. Compatibility exists if there is no flocculation or clabbering or explosion.

The **WALE Method** is a recommendation for mixing order when the label does not recommend a procedure. Into a half filled spray tank, with agitation, add first the wettable powder (WP) formulations, second, any aqueous (A) formulations, followed by liquid (L) formulations, followed by emulsifiable concentrate (EC) formulations. Allow two to three minutes between the addition of each product. Maintain agitation during filling and through application. Follow label directions for each material added to the tank.

Observe the "**comfort index**" of 140 when spraying most emulsifiable formulations denoted by EC to avoid foliar burn during hot humid days. The temperature plus the relative humidity should add up to less than 140 when the spraying is done to reduce the likelihood of burn.

Check with the local Extension office if there is a place to turn in empty plastic pesticide containers. They will also know if and when pesticide turn-in days will be held for unwanted, leaking, and old pesticides.

## **WEED CONTROL**

Weed control is an essential requirement in the field nursery operation. Perennial weeds should be removed prior to planting with continuous cultivation or postemergence herbicides. Weeds can be prevented after planting with preemergence herbicides. Weeds which escape or perennial weeds which reoccur can be sprayed with postemergence herbicides or mechanically removed. Use extreme caution when using non-selective postemergence herbicides, such as Roundup.

Cultivation between rows on closely spaced plantings provides good weed control. A weed control program should be developed prior to planting. The program should be initiated immediately after planting and continue through the first three years of the crop. North Carolina research proved that a weed free strip in the row is essential for maximum production. The width of the weed free strip should be increased as the plants grow, but is not as critical through the harvest years.

The clean row can be achieved by cultivation or herbicides or a combination of the two practices. A grass sod middle does not interfere with the growth of the ornamentals in the row, as long as the clean row is wide enough. So, if the soil is likely to wash away on steeper slopes, mow the middles rather than cultivate them.

[Refer to web site.](#)

**Glossary / Definitions / Dictionary** – An abbreviated version.

**Rainfast** – The period of time required for a sprayable product to dry or be absorbed on to foliage, so that rainfall or irrigation does not affect the effectiveness.

**Number of Days Active** – The period of time that the preemergence manufacturer states on the label that the product will remain active, waiting on activation by rainfall or incorporation.

**Inches of Water to Activate** – The amount of rain or irrigation (in inches) required to activate the preemergence herbicide according to the label.

**Spray pressure (psi)** – The pressure recommended by the label for application. More important for the postemergence herbicides if applied over tall or dense foliage, in order to obtain coverage.

**Gallons of Water per Acre Recommended** – The recommended volume of spray water to use when applying the product, according to the manufacturer's label.

**REI (in hours)** – The number of hours that legally must pass before labor is allowed to return to the area sprayed. REI stands for restricted entry interval.

**Bark** – Term for all the tissues outside the cambium; including the epidermis, cork, cortex, and phloem.

**phloem** – Inner bark conducting tissues that transport organic substances, primarily carbohydrates, from leaves and stems to other parts of the plant, including the roots.

**cambium** – The meristematic zone or cylinder, one cell thick, that produces secondary phloem and xylem. A thin sheet of dividing cells responsible for increase in stem thickness. It is invisible to naked eye but is essential to the life and growth of the plant. It must come in contact between the two pieces for budding or grafting to be successful.

**xylem** – Wood tissue. Active xylem is sapwood; inactive xylem is heartwood. Responsible for the translocation or movement of water up the stem.

Taxonomy – the science of classification, dealing with the arrangement of plants and animals into categories according to their natural relationships.

**Botanical Plant Classification Terminology:** (from Dirr)

Accepted Taxonomic Units: Kingdom, Division, Class, Order, Family, Genus, Species, Variety, etc.

Genus – A category whose components (species) have more characters in common with each other than they do with components of other genera within the same family. The plural of genus is genera.

Species – The most important unit in classification with many definitions depending on authority. A group of individuals that adhere to the essential identification characteristics but display sufficient variation so as not to be categorized as replicas of one another. The plural of species is species.

Variety or subspecies – A group of plants subordinate to a species.

Cultivar – Horticulturally is the most important unit of classification.

Ex. Genus, Species, Variety: *Gleditsia triacanthos* var. *inermis*, Thornless Common Honeylocust

Ex. Genus, Species, Cultivar: *Cercis canadensis* 'Forest Pansy'

**Trademark Names:** Present day plant commerce has focused on protection of new introductions so that the names cannot be used for any other plant or product. If someone other than the discoverer wishes to grow and market a trademarked plant, a licensing and royalty agreement must be consummated. Trademark names have no taxonomic validity and so a nonsense cultivar name must be developed. Anyone who shows continued use of a specific name for a plant and places a <sup>TM</sup> in superscript behind the name has a sole right to that name. A registered trademark is signified by a <sup>R</sup> (with a circle around the r) in superscript. This means that the name was registered with The Office of Patents and Trademarks in Washington, D.C.

Examples: *Ulmus parvifolia* Allee® ('Emer II')

*Betula nigra* Dura-Heat <sup>TM</sup> ('BNMTF')

**Bush** - Grown by the thousands; mostly spring flowering. Not worth much individually. Considered a negative term by the more elite.

**Shrub** - Worth at least 50 cents more than a bush. A better word/more professional. Sounds better than bush.

**Greenhouse** - Any structure built for any phase of plant production that is heated &/or cooled. Could be a poly covered Quonset house or glass.

**Quonset house** - A frame of bowed pipe, covered with shade cloth or poly. An inexpensive design to build and maintain.

**Shade house** - A Quonset house covered with shade cloth to protect some species of containerized plants.

**Propagation house** - A Quonset house covered with clear poly used for rooting cuttings.

**Overwintering house** - A Quonset house covered with clear or white poly to protect containerized plants from cold temperatures.

Green Manure – A fresh green crop that is plowed under to increase the organic matter content of the soil.

Lateral bud – A bud in the axil of a leaf.

Lateral branch – A shoot or stem growing from a parent branch or stem.

Leader – A dominant or co-dominant, upright stem. Becomes the main trunk of a tree.  
Leaf bud – A bud that produces only leaves.

Internode – Region of a stem between any two nodes.

Node – The region of the stem where one or more leaves are attached. Buds are commonly borne at the node, in the axils of the leaves.

Internodal cut – A cut made between lateral branches or buds.

Opposite – Term applied to leaves or buds occurring in pairs at a node.

**Irrigation** - The redistribution of previous precipitation.

**Liner** - A young plant ready to be planted in the field or container. Could have started as a rooted cutting, seedling, bud or graft. Can be 6 inches or 6 feet tall.

**Liner row** - Liners are planted into a row at a close spacing for 1 or 2 years to grow a larger root system; to avoid tying up extra land when there may be some mortality because of a smaller than normal root system. Better when placed in good soil with drip irrigation.

Nitrogen-fixing bacteria – Bacteria living in soil or in legume roots that convert atmospheric nitrogen into nitrogen compounds in their own bodies. Is routinely added to legume seed prior to planting.

**Nurseryman** - Someone that grows nursery stock. A sexist term, like postman.

**Nursery producer** - Someone that grows nursery stock, male or female.

Perennial – A plant living year to year, not dying after flowering.

Phytotoxicity or Phyto - Anything that alters the appearance or growth (rate) of a plant.

**Planting depth** – Plant so the root flare or collar is level with the soil or media surface. Too deep is worse than too high. Roots too deep will die without sufficient oxygen.

Root hairs – Tubular outgrowths of epidermal cells of the root in the zone of maturation.

Seed – A reproductive organ formed by seed plants following fertilization. May only be an embryo covered with a seed coat.

**Scarification** – The seed treatment employed to break dormancy by treatment with abrasives, etc.

**Stratification** – The exposure of dormant seeds to cold, moist conditions to break the dormant period. An artificial duplication of winter conditions.

**Soil** - What plants in a field grow in.

**Dirt** - What is swept from the floor.

**Media** - What plants in containers grow in. Normally pine bark based.

**Substrate** - New term for media.

**Translocation** – The movement of food and water from one part of a plant to another.

**Transpiration** – The loss of water from plant tissues in the form of vapor.

**Weed** - A plant in the wrong place. An unwanted plant, where ever it is. Could be a dogwood tree in a block of maple; a walnut tree in a corn field.

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### Precautionary Statement

In order to protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store, or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label. Persons who do not obey the law will be subject to penalties.

### **Disclaimer Statement**

Pesticides recommended in this publication were registered for the prescribed uses when printed. Pesticides registrations are continuously reviewed. Should registration of a recommended pesticide be canceled, it would no longer be recommended by the University of Tennessee. Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others which may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product.

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