NC STATE UNIVERSITY

Field Production of Nursery Stock:
Field Preparation, Planting, and Planting Density

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Introduction

Interest in producing field-grown nursery stock has increased in recent years as agricultural producers have considered diversifying. Although many growers are familiar with field production of other agricultural crops, they may have less experience with nursery stock. Some aspects of growing shade trees in the field are similar to other agricultural enterprises, but many characteristics—such as procuring line-out stock, spacing, planting, and managing a crop for more than one year—are quite different. Initially, new growers must plan a marketing strategy to identify clientele and determine what plant species or cultivars to grow. Depending on the final plant size at sale, growers can determine the field layout, spacing, and equipment required to meet the strategic plan. Generally, if nursery stock is sold within a local area, marketing may be limited to retail garden centers, which prefer small, well-formed trees and shrubs. Landscapers, on the other hand, need larger plant material and in some cases may prefer specific leader, canopy height, and branch structures when they select shade trees at the nursery. Shipping nursery stock to other geographic locations requires special handling during harvest and transportation. The more specific the marketing strategy, the easier it is to determine which plants to grow and how to design the planting plan.

Soil Amendments and Cover Crops

Nursery professionals should implement best management practices that maintain and improve soil quality throughout the year, from fallow periods to harvest. The term "soil quality" refers to the fitness of a soil to function within its surroundings—to support plant and animal productivity, to maintain or enhance water and air quality, and to support human health and habitation. Soil quality information is available from the U.S. Department of Agriculture's Natural Resources Conservation Service and online at http://www.nrcs.usda.gov/search.

Amending the soil and planting cover crops are the most effective best management practices to help field nursery growers. Amending soils with organic matter improves soil quality and structure, aeration, water retention, drainage, and the quality of nursery stock. Some nursery species develop a more fibrous root system as the amount of organic matter is increased. Additionally, cover crops reduce soil erosion while increasing the nutrient content of the soil. Another good practice is to establish filter strips, which bind and trap nutrients and soil during heavy rains (Figure 1).

Reducing tillage is one way to decrease soil loss from erosion. High winds and heavy rains cause major soil losses and leaching of nutrients during periods of high volume run-off. Frequent tilling increases that loss by changing soil structure, contributing to soil compaction, and reducing water infiltration. Washes and gullies are more likely to occur. Moreover, frequent tilling reduces the activity of soil organisms that would otherwise break down nutrients. Therefore, reducing tillage decreases run-off while providing an environment for natural organisms to complete the nitrogen cycle.

Organic matter amendments—such as composted bark, yard waste, and compost—can be expensive to transport and apply in significant quantities. Growers should use these amendments in the most intensively cultivated sites, such as seedbeds or transplant production beds. If available, composts from municipal yard wastes offer affordable organic sources for amending fields. Because composted yard wastes generally provide only 0.2 to 0.5 percent nitrogen, between 50 and 200 tons per acre can be applied. Applying 50 tons per acre

Figure 1. Cover crops used during production, clockwise from top left: Sudex grass (Sorghum-sudan grass hybrids) being mowed on fallow field; Sudex in row middles; buckwheat in fallow field; tall fescue in the drive and row middles; and wheat in the row middles. Cover crops within rows and during field preparation help reduce soil erosion, build soil quality, add organic matter, and contribute nutrients simultaneously (see cover crop section).

provides about a half-inch of coverage over a one-acre area, while 200 tons per acre will be approximately 2 inches deep.

Animal wastes such as cattle manure or poultry litter can be applied directly to fields in light applications of ¼ to ½ inch over surface areas but work best when incorporated into the soil. If these wastes are incorporated, 75 to 100 percent of their nitrogen may be available the first year. Rates of application for either organic matter or animal waste should be based on nutrient analyses. Pay particular attention to the metal content of animal wastes. Zinc and copper can become toxic if repeated applications are made annually. Foliar tissue analysis of new, fully expanded leaves collected early in the growing season provides valuable information about the efficiency of soil amendment applications and helps determine if any supplement is required.

A cost-saving alternative to applying organic materials over the entire field is to incorporate the organic matter into planting rows only. If rows are spaced 12 feet apart and the root zone is considered to be 2 feet on each side of the stem, adding organic matter to this 4-foot-wide strip will reduce the amount applied to the field by two-thirds.

Cover crops can significantly reduce soil loss, as can cover crop rotation. Planting hybrid sudan grass in large fallow areas during summer months, followed by dwarf barley as a winter cover crop, helps reduce sediment and nutrient loss. Grasses and small grains can also be used in a double-cropping system. For example, small grains can be sown in the fall, then killed with herbicide or plowed in before seeds are produced in spring (Table 1). Sorghum-sudan grass hybrids, buckwheat, and even corn are commonly used as summer cover crops. The abundant and rapid growth of these crops produces large amounts of biomass. To increase the amount of organic matter in soil, mow sudan grass at least twice to prevent seed formation, then plow or disk under in fall.

Organic matter increases when cover crops are used in production, and the most important improvement is the increased size of soil aggregate fractions in the 1- to 2-millimeter size range. An increase in the larger aggregates facilitates water infiltration and retention and provides a better biological habitat and a better rooting environment. The number of resident fungivores and macropredators is directly linked to cover-cropping practices. Fungivores regulate the rate of nutrient mobilization, while macropredator density has been correlated with pest control. Cover cropping also stimulates arthropods and earthworms. Deposition of green manure cover crops on soil surfaces has been shown to support high populations of beneficial mites, which are biocontrol agents.

Filter strips reduce erosion by first slowing the movement of surface water, then increasing its infiltration, in addition to trapping or binding the sediments and nutrients carried by the surface water. To be an effective best management practice for field production, filter strips should cover no less than 70 percent of the surface and be at least 12 feet wide. Cool-season grasses used as filter strips are most effective during critical erosion periods in fall, winter, and spring, when rainfall is frequent and storm runoff excessive.

Storm water ponds and wetlands used as natural filters can provide even greater sediment and nutrient retention than filter strips. Field nurseries often are located on land with gentle slopes where sediment loss potential is high, particularly if vegetation is sparse. Depending on surface cover, slope, and environmental factors, sediment retention basins may require cleaning as often as every two years. These materials may be recycled and spread back on the fields.

Conservation efforts can help reduce soil and nutrient loss from wind erosion and storm water movement off site. Soil-stabilization and erosion-control best management practices include:

- planting across slopes and contoured layout of fields
- using cover crops for fallowing land and during all facets of production
- using vegetation in aisles, row ends, drive roads, and field border strips
- grassed waterways
- sediment dams in waterways
- bio-swale collectors and wetlands
- irrigation practices that do not increase erosive washes.

Field Preparation

Crop stubble, fertilizer, lime, and soil amendments should be incorporated into the soil, whether or not a green manure program is followed. Mow tall weeds before seed

Figure 2. Field preparation prior to planting. In late summer and early fall, tall fescue grass seed was sown and allowed to grow over winter. (clockwise from top left) In early spring, planting rows were selected and sub-soiled twice approximately 18 inches apart within the row (the subsoiler on the top right is 3 to 4 feet apart). Rows were rotovated (bottom right) and then mounded up for planting (bottom left).

Table 1. Seeding rates and planting dates of cover crops used in field production of ornamental plants.

Species	Seeding Rate	Weight (pounds/bushel)	Planting Date
Barley	2.0 bu/A	48.0	Aug.–Oct.
Rye (annual)	1.5 bu/A	56.0	Aug.–Oct.
Ryegrass (annual)	2.0 bu/A	24.0	Aug.–Oct.
Oats	1.5 bu/A	32.0	Aug.–Oct.
Buckwheat	1.5 bu/A	45.0	Aug.–Oct.
Wheat	25.0 lb/A	60.0	Aug.–Oct.
Crimson Clover	20.0 lb/A	60.0	Aug.–Oct.
Sorghum-Sudan Hybrids	25.0 lb/A	50.0	April–May

dispersal, then disk or plow under. This will permit more effective soil mixing during plowing and minimize the problem of long, coarse stems becoming entwined in equipment.

A chisel plow will mix materials efficiently into the soil, ensuring an even distribution of materials and rapid root development during the growing season. Rotovating can also prove effective but generally does not mix the soil as deeply as a chisel plow. Avoid using a moldboard plow, because this implement overturns the top layer of soil and deposits it just beneath the soil surface rather than distributing it evenly throughout the soil. For best results, chisel plow twice. If erosion is not a problem, plow first across the field in one direction, then plow at right angles to the first path. Be careful not to destroy terraces and contours while plowing.

A simple way to prepare the field is to chisel plow in the fall and sow a cover crop such as tall fescue. In winter, kill the grass in the planting rows with a herbicide. Subsoil twice within the planting rows, either 18, 36, or 48 inches apart. Rotovate crop stubble, fertilizer, lime, and soil amendments into the planting rows. Slightly mound the planting rows to permit drainage (if applicable) and decrease settling around plants (Figure 2).

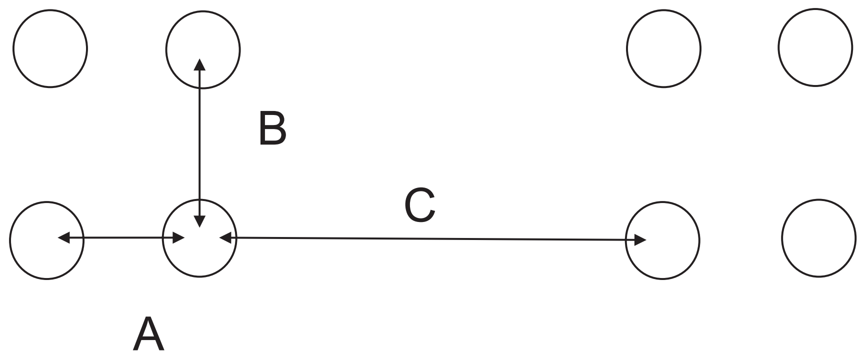
Fumigation. When weeds, soilborne insects, nematodes, or pathogens cannot be controlled adequately after the crop is planted, or if noxious pest inspection standards cannot be met by any other means, then fumigation may be the most practical pest control strategy, particularly in valuable, pest-prone crops. Depending on the fumigant, chemicals can be highly toxic and kill most insects, pathogens, nematodes, and weeds. Fumigation is expensive and is used only when other management options will not provide economically viable control.

Sample Cover Crop Plan

Suppose a grower sells 1 acre of hemlock per year, on a four-year rotation. The grower would require 4 acres over four years to grow the crops, plus 1 acre for a green manure crop (5 acres total). In a typical cycle, an acre would be sold by April. Those fields should be plowed or rotovated, leveled, fertilized, and sown with a sorghum-sudan hybrid as soon as possible after the hemlock is harvested. This cover crop should be mowed at least once, and perhaps twice, then plowed under in September. Ideally, a small grain such as rye could be planted as a winter cover. Suppress the rye between the rows by either mowing or spraying with a grass herbicide. One variation to this method is to sow oats instead of rye in the fall. In spring, plant directly into the oats. In this case, the oats would be left within planting rows to provide some shade and wind protection while the transplants become established in late spring and early summer. A grass herbicide would then be used to suppress the oats when they reached 6 to12 inches tall. Oats can also provide protection during the first winter for crops that do not develop an extensive root system after planting. The oat roots help prevent the soil from "frost-heaving," which can push young, shallow-rooted plants out of the ground in normal freeze-thaw cycles. Moreover, oat foliage provides some protection from windburn and windblown soil.

Two commonly used fumigants are metham-sodium and dazomet. The most effective soil fumigant, methyl bromide, is no longer available except for certain exempted uses such as in forest nursery seedbeds. Metham-sodium and dazomet are somewhat less effective on some pests and take longer to dissipate from the soil before planting, but they are easier to handle and somewhat less toxic than methyl bromide. Because each fumigant is toxic and expensive, it must be carefully applied to ensure both the safety of the fumigator and the effectiveness of the treatment. Furthermore, purchase and application of these products requires certified applicator licensing.

Although metham-sodium is a liquid and dazomet is in granular form, the mode of control is from methyl isothiocyanate (commonly referred to as MIT), which is released as a gas after the materials are applied to the soil. Metham-sodium may be easiest to use on small areas as a liquid drench. Larger areas may be treated with tractor-mounted soil injectors specifically designed for the purpose. For best results, cultivate the soil thoroughly, and irrigate to uniformly moisten it. Then apply metham-sodium at a rate of 1 pint per 50 square feet of surface area. After application, irrigate the soil with enough water to saturate the surface. As with all common fumigants, cover the treated area with plastic sheeting to achieve



A. Spacing between rows.
B. Spacing within rows.
C. Spacing of drive row.

Example 1. Two rows 6 ft apart (A), trees 4 ft apart within row (B), 10 ft drive rows (C).

8 ft (3 ft between rows + 5 ft of drive row) x 4 ft (2 ft either side of tree within row) = 32 ft^2 per tree

43,560 ft^2 per acre ÷32 ft^2 = 1,361 trees per acre.

Example 2. Two rows 6 ft apart, trees 6 ft within row, 10 ft drive rows.

6 ft x 8 ft per tree = 48 ft^2 per tree; therefore, 43,560 ft^2 per acre ÷ 48 ft^2= 907 trees per acre.

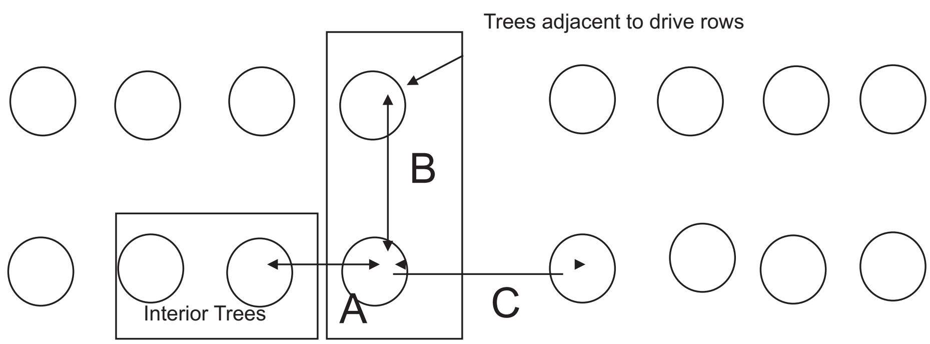
Example 3. Two rows 8 ft apart, trees 8 ft within row, 12 ft drive rows.

8 ft x 10 ft per tree = 80 ft^2 per tree; therefore, 43,560 ft^2 per acre ÷ 80 ft^2= 544 trees per acre.

Example 4. Two rows 10 feet apart, trees 8 feet within row, 14 foot drive rows.

8 ft x 12 ft per tree = 96 ft^2 per tree; therefore, 43,560 ft^2 per acre ÷ 96 ft^2= 454 trees per acre.

Examples 1 through 4 show how to determine the number of trees per acre using a spacing pattern of two rows and then a drive row. The spacing between rows, as well as in within rows, should be based on the salable sizes of the trees being grown.



A. Spacing between rows.
B. Spacing within rows.
C. Spacing of drive row.

Example 5. Four rows 6 ft apart (A), trees 6 ft apart within row (B), and 10 ft drive rows (C). For this example, we need to calculate an average square footage for each tree based on both the trees adjacent to the drive rows and the trees on the interior rows.

Trees adjacent to drive rows

6 ft (3 ft either side of tree within row) x 8 ft (3 ft between rows + 5 ft of drive row) per tree = 48 ft^2 per tree.

Trees on the interior

6 ft (3 ft either side of tree within row) x 6 ft (3 ft between rows) per tree = 36 ft^2 per tree.

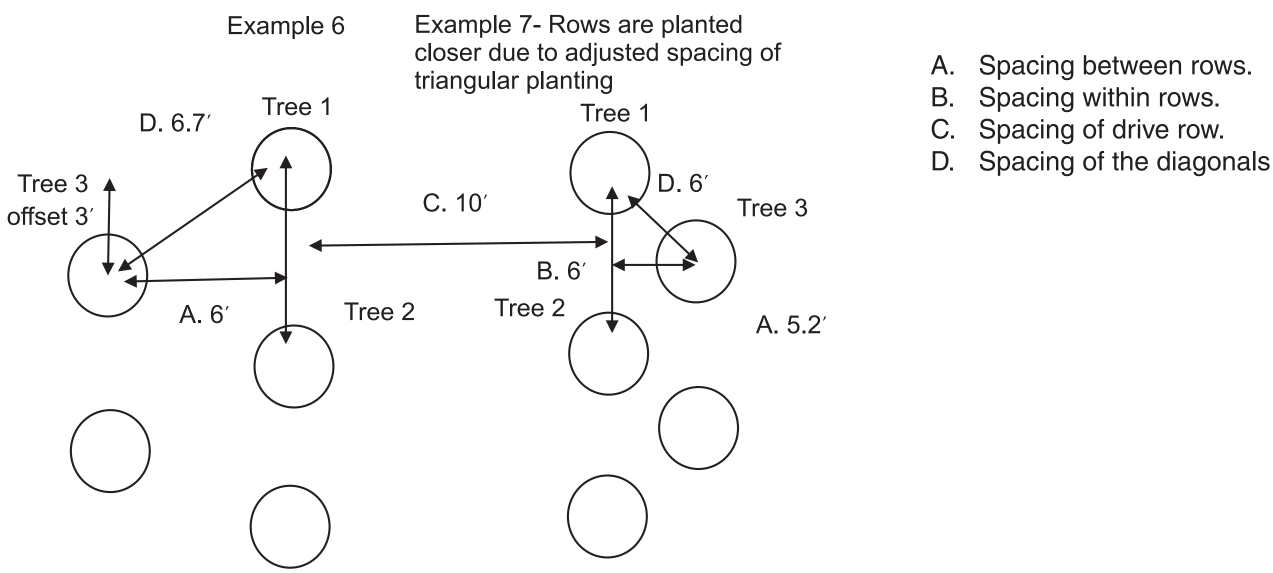
(48 ft^2 + 36 ft^2) ÷ 2 trees= 42 ft^2 per tree; 43,560 ft^2 ÷ 42 ft^2 = 1037 trees per acre. This allows a grower to utilize more land for growing trees while providing more square footage for canopy formation and using less land for transportation.

Example 5 uses four planting rows and then a drive row. In this example, not every tree has the same amount of growing space. For example, trees planted adjacent to the drive row benefit from the extra area of open space. Trees located in the interior of the four-tree row are surrounded by other trees. Therefore, they have less area than the other trees on the outer edges.

maximum effectiveness. The plastic helps ensure that the fumigant remains in the soil long enough to be effective before escaping into the atmosphere. Remove the plastic and cultivate the treated area 7 days after application to a depth of 2 inches. Do not plant until 14 to 21 days after treatment. If the soil is cold and wet, postpone planting further. Always refer to the product label for details and precautions.

Dazomet is easily applied with any spreader. Rototill to a depth of 6 inches immediately after application, then irrigate. Although not mandatory, covering the treated area with plastic will achieve the best results. If plastic sheeting is not used, roll the surface to seal it, and keep the soil surface moist for several days to slow the loss of methyl isothiocyanate from the soil. Again, refer to the product label for details and precautions.

Regardless of the fumigant used, soil preparation is the key to success. Soil should be cultivated twice to a depth of 6 to 8 inches: once 7 to 10 days before fumigation and again immediately before fumigation. Tillers and rotovators are excellent for this purpose. At treatment time, the soil should be free of clods and fresh organic debris, moist enough for seed germination, and have a temperature greater than 50º F at a depth of 6 inches. Because most fumigants are bound by high levels of un-decomposed organic material (roots, stumps, leaves, and grass), remove organic debris or allow it to decompose before fumigation. If the soil is not properly prepared or free of fresh organic matter, the fumigant may not kill insects, diseases, nematodes, or weeds that are present. Although the soil should be moist,



Example 6. A row is planted with trees approximately 6 feet apart within the row. The adjacent row is 6 feet away and trees are also planted 6 feet apart within the row. There is one exception, however: the second row of trees is offset 3 feet from the first row before planting. This shift in planting uses a little more growing area in the field but yields a similar amount of canopy growing space, while providing other benefits. Plants are shifted 3 feet in the planting row, so more land is required than just planting trees in straight, even rows. Plants occupy about 51 ft^2 of growing area rather than 48 ft^2 described above in Example 2 for trees on 6-by-6-foot spacing. This is due to the offset spacing, because not every tree is exactly 6 feet away from every other tree. Trees that are diagonal to one another, such as trees 1 and 3 in Example 6, are actually 6.7 feet apart. This change allows for more canopy space to be shared among trees and allows more light to penetrate between row plantings. Moreover, the offset planting allows more room for digging equipment and crews to maneuver around trees, limiting potential damage and maintaining quality. Therefore, 854 trees are planted per acre instead of 907.

Example 7. Triangular spacing uses the extra spacing between diagonal trees to plant trees closer together. If tree 3 is planted 6 feet apart from both tree 1 and tree 2, then the tree will actually be spaced 5.2 feet from the center of the adjacent row (see A and D in rows to the right). This method yields 46 ft^2 per tree, or 946 trees per acre. This method offers slightly less canopy area than in Example 2 above, but more trees are planted per acre in the same layout design.

Examples 6 and 7 illustrate planting on a triangular or offset spacing between adjacent rows.

wet soils are not sufficiently aerated to allow free movement of the fumigant within the soil, so fumigants will perform poorly.

Fall is an excellent time to fumigate because soils are warm and proper moisture levels are easier to attain than in winter or spring. Rooting beds and seedbeds are used frequently during the cold winter months. Without fall fumigation, it is difficult to achieve the required temperature and moisture conditions needed to fumigate in the winter or early spring.

County Cooperative Extension agents are good sources of advice on which fumigation technique would be best for your area. An experienced pesticide applicator should help novice growers the first time beds are fumigated. Fumigants are highly toxic chemicals that must be handled properly to be safe and effective.

Planting Density

In choosing planting dimensions, account for space required by fertilizing, cultivating, mowing, and spraying equipment. Spacing is always a concern in new fields, especially if the final size of the plants or the market for the crops is unknown. If trees might be sold to professional landscapers or used as municipal street trees, space them wider to allow for more growth and better access during harvest. Wider spacing is also encouraged if the market strategy is uncertain, because it provides more options for finding a market before the trees become overgrown. See examples 1-7 to learn how spacing and layout can affect the number of trees per acre. A spacing method

Figure 3. Root systems of field-grown, balled and burlapped liners of (top) dogwood (*Cornus florida*) and Japanese Stewartia (*Stewartia pseudocamellia*) after the burlap has been removed from the harvested plants. Note that there appears to be 6 to 8 inches of “soil creep” above the root flare of the dogwood. This suggests that the tree was planted too deeply during production. As a result, adventitious roots have tried to form above the root flare. Because the actual root system was planted too deeply, it was removed by the digging spade during harvest. The root flare of the Stewartia was planted at the correct depth in the field. The root collar is visible, and the root system is extensive and fibrous.

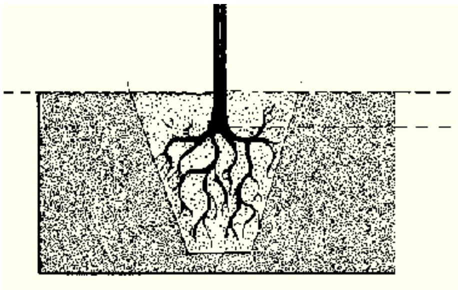


Figure 4. Planting liners too deeply can cause soil buildup high around the collar of nursery stock, creating a false soil line. Subsequent planting in the landscape at that false soil line is harmful to the tree's health.

that allows the most flexibility is planting two rows 8 feet apart and a drive row of 10 to 14 feet on each side of the two rows. Repeat this pattern across the field. This spacing allows greater room for digging and results in less injury to trees during harvest. Smaller flowering trees such as dogwoods and shrubbery can be spaced 6 feet apart within rows, while larger tree species should be spaced up to 10 feet apart within the row. When calculating the number of trees per acre, assume that each tree is considered to "own" half the space between it and the next tree or row. In reality, however, the canopies and roots may exceed half the distance by harvest time.

Larger nurseries use main or firebreak roads for field loading. Most smaller nurseries load onto tractor-pulled wagons or small trucks to transport plants to the loading area. Plan for enough space for transport vehicles and other maintenance equipment. To determine the minimum distance needed between rows, add the width of the tractor plus the maximum width required by American Standards for Nursery Stock for that crop. For example, a tractor might be 48 inches wide. In

Figure 5. Planting containerized liners using a tractor-driven transplanter. (clockwise from top left) Prior to planting, plants were removed from containers, soil was removed from the top portion of the root ball to expose the root flare, and circling roots were cut or removed. The grower is taking care to place plants so that the root flare is even with the new field soil level. Afterwards, plants are watered and drip irrigation is installed (not pictured).

growing a crop of 5- to 6-foot trees, another 48 inches are required for the plants to meet standards; therefore, rows must be at least 96 inches or 8 feet apart.

One method of increasing planting density is to plant some species, such as dogwoods, 3 feet apart within rows and after two years, dig and sell every other plant down the row. The following season, the remaining trees would have additional space to develop caliper and full, well-branched canopies. In theory, this method seems like a good idea. There is, however, a critical issue with this plan: there must be a sales mechanism in place for the trees that are dug after two years. If all the alternating trees are dug and sold, or possibly containerized for selling during the current season, this plan might be feasible. However, in many cases, if the grower has no immediate market for the smaller trees or a place to hold them, then the entire crop becomes overgrown and diminishes in value.

Figure 6. Hand planting bare-root deciduous tree liners. (clockwise from top left) Workers select liners from sawdust, which was used to heel-in liners prior to planting. (top right) Root systems of bare-root liners are held so that the root flare or root collar (portion of the stem where the trunk meets the root system) is even with the existing soil level. Notice that the graft or bud union is about 3 to 4 inches above the soil line and the root collar is just above the soil surface. On some liners, graft unions may be absent, but the root collar should still be planted just above the soil surface. This method will require staking in the field immediately after planting. (bottom right) Field soil is placed around the existing roots and covers about 1 inch of the root system. (bottom left) After correct planting, soil should cover the uppermost primary roots but not cover the root collar.

Figure 7. Drip irrigation reduces soil erosion and nutrient leaching and conserves water.

Planting

Although field layout should be determined well in advance of planting, the actual distribution of plants in the field is determined at planting. Grading transplants is crucial. Plants of similar size and grade can be expected to grow at approximately the same rate and should be planted together to create uniformity in production stands. Harvesting similarly sized trees is more cost effective.

Invest in the largest and highest quality liners that are affordable at planting. About half of the liners from a seedbed may not be large enough or have adequately branched root systems when planted. If balled and burlapped plants are purchased to be used as liners, peel back the burlap to inspect root systems prior to planting. Plants may have been set too deeply during production in the liner stage or have substandard root systems (Figure 3). Planting liners too deeply can create a false soil line above the root system, which can lead ultimately to failure in the landscape (Figure 4). Quality liners make quality plants.

To ensure that rows will be planted straight, mark the first row with rope, strings, wire, or some similar guide attached to stakes. Set plants at the determined spacing along this line, and make sure that the second row is planted parallel to the first. These first two rows are used as guides for planting the rest of the field. A steady hand is important when planting mechanically because the tractor's tire tracks are often used as guides to ensure a uniformly spaced field. Mechanical transplanters are well suited for planting a large number of similarly sized plants (Figure 5). Mechanical transplanting is easier when plants are carefully graded and the field is relatively level and uniform. If these conditions cannot be met, then consider planting by hand (Figure 6).

Although field-ready transplants should be sufficiently hardened to withstand the rigors of production, they should be kept moist and shaded as much as possible before being planted. Be especially careful not to let roots dry out. Soak roots for 1 or 2 hours within 24 hours of planting to help increase moisture and improve the plant's chance of survival. Various starch-based hydrogel dips may also help keep roots from drying out.

Set transplants into moist soil in late winter and early spring in the piedmont and mountains. Freeze-thaw cycles during winter make late fall and winter plantings less successful in these areas. Transplants set in spring will have the opportunity to establish a root system prior to flushing foliage. A well-established root system aids the uptake of water lost from tender foliage. Additionally, transplants are often not available from field-grown liner producers until late January or February. Planting late-fall and winter in the lower piedmont and coastal plain, however, can be successful when liners are available.

Even when liners are set into moist soil or water is applied to the planting hole by a mechanical transplanter, it is a good idea to water recently set transplants within 24 hours. Water, whether from a sprinkler truck, irrigation system, or rain, will help firm the soil around roots, thereby eliminating air pockets that might dry out plants.

For most species, set liners at the level where plants were growing in the transplant bed. If soil is particularly soft at planting, liners may be set slightly higher to allow for

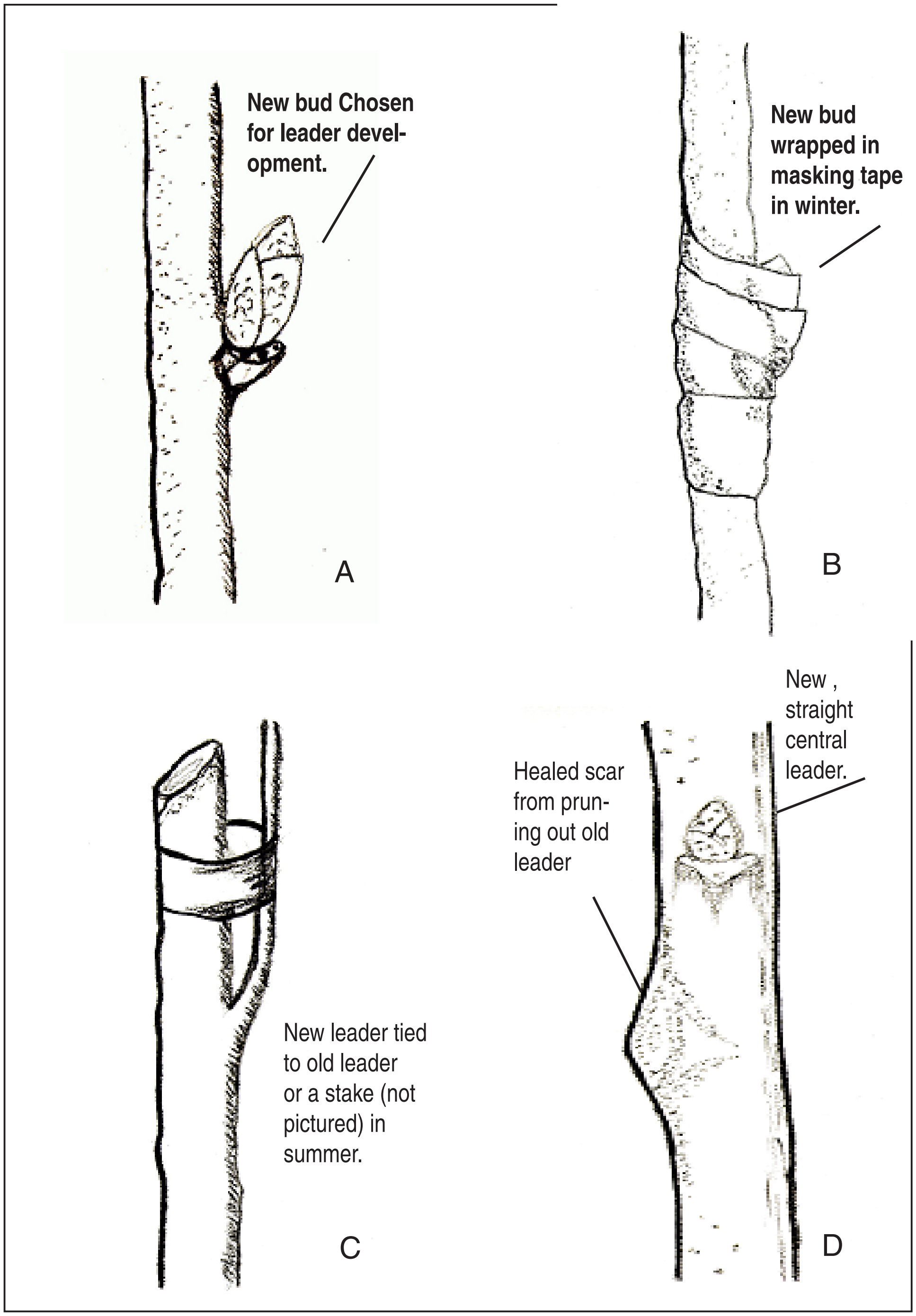


Figure 8. A new, straight leader developed by choosing a (top left) new bud and (top right) wrapping it with masking tape (a bud clip might also be used). After the buds expand and a new leader is produced (bottom left), tie it to the old leader or to a stake the following summer. The old leader can be pruned out in late summer, and the injury should (bottom right) heal in a year or two while a new leader is produced. After pruning out the old leader, tie the new leader to a stake to keep it straight throughout production.

settling. There are no good horticultural reasons to set liners deeper than plants were previously growing. In fact, setting liners too deep frequently results in stunted growth and death of many species (Figure 1).

Pruning at Planting. The most important aspect of growing nursery stock during the first year is root establishment and development. Top form and shape are less important for small liners than root growth, thus allowing the top to grow provides the energy to develop roots. Small, non-irrigated liners often experience loss of leaders and secondary branch dieback, which requires pruning later. Applying drip irrigation increases the survival of first-year liners (Figure 7).

Pruning during the first year should be limited:

- Prune unbranched nursery lineout stock if the plant is too tall and weak to stand erect and if staking is impractical.
- Prune dead terminals on single-stemmed trees if a new leader is needed. If the leader is pruned or is dead, branching will occur during the first year on whips, and these may also require some heading back to keep vigorous shoots from growing too long.
- Any vigorous lateral branches of newly transplanted liners may need to be pruned by midsummer. On trees that are sold as straight, single-stemmed specimens, such as maples, ash, oaks, and flowering pears, prune any vigorous lateral branches that outgrow and suppress the main leader.

Figure 9. Selective summer pruning to choose a central leader and attach it to a stake. Summer is also a good time to remove water sprouts and dead limbs. Providing stakes that are taller than the central leader throughout production is an important best management practice to maintain straightness and increase tree quality. Because stakes vary in height, smaller stakes may be attached to larger stakes to reach over 10 feet in height. One worker is using drywall leg extensions to reach the top of the tree, while the other is on a rented, mobile lift platform. Flexible fiberglass stakes may bend along with trees to allow employees to prune while standing on the ground or on a low, stable platform.

Select a lateral bud or shoot as a new terminal if the terminal of a leader is dead or if it is cut back while the tree is still dormant. On pears, cherries, and crabapples, remove three to four buds below the selected terminal bud to prevent multiple leaders from forming. A bud clip placed next to the bud or masking tape wrapped around the bud can direct the growth upward without a crook forming (Figure 8). If the tree is opposite budded, remove the bud opposite the one selected as the terminal. If a terminal dies after shoot growth has occurred, a lateral shoot can be bent upward and attached to the portion of the dead terminal for support.

Remove other competing shoots, or head them back at a node approximately one-half the length of the shoot. The old, dead leader can be removed after the new terminal is firm enough to stand alone, or the dead terminal can be removed during dormant-season pruning.

Often the best choice for misshapen seedling trees is to cut them off at the ground just before bud break in the second season. This practice can result in high mortality in dogwoods, Japanese birches, and other plants with low vigor, so use this method selectively. After new shoots develop, the healthiest and straightest one should be selected as the central leader and all others removed.

Any other pruning the first year should be confined to broken branches and large lateral branches that are out of scale with the main leader. Remove any large lateral branches that are low on the main stem. Smaller low branches may be pruned back to two or three buds to help caliper development of the main stem. Remove these short branches during dormant winter pruning. If branched trees are planted, similar procedures may be required to reduce competition of lateral branches with the leader. By mid-summer, competing lateral branches may need pruning to approximately one-half their length by cutting to an outward-facing bud, and a central leader should be chosen and fastened to a stake (Figure 9).

For clump or multi-stemmed trees such as river birch and crape myrtle, no pruning is necessary during the first year; however, all but three to five main stems should be cut at ground level before the second growing season.

Conclusion

Apply best management practices throughout the production of woody ornamentals.Soils are living systems much like a forest, but on a smaller scale. continually investing in the health of the system by using organic matter, Cover crops, drip irrigation, reduced tillage, and proper planting design will provide years of crop production. The healthier the soil, the shorter the production time, and the easier it is for crops to withstand and overcome short-term disasters like drought, freeze, and pest outbreaks. Creating a sustainable production system will ensure that soil, nutrients, and water are available today and for future production cycles.

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