

Reviews

Scheduling Woody Plants for Production and Harvest

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Summary. Growth characteristics and marketing of woody ornamentals prevent crop scheduling common in floriculture crops. However, many tasks in the production of woody ornamentals require coordination with the season and/or physiological state of the species. Since most woody ornamental nurseries produce many species or cultivars, a variety of tasks occur concurrently. This review highlights the major tasks required during production for most species of woody plants. The physiological and environmental factors that dictate or influence scheduling are discussed.

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Crop scheduling, for most horticulturists, is associated with floriculture and greenhouse production. The term immediately conjures up images of specific flower crops timed to reach their peak near major holidays; i.e., roses in mid-February and late May, Easter lilies in April, etc. However, ask a woody ornamental producer about their crop scheduling and the usual response is a blank stare, or they recite their production projections for the coming years. Because of the nature of woody ornamentals, growers do not plan production of one specific crop after another; i.e., azaleas in the spring, followed by photina in early summer, etc. Woody ornamentals are produced for a broad sales period with all species marketable during the same period, rather than each or a few species targeted for a specific date. Woody ornamental sales typically are concentrated from early spring to late fall, but often continue year-round. Unlike some floriculture crops, woody ornamentals do not lose their value after a holiday or narrow-targeted period is past. At best, plants will reach marketable size

in one growing season. But, as in the case of tree farms, a production cycle may be 5 to 10 years long. Thus, crop scheduling, defined here as exact timing and the manipulation of an environment to produce a specific crop within a narrow target period, does not exist in the woody ornamental production scheme.

If, however, crop scheduling is defined as performing specific tasks at certain times during the production of a crop, then several schedules can be found in woody ornamental production. These can be grouped into the areas of propagation, production, and harvest. This review examines the use of scheduling within each of these areas and provides examples, and, where possible, supporting research for these schedules. In some cases, however, there is little or no research to support specific schedules employed by woody ornamental producers. In such cases, the experience of growers themselves is used.

Propagation

Seeds. Propagation by seeds involves the development of three major schedules: collection, processing and storage, and sowing. Because woody ornamentals consist of a vast group of unrelated plant material, the exact timing and length of each schedule are highly species-dependent. Several references are available that provide the information needed for most seed propagation (Dirr and Heuser, 1987; Hartman and Kester, 1975; Schopmeyer, 1974).

Scheduling seed collection is dependent on species, location, and experience. Often, fruit or seed is collected before the fruit becomes overripe, cones open, or seed coats completely dry (Cram, 1982; Heit, 1971, 1975). This results in more rapid and/or higher germination than waiting until the fruits or seeds are fully mature (Cram, 1982; Heit, 1971). Because fruits and seeds are a source of food for wildlife, earlier collection also prevents damage and consumption by birds and other animals (Cram, 1982).

Species characteristics dictate when seed collection must be scheduled. Most maple and ash species produce seed in the spring; these must be collected in early summer. However, the Rocky Mountain maple (*Acer glabrum*) produces seed in late fall (Heit, 1971), as do most oak species.

Seed and fruit maturity are also dependent on latitude and altitude. Thus, seed collection for each species must be well-planned. Inappropriate scheduling of seed collection may result in more difficult and complex processing and storage, lower germination, and/or fewer seeds being collected.

Processing and storage of seed prior to sowing are also highly species-dependent. Some species require stratification before further processing. For superior germination, many hardwood trees and shrubs appear to require a period of warm, moist treatment prior to a prechill treatment (Hartman and Kester, 1975; Heit, 1975). Others, such as *Magnolia* spp., may require just a chilling treatment prior to sowing (Heit, 1975). Still other species germinate best when sown into a seedbed directly after harvest (Fordham, 1976; Heit, 1971). Pre-sowing treatments may last from several weeks to nearly a year. The timing of each phase generally has been determined for most popular species and may be found in the references mentioned previously. Because the length of pre-sowing treatments and the shifting from one to the other is sometimes crucial, exact scheduling of these pretreatments is very important.

Scheduling the sowing of seed is often dependent on the completion of the processing and storage phase. Once seeds have been stratified, they are programmed for immediate germination and cannot be held in storage for any extended time without loss of viability (Hartman and Kester, 1975). Thus, seedling beds or propagation containers must be prepared in advance of the labor scheduled for sowing. This may involve lifting of a previous crop of seedlings, sterilization of the seedbed or media, filling seedling trays, etc. Some growers forego the sometimes complicated stratification procedures, opting instead to direct-sow the seed into field beds in the fall to early spring (Fordham, 1976). This reduces the record-keeping and the complexity of the scheduling, but extends the propagation phase.

Propagation by seed requires coordinated scheduling of seed collection, pre-sowing treatments, and preparation of the germination area. Failure to properly coordinate these schedules can result in loss of profit at the end of the production cycle.

Cuttings. Most woody orna-

mentals, including some shade trees, are propagated by cuttings. Cuttings usually produce true clones, which facilitate production and sale of a uniform crop. With cultivars, clonal material is essential, and cuttings provide the most economical method of propagation. Cuttings generally are removed from the stock plant at one of three physiological stages. Softwood cuttings are taken during active shoot elongation when leaf expansion is ongoing and stems have little lignin. Semi-hardwood cuttings are taken in the period after shoot elongation, and leaf expansion has stopped. Leaves at this stage have achieved the mature-green color and the stems are becoming increasingly lignified. Hardwood cuttings usually are taken in the fall or winter. At this time the apical buds are dormant, the stems lignified, and the leaves may not persist (Hartman and Kester, 1975).

Allowing the flexibility to schedule cutting collection based on physiological status rather than calendar date is essential for successful propagation. The timing and type of cutting that results in the greatest success is highly dependent on the species. Plant growth timing varies from one year to the next because it is influenced by the environment, fertilization, and irrigation schedules. Thus, propagation by softwood or semi-hardwood cuttings requires flexibility in scheduling of up to several weeks from year to year. For example, optimum rooting of several *Acer* spp. by softwood cuttings was determined at Dow Gardens in Michigan in 1979 (Chapman, 1979) and 1980 (Chapman and Hoover, 1981). In both years, *A. campestre* was found to root with the highest percentages in early June. In 1979, the percentage dropped off rapidly in mid-June; yet, in 1980, this decline did not occur until late August. *A. platanoides* cuttings were 85% successful in mid-June 1979, but only \approx 50% successful at the same time in 1980. However, by mid-July 1980, rooting had increased to 80%.

Many difficult-to-root deciduous species have been rooted successfully as softwood cuttings. Hardwood cuttings of *Ilex verticillata* taken in Michigan in early March were not successful commercially (14%), but 82% of softwood cuttings did root in early June (Boylan and Davidson, 1975). Several crabapple (*Malus* spp.) species

were rooted successfully in late May at the Univ. of Illinois (Burd and Dirr, 1977). However, by mid-June, success declined rapidly and was no longer feasible commercially. Timing for collection was also critical for *Acer* spp. Rooting percentages not only declined rapidly as shoot elongation slowed in mid-summer, but success was very low for cuttings taken too soon after budbreak in early spring (Chapman, 1979).

Certain species appear to be propagated mainly in certain seasons. Most *Taxus* spp. are propagated by cuttings in mid-winter (Scheer, 1976; Sabo, 1976; Verkade, 1976). Some dwarf *Chamaecyparis* spp. are propagated readily in the fall or mid-winter (Kinsey, 1978). *Rhododendron* (*Rhododendron* spp.) cuttings also are generally taken in the fall (Kinsey, 1978; Hughes, 1981). However, a few growers in the southeast propagate *rhododendron* cultivars in mid-summer.

For other species, scheduling propagation by cuttings can be less critical. Azaleas (*Rhododendron* spp.) generally can be propagated by cuttings anytime of the year with proper temperature and misting. Similar year-round success has been reported with *Chamaecyparis* spp. (Thomsen, 1978). Hybrid larch cuttings also have been propagated successfully when taken as semi-hardwood summer cuttings or hardwood winter cuttings (John, 1979).

Grafting and budding. Some species can be propagated commercially only by grafting or budding. Generally, most angiosperms are budded rather than grafted. This usually requires collection of the budwood during late winter, and proper storage if the stockplants are to be budded in the spring. While chip-budding and some other budding procedures do not require the cambium of the stock plant be in active growth, it is required for the most common budding procedure, T-budding (Hartman and Kester, 1975). Again, flexibility must be incorporated into the spring schedule to allow for year-to-year variability. To permit more-reliable scheduling and reduce the spring work loads, containerized stock plants can be budded in the greenhouse during the winter. Stock plants must be brought into the greenhouse in advance of the scheduled budding date to allow for resumption of cambial growth.

Ornamental conifers are grafted

almost exclusively in mid-winter (Beeson and Proebsting, 1989; Hatch, 1982; Thomsen, 1978). Generally the rootstocks are brought into the greenhouse 6 weeks prior to the start of the grafting period to induce active growth. Some studies, however, demonstrated higher success rates using dormant rootstocks grafted in mid-winter and kept dormant in a cold frame after grafting (Beeson and Proebsting, 1989). There have been some reports of fall-grafting of conifers (Holst, 1956), but not for ornamental production.

Production

There are several unnoticed schedules during woody ornamental production. The execution and timing of each affects plant growth and marketability. In some cases, inappropriate scheduling can result in plant death or severe injury, which reduces quality. As was indicated for propagation, the exact timing and importance of these schedules are species- and geographic-location-dependent.

Transplanting. Propagated material usually is transplanted from the propagation area into the field or containers in the spring and early summer, although there are many variations of this. Sometimes material propagated in the fall is potted into small containers to establish a better root system, and is then over-wintered in a greenhouse or cold frame. In northern areas, where the chilling requirement is met before propagation, maintaining the liners in a warm greenhouse promotes shoot growth and reduces production time by up to a year (Cross, 1979). Plants over-wintered or grown in cold frames or greenhouses then are transplanted into the field or a larger container the following season. At the Univ. of California, Davis, four tree species were transplanted from seed trays into 32.4 m² peat pots and later from these into 1-gal containers at various times (Harris et al., 1971a, 1971b). Optimum root development and tree size after 1 year occurred for those trees transplanted the earliest in each step. From the seedling tray, this was when the taproot was parallel for 25 mm to the bottom of the tray (25 to 46 days after germination, depending on species). Optimum transplanting from peat pots occurred when roots had grown \approx 13 mm through the cup wall

(21 days in the peat pots). Delayed transplanting resulted in smaller trees.

For some tree species, fall transplanting into the field results in more growth the following year compared to waiting until spring (Hinesley, 1986). This has been attributed to root exploration into the soil during periods when the soil is not frozen. In areas with mild winter temperatures, transplanting may be done year-round.

Once containerized, most woody ornamentals can be transplanted into the field or to a larger container anytime throughout the year if the climate and moisture are favorable. In many areas of the United States, growers will transplant liners into 1 gal containers for the first growing season. These then are transplanted, or "stepped-up," to larger containers (11.4- or 19.5 liter) for the second and possibly third growing season. These plants then are marketed upon reaching a specific size. The advantages of this over-transplanting of liners into the market-size container include reduced space requirements; less loss with liner failure; more rapid shading of the container, resulting in cooler growth medium; and reportedly more-rapid growth (staff of Tampa Wholesale Nursery, personal communication). This is hypothesized to occur due to more efficient fertilizer and water use. The disadvantages include added labor cost for additional transplanting and possible plant growth reductions. Growth reductions will occur due to water stress and/or root constriction if transplanting is delayed. Generally plants scheduled for marketing in larger containers are stepped-up when the roots have stabilized the container media. For very large container-grown trees (65- to 190-gal), two or three additional transplantings are common. Often plants are stepped-up into larger containers on the spur of the moment rather than as a scheduled event. This usually occurs if production exceeds the marketing for a specific size or if a larger size sells better than expected, and stocks are low (R. Newton, personal communication).

Spacing. Even though plant growth is variable and linked to the micro-climate under which they are produced, growers can estimate roughly when a crop will reach a certain size. Depending on the market for the plants, spacing may or may not be required to produce the canopy char-

acteristics desired. If a dense, well-formed canopy is the goal, then spacing of the plant material must be scheduled into the production scheme.

Once plant canopies begin touching, the development of a canopy comes under the influence of those individual plants around it. If this interaction is allowed to continue canopies will be more upright and narrow, with long internodal growth and proportionally less caliper growth. This also often leads to less-rigid shoots. This is a desirable trait for stock plants for grafting or budding. Stock plants often are grown in a tight grouping to achieve this effect. However, for many ornamental shrubs a dense, rigid canopy is preferred. To obtain this plants must be spaced to minimize the influence of adjacent canopies. For container production, this is accomplished easily by moving the containers farther apart; while in field-grown situations, interspaced plants can be dug selectively at a smaller size. Because growth rates can be estimated roughly, spacing can be scheduled in the production cycle. This step may be eliminated by spacing the plants initially to account for marketable size. However, the disadvantages far outweigh the reduction in planning and labor cost. Growing plants with as tight a spacing as possible reduces production overhead (area/plant), greatly increases irrigation efficiencies for container plants (Furuta, 1978; Beeson and Knox, 1991), reduces weed competition, and reduces soil and air temperatures by mutual shading. The reduced temperatures and weed competition result in greater growth rates (Keever and Cobb, 1984). The distance plants are spaced and their growth characteristics will determine how frequently spacing should be scheduled.

Pruning. Pruning generally is required for all woody ornamentals. When pruned properly early in production, less-severe pruning is required later. This prevents delays in marketing while waiting for the plant to recover and reach market specifications.

Pruning schedules depend on characteristics of the species, growth stage of the plant, and time until marketing. If the plant will not be marketable the coming year, most pruning is recommended in the late winter or early spring, prior to budbreak. For trees, the second-best time for pruning is 3 weeks after shoot

elongation stops. Trees should never be pruned during periods of active shoot elongation (E. Gilman, personal communication). A light shearing for young shrubs, such as boxwood, will produce a denser and more-compact plant, but may have to be repeated once or twice more in mid- to late summer. For shrubs and some tree species with more cyclic growth patterns, such as *Rhododendron*, *Ilex*, and *Pittosporum* spp., removal of the apical buds may be required two or three times during the season to promote good branch development. For young trees, spring pruning should be severe enough to correct any problems with branch spacing, dual leaders, or excessive branch growth. As the trees become older, pruning should evolve into a more maintenance-oriented activity, such as removal of crossing or diseased branches.

If flowering trees or shrubs are to become marketable in the coming year, pruning should be scheduled to correspond with flowering. Those that bloom before mid-summer, such as azalea, should be pruned after flowering. Those that flower in the latter half of summer (i.e., hydrangea) should be pruned in early spring before flower bud development (Hensley, 1979).

Pruning should not be scheduled in early fall. Heavy pruning during this time could promote budbreak and the onset of active growth in some species. If pruned too late in the fall, the plants may not acclimatize sufficiently to cold.

Root-pruning. Root-pruning generally is restricted in use to seedling and tree production. For seedlings, tap roots and kinked roots should be pruned at the first transplanting (Harris et al., 1971a). The longer this pruning is delayed, the poorer the resulting root system and the smaller the plant compared to properly timed root-pruning (Harris et al., 1971b).

There is still debate on the scheduling of root-pruning of field-grown trees prior to harvest. Watson (1986) recommended root-pruning 2 to 5 years prior to harvest, whereas, Gilman and Kane (1990) found the greatest harvest of fine roots occurred when root-pruning preceded harvest by only 3 months. This also resulted in better growth after transplanting than those not root-pruned. In a review of root-pruning, Gilman (1990) reported that conflicting results and insufficient evidence found in the literature pre-

cluded any decisive conclusions as to the optimum scheduling of root pruning for field-grown trees. Until more direct studies are reported, a conservative approach would be to schedule root-pruning 8 to 12 months and again 8 to 12 weeks prior to harvest (E. Gilman, personal communication). Roots should be pruned several inches inside the harvested ball.

Irrigation. Perhaps the most limiting factor for good plant growth is water. Despite its importance, there have been relatively few studies of irrigation scheduling for woody ornamental production. Most studies of irrigation on woody ornamentals have focused on rates rather than frequencies. The frequency with which irrigation is applied is dependent on the season, plant species, production method, and grower preference. Frequencies usually range from once a day to once every 3 days during the summer in the southeast, to none during the winter in the north.

As with propagation, irrigation schedules must remain adaptable to changing weather patterns. Too often when systems are under automatic control, one can see plants irrigated during rainstorms. This not only wastes water and energy, but also can increase leaching of fertilizer; all of which result in higher production costs. Often irrigation is scheduled not by plant needs, but by the capacity of the system. Even with daily dawn irrigation, moderate degrees of water stress occurred in mid-afternoon in four species of woody ornamentals grown in 3-gal containers during the summer in Florida. This moderate water stress was found to reduce plant growth significantly over a season (my unpublished data). Similar results were reported earlier for azaleas growing in Alabama. Plants watered with overhead irrigation in the early evening (2100 HR) grew less than those that received the same volume of water with overhead sprinklers at mid-day (1300 HR) or split into two periods [1000 and 1500HR (Keever and Cobb, 1985)]. Maximum growth occurred with the split application and was consistent with the lowest canopy and growth-medium temperatures. Unfortunately, this is also the least efficient time to irrigate with overhead sprinklers due to the high evaporation rates.

Some tree operations using fabric containers for in-ground field production are transplanting harvested trees

into large rigid containers (65 to 200 gal) for marketing after roots have regenerated. Recent studies suggest irrigation frequencies of three to four times a day with low volumes are required during this period to limit the severity of water stress for trees with poor root systems, such as *Quercus virginiana* (my unpublished data). Once roots have regenerated sufficiently, frequencies of two to three times a day are recommended for 4-inch-caliper trees transplanted from 24-inch fabric containers in 65-gal containers. For trees grown in the ground, split applications of trickle irrigation resulted in less growth of pin oak when equivalent daily volumes were split into two or four applications, compared to once daily (Ponder and Kenworthy, 1976). Of the split applications, four times a day produced less growth than twice a day. The authors suggested competition from the sod as a reason for reduced growth with split applications.

In the fall many growers reduce the frequency of irrigation to induce water stress. This is believed to induce dormancy in the buds and promote increased cold hardiness. There is some evidence supporting this. For citrus rootstocks, decreased xylem water potential brought on by water stress or reductions in soil temperature were associated with increased cold hardiness (Wilcox et al., 1983). In evergreen azaleas, lowering stem water content was found to lower the critical temperature for freezing injury (Lumis et al., 1972). However, most "leafburn" of evergreen shrubs during the winter occurs due to dessication of the leaves, rather than freeze injury.

Induction of water stress also is believed to promote flower bud formation in fall-budding shrubs and flowering trees. While this may not have been confirmed scientifically, it is a common practice and is generally accepted as a real phenomenon.

Irrigation should be scheduled during the spring and summer months to limit water stress as much as possible. Where plants will be subjected to freezing temperatures, irrigation in the fall should be reduced to promote plant dormancy. This also may promote flower bud set. Once ambient temperatures remain cool and dormancy is ensured, evergreen plants should be irrigated as required to maintain adequate soil moisture. Low soil tem-

peratures reduce water absorption by roots and generally maintain low water potentials in the plant.

Fertilization. Fertilizer rates and scheduling are, perhaps, the most intensely researched area of woody ornamental production. Specific schedules will not be addressed, since most major fertilizer companies produce tables of recommended rates and frequencies for their specific formulations. Rather, the focus will be on those factors that cause deviations from the recommended schedules.

For granular fertilizers, release and residual activity is determined by the release mechanism, moisture, temperature, and exchange capacity of the growth medium. Because most granular fertilizers consist of inorganic forms of the nutrients, they are readily water-soluble and leach rapidly from soilless media with excess rain or frequent irrigation. For plants grown in native soils, residual activity is generally longer, except in very sandy soils. Granular fertilizer applications to field soils should be based on local experimental data.

Some nurseries fertilize by injecting liquid fertilizer into the irrigation water at preset times. Studies with azaleas and viburnum indicated that more-frequent, less-concentrated applications produced more growth than less-frequent, more-concentrated applications (Poole and Dickey, 1960; Dickey et al., 1961). Plants grown with fertilizer intervals of 2 weeks were better than those fertilized every 8 weeks.

In recent years, many woody ornamental growers have replaced granular fertilizers with slow-release or timed-release fertilizers. These are produced with various nutrient release rates, generally ranging from 3 to 4 months up to 18 months. The release rates are determined based on constant temperatures, ranging from 21 to 25C, and are specific for a given brand (Lamont et al., 1987). Nutrient release from these resin-coated fertilizers is almost totally dependent on temperature and only slightly affected by soil pH, moisture content, or microbial activity (Sharma, 1979). Lamont et al. (1987) evaluated the effect of various constant temperatures and their duration on the nutrient release from Osmocote and Nutricote. All formulations were rated for a 32- to 36-week release. At 20C, all retained

≈ 60% of the nutrients after 19 weeks; but at 10C incubation, roughly 75% remained; at 45C only 30% remained. Thus, scheduling fertilizer applications must take into account soil or media temperatures. In Florida, growers have found that many long-term slow-release fertilizers must be applied twice during the period of March through October to maintain good plant color and growth.

Winter hardiness of ornamental shrubs is affected by plant nitrogen status in the fall and early winter. In northern areas, high concentrations of nitrogen in the tissue had little or no effect on cold hardiness (DeHayes et al., 1989; Havis et al., 1972; Pellett, 1973; Pellett and White, 1969). In some cases cold hardiness was enhanced over nitrogen-deficient plants. However, in the southern region of the United States, fall tissue nitrogen concentrations were correlated negatively with cold hardiness (Kelley, 1972; Stimart et al., 1985; Wright et al., 1978). High nitrogen was considered to promote or maintain active cellular growth, making the plants more susceptible to injury or death from subfreezing temperatures in the south. The negative correlations were found in studies in Maryland, Kentucky, and Virginia with several different species.

The contradicting effects of tissue nitrogen on plants in the northern and southern United States may be explained by differences in fall temperatures. Wright et al. (1983) found that nitrogen fertilization under moderate temperatures promoted active cellular growth, as evidenced by shoot elongation. However, at cool temperatures, nitrogen tissue concentrations increased but did not induce shoot growth. When scheduling late summer/early fall fertilization, the effect of nitrogen on plant cold hardiness must be considered. The last scheduled fertilization will depend on location (temperatures), fertilizer longevity and availability, and application rate.

Pest and disease control. Profitable production of woody ornamentals requires rapid and disease- and pest-free growth. Unfortunately, rapid growth also makes plants more susceptible to disease and pests. Therefore, pest and disease detection or prevention programs must be scheduled regularly in the production scheme and followed rigidly. Generally, disease and pest control can take one of

two directions, integrated pest management (IPM) or preventative spraying.

In recent years there have been numerous articles and courses on IPM, so the details will not be covered here. In general, IPM involves regular examination of a crop or area to determine the level of infestation of a pest or disease. Once it is determined that the level is near a threshold for economic damage, a control program is initiated and continued until the threat is removed. Because populations of pests or diseases can increase rapidly under certain conditions, surveys must be performed regularly. These may have to be scheduled at more frequent intervals during periods known to be optimum for specific pests or diseases. A missed threshold could lead to severe infestations and production delays or even crop loss.

A preventative spray program consists of regular applications of pesticides and/or fungicides at set intervals during all or a portion of a growing season. The interval between applications is based on chemical label recommendations and/or results from local trials. Generally, fungicides are used predominantly in preventative spray programs, while insecticides are used as damage is observed.

Harvesting

Harvesting of woody ornamentals generally is associated with field production. Plants usually are harvested bare-root, balled and burlapped (B&B), or by tree spade, but a growing number of tree farms in certain areas of the country are using in-ground fabric containers for production and harvest. The type of production and harvest procedure dictates when harvest can be scheduled.

Plants to be handled bare-root should be dug in the late fall to early spring. Maximum root regeneration and survival of these trees appears to be dependent on species. *Tilia cordata* seedlings lifted bare-root had the greatest survival when fall-dug and planted (Whitherspoon and Lumis, 1986), as did several species of *Taxus* (Lathrop and Mecklenburg, 1971), whereas spring digging was best for *Liriodendron tulipifera* (Kelly and Moser, 1983) and Norway maples (Watson and Himelick, 1982). Other tree species such as green ash or ginkgo appear to lift quite well in late fall or

early spring (Watson and Himelick, 1982). For coniferous species, digging after the first frost (late October) resulted in the highest survival rates for mugo pine (*Pinus mugo*) dug from early September until late November (Whitcomb and Pinney, 1983). Early spring lifting (late April, around budbreak) also has been very successful for conifers (Tripepi and Carter, 1989; Whitcomb and Pinney, 1983).

Plants dug as B&B material or by tree spade can be dug nearly anytime during the year if given reasonable post-digging acclimation and care. However, most B&B or spade-dug plants are dug in late fall to early spring. The period of active shoot elongation should be avoided because root regeneration during this time is minimum (my unpublished data; Watson and Himelick, 1982).

Trees produced in fabric containers also can be dug throughout the year if proper post-digging care is employed. Again, however, harvest should be avoided during shoot elongation and not initiated again until the new growth hardens. Many tree farms in Florida concentrate most of their harvest of fabric containers during the late fall until budbreak in the spring (early March). Most of these trees are transplanted into large containers for marketing after root regeneration has occurred. Trees sold in the fabric containers are usually dug 2 to 3 weeks prior to transport to permit proper post-digging acclimatization.

Conclusions

There are many unnoticed schedules involved in woody ornamental production. Because most production is outdoors, nearly all are linked to the season and local climates or microclimates. All schedules must be adapted to the nursery in which they are used. Research on tree and ornamental woody plant production is therefore limited in its direct applicability to every nursery situation. To develop optimum production schedules and maximum profits, nurseries should conduct their own trials based on the results of experiments reported in the literature.

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