Hoosier Tree Planter's Manual

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Hoosier Tree Planter's Manual

PURDUE UNIVERSITY
Cooperative Extension Service, Lafayette, Indiana
The Hoosier Tree Planter's Manual*
By E. J. LOTT and W. L. FIX, Purdue Extension Foresters

INDIANA LANDOWNERS plant forest trees for a number of purposes. The most common types of planting are for reforestation of abandoned or eroded land, windbreaks, control of water and wind erosion, Christmas trees, production of fence posts and wildlife food and cover.

Successful planting of forest trees depends on the selection of proper species for the planting site, correct planting methods, and the care given to the plantation after planting.

WHAT TO PLANT

Reforestation

Many people are concerned because the pines are being planted for reforestation in Indiana which is considered a hardwood state. Agricultural use or misuse of land has resulted in soil conditions where the protective cover has been destroyed. Pasture and cultivation have so changed soil conditions that they are no longer forest soils. Consequently, reforestation of these areas is not simply a replacement of the native species which once grew there. The major reforestation problem is the selection of species which will become established and grow on these non-forest soils.

Although a large number of hardwoods have been planted during the past 40 years, the successful plantings are few in number. It is apparent from observations of these plantations that most of the lands which have been, or are to be, reforested are not suitable sites on which to plant species such as black walnut, tuliptree, ash, oak and other hardwoods.

Apparently most hardwoods are definitely trees of the woods and are not adapted to open field planting. At the present time, practical methods of establishing hardwood plantations on old fields have not been developed. Hardwoods require soil which contains far more organic matter (hence waterholding capacity) and is loose, porous and better aerated than soils found on most of the eroded, open field sites where attempts have been made to grow them.

The planting of pines on non-agricultural soil in Indiana appears to be the best and quickest way to eventually establish, through natural succession, a
stand of native hardwood trees. In practically every pine plantation that is 5 or more years old, and is within the range of hardwood seed trees, the seedlings of native species become established —regardless of soil or location. Since pines generally succeed best when planted on old field sites, it is evident that they can return depleted soil to a productive condition.

The characteristics of the six species which are recommended for present-day reforestation are shown in Table 1. Under certain soil and site conditions a number of other species, including some hardwoods, can be planted. These species, along with their site requirements, are listed in Purdue Mimeo F-36, Tree Planting Guide.

Pure Plantings and Mixed Plantations

Judging by the growth and development of the forest plantations that will grow in Indiana, there is little evidence to warrant a recommendation that mixed stands should be favored or that pure plantings are more desirable. Since most of the plantings made in any year, excepting those on state and federal forests, are less than 25 acres, it is immaterial whether a pure or mixed stand is planted. Usually the soil and site
<table>
<thead>
<tr>
<th>Species</th>
<th>Site Requirements</th>
<th>Character of the Stand</th>
<th>General Form</th>
<th>Seeding Habits</th>
<th>Growth and Development</th>
<th>General Recommendations</th>
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<tbody>
<tr>
<td>Pinus strobus</td>
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<td>Pinus resinosa</td>
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<td>Pinus banksiana</td>
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<td>Species</td>
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<tr>
<td>Pinus echinata</td>
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<tr>
<td>Virginia pine</td>
<td>Prefers heavy clay soils without any other vegetation. Grows on all but extremely poorly drained sites. Will grow on sandy soils.</td>
<td>Dense stands. Trees develop large branches and produce much needle litter.</td>
<td>Tendency to develop crooked stems. Best form in mixed stands.</td>
<td>5-year-old trees produce a crop of viable seed. Aggressive species seeding in on old abandoned, eroded fields in southern Indiana.</td>
<td>Very quick initial growth. Drought-resistant.</td>
<td>Best for planting on severely eroded soils in southern Indiana.</td>
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<tr>
<td>Pinus virginiana</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Liriodendron tulipifera</td>
<td></td>
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</tbody>
</table>
conditions most generally encountered will require that more than one species be used. Therefore, extensive areas of pure pine plantations will not prevail.

If more than one species is used, it is a good policy to mix the species in groups or bands, because of the possible differences in rate of growth. In alternate row mixtures the slower growing trees may be shaded over and eventually lost.

Alternate row mixtures of white pine and tuliptree have been established, and the two species apparently grow well together on sites suitable for tuliptree.

In several instances row mixtures of tuliptree and black locust have grown well together. However, when the black locust was harvested for fence posts or poles, the tuliptrees remaining were badly damaged by sunscald resulting from the sudden opening up of the stand.

**Planting Nuts or Acorns**

In addition to planting seedlings or transplants, some planting has been done using "stratified" nuts or acorns stored cool and moist from collection till planting time. Very little good experimental data is available on this method, especially in reforestation of eroded lands, with which this circular deals primarily.

Some success with walnuts has been reported where these nuts are planted in good woods or crop soil and protected against squirrels or mice. One protective method is to plant the walnut in a small can of earth, leaving one end of the can open and puncturing several openings ¾ to 1 inch in diameter in the other end. Bury the can of earth with the walnut in it about 1 inch below the surface, open end down.

The American Walnut Manufacturers' Association is supplying its members with stratified walnuts in the hope of increasing the quantity of walnut timber in the central hardwood region, including Indiana.

**Windbreaks**

There are two types of windbreak plantings, the farmstead windbreak designed to protect the farm buildings and the field windbreak to prevent wind erosion in crop fields.

**Farmstead Windbreaks:** White and red pine are the best farmstead windbreak trees. Norway spruce is a good species for good soils in northern Indiana. Chinese arborvitae is also satisfactory, especially for the outside edge of the windbreak. A mixture of species is a good insurance factor in case an insect or disease attacks a particular species. For landscape effect, a group mixture gives variation in color and form. At least three rows of trees are needed for an effective farmstead windbreak.
This requires a strip of ground 55 to 65 feet wide depending upon spacing.

For further details concerning farmstead windbreaks obtain a copy of Purdue University Mimeo F-38, *Ten Pointers on Farmstead Windbreaks*.

Figure 2. Schematic drawing of an exposed farmstead facing south, showing the building group before the windbreak and landscaping (above) and a view of the farmstead several years after planting of the windbreak and landscaping (below). Such a windbreak can add much to the comfort and satisfaction of farm living.
Figure 3. The growing of pines for Christmas trees has become a big business in Indiana. Here Scotch pine Christmas trees are being loaded onto a trailer at the plantation.

Field Windbreaks: Red, white and jack pine may be used for field windbreaks especially in sandy areas. (In southwestern Indiana white pine used in sand field windbreaks have been subject to drought and bagworm damage.) For muck soil windbreaks in northern Indiana, cuttings of green or golden hybrid willows are recommended. The cuttings should be made 18 to 24 inches long from thumb-size or larger branches that have not yet started their spring growth. They may be pushed down by hand, in soft muck soil. Leave only 2 to 3 inches sticking above the soil with the buds pointing upward. Be sure that the soil is firmly packed around the cutting.

Specialized Plantings
Trees are also planted for a number of special purposes such as Christmas trees, fence post production, erosion control, wildlife food and cover, and others. The
general tree planting practices discussed in this circular are applicable to these specialized plantings. More specific recommendations should, however, be obtained from the following publications which are available from county agents, extension foresters, or the Department of Forestry and Conservation at Purdue University.

F-11, Growing Black Locust
F-17, Growing Christmas Trees in Indiana
F-20, List of Christmas Tree Publications
F-25, Producing Quality Christmas Trees
F-26, Protect Your Christmas Tree Plantation
F-36, Tree Planting Guide
F-38, Ten Pointers on Farm Windbreaks
F-12, A Key to the Evergreens of Indiana

Figure 4. The white pine, when carefully sheared annually, makes an excellent Christmas tree.

Figure 5. The red pine, when carefully sheared in June and July, also makes an excellent Christmas or windbreak tree.
PLANTING STOCK

Where to Get Trees

Trees grown in state forest nurseries in Jackson County and in Pulaski County are distributed at cost by the Division of Forestry of the Indiana Department of Natural Resources at Indianapolis. These seedlings or transplants are usually about 12 inches high. If trees in lots of 50 or more are required, application blanks may be obtained from the County Extension Agent, Soil Conservation District offices, County Agricultural Stabilization and Conservation offices, the Indiana Division of Forestry at Indianapolis or the Department of Forestry and Conservation at Purdue University. Those having special planting problems should write to the State Extension Forester, Department of Forestry and Conservation, Purdue University.

Application blanks for nursery stock are available from early September to the first of March. Applications should be in as soon as possible after the blanks are issued in September. Some species are sold out before January 1 in normal years. The planting stock grown in state nurseries is not intended for ornamental use; it must be protected from livestock; it may not be resold with roots attached; and it cannot be planted within town or corporate limits.

Size and Age of Planting Stock

Successful plantings require sturdy, hardy, well balanced planting stock. The experience of the past 15 years indicates clearly that high quality planting stock is essential. It is also evident that the best stock is needed for the most exposed planting sites. While low initial planting costs are desirable, the use of low cost, inferior planting stock results in poor
survival, with the consequent replanting costs to be added if establishment is to be secured.

Improvement in forest tree nursery practices have made it possible for tree planters to obtain 1-1\(^{\text{st}}\) transplants which are as suitable as the large sized stock which was formerly thought necessary. For best results, the following classes of planting stock are required; white pine (2-1 or 2-2), red pine (2-1), Jack pine (1-1), short leaf pine (1-0), Virginia pine (1-0), black locust (1-0), and tuliptree (1-0).

**How Many Trees Do You Need?**

First measure (or estimate) the acreage you will plant. Use this table to find how many trees you will need:

<table>
<thead>
<tr>
<th>Spacing (feet)</th>
<th>Trees per acre</th>
<th>Type of planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>4x4</td>
<td>2,700</td>
<td>Christmas tree</td>
</tr>
<tr>
<td>5x5</td>
<td>1,700</td>
<td>Christmas tree</td>
</tr>
<tr>
<td>6x6</td>
<td>1,200</td>
<td>Christmas tree or erosion control reforestation</td>
</tr>
<tr>
<td>7x7</td>
<td>900</td>
<td>8x8</td>
</tr>
<tr>
<td>8x8</td>
<td>700</td>
<td>reforestation</td>
</tr>
</tbody>
</table>

Studies of all species in many plantations and on varied sites indicate very clearly that with the exception of loblolly and Virginia pines, spacing of trees closer than 6 x 6 feet appears to be unnecessary. Spacings wider than six feet were seldom encountered in the field studies, and consequently, wider spacings might be desirable.

Even where the objective of tree planting is to provide cover to protect the soil, spacings less than six feet do not appear necessary.

Black locust on many sites will serve to protect the soil and check erosion if trees are spaced 6 x 6 feet and fertilized at the time of planting, thereby eliminating the necessity of trying to quickly establish protective cover by planting many closely-spaced trees.

In large Christmas tree plantations leave a 10-foot roadway for each 20 rows of trees. This will be needed when trees are cut. With a 6 x 6- or 7 x 7-foot spacing where less than 5 percent of the trees die the first year, no replanting will be necessary. If more than 5 percent die, or with an 8 x 8-foot spacing, you should plan to replant the openings the next year.

Spacing of the trees in farmstead windbreaks depends on the species, location and type of soil. Minimum spacing for any species should be 12 x 12 feet, with the trees 12 feet apart in the rows and the rows 12 feet apart. On good soils, especially the prairie soils of northern Indiana, a spacing of 16 x 16 feet is indicated. Rapid growth in these areas causes heavy side limbs, which, if the trees are planted too closely, tend to become shaded off, thus losing
Figure 7. The Purdue tree planting machine, now available commercially with various adaptations, is commonly used in large-scale plantings.

Effectiveness as a wind barrier. Careful shearing as the trees grow will make the trees more compact and prevent some of this crowding.

A three-row windbreak with 12 foot spacing requires 40 trees for every 10 rods of length. On a 16 foot spacing, 30 trees per 10 rods of length would be required.

PLANTING SEASON

Early spring is the best season for planting trees in Indiana. The full planting season may extend from about March 15 to April 30. Planting should begin just as soon as the frost has left the ground and when the soil is sufficiently dry to work well.

Fall planting of forest trees is not recommended. Fall planted trees are susceptible to winter killing, to rodent damage and to frost heaving on heavy soils.

SITE PREPARATION

Soil Preparation

Soil preparation is important in planting forest trees. Do not interrupt the growth of the tree any more than is necessary, and get it growing in its new location quick-
ly. Plantations show better survival and growth where the following soil preparation was made:

Heavy sod should be plowed the previous fall in order to improve the soil condition for planting next spring. Another alternative is to plow strips where the trees are to be planted or to plan the planting so that the area between the rows can be moved the first few years. On sloping land plowed strips should always follow the contour of the land to avoid soil washing. On well-drained soils plant the trees in the bottom of the furrows; on poorly drained soils plant on top of the back furrow. Where plowing is not practical, the sod should be removed from an area 24 inches square in each spot where a tree is to be planted. This is called "scalping."

Where large quantities of trees are to be machine planted in sod areas, site preparation should consist of brush clearing and mowing only. Spraying the summer before with chemical brush and weed killers is desirable.

**Woods Openings**

No soil preparation is necessary unless a sod cover is present. Leave brush or brier growth areas unplanted since natural hardwood seedlings will grow there as well as if planted. Hardwoods such as tuliptree may be planted in woods openings where soil and moisture conditions are suitable. Pines are not recommended for planting in woods openings since they will not grow well in shade. Neither will pine compete with dense clumps of sassafras, persimmon, or other trees in abandoned field plantings. Where such clumps occur, they may be clear cut, the stumps treated to prevent sprouting and the area then planted.

![Figure 8. A newly planted field of red pine planted by machine on the contour.](image)
Figure 9. If trees cannot be planted same day as received, open bundle and heel in.

CARE OF TREES ON ARRIVAL

As soon as the crate or bale of trees is received, they should be taken to a cool shaded spot near the planting site and "heeled" in. Dig a trench as deep as the roots of the seedlings and put the trees against the back of the trench in a thin layer. Slope the back of the trench toward the south. Open the bundles, and be sure to cut the strings on the separate bunches. If an uncut bundle is "heeled in," air will dry out the center, and the inside trees will be dead before they are planted. Cover the roots with moist earth at once, and water or tamp it down to close all air spaces.

Tree roots are delicate. Avoid stripping or tearing root hairs; do not pull trees from the heeling-in trench or from a tangled mass in the bunch. Above all, keep them moist. The trees should be carefully handled throughout the planting operation. This pays dividends in better growth and survival.

If a tree is worth planting it is worth planting well.
HOW TO PLANT

Hole Planting

Two implements are needed for planting trees by the hole method. First, a bucket that will hold the tree roots in water, and second, a roundpointed shovel. Some planting is done by grub hoes or mattocks. Good planting is assured by digging a hole big enough to spread the roots as well and as deep as they grew before.

Never let tree roots dry out for an instant.

In field planting a two-man crew works well. One man carries the bucket of trees, with enough water to cover the roots. The second digs the hole properly.

Figure 10. Keep roots moist during planting.

Figure 11. Steps in planting by the center hole method.
Figure 12. It is important that trees be placed in the ground at the same depth as they were in the nursery.

The first man takes one tree from the pail when the hole is dug, and holds it while the second man sifts and packs the soil back around the roots. *Don't let the tree sag.* That means hold it at the same level it grew in the nursery, while replacing the soil around the roots. Tamp the soil thoroughly around the roots, to remove all air space.

CHECK: *It should be difficult to pull up a well-planted tree. If it pulls up easily, it was carelessly planted.*

Figure 13. A two-man crew works well in planting trees by the hole method with one man digging the holes and the other planting the trees. Note bucket to keep tree roots moist.
**Slit Planting**

Small seedlings, or trees with one main root system, are frequently planted by the slit method, using a planting bar. This method cannot be used for planting trees which have a fibrous root system. The choice between slit and hole planting in the past has depended upon the planter, the class or size of planting stock and the soil. However, the evidence that is available favors the hole planting system except in light sandy soils.

Slit planting is often responsible for the development of a one-sided root system on the transplanted trees, especially on heavy clay soils. Such trees are seldom windfirm and, consequently, give poorer growth and larger losses than hole-planted trees.

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Figure 14. Steps in slit planting with a planting bar.

Figure 15. Plant on the contour. Space no closer than 6 x 6 feet.
Machine Planting

Tree planting machines are now widely used in reforestation efforts in gently sloping areas accessible to farm tractors. Survival studies show machine planting under favorable conditions to be comparable to hand-planting. However, planting machines require soil dry enough to work and a sturdy ground cover on heavy clay soils to give good traction for the tractor.

The chief problems encountered in machine planting are correct spacing of trees, setting the tree at proper depth and covering all the tree roots. Advantages of machine planting are its lower cost, the rapidity of planting and ease of planting larger size stock. Even though many open fields may be largely planted by machine, hand planting is still necessary in rocky and badly eroded areas.

FERTILIZING PLANTED TREES

On soils of low fertility the initial growth of black locust seedlings can be increased by using fertilizer. One tablespoonful of 2-12-6 fertilizer should be placed in the hole at the time of planting. It is not necessary to mix soil and fertilizer together. Experiments have shown that the height and diameter growth of fertilized seedlings is more than twice that of non-fertilized seedlings. The root development of fertilized trees is five times that of non-fertilized trees.

Experiments have also shown that fertilizing coniferous seedlings or transplants at the time of planting, using the same technique as described for black locust, has not proved successful. Survival of fertilized trees was 10 percent compared to 85 percent for non-fertilized trees. It is probable that the root tips of the pines were injured by the fertilizer.

CARE AFTER PLANTING

Protection

Grazing: Most people do not know that livestock grazing destroys more timber and plantations in Indiana than fire. Livestock eat young seedlings and trample the protective soil and leaf cover, thus encouraging erosion and drying of the soil. Hogs will also damage seedlings. The
plantation should not be set out if it cannot be permanently protected from livestock, including poultry.

Trees should be planted at least 10 feet from fences, out of reach of livestock.

Fire: If fire does not kill the tree outright, it will expose or burn the roots and leave fire scars on the stem, permitting butt rot. All these lower the future value of the tree. Fire lanes 6 feet or more in width should be plowed around the plantation. They should be disced once a year to keep them free of weeds and grass. In a large plantation, fire lanes should also cross the area, to save most of the plantation if fire occurs. If fire lanes are to be plowed or disced to expose bare soil they should be "on the contour," or erosion and gullies may develop.

Rodents and Insects: Where rabbits and squirrels damage young trees, it would be advisable to open the area to hunters during the hunting season. However, hunters should be warned to be careful with fire. Field mice sometimes girdle young trees at the ground line. Poisoned bait may be placed in the runways to reduce such damage.

If insect injury is noted on the planted trees, owners are urged to report and send samples of insect injury either to the county agent, the Forestry Department at Purdue University, or to the Division of Entomology of the Department of Conservation at Indianapolis.

Replanting: Trees which died in the original planting should be replaced the next year to keep the plantation fully stocked. Larger stock such as 2-1 or 2-2 should be used for this.

**CULTURAL PRACTICES**

**Mulching**

In small plantings, and especially in farmstead windbreak plantings, a mulch of straw, peat or similar material may be placed around the tree in a 4-foot radius about 3 inches deep. This, if replaced as needed, will keep weeds down until the lower branches of the tree cover the area. Openings should be left around the stem to prevent mouse injury. (This has not proved very satisfactory in southern Indiana since too many rodents are attracted to the mulch.) If trees are mulched, beware of fire!

**Cultivation**

In farmstead windbreak plantings, shallow cultivation for 2 or 3 years is desirable, where it can
be done. As with any other crop, this improves the growing conditions and helps the trees get off to a better start. Cultivation also serves to keep weeds and sod from competing with the trees for moisture. On slopes always avoid soil erosion by planting and cultivating on the contour.

Release
Where seedlings are planted adjacent to scattered native trees in abandoned fields, some release work may be needed within a few years after planting. By cutting or killing over-topping undesirable trees and vines, the planted tree will be released to make maximum growth.

Pruning
None of the pines used for reforestation will prune themselves early in their development. Although branches of planted pines start to die as soon as the stands close, they persist even in the oldest plantations. The tendency toward natural pruning is more pronounced in shortleaf pine than any of the other pines.

If knot-free lumber is desired from planted stands, then artificial pruning of the pines is necessary. Pruning should be confined to selected crop trees which are well-distributed over the area and are of good form, quality, and which occupy a dominant position in the stand. Even though very little artificial pruning has been done in Indiana, the work indicates that pruning should start when the plantations are about 10 to 15 years old.

Shearing
Careful shearing of the new growth on pines planted for Christmas trees and windbreaks is necessary to form more compact and better-shaped trees. An illustrated discussion of correct shearing practices is given in Purdue Forestry Mimeo F-25.

CONCLUSION
This manual does not attempt to cover all of the problems in tree planting. It does, however, attempt to give the tree planter the essentials. Questions and problems which are not covered here should be referred to the Department of Forestry and Conservation, Purdue University, Lafayette, Ind., or to your county Extension agent.

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