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PLANTATION ESTABLISHMENT: SITE PREPARATION AND TREE PLANTING METHODS

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INTRODUCTION

The Silviculture and Ecology of the Central Hardwoods research unit of the USDA Forest Service is developing a series of technical notes for the management of forest lands in the Midwest. Many of the technical notes on different aspects of hardwood plantation establishment have been completed. At the request of the editor, the technical notes for site preparation, slit method of planting, and hole method of planting were modified slightly for publication in this issue of the Walnut Council Bulletin. The author would appreciate your feedback and suggestions for improving these technical notes.

SITE PREPARATION

Site preparation involves the removal of perennial weeds and woody competitors before trees are planted. A relatively small advance investment in site preparation can substantially reduce the future expense and labor of controlling weeds and woody competition after tree seed is sown or seedlings are planted.

It is best to complete site preparation during the summer or fall before establishing the tree planting. Site preparation includes:

- Clearing the site of woody vegetation to permit the use of farm machinery such as moldboard plows, disks, harrows, and seed or seedling planters; and
- Killing existing stands of introduced highly competitive forage grasses such as tall fescue, smooth brome grass, and reed canary grass.

The two most common methods of site preparation are mechanical cultivation and application of broad spectrum herbicides. For small plantings, individual planting spots can be prepared by treating planting spots with a post-emergent, broad-spectrum herbicide or by scalping the soil surface to remove grass and other weeds. Planting spots should be at least 4- to 5- feet in diameter for hardwood seedlings. In large, relatively level areas with little woody vegetation, sites can be periodically plowed or disked during the summer and fall. On sites prone to soil erosion, strips 3- to 6-feet wide can be plowed or disked to form the future planting rows. If the slit method of planting is to be used, allow enough time between plowing and disking for the soil to settle.

Site preparation is a good time to correct soil problems. It is



Incorporate lime, phosphorus, and green manure crops during site and seedbed preparation.

easier to incorporate lime and phosphorus into the soil during site preparation than to do it after planting. Apply lime to bring the soil pH to 5.5 to 6.5. If the soil is deficient in other nutrients, also apply and incorporate those fertilizers during site preparation. Even if soil tests indicate that soil nitrogen is deficient, apply nitrogen fertilizer sparingly, because it stimulates the growth of weeds during the critical tree establishment period.

Although intensive mechanical site preparation increases the risk of soil erosion, it can create a suitable seedbed for establishing a ground cover that may be less competitive than invading weeds. A dense cover of low-growing legumes or cereal grains shades the soil, helps conserve soil moisture, and reduces the germination of weed seed. Legume cover crops can also fix atmospheric nitrogen and become a future source of slow-release nitrogen for the tree seedlings.

A cost effective method for site preparation involves cropping the land with annual forage or native legumes or one of the cereal grains such as milo or corn the summer before planting the trees. Herbicides used to control weeds within these crop plantings should be selected carefully to reduce "carryover", which may harm the future hardwood plantation. Row crops also provide relatively straight rows of stubble that can be followed when sowing seeds or planting tree seedlings.

Use chemical site preparation in forest openings or on sites too steep or stony to cultivate. Herbicides usually are sprayed in

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Kura clover seeded as a ground cover during site preparation for a pecan planting.

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planting spots 4- to 5-feet in diameter or in strips 3- to 4-feet wide. Vegetation should be killed in late summer or early fall with a mixture of a broad-spectrum, post-emergent herbicide to kill living perennial vegetation and a pre-emergent herbicide to suppress fall germination of weed seed near the soil surface. On sites dominated by cool-season grasses such as tall fescue, mow the site in late summer to stimulate early fall re-growth before the fall application of a post-emergent herbicide. Herbicides should be selected based on type of perennial vegetation present, soil characteristics, and distance from open water.

SLIT METHOD OF PLANTING

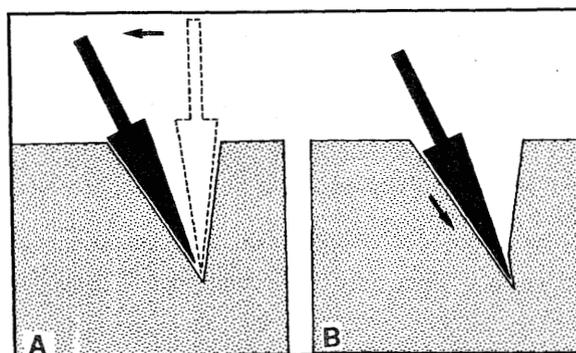
The slit method is the fastest method for planting tree seedlings with prominent taproots and well-developed lateral roots such as the oaks, ashes, and black walnut. Whether to hand- or machine-plant is governed largely by the number of seedlings to be planted, accessibility of the area to tractor-drawn equipment, and amount of large woody debris or rocks at the planting site. The main disadvantages of the slit method are that lateral roots are compressed into the single plane and that slits can open during summer droughts when soils shrink.

Here are some guidelines for using the slit method of planting:

- Open only one bundle of seedlings at a time; keep unopened bundles in the shade.
- Prune the taproot of bare-root seedlings to the length of the equipment used to make the planting holes (usually 8- to 10-inches); taproots longer than the planting hole will fold to form J- or U-shaped roots that grow poorly.
- First order lateral roots, e.g., roots greater than 0.1 inch in diameter, need to be cut to a length of 2- to 3-inches so they fit in the planting hole without folding, but should not be removed entirely.
- Except for species with opposite buds and branching (e.g., maples and ashes), hardwood seedlings can be top pruned to facilitate handling.
- Discard small seedlings, especially those with few lateral roots as well as diseased and damaged seedlings.
- Keep roots moist, but not wet before planting. If possible, soak seedling roots in water for 1 or 2 hours before planting.
- Keep roots moist during planting by keeping them covered with damp moss. Small roots are easily killed by exposure to wind and sun. Planting on cool cloudy days minimizes seedling dehydration.
- Plant seedlings at the same depth to 1 inch deeper than they grew in the nursery.
- Soil must be tightly packed around the taproot without leaving an air pocket at the bottom of the slit, i.e., newly planted seedlings are difficult to pull out of the ground.
- Do not plant in depressions or leave a depression around the planting slit. On poorly drained sites, seedlings may benefit from planting on raised mounds.

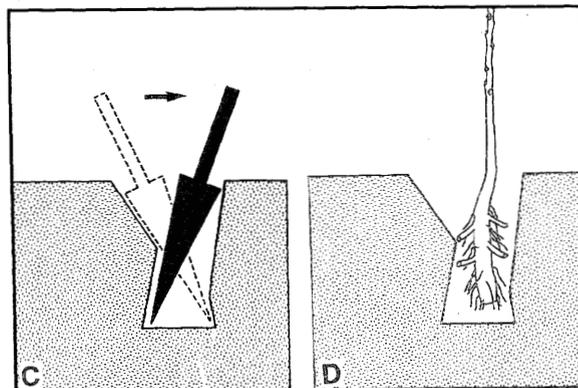
For plantings only a few seedlings or on sites too small for farm equipment, a variety of hand tools can be used to plant seedlings. Use a KBC bar with 12 inch blade when planting seedlings in hard or rocky soil. Use an OST bar (dibble) or hoedad with a blade designed for a 12 inch planting depth in soft soils. Reinforced tile spades (also called sharpshooters) with a 14 inch blade are also available from some forestry suppliers.

The following illustrates the steps to the slit method of planting when using a KBC bar, dibble, or tile spade.



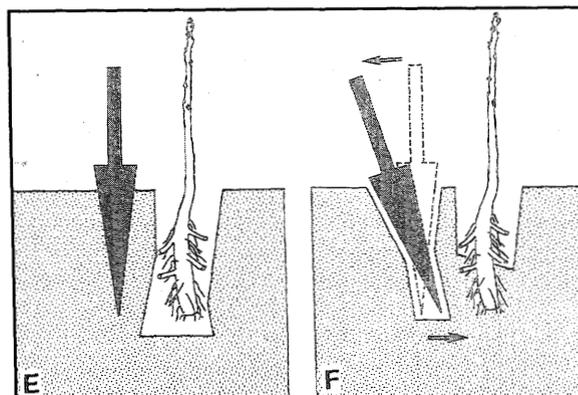
A Insert handle straight down and pull backward.

B Push blade down at same angle to get a new bite.



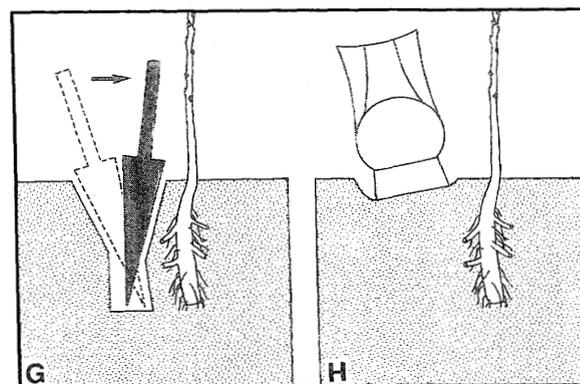
C Push handle forward to open planting hole.

D Set seedling in hole at correct depth.



E Push blade straight down about 2" behind hole.

F Pull handle back to pack soil around lower roots



G Push handle forward to pack soil around upper roots.

H Repeat last 3 steps and close third hole with heel of your shoe.

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When planting more than a couple thousand seedlings, consider using a tree planting machine. Machine planting usually does not work well for small plantings (less than 5 acres), on rough or rocky sites, or steep slopes. Contact your local forester for information on the availability of tree planting equipment and services in your area.

Machine planting involves using a tractor-towed planting machine that consists of a rolling coulter that cuts through the soil, a trencher or planting shoe that temporarily creates a slit in the soil, packing wheels that firm the soil around the planted seedling, and holding trays to store seedlings and keep roots moist. The coulter and trencher depth should be set deep enough to prevent roots from forming an L-shape at the bottom of the slit. As in hand planting, seedling roots should be kept moist and covered. The larger tap-rooted hardwood seedlings require heavily-built planters capable of cutting deeper and wider slits than most commercially available tree planters that are suitable only for planting conifer or shrub seedlings. Pulling hardwood tree planters may require a crawler or four-wheel-drive tractor. To prevent damaging the stem and terminal buds of tall hardwood seedlings, the path between the trencher and packing wheels should be free of obstructions.



Heavy-duty tree planters and tractors are needed to cut large, deep trenches for planting hardwood seedlings.

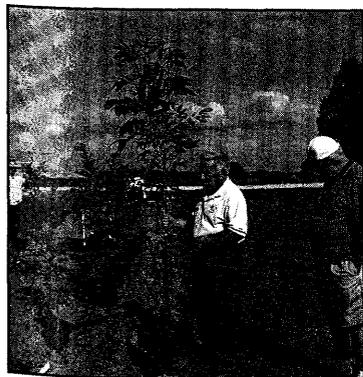
A four-person crew is recommended for machine planting, including a:

- person to prepare seedlings for planting,
- tractor driver,
- tree planter, and
- tree packer.

Although most planters have packing wheels that firm the soil around the seedling, a tree packer can assure that planting slits are completely closed. By walking behind the planting machine, the tree packer can further compress the planting slit by foot and also straighten seedlings where necessary. Remember, on clayey soils given little site preparation, the slits created by the planter often open when soils shrink during summer droughts.

HOLE METHOD OF PLANTING

The hole method of planting allows trees to develop a more natural root system because roots are spread in all directions within the planting hole. It is the preferred method for planting large stock (stock with stems larger than 1 inch in stem diameter or caliper), containerized seedlings, and balled-and-burlapped stock and for planting on rocky soils. Containerized seedlings are either sold in the containers they grew in or lifted from nursery beds and put in containers to facilitate shipping. Balled-and-burlapped stock is typically small saplings with burlap covering a ball of soil (in which the roots are embedded) that has been tied with wire or twine. The main disad-



Container-grown seedlings best planted using hole method.

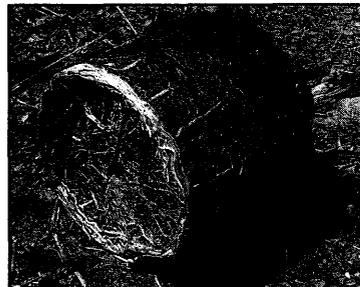
vantages of the hole method of planting are that it is slower and more labor intensive than using the slit method of planting.

Precautions to follow when using the hole method of planting include:

- Before planting seedlings of species that do not tolerate "wet feet", determine if drainage is adequate for the tree species by digging a hole and filling with water. Water should drain away at the rate of 1 inch or more per hour.
- Always transport planting stock by carrying the plant by the container or root ball – not by the trunk.
- Keep roots moist during planting as small roots are easily killed by exposure to wind and sun. Handle only a few seedlings at a time and leave the remaining seedlings covered in the shade and exposed to neither high nor freezing temperatures.

The basic steps for the hole method of planting are:

- Make a hole as deep and approximately twice as wide as the root ball using a round point shovel. For bare-root seedlings with fibrous roots, make the hole 6 inches wider than needed when the roots are spread out. With small planting stock (e.g., seedlings <math><0.75</math> inches in basal stem diameter or caliper) consider using a mattock or grub hoe for making planting holes quickly and efficiently.
- Create a pedestal of firm soil in the center of hole on which to set the taproot or rootball. Dig the outer edges slightly deeper than the center to create a pedestal to improve drainage. Alternatively, create a mound of soil in the center of the planting hole and firmly pack to create a solid pedestal on which to set the tap root or root ball. The normal pattern for root growth is in a lateral direction. Undisturbed or packed soil at the bottom of the hole will provide a firm and stable support for the tree.
- Cut the taproot and lateral roots to fit the depth of the planting hole, not the width of the planting hole, to retain maximum root mass. New root regeneration normally occurs at the ends of the cut taproot and larger lateral roots.
- On containerized stock, seedlings should be removed from the container before planting, unless the container is biodegradable. To remove seedlings, try tapping the sides of the container to loosen the root ball; otherwise cut down two opposite sides with snippers and pull the seedling from the container. Leave the soil ball intact if possible



Cut circling roots before planting or when filling the planting hole.

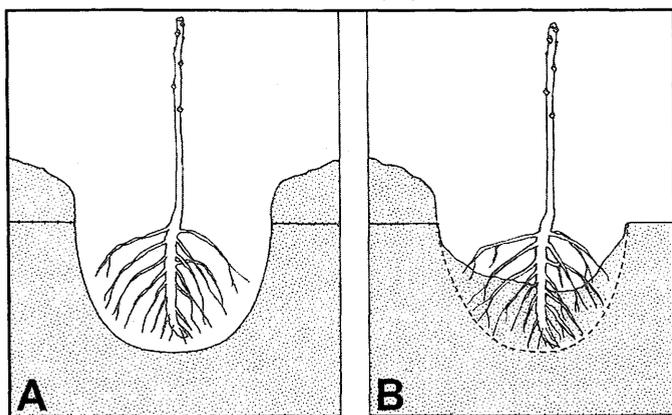
- Examine container-grown planting stock for circling roots and twisted taproots. Cut taproot to remove bent portion and cut lateral roots so no roots extend more than a quarter-way around the root ball. Cut away diseased or damaged roots.
- On balled-and-burlapped stock, try to remove all twine or wire, treated burlap, and wire baskets from root ball. At a minimum, pull the burlap and any twine or wire away from the upper half of the root ball. Balled-and-burlapped saplings should be set so that the top of the ball of soil is slightly below ground level.

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Planting holes should be as wide and deep as roots with a pedicel of firmly packed soil in the center

- Plant the seedling so the taproot or main root is planted vertically. All roots should be pointed down and not bent to fit the hole. Do not twist the roots of bare-root stock into a small planting hole. Seedlings planted with L- or J-shaped roots grow poorly.
- Fill the hole about half full with the soil taken from the planting hole and lightly tamp to remove air pockets. Minimize the amount of snow, ice, duff, or debris added to planting hole. This material can create air pockets upon melting or decomposing.
- If there are pronounced differences between the texture of the soil in the root ball and surrounding soil, use a shovel to make a series of cuts across the two soils to mix the two soils. If these edges are not broken, roots of container-grown stock are likely to grow in self-strangling circles within the original root ball rather than grow into the field soil. This is especially likely in poorly drained or heavy clay soils.
- When planting only a few seedlings, consider adding water to the planting hole and letting it settle before proceeding to the next step. This will help stabilize the tree and rehydrate the soil that had been removed when holes are dug more than a few hours before planting.
- Finish backfilling with soil by adding 2 to 3 inches of soil, then tamping, and adding more soil until the hole is filled. Tamping removes air pockets. Continue using a shovel to disturb the area between the soil on the rootball and the field soil.
- Plant seedlings so that the soil surface at the planting spot remains level. Some tree planters recommend forming a small dike of soil around the outer edge of the planting hole to create a reservoir to trap and hold water during the first summer after planting. Seedlings may benefit from planting on raised mounds on sites with wet, poorly drained soils.

HERE ARE SOME ADDITIONAL GUIDELINES:

- Consider using a two-person or tractor-mounted post-hole digger with an 8 or 10 inch auger when planting large numbers of trees. Clearly mark the proper depth on the auger so holes are not dug to



A. Two-person or B. Tractor-mounted post-hole augers speed hole planting of hardwood seedlings

deep. Be sure to tamp down the loose soil in the bottom of the hole before planting the tree, or it will settle and leave the tree sitting in a depression.

- When using augers or tree spades in soils that are high in clay or very wet, the wall of the hole may become 'plastered' from the 'slicking' effect of the auger or blades. This creates a glazed pot-like wall that tree roots may not be able to penetrate. To avoid this problem when using an auger, use a tile-spade to cut the sides of the hole about an inch wider and then tamp the loose soil that has fallen into the bottom of the planting hole. When using a tree spade, break up the surface of the planting hole with a shovel before placing the tree in the planting hole.



Tree spades come in many sizes.

- Large saplings and small pole-sized trees can be transplanted using a tree spade to both lift and plant trees. The larger the tree, the larger the tree spade that will be needed. When using a tree spade, a hole is first cut in the future planting spot. The soil from the new planting hole should be used to fill in the hole made when the tree is lifted. Care should be taken to cut the holes made when lifting the tree at the same depth as the previously dug planting hole.

POST PLANTING AFTERCARE

After-care of planted trees includes protection from sunscald, stem and branch pruning, protection from wind and wildlife damage, ground cover management, and fertilization. Here are some general guidelines for each activity.

- Large planting stock grown in dense nursery beds typically have thin bark or have been heavily pruned. These trees are the most susceptible to sunscald. To reduce the risk of sunscald, paint the tree stem with a mix of 1 part white interior latex (no mineral oil or refined petroleum products) paint to 3 parts water to reduce the stem's absorption of sunlight.

- Large bare-root and balled-and-burlapped saplings have lost most of their root system and the ability to extract sufficient soil moisture to support the crown. Some stem and branch pruning will help balance the crown in proportion to the remaining roots. Pruning to reduce crown size should preserve the terminal shoot while removing entire lateral branches, especially damaged branches and forks.

- Large planting stock should be staked to prevent wind-throw. Attach three evenly spaced guy wires near the middle of the tree just above a branch using broad, soft strapping material such as woven belt fabric or padded wire that will not cut into the bark. Ties and guys should be removed after one year.

- Begin corrective pruning a year after the tree was planted to maintain a single terminal shoot. Even with these precautions, initial tree growth will be very slow and it may be several years before large trees acclimate to the new site.

- Use of organic mulches over an area slightly larger than the planting hole is recommended because water stress is the chief factor limiting transplanting success. A 3 to 4 inch deep layer of mulch will not only suppresses weeds but also keeps soils cooler, reduces water evaporation of soil surfaces, and reduce injuries by keeping mowers and other equipment away from the stems.

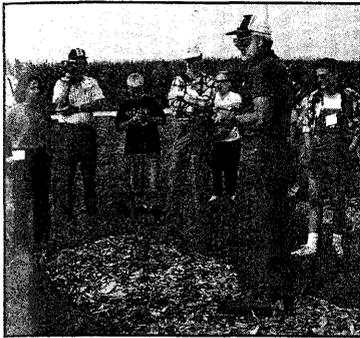
- For large plantings, application of pre-emergent and post-emergent herbicides to control weed competition will be more

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A four inch deep layer of mulch provides adequate weed control and minimized evaporation of soil.

cost effective than mulching. Mowing to control competition is not recommended because it does not remove below-ground competition for moisture and nutrients and because trees are frequently damaged by mowers.

- Fertilization is not recommended the first year after planting. Most planting stock has sufficient nutrients stored in the tree or the container medium for the first year's growth. Addition of fertilizers can burn the

roots or draw water out of the root, dehydrating the root system,

in addition to stimulating increased weed competition.

- If newly planted trees develop small yellowish leaves, consider adding a slow-release source of nitrogen at rates up to one pound of actual nitrogen per 1000 square feet of weed-free area.

- In areas with high rabbit and rodent populations, trees should not be mulched and the lower foot of the stem should be wrapped with bio-degradable or photodegradable tape. An alternative is the use of 24-inch tall mesh or plastic tree shelters.

- In areas with high deer populations periodically apply deer repellents. An alternative is the use of 4 to 5 foot tall plastic tree shelters.



Use of herbicides to control weed competition.

JOIN US AT THE ANNUAL MEETING IN AUGUST

Our Missouri chapter is pleased to host the National annual meeting this year from August 3-7 in Columbia, Missouri. They would welcome you to join them as we enter the heart of Missouri for two days of field tours.

GENERAL PROGRAM PLANS INCLUDE:

Sunday August 3 Landowner Show and Tell

**Monday August 4th Field tour to Harlan Palm farm and Kent and Lori Deimeke farm
Evening with the Experts**

**Tuesday August 5th Field tour to Brundage Agroforestry site, Missouri-Pacific Lumber, CRP plantings, and the University of Missouri Horticulture and Agroforestry Research Center
Evening banquet**

Wednesday August 6th Technical sessions on soil suitability, economics of plantation culture, marketing improved nuts, a research update, managing your legacy, etc.

Thursday August 7th Optional tours of Hammons Products Company ShoNeff Plantation and Processing Plant

On August 4th, during our field tours to the Palm and Deimeke farms, we will look at a number of interesting topics. We will see the results of manual pruning, participate in tree selection and thinning discussions, and hear appraisals by foresters and log buyers of the value of specific trees and harvest recommendations.

In our visit to a native walnut stand, we will compare the growth of trees under different soil conditions, discuss crop trees and what to keep, see a TSI demonstration and review the opportunities to rejuvenate some areas that have lower-valued species.

On August 5th during our tours to the Brundage planting and HARC Research Center, we will look at field performance of timber and nut clones, pruning practices, benefits of ground cover management, and an equipment display.

This is just a brief overview of some of the great information you can collect at a Walnut Council meeting. Combine that with the chance to network with other landowners and foresters and this meeting is a real value and lots of fun!

TO RESERVE YOUR ROOM, CALL THE HOLIDAY INN SELECT AT (573) 445-8531 AND ASK FOR GROUP WC8.
WE WILL HAVE COMPLETE PROGRAM INFORMATION AND REGISTRATION IN THE NEXT BULLETIN OR
CHECK OUR WEBSITE AT www.walnutcouncil.org/annualmtg.htm.

