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# OAK REGENERATION PRACTICES: PLANTING OAKS FOR AFFORESTATION

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Millions of oak seedlings have been produced by tree nurseries and planted in the eastern United States each year since the 1980s. Most of these oak plantings have been unsuccessful, as they are not apparent on the landscape. Possible causes include inadequate site preparation, failure to control competing vegetation, not matching the species to a favorable site, and poor planting stock.

Most oak plantings occur on former agricultural or pasture lands where seed sources or sprouting are not present. Afforestation is plantings which changes land use from non-forested areas to growing trees. Planting hardwood trees is a long-term, costly proposition (refer to the fact sheet on oak enrichment planting) involving site preparation, control of competing vegetation (probably several times), cost of seedlings, and cost of planting. Great strides have been made for nurseries to produce higher quality seedlings and in proper planting procedures. This fact sheet focuses on tree density (spacing) decisions, use of ground covers, and control of unwanted competing vegetation before and after planting.

*Afforestation planting of oak on an old field site. Even though the field was site prepared and herbicide vegetation control is evident between planted rows and seedlings, volunteer yellow-poplar and sweetgum (right and left of the oak seedling, respectively) will outgrow and overwhelm the planted oak seedling.* Photo Credit: *Wayne K. Clatterbuck*

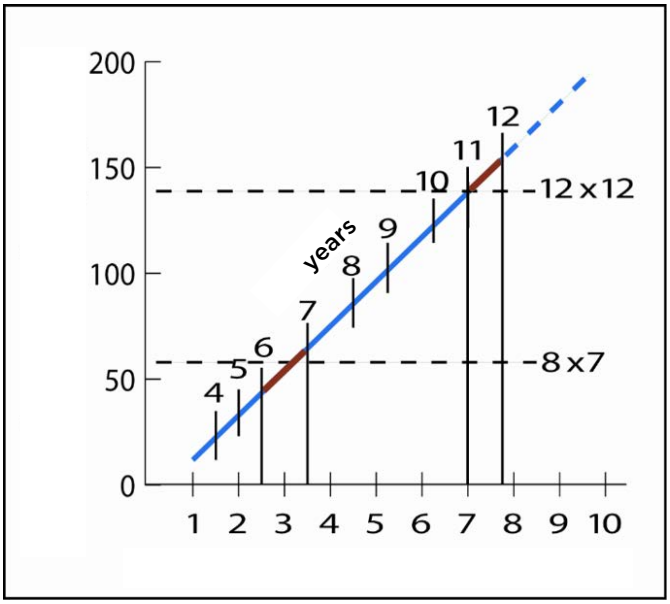
## SPACING

The first decision is to determine the spacing to plant seedlings. The spacing will depend on several factors: objectives for the trees in the planting, expense of seedlings and planting, and cost and effective control of competing or unwanted vegetation. Narrow spacings encourages tall, skinny trees with slender crowns and small diameters. A greater number of trees are planted, increasing initial costs. Trees will consume the available growing space quickly such that costly precommercial thinning operations are required. With wider spacings, fewer number of trees are planted, resulting in shorter-bodied stems with crowns that are more horizontal than vertical. At the wider spacings, growing space is available for a longer time period before the trees occupy all the growing space (canopy closure) resulting in larger diameters. Thinnings at these wider spacings may produce some revenue, but tree form and clear bole length may be compromised.

As illustrated in the following graph, narrow spacings close the available growing space in the canopy faster (more trees per acre) than wider spacing where the canopy takes longer to close. The consequences of these spacings are that at narrow spacings, less competition control is required before canopy closure, but trees are smaller in diameter. At wider spacings, canopies take longer to close, resulting in a greater length of time for competition control. For most plantings, depending on objectives and cost, a compromise of 400 to 500 planted seedlings per acre (combinations of 9- to 12-foot spacing between and within rows) would strike a balance between number of competing vegetation control treatments before the canopy closes and desirable tree growth and form.

For example, if the management objective is to produce as much mast as possible, wider spacings with large tree crowns would be optimum. If longer tree boles for timber production are desired, then narrower spacings would be preferred. Even at the spacings suggested, additional thinnings will be required after each canopy closure to increase the growing space per tree as the trees mature in the plantation. Ultimately, at 40 to 60 oak trees per acre are desired at maturity.

Thorough site preparation prior to planting is essential to control unwanted vegetation. The better the site preparation at this time without the seedlings, less vegetation control will be necessary following the planting, allowing seedlings more growth resources. One option is to pre-plant compatible ground covers such as small grains (winter wheat, grain ryes, oats) to discourage colonization of unwanted broadleaf weed seed. Seedlings should be planted directly into the ground cover. Typically, fields that were in row crops the season before seedling planting have little residual vegetation to control. Fields that are fallow for several years will require greater vegetation control efforts. Perhaps the most difficult afforestation conversion is from fescue pastures to planted trees. Fescue, with its thick, fibrous, surface root system, intercepts most precipitation, preventing moisture from reaching the roots of the planted seedlings. Thus, the fescue should be eliminated. Often fescue is controlled in strips within a fescue field to minimize herbicide costs. A row of seedlings is then planted in the strips. Efforts to control the encroachment of fescue and other vegetation into the strips after planting have proved to be troublesome, affecting seedling growth and requiring further vegetational control with escalated costs. Refer to the weblink below for various options and guidelines for successfully establishing ground covers.




*Crown closure interval for northern red oak. Blue line represents groundline diameter/crown surface area for plantations on a temporal scale. At 8- by 7-foot spacing (800 trees per acre) the planting will close canopy during the 6th growing season. At the 12- by 12-foot spacing (302 trees per acre), the canopy will close during the 11th growing season. From Stringer, Clatterbuck & Seifert (2009).*

*Grass with its thick, fibrous root system is a serious moisture competitor to growth of planted seedlings and should be controlled.*
Photo Credit: *Wayne K. Clatterbuck*

A broad-spectrum herbicide is applied for site preparation prior to planting to influence a wide array of residual, competing vegetation. Mowing or bushhogging may be necessary to reduce vegetation height so herbicides can be more easily applied. Once seedlings are planted, mowing or disking is not effective for vegetation control since the method would be conducted several times a year, increasing time and expense. Mowing does not control rootstocks which continue to resprout. The frequency of mowing also increases the probably of damage to seedlings by the equipment. A benefit of mowing competing vegetation late during the growing season is to avoid seed dispersal and spread of the unwanted plants. Herbicidal weed control is a better choice. The herbicide is translocated to the roots of the vegetation, disrupting plant processes which causes the plant to die, be stunted, or diminished.

Several herbicides can be applied depending on the weed complex to be controlled. The specifics or scenarios for each herbicide are discussed in the further reading references cited below and are beyond the scope of this fact sheet. Two aspects to be considered is whether to apply a pre-emerge or post-emerge herbicide or a broadleaf or grass herbicide based on the weed complex. **Remember that broadleaf trees are impacted by broadleaf herbicides**.

If controlling broadleaf weeds after planting, directed spray broadleaf herbicides are necessary such that the spray is not directly applied to or drifts onto the tree seedlings. Once tree crowns grow above the weed complex such that they are receiving full sunlight, weed control is no longer required. Eventually, the tree crowns will shade out the ground vegetation.

**To Avoid Herbicide Injury and Weed Competition of Planted Seedling**

- Control of annual and perennial weeds is much easier before seedling planting. Adequate planning and site preparation before planting is essential for success.
- Use herbicides to control unwanted vegetation that is present after planting. If only grasses are present, spray grass herbicides over the top of seedlings (refer to weblink below for specific herbicides). These grass specific herbi cides will not affect the broadleaf seedlings. If broadleaf competition is present, use directed spray of a broadleaf herbicide making sure the spray does not get on the planted seedling. Retreatment of broadleaf herbicides will be necessary until the seedling grows above the weed complex.
- Mechanical cultivation (disking and hoeing) can be used but should be repeated several times during the growing season. Mechanical cultivation usually results in damage to the seedlings. Mowing or bushhogging are not feasible because it favors the grass, the greatest moisture competitor of tree seedlings.

Mixed species plantings are recommended for afforestation plantings. Unlike monocultures, advantages of mixed species plantings include increased diversity and resiliency of vegetation and wildlife, better stand resistance from insects and disease, greater vertical and horizontal complexity, and synergism between and among species that could lead to improved tree form, grade, and growth. Choosing species to plant in mixtures involves evaluating species that occur and are compatible on similar sites, their light tolerances, and differential growth rates. Most natural stands dominated by oak did not originate as pure oak stands, but developed in the midst of other species. The primary disadvantage of mixed species plantings is that results are uncertain. Knowledge about the devel- opment of mixed species plantings is in its infancy. The ecology of the species involved, the various site attributes, and differential species growth rates should be thoroughly assessed for planning prescriptions, spacings, and silvicultural treatments.

## FURTHER READING


Clatterbuck, W.K., Coakley C. 2023. Minimizing erosion on harvest sites by revegetating logging roads, skid trails and landing. Extension Publication PB 1916. Knoxville, TN: University of Tennessee Extension, Institute of Agriculture. 9 p. (https://utia.tennessee.edu/publications/wp-content/uploads/sites/269/2023/10/PB1916.pdf).

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Stringer, J.W., Clatterbuck, W., Seifert, J. 2009. Site preparation and competition control guidelines for hardwood tree plantings. Extension Publication PB 1783. Knoxville, TN: University of Tennessee Extension, Institute of Agriculture. 36 p. (https://utia.tennessee.edu/publications/wp-content/uploads/sites/269/2023/10/PB1783.pdf).


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