

# Introduction

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**Facing Page:** *Nursery worker in tall hardwoods. (Photo by Greg Hoss.)*

## The Importance of Hardwood Seedling Production

It's easy to get the wrong idea about hardwoods. Recent surveys indicate that hardwood seedlings make up less than 5 percent of the total number of seedlings produced in the Eastern United States (Hernández et al. 2017). Of the approximately 1 billion tree seedlings produced in the Eastern United States in calendar year 2016, a little over 42 million were hardwoods. For many reasons, however, that relatively small number does not accurately reflect the true importance of hardwood seedlings to the forest economy or ecology of the region. First, for some States, particularly Ohio, Indiana, Illinois, Iowa, and Missouri, hardwoods are 75 percent of their total nursery production and the foundation of their seedling production and reforestation programs. Second, hardwood prices across the region are about three times higher than conifer prices, and hardwood sales can represent a significant amount of revenue for those nurseries producing them. The sale price of a premium graded hardwood, for example, can be as much as 10 times that of an ungraded loblolly pine. The relatively small production numbers for hardwoods do not necessarily indicate their economic importance to nursery sales.

The number of hardwood seedlings produced also does not indicate their ecological importance. Many species of hardwoods are planted as much to produce wildlife food as to provide an economic return. Landowners have been interested in hardwoods to improve wildlife habitat for a variety of reasons. Whether mast-producing oaks or fruit-producing cherries, the benefits to wildlife from hardwood seedling sales is hard to quantify. In addition, landowners have often been interested in planting hardwoods for purposes related to environmental improvement such as wetland conservation, species diversity, and any number of environmental quality issues. The impact of these efforts can be significant in terms of seedling sales and service to an environmental quality mission.

Finally, many hardwood sales are for a small number of seedlings for programs such as Arbor Day celebrations, Boy Scout troop activities, and city landscaping projects. These activities reach a large number of people involved in improving their homes and communities. It is hard to determine how this might affect the public's perception of forestry and its understanding of the contribution of forest tree nurseries to environmental management and the quality of their lives. So, while forest tree nurseries in the Eastern United States may produce over a billion seedlings, much of the public relates to the sale and utilization of only a small portion of that production because it directly impacts the public's lives.

## The Challenge of Hardwood Seedling Production

Although hardwood seedling production serves a variety of very important functions, they are not always easy to grow. More than a few nursery managers may have felt that the headaches are not worth either the sales or the public relations benefits that hardwood production may provide. The list of disadvantages to growing hardwoods is long.

- **Species diversity.** A single nursery may grow anywhere from 10 to 40 hardwood species, each with their own characteristics and challenges. This diversity is perhaps the most challenging aspect of growing hardwoods. One need only contemplate trying to accurately sow walnut (*Juglans nigra* L.) with an average of 40 seed per pound, followed by green ash (*Fraxinus pennsylvanica* Marsh.) with 20,000 seed per pound. This challenge is to be followed by differing stratification characteristics, growth rates, pests, and other characteristics that may differ among species.
- **Genetic improvement.** The seed for virtually all hardwoods come from open pollinated natural stands. There are few seed orchards that might provide some genetic improvement and consistency. Using seed from natural stands increases seedling variability in the nursery bed.
- **Seed production.** There are few commercial producers of high-quality hardwood seed. Much of the seed used in hardwood seedling production must be gathered and processed locally. Some species have fleshy fruit, some have wings, dormancy and stratification requirements vary greatly, and seed crops are highly irregular.
- **Bed spacing.** While pine seedlings may be produced at 20 to 25 seedlings per square foot of nursery bed, hardwoods usually are grown at somewhere between 5 and 15 seedlings per square foot. This means increased nursery bed space that must be fumigated, tilled, bedded, maintained, and harvested.
- **Cultural treatment.** Hardwoods consume more water and fertilizer than do pine. Species react differently to top pruning. Information on weed control is more limited than for conifers.
- **Lifting.** Their size and root structure make hardwoods much harder to lift as compared to conifers. The process typically requires significant hand labor and increased handling and sorting. The mechanization of hardwood lifting is not well developed and fewer seedlings can be carried on a trailer or in an individual container.

- **Grading.** Because there is considerable morphological diversity in most hardwood crops, grading and/or culling is often required, which increases labor and supervisory inputs.
- **Storage.** Hardwoods require a significant amount of cooler space due to their larger size. Packaging is sometimes more problematic because of hardwood root morphology. Some species of hardwood store well, others do not.
- **Research support.** One of the most serious drawbacks to hardwood seedling culture is the nearly total lack of active research looking at seedling production improvement. While there have been past studies related to seedling quality and outplanting performance, other issues like weed control, nutrition, genetic improvement, and harvest mechanization have not received the concentrated effort or funding that has been afforded the culture of conifers.

## The Objectives of This Guide

Fortunately, even with all the serious challenges faced by hardwood nursery managers, a cadre of dedicated professionals is meeting these challenges. Much of what is known about hardwood seedling culture is scattered throughout the various nursery managers, university personnel, and Federal researchers who have worked with hardwood seedlings. Much has been learned over the past 40 years since Robert Williams and Sidney Hanks of the U.S. Department of Agriculture, Forest Service, prepared the first *Hardwood Nursery Guide* in 1976. It is well past time that the state of knowledge for hardwood seedling culture be redefined and documented. That is the primary objective of this guide.

Geography is one of the more difficult challenges faced by the organizers of this guide. A wide variety of climate and

topography may be found in the “Eastern United States” (USDA Forest Service, Regions 8 and 9). The average low and high temperatures, number of frost-free days, and other basic climatic characteristics vary greatly when comparing Pennsylvania to Mississippi. Frozen soil is unlikely in South Carolina, but it is an annual event in Wisconsin. Topography in the Eastern United States varies from the heights of the Appalachian Mountains of Vermont and New Hampshire (upwards of 5,000 feet [ft]; 1,500 [meters] m), to the Mississippi River Delta of Arkansas (as low as 100 ft; 30 m). All these factors impact sowing dates, timing of cultural activities, lifting, and planting dates. Nevertheless, many of the same hardwood genera are spread across the region, and in some cases the same species might have a very wide distribution. More importantly, the problems faced by nursery managers in one part of the region are not all that different from the problems in another part. Seedbed preparation, weed control, and lifting operations are similar wherever the nursery may be located, although the timing may be different. The important consideration when organizing this guide was to gain and incorporate the perspective of experienced managers and researchers from across the region.

This guide is the result of contributions from a large number of individuals who either have direct field experience in the cultivation of hardwoods or considerable research experience with hardwood culture. It is hoped the guide will be a useful and practical source of information and that both the inexperienced and the experienced nursery manager find it beneficial.

## Reference

Hernández, G; Haase, D.L.; Pike, C. [et al.]. 2017. Forest nursery seedling production in the United States – fiscal year 2016. *Tree Planters’ Notes*. 60(2): 24–28.

