WRP Technical Note VN-EM-1.1
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Container Oak Seedlings for Bottomland Hardwood (BLH) Restoration

PURPOSE: This technical note discusses growing Nuttall oak (*Quercus nuttallii* Palmer) seedlings in containers for small (BLH) restoration projects. This method may increase seedling survival and improve restoration success in frequently flooded areas.

BACKGROUND: Restoration of BLH forests often requires reforestation of reclaimed agricultural fields subject to frequent flooding. Establishing oak species (*Quercus* spp.) in these areas will improve the habitat function of BLH by providing mast for wildlife. For many areas, the conventional planting season of mid-December to late-February coincides with periods of heavy precipitation and flooding. While some oak species are considered moderately flood tolerant, they cannot withstand long periods of inundation, especially when flooding extends into the growing season.

Traditionally, restoration has been accomplished with bare-root seedlings or direct seeding with acorns. Several problems arise when flooding occurs during the planting season: 1) inaccessibility of the site, 2) inundation of newly planted seedlings, and 3) poor stock quality as a result of unavoidable, long-term storage (i.e., mold, mildew, and dry rot). Storage is often unavoidable because nursery operators must harvest seedlings before preparation of the seed bed for next year's crop. If planting occurs prior to flooding, seedlings must tolerate flooding during the growing season and survive the summer drought that usually follows. A stock which can be planted after the spring flood, yet survive the anticipated summer drought, is needed for successful reforestation of frequently flooded areas.

Container oak seedlings may alleviate planting problems encountered with bare-root seedlings and direct-seeding on flooded sites. For instance, growth in containers promotes a more fibrous root system as well as a higher root to shoot ratio (Fig. 1). This is a goal pursued by nursery operators with bare-root stock. However, harvesting bare-root seedlings results in a large portion of the root system remaining in the seed bed. During planting, pruning of the root system is often necessary to properly plant the seedling. Consequently, the root system of a planted bare-root seedling consists of only a few primary and secondary roots. In contrast, the root system of a container seedling is bound to the media until planting, resulting in no root damage or loss from harvesting or pruning. This allows the planting of an undisturbed fibrous root system with a large surface area, increasing absorption capacity for water and nutrients in drought conditions and oxygen in hypoxic conditions.

The literature supports the use of container seedlings to extend the planting season (Graber 1978, Yeiser and Paschke 1987). Extending the planting season allows flexibility in the planting schedule and eliminates storage problems encountered with bare-root seedlings and seed. Seedlings remain in the containers and receive water and nutrients until optimum planting conditions occur.

METHODS: Choose a species that is suitable to the conditions of the site. Nuttall oak, a species known to grow well on poorly drained soils, is a good example. The seed source should be located within a 100 mile radius of your planting area. Nuttall oak seeds can be collected beginning in October or purchased from a seed vendor. Seed may be stored according to methods prescribed by

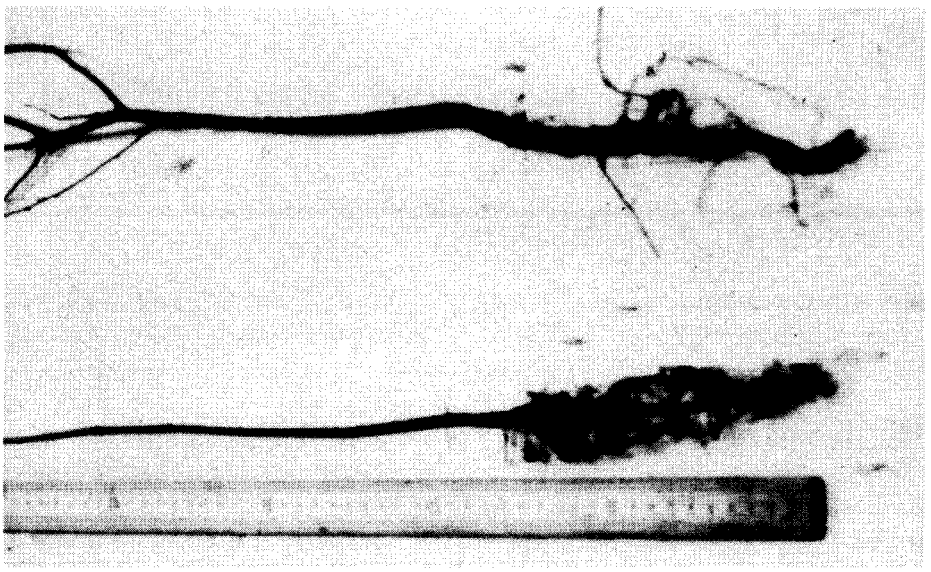

Figure 1. Comparison of root system of bare-root and container seedlings

U.S. Department of Agriculture Forest Service (1974). The seeds should be soaked in water for a 24 hr period. Floating seeds should be discarded because they are probably not viable. The non-floating seeds are placed into polyethylene bags for a period of 60 to 90 days at 5°C. This process is known as artificial stratification, necessary to break seed dormancy. Following the stratification period, seeds should be sown directly into containers filled with potting medium. Suggested container size is 164 cm^3 plastic cone containers filled with a 1:1 ratio of vermiculite and sphagnum moss. Place the containers at a 8 x 8 cm spacing. This spacing promotes the development of a uniform crop of seedlings by reducing inter-seedling competition for light and allowing homogeneous delivery of water and nutrients. Germination and initial growth (approximately 3 weeks) should take place in a greenhouse. Seedlings should then be moved to a shade house covered by 50% shade cloth for the remainder of the growing season (Fig. 2).

Seedlings should be checked daily for desiccation by touching the media and observing any evidence of leaf wilting to determine when watering is necessary. As temperature increases, it may be necessary to increase watering to daily either in the morning or late evening. The potting medium does not supply nutrients to the growing seedlings, it is therefore necessary to fertilize. Fertilizer should be applied weekly, beginning with a 9-45-15 ($N\text{-}P_2O_5\text{-}K_2O$) to promote root growth. After a 3 week period, fertilize with 20-20-20 or 15-30-15 to maintain shoot and root growth. Toward the end of the growing season, fertilizer should be switched back to 9-45-15 and watering reduced to promote bud set. Magnesium in the form of epsom salt ($MgSO_4$) and liquid iron can be added to the fertilizer solution to supply minor nutrients. The actual amounts of fertilizer applied will depend on the amounts of watering and rainfall. For the 1992 growing season at the U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, each seedling received approximately 67 mg of nitrogen.

CONCLUSION: Some concerns to be noted when growing container seedlings are maintaining moisture within containers and the leaching of fertilizer. Maintaining moisture in the containers can be a problem during summer months because of high evapo-transpiration rates. This can be avoided with an automated irrigation system. Leaching of fertilizer may occur due to increased watering. In addition to fertilizer rates mentioned above, slow-releasing fertilizer (13-13-13) pellets can be added as top dressing at a rate of 500 mg/container to compensate for the leaching.

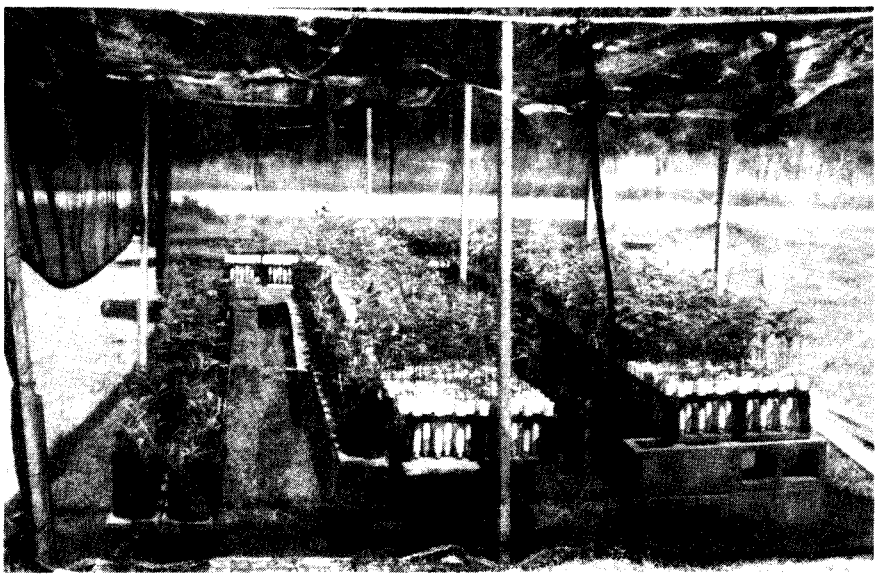

Figure 2. Container seedlings in shadehouse covered by 50% shade cloth

Production of a uniform crop of container seedlings can be achieved (Table 1). For all of the measured variables, bare-root seedlings averaged larger than the container seedlings. However, the key component to seedling survival is the establishment of a viable root system. The container seedlings, because of a fibrous network of roots, have a greater capacity for absorption (Fig. 1) which translates into a better chance of seedling establishment in difficult situations. Although the root systems of bare-root seedlings appear to be more than twice the size of container seedlings, the mass consists of only primary and secondary roots which are often pruned before planting.

Previously, container seedlings have not been frequently used in the South due to high cost and unavailability of large quantities. Availability is no longer a problem but many still consider the initial cost too high. However on a per seedling basis, purchase price is about $ 0.25 for a bare-root seedling versus $ 0.29 for a container seedling. The difference in seedling cost is balanced with the potential for increased survival. Preliminary data from a field study at Lake George, MS, show 75% seedling survival for container stock versus 45% for bare root. The selection of a tree species suitable for the site, and seedlings grown in containers, coupled with an extended planting season, may allow the reforestation of frequently flooded sites which otherwise would be difficult or impossible to replant.

REFERENCES

Graber, R. 1978. Summer Planting of Container-grown Northern Hardwoods. U.S. Department of Agriculture Forest Service Research Note NE-263:1-5.

Yeiser, J. L. and J. L. Paschke. 1987. Regenerating Wet Sites with Bare-root and Containerized Loblolly Pine Seedlings. Southern Journal of Applied Forestry 11:52-56.

U.S. Department of Agriculture Forest Service. 1974. Seeds of Woody Plants in the United States. C.S. Shopmeyer. Technical Coordinator. U.S. Department of Agriculture, Agriculture Handbook 450. Washington D.C. 883 p.

Table 1. Morphological Characteristics of Container and 1-0[1] Bare-root Nuttall Oak Seedlings Outplanted at Lake George, MS, Jan. 21,1993

Variable	Stocktype			
	1-0 Bareroot		Container	
	Mean	Standard Error	Mean	Standard Error
Height (cm)	62.9	2.0	47.1	1.7
Root Collar Diameter (mm)	7.4	0.3	6.1	0.1
Root Oven Dry Weight (g)	6.8	0.5	2.5	0.1
Shoot Oven Dry Weight(g)	8.9	0.7	3.1	0.1
Shoot to Root Ratio	1.3		1.2	

[1] 1-0 Bare-root describes a seedling grown one year in a seed bed and no years in a transplant bed.

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