CONTAINERIZATION OF OAK SEEDLINGS

FOR THE OAK-HICKORY REGION--A PROGRESS REPORT [1]

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Abstract.--Preliminary tests of containerized oak seedlings in the oak-hickory region have been encouraging; however, growth rates of outplantings must be increased to make such systems practical. Author suggests seedlings might have to be produced in relatively large volume containers and root-shoot ratios might have to be optimized for maximum growth potential.

INTRODUCTION

Research on the production and performance of containerized upland oaks (Quercus spp.) for the oak-hickory region is still in its infancy. My own containerization research began less than 2 years ago, and has centered on the evaluation of container propagation systems, including both greenhouse and outdoor production trials.

This research has emerged largely in response to an increasing interest in artificial regeneration of oaks and to a dissatisfaction with the performance of conventional nursery stock. By using proper silviculture, oaks in the oak-hickory region can be naturally regenerated under mature even-aged stands (Sander and Clark 1971). However, artificial regeneration may be needed where natural regeneration fails or is inadequate, or if attempts are made to establish genetically superior stock (Russell 1971, Cech 1971). Furthermore, artificial regeneration will be needed if emerging efforts to manipulate oak forests for diverse nontimber purposes are to be achieved.

Because most opportunities for oak plantings will be on forest sites, successful artificial regeneration will require oak seedlings capable of growing about 1-1/2 to 2 ft in height/yr during the first 20 yr if they are to compete with other rapidly growing woody vegetation. To date, conventional nursery stock has not demonstrated this capability. However, some significant gains have been made by using select stock and fertilization to speed up early growth in oak (Olson and Hooper 1972, Foster and Farmer 1970). The advent of the containerized seedling possibly offers another method of doing so.

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PRELIMINARY TESTS

An outplanting of 1,200 containerized oaks in the Missouri Ozarks was made in April 1968. Five oak species were planted: white oak (Quercus alba L.), black oak (Q. velutina Lam.), northern red oak (Q. rubra L.), scarlet oak (Q. coccinea Muenchh.), and post oak (Q. stellata Wang.). They were grown for 6 weeks in 1-1/2 by 10-in, paper mailing tubes filled with forest topsoil and then outplanted in a clearcutting given intensive weed control. Half of these 1,200 tubelings were treated with a slow release magnesium ammonium phosphate (8-40-0) fertilizer at a rate of 100 lb/acre of N.

Although formal statistical comparison of this outplanting with 1-0 stock of earlier trials was not possible, the 5-yr performance of the tubelings was nevertheless encouraging, particularly the fertilized red, black, and scarlet oaks (table 1). However, the need for even greater improvment in growth was apparent. Consequently, during the last 18 mo, I have been testing several of the new container systems including book planters,

Table 1.--Fifth-year height and survival of oak tubelings

Oak species	Mean height of survivors		Trees $\geq$ 4 ft		Survival	
	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized
	Ft	Ft	Percent	Percent	Percent	Percent
Black	[1]3.7	2.7	[1]41	11	83	87
Northern red	4.3	4.1	[1]57	44	86	80
Scarlet	3.9	3.4	[1]41	27	[1]85	68
White	2.9	2.9	21	18	80	71
Post	2.0	1.8	2	2	73	60

[1]Indicates statistically significant (5 percent level) improvement attributable to fertilization.

styroblocks, wood-pulp fiber blocks and polyloam blocks. All my tests have been with relatively large volume containers ranging from 8 to 40 in. ^{3} and have included northern red, black, and scarlet oaks. Although I found that oak seedlings could be produced in all of these containers, I have concentrated on the 10 and 30 in. ^{3} book planters because they are adaptable to a variety of greenhouse and outdoor production setups. I also had been able to produce larger seedlings in the book planters than the other containers within a 4-mo propagation period.

In greenhouse trials with these book planters, I used a commercial rooting medium of peat moss and fine horticultural grade vermiculite premixed at a 1:1 ratio, which I subirrigated twice weekly for 12 to 24 hr. The 2- to 3-day dry-down periods reduced the moisture in the rooting medium to about 75 to 85 percent of moisture holding capacity. I periodically used an overhead misting system to prevent excessive salt accumulation in the containers and to maintain pH at 6.0 to 6.4.

I added nutrients to the subirrigation water every third or fourth wetting period: 1/2 tbsp (10 gm) of 30-10-10, 1/8 tsp (0.6 gm) of a commercially available trace element mix, and 1/4 tsp (1 gm) of iron chelate (10 percent Fe) per gallon of water.

During the winter months and early spring, I used 1 hr of low intensity incandescent lighting to interrupt the normal diurnal dark period every 3-1/2 hr. I maintained temperatures between 70 degrees and 90 degrees F, and humidity between 30 and 60 percent in the greenhouse.

By the end of the 16-week winter-spring production period, oak seedlings averaged 6 to 12 in. in height and 4/32 to 5/32 in. in basal caliper, depending upon species and container size. The larger 30 in. ^{3} containers consistently produced the largest seedlings. However, I believe that even larger stock can be produced in both container sizes given additional refinements in nutrition, watering, lighting, and greenhouse humidity control.

During the following summer (1973), I adopted an outdoor propagation system that employed an overhead watering system following procedures modified after Matthews (1971). I also found this system produced 6 to 12 in. oak seedlings that averaged 4/32 to 5/32 in. in basal caliper. Comparative studies of the field performance of this containerized stock with conventional 1-0 stock are now in progress.

PROGNOSIS

To match the growth rate of natural regeneration, we will need a two- to three-fold improvement over the best results demonstrated to date. Whether or not this is possible remains to be determined. Relatively large volume containers, such as the 30 in. ^{3} book planters, and long propagation periods in greenhouse and/or outdoor propagation beds appear to offer possible solutions.

However, I believe root-shoot balance will be a critical factor in producing seedlings with the needed growth potential. For example, Owston (1972) observed that large containerized seedlings may be more vulnerable to water stresses than smaller seedlings because of their relatively large crowns and restricted rooting area. Nevertheless, Sander (1971, 1972) reported that large basal stem diameter, which is an apparent correlate of root mass, is related to rapid shoot growth in natural oak reproduction. Thus, the way to produce oak seedlings having high growth potential may be to maximize total root mass within the limits of a practical container volume and to balance this root mass with a shoot that has adequate, but not maximal, transpirational surface area.

LITERATURE CITED

Cech, F. C.
1971. Tree improvement research in oak species. In Oak Symp. Proc. p. 55-59. USDA For. Serv., Northeast. For. Exp. Stn., Upper Darby, Pa.

Foster, A. A., and R. E. Farmer, Jr.
1970. Juvenile growth of planted northern red oak: effects of fertilization and size of planting stock. USDA For. Serv. Tree Plant. Notes 21(1): 4-7.

Matthews, R. G.
1971. Container seedling production: a provisional manual. Inf. Rep. BC-X-58, Pac. For. Res. Cent., Can. For. Serv., Victoria, B. C. 57 p.

Olson, D. F., Jr., and R. M. Hooper.
1972. Northern red oak plantings survive well in southern Appalachians. USDA For. Serv. Tree Plant. Notes 23(1): 16-18.

Owston, P. W.
1972. Cultural techniques for growing containerized seedlings. West. For. Nursery Counc. and Intermt. For. Nurseryman's Assoc. Joint Meet. Proc. Olympia, Wash. p. 32-41.

Russell, T. E.
1971. Seeding and planting upland oaks. In Oak Symp. Proc. p. 49-54. USDA For. Serv., Northeast. For. Exp. Stn., Upper Darby, Pa.

Sander, I. L.
1971. Height growth of new oak sprouts depends on size of advance reproduction. J. For. 69: 809-811.

1972. Size of oak advance reproduction: key to growth following harvest cutting. USDA For. Serv. Res. Pap. NC-79. 6p. North Cent. For. Exp. Stn., St. Paul, Minn.

and F. B. Clark.
1971. Reproduction of upland hardwood forests in the Central States. USDA Agric. Handb. 405, 25 p.

Question: How do containers affect taproot production?

P. Johnson: I really can't answer because we have not yet achieved anything approximating an optimum system for oak. de have not taken full advantage yet of the rooting capacity in the 30 in.^{3} book planters. I think there is a possibility we could successfully plant a tree that has no top; most hardwoods have terrific capacity to sprout. Maybe we should be concentrating on maximum root mass, per se. It's a possibility.

Question: Is oak wilt a problem in your plantations?

P. Johnson: Oak wilt is not a problem in container production nor in nursery production. It is a disease that affects primarily mature, very old-age stands.