EFFECTS OF VARIOUS METHODS OF ROOT PRUNING ON THE ESTABLISHMENT OF TRANSPLANTED RED OAK SEEDLINGS

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Northern red oak seedling survival decreases with the severity of root pruning treatments, but seedling height growth differs very little among treatments after 4 years in the field. Successful field establishment of dormant northern red oak seedlings is partly dependent on the number of roots left intact after lifting from the nursery bed.

The objective of this study was to measure the effects of various methods of root pruning on the survival and growth of transplanted northern red oak (*Quercus rubra L.*) seedlings over a 4-year period after outplanting.

The physiological condition of dormant 1-0 northern red oak seedlings is of primary importance in obtaining successful establishment after planting. Successful establishment can be defined here as high survival in conjunction with rapid height growth. These factors are necessary in order for seedlings to compete with associated vegetation for light; otherwise, oaks will fall prey to browsing animals and/or stagnate on site (1,2). The key to success after planting depends to a considerable extent on the ability of the root system to provide stored carbohydrates, nutrients, and water to all plant components for spring growth and to generate new roots for the absorption of nutrients and water for continued seasonal growth. During the lifting operation, taproots are severed, usually at a depth of 15 to 25 centimeters,[1] and lateral roots are often broken when seedlings are pulled. Additional physical and biological root damage may occur throughout the remaining operations of grading, bundling, storing, shipping, and planting. Root fresh weight, length of taproot, number of lateral roots, and ecto- or ectendomycorrhizal incidence percentage contribute to the capacity of the root system to carry the entire plant through the establishment phase.

In the spring of 1973, 196 dormant 1-0 northern red oak seedlings from a single seed lot were removed from one location in a nursery bed located in Clements State Nursery, West Virginia Department of Natural Resources. Seedlings were washed out of the bed using a regulated spray of water from a hydromulching machine. Nearly 100 percent of all root systems were removed intact. Seedlings with single stems and taproots were selected, bundled, and stored at 3° C for 30 days until planting. Seedlings were divided randomly into seven root-pruning treatment groups of 28 seedlings each.

- T-1: 3-centimeter taproot left intact
- T-2: one-third of taproot left intact
- T-3: two-thirds of taproot left intact
- T-4: lateral roots removed from lower half of taproot
- T-5: lateral roots removed from upper half of taproot
- T-6: all lateral roots shortened to 5 centimeters
- T-7: control; no root Pruning

The seedlings were planted by shovel in single tree plots in a completely randomized design at a .6- x .6- meter spacing on an agricultural site that had been plowed and disced 30 days earlier. The soil was heavy in clays; pH—6.0; and adequately supplied with available potassium, phosphorus, magnesium, and calcium to a 20-centimeter depth. The area was enclosed with ½ -inch metal hardware cloth fence for protection against small animals. No watering, fertilizing, cultivating, shading, or mulching was done. Weeding was done by hand and by the use of Amitrol-T herbicide applications when needed. Seedling survival and height measurements were recorded seasonally for 4 years.

Results and Discussion

Survival decreased in all seedling treatment groups over the 4-year period (table 1). Seedlings receiving the severest root pruning treatment (T-1) had greater mortality (57 percent) than all other treatment groups. The high mortality in T-1 and T-2

[1] Survey of 10 nurseries in West Virginia, Pennsylvania, Ohio, Virginia, and North Carolina.

Table 1.—*Number of survivors (n) and mean height growth (Ht in cm) of northern red oak seedlings for seven root pruning treatments during a 4-year period.*

Root pruning	*Initial*		*Year 1*		*Year 2*		*Year 3*		*Year 4*		*Year 4*
treatment	n	Ht	n	Ht	n	Ht	n	Ht	n	Ht	S.D.(±) Ht
T-1	28	15	22	14	15	23	13	38	12	84	49
T-2	28	14	24	15	21	29	21	47	19	73	42
T-3	28	15	26	17	27	26	24	42	24	85	55
T-4	28	13	26	15	24	26	22	50	20	93	33
T-5	28	16	27	17	26	25	21	49	26	84	48
T-6	28	14	27	15	25	26	23	44	23	88	57
T-7	28	13	28	15	28	29	22	56	25	101	55

can probably be attributed to the severity of the root pruning treatment. (Note the higher rate of decline in survival over the study period.) Seedling survival was greater than 80 percent in T-3, T-5, T-6, and T-7. Seedling survival was less than 80 percent in T-1, T-2, and T-4. Resprouting of seedlings previously reported dead accounts for the fluctuations in survival for T-5 and T-7. Possible browsing damage by deer and dieback of seedlings may account for these previously reported dead seedlings.

The mean height growth of living oak seedlings for all seven treatment groups over the 4-year period is presented in table 1. The growth curves for all the seedling groups are typically exponential, and there is no significant difference between the mean heights of these treatment groups at the .05 probability level. The means and standard deviations of the oak seedling heights after 4 years of growth are presented in table 1. There was considerable variation of individual heights within these groups. Although survival was influenced by the root pruning treatments, it is concluded that normal lifting operations at the nursery are adequate to ensure good survival of field-planted oaks as long as two-thirds of the taproots are left intact.

Literature Cited

1. McGee, C. E. 1968. Northern red oak seedling growth varies by light intensity and seed source. U.S. Department of Agriculture, Forest Service, Research Note 90, p. 1-4, Southeastern Forest Experiment Station, Asheville, North Carolina.

2. Olson, D. E., and R. M. Hooper. 1972. Northern red oak plantings survive well in southern Appalachians. U.S. Department of Agriculture, Forest Service, Tree Planters' Notes 23(1):16-18.