PLANTING NORTHERN RED OAK: A COMPARISON OF STOCK TYPES

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Abstract: Height and survival values of northern red oak (*Quercus rubra* L.) were compared three years after outplanting as functions of: stock types (direct-seeded, 1-0, 2-0, 1-1, 2-1, and 2-year-old seedlings grown in 7.9-liter pots), presence or absence of undercutting in the nursery, and presence or absence of top-clipping when field planting. In all, 33 or more completely randomized single-tree plots for each of 17 different treatments or treatment combinations were represented at recently clear-cut sites in northern, central, and southern Pennsylvania. The same seed source was used in all seedling treatments. Seedlings were protected from white-tailed deer browsing by 6-strand electric fences and competing vegetation was removed.

After three growing seasons, survival ranged from 94% to 92% at the northern and central plantings, where there were no obvious treatment differences, to below 70% at the southern site. At the southern site, treatment survival percentages ranged from a high of 97 for unclipped containerized stock to a low of 48 for one of the unclipped 1-0 stock treatments. The only discernable pattern in survival at this site was that, for 2-0 and 1-0 stock treatments, undercutting resulted in an average 19% survival advantage.

Germination of direct-seeded acorns was 90%, 63% and 20% for the northern, central, and southern sites, respectively. Pilferage of acorns by animals accounted for only a 3% loss at all three sites combined. Germination differences were most likely due to soil physical properties and weather.

Site means for total height were statistically different ($p<0.0001$) at 62, 86, and 134 cm for the southern, northern, and central plantings, respectively. There was a statistically significant site x treatment interaction, but 41% of this interaction is attributable to the uneven performance of just two treatments across sites. The direct-seeded and 2-1 unclipped treatments performed relatively better (compared to other treatments) in the shorter, southern plantation than in the central and northern plantations. With these exceptions, the treatment rankings indicated by the data below are generally representative of individual site results.

Considering all sites together, treatment differences in total height after three years in the field were highly significant ($p<0.0001$). Of all treatments, two-year-old containerized seedlings were the tallest at 151 cm (162 and 141 cm, unclipped and top-clipped, respectively). Of all remaining treatments, the 2-0 seedlings were tallest at 115 cm, and these were 62% taller than 1-0 seedlings. Transplanted seedlings (2-1 and 1-1) were smaller than non-transplanted 2-0 seedlings. Undercutting in nursery beds produced variable results: it

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improved the height of 2-0 seedlings by 10% (P=0.05) but reduced the height of 1-0 seedlings, though not significantly. Except for containerized stock, top-clipped seedlings were generally taller than unclipped seedlings, but none of the differences were statistically significant. Seedlings arising from from direct-seeded acorns were not significantly different in height from 1-0 planted seedlings.

In summary, transplanting in the nursery did not result in improved field performance after three years, and undercutting gave variable results. The containerized seedlings performed best overall but their growth advantage may have been more than offset by the added costs and efforts of production and planting. Among all other treatments, 2-0 bareroot seedlings (especially if undercut in the nursery) unquestionably produced the tallest seedlings and had good survival. In most comparisons, top-clipped seedlings performed slightly better than unclipped seedlings, and this treatment facilitates handling. Perhaps most surprisingly, direct-seeded plants were as tall as seedlings from 1-0 stock, suggesting the possibility of a considerable savings in the cost of artificial regeneration if acorn viability is good and predation is minimized.