Producing Blue Oak Seedlings: Comparing Mini-Plug Transplants to Standard Bareroot and Container Stock

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Abstract-Blue oak (*Quercus douglasii*) is one of several species of native California oaks that is reported to be regenerating poorly in portions of the state. Although blue oak has little commercial value other than for firewood, it provides vital habitat for numerous wildlife species and is highly valued for aesthetics. In the last decade there have been efforts to develop techniques to successfully regenerate this species artificially. Procedures for growing both bareroot and container seedlings have been evaluated in research trials and both stock types have been grown and outplanted operationally. While both bareroot and container plants have performed adequately in the field, we were interested in evaluating a relatively new stock type called a "miniplug transplant". These are seedlings that are grown for several months in relatively small, shallow containers , and then transplanted to bareroot nursery beds in the spring. While in the containers, seedling roots grow rapidly, but due to the shallow container depth, they repeatedly air prune themselves. As a result, a highly branched root system, with numerous growing tips, develops. When these mini-plugs are transplanted to a bareroot bed, they often develop a more fibrous root system and a more favorable shoot/root ratio than conventional stock types grown for the same length of time. As such, they may be better able to survive and grow in the hot, dry summers characteristic of California's blue oak woodlands. This study was undertaken to evaluate the mini-plug approach for growing blue oak seedlings, and compare the field performance of this stock type to 1+0 container seedlings and conventional 1+0 and 2+0 bareroot nursery stock.

All seedlings for this study were grown from acorns collected at the same location. The 2+0 and 1+0 bareroot seedlings were sown in late fall, 1989 and 1990, respectively. The container and mini-plug seedlings were sown in early December, 1990. The mini-plug seedlings were grown for five months in 1.5 inch x 1.5 inch x 3 inch plant bands on raised racks with open bottoms to promote air pruning of the roots. In early May, 1991, they were transplanted into standard bareroot nursery beds, where they were grown until the following winter. All four stock types were outplanted in January, 1992. At time of planting, 20 each of the 1+0 bareroots, 2+0 bareroots and mini-plugs were randomly selected for destructive morphological assessment. Each seedling was cut at the cotyledon scar and stem height and caliper just above the cut, were recorded. The shoots and roots were then placed in separate paper bags and dried for 48 hours at 70^{o}C. The shoot/root ratios were then calculated. The initial height and diameter of each field-planted seedling was also recorded. Each seedling was evaluated at the end of each subsequent growing season for survival, total height and basal diameter. This data was analyzed using analysis of variance for a split-plot, randomized block design.

The morphological data indicated that the mini-plug transplants developed much larger and more fibrous root systems than any of the other stock types. For the first three field growing seasons, the mini-plug transplants also grew considerably larger than either the 1+0 containers or 1+0 bareroot seedling stock types. However, the average heights and calipers of mini-plug transplants and 2+0 bareroots were very similar, and there were no significant differences between these stock types for either variable during any of the four years of the study. Survival of all stock types was high, averaging over 92% for the plot as a whole at the end of four years The only significant difference in survival occurred the first year, when the 1 +0 containers had significantly lower survival than the other three stock types. After the second year, only one seedling in the experiment died, indicating that once the plants survived the first two seasons, there was a high likelihood they would remain alive. During the

fourth year of the study, differences among the stock types lessened. Average caliper for all four stock types was similar, although the mini-plug transplants and 2+0 bareroots remained significantly taller than the 1+0 containers or 1+0 bareroots.

This study indicates that by sowing blue oak acorns in small containers (mini-plugs), and then transplanting them to bareroot nursery beds after several months, it is possible to produce significantly larger seedlings, with larger root systems, in the same amount of time required for standard container or bareroot stock types. Mini-plug transplants also maintained their size advantage over 1+0 containers and 1+0 bareroots in the field for the first three growing seasons. By the fourth field season, however, differences among stock types diminished and there were no significant differences in survival or caliper among any of the four stock types evaluated. However, miniplug transplants were still significantly taller, so there did appear to be some relatively long-lasting benefit from this method of production. However, if the overall trend of diminishing benefit over time continues, it appears that the initial advantage of mini-plug transplants will eventually be lost. Since they are considerably more costly to produce (at least with the current level of technology) than either standard container or bareroot seedling of the same age, mini-plug transplants do not, therefore, appear to be cost-effective for growing blue oaks at this time.

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