Artificially Regenerating Native Oaks in California

by Douglas D. McCreary
Natural Resources Specialist
University of California
Sierra Foothill Research
and Extension Center, USA

Since the turn of the century, there have been persistent reports that the natural regeneration of several species of native California oaks is inadequate to sustain their populations. The primary species of concern are blue oak (*Q. douglasii*), valley oak (*Q. lobata*) and Engelmann oak (*Q. engelmannii*). These are all deciduous white oaks, endemic to California, that grow primarily in the foothills or lower elevation valleys. Unlike many oaks in other parts of the United States, these species have little commercial value other than for firewood. As a result, there has been little economic incentive to study them. Interest in their ecology and management has sprung up in the last two decades. Fear has arisen that important aesthetic and wildlife values associated with these species will be depleted or lost if we don't understand the factors contributing to poor regeneration and take steps to enhance regeneration through artificial means. Unfortunately, until recently, few native oaks were produced in the state and relatively little research was directed towards growing vigorous, healthy stock, or to understanding factors which influence field performance. To help develop guidelines for successfully artificially regenerating native California oaks, research projects have been undertaken during the last ten years. Projects at the University of California's Sierra Foothill Research and Extension Center, 30 km northeast of Marysville, and at the California Department of Forestry and Fire Protection nurseries at Davis and Magalia have focused on developing practical, low-cost techniques for producing, planting and protecting oak seedlings. Hopefully this information will promote greater success in regeneration plantings and help ensure the long-term conservation of these important indigenous species.

contd. on pg. 70

Regenerating Native Oaks . . .

contd. from pg. 69

Acorn Projects

Several studies have examined acorn collection, handling, storage and planting, including the best time to collect blue oak acorns and the effect various pre-storage treatments have on germination. Results have indicated that acorns can be successfully collected over a fairly wide interval, extending from late August until late October. Acorns from these harvest dates had high germination, as long as they were not allowed to dry out before storage. However, the earlier the acorns were collected, the earlier they tended to germinate. Soaking acorns for a day prior to storage had little effect. Drying acorns, however, reduced both the rate and amount of germination. A 10 percent reduction in moisture content resulted in almost 40 percent less total germination, and all acorns that lost 25 percent or more of their moisture after harvest failed to germinate during the 10-week test interval.

Another project examined the effect of trimming acorn radicles on field growth and survival of blue oaks. For this study, a large group blue oak acorns were pregerminated by placing them in moist vermiculite at room temperature. They were then divided into treatments including acorns whose radicles were left intact, and acorns whose radicles were partially cut off. While radicle trimming tended to promote multi-branched root systems, it had no effect on field performance. Another study examined sowing date. In this project, the date acorns were outplanted greatly influenced seedling emergence, as well as survival and height growth. Sowing in the early fall (October 10 or November 10) resulted in earlier emergence, greater survival and increased height growth, compared to sowing in the late winter (March 10) for both blue and valley oaks. In the Mediterranean climate of California, where there is often little rainfall after April, early acorn sowing apparently gives seedlings a better chance to become established before soil moisture becomes limiting.

©Guy & Edith Sternberg

An ancient, picturesque specimen of Quercus douglasii *Hook and Arn. in Oak Creek Canyon, southeastern Kern County, California.*

Producing Oak Seedlings

Several methods of growing native California oak seedlings, including both bareroot and container production, have been evaluated.

This research has demonstrated that there are a variety of oak seedling stock types that can be successfully propagated and outplanted. The type of stock best suited for a particular planting will depend on a host of factors, including costs, seedling availability, and conditions at the planting site. One-year-old bareroot blue and valley oak seedlings have had high survival and vigorous growth after outplanting, as long as the roots were undercut early enough in the nursery to promote the development of a fibrous root system, and the seedlings were lifted and planted in the field by mid-March. Similarly, blue oak seedlings grown for one year in a wide range of container sizes have performed well in the field. While seedling size at outplanting was directly related to the size of the container they were grown in, by the end of the second field season, these differences had all but disappeared and seedlings from the container sizes tested grew about the same.

A study also compared the field performance of standard one-year-old blue oak container stock with that of seedlings grown for only 4 months and outplanted the spring after the acorns were collected. While the younger stock at outplanting was much smaller, after the first field season, survival and total height were significantly greater. This trend continued for the subsequent three years. Since 4-month old seedlings are far cheaper to produce, they may be a preferred stock type for future regeneration programs for this species.

Another study compared both standard container and bareroot nursery stock to a new stock type called mini-plugs, which are seedlings that are grown for several months in small, shallow containers and then transplanted to barefoot nursery beds in the spring. While in the containers, the oak's 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. The mini-plug transplants in this study grew larger initially and performed better in the field during the first three field-growing seasons than the other stock types. By the fourth year, however, there were no significant differences in survival or diameter among any of the stock types evaluated. The mini-plug transplants were also considerably more expensive to produce, so at present, we cannot recommend this stock type for commercial production of oaks.

Finally, several studies have compared the field performance of directly sown acorns to that of transplanted container seedlings. In general, the direct-seeded acorns have performed as well or better than transplanted seedlings. The one exception has been in field sites where acorn depredation was a serious problem because of high populations of rodents. In such instances it can be difficult to successfully establish oak seedlings from acorns without somewhat heroic efforts to protect the seeds in the ground from animal depredation. Without adequate protection, a high percentages of the planted acorns will be eaten before they can grow into seedlings.

Seedling Planting and Protection

Many areas targeted for artificial regeneration of native oaks in California are on hardwood rangelands where dense annual vegetation, compacted soils, and animal herbivory, can limit recruitment success. Controlling competing vegetation through scalping, spraying or mulching can greatly improve the survival and growth of outplanted seedlings. In a study initiated several years ago, various levels of weed control (diameter of weed-free zones around seedlings) were compared. Results indicated that seedling height and diameter growth were strongly related to the diameter of the weed-free areas, up to a diameter of 1.8 m. In this same trial, we also compared the field performance of seedlings protected with treeshelters (double-walled plastic tubes) to those covered with aluminum screens. During

contd. on pg. 72

Regenerating Native Oaks . . .

contd. from pg. 71

the first season, seedlings in treeshelters had higher survival, more flushes, grew taller, and were more resistant to attack from small sucking insects, which were able to pass through the screens. By the second year, the seedlings in the tubes also had significantly greater diameter and diameter increment. Subsequent trials with treeshelters have also shown that they greatly stimulate height growth, even of seedlings several years old that have been stunted due to harsh field conditions. Treeshelters have also successfully protected seedlings from a wide range of animals, including deer, rabbits, cattle, voles and grasshoppers, and have had fewer maintenance problems over the long term.

Studies have also shown that augering holes prior to planting can improve field performance — especially on compacted sites — by allowing seedling roots to more easily penetrate downward and obtain soil moisture unavailable at shallower rooting depths. Fertilizing seedlings with slow release fertilizer tablets at the time of planting has also resulted in large short-term increases in both diameter and height growth in field trials.

Conclusions

These studies suggest that native California oaks can be successfully propagated and outplanted if sufficient attention is paid to maintaining the physiological quality of the acorns and seedlings, if they are planted properly, and if the plants are protected and maintained in the field. The survival and growth of oak seedlings in natural settings is often limited by harsh environmental conditions. By providing a more favorable environment through weed control, augering, fertilization and protection with treeshelters, rapid juvenile growth after outplanting can be stimulated. This should allow seedlings to quickly grow above the level where they are particularly vulnerable to browsing pressures, and help ensure the success of regeneration plantings. However, it is important to note that all of this research has been underway a relatively short time — at least compared to the life span of oak trees — so any conclusions regarding the long-term effectiveness of these treatments must be made cautiously. Also, while we have had considerable success in research plots under controlled conditions, we have also found that it is much more difficult "in the real world". Even at the Research Center we have had much greater difficulty getting oaks established in larger plantings where we have had less control of the environment.

Finally, to date, there have still been few large scale oak restoration plantings in the state due, primarily, to the high costs of maintenance and protection. The main groups actively planting oaks are developers, as part of mitigation for tree removal, and The Nature Conservancy, as part of riparian restoration projects along the Cosumnes and Sacramento Rivers. It is hoped that as awareness of the critical ecological role that oaks play in the natural environment of California increases, and the costs of artificial regeneration decline, more areas will be artificially regenerated with native California oaks.