

2001-2002 Progress Report to the Elvenia J. Slosson Endowment

**Stock Block Establishment and Manipulation to Enhance Rootability of  
Superior Forms of Oaks for Western Gardens**

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## **Introduction**

The University of California, Davis Arboretum has a valuable and widely recognized collection of *Quercus* species native to the western United States and Mexico. This collection has been nominated to the North American Plant Collections Consortium as the western repository for oaks. Within the collection are individual trees with characteristics such as small size, columnar form, and heat and drought tolerance that make them desirable for use as garden and urban landscape plants in California and other areas of the western United States. Because of the genetic variability inherent in *Quercus* species, these desirable individuals cannot be propagated from seed, because only a small percentage of the progeny would have the desirable characteristics of the selected mother plant. The only commercially practical means of capturing these desirable characteristics is to propagate the selected individuals by cuttings. However, these selected individuals are now 30 or more years old and are, therefore, difficult to root by stem cuttings (Olson, 1969; Morgan et al., 1980).

In research with other difficult to root species it has been shown that manipulation of stock plants from which cuttings are taken is the most successful approach to increasing the rooting ability of cuttings (Maynard and Bassuk, 1987; Davis, 1988). Such research has shown that two of the most successful and generalized methods of stock plant manipulation for enhancing rooting of cuttings are:

- A. Severe pruning to soil level (coppicing) of the stock plants.
- B. Stooling or etiolation (base of shoots grown in the absence of light) of shoots on coppiced stock plants.

Such approaches are used successfully in commercial production of apple, cherry and avocado rootstocks and lilac cultivars.

The goal of this project is to develop methods for the cutting propagation of selected, desirable individuals of *Quercus* species so that they can be introduced into the nursery trade for use in California gardens and urban landscapes. This goal will be pursued through the following objectives:

- A. Develop procedures for establishment and maintenance of coppiced stock plants to serve as a source of cuttings with increased rooting ability.
- B. Develop commercially acceptable methods of rooting cuttings taken from the optimally manipulated stock plants

The methods developed in this project could also be applied to the clonal propagation of individual oak trees that show resistance to *Phytophthora ramorum* – the causal agent of Sudden Oak Death disease that is now spreading inland from the northern California coast.

## **Methods and Results**

The project team chose 9 species and hybrids of oaks to study (Table 1). Each species had desirable landscape qualities, which included: moderate size and attractive forms for home gardens, drought-tolerance, and general beauty. *Quercus agrifolia* was also

included because of interest in using our methods for study of resistance to Sudden Oak Death, which is threatening this species. The objective of the first phase of the project was to establish clonal stock blocks from the best individual of each selected species.

Table 1. Selected oaks from the UCD Arboretum for home gardens

| <b>Species</b>                              | <b>Common Name</b> |
|---|--------------------|
| <i>Quercus agrifolia</i>                    | coast live oak     |
| <i>Q. cerris</i>                            | Turkey oak         |
| <i>Q. chrysolepis</i>                       | canyon live oak    |
| <i>Q. coccifera</i> ssp. <i>calliprinos</i> | Levantine live oak |
| <i>Q. crassipes</i>                         | piptza             |
| <i>Q. kelloggii</i> x <i>Q. wislizenii</i>  | oracle oak         |
| <i>Q. mexicana</i>                          | cozahuatl          |
| <i>Q. robur</i> x <i>Q. mongolica</i>       | hybrid oak         |
| <i>Q. tomentella</i>                        | island live oak    |

#### Cutting Propagation

Experiments to produce stock plants and to assess the rootability of cuttings from mature oaks in the Shields Oak Grove of the UCD Arboretum began in early April 2001.

Terminal cuttings (8 to 12 nodes in length) were taken from those oaks chosen for study whose new growth had become hard enough for good survival on the mist bench. These included *Quercus cerris*, *Q. agrifolia*, *Q. kelloggii* x *Q. wislizenii*, *Q. coccifera* ssp. *calliprinos*, and *Q. robur* x *Q. mongolica* (Figure 1). These cuttings were trimmed, surface-sterilized, and then dipped in either a 10,000 ppm or 5,000 ppm indole-butyric acid (IBA) in 50% ethanol solution. The rooting environment included bottom heat at 80° F with intermittent mist. The rooting media used was a mix of perlite and vermiculite (1:1), and shallow 6" x 10" trays were used as rooting containers. Each species had 15-20 cuttings per treatment. Cuttings were checked weekly for rooting, as well as to remove dropped leaves or degraded cuttings.

In May, another round of cuttings was taken from the same 5 individual oaks as above. These included both terminal cuttings and trunk sprouts from 1 to 3 meters above the soil surface. Trunk sprouts were included because of their presumed juvenility, known to enhance rootability. The cuttings were treated with either 5,000 or 10,000 ppm IBA as before, and placed on the mist bench. Each species had 15-20 cuttings per treatment.

By early July, all of the oaks to be studied had partially-hardened spring growth suitable for cuttings. Terminal cuttings and trunk sprouts (when available) were collected from *Quercus crassipes*, *Q. mexicana*, *Q. tomentella*, and *Q. chrysolepis*, as well as from the 5 oaks from above. *Q. chrysolepis* was added to the study list because of availability of stump sprouts (Figure 1) with presumed juvenility, known to enhance rootability. Cuttings from a mature *Q. chrysolepis* adjacent to the stump sprouts were taken as a control for comparison. For this round, hormone concentrations were lowered because some cuttings taken in previous months showed basal tissue damage, potentially from excessive hormone levels. All cuttings in this group were treated with either 2,500 or

5,000 ppm IBA and placed on the mist bench. Each species had 15-20 cuttings per treatment.

Figure 1. Stump sprouts of *Quercus chrysolepis* in Shields Grove



Another round of trunk sprouts were taken from the two rare Mexican oak species, *Q. mexicana* and *Q. crassipes*, in September and treated with either 2,500 or 5,000 ppm IBA. The relative height of the sprouts on the mature trees was noted to test for differences in rootability.

As expected from the literature, tip cuttings from mature oaks proved difficult to root. None of the cuttings taken in April produced roots at either hormone concentration, although a few cuttings of *Q. cerris* and *Q. agrifolia* produced callus tissue at the base of the cuttings. The cuttings taken in May performed slightly better. One of the *Q. agrifolia* cuttings treated with 10,000 ppm IBA produced enough roots to pot up, while the rest produced more callus than those taken in April. The rooting was similarly low for most of the cuttings taken in July, with one exception - the stump sprouts of *Q. chrysolepis* rooted in significant numbers (Figures 2 and 3). Note that tip cuttings taken from adjacent, mature individuals of *Q. chrysolepis* (control) failed to root. We believe that the juvenile nature of these stump sprouts was the reason for higher rooting, and we plan to exploit this characteristic to produce clones from the other mature trees. Two cuttings of *Q. agrifolia* treated with lower concentrations of IBA (2500 ppm) also rooted well enough to pot up (Figure 4). None of the trunk sprouts from the Mexican oaks successfully rooted.

Figure 2. Relative Rooting of Oak Cuttings

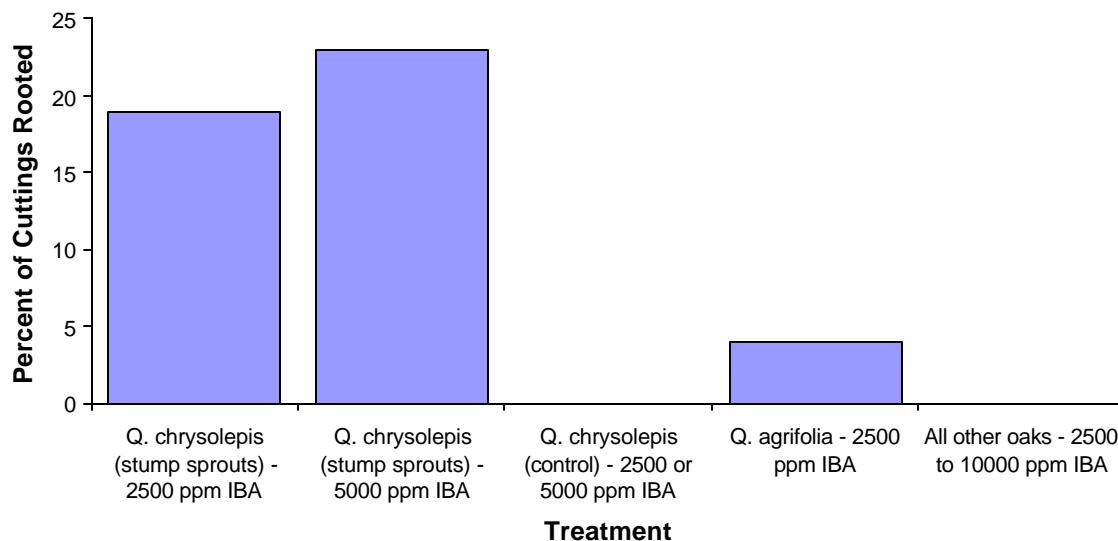


Figure 3. A few of the *Quercus chrysolepis* clones



Figure 4. *Quercus agrifolia* clones



### BAP, Promalin and Severe Pruning Treatments

Select oaks in the Shields Grove were chosen for treatments to encourage juvenile growth, which has higher rootability as described above. Crowded individuals of *Q. crassipes*, *Q. mexicana*, and *Q. coccifera* ssp. *calliprinos* were pruned severely to encourage the growth of juvenile shoots, as in the *Q. chrysolepis* stump sprouts which rooted significantly in earlier experiments. The *Q. coccifera* ssp. *calliprinos* was severely pruned in January 2002, while the two Mexican oaks were severely pruned in March 2002.

In March, 2002, each of these stumps was divided evenly into 3 treatment sections and sprayed with either Promalin (a commercial mixture of BAP and GA 4/7) at 450 ppm or 900 ppm (diluted with DI water) or water (control), to encourage sprouting (the *Q. coccifera* ssp. *calliprinos*, which was pruned earlier, was already showing basal sprouting). Unpruned trees of the Mexican oak species were also basally sprayed with Promalin to see if sprouting would occur without having to severely prune the trees. Unpruned trees of *Q. agrifolia*, *Q. chrysolepis*, and *Q. tomentella* were also treated with Promalin to encourage basal sprouting. Stumps were sprayed to wet and examined for basal sprouting once a week. In late May, the Promalin solution was diluted with 50 % alcohol instead of water in hopes of getting better penetration through the tree bark. However, this treatment caused tissue burn, probably from alcohol or Promalin phytotoxicity. In July 2002, all of the severely pruned trees showed basal sprouting. The Promalin treatments were insignificant for encouraging basal sprouting in the Mexican oak species, with the only vigorous growth coming from the control portion of the stump (Figure 5, 6).

Figure 5. Basal sprouting from *Q. crassipes*.



Figure 6. Basal sprouting from *Q. mexicana*.



In early June, 2002, cuttings were taken from the stump sprouts of *Q. coccifera* ssp. *calliprinos* and from an adjacent mature tree of the same species. The cuttings were sorted by hardness. The softest tip cuttings were taken to the fog chamber at the Department of Environmental Horticulture, while the rest were treated and put on mist benches in the Arboretum nursery (Figure 7). Cuttings were treated with IBA at either

2500 or 5000 ppm diluted only with water, as there was concern that the ethanol mixture used in earlier trials was burning the stem tissue. Rooting media was a 1:1 mixture of perlite and vermiculite as before and the same rooting containers were used. The cuttings are still unrooted on the mist bench as of the writing of this report.

Figure 7. Oak cuttings on Arboretum mist bench.



### Root Sprouts

Large numbers of root sprouts were observed on a mature *Quercus tomentella* in the Arboretum collection, indicating another possible source of juvenile shoots. To encourage more root sprouting, large roots were excavated on this same tree and another *Q. tomentella* in the Arboretum that has a superior form. Promalin spray was applied to the exposed roots as in the stumps above. After a month of this treatment produced no effect, roots were wounded with a clean knife, and a viscous mixture of lanolin (1 oz.) and BAP (3 ml at 5mg/ml) was applied to the wound and covered with parafilm. This cream was applied again two weeks later and re-covered with parafilm in hopes of causing sprouting at the wound.

No new sprouting at the treated wounds was observed but cuttings were taken from the existing root sprouts in early June, 2002. As with the *Q. coccifera* ssp. *calliprinos* stump sprouts, these root sprouts were dipped in 2500 or 5000 ppm aqueous solution of IBA. Cuttings from mature branches of the same tree were also treated with hormone at the above concentrations to serve as the control. Rooting media was a 1:1 mixture of perlite and vermiculite as before and the same rooting containers were used. These cuttings are still unrooted on the mist bench as of the writing of this report.

### Chip-budding

Experiments with budding were conducted due to the challenges of rooting mature oaks from cuttings. Literature suggests that oak clones can be produced by grafting and

budding, but there can be compatibility problems between the red oak and white oak subgenera, and even between ecotypes of the same oak species (Coggeshall, 1996). For this reason, it was important that the rootstocks be as closely related to the scion buds as possible. Seedlings of *Q. agrifolia* were obtained as rootstocks for the selected *Q. agrifolia* individual in the Shields Grove. *Q. chrysolepis* seedlings were used as the rootstock for budding the closely related *Q. tomentella* (both of these species are members of the Intermediate Oak subgenus).

Scion wood from the select individuals of *Q. agrifolia* and *Q. tomentella* was collected in August, 2001. The scions were chip budded onto the rootstocks due to the small diameters of the seedling rootstock stems. Upon examination eight weeks later, none of the buds had fused to the rootstocks. We believe that the size of the rootstocks were too small for successful grafting. The rootstocks have been potted up and will be grown on for another attempt in August 2002, at which time they will be larger, and potentially better for grafting or chip budding.

### **Conclusions**

The first phase of this project provided many insights and will guide our strategy in subsequent experiments over the next year. These will focus on encouraging and rooting juvenile sprouts from the basal areas of selected mature trees to establish a stock block for each species. Our success with the rooting of stump sprouts supports our hypothesis that juvenile cuttings taken from hedged stock plants is the best method to clonally propagate desired oaks in large numbers. The challenge now is to produce larger numbers of plants for the stock blocks, which can then be further manipulated to develop protocols for reliably rooting superior oaks in large numbers. We thank the Slosson Endowment for continued support of this research.

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