Clonal Oak Propogation: Almost a Reality

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Rarely has there been a tree so worthy of vegetative propagation, yet one so stubbornly difficult to achieve it with, as the oak. In their large native ranges, oaks display considerable variability that is of great interest to the horticulturist and nursery professional. Variation in growth rate, leaf color, branching habit, stature; tolerance of droughty, wet, high and low PH soils; and ease of transplanting are just some of the characteristics noted by oak enthusiasts. To whet the appetite further, oaks are notoriously interfertile within their black and white oak subgenera, giving rise to numerous purported hybrids that exhibit still greater variation in growth habit and environmental tolerance. All this has not gone unnoticed by propagators who have tried many techniques over the years to produce superior clonal selections.

For most other shade trees, the various arts of budding and grafting have served well to produce desirable, clonal scions on seedling rootstocks. This has proven more difficult with oaks, with some success coming in the white oak group, most notably with *Quercus robur* variants.

Stool-bed layering

We have chosen to investigate the potential of clonally propagating oaks on their own roots, from cuttings or stool beds, because much of the desirable part of the plant resides

underground. We are not the first to try this. There are numerous published reports on oak vegetative propagation; the most successful share the conviction that stock-plant juvenility is the key to success. It is not difficult to propagate cuttings taken from one- or even two-year old seedlings; however, with the odd exception, rooting percentages generally fall through the floor after that. Having gone that route, we changed course in order to bring to bear another powerful tool in inducing juvenility - that of stool-bed layering.

With this ancient technique, seedlings are allowed to grow for several years, perhaps three to five, and then prior to budbreak in spring, they are cut back to ground level, leaving an inch or so of stem attached to the root system. This is the same technique used in creating a coppice where many buds form on the cutback stub, giving rise to numerous vigorous shoots on the mother plant. In the traditional stool-bed method, as these shoots grow, soil is gradually mounded up around the shoots covering their bases about a third to half way up the stems. The mounds are kept moist through the summer and by the fall many of the shoots will have rooted into the soil mounds. When dormant, these rooted shoots are then undercut and planted out, leaving a newly cut-back mother plant to repeat the process the next year. This traditional method has proved occasionally successful with oaks, leading us to modify the procedure in the following ways.

Our modified approach

Stock plants are planted into three- to five-gallon containers. If we start with an older (5-year-old) plant we put it directly into the larger container. Anecdotally, we have noticed that young stool beds may produce some rooted shoots; however, as the stool-bed stock plants age in the field, rooting percentages fall off. We haven't seen this same effect with stool beds grown in containers. We hypothesize that root restriction is helping to increase rooting in the stool-bed shoots. This is plausible because we know that the production of cytokinins, a growth hormone, is reduced when root growth is restricted. It is well documented that cytokinins inhibit adventitious root growth on stems. This theory will be tested in the coming year.

After our dormant stock plants are potted up just prior to budbreak, we cut them back just as we would do to a field-grown plant. We watch to see the buds form on the cutback stem and here we begin manipulating the environment still more. Just as the buds begin to swell we place the stock plants under black-cloth tents in a greenhouse to promote etiolation, allowing the buds to grow out in near darkness (about 98 percent light exclusion). It is important to prevent the shaded plants from "cooking" under the black cloth, so white plastic is draped over the black cloth and fans placed inside the tents which serve to keep the

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air temperature only a few degrees warmer than the temperature outside the tents. The shoots grow quickly and look characteristically etiolated (no chlorophyll, long internodes, underdeveloped leaves). When the shoots get to be 7-15 inches long, we paint their bases with 8000 indole butyric acid (IBA) dissolved in 20 percent aqueous DMSO solution, and are careful not to get the solution onto the growing tips. We place a bottomless pot, which is slightly smaller than the stockplant container, over the shoots allowing it to rest on the soil surface of the potted stock plant. After the IBA dries, a light soilless mix of peat and perlite is added to the shoots contained within this "chimney" pot. Moist soil is added about half way up the stems, leaving the growing points exposed. The black cloth is gradually taken away over the period of one week to allow for acclimation of the etiolated shoots to the light. The shoots green up and begin to look more like normal oaks very quickly. At this point our job is to keep the soil moist and replenish it in the chimney should the shoots grow much more.

This year we have begun to check on when rooting begins by removing the chimneys and letting the soil fall away. To our surprise we have seen significant root growth as early as two weeks after hormone treatment.

Experimental variables

We are in the midst of a very extensive experiment using the following oak species: *Quercus bicolor*, *Q. macrocarpa*, *Q. palustris*, *Q. accutissima*, *Q. robur*, *Q. muhlenbergii*, *Q. rubra*, *Q. alba* and *Q. coccinea*. Some of the variations to the general method I described above include the use of different light sources with and without previous etiolation. One of the theories of why etiolation is so powerful is that it prevents red light from changing physiological factors in the plant which inhibit rooting through its action on a pigment called phytochrome. The action of red light or far-red light changes the phytochrome pigment in ways that trigger different physiological processes. When red light (present in sunlight) falls onto the plant, many of what we think of as normal growth responses take place. In the dark or in far-red light, the phytochrome pigment is changed to produce other growth responses - similar to what we see in etiolated plants (long internodes, lighter colored leaves). We have just begun investigating whether far-red light can substitute for the etiolation effect or add to it. Some of last year's preliminary results are intriguing. All shoots

in these trials received 8000 IBA. The only other variables were light quality and whether shoots were exposed to the etiolation treatment beforehand.

As can be seen in the chart below, growing the stool-bed shoots in white light alone is very inhibiting to rooting. The results with *Q. palustris* are intriguing in that it appeared that far-red light, even in the absence of prior etiolation, helped to stimulate rooting. I am confident that this year's more extensive experiments where we are repeating all the treatment differences with many species and with greater numbers of plants will reveal whether we are solidly on the right track. Undoubtedly, it will also raise new questions as well. I hope to present the results of the experiments that are just underway now at the Third International Oak Conference in North Carolina in 2000. See you there!

Table 1. Rooting of stool sprouts by oak species for different treatments.

Species	Treatments	% Rooted Stool Sprouts
Q. accutissima	White light only	*4*
	Etiolation plus far-red	*78*
Q. palustris	White light only	*5*
	White light plus far-red	*42*
	Etiolation	*25*
	Etiolation plus far-red	*46*
Q. bicolor	White light only	*0*
	Etiolation	*52*
Q. macrocarpa	White light only	*0*
	Etiolation	*35*
Q. alba	White light only	*0*
	Etiolation plus far-red	*40*
Q. rubra	White light only	*0*
	Etiolation	*43*