Growing Fibrous-Rooted Oak Liners: A Methodical Approach can Yield Striking Results

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American oaks are distributed across every region of the country. Their bold structure helps define our forests and urban landscapes. Who can forget the sight of southern live oaks draped with spanish moss, or immense midwest specimens of bur oak with their timeless majesty? Their drought tolerance makes them a reliable source of food and shelter for wildlife. The durability and strength of oak lumber cut from vast eastern forests over the past 200 years helped build the strength of our nation. In his memoirs, John Charles Fremont wrote of seeing an oak woodland in northern California in March, 1844: "From the upland we descended into broad groves on the river, consisting of the evergreen, and a new species of white-oak...Among these was no brushwood; and the grassy surface gave to it the appearance of parks in an old settled country. We made an acorn meal at noon, and hurried on; the valley being gay with flowers and some of the banks being absolutely golden with California poppy...Here the grass was smooth and green, and the groves very open; the large old oaks throwing a broad shade among sunny spots."

Today, we are protective of the few remnants of these original oak forests of our heritage.

As nursery managers, we are just beginning to realize the market potential of this familiar genus of trees. In my recent informal survey of a half-dozen Oregon shade-tree growers, respondents indicated that oaks make up a consistent 10% to 12% of sales. Each grower intended to expand his offerings in this group of plants, prompted by inquiries from enthusiastic sales staff: "When are you going to get us more of these oaks?" There is also a solid trend toward greater selection that has increased demand for species such as chinkapin, chestnut, shingle, willow, and black oaks. Whether driven by increased awareness of their merits or the trend toward "natives" in the trade, it seems that oaks are increasingly popular.

Yet, there is a less sanguine aspect to the oak story. To many nursery managers, oaks remain a bit of an enigma. Personally, we appreciate them as landscape trees; we'd like to grow more of them. But how many of us might call to mind an oak seedling when the terms "carrot-rooted" or "dog-legged" are mentioned? No wonder we are uncertain how we feel about oaks. We've accepted higher-than-average costs and losses due to mediocre lining-out stock. It's hard to appreciate a group of trees that may take an extra year or two to finish and are still a source of adjustments later. Until recent years, oak liners have been propagated almost exclusively in field seedbeds. Nursery managers have had to accept oak liners that were of inconsistent root quality. "Oaks are tough plants", we have rationalized. "They'll make it. We'll root-prune them and cut the tops off so they throw up a good leader."

Why have we lowered our expectations when we purchase oak liners?

As nursery professionals, we need to re-examine traditionalnotions and accepted practices of oak propagation. Challenged to offer greater numbers and range in oak nursery stock, we must elevate our standards and grow liners that will flourish. We

cannot continue to offer plants we expect merely to survive. Would any of us try a restaurant that guaranteed its meals to be merely edible?

Recent advances in plug culture give us new opportunity to dramatically improve the root character of many tap-rooted nursery plants. Following is a brief summary of the propagation program we have developed over the past 7 to 8 years.

It is important to recall what happens when an acorn begins to germinate. Perhaps you have seen the nuts sprouting on the ground under white oaks in the autumn, or under the litter of red oaks in the spring. In either case, the root emerges from the seed well in advance of the shoot. So the germinating seed in the forest is already well-anchored into the soil several weeks before the shoot emerges to the light of day. Before the new shoot develops its first set of true leaves, the seedling is nourished by the seed leaves, or cotyledons. These cotyledons contain rich reserves of carbohydrate, protein, and oil. The large cotyledons provide the necessary energy and nutrients for oak seedlings to grow such a dominant primary root before it develops any shoot or true leaves.

Given the tendency for oak seedlings to develop taproots, it is essential to develop a well-thought-out plan for growing 1-year oak seedlings with fibrous roots.

The first, most important element of our strategy is to prune the primary root while there is no top. It is impossible to stress a seedling shoot which has not yet developed. By root-pruning the seedling before it has grown a shoot, we can avoid pruning it at any time again during the critical first year of its development. We air-prune the seedling's primary root by germinating the acorn in February in a "plug-tray" on the bench in a greenhouse. Growing Systems Inc. 73-cell trays work well for us: the conical individual cells measure only 2-1/2 in. deep by 1-1/2 in. across the top. Considering that some acorns are relatively large, you can imagine that we need to be creative when planting a big acorn like that of bur oak or chestnut oak. It is not necessary to bury the seeds if the flats are kept moist until the root grows into the soil mix.

Why do we choose such a small plug? Because it forces the root immediately down - there is little lateral room for the root to develop a "dog-leg". The shallow depth also insures that this young plant will be air-pruned very close to the soil surface. So its new, cultured root system will originate only a couple of inches below the crown. To achieve this air-pruning of taproots, it is critical that the flats not be left on the ground. An anchored flat is the result if flats are neglected and roots are allowed to grow out the bottom of the plugs into the ground.

It is possible to keep the seedling in this small plug for several months into the spring and early summer if prudent watering is practiced. The biggest risk of holding plugs for an extended time is that the vigorous liners may dry out from uneven hand watering or develop root disease from over watering. We find that irrigation booms are indispensable for even watering. A conservative water management program insures freedom from root diseases.

A cautionary note: merely pinching the primary root tip once is ineffective to induce the development of a fibrous root system in oak seedlings. The trimmed root usually forms a single new taproot at the point where the root was pinched. And it may become more crooked than a root left unpinched. So what is a grower to do?

We have found that a second critical step in growing 1-year oaks for maximum fibrous root development is to leave the seedlings in their plugs on the bench for at least 6 to 8 weeks after germination. During this time, we deny the air-pruned

taproot any opportunity to throw out a single new taproot. It responds by forming a substantial mass of callus that develops into new meristem tissue, forming numerous new small root-tips, or growing points. So, left in the plug for a few months, the young seedling develops the potential to grow many small fibrous roots using the same energy and vigor that it would normally have expended to develop a single taproot. Further, roots above the callus expand, filling the soil mix in the tiny plug. For handling purposes, the individual plugs can be removed without a frustrating loss of the soil mix.

Once a crop of seedlings is root-pruned and callused, the young liners can be shifted into larger pots or transplanted to beds outdoors. We find a ready market for 3/16-in. and 1/4-in. caliper transplants, so the great majority of our material is planted out into raised transplant beds of river-bottom sand in May and June.

It is useful to once again consider the natural scheme of things in the forest. We have all observed perfectly healthy old oaks and other trees growing in shallow soils or on rocky hillsides, green as grass in the worst of droughts. They successfully reproduced their kind and evolved in these conditions for eons before we ever came on the scene to consider how to propagate them with all of our fertilizer and irrigation technology and college degrees. Almost all plants survive in nature by forming symbiotic relationships with soil microorganisms. We can benefit by observing these soil organisms and applying them in nursery practice.

So the final key ingredient in our strategy to grow the best transplants possible is to inoculate our outdoor beds with spores of a mycorrhizal fungus that grows in association with oaks. After the first autumn rains, we simply collect the mushrooms from the ground under mature oak trees. Alternatively, we may collect them from established transplant beds in the nursery early in October. Although it's true that oaks can be overtaken by pathogenic fungi, we have never collected mushrooms except from under obviously healthy trees, so disease has never been a concern.

We homogenize the collected mushrooms with water in an old blender and mix the resulting slurry with about 20× its volume of sawdust. This inoculum is held in a woven poly sack for 6 months outdoors in a shaded spot. At transplanting, we sprinkle the sawdust inoculum lightly on raised transplant beds immediately before they are planted. Our observation is that transplants cultured for fibrous roots as described develop mycorrhizal roots quickly during the first growing season. We note the mantle of creamy-colored fungus mycelium on the feeder roots when we inventory in August, and at harvest. Inoculating the beds is especially beneficial if a grower has fumigated the soil being planted.

By using the naturally occurring fungus from under the trees which lends these oaks their durability and drought tolerance, we form a simple but complete propagation strategy. Great control is achieved over the germination process in the greenhouse while the seedlings are feeding off the stored energy and nutrients in the seed. But the wide-open spaces, full sunlight, and natural moisture buffer of the open field, coupled with the symbiotic mycorrhizal fungus, combine to yield a repeatable system for producing high-quality oak liners.

The benefits of these relatively simple propagation practices are enormous in terms of plant quality and profitability for ourselves and our customers.

We get much better use of valuable seeds in greenhouse propagation. The crows do not bother our germinating acorns under protective greenhouse cover. Neither

frost, heavy spring rains, nor weeds are a problem. Seedlings thrive in the warm greenhouse environment, effectively extending our growing season.

Transplanting is accomplished after the soil is warm in May and June when fields are easily worked, not wet. Availability of phosphorous is much better in warm soil due to greater microbial activity. The young transplants take off immediately.

We gain the capability to manage a crop for certain desirable caliper grades, based upon the controlled spacing of transplants in the row.

We find we can use fewer sprays for powdery mildew in susceptible white oaks when there is better air circulation around well-spaced transplants.

At inventory time, we easily calculate availability based upon a uniform stand of transplants.

During grading, there are fewer grades to sort compared with seedling-grown stock. Culls are few.

When customers open the box or take delivery, they comment "Wow, these oaks have some amazing roots!"

Garden center operators can re-pot these liners in late winter and early spring and sell them within the same spring. This means fewer plants to carry over at unreasonable expense through a hot summer season.

For customers who re-plant into field rows, the stand is uniform and transplants grow well from terminal buds in the spring. No labor is required to cut off half the taproot and most of the top so the liner can be planted with the expectation that it merely "survive" for a year while it recovers from abuse and major surgery. At least a year is shaved from the production cycle.

The beauty of this system lies in its fundamental simplicity. The focus from the beginning is upon development of maximum fibrous roots within one growing season, without any stress on the plant from root pruning. A well-grown, 1-year transplant is hard to beat in terms of plant value, considering delivered cost. It is like a loaded weapon: lots of power in a small package if it is handled properly.

Customers may be fooled or snowed once, but solid business is repeat business. Value in root systems must be the focus of that effort.