Propogation of Seedling Oaks: Root Purning by Air, Chemical and Mechanical Methods

by Kenneth Menzer, ABACUS
Auburn, California
USA

Many of the oak trees that I have examined recently that were planted from bare-root and/or containerized seedlings have root-health problems. The "root" of this problem seems to be the initial propagation methods that often ignore the seedlings' taproot. There are 3 methods of planting acorns and dealing with the oak's taproot via pruning. They are: 1) *Air Pruning*, generally preferred for small quantities of seedlings or difficult-to-transplant species; 2) *Chemical Pruning*, which is best for larger numbers of seedlings and oaks that can be bare-rooted prior to transplanting; and 3) *Mechanical Pruning*, best suited for the mass production of easily transplantable oaks, usually by large commercial growers. Proper treatment of acorns as they are propagated into seedlings will allow for highly improved root systems and superior oaks to be transplanted to containers, to be field grown for balled and burlapped trees, or to be directly planted as small oak seedlings.

My occupation is unusual in that I have three different divisions in my **"ABACUS"** tree business: 1) consulting arborist, 2) wholesale tree nursery, and 3) landscape design and orchestration. For the consulting part, I check and analyze stressed, dead, and dying trees to discover what is causing the health or structural problems. Trees may be stressed to the point of demise from natural or manmade events. Sometimes the manmade sequence of events (i.e.: over- or under-watering, herbicide applications, construction damage, etc.) may weaken the tree to the point that natural diseases or insects may easily invade it. One of the more common problems is the root system and noticeable overlapping surface roots. Further underground investigation

usually finds circling, twisted and damaged roots, not a normal healthy radiating fan shaped root system.

As a wholesale nurseryman of small-containerized trees, I am constantly looking for newer and better quality methods for propagating cuttings and seedlings. I am also interested in improving the transplanting techniques from the field- or bed-grown trees into the shippable / saleable containers. So I want higher survival rates (especially of the difficult to grow trees), faster growth rates, and improved overall tree quality for a better return on my invested time and money. I had been purchasing seedling liner stock to plant into pots, but their roots were already a kinked, knotted and circling mess before they were ever placed into a pot. It seemed impossible to purchase oak seedlings with a quality root system. I had to start growing seedlings for myself with a different system that would really provide change of the initial root patterns, to avoid failure long after the initial tree sale.

©Guy & Edith Sternberg

Quercus coccinea, *notoriously difficult to transplant, responds well to undercutting in the nursery bed.*

contd. on pg. 72

Propogation of Seedling Oaks . . .

contd. from pg. 71

My tree profession as a landscape design professional requires me to be a kind of tree obstetrician and coroner, working with trees from birth to death. This gives me a different perspective of some "man caused" tree problems from the very start, as almost all of the planted trees come from wholesale nurseries. There are definite problems with transplanted oaks because of their infamous taproot. Before the first cotyledons appear, the radical (embryonic root that will become the taproot) can already be many feet into the ground. The oaks that I have analyzed with the greatest root problems are those that were transplanted at some point in their lives. Most of these trees were started as seedlings and then were transplanted into larger containers. These little trees have an extremely deep taproot at a young age, and are almost impossible to transplant unless pre-planning is utilized to develop a compact and well-branched "container-sized" root system. Acorns planted directly into containers will grow circling (also called girdling) root systems, which can cause the early demise of the tree.

The major considerations in choosing one of the three pruning methods described above when producing seedlings are the species that are being grown, the production capacity of your nursery, and the machinery that is available to you.

Air Root Pruning

While there are different ways of utilizing this method, the system I use has worked well. I make up a movable size frame, either 3' x 6' (.914 m x 1.829 m) or 4' x 8'(1.219 m x 2.438m), that is further divided into 4" x 4" (10.16 cm x 10.16 cm) grids of steel mesh. On the bottom of the frame, a ¼" x ¼" (1.9 cm x 1.9 cm) aluminum mesh is placed to retain the planting soil, but does not restrict root growth. The frame is placed on concrete blocks to hold it off of the ground and to allow for airflow. Into the 4" x 4" grids are placed rolls of the "waste" plastic sheets of post-recycled x-ray film that have had the silver removed and are 12" (30.48 cm) tall. The 4"∅ x 12" cylinders are filled with 10" (25.4 cm) of soil. An acorn is placed in each of the planting tubes and watered. After germinating and growing to the bottom of the container, the radical grows through the ¼" screen and is exposed to the air where the tissue of the root cap desiccates and dies. However, there are enough hair roots to sustain the root with moisture and nutrients, and then other apical meristem tissues start to grow along the roots epidermis. This is the important start of branching with the least amount of loss or damage to the new root system. The recycled x-ray film is clear, or in some cases a light blue, so light penetrates the film and also discourages roots near the outside edges of this bottomless germination "pot". The depth of 10" is perfect for subsequent transplanting into the #5 pots (also mistakenly called 5 gallon pots, as they only hold 3.5 gallons or 20.82 litres of soil).

Certain oaks, like cork oak (*Q. suber*) and canyon live oak (*Q. chrysolpis*) have high transplant mortality rates if they are grown as bare-root stock. If they are transplanted with their x-ray "pot", however, and the soil has been placed around it, the plastic sleeve easily pulls out, with very little root disturbance.

The down side of this system is the amount of manual labor required to grow each oak. In a hot and/or dry climate, frequent watering is required, sometimes 3 – 5 times per day. The fill-

ing of the cells with soil and the planting of one acorn per pot requires additional labor, but if one is growing special or difficult-to-grow oaks, then it is an excellent and simple method.

Chemical Root Pruning

The chemical used in this method is solid copper mesh. It is simple to use, long lasting, and non-toxic to humans. Others use chemicals like Trifluralin, which does stop root growth at the tip, but I find copper mesh is the simplest, cheapest (initially and it is reusable for many growing seasons), safest, and is very successful with oaks (these systems may not work well with all tree species).

My system consists of a 3' x 6' (.914 m x 1.829 m) or 4' x 8' (1.219 m x 2.438 m) cedar or redwood frame that is 7-1/2" (19.05 cm) deep. The bottom is covered with a #16 pure copper woven mesh. The frame is laid upon a flat garden soil plot and filled with a loose planting soil mix. Acorns that have been correctly stratified are then planted 2 – 3" (5.08 – 6.62 cm) apart, in rows 3 – 5" (7.62 – 12.7 cm) apart (depending on the species of oak). The acorns are watered-in and with proper sunlight; warmth and water, should germinate soon in their normal cycle. The same process as with the air root pruning will occur; the copper will chemically kill the root tips and new roots will start branching off the initial radical. There will be a shorter root system of about 6– 7" (15.24 – 17.78 cm) that easily fits into potting containers when transplanted. The seedlings are fairly easy to manually (by hand or with a small trowel) remove from the soil to be

©Guy & Edith Sternberg

Quercus suber *is well adapted to container culture using air-pruning techniques to limit root elongation.*

contd. on pg. 74

Propogation of Seedling Oaks . . .

contd. from pg. 73

potted, field planted, or shipped bare-root. Many hundreds of oaks can be grown in a small frame and with less exacting care than with the air root pruning method.

The shortcoming of this system is that the roots can become very intertwined with other closely planted oaks, so they need to be carefully shaken apart to separate them from each other. Most of the evergreen oaks have a higher mortality rate with this system due to the rough root treatment. Some of the more aggressive oaks (i.e.: chestnut-leafed oak, *Q. castaneifolia*) need to be placed a little farther apart when planted and the roots will still be too long horizontally for planting into #5 containers. When the long roots are pruned, it will generally cause some transplant recovery time and a greater mortality percentage rate. Since the trees are planted fairly close together in the frame, there is a need for a time-release fertilizer as the competition is rigorous; without fertilization, the seedlings will remain small. Some roots may grow through the copper screen, but will either be pinched-off by the screen as they grow in diameter or will be cut when the trowel is pushed along the screen to lift the seedlings for removal and transplanting.

Mechanical Root Pruning

This method is best for producing large quantities of seedlings. The stratified acorns are placed in a prepared bed of loamy soil for germination; the spacing is usually determined by the species of tree grown. The plant-ing bed width is determined by the tractor utilized and the width of the custom made undercutting blade. The oak species that work best with this system are: northern red oak (*Q. rubra*); scarlet oak (*Q. coccinea*), and pin oak (*Q. palustris)*. During the growing season the roots are cut off at regular intervals by a tractor-mounted honed and flattened "U" shaped blade. Some more sophisticated units actually vibrate slightly side-to-side to cut the roots better and to slide through the soil with a smaller coefficient of drag. During the growing season the blade will gradually be set to an increased depth. The following winter when the oaks are the most dormant, but the ground is not frozen, another larger flattened angled "U" shaped blade is pulled under the trees like a plow to push the developed trees out of the soil. The trees are then picked up by hand, and the dirt is easily removed by shaking.

The problems with this method include: 1) expensive equipment is needed, including a variety of blades and a very special, custom modified, powerful, steel/rubber tracked tractor; 2) a large production facility is required to support the needed equipment, as well as a bare-root storage facility for the seedlings once they are dug; 3) few oak trees do well with this form of root pruning; and 4) since different acorns of the same species germinate at different times, this method can cut a substantial portion of new roots, rather than just nipping the tip as with the other systems, whenever the root comes in contact with the air or copper screen.

Conclusions

To have quality oak trees, it is important to produce quality nursery stock with the best root systems possible that will transplant successfully and grow properly to maturity. The oak's taproot can be a problem unless dealt with at the first planting of the acorns and during the first year of its life. The simple methods described in this paper can produce quality oaks seedlings with the best oak root system possible when the oaks are to be transplanted as nursery stock.