

Real Root System Improvement Starts at Seed Germination.

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Root Pruning is most effective when it occurs four inches below the seed a few days after germination.

In all phases of the nursery industry there is always talk about roots. And some of the old practices are somewhat effective. Root Pruning in the field sometimes does some good, but not always. In *Production of Landscape Plants II*, I devote an entire chapter trying to explain cause and effects of root pruning. I close with the statement “travel at your own risk!” Foresters are big on transplanting tree seedlings from one ground bed to another and sometimes yet another in a laborious attempt to somewhat improve root systems before out planting. These are labeled 1-1 or 1-2 or 1-2-1, etc, with numbers indicating number of years in a location. The primary reason benefits are few is because when a taproot is undercut in bed one, when planted in bed two, a new or multiple taproot-like roots often return to dominance. Both procedures produce minimal benefits for all the time and effort.

A few years after son, Andy, returned to work with me here at Lacebark Research Farm, during a discussion about roots and transplanting, he remarked “Mother Nature did not provide for transplanting!” What an insightful statement: true, direct and to the point. I remember commenting, “I wish I had said that!”

When a seed germinates in nature, the fundamental objective is to extend the primary or taproot as deep and as fast as possible in order to secure the young plant in place and access moisture, critical to survival. Every seed of every species has this same objective. With some species, the dominance of the taproot is short lived. With trees and some other species, taproot dominance may continue for a number of years. As long as the tip of the taproot remains active, development of secondary branch root production is suppressed. However, in the long term anchorage of a tree and gathering of water and nutrients to support energy production in leaves ---the secondary branch root system in the top 10 to 12 inches of soil is far more important.

Most of this is generally known and accepted. But what is still mostly unknown or ignored is the practical and economical way to skip the multi-year dominance of a taproot and go directly to the much more supportive, multi-branched secondary root system (Figure 1). The key is air-pruning the taproot while it is still soft and actively growing. If you miss this opportunity, you cannot go back. When older roots are cut using antique ways, an open wound is created, ideal for entrance of pathogens. In addition, older tissue is much less responsive to pruning and secondary root production. When an older root is pruned, new roots develop mostly around the face of the pruning cut. By contrast, when a very young root is air-pruned, no open wound is created. The dehydrated root tip is much like a cauterized wound and unsuitable for pathogens. When a soft and active root tip is air-pruned, very quickly, typically in only a day or two, secondary and more horizontal branch roots begin to grow from the short vertical axis of the taproot. And, importantly, these secondary roots develop around the entire circumference of the taproot (Figure 2).



Figure 1. This tree was propagated in the original RootMaker® container, then transplanted directly to the field. After six years, the soil was watered well, then the tree was pulled using a strap on the stem. Note the extensive horizontal root system as well as roots growing variously downward. Such a root system provides maximum stability for the top and exploration of the soil for water and nutrients.



Figure 2. The red oak seedling on the right is two days old. The seedling on the left is four days old. Both were planted in an 18 cell RootMaker propagation container. Note the darkened tip of the taproot where it emerged four inches below and was air (dehydration) pruned. Once taproot dominance is stopped, secondary branch roots develop and top growth begins.

However, the zone of primary influence of air-pruning only extends back on a root about four inches. I call this the four-inch-rule, as it appears to apply to all root tips air-pruned or trapped so

they can no longer extend. For example, in a bottomless sleeve type container 12 inches deep, secondary roots develop mostly in the bottom four inches and all are oriented to grow down. In this case, the taproot from the soil surface to a point about eight inches below, functions like a conduit, transferring water and nutrients to the top and energy from leaves in return, but adds almost nothing to stability of the plant. On the other hand, air-pruning seeds at a depth of four inches, plus, air-pruning on container sides, provides the most supportive and effective root system (Figures 3 and 4). RootMaker® propagation containers are four inches deep for this precise reason.



Figure 3. After three weeks in an 18 cell RootMaker® propagation container, secondary roots have reached container sidewall and additional air pruning and tertiary roots are developing. Note the shape of the propagation container and openings in corners for air pruning.



Figure 4. Catalpa seeds were planted in 18 cell RootMaker® trays 4-17-05. Photo was taken 7-6-05---- 0, 4, 8, and 12 days after transplanting. When active root tips are present and poised to extend, root development following transplanting is amazingly fast. As long as planting is "green side up", success is practically guaranteed.

However, pruning the tip of a taproot at four inches and developing a fibrous network of secondary and more horizontal roots is only part 1 in developing a sound root system. Part 2, which is equally

important to long term plant anchorage and health, is keeping the young roots poised to grow mostly horizontal and avoid having a wad of roots growing in a circle around the inside of a conventional plastic pot. Larger RootMaker® containers are designed to air-prune at the container sidewall and maintain roots poised to grow horizontally immediately following transplanting. This is done with a series of ribs and ledges that stop root circling and direct roots into openings for continued air-pruning. Not only does this stop root circling, but it creates a root system throughout the volume of growth medium and not just in a congested layer at the sidewall (Figure 5).



Figure 5. Transplanting seedlings with excellent root systems into conventional smooth walled plastic pots is a gross error. Roots grow outward, contact the sidewall and circle. Active root tips decline and anchorage of the plant is poor (right). By contrast, when a rooted cutting or seedling from a RootMaker® propagation container is transplanted into a three gallon RootMaker container, roots grow out, contact the sidewall and are guided by ribs and ledges into openings for additional air pruning. The result is a continued fibrous root system with no circling and large quantities of root tips are poised to extend and establish the plant in the field or landscape.

It is also important to avoid the common error of leaving plants in RootMaker® containers too long. The assumption is often made that because roots do not circle in RootMaker® containers, plants can remain in them longer. Wrong! It is best to transplant as early as possible. Reality is that because of air-pruning during propagation and continuing in larger sizes of RootMaker® containers, roots fill the volume of growth medium faster. As space for further root exploration declines, so does growth of the top. In this respect, plant response is similar to becoming root bound in a conventional round pot. However, in RootMaker® containers roots cannot circle and there are root tips poised at most air-pruning locations. Therefore, when transplanted, roots rapidly extend and top growth resumes. Do not cut or otherwise abuse the root system of a RootMaker® grown plant as this will damage root tips waiting for the opportunity to grow. To gain full benefits from this unique system, transplanting earlier is better than later, especially out of RootMaker® propagation containers. This is due to the limited volume plus rapid proliferation of roots at this stage. And, best of all, air-root-pruning in RootMaker® containers occurs 24-7 and without an aching back or breaking a sweat.