

Roots: the Next Step Forward.

Dr. Carl E. Whitcomb Lacebark Inc. Stillwater, OK 74076

Large strides forward have been made in container growth media, micronutrients, slow release N-P-K fertilizers, weed control, watering systems and more. The next 'frontier' is improvements in root branching and root development throughout the growth medium and not just in a thin layer of circling roots inside the pot sidewall. Having a fibrous root system throughout the growth medium improves water use efficiency, absorption of nutrients and reduces nutrient leaching, plus roots are more insulated from extremes of heat and cold and plants establish more rapidly for your customer. Root pruning to stimulate branching can be safely and effectively accomplished by air-root-pruning, constriction pruning and root-tip-trapping. Very young and actively growing root tips respond to air-root-pruning by producing many secondary roots compared to pruning of older roots. With plants grown from seed, the critical time for most effective root pruning can be in as little as 3 to 5 days following germination. If this window of opportunity is missed, there is no going back. And for greatest benefits, roots should be air-pruned no more than four inches below the seed and on the sides of the pots as well as the bottom.

Most water and nutrient absorption occurs at or just behind the white root tip. One root tip can absorb X amount of nutrients in a given period of time. If that root tip can be stimulated to branch to make 10, 50 or 500 root tips, nutrient absorption increases proportionally. With conventional containers some 80 to 90% of the active root tips grow in a narrow zone typically no more than one-fourth to one-half inch thick, pressed against the container sidewall. If root branching occurred but the new roots were also pressed against the sidewall, nutrients would soon be depleted in that zone and oxygen would also become limiting. On the other hand, when root tips grow out from the base of the plant and are stimulated to branch as a result of air-root-pruning or root-tip-trapping when they reach the sidewall, branching typically occurs back along the young root about four inches. The '4-inch rule' appears to apply to all species when roots are young and reactive. For example, in a study conducted during June 2005, Catalpa tree seedlings grown in 18 cell RootMaker® trays were transplanted into three gallon containers, 12, 8, 4 and 0 days before root growth was evaluated. Only 12 days following transplanting and large numbers of roots had grown out from the original root ball in all directions reaching the sidewall and bottom of the container. The reason for the massive number of roots produced was air-root-pruning in the 18 cell RootMaker® tray. If this large number of roots hits the side of a smooth conventional container and begins to circle, little is gained. On the other hand, if this large number of roots contacts the sidewall and is again either air-root-pruned or pruned by root-tip-trapping, the resulting mass of additional branch roots infiltrates the entire mass of growth medium for maximum absorption of water and nutrients to support top growth.



Air-root-pruning results when actively extending root tips are guided into openings in the container sidewall where the tip dehydrates and dies. Secondary roots quickly develop back of each pruned root. The dead root tip has effectively been cauterized and is unlikely to be colonized by pathogens. The key to air-root-pruning is container design that guides root tips into openings without having the openings so large and numerous that rapid evaporation and salt accumulation become an issue. All RootMaker® containers have been designed to provide maximum air-root-pruning with minimum sidewall openings.

Root-tip-trapping is accomplished using a spun-bonded fabric laminated on one side with white poly. When root tips contact the sidewall of containers made using this material, the tip is trapped and can no longer extend. The trapped root tip will typically stop elongating, become pudgy, then lose hormonal control over root development and secondary branch roots develop. The advantage of this root-pruning technique is that no water is lost through the container sidewall and roots are fully contained, even when in the ground or snugly inside another container. Plus, when used above ground, the white outer coating reduces root zone temperature by about 20° F. This cooler temperature allows root growth on the side of the container exposed to sun and avoids problems associated when roots are killed by heat.

Root girdling or constriction-pruning is effectively accomplished in field soil where roots are allowed to grow through a fabric container wall where all openings are precisely 5/64 inch. Young root tips extend freely through the myriad of fabric openings, but as soon as they increase in diameter they become girdled or constriction-pruned. Because the roots are young and actively growing, secondary root branching occurs similarly to air-root-pruning or root-tip-trapping, only inground. Roots function outside the container and still absorb water, nutrients which are transferred to leaves via central xylem tissues. However, constriction limits downward movement of sugars from leaves in the outer root tissues at the inside fabric wall. This accumulation of sugars causes nodules to form that have many root buds. When the tree is harvested and fabric removed, root growth from the nodules is robust.

For more information Plant Production in Containers II offers photos and explanations.