**Benefits of RootMakers®:**

- Create a fibrous, non-circling root system. (without toxic chemicals)
- Promote horizontal root branching.
- Greater efficiency of water and nutrient absorption.
- Accelerates plant growth, increases vigor.
- Compliments a variety of production methods above ground, in-ground, or in-pot.
- Wide range of sizes. (propagation to large containers)
- Each fibrous root system compliments the next.
- Creative solutions for water conservation, insulation, and blow-over.
- Plants are equipped for rapid transplant success and long-term health.
- Researched and patented.

**Make it happen.®**

Nature didn’t consider transplanting... RootMakers® do.

RootMakers® are designed to create fibrous, non-circling root systems horizontally and vertically at all phases of production to equip plants for transplanting success. Our products aren’t just “containers” but rather root production tools. Each step compliments the next, building upon the previous fibrous root system. A fibrous root system means a greater root tip surface area and translates to a greater efficiency in the absorption of water and nutrients; an increase in growth rate, establishment, and vigor; a higher transplant survivability; and ultimately, superior performance for your customers.

RootMaker® has a wide range of products and sizes to fit your production needs. The critical start is with our propagation containers. Build upon that fibrous root system with each transplant shift. Follow the “4-inch Rule” (allow about 4 inches of new sidewall distance between old rootball and the side of the new container) and continue root branching with the container that best fits your production requirements. If field planting, the Knit Fabric In-Ground container ranges in size from 8” up to 48”, or for Pot-in-Pot the soft-sided, white RootTrapper® container is custom made as the production insert. If continuing the Whitcomb System® above ground, RootTrappers® sizes 5 to 30 gallon, or the versatile RootBuilder® II expandable container, sizes 3 to 30 gallon can be used. Finish strong with larger RootBuilder® II up to 150 gallons or larger or RootTrapper® to 60 gallons. Each step stimulates root branching and compliments the next, creating a fibrous root system vastly superior to conventional production methods.

**The Whitcomb System® Background.**

Dr. Carl E. Whitcomb received his Ph.D. in horticulture, plant ecology, and agronomy from Iowa State University in 1969. He was a professor at Oklahoma State University 1972 - 1985, then began his own horticultural research company, Lacebark Inc. Root constriction pruning grew from a chance observation in 1967. He was the first to perform air-root-pruning in 1968 using milk cartons with bottoms removed. This eventually lead to RootMaker®, RootBuilder®, RootTrapper®, and Knit Fabric In-Ground Containers. Accomplishments include: four books (Plant Production in Containers II, Production of Landscape Plants II (in the field), Know It and Grow It III, and Establishment and Maintenance of Landscape Plants II), 26 patents (container designs, Dynamite® crapemyrtle, etc.), papers published in several hundred journal and technical publications, and numerous nursery industry awards.
How The Original Root-Pruning Container System® works.

Before beginning nursery production, consider your seed source and its adaptability to your geographic region. For example, redbud seed from a parent tree along the Gulf Coast will produce seedlings that will be injured or killed in Tennessee or Kentucky. Conversely, redbud seed from Tennessee will produce seedlings that will grow along the Gulf Coast but may flower poorly.

RootMakers® require a wire bench or other support 18 to 24” above the floor to allow good air circulation and thus efficient air-root-pruning on all sides of the container, not just the bottom.

RootMaker® Propagation Containers

The first step toward creating a fibrous root system is RootMaker® propagation containers. Besides the original injection-molded 4-pack (Patent #4,753,037), there are the thermo-formed RootMaker® II 18-, 32-, and 60-cell trays (USA Patent #5,557,886). The 18 and 32-cell are also available as pull apart trays.

Choose a support flat with open mesh sides and bottom. Six 4-pack RootMakers® fit a 12” X 18” flat (Ex: Sunnyside flats from Dillen Industries). The 60-, 32-, and 18-cell RootMakers® fit a standard 10” X 20” mesh bottom/ open-sided flat.

The RootMaker® Express™ 18 (25 cu. in.) is an injection-molded new and improved single. Our new Shuttle™ tray neatly holds 18 of the Express™ 18’s or the 18-cell pull apart singles for sorting, grafting, and grading.

These southern red oak seedlings are 3 days old. Left, without benefits of air-root-pruning. Right, air-root-pruned in RootMaker® II propagation container. This critical air-root-pruning accelerates growth and increases efficiency. Continue to build this fibrous root system through all phases of production.

RootMakers® propagation containers can be filled with a mix of peat and perlite 40/60 or peat, perlite, and vermiculite 40/40/20, or pine bark, peat, and perlite at 50/30/20 by volume. Add 1.0 pound of Micromax® micronutrients, 3 pounds of dolomite, and 6 pounds of Osmocote® 18-6-12 (no substitutes) per cubic yard of mix.
Timing is also very important. Once a fibrous root system has been created, it is time for the next step to a larger container. If plants are left in RootMakers® too long the benefits will begin to decrease and water management may become more difficult, due to the unique, high concentration of roots. Monitor your plants’ progress. The length of time in RootMakers® propagation containers varies greatly but is typically no more than 2 to 4 months.

Root system from 60-cell tray RootMakers®.

RootMaker® 18-cell showing washed tree root system (left).

Root system out of space
Prime transplanting window
Good growing conditions, developing root system

RootMaker II Container Volume

<table>
<thead>
<tr>
<th>Time</th>
<th>60-cell</th>
<th>32-cell</th>
<th>18-cell</th>
</tr>
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<tbody>
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<td>0</td>
<td>6.0 cu.in/cell</td>
<td>11.0 cu.in/cell</td>
<td>25.0 cu.in/cell</td>
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<td>4</td>
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<td>8</td>
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Catalpa showing root growth after 0, 4, 8, and 12 days out of RootMaker® 18-cell.

RootBuilder® II technology is now available in a quart sized kit. Called simply, the RBQ™, this highly efficient air-root pruning container creates a strong liner for grafting.
Seize every opportunity to continue root branching momentum. Depending on your production requirements, there are several options. A good rule of thumb is “the 4-inch Rule” (visit www.rootmaker.com for full explanation of this phenomenon). Similar to pruning shrubs, research has shown that when a root is pruned, root branching occurs at the tip to about four inches back. This is why RootMaker® propagation containers are 4 inches deep. If plants are shifted to a larger RootMaker® container with a sidewall difference less than 4 inches, excellent branching will occur but this fibrous root system will soon exhaust container volume and may require an additional shift. If plants are shifted to a container that has a sidewall difference greater than 4 inches, some root branching opportunities or sales could be missed.

To illustrate the 4-inch Rule, this large rootball of a 3.5 inch diameter lacebark elm which had been growing in an 18” diameter RootBuilder® for 1.5 years, was cut in half with a chain saw. White lines indicate this tree’s first year root systems from RootMaker® 4-pack and RootMaker® 3-gallon. Note the complimentary effect of each container size with the next to create an extremely fibrous root system.

RootMaker® 1, 3, and 5 Gallon (Patent #4,753,037)
Many nurseries shift to 1, 3, or 5 gallon RootMakers®, generally in May, June, or early July, then allow these seedlings to grow in this container until fall planting in the field or the next shift. All models of our 1 (round or square) 3, and 5-gallon RootMakers® have many openings designed to continue the air-root pruning process.

A good mix for above-ground RootMakers® is ground pine bark, peat, and sand 60/20/20 by volume. To this, add 1.5 pounds of Micromax® micronutrients and 14 pounds of 17-7-12 Osmocote® per cubic yard. The quantity of dolomite required for best growth depends on the minerals dissolved in your irrigation water. Other recommendations are site specific.

Root systems created by RootMaker® 1-gallons (above) and 3-gallon with mix washed out of right example.

Oaks in nursery production in 3-gallon RootMakers®.
In this container, roots are insulated from temperature extremes and are directed to openings 3/32 inch in diameter. Through these holes roots extend into the soil to absorb water and nutrients and provide stability. Roots cannot expand beyond the 3/32 of an inch which causes an accumulation of sugars and starches inside the container. Root branching occurs behind this constriction. At harvest, small roots outside the container are broken off. Once the Grounder™ is harvested, shift the plant into any larger RootMaker®, or a cheap blow-molded pot to go to market, then reinstall the Grounder™ while the hole is still open.

RootMaker® Grounder™ 5 gallon
Our 5-gallon Grounder™ is a unique option because it was designed to be installed in the ground but may be used above ground. This container requires a well-drained soil and can be filled with either soil or a soilless mix.

RootBuilder®II HIGH 5™ and RB™
RootBuilder®II is assembled around a root-directing bottom disk to form 3, 5 (mix down several inches) or 7-gallon (completely filled) containers. This innovation greatly assists handling and creates an unparalleled fibrous root system.

Cinder Blocks
One of our most popular methods of liner production utilizes concrete cinder block cavities. Our 5” bags slip snugly into each cavity. Here, blow-over is eliminated and roots are insulated from temperature extremes, and continue the root branching procedure either by root-tip-trapping or root constriction.

Dense, fibrous root system from HIGH 5°.
Installation of Knit Fabric containers is accomplished with an auger of same or larger size. A depth control gauge on the auger allows for a uniform 12 inch depth. It is important to level the hole bottom to prevent a “bowl” effect. The container is then set in the hole and held open with a plastic expandable sleeve. Fill container with same field soil. At least one inch of the Knit Fabric container should remain above soil line to prevent roots escaping over the top. The system works better when care is taken to keep the sides of the fabric container straight when packing the backfilled soil.

Although somewhat labor intensive during installation, harvesting is almost a treat. For the smaller sizes (8 to 14”) one person can spade around the outside of the container to sever the small roots, rock the tree back and forth, and lift the tree out of the ground. For larger container sizes (18”, 24”), “popping out” with the forks of a front end loader or skid steer works well. Trees also can be harvested with a double-loop of a nylon strap, when plants are dormant and field conditions are moist.

With the Knit Fabric container, small roots extend through the fabric but are unable to expand, causing a constriction which leads to root branching and an accumulation of energy. Water management is less complicated in the field and the root system is protected from temperature extremes. When a tree in the Knit Fabric container, generally sizes 8” to 24” (30”, 36”, 48” special order) is harvested, the fabric is removed and, once planted, is provided the benefit of having a great majority of the root system not only intact, but well branched and equipped to establish into the surrounding soil horizontally rather than just downward.

Before transplanting in the landscape or a larger container, the Knit Fabric is cut and torn off.

Above, fabric was removed and soil washed away to show root branching and fibrous root system poised for rapid regeneration.

Close inspection shows the callous swelling on both sides of the container.

This procedure has been tested on many species but is not recommended for use on pecans or palms.
The **RootTrapper® Soft-sided Container**

The **RootTrapper®** provides the mobility of remaining above ground and is generally 5 to 30-gallons at this shift. This is a black, spun-bonded fabric which has been laminated with a white coating. This unique container stops circling roots and continues to stimulate root branching by trapping root tips.

The white outer coating greatly reduces container temperature so roots do not die on the sunny side as with black plastic containers. Water usage is also reduced as there are no large drain holes or evaporative sides; water seeps out the hundreds of holes created by the base stitching. When ready to harvest, slit down the sides with a utility knife, peel off container, and marvel at the root system. We have been able to use heavy duty staples to rejoin the side wall together and reuse **RootTrappers®** for another season or two, at a slightly reduced diameter. (Using Arrow stapler model P-35 with 3/8 inch staples, or Stanley Bostich 9/16" C-ring fasteners).

**RootTrapper® Options**

The success of this container has led to other versions to better suit some production needs. The **RootTrapper® “Grounder”** has a base material which allows roots to grow through and peg into the soil. This not only reduces blow-over but permits the plant to reclaim water and fertilizer. The **RootTrapper® II** is not laminated on the bottom 2 inches of the container sidewall. By allowing better drainage near the base but not totally exposing the container sidewall to rapid evaporation, moisture and aeration for the entire soil column is improved.

The **RootTrapper® Pot-in-Pot insert.**

Now available to custom fit your socket pot. Major root escape is no longer a problem plus a fibrous root system is created by root-tip-trapping. At harvest, roots are insulated from temperature extremes.
Large Containers
By now the system has been in effect for at least 2 growing seasons and we are dealing with a tree/shrub of considerable size and a well-branched root system. One option is to plant and harvest in the field conventionally. Another option is the RootTrapper® which comes in sizes up to 60 gallons for continued benefits of root-tip-trapping for another season.

The RootBuilder®II Container
The RootBuilder®II expandable plastic container is another option. This highly successful, versatile container now has been redesigned and is patent pending. It comes in a continuous roll and can be cut to create the size of container you require. (Or pre-cut for sizes 15 to 70 gallon.) With a few inches of overlap, the container is assembled by connecting with cable ties, which do not block openings for air pruning.

The bottom of the RootBuilder®II can be our RootBuilder® base material which allows roots to penetrate into the soil, pre-cut RootTrapper® discs, or other material that is imperious to roots such as 6 mil. poly., or a spun-bonded weed-barrier type fabric which aides movement of the container.

A hole is at the tip of each outwardly projecting funnel on the sidewall of this container. For instance, a 30-inch diameter, 18-inch sidewall RootBuilder®II container is 45 gallons and contains 1600 funnel openings. However, the sum of these openings is only 6% of the container sidewall so water loss is minimal. As a result of the sidewall configuration, a portion of sidewall is shaded, reducing temperature and evaporation. Roots are directed outward to these holes and forced to branch yet again by air-root-pruning, thus completing the Whitcomb System®. If needed, the cable ties can be cut, then an additional RootBuilder®II piece can be added to create a larger container. Ultimately, this is a superior tree with a superior root system, given the best chance for survival in any landscape situation.

RootTrappers® and RootBuilders® create thousands of active root tips for a strong finish, such as with this 4” diameter oak.
**Chaps®**
This stem protector has several unique qualities. The outside lamination protects the base of young trees from herbicides. Because **Chaps®** are white, they also reflect light, thus working with the soft inner fabric to insulate stems from temperature extremes which can lead to excessive cell elongation and weak growth. Also, unlike other rigid stem protectors, the soft inner fabric of **Chaps®** prevents scuffing and scraping of stems. **Chaps®** are reusable and installation is completed with a stapler.

**RootSkirts®**
Root death on the sun-exposed side of black plastic containers is a common but ignored occurrence. The **RootSkirt®** is a sleeve of laminated fabric which slips over a plastic container to moderate root temperatures. During Oklahoma summers, root zones in containers protected with **RootSkirts®** have been as much as 20 degrees cooler due to the white, light and heat-reflecting coating. These insulating qualities also moderate temperatures in winter.

![Above, crapemyrtle with (left) and without (right) temperature protection of a RootSkirt®.](image)

**RootCaps™**
**RootCaps™** reduce weeds without chemicals and reduce water loss. With our media cover even under weedy conditions, one herbicide application has lasted one full growing season. **RootCaps™** remain in place and are economical.

**RootBarriers.**
When installed in a trench, this unique fabric traps root tips and works as a root barrier in landscaping. The 36” wide rolls are installed with the “fuzzy” side toward the roots to be trapped.

**RootMakers®** aren’t just containers for “holding” plants; they are intensive production tools. Once a fibrous root system has been created, it is time for the next step or shift to a larger container. **RootMaker®** grown plants will have highly branched root systems ready to shift sooner than conventional containers of similar size. The sooner this shift is made, the sooner your plant has made an additional jump on the competition. **RootMaker®** plants don’t just survive, they thrive.

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Certification/Books

RootMaker®
Products Company, LLC
Certified Grower Program

RootMarker® Certified Select
- Trees or shrubs must have been grown from seed or cuttings in RootMaker® propagation containers.

RootMaker® Certified Gold
- Trees or shrubs must meet Certified Select requirements plus,
- Complete at least a second step or shift to a larger container from the line of RootMaker® products. This includes 1, 3, or 5-gallon RootMakers®, cinder block bags, RootTrappers®, RootBuilder®II, or Knit Fabric field-growing containers.

RootMarker® Certified Platinum
- Trees or shrubs must meet Certified Gold requirements plus,
- Complete at least a third step or shift by “finishing” in RootTrappers® or the RootBuilder®II Expandable Above Ground Containers.

Disqualifications:
- Plants grown in plug trays
- Plants grown in smooth, conventional containers
- Plants damaged by toxic levels of copper

The RootMarker® Certified Grower Program is open to commercial plant production nurseries or tree farms, whose primary business is providing top quality plant material to another nursery, landscape contractor, or the general public via retail garden centers. Cooperating nurseries and tree farms agree to follow best management practices available in other aspects of plant growth and health. RootMarker® Products Company will make available a list of best management practices for anyone seeking assistance.

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Note: Individual results may vary, depending on the manner in which the product is used, and its location. Manufacturer assumes no responsibility to any product as used, and its location. Manufacturer assumes no responsibility to any purchasers or users of RootMarker® products. No warranties, either expressed or implied, are made with respect to the RootMarker® products, including, but not limited to, the implied warranties of merchantability and/or fitness for a particular purpose, and Manufacturer expressly disclaims all warranties not stated herein. In no case shall Manufacturer’s liability exceed the purchase price of the RootMarker® products purchased.

Lacebark, Inc.
Lacebark, Inc. is a horticultural research company located near Stillwater, Oklahoma. It was created in 1986 by Carl Whitcomb, Ph.D. His research has led to such developments as Micromax® micronutrient fertilizer, several patented container designs (RootMarker®, RootBuilder®, etc.), and eight patented crapemyrtles (Dynamite®, Pink Velour®, Red Rocket®, Tightwad Red®), to name a few. Currently, research continues on developing new cultivars of crapemyrtle, butterfly bush, redbuds, lilacs, river birch, elm, and others. Research also addresses cultural factors in containers, the field, and the landscape, from water chemistry, nutrition, improved root systems, weed control, intercrops, and more. Whitcomb also does consulting and speaking on a variety of topics, as time allows. Lacebark, Inc. publishes Dr. Whitcomb’s four books.

Know It and Grow It III: A Guide to the Identification and Use of Landscape Plants (3rd Edition published 1999) 8.5” by 11” format, over 800 pages and 2000 black and white photos, weighs over 6 pounds. Not a pocket reference manual. Covers most of the plants that can be grown east of the Rocky Mountains and from the Gulf Coast to Canada. Each plant has several photos plus a map showing geographic area to which it is adapted. Both common name and scientific name index makes it especially easy to use. No line drawings and no botanical gibberish; blunt, and to the point. Price: $60.00 plus $12.00 shipping via UPS.

Plant Production in Containers II
Revised 2003, Reprinted 2006 with new format and cover. Covers all aspects of producing plants in the unique, man-made environment called a container, from propagating from seed or cuttings, to growth medium, nutrition, watering, weed control, and more. Over 460 pages, 8.5” by 11” format, hardback, many photos. Price: $69.00 plus $8.75 shipping via UPS.

Production of Landscape Plants II (in the field) (2nd Edition Published 2001) Covers all aspects of field production, including bare root, balled-in-burlap, pot-in-pot, knit fabric in-ground containers, and more. Over 700 pages, 6” by 9” format, hardback, many photos. Price: $49.00 plus $8.75 shipping via UPS.

Establishment and Maintenance of Landscape Plants (3rd Edition Published 2006) Covers drainage, nutrition, and other factors dealing with both the planting and establishment and the long term care of landscape plants. 350 pages, 8.5” by 11” format, hardback, many photos. Price: $59.00 plus $8.75 shipping via UPS.

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Behind every fibrous tree root system like this is a RootMaker®.