NEW JERSEY AGRICULTURAL EXPERIMENT STATION
RUTGERS COOPERATIVE RESEARCH & EXTENSION

FS519

Fact sheet

For a comprehensive list of our publications visit ***www.rcre.rutgers.edu***

Pot-In-Pot Nursery Production System: What You Need to Know Before Establishment

Gladis Zinati, Ph.D., Extension Specialist in Nursery Management

Pot-in-pot (PIP) or PNP plant production system is a hybrid of field and above-ground container production. It combines several advantages found in both systems. The PIP production system is being adopted rapidly by growers of shrub, shade, fruit, and flowering trees. The system consists of a two containers. A strong plastic container, the "**socket pot**," which is placed permanently in the soil so that 3 to 4 inches of the container lip protrudes above the soil surface, and a second container of the same size, the "**insert pot**," which contains the plant grown in a soilless medium, is placed into the socket pot. Unit sizes vary from 3 to 30 gallons. On an acre basis, the 7 to 15 gallon sizes appear to be the most popular.

Proper installation of the PIP facility may require only minimal maintenance. However, the cost of developing a PIP system may range from $30,000 to $38,000 per acre. The cost of the socket pots, insert pots, irrigation systems, equipment rentals for land preparations and hole's excavation, and labor expenses must all be considered. The initial cost of implementing the system is considered to be the primary disadvantage of PIP. But, keep in mind that this is a onetime expense. Over time, the reduction in labor cost associated with PIP production combined with a shortened production time should make up for the initial investment.

Advantages of the PIP System

The PIP production system provides many advantages over container and field production. The PIP system:

- Insulates the root zone from extreme temperature variations. Root temperatures of trees grown in PIP may range from 13 to 19°C (23–34°F) lower than the root temperatures of trees grown in above-ground containers (AGC). In the AGC, the roots in the western quadrant of the container are often injured or killed by the high temperatures. For example, *Ilex* spp. plant roots cease functioning when temperatures exceed 31°C (87.8°F). The PIP system insulates plant roots from summer's heat and winter's cold. It eliminates building frost protection structures. Proper selection of winter hardy plants is advisable for successful production (refer to RCRE FS528 for more information on winter hardy plants).

- Improves overall plant growth and vigor due to root temperature moderation and moisture content control. Research has shown biomass increases of 20% for above-ground portions and 50% increases in root mass of plant grown in this system, compared to AGC production.

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS COOK COLLEGE

- Allows in-place overwintering.
- Decreases production time from liner to finished product.
- Reduces water usage by 40% using micro irrigation spray stakes compared to overhead AGC production system.
- Offers year-round harvest capability.
- Reduces labor cost associated with staking to prevent blow-over and in-field harvesting.
- Eliminates root loss associated with field digging.
- Is more environmentally friendly than field production because it reduces soil mining, a condition where the topsoil is removed with the root balls in conventional field culture.
- Offers light-weight shipping compared to ball and burlapped plant material with less damage.
- Prevents tipping over of plants, therefore, reducing labor cost and potential spillage of fertilizer.

Disadvantages of the PIP System

- Initial cost of installation is higher than in other production systems.
- Potential problem of drainage in poorly drained soils.
- Root may grow into socket pot and surrounding soil, making plant removal difficult and reducing plant quality.
- Inner and outer containers may stick together, making removal difficult.
- Bottom of the insert pot may sag, causing an uneven base.
- Plants may be exposed to winter wind's drying effects (desiccation) and scald injury.
- Limited flexibility in spacing plants.

Requirement of the System

The system requires adequate drainage; a high quality, reliable water source; in and among pot weed control; and adequate fertilization practices.

Drainage

Field soil with good drainage system is essential to the success of PIP. A soil percolation test is recommended to determine soil drainage rates prior to initiation of the PIP system. A Natural Resource and Conservation Service (NRCS) rating of "moderate" or "rapid" soil permeability would be sufficient. Sandy soils are well suited for PIP production. Precautions need to be taken if sites have heavy soils that drain poorly. If the pot is allowed to sit in standing water for a period of time, root damage will occur. The PIP system is not recommended if the test results show slow soil permeability rates unless a sub-surface drainage system is installed to provide adequate drainage. Tile is usually laid in the bottom of the trench just below the bottom of the socket container. To avoid flooding, drain tile should be installed in the row approximately 6 to 10 inches below the bottom of the socket container. Four inch-corrugated drain tile is usually used for drainage. Some growers install four-inch perforated corrugated ADS (advanced drainage system) tiles covered by a filter fabric and ¾ inch clean stone (gravel) below the row of containers. However, the gravel layer may become clogged with sediment over time. Drain lines should slope to one end of the field so that they carry water from the PIP growing area. The ends of the drain lines can be connected to a header or manifold that carries drainage to a detention basin or the ends can be left open and drained across a grass filter strip. NRCS can be helpful in designing the drainage system. Development of the site includes grading the field to optimize surface water movement away from the production area and prevent erosion across the site.

Irrigation

The system requires a high quality, reliable water source. Micro irrigation is used in the PIP system. Distribution of water over the surface of the pot is essential to develop a uniform root system in the pot. A single column of water such as supplied by a drip emitter in a pot with a soilless growing media will not move across the pot but may channel in one spot through the pot, therefore, may not be suitable. PIP containers are usually irrigated with a 360 degree spray nozzle turned upside down to spray water across the entire media surface of the container. Smaller containers up to 15 gallons frequently have only one spray stake, while 25 gallon containers and larger usually require at least two. Most spray nozzles are low pressure (15 to 40psi) and supply between 10 to 25 gallons per hour application. These spray stake nozzles have much larger orifices, compared to drip nozzle orifices, which supply water at 1 to 2 gallons per hour in field production. Plant growth can be maximized and plant stress can be reduced by making multiple water applications per day. Screen filters are used to remove sediment from water (well or public water) and prevent plugging nozzles in PIP. Those who use recycled pond water or surface water need to use disk filters to provide adequate filtration.

Spacing

Spacing of containers is dependent upon the size of the canopy at harvest time. Common spacing in both directions has been 4, 5, or 6 feet. Smaller containers may be placed lip to lip in the row while minimum spacing of 15 gallon containers is 4 feet between rows and 4 feet between containers. Spacing is wider for 25 gallon and larger containers.

Weed Control

A thick layer (more than 3 inches) of light colored-wood chip mulch or a heavy grade landscape fabric between containers can be used to reduce weed pressures. An X is cut in the fabric above each socket container it covers. The fabric reduces erosion, reduces or eliminates weed maintenance, allows movement around the area at all times with a dry surface, and keeps UV light from reaching the socket pot. Grass strips between rows provide similar advantages to wood chip mulch or landscape fabrics. Acreages that are not covered can be maintained on an as-needed basis. Although weed growth in the soil between the socket pots is much less due to individual pot irrigation (drip irrigation) compared to broadcast sprinkler irrigation, residual weeds can be controlled by pre-emergent herbicide and/or post-emergent herbicide applications if mulches or covers are not used. Recommendations for weed control in and among containers can be found online at the website: *www.rcre.rutgers.edu/pubs/pdfs/e261.pdf*.

Fertilization

The PIP system depends on micro irrigation which requires the use of an efficient and effective way of fertilization. Research has shown that incorporation of controlled-release fertilizers, such as Nutricote®18-6-8, or Osmocote® High N 22-4-7 increased plant shoot growth (e.g. Red Maple) compared to using slow-release fertilizer, Woodace® 19-6-12 at the same amount of nitrogen. Top-dressing media with controlled-release fertilizer seems less successful as the fertilizer is exposed to less moisture.

In summary, the pot-in-pot production system provides growers with an alternative production system to field and above-ground container systems. If a PIP nursery is designed and installed properly, the grower will benefit from quick returns and his/her facility can be environmentally friendly and profitable over a long period of time.

References

Barkley, S. 2001. *Establishing a Nursery in Alberta: Container Growing*. www.agric.gov.ab.ca/crops/trees/nursery8.html.

Bilderback, T. www.ces.ncsu.edu/depts/hort/nursery/pdf/cultural_practices/container/PnP.pdf.

Fare, D.C. 2001. *Controlled-Release Fertilizer Application Methods Affect Maple and Plum Growth in a Pot-in-Pot System.* HortScience 36(3):539.

Mathers, H. 2000. *Pot-in-Pot Container Culture*. www.ngia.com.au/publication_resources/NP_Pdf/NP_2000-02.pdf.

Mathers, H., and R. Zondag. 2002. *Nursery Stock Production Using the Pot-in-Pot Technique*. www.hcs.osu.edu:16080/basicgreen/containerproduction/index.htm.

Merwin, M. *Nursery Tests New System to Combine Ornamental Plant Production with Forestry*. www.aftaweb.org/entserv1.php?page=21.

Robbins, J.A., and G. Klingaman. 1999. *Starting a Wholesale Nursery — Part I*. www.uaex.edu/Other_Areas/publications/PDF/FSA-6055.pdf.

Sellmer, J., R. M. Bates, T.L. Harpster, D. Despot, and L. Kuhns. 2003. *Efficacy of Fall Applied Herbicides in Pot-in-Pot Nursery Tree Production*. HortTechnology, 13 (4):729-730.

Skillman, L. 2002. *Pot-in-Pot Nursery Production May Provide New Crop Opportunity*. www.ca.uky.edu/agc/news/2002/Jul/potf.htm.

Tilt, K., D. Williams, C. Montgomery, B. Behe, and M. K. Gaylor. 1994. *Pot-in-Pot Production of Nursery Crops and Christmas Trees*. www.aces.edu/pubs/docs/A/ANR-0893/.

Zinati, G.M. 2004. *Management Recommendations on Cold Hardiness and Dehardening for Container-Grown Nursery Crops*. Rutgers Cooperative Research & Extension, FS528. www.rcre.rutgers.edu/pubs/pdfs/fs528.pdf.

Desktop publishing by Rutgers–Cook College Resource Center

Published: February 2005

RUTGERS COOPERATIVE RESEARCH & EXTENSION
N.J. AGRICULTURAL EXPERIMENT STATION
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
NEW BRUNSWICK

Distributed in cooperation with U.S. Department of Agriculture in furtherance of the Acts of Congress on May 8 and June 30, 1914. Rutgers Cooperative Research & Extension works in agriculture, family and community health sciences, and 4-H youth development. Dr. Karyn Malinowski, Director of Extension. Rutgers Cooperative Research & Extension provides information and educational services to all people without regard to race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Rutgers Cooperative Research & Extension is an Equal Opportunity Program Provider and Employer.