University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service

Center for Crop Diversification Crop Profile

Pot-in-Pot Nursery Production

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Introduction

"Pot-in-pot" describes a nursery production system that uses containers (production pots) placed inside permanent in-ground containers (socket pots). Pot-in-pot is used for the production of caliper-sized shade trees, flowering trees, and large shrubs. The pot-in-pot system combines many of the benefits of field production with the marketing flexibility of container production. Container-grown plants can be sold at any time of year and with relatively short notice, whereas harvesting of field-grown plants requires more planning and is typically not done during the summer or extremely wet periods. Plants grown or held in a container for too long will become "pot-bound" and decrease in quality, therefore, planning for the production and marketing cycle is important. Advantages of pot-in-pot versus aboveground container production include: root protection from extreme hot and cold temperatures, greater pot stability for reduced tipping over, and ability of plants to both grow and overwinter in a single fixed location.

Marketing

Nursery crops are marketed in several different ways:

Retailers market directly to the end consumer, typically homeowners. This is most commonly done either through retail nurseries, which produce some or all of their own plant material, or garden centers, which purchase their inventory from a wholesale nursery. These businesses must be conveniently located for consumer access, ideally near urban or high-traffic areas. Retail nurseries additionally require adequate space and facilities for production, either on-site or at a nearby location.

Mail-order nurseries also sell directly to the end consumer, but their plants are shipped directly to the customer rather than sold at a retail outlet. This is a great option for nurseries that produce specialty plants and whose customers are plant enthusiasts located across the country or globe. The vast majority of mail-order nurseries sell either bare root or small container-grown plants (1 gallon containers or smaller) due to high shipping costs and difficulties in packaging, but larger plants can also be sold by mail-order nurseries if they are highly valuable.

Wholesalers produce plants that are typically sold in large batches at significantly lower prices to landscapers, retailers, or other nurseries, which grow and resell the material at a larger size. Wholesale production is most efficient and profitable when a limited number of plants are grown in large numbers.

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Re-wholesalers purchase large orders of various plants from wholesale producers and resell the plants to landscapers requiring diverse but smaller orders.

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Landscape nurseries produce plants for their own in-house landscaping service, but may have a retail outlet as well.

Licenses and Shipping Regulations

Any business that sells plants capable of overwintering outdoors must obtain a nursery or nursery dealer license. In addition, businesses that sell plants to out-of-state customers should also obtain a license, regardless of the plants' ability to overwinter. In Kentucky, these licenses are obtained from the Office of the State Entomologist. Additionally, shipment of plants or plant parts to other states or countries can, in many cases, require a Phytosanitary Certificate. Nurseries can contact the Office of the State Entomologist to determine if a certificate is needed and how it can be obtained.

Market Outlook

The nursery business is driven by new home construction and healthy consumer spending, which have both been sluggish since 2006. A weak economy and relatively high input costs, especially labor, resulted in a weak, though slightly improved, 2012 marketing season. Demand increased in 2015 and 2016 for most green products, particularly trees, shrubs, and sod. Economic recovery and recovery of housing starts improve the outlook for the nursery industry. The green industry saw a modest rebound in 2015 with signs of broader economic recovery, especially more housing starts. Nursery firms continued fairly conservative business strategies, but many nurseries implemented capital improvements beginning in 2014 with a view toward future growth. Planting of long-term crops has increased since 2012 but not to the levels of those before the housing bubble burst in 2008. Nursery producers will want to develop a business plan that takes into account the cyclic nature of the economy and the potential for a related uncertain housing market.

Production Considerations

Site selection

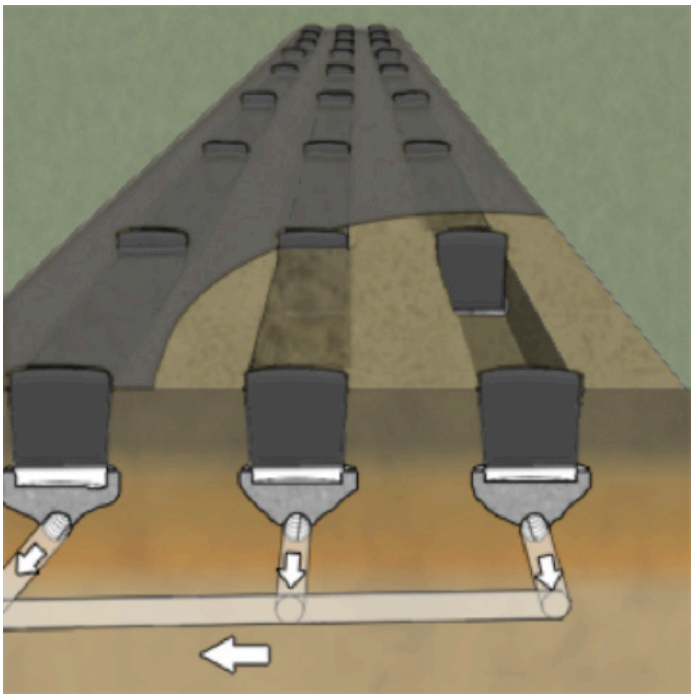
Internal soil drainage is the primary consideration for pot-in-pot production. Drowning of plants when the socket pot fills with water is one of the most common reasons for system failure. Most Kentucky soils do not drain well and a drainage system will need to be installed under the socket pots.

A reliable source of clean, pest-free water is another important consideration in selecting a suitable location. The ideal site will have a slightly sloping topography (1 to 2 percent) and offer water drainage to a pond or retention basin for recycling back to the crop. Avoid fields with hardpans and those that could flood periodically. Sites where cold air accumulates (frost pockets) should only be planted with cold hardy species.

Installation

Installation of socket or in-ground pots requires considerable planning and preparation. The socket pot and production pot need to be compatible units that are manufactured specifically for this purpose. The size of the in-ground pot not only determines the size of the production pot, but also the size of the plants that can be grown. Common sizes for pot-in-pot are #7, #15 and #25 containers. Choice of container size is important based on market demand and is a relatively permanent decision for the system. Consideration of installation methods for low-volume irrigation using in-pot spray stakes must be made at this time.

Holes for the socket pots can be dug individually using the auger method if the soil is well-drained. The trench method is used where sites are poorly drained, and most Kentucky soils require such trenching. In this case, drainage tiles are laid in the bottom of a trench, with socket pots placed directly over the tiles. Regardless of the excavation method, socket pots are permanently buried with only the top rim of the pot extending above ground level. Any weed control fabric that will be used in the planting area is laid after the socket pot installation has been completed. The fabric is stretched over the pots and secured at



the edges. An x-shaped cut is made into the fabric prior to placing the production pot into the socket pot. The production pot containing the tree or shrub in a customized soilless growing substrate is then set into its in-ground pot.

Rooting-out (growth of roots through the production pot's drainage holes into and through the socket pot) can be a significant problem in pot-in-pot production. Rooting-out slows harvest by making it very difficult to remove the inner pot from the socket pot. Reducing root escape can be a challenge, and different mechanical and chemical methods have been attempted with varying success. Refer to University of Tennessee handout, *The Pot-in-Pot (PNP) Production System,* for suggested solutions.

Crop selection

The pot-in-pot system can be used for any tree or shrub that can be grown in containers. Because of the labor and expense required for pot-in-pot installation, it is best to select higher value crops that will bring in greater returns. As is true for any outdoor nursery, the selected species and cultivars must be well adapted to local climatic conditions and reflect the defined market. The initial size of the transplant into the pot-in-pot system will directly affect the up-front costs and the length of the production cycle.

Growing media

The most frequently used growing medium for container production is aged pine bark. Peat and sand are common amendments used in varying amounts. It is important that media be well drained. Mixes remaining overly wet for prolonged periods can result in root death from lack of oxygen or root rot. Media that dries out is difficult to re-wet and will also inhibit root development.

Maintenance

Supplemental water is provided via trickle emitter or spray stake irrigation systems that direct water into each individual container. To maximize irrigation efficiency, plants with similar water requirements should be grouped together. Nutrients are generally supplied using a controlled-release fertilizer incorporated into the growing mix.

Woody plants grown for the landscape trade tend to require specialized pruning. Nursery-grown trees and shrubs are pruned to control size, thin canopy, and improve quality. Shade trees are often pruned in both winter and summer to ensure that a central leader is maintained and the shape of the tree canopy is in proper proportion to the trunk. Shrubs are pruned regularly to establish a height and density for the planned market. Trees may need to be staked to maintain a straight trunk.

Pot-in-pot plants do not require winter protection in Kentucky if the pot-in-pot system is installed correctly. Insulating native soil must come up to the brim of the socket pot, and there must be a tight seal between the two pots, as well as between the socket pot and the ground.

Pest management

Insect and disease pests vary, depending on the plant species and cultivar. Management requires integrated pest management (IPM) strategies, such as planting resistant cultivars, scouting for pests, managing irrigation times, and practicing best management practices.

A vegetation-free area needs to be maintained around trees and shrubs in pot-in-pot production. Landscape fabric may be placed over the production area to reduce weed pressure. Alternate methods of weed control include hand weeding, mowing, mechanical cultivation, mulching, and chemical methods. Strategies for managing weeds between rows (row

"middles") include cover cropping (most often with fescue or crimson clover), mowing, mechanical cultivation, and chemical methods.

Algae can be a serious problem in irrigation systems and in ponds serving as sources of water. Two major contributing factors are over-fertilization and over-irrigation, which increase nutrient run-off into ponds. Shallow, stagnant water also increases algal growth in ponds, so shallow areas may need to be dredged and deepened.

Harvest

Pot-in-pot plants are generally sold as finished plants with all the characteristics expected in the marketplace regarding form, size, branching, and trunk size. Plants in their production pots are lifted from the socket pot and can be quickly harvested any day of the year. The time it takes for plants to reach a saleable size varies depending on the type of plant and growing conditions.

Plants can be grown in a single container for only a limited length of time. Pot-in-pot nursery crops are generally rotated through production on a two-year cycle. Plants must be re-potted to a larger container before they outgrow their current container, otherwise plant quality is greatly reduced and plants become unsalable. Severe root escape can also make removal of the production pot extremely difficult, and costly damage to the pot-in-pot system may become unavoidable.

Labor requirements

Labor is required for potting, pruning, irrigating, controlling weeds, staking, applying pesticides, and harvesting. The level of management for pot-in-pot is intermediate between the low demand of field production and the higher demand of container-grown plants. Approximate per tree labor requirements include 10 minutes for planting, 30 minutes for pruning, 30 minutes for maintenance, and 5 minutes for harvest.

Economic Considerations

Beginning a nursery business requires a large capital investment, even if land does not need to be purchased. The main expenses involved in establishing a pot-in-pot site include the drainage system, socket containers, irrigation system, and socket pot hole excavation. The greatest drawback of pot-in-pot production is its significantly higher initial expense compared with other production methods. Other expenses not included in the estimate below but common to the nursery industry include equipment, buildings, utilities, insurance, licenses, inspections and capital costs. With the large overhead investment required, a pot-in-pot nursery will usually take six or more years to be economically profitable.

Despite the large start-up costs, overall return for pot-in-pot has been reported to be equal to or greater than conventional field or aboveground container production. This is because the initial investment can result in production efficiency, labor cost savings, and possible marketing advantages over other systems. However, a grower must be prepared to make substantial investments before realizing any positive returns. It can take two to four years of operation before significant returns can be expected, and an additional three to five years before showing a profit. Price fluctuations may result in a longer payback period, as pot-in-pot production is extremely sensitive to sale price. The nursery operator will need to be able to handle the cash flow ups and downs associated with seasonal sales.

Below are 2016 per acre budget estimates for pot-in-pot production (1,144 red maple trees in #15 containers per acre for two growing seasons and marketing 1,087 trees). Use these numbers only as a guideline. Budgeting aids are listed in the Selected Resources section to allow estimates to be made for a specific operation.

Item	2016 Estimates
Installation costs[1]	$32,000
Planting costs[2]	$31,000
Production costs[3]	$6,500
Harvest costs[4]	$500
Revenue[5]	$81,525

[1] Includes sockets, fabric, and irrigation system, 20-30 years of life

[2] Includes liner, insert pot, labor, media, and stakes

[3] Includes pesticides, irrigation, fertilization, and labor for 2 years

[4] Includes labor, etc.

[5] Based on 1,087 trees marketed at $75 per tree

Selected Resources

- Kentucky Office of the State Entomologist (University of Kentucky) http://www.uky.edu/Ag/NurseryInspection/

- Marketing Your Nursery (University of Kentucky, 2013) http://www.ca.uky.edu/HLA/Dunwell/marketingyournursery.html
- Nursery Crop Production (University of Kentucky, 2013) http://www.ca.uky.edu/HLA/Dunwell/Nlgetstart.html
- Nursery Crops (Win Dunwell's Web page) (University of Kentucky) http://www.ca.uky.edu/HLA/Dunwell/win1.html
- Physical and Economic Requirements for Pot-in-pot Nursery production (University of Kentucky, 1996) http://www.ca.uky.edu/HLA/Dunwell/PNPMCN.html
- Plant Material Shipments: Federal and State Plant Protection Regulations Relevant to Your Nursery Business (University of Kentucky, 2011) http://www.ca.uky.edu/agc/pubs/ho/ho99/ho99.pdf
- Pot-in-Pot Nursery Production (University of Kentucky, 2011) *video* http://www.youtube.com/watch?v=wNeBurkznIk
- Pot-in-pot Nursery System Cash Flow Worksheet (University of Kentucky, 2009) http://www.uky.edu/ccd/tools/budgets
- Pot-in-pot Nursery System Cash Flow Worksheet Annual Sales Version (University of Kentucky, 2010) http://www.uky.edu/ccd/tools/budgets
- Sustainable Production Systems: Efficient Wholesale Nursery Layout (University of Kentucky, 2013) http://www.ca.uky.edu/agc/pubs/HO/HO109/HO109.pdf
- Trees, Shrubs, Ground Covers and Vines Suitable for Kentucky Landscapes, HO-61 (University of Kentucky, 1997) http://www.ca.uky.edu/agc/pubs/ho/ho61/ho61.pdf
- Best Management Practices: Guide for Producing Nursery Crops (Southern Nursery Association, 2007) http://www.sna.org/Default.aspx?pageId=1140025
- Commercial Nursery Production Information (University of Tennessee) https://extension.tennessee.edu/mtnpi/Pages/default.aspx
- Comparison of Field, Conventional Container, and Pot-n-pot Production (University of Tennessee, 2009) https://extension.tennessee.edu/mtnpi/Documents/handouts/Beginning_in_Nursery/Comparision_of_Production_Systems.pdf
- Economics of Producing Nursery Crops Using the Pot-in-Pot Production System: Two Case Studies (University of Tennessee, University of Florida, Auburn University, 2002) https://extension.tennessee.edu/mtnpi/Documents/handouts/Pot-N-Pot%20Production/Pot-N-Pot_Economics.pdf
- IPM for Select Deciduous Trees in Southeastern US Nursery Production (Southern Nursery IPM Working Group, 2012) http://wiki.bugwood.org/IPM_book
- Nursery Crop Science Commercial Horticulture Information Portal (North Carolina State University) http://www.nurserycropscience.info/
- Pot-in-Pot (PNP) Production System (University of Tennessee, 2009) http://www.tnstate.edu/faculty/ablalock/documents/Pot-N-Pot.pdf
- Sustainable Small-scale Nursery Production (ATTRA, 2008) http://attra.ncat.org/attra-pub/nursery.html

Reviewed by Carey Grable and Josh Knight, UK Extension Associates **January 2017**

Photos by Dewayne Ingram (Page 1), Sarah Vanek (Page 2), University of Kentucky; graphic by Josh Knight (Page 3), University of Kentucky

For additional information, contact your local County Extension agent