Nursery Tree Production and Transplant Success of *Pyrus calleryana* ‘Glen’s Form’ (Chanticleer®) Influenced by Container Types and Overwintering Treatments

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Nursery Tree Production

- The Colorado Green Industry (GreenCo) is a $1.8 billion industry yearly
- Nursery and tree care sectors amount to $503.3 million yearly
- Nursery tree production can be done in many ways, but primarily trees are sold as balled and burlapped (B&B) or containerized (some bare root)
Field Grown Trees
Containerized Trees

- Container tree production is a very popular way to grow ornamental trees in the nursery.
- More common than field-grown trees in many parts of the U.S. (Hodges et al. 2008)
Advantages of Containerized Trees

- For the nursery:
  - Easier to move and handle during production
  - May take up less space
  - Easier to ship
  - Roots remain intact during production
  - More marketable to consumers

- For the consumer:
  - Easier to move
  - Less intimidating than B&B
  - Easier to transplant
Disadvantages of Containerized Trees

- Inputs are often greater than field production
  - Media
  - Fertilizer
  - Water
  - Labor
- Abnormal root growth
  - Circling roots
  - Malformed roots
- Container type may increase media temperature
  - Root death
The Black Plastic Pot

- Relatively inexpensive for producers ($4.25 for a #15)
- Made from many different plastic types
- An estimated 350 million pounds of black plastic containers are thrown away each year (Missouri Botanic Gardens)
- The black color absorbs heat, increasing media temperatures and ultimately killing roots
- Pot shape and slick sides are prone to circling roots, or misshapen roots
Container Media Temperatures

- Woody plants prefer root temperatures between 15-27 °C (59 °F to 80 °F)
- If temperatures increase beyond ideal thresholds then water and nutrient uptake is affected; possibly root morphology
- If too cold (-5 to -23 °C) the root cells are frozen and root death occurs
- If too warm (above 35 °C), roots degrade and cells die
- Typically on the west or southwest side of the container

What Are the Other Options?

- Studies have been done using varying types of container materials
  - Colored plastic (i.e. white)
  - Pressed fiber
  - Recycled foam padding (Ohio State—currently in research)
  - Recycled insulation (Ohio State—currently in research)
  - Fabric
  - Many others
Any Success?

- Some have promising results, but expense, production differences and availability may prevent nurseries from using these materials.
- Black plastic still most common and most economical in many cases.
Disadvantages of Overwintering Containerized Trees

• Overwintering containers in northern climates is expensive and takes a lot of labor
• Three overwintering methods
  • Consolidated in production area and covered with plastic
  • Consolidated and placed in a poly-covered Quonset structure
  • Larger plants are left in the field and “heeled in” with mulch
• An estimate from Willoway Nurseries (Avon, OH) found that to consolidate 300 acres of containers costs nearly $500,000 each year (Dan Struve, personal communication)
What We’re Studying...

- Using Chanticleer® pear....
Why Chanticleer® pear?

- *Pyrus calleryana* Decne. ‘Glen’s Form’
- The industry has some trouble overwintering this species in containers
  - Branch dieback
  - Flowers too early (?)
- Popular ornamental landscape tree
  - Pretty white flowers
  - Shiny, glossy green leaves
  - Reddish-purple fall color
What We’re Studying…

- Using Chanticleer® pear:
  - **Experiment #1:**
    - Three different container types
    - Evaluate plant growth and media temperatures during nursery production
    - Two overwintering methods will be tested on the three container types
  - **Experiment #2:**
    - Take trees produced exactly to those in Experiment #1 and plant them to evaluate landscape establishment potential
Hypotheses—Production Experiment

- Container type will affect root growth during production; the fabric containers will reduce or prevent root circling compared to black plastic.
- The trees will grow faster, with greater root:shoot ratios in the fabric containers than in black plastic.
- The fabric containers will allow for overwintering success without added labor to consolidate pots in the fall.
- Ambient soil temperatures in the fabric containers will be moderated, with fewer extreme temperature swings than seen with black plastic pots, and may prevent root desiccation from extreme heat or cold temperatures.
Hypotheses—Landscape Establishment

- Trees grown in the fabric containers will establish better (and more quickly?) than those grown in black plastic, because of improved root systems.
- Measured by photosynthetic gas exchange and growth and pre-dawn leaf water potential.
Materials and Methods

- Nursery production plot is at PERC on the CSU campus on the east side of the greenhouses
The Containers

- All #15 in size
- Container #1: Black Plastic
- Container #2: Root Pouch®
- Container #3: Smart Pot®
Container #1: Black Plastic

- Purchased from Fort Collins Wholesale Nursery (Fort Collins, CO) for $2.75/ea.
- Previously used
- Have handles
- Measures 20”W x 15”T
Container #2: Root Pouch®

- Averna & Associates, Hillsboro, OR
- Retail cost $2.20
- Have handles
- Made, in part, from recycled water bottles
- Biodegradable, lasting 3-4 years
- Measures 17”W x 15”T
Container #3: Smart Pot®

- “The air pruning fabric container”
- High Caliper Growing-Root Control, Inc., Oklahoma City, OK
- Retail cost $3.00
- No handles
- Measures 18”W x 14.5”T
Trees Planted in May 2010
Materials and Methods

- Destructive Nursery Harvests
  - September 2010
  - September 2011
Materials and Methods

- Landscape planting dates
  - October 2010
  - October 2011*
  - March 2012*
  - October 2012
- Once planted, trees will be measured for height and caliper monthly
- Pre-dawn leaf water potential as a measure of plant water stress
- Photosynthetic gas exchange as a measure of plant stress and growth potential
- Trees will be air spaded to look at establishing root system

*The March 2012 planting will replace the October 2011 planting due to storm damage
Overwintering Treatments

- Left “lined out”
  - Trees were placed pot-to-pot in a single row attached to the wire
  - Pots were randomly placed on the line
  - Media temperatures will be taken in center and on SW side
    - 5 cm down (center)
    - 5 cm down and in (SW)

- Consolidated into a block
  - The trees from each experiment were randomly placed pot-to-pot in a 5x6 block (30 total trees)
  - Media temperatures will be taken in center and on SW side
    - 5 cm down (center)
    - 5 cm down and in (SW)
Overwintering Process #1: “Lined out”
Overwintering Process #2: Consolidated
Results 2010

- In 2010 there were no significant container effects on: season-end height, fresh and dry leaf weight, shoot and root weight, and new growth increments.

- Differences in caliper, root ball integrity, circling roots, and root matting were significantly different among container types.

- Root balls of trees grown in Smart Pot® (SP) containers were more prone to breaking apart compared to black plastic (BP) or Root Pouch® (RP).

*Significant at the $Pr > F 0.05$
Results 2011

- In 2010-2011, overwintering treatments were significant* for height, dry leaf weight, dry shoot weight, leader growth and total root ball dry weight
  - The consolidated overwintering treatment resulted in larger plants with significantly larger root systems (almost 350 g more by dry weight)
- Container type was significant* for leaf area, percent leaf moisture, root ball quality and bottom root matting
  - For most measurements, the black plastic pots differed significantly than fabric container types

*Significant at the $Pr > F 0.05$
Height (cm) of Chanticleer® pear grown from 2010-2011 in three container types.

*Indicates significance at the Pr > F 0.05
Caliper (mm) of Chanticleer® pear grown from 2010-2011 in three container types.

* Indicates significance at the Pr > F 0.05
Average Weekly Media Temperatures (C) from 12 Dec 2010 to 10 April 2011
(Container Type x Overwintering Treatment)
Average Weekly Media Temperatures (C) from 19 May 2011 to 6 Oct 2011 (Container Type and Time of Day)

Dataloggers flooded
A few conclusions

- It was observationally noted in spring 2011 that BP trees flowered and leafed out earlier than RP and SP trees and likely suffered more frost damage on early spring growth; growth for BP trees was significantly less vigorous in 2011.
- Black plastic containers warmed up the media faster, which stimulated growth
A few (more) conclusions

- After the first growing season, new root growth reached the sides of BP containers and started to circle, but this was less common for RP and SP containers.
- The fabric may have stopped root growth when it came in contact with air (“air pruning”) instead of smooth-sided plastic, forcing roots to branch back within the root ball and not continue growth on the outer periphery.
- Harvest 2 data confirms this; BP containers had significantly more circling roots than RP or SP containers.
What’s the bottom line?

• Thus far...
  • Leaving plants “lined out” isn’t the best management strategy; plants grew better in the consolidated blocks
  • Black plastic containers, at this point, are not “winning” the race
    • The two fabric types are growing better plants
Where We’re at Currently

• Processing and analyzing statistics for the nursery production study
  • Plan to publish results in the *Journal of Environmental Horticulture*

• Processing and analyzing statistics for the first season of landscape establishment study
  • Were the root systems really that different?

• Two additional landscape plantings in 2012

• Data collection for landscape establishment will continue in 2012 and 2013
Have you hugged your root ball lately???
Questions and Comments?