GROWERTALKS

Features

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Rethinking the Black Nursery Pot

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Figure 1. Container-type trials at the University of Florida with blueberry, ginger, lemongrass, olive and turmeric.

Figure 2. Substrate temperatures inside three types of container: a black nursery pot, a black Pioneer pot that has a double layer (insulation) and evaporative cooling in the inner layer, and a white-painted Pioneer pot, which also reflects radiation. Temperature was measured on the south side of the pot between substrate and plastic wall at 4-in. (10-cm) depth on a warm and sunny Florida day (89F/31.7C) air temperature with an average 1,773 micromol·m-2·s-1 of photosynthetically active radiation.

Just imagine if you were forced to sit in a black plastic spa pool all day in sunny summer weather surrounded by black landscape weed mat. You might sympathize with how hot roots get in a black nursery container!

In the first part of this series, we presented data showing that soil temperatures in the summer in a black nursery container can easily reach 126F (52C), even in northern U.S. locations like Minnesota. In contrast, optimal root temperature for many temperate plants is around 77F (25C), with increasing stress and mortality above 86F (30C).

Negative effects of high root zone temperature on plant growth include:

• Lower leaf photosynthesis, resulting in decreased crop yield and quality

• Root death and less root growth, especially of fine root hairs

• Rapid drying of the substrate

• Reduced root function in terms of nutrient and water uptake

• Increased infection of stressed root systems by pathogens

• Lower dissolved oxygen available for roots in hydroponics

If you're growing plants that are exposed to high sunlight intensity and warm air temperature—such as nursery stock, fall mums, hemp, or potted vegetables or blueberries—consider strategies to reduce root temperature in order to reduce losses while increasing crop yield and quality. University of Florida (UF) and University of Minnesota trials, and a wealth of other researchers, have shown the importance of pot type in terms of:

• **White outer color** to reflect incoming radiation. In a study by Markham et al. (2011), flat or gloss white-painted

pots had lower substrate temperature than silver-painted pots, which in turn was lower than either black or green pots. Most white containers have an inner dark-colored layer to exclude light, which can inhibit root growth in many species.

• **Insulation** options, such as an air layer between an inner and outer pot (as in a Pioneer pot or other pot-in-pot systems), partially burying the pot, or using material like polystyrene foam. Ease of pot transport, respacing and reduced setup costs are advantages if the insulation is built into the above-ground pot itself, rather than burying the container.

• **Evaporative cooling** using materials such as a porous fabric (for example, paper, felt or coconut coir) or with a slitted container that allows water loss through the container wall. An important consideration is that pots with evaporative cooling use more irrigation water. For example, an extensive multi-state study by Wang et al. (2015) measured around 25% more water use in fiber pots than non-porous plastic, but this varied by location and container material.

Figure 2 shows the improvements that result from the double insulating layer and evaporative cooling from the inner liner of a black Pioneer pot, compared with a black nursery pot. White color further reduced the temperature to 27F (14.7C), cooler than a black pot.

Figure 3 shows the maximum substrate temperature that occurred over the course of a 10-month growing season in Gainesville, Florida. Temperatures of the black pots were in the high stress range above 115F (46.3C). This temperature was reduced by A) white paint applied to the black container; B) growing in a Pioneer pot that has an inner slitted pot inside an insulating outer pot; or C) using a white fabric Light Pot.

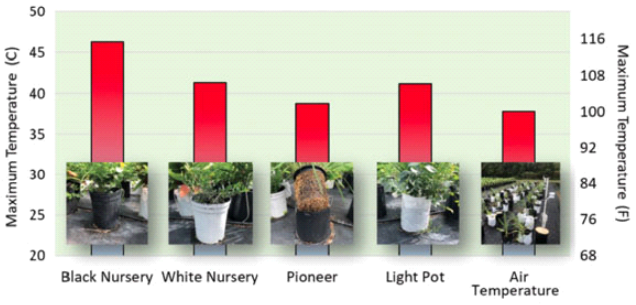

Figure 3. Maximum substrate temperatures (three sensors per pot type, 2 in. [5 cm] down into the pot and 1 in. [2.5 cm] from south edge) measured between July 2020 to April 2021 with four pot types—a black nursery pot, white-painted nursery pot, black Pioneer pot-in-pot and white fabric Light Pot—and compared with air temperature.

Figure 4. Effect of pot type on early establishment of olive liners (October 14, 2020, three plants per pot, 13 weeks after transplant).

Reduced temperature results in increased plant growth. For example, in our UF trial, we saw statistically consistent effects for blueberries and olives. Figure 4 illustrates the faster growth of olive liners in Pioneer and Light Pots. Blueberries and olives grown for 10 months in Pioneer pots had a 33% larger caliper compared with black nursery pots. Shoot fresh weight (grams per pot) was higher in Pioneer pots (730g) or Light Pots (700g) compared with black pots (482g) or white pots (567g). This would result in shorter crop time, and potentially more crop turnovers and harvested yield.

There are other strategies to reduce root zone temperature:

• Sunlight intensity can be reduced through shading, but only shade to the extent that low light does limit photosynthesis and crop yield. Movable shade that's applied during peak heat hours is more efficient than fixed shade.

• Do not let plants dry out. This is a common-sense strategy to allow plants to transpire and cool leaves in hot conditions. Water also buffers temperature increase and evaporation of the soil surface has a cooling effect. For example, Amoroso et al. (2010) found that soil temperature was up to 2 to 5C cooler for plants irrigated to 100% of container capacity compared with plants lightly watered to 30% of container capacity.

• Low irrigation water temperature will have a temporary cooling effect, but avoid A) waterlogged conditions; and B) the shock of overhead application of cool water onto warm foliage in sensitive species like African Violets. Water

chilling is a key strategy in hydroponic systems, such as nutrient film technique (NFT) in summer.

• Large container size. Substrate in the center of pots varies less than the outside layers close to the pot wall. Large pots dry out more slowly, have less surface area relative to volume and buffer temperature change.

There are many factors that go into selection of pot type and other strategies to reduce root zone temperature. For example, market demand for particular pot types, appearance at retail, plant movement around the nursery, ease of removal from the container for transplanting, availability (especially in COVID times!) and cost all affect container choice. A black nursery container may be the cheapest option, but saving pennies on a pot may be an expensive choice in terms of yield, quality and crop shrinkage. **GT**

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