Significance to Industry

The economic cost to the U.S. nursery industry of bark cracking is conservatively estimated at $6.6M annually (or 2.5% of finished inventory) according to recent calculations. This estimate does not include the additional estimate of $14M in landscape tree failures due to bark cracking. The nursery cost estimates continue a pattern of strong and steady increased severity and frequency of bark cracking throughout the US nursery/landscape industry since 2004. Concurrently, (2001-05) consumer preference for faster working glyphosate products was driving the production and use of various surfactants to break down the outside of plants to increase the rate and amount of glyphosate uptake. However, in 2005 researchers at Ohio State University (OSU) speculated that bark cracking was not solely related to cold injury as was widely and previously accepted (Mathers, 2006) but that the absorption of glyphosate into thin or pigmented-bark was also a factor due to the reduction of cold hardiness. Exposure of an ornamental plant to glyphosate through green bark is considered a sub-lethal dose (Kuhns, 1992).

Nature of Work

Sweetbay magnolia (Magnolia virginiana) and kousa dogwood (Cornus kousa) were planted in the field the week of May 21, 2007 on Waterman Farm at Ohio State University Columbus, OH. Trees were all one year old bare root plants with an average height of 42 cm and a caliper of 4.1 cm. The experimental design was a split plot design (treatment=main plot, sub-plot/species or sub-sub plot) in a randomized complete block with seven sub samples per species, per treatment, with five replications. Plants were spaced 2’ x 9’ in and between rows, respectively. Overhead irrigation was immediately applied following planting (Fig. 4).

Field Treatments: Two fertilizer treatments of ammonium nitrate were applied on June 13, 2007: 125 pounds per acre and 250 pounds per acre. Additionally, Osmocote (14-14-14) was applied at a rate of 50 lbs/N/acre on August 1. Four herbicide or weed suppression treatments were subsequently applied on June 22, July 25, August 29, and October 2 (2007): Roundup Original Max, Roundup Pro, and a 1% solution of Ample 60. The herbicide treatments were applied at a 5% solution, or 6.5 ounces/gallon. All herbicide treatments were applied using a five gallon backpack sprayer with a LFG 80” nozzle.

Freezing Treatments: On December 3, five of the seven sub samples were dug out of the field. Plants were soaked overnight in water to lessen soil from roots. Roots were washed on December 4 and 5, 2007 and measured using a volumetric flask and with displacement to estimate root volume. This technique was repeated after bottom heat treatments were imposed for 70 days. Trees were placed in quart or pint size (depending on mass of roots) polyethylene bags and filled with a moistened 50-50 sand/perlite mixture to cover roots and tied with wire ties. Trees were then put inside a walk-in cooler set at 5° C ambient temperature (Fig. 5). Two-sided wooden boxes, measuring 3’ x 10’, were placed in the cooler with heating mats set at 8°, 11°, 14°, and 17° C under each box. Sawdust was packed around the bags containing trees in the boxes to facilitate even heating over the root surface. To assess cold hardiness, 1-3 millimeter segments of stems (new growth) and primary roots were removed. Two to three segments of each roots and stems were put into test tubes and put into an ultra low freezer (Formic Scientific, Inc., Marietta, OH). Segments were frozen at a rate of -6° C per hour at the following temperatures: no freezing, 4°, 12°, 18°, 24°, and 30° C. Immediately after removing from freezer, 3 milliliters of distilled water was added to each test tube, and shaked overnight at 200 rpm. An initial baseline electrical conductivity (EC) reading was taken at this time for all temperature treatments. The tubes were then autoclaved at 121° C for 20 minutes to completely kill all cells. The tubes were then shaken again overnight at 200 rpm. After shaking, a final EC reading was obtained for all treatments. The baseline EC was subtracted from the final EC and recorded as the differential EC for reporting of cold hardiness. The assumption is that the higher the differential, the greater the cold hardiness of the tissue (Stergios and Howell, 1973).

Graphs

References


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-Undergrad Somerfield
-Dani Riveria

Department of Horticulture and Crop Science Ohio State University