

Cold Hardiness Comparison of Containerized and Bareroot Tree Liners Outplanted in the Field

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Significance to Industry: Retractable roof greenhouses (RRG's) have been found to increase growth (Stoven et al., 2006) reduce disease incidence, extend growing seasons (Stoven et al., 2006) and produce superior containerized tree liners (Mathers et al., 2002; Stoven et al., 2006). The RRG grown containerized liners offer a feasible alternative to field bareroot liner production based on price, availability and niche markets such as coarse-rooted, difficult-to-transplant and native taxa. Additionally, data indicates RRG grown tree liners have decreased mortality rates after planting into the field and accelerate tree field production in Midwestern states when planted in October out of 3 gallon containers versus bareroot liners produced in the Pacific Northwest (PNW) or liners grown in a combination heated greenhouse-outdoor (CHGO) production environment (Mathers et al., 2005).

Materials and Methods: At The Ohio State University (OSU) Waterman Farm, Columbus, OH, four species of tree liners were out-planted from three environments. Tree were irrigated and fertilized as per Mathers et al. (2005). The three environments where liners had been produced were a peaked RRG (Cravo Equipment, Ltd., Brantford, ON, Canada) in 11.4 L classic Spinout® treated containers (Nursery Supplies, Inc., Fairless Hills, PA), a combination heated greenhouse-outdoor (CHGO) production environment also in 11.4 L containers at OSU, Columbus, OH and bareroot liners from Pacific Northwest (PNW) nursery fields, Canby, OR. The OSU liners had been produced according to the methods described by Stoven et al. (2005). The OSU liners were planted in the field in October 5, 2003 and bareroot liners were planted (when traditionally available for planting in Ohio) April 26, 2004. All plants were trained to 2 m tall bamboo stakes (A.M. Leonard, Inc., Piqua, OH) installed at planting. In August 2005, the bamboo stakes were replaced with TMO-PRO stakes (T-MATE-O, Charlestown, IN). Perennial ryegrass was seeded in the fall of 2003 between the rows and mowed as required. Row spacing between-rows is 12 ft and in-row 6ft. The four species evaluated are, *Acer xfreemanii* 'Jeffersred' (Autumn Blaze™ red maple), *Malus* 'Prairifire' (Prairifire crabapple), *Cercis canadensis* (Eastern redbud) and *Quercus rubra* (red oak). Cuttings were taken from terminal ends of shoots on January 29 and March 21 (deacclimation study) of 2007 to assess cold hardiness. Cuttings were placed in a cooler overnight at 5⁰ C. The plants were then frozen at nine temperatures (-6⁰, -9⁰, -12⁰, -15⁰, -18⁰, -21⁰, -24⁰, -27⁰, and -30⁰ C) in an ultra low chest freezer (Forma Scientific, Inc., Marietta, OH). The ultra low chest freezer was programmed to decrease temperatures at 3⁰ C per hour. Cuttings were removed from the freezer after the temperature reached the desired level and then stored overnight in a 5⁰ C cooler. The twigs were placed in an incubator with 100 percent humidity for 7 days. Two viability evaluation methods, visual ratings (amount of live tissue) and TTC (Triphenyl Tetrazolium Chloride) were used. Visual observations were conducted on a 1-5 scale with 1 being fully alive or no damage

and 5 being completely dead and with a brown cambium layer. TTC was performed by using the methods of Ruf and Brunner (2003). Visual observations and TTC analysis data were subjected to ANOVA using the GLM procedure within SAS® (SAS Institute, Inc., Cary, NC, 2000). Fisher's least significance difference test were used to compare means a $P \leq 0.05$ was used (SAS® Institute Inc.). The Type II Sum of Squares analyses was performed and graphs were produced in Excel from the analyses. All factors were considered fixed effects; therefore all terms were tested for significance against the error mean square.

Results and Discussion: Visual differences for regrowth demonstrated significance within species from -6°C to -30°C (Figure 1). When pooled over species, there were no significant differences noted from -6°C to -30°C . TTC readings demonstrated no significant differences between trees from the RRG, bare root trees from the West Coast, or CHGO visually or through TTC readings (Figure 2). According to Ruf and Brunner (2003), reduction of triphenyltetrazolium chloride (TTC) is directly linked to the respiratory chain. This is the indication of alive versus dead tissue. Visual readings measure the amount of green tissue remaining within the cambium layer (Stergios and Howell, Jr., 1973). This accounts for the differences between visual readings and TTC readings. Data from this experiment provides evidence that cold hardiness is not affected by previous environment.

Literature Cited

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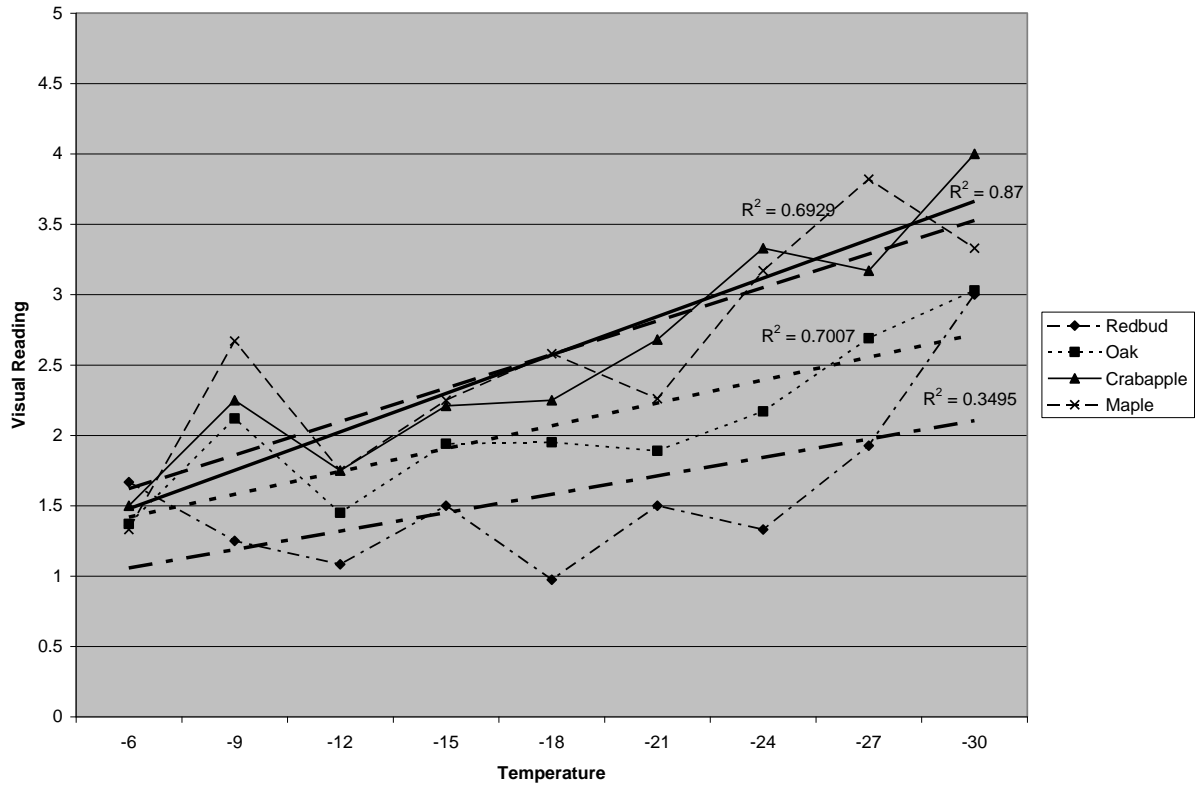


Figure 1. Visual ratings of four species of nursery liners over nine temperatures averaged over three environments (LSMeans with $\alpha = 0.05$: Redbud = 0.6, Oak = 0.74, Crabapple = 0.71, Maple = 0.77). Visual ratings were conducted on a 1-5 scale with 1 being fully alive or no damage and 5 being completely dead and with a brown cambium layer.

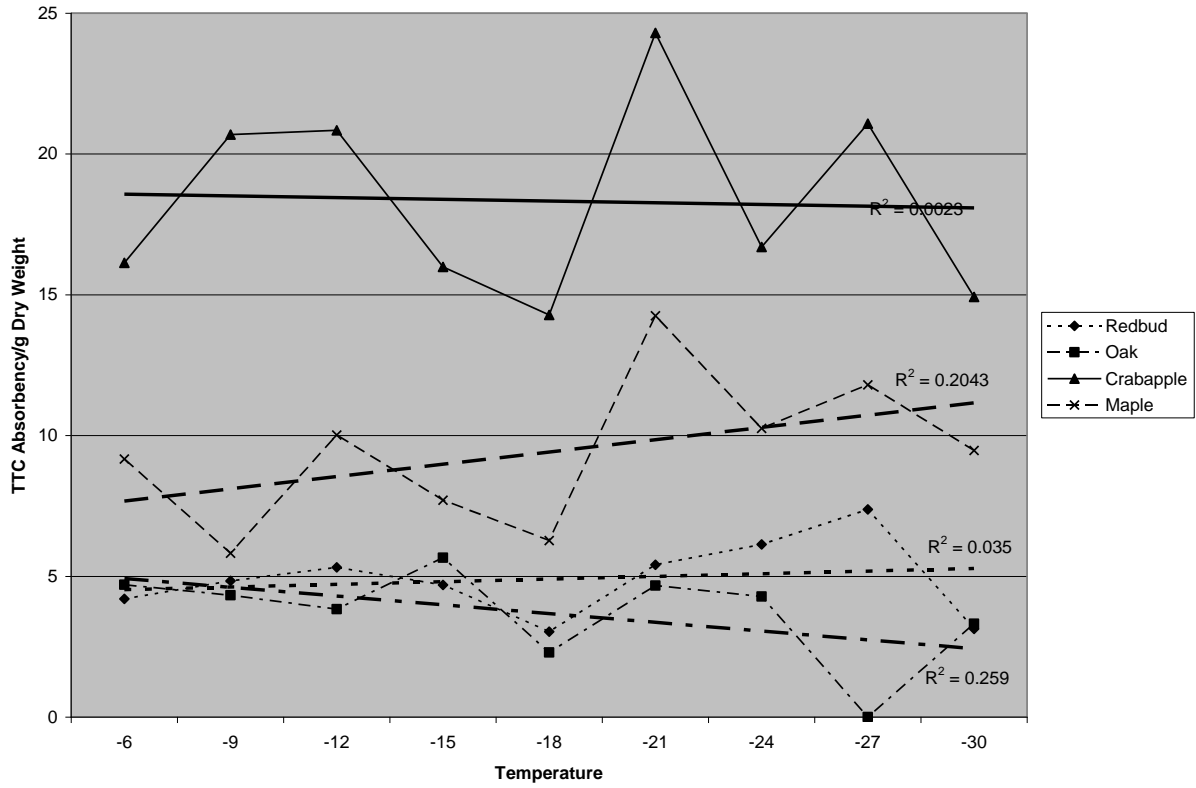


Figure 2. Triphenyltetrazolium chloride readings of three temperatures on four species of nursery trees. Note that no significant differences noted at the $P = 0.05$ level (within each species).