Effect of Herbicides and Grass/Groundcover on Cold Hardiness of Field Grown Nursery Stock

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Significance to industry: Weed control is a vital aspect of nursery production. Weeds can compete with the crop for nutrients, light, and water, and can harbor insects or disease. With as much as $4000/ac/year spent on chemical herbicides within the nursery/landscape industry, it is a major expense. A way to minimize postemergence herbicidal cost and labor is by the use of preemergence herbicides. Preemergence herbicides form a barrier in the top two inches of the soil profile, which is where a portion of the feeder roots of the crop are located. According to Pellett (1971) (Chandler, 1954; Pellett and White 1969; Weiser, 1970), within the same plant, the root system is considerably less cold hardy than that of stem tissue under field conditions. The objective of this study is to evaluate the cold hardiness of three species of tree liners grown in grass groundcover, cultivated and herbicide treated (flumioxazin) environments.

Materials and Methods: At The Ohio State University (OSU) Waterman Farm, Columbus, OH, three species of tree liners were planted (*Malus* 'Prarie Fire', *Cercis Canadensis,* and *Quercus rubrum*) on October 26, 2004. There were three treatments, which included: herbicide applied in fall and spring (Sureguard), grass ground cover up to tree (tall fescue), and bare soil (cultivated). There were four replications per treatment and three sub samples per replication. Trees were subjected to Sureguard (flumioxazin) treatments on November 18, 2004, April 14, 2005, August 19, 2005, and April 27, 2006. Tall fescue was seeded on April 18, 2005. Cultivation was performed as needed in the clean cultivation treatments. Cuttings were taken from terminal ends of shoots in January of 2007 to assess cold hardiness. Cuttings were placed in a cooler overnight at 5^0 C for acclimation. The plants were then frozen to nine temperatures at 3° C increments (-6º, -9º, -12º, -15º, -18º, -21º, -24º, -27º, and -30º) in an ultra low chest freezer (Forma Scientific, Inc., Marietta, OH). The ultra low chest freezer was programmed so that the temperature was lowered at a rate of 3^o C per hour. Cuttings were removed from the freezer after the temperature reached the desired level and then placed in a 5° C cooler overnight for acclimation. After acclimation, the trees were placed in a 100% humidity chamber for 7 days. Two viability evaluation methods, visual (amount of live tissue) and TTC (Triphenyl Tetrazolium Chloride) were used after cold treatments were imposed. Visual observations were conducted on a scale of one to five (one being no damage, intact, green cambium layer; five being dead, brown, non-intact cambium layer). 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 were significant for redbud from -6 to -30 (Figure 1). For oak, significant differences were noted for visually when comparing -30 to other temperatures. There were no significant differences noted visually for crabapple. There was a trend indicating that redbud had the greatest cold hardiness, while crabapple had the least cold hardiness (Figure 1). TTC readings were not significant for treatment or temperature for any of the species (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). From this study, there seems to be no differences on cold hardiness between trees where SureGuard and glyphosate are applied, trees with a grass groundcover, and trees where there is cultivation. The study is being repeated in 2007.

References:

Chandler, W.H. 1954. Cold resistance in horticultural plants: a review. Proc. Amer. Soc. Hort. Sci. 64: 552-572.

Pellett, H. 1971. Comparison of Cold Hardiness Levels of Root and Stem Tissue. Can. J. Plant Sce. 51. pp. 193-195.

Pellett, N. E. and White, D.B. 1969. Soil air temperature relationships and cold acclimation of container-grown J*uniperus chinensis* Hetzi. J. Amer. Soc. Hort. Sci. 94: 453-459.

Ruf, M., and Brunner, I. 2003. Vitality of Tree Fine Roots: Reevaluation of the Tetrazolium Test. Tree Physiology. 23: Pp. 257-263.

Stergios, B.G., and Howell, Jr. G.S. 1973. Evaluation of Viability Tests for Cold Stressed Plants. Michigan Agricultural Experiment Journal Article. Number 6241.

Weiser, C.J. 1970. Cold acclimation and injury in woody plants. Science 169: 1269-1278.

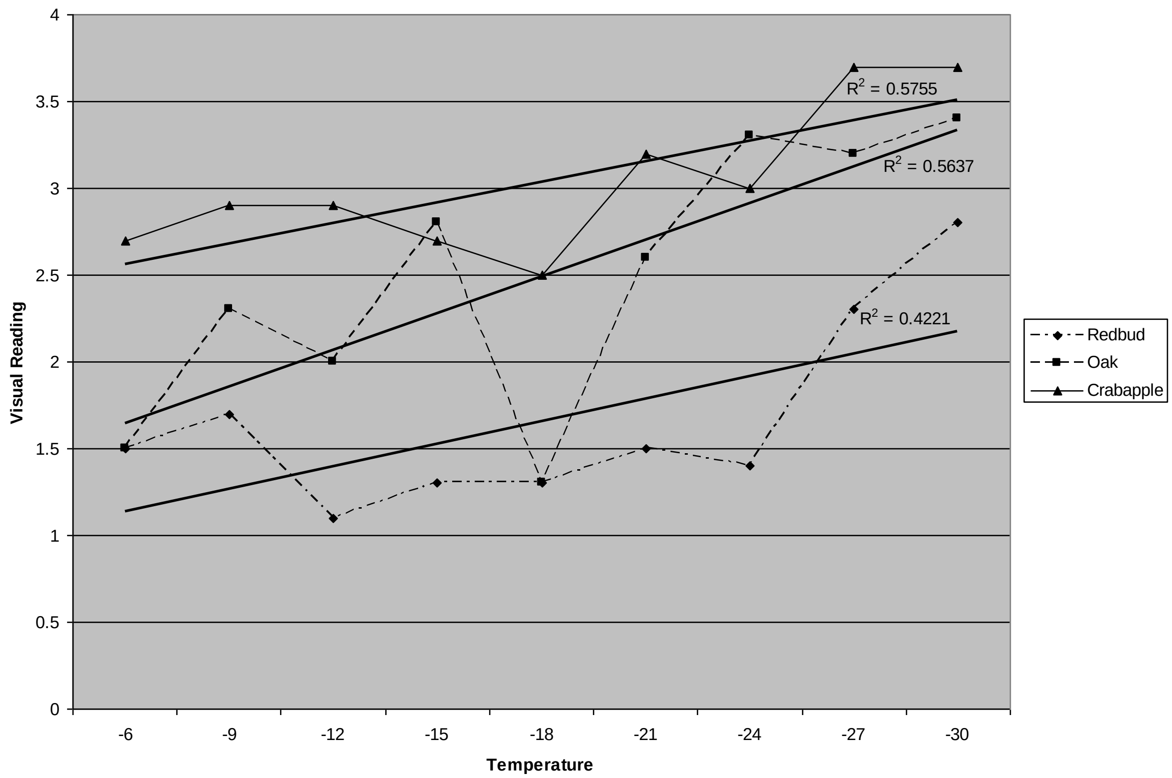

Figure 1: Visual readings of three species of tree liners after freezing at nine temperatures averaged over all treatments. LSMeans based on α = 0.05: Redbud = 0.79, oak = 0.87, maple = 1.05.

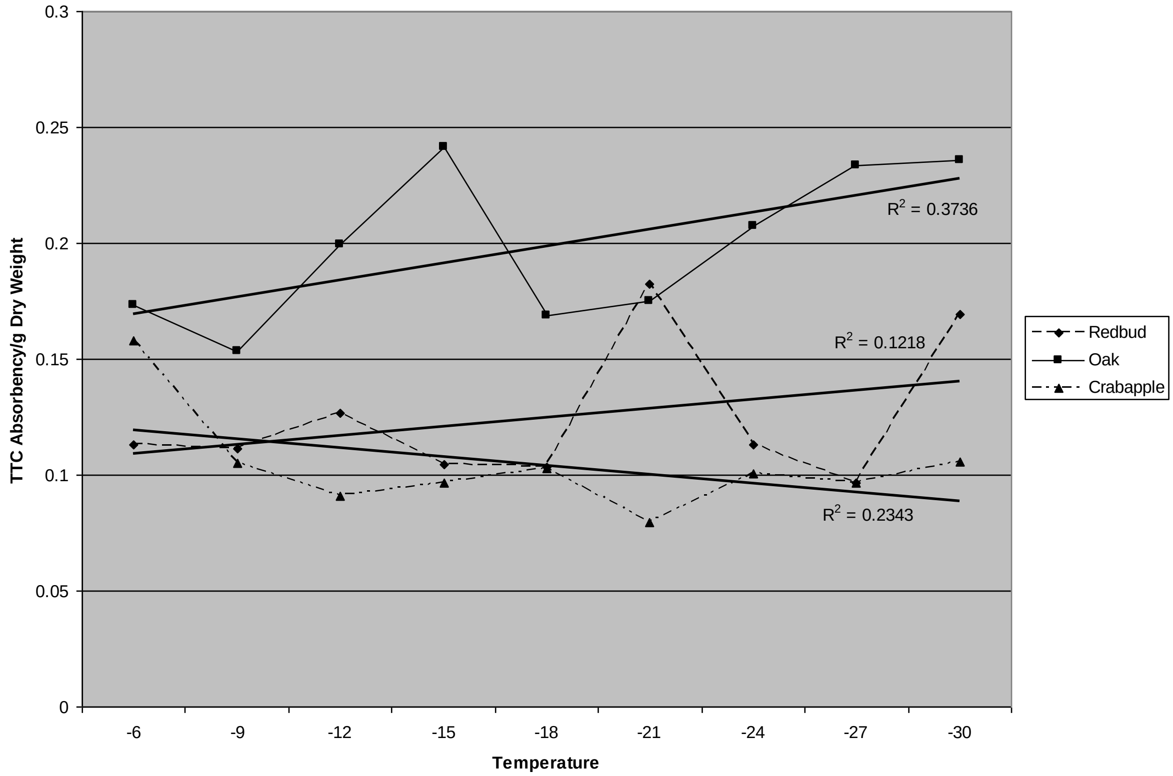

Figure 2. TTC readings/gram dry weight for three tree species over nine temperatures averaged over three treatments. There were no differences between temperatures.