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. Common practices of weed control within nursery production include mowing, tillage, and chemicals. With the majority of fine root hairs of trees located in the top six inches of soil (Conlon and Clatterbuck, 2008), there is a possibility of damage occurring due to herbicide or cultivation. In a study by Haynes (1981), it was found that in comparison with grass, herbicide treatments encouraged root growth close to the soil surface. This was due to the decreased competition. Haynes (1981) found almost no root growth in the top 20 cm in cultivated treatments. Disruption of roots can play a vital part in the cold hardiness of a plant. Within the same plant, the root system is considerably less cold hardy than that of stem tissue under field conditions (Pellett 1971, Chandler, 1954; Pellett and White, 1969; Weiser, 1970). Three species of trees were evaluated, redbud (*Cercis canadensis),* red oak (*Quercus rubra),* and crabapple (*Malus* 'Prarie Fire'.

Materials and Methods:

Field Treatments: At The Ohio State University (OSU) Waterman Farm, Columbus, OH, three species of tree liners were planted, redbud (*Cercis canadensis),* red oak (*Quercus rubra),* and Prarie Fire Crabapple (*Malus* 'Prairie Fire'). The experimental design was a completely randomized design with four replications and three sub-samples/replication. Plants were spaced 1.524 m x 2.473 m within and between rows, respectively. In 2007, trees were, on average, a height of 2.134 m with a caliper of 32 mm. There were three treatments: Sureguard (flumioxazin) and glyphosate applied in fall and spring, sod cover up to tree (tall fescue), and bare soil (cultivation) (Fig. 5). Sureguard was applied at .34 lb/ac, while glyphosate was applied at a 5% solution, or 6.5 ounces/gallon. Tall fescue (*Festuca arundinacea*) cultivars of 'Labarinth', 'Five Point', and 'Falcon IV' were seeded April 18, 2005 and reseeded June 24, 2005. Trees were subjected to flumioxazin treatments on November 18, 2004, April 25 and August 19, 2005, April 27, 2006, August 1 and November 2, 2007, and May 28, 2008. Cultivation was performed as needed in the clean cultivation treatments. Shigometer (Osmos, Buffalo, NY) readings were obtained from the field in January 2008.

Freezing Treatments: Cuttings were taken from terminal ends of shoots in January 2008 to assess cold hardiness. Cuttings were placed in a cooler overnight at 5^{o} C for acclimation. The plants were then frozen to nine temperatures at 3^{o} C increments (-6, -9, -12,-15,-18,-21,-24,-27, and -30 ^{o}C) 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/hour. Cuttings were removed from the freezer after the temperature reached the desired level and then placed in a 5 ^{o}C cooler overnight for acclimation. After acclimation, the trees were placed in a 100% humidity chamber for

seven days. Visual observations were then 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 were subjected to ANOVA using the GLM procedure within SAS® (SAS Institute, Inc., Cary, NC, 2000). Fisher's least significant difference was used to compare means with $\alpha \leq 0.05$. 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:

The three species each had an increase in visual ratings (reduction of green tissue) as the temperature decreased. -18 ^{o}C was the temperature at which each of the species began to exhibit necrotic tissue. In redbud, cultivation and herbicide treatments were significantly more cold hardy than that of the grass covered treatment (Fig. 1). For crabapple, cultivation was significantly more cold hardy than that of the grass covered treatment with regard to visual ratings (Fig. 1) and shigometer readings (Fig. 2). These findings correlate with Haynes (1981), who states that, in comparison with grass, herbicide treatments encouraged root growth close to the soil surface. Haynes (1981) also found almost no root growth in the top 20 cm in cultivated treatments. Conlon and Clatterbuck (2008) state that the majority of fine root hairs are located in the top six inches of soil. Competition of the fine root hairs of the crabapple and redbud, with the grass roots led to a decrease in cold hardiness with the grass covered plots. Observations were made in the spring of 2008, which indicated less flowers on redbud in the grass covered plots, compared to that of herbicide and cultivated plots. This could be due to water competition with the grass cover.

References:

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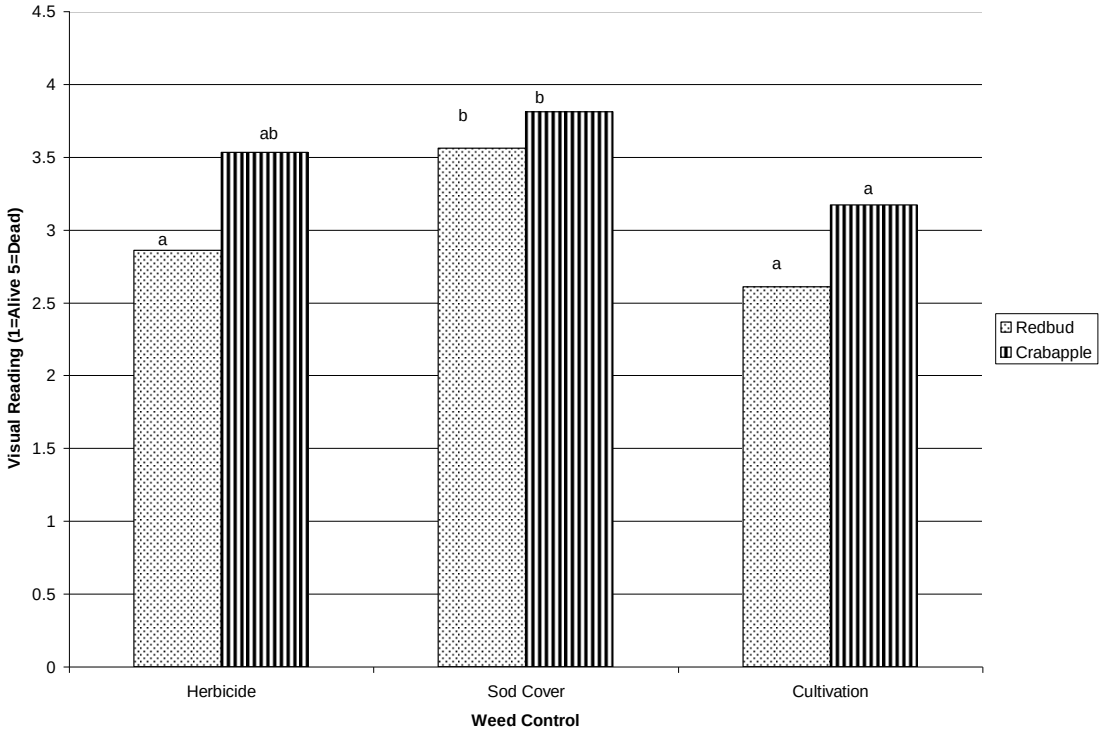

Fig.1. Visual browning of redbud (*Cercis canadensis)* and crabapple (*Malus* 'Prarie Fire' after freezing that were subjected to three weed control practices. Data pooled over all temperatures. Letters indicate significance between similar colored

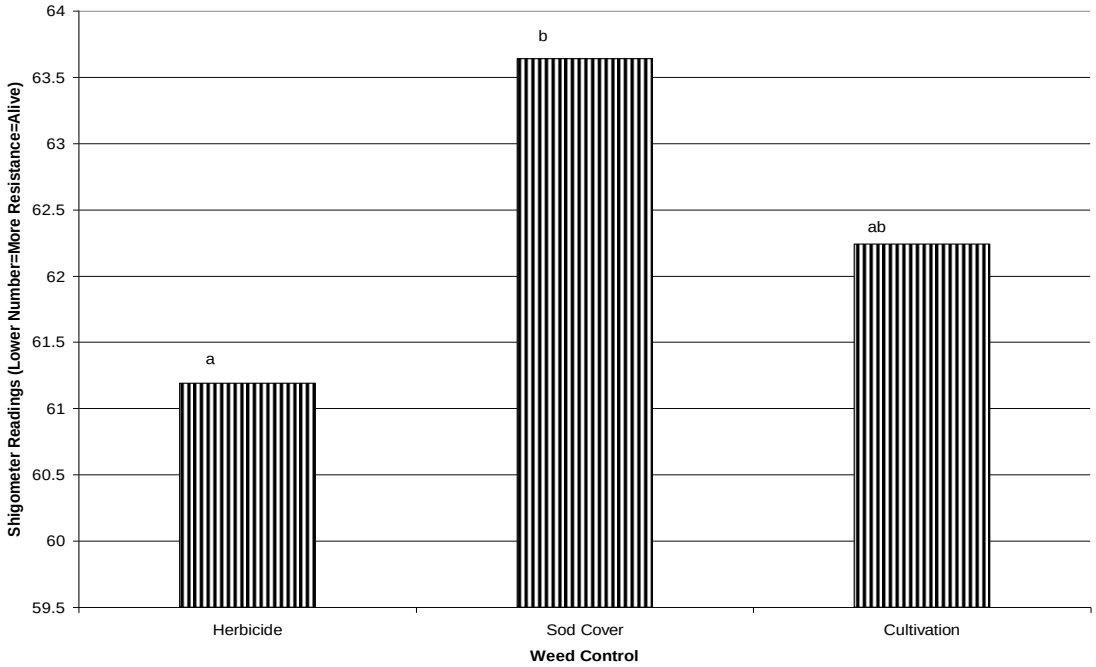

Fig. 3: Shigometer readings of crabapple (*Malus* 'Prarie Fire) taken in January that were subjected to three common weed control practices. Data pooled over all temperatures. Letters indicate significance between similar colored bars. LSMeans α=0.05.