Cold Hardiness and Morphological Characterization of Containerized Conifers Used as Live Christmas Trees

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Containerized conifers are increasingly marketed and used as live Christmas tree in the United States and around the World. The idea is to use the tree for the holidays and plant it into the landscape after the season. However, prolonged duration under warm winter indoor conditions can reduce the cold hardiness, resulting in shortening of the dormancy and resumption of growth. The goal of the study was to investigate the morphological and physiological changes on trees exposed to indoor conditions with the aim to determine the optimal duration for indoor use of live containerized trees.

The study

Three species, Black Hills spruce, Balsam fir and Douglas fir were included in this study. Fifteen trees of each species measuring 3-4 ft in height were dug in the fall of 2006 and potted in a potting medium made of pine bark (85%) and peat moss (15%), with a sulfur amendment to achieve a target pH of 5.5. In addition nine 5 ft tall pot-in-pot container-grown Black Hills spruce donated by Candy Cane Christmas tree farm were included in the study.

All trees were transported into a heated room at MSU for conditioning and testing. Trees were assigned at random to three indoor display durations: 0 (control), 10 or 20 days. All trees were placed in a heated and lighted room simulating conditions similar to those a containerized tree would be exposed to in any standard household. Trees were watered as needed and thermocouples connected to dataloggers were used to measure soil and air temperatures in each treatment. Cuttings were taken from each tree on days 0, 3, 7, 14, and 20 for cold hardiness testing. The cuttings were divided into one control and 10 temperature treatments from -3 to -30°C for the artificial freeze testing.

Visual evaluations were made on both the buds and the needles of each clipping, and the temperature necessary to cause more than 50% damage (LT50) on buds and needles was recorded as the cold hardiness temperature. At the end of the indoor exposure, trees were moved into an unheated barn until planting in the spring on March 30, 2007. The post transplant quality and survival was assessed on a monthly basis and the final evaluation and survival recorded three months after transplanting.

Bud Morphology

Our study showed that it took average temperatures of -27°C to -30°C to cause more than 50% damage (LT50) on buds of trees that were not brought indoors. After 3 days indoors, the LT50 was between -24°C and -27°C depending on the species. After 7 days indoors, the LT50 decreased by another 3 degrees to -21°C for balsam fir and Douglas fir, and -24°C for Black hills spruce. After 14 and 20 days indoors it took temperatures of -18°C and -15°C to caused more than 50% damage on buds respectively (an example for black hill spruce is presented in figure 1).

This indicates that after 20 days indoor display, trees are hardy to approximately -15°C, and when placed outdoors, tress are likely to develop serious winter damages if the outdoor temperature reaches this point. For example, average January temperatures for East Lansing are -11°C, and the record minimum temperature is -29°C. The maximum air, minimum air, and average soil temperatures (inside the pot) recorded during our experiment are presented in figure 2 below. The difference between average winter temperatures and the bud and needle LT50 following various indoor exposure treatments, gave us an indication

of what can be acceptable. The study showed that the LT50 after 14 days (-18°C) and 20 days (-15°C) are very close to winter averages and shall normally result in serious bud damage. After 3 and 7 days indoor buds had LT50's 10°C or more below normal winter averages suggesting good bud survival, unless we have an exceptional cold year with temperatures nearing this bud LT50 temperature.

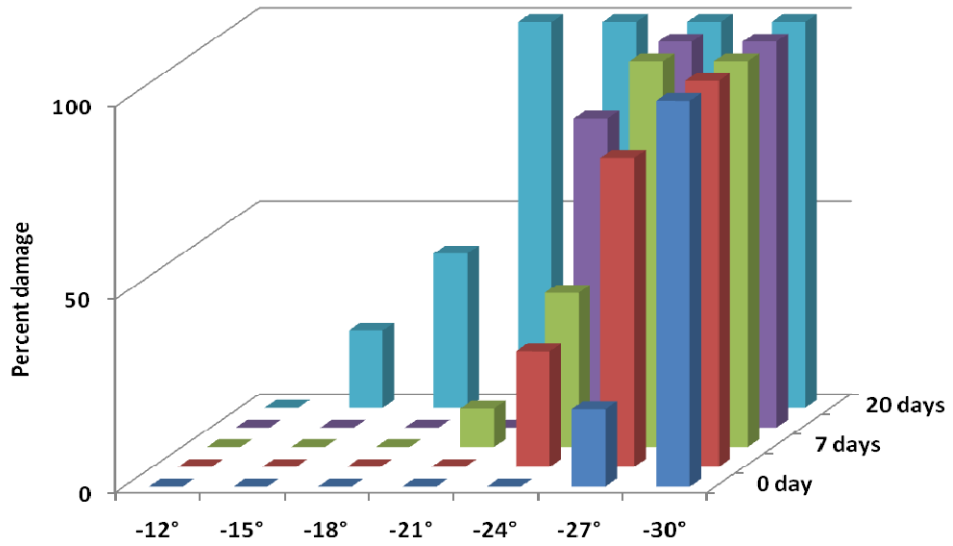

Figure 1: Bud damage rating for Black hills spruce after indoor storage and laboratory artificial freezing test.

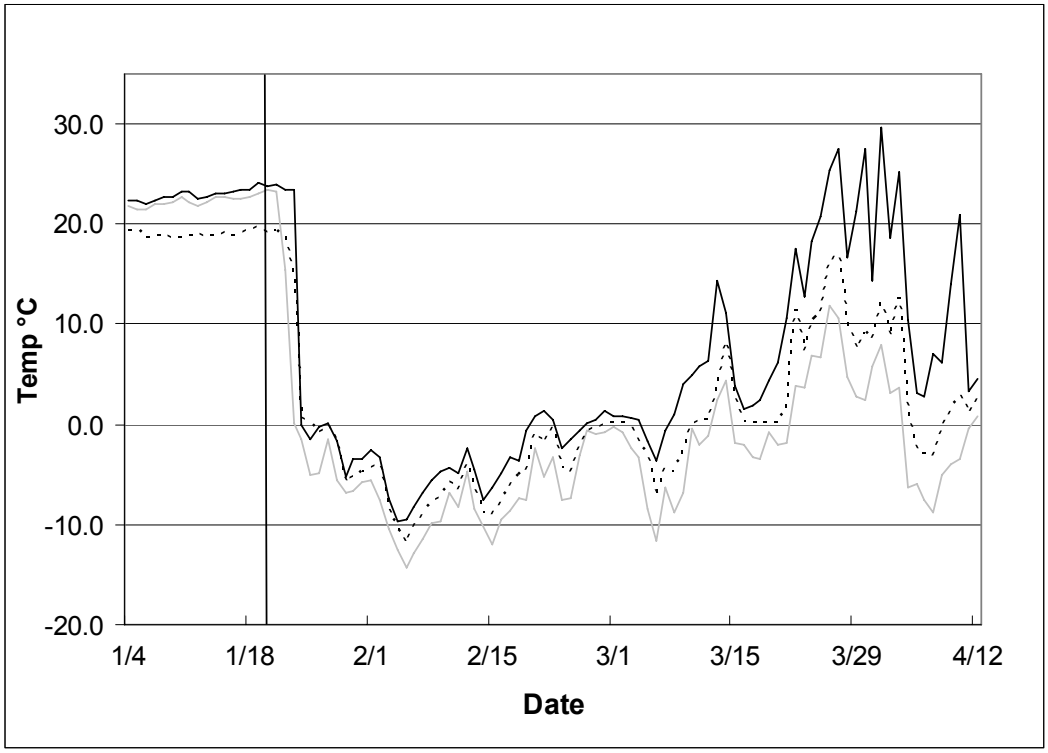

Figure 2: Maximum air (black line), minimum air (grey line), and average soil temperatures (dashed line) observed during treatment. The vertical line represents the time at which the last trees were moved into cold storage.

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