DAVENPORT LIVING SNOW FENCE
DEMONSTRATION: TEN-YEAR SURVIVAL AND GROWTH UPDATE

By
Donald Hanley, PhD, Extension Forester Emeritus, School of the Environment, WSU, Gary Kuhn, State Forester, (retired), USDA Natural Resources Conservation Service, Spokane, Dennis J. Robinson, State Forester, (retired), USDA Natural Resources Conservation Service, Spokane, Andrew B. Perleberg, Extension Forester, WSU, Wenatchee, Brenda Hanley, PhD student, Bioinformatics and Computational Biology Program, University of Idaho, Moscow
Davenport Living Snow Fence Demonstration: Ten-Year Survival and Growth Update

Introduction

This WSU Technical Bulletin discusses the Davenport Living Snow Fence, a dry land Rocky Mountain Juniper (*Juniperus scopulorum*), demonstration that was planted in 2003 and provides data on tree growth and survival rates during its initial decade. The primary purpose of this planting was to demonstrate implementation. A secondary purpose was to report on tree growth and row variability. This demonstration was not intended to measure snow-catching effectiveness, although this could be accomplished in subsequent years.

Demonstration Objectives

Snow fences are common in areas subject to significant snowfall, such as the Great Plains and upper Midwest, but they are not common in eastern Washington, despite abundant snowfall and problems with drifting snow along roadways. A demonstration of living snow fence windbreak effectiveness was needed to help landowners and the affected public, in particular motorists, visualize their utility for lessening snow drift on roads in this region of Washington.

This demonstration was also done to help dispel the false notion *that trees will not grow here* and other similar false beliefs. Successful living snow fence demonstrations in southeastern Idaho and small-scale dry land test plantings of junipers near Ritzville, Wash., suggested that living snow fences could be useful for reducing snow drift on roadways in eastern Washington.

Demonstration Design

A federal, state, county, and university partnership was developed to explore the utility of a living snow fence windbreak in Washington by establishing a living snow fence along State Route 25 north of Davenport, Washington. Data on the 10-year survival and growth of Rocky Mountain junipers used to create this living snow fence were compared with the survival and growth rate through the first 5 years after planting, as reported by Kuhn, Hanley, and Gehringer (2009).

In assessing the living snow fence windbreak, the most commonly applied design from the Great Plains region of the U.S. was used. The design has an excellent track record for being effective in that area (National Agroforestry Center personnel, pers.comm.). Evergreen trees and shrubs make excellent snow fences to reduce wind and trap snow along road sides and other areas where drifting snow may pose problems for drivers (Brandle and Nickerson 1996).

The project site was located approximately 14 miles north of Davenport, Wash., along State Route 25 (Latitude 47.8369605, Longitude -118.212447). It is a well-traveled north/south road in which the prevailing wind is from the west and snow frequently accumulates on the road. The planting site can be described as having a dry cropland soil consisting of a deep silt loam (USDA-NRCS 1981). The Davenport area receives about 13.8 inches of total precipitation (30 inches of snow) annually with very little precipitation from July through September (U.S. Census Data 2015).

Container-grown Rocky Mountain juniper seedlings of the Bridger Select province (USDA-NRCS Plant Materials Center, Bridger, MT) were grown at the University of Idaho greenhouse for one year. In 2003, 532 seedlings were planted in four 880-foot-long rows using a double, twin-row, high density design (Figure 1; Helwig 1983).

These trees were planted on the windward (west) side of the highway in paired rows with trees 6 1/2 feet apart in the row, and the rows being 8 feet apart. The second twin row was 42 feet from the first. Trees in the easternmost row pair were 100 feet from the highway.

![Figure 1. Davenport living snow fence design. (Adapted from Kuhn et. al. 2009.)](image)

The double, twin-row, high density design is used commonly throughout the arid region of southern Idaho and the Great Plains with good success. Seedlings were approximately 8 inches in height when planted. A black woven polypropylene fabric, Lumite® from Shaw Fabric Products, was used for weed control and soil moisture conservation, which is now a common practice with this windbreak design in the Great Plains region.

Annually, from 2003 to 2007 and then in 2013, tree survival, height, and crown width were measured on every fifth tree in each row (Figure 2). A total of 27 trees were sampled in each of the four rows.
Demonstration Results

The trees in this demonstration not only survived at a 99% rate after 10 years, but also grew significantly taller during this period (Table 1). The total height sample mean and sample median at the end of ten years were 9.6 feet and 10.0 feet, respectively. As mean tree size increased, so did the variability in individual tree size, as indicated by increasing standard errors over time.

Table 1. Mean tree height and crown width in the Davenport Living Snow Fence.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Tree Height (ft)</th>
<th>Mean Crown Width (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>9.7 (0.2)</td>
<td>6.0 (0.1)</td>
</tr>
<tr>
<td>2007</td>
<td>6.6 (0.1)</td>
<td>4.1 (0.1)</td>
</tr>
<tr>
<td>2006</td>
<td>5.8 (0.1)</td>
<td>4.4 (0.1)</td>
</tr>
<tr>
<td>2005</td>
<td>4.5 (0.1)</td>
<td>2.7 (0.04)</td>
</tr>
<tr>
<td>2004</td>
<td>3.3 (0.1)</td>
<td>2.0 (0.035)</td>
</tr>
<tr>
<td>2003</td>
<td>1.9 (0.1)</td>
<td>1.0 (0.023)</td>
</tr>
</tbody>
</table>

*Measurements include standard errors (in feet) for all sampled trees during the past ten growing seasons.

Studying the raw data and Figure 3 suggested that height differences between rows existed. The one-way analysis of variance (ANOVA) for tree height by row returned that a statistically significant difference exists between rows (F=3.103, p=.0359).

Further investigation, using the Tukey Honest Significant Difference Test, determined that tree height in the first row on the west side (W1) was significantly different from the first row on the east side (E1), but that other row pairs exhibited no statistically significant differences. Trees in row W1 averaged 10.4 feet and those in the first leeward row, E1, were 9.0 feet. Other rows were not significantly different.

The crown-width sample mean and sample median at the end of ten years were 6.0 feet and 6.1 feet, respectively. Tree height and crown width means and associated standard errors are shown in Table 2. Crown closure of the double twin-row windbreak occurred between the 5th and 10th growing seasons (Figure 4).

It appears that supplemental irrigation, if available, would improve these growth results, based on the fact that the trees on the windward side (row W1) trapped the most snow (measured for only one year) which provided extra soil moisture to the trees, resulting in statistically taller individuals.
Table 2. Sample mean and standard errors for tree height and crown width, by row, after ten growing seasons.

<table>
<thead>
<tr>
<th>Row</th>
<th>Mean Tree Height (ft)</th>
<th>Mean Crown Width (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West 1</td>
<td>10.4 (0.28)</td>
<td>6.4 (0.15)</td>
</tr>
<tr>
<td>West 2</td>
<td>9.3 (0.37)</td>
<td>6.2 (0.18)</td>
</tr>
<tr>
<td>East 1</td>
<td>9.0 (0.34)</td>
<td>5.8 (0.13)</td>
</tr>
<tr>
<td>East 2</td>
<td>9.9 (0.24)</td>
<td>5.9 (0.19)</td>
</tr>
</tbody>
</table>

Crown closure was achieved between the fifth and tenth growing seasons. (Photo by Andy Perleberg, WSU Extension.)

Crown closure is a good indicator for windbreak functionality, given that snow depths in the winters of 2007 and 2008 (Figure 5) averaged 35 inches behind the windbreak, while at the road snow depths averaged less than 6 inches. The one-way ANOVA for crown width returned that no significant differences exist between rows.

The high survival rate can be attributed to good site preparation, high quality nursery stock of a hardy species, proper planting technique, high quality Lumite® ground cover, and minimal periodic maintenance. Lumite® ground cloth (fabric mulch) has proven to be highly effective in windbreak establishment in the Great Plains (Geyer 2001; Atchison 2004).

The living snow fence demonstration was designed to investigate survival and growth, with a secondary interest in snow capture (Figure 5). It was not designed to analyze the fabric mulch impact in a traditional scientific fashion. However, there is a strong indication that its use helped the windbreak achieve exceptional survival and growth.

Periodic maintenance consisted of ripping the fabric mulch once, at year five, to accommodate larger stems and an annual inspection for rodent and other wildlife damage. The advantage of fabric mulch was that no supplemental irrigation was needed and very little weed control was necessary, except at the edges of the fabric.

Living snow fences show great promise in providing windbreak service in eastern Washington for many decades (Figures 6, 7, and 8). The successful establishment and growth of the living snow fence in Davenport, Wash., has provided a basis for others to invest in developing additional living snow fences near Anatone, Wash., and Athena, Oregon.

Conclusion

This ten-year Rocky Mountain juniper living snow fence demonstration has shown that excellent tree height and crown-width growth, coupled with very high survival rates, can be achieved in eastern Washington.
References


U.S. Climate Data. 2015.


Acknowledgements

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