NYSDOT Living Willow Snow Fence Training Program 2011

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State University of New York College of Environmental Science and Forestry
NYSDOT Snow Fence Training, Walton, NY, May 24-25, 2011
Background
The Challenge

- Snow and ice removal and control costs over $2 billion annually in the US
- NYSDOT annual S&I costs are $252 million
  - $154 million labor
  - $38 million equipment
  - $60 million materials
- Blowing and drifting snow causes:
  - Reduced visibility
  - Impaired road conditions
  - Reduced road width
  - More frequent road closures
  - Increased number of accidents and injuries
  - Increased need for plowing and deicing materials
The Challenge

- Mechanical snow removal costs up to 100 times more than trapping snow with snow fences (SHRP 1991)

- Options
  - Wood, plastic or other structural snow fences
  - Living snow fences
Historical Use of Snow Fences

The forest acts powerfully in checking the force of the winds because the elastic swaying of the twigs and branches is a very effective hindrance to the movement of air.

~Gifford Pinchot, 1905

Rock snow fences protecting a railroad cut in SEW Wyoming were probably built in 1868 (Tabler 2003)

Snow fences protecting the Union Pacific Railroad in 1901 (Tabler 2003)
Structural snow fences

- Less costly than snow removal
  - Snow removal costs about $3/ton (Tabler 2003)
  - A 4 ft high snow fence can trap up to 4.2 tons of snow per linear ft
  - That is >24,000 tons per mile

- Temporary or permanent
  - Wood or plastic composite
  - Cost varies with material and installation location

- Visually unappealing
Temporary Structural Snow Fences

- In areas with large snow transport loads, 4 ft structural snow fences can become buried and ineffective.
Temporary Structural Snow Fences
A Solution – Larger Structural Fences

- Permanent structural snow fence being tested in the town of Scott

- Challenging to properly design and locate permanent snow fences with limited rights of way
A Solution – Larger Structural Fences

Structural snow fence along highway 219
A Solution – Larger Structural Fences

Structural snow fence along highway 219
Another Solution - Living snow fences

- Designed plantings of trees, shrubs, and/or native grasses that are strategically established short distances upwind of area of concern used to control drifting snow

- Key characteristics for suitable species
  - High density that extends to the ground
    » Many deciduous trees do not have this form and are ineffective for snow fences
  - Rapid growth
    » Several conifers have good crown depth and density but are slow to establish
  - Suited to local soil and climate conditions
  - Easy to establish and maintain
Living snow fences - Benefits

- Over the long term they can be cheaper than plastic or wood snow fences
- Effective in years with heavy snowfall once established
  - Young living snow fences can be damaged by heavy snow accumulation
- Potential to provide wildlife habitat
  - May be a benefit or limitation
- Potential for income generation for landowner from materials produced from shrubs and trees
- Opportunities for carbon sequestration
Cost benefit ratio of living snow fences in MN ranged from 2:1 to 36:1 (Gullickson et al. 1999)

- Used average snowfall (32 inches)
- $1/ton snow removal (it can be $3/ton or greater in severe storms)
- Only benefits related to snow removal were used as benefits
- Benefits would be higher if road closure and accident reductions were accounted for

Developing a cost benefit model for conditions in NY as part of this project
Benefit cost ratio will increase as the amount of snow transported increases and the cost of removal increases.

Benefit cost ratio for snow fences as a function of average annual snow transport and cost of snow removal (Tabler 2003)
Living Snow Fences - Limitations

- Traditional living snow fences require 6 – 20 years to become effective (Tabler 1994)
  - Address with choice of plants and design of system
- Require more space than manufactured snow fences because they often require more than one row of plants
- Biological systems – more care need to establish, potential for damage from pests and diseases
- They are permanent installations so sometimes it is harder to get landowner cooperation
Potential Solution – Willow Snow Fences

- A double row of densely planted shrub willows
  - Easier to establish
  - Rapid growth
  - Dense canopy and lots of stems near the ground
- May not meet aesthetic expectations of landowners and community
  - Mix with other species if desired
- Shrub willow research at SUNY ESF since 1986
  - Excellent knowledge base of willow growth, development and management
- Over 1,200 varieties of shrub willow

Mature single row willow snow fence in central NY
Keys for Success

- Collaboration with multiple agencies and landowners
- Planning and design in advance
  - Use of SnowMan software very beneficial
- Proper site preparation
- Careful planting and maintenance

Willow snow fence two years after coppicing

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Principles of Blowing and Drifting Snow and Snow Fence Design
Snow Transport

- Factors influencing the amount of snow that could be transported
- Important for determining the storage capacity of a snow fence

(Tabler 2003)
Near Snow and Far Snow

- Different designs and approaches are needed to address near and far snow problems.

Near snow and far snow often require different solutions (Tabler 2003)
How Snow Fences Work

- Snow fences redirect and change wind speed
  - Wind speed increases over the top and around the sides of the barrier
  - Wind speed is reduced below the top of the barrier and downwind, from the snow fence

Figure 3.3. Schematic representation of turbulence in the wake and in the quiet zone behind a model windbreak.
Snow Drift Development

◆ Snow drifts develop in stages over time
◆ Main components of snow drifts are shown below

Figure 3.31. Slip-face and circulation region formed by a 50%-porous snow fence during the intermediate stages of growth (Tabler and Jairell 1993).

(Tabler 2003)
Snow Drift Development

- Maximum depth of drift in stage 1 (dates 1 – 3 below) is about 1.0 – 1.2 the height of the snow fence for a 50% porous fence.
- Stage 3 (dates 4 – 6 below) occurs as depth of drift approaches its maximum.
- Stage 4 (date 7) occurs when drift is smooth with no slip face or circulation zone. At this stage the snow fence is not trapping snow. Good snow fence design will avoid reaching this stage.
Snow Drift Development

- Potential snow storage is related to the height of the snow fence.
- Doubling the height of the snow fence increases snow storage potential by 4x assuming all other factors are equal.

Snow storage capacity of structural snow fences can become filled making them ineffective.
Snow Storage vs. Height
50% Density Structural Snow Fence

- Snow can be stored upwind and downwind from snow fences.
- For 50% density shown here the amount of snow stored upwind is relatively small.
- As density increases the amount of upwind snow stored increases.

Snow storage capacity in upwind and downwind drifts formed by a Wyoming snow fence (Tabler 2003)
### Snow Storage vs. Height
#### 50% Density Structural Snow Fence

<table>
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<th>Tons of snow/linear ft.</th>
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<tr>
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*(Tabler 2004)*
Snow Drift Development
(Double Row of Shrub Willow Two Years After Coppicing)
Snow Drift Development
(Double Row of Shrub Willow Two Years After Coppicing)

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Snow Fence Density / Porosity

Snow fence density or porosity effect ability to trap snow and the shape and size of an equilibrium snow drift change:

- Solid fence has larger drifts on the upwind side and smaller drift downwind.
- Snow fence density of 50 – 60% (porosity of 50 – 40%) has the greatest storage capacity.
Snow Fence Density / Porosity

(Drift Profiles for 0%, 25%, 37.5%, and 50% Porosities)

(Tabler 2003)
Snow Fence Design

Snow fences—either structural or living—are only some of the options to address blowing and drifting snow.

The situation needs to be addressed properly so that the best solution is implemented.

Other possible solutions may include:
- Modification of cross sections
- Changes in snow removal practices
- Modification of safety barriers
- Management of roadside vegetation or structures including signs
Controlling Far Snow with Snow Fences

Keys for a successful installation:

- Adequate storage capacity
  - Factors such as height, porosity and location are important
- Durable so that it lasts
  - Benefits associated with initial investment increase over time
- Proper coverage of problem area
  - Long fences without openings and gaps
Snow Fence Design

- Several important factors associated with proper design and placement of snow fences
- Calculating snow transport (i.e. the amount of snow transported by the wind over a given period of time and distance) or capacity needed
  - Identify the snowfall over the snow accumulation season
  - Identify the snowfall water equivalent
  - Identify the relocation coefficient
  - Determine the prevailing direction of greatest snow transport
    - Measure orientation of snow drifts formed by large objects late in the snow season
    - Analyze historical wind records
  - Determine the fetch distance for your location
Snow Fence Design

◆ Determine required snow fence height
  – Distance from the road
◆ Determine required set back for snow fence
  – Key factors are
    » Amount of transported snow
    » Porosity of snow fence
    » Height of snow fence
◆ Length of fence should extend from either side of the problem area that is calculated
Figure 6.92. Snowdrift profiles predicted with the SNOWMAN drift generation routine, compared with measured drift profile at a site on Wyoming I-80.
Tool can be used to develop specific parameters for snow fence design based on site specific conditions.
Assessing Site Conditions for Plants
Assessing Site Specific Conditions

- More permanent characteristics of living snow fences can be an issue with landowners
- Landowner objectives
  - Clearly identify and discuss the landowner’s short and longer term plans and intentions for the area being considered
  - Design will have to fit with the landowner’s plans and preferences for the area
    » Location of living snow fence may not be ideal
    » Planting design and species selection may have to be adjusted to accommodate landowner
    » Site preparation and maintenance may have to be modified
Landowner Involvement is Essential
Successful living snow fences start with proper site assessment

Proper site evaluation will help to avoid many establishment and long term growth and survival problems

- Site limitations such as wet areas, excessive slopes, stones, fence line removal/trimming
- Soil conditions
- Current and previous land use history
- Existing vegetation
  - Woody plants
  - Herbaceous annual or perennials
  - Agricultural crop
Site Limitations

◆ Walk the site and determine if there are any barriers to preparing, planting or maintaining the site
◆ If limitations exist work with the landowner and create a plan to modify them if possible
  – Physically modify the site
  – Adapt equipment to suit the site
  – Change the snow fence design to avoid limitations
Site Assessment – Soil Conditions

◆ Soil survey
◆ Soil samples and testing
◆ Site specific assessments
  – Drainage problems
  – Bulk density or root growth restrictions from hardpans or fill material
Assessing Site Specific Conditions

◆ Soil type and conditions
  » USDA soil survey information for fields or areas away from the right of way
  » Specific soil conditions should be assessed, especially on right of ways
    ◆ Soil samples and testing
    ◆ Identify other potential limitations such as wet or seasonally flooded areas, rocks, fence lines, other barriers
  » Collect soil samples, assess rooting depth and potential barriers to successful growth
Soil Test Results

**SOIL TEST REPORT FOR:**
TIMOTHY VOLK
SUNY ESF
1 FORESTRY DR
SYRACUSE NY 13210

**ADDITIONAL COPY TO:**
AMOS K QUAYE
NY

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**SOIL NUTRIENT LEVELS**

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<tr>
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<td>(K₂O)</td>
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<td>(MgO)</td>
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<tr>
<td>Calcium(CaO)</td>
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**RECOMMENDATIONS FOR: Landscape, Maint, pH 7.0**

**Limestone, Calcium And Magnesium Recommendations**

Apply the following quantities of limestone, epsom salts and/or gypsum to the soil to correct soil pH, calcium and magnesium levels.

- **Calcic Limestone:** 16 lb/100 square feet (ca. 3 % MgO)
- **Magnesium:** NONE
- **Gypsum (CaSO₄):** NONE

**Nitrogen, Phosphate And Potash Recommendations**

Apply 3.5 lbs per 100 square feet of 5-10-10 and 0.75 lbs per 100 square feet of 0-46-0.

**MESSAGES**

The above lime and fertilizer recommendations are for this soil sample and this season only. Nitrogen, phosphate and potash recommendations are for fertilizers containing specific ratios of nitrogen (N), phosphate (P₂O₅) and potash (K₂O). As an example, 5-10-10 contains 5 % N, 10 % P₂O₅, and 5 % K₂O. If fertilizers with the ratio(s) shown are not available, contact your local garden center or fertilizer supplier for the appropriate substitution.

**LABORATORY RESULTS:**

<table>
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<th>Nutrient/Element</th>
<th>% Exchangeable Cation (mmol/100g)</th>
<th>% Saturation of the CEC</th>
<th>Organic Matter %</th>
<th>Nitrate-N ppm</th>
<th>Soluble salts mg/liter</th>
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<tr>
<td>Cu</td>
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For Methods: 1:1 soil/water pH, Mehlich 3 (ICP), Mehlich Buffer pH, Saturation of Cations

**Optional Tests:**

- Nitrate-N ppm
- Soluble salts mg/liter

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Soil Testing Results

- If organic matter is less than 1.5% consider incorporating an organic amendment like composted yard waste, manure, or other locally available sources.
- Remember that organic amendments will also address some nutrient limitations if they are present.
- Pay attention to other characteristics like pH and nutrient level.
- Do not add nitrogen (N) fertilizer in the first year, but use results as a guide for second year.
  - If mulch is used as part of post planting weed control strategy then N rates should be increased.
Soil Survey Information
Route 10
Selecting Plants for Living Snow Fences
A limitation of living snow fences is the time required for them to become effective
- Can take up to 20 years
- But can be as short as 2 – 3 years

Time for living snow fences to become effective depends on:
- Site preparation prior to planting
- Growth rate of plants
- Growth form and habit of plant
- Spacing of plants
- Management of site (weeds and nutrients) after watering
- Quantity of snow transport
Selecting Plants – Growth Characteristics

◆ Growth rate
  – Slower growing plants will take longer to form an effective living snow fence
    » In some cases this can be 15 – 20 years
    » Greater potential for damage during this time resulting in gaps
  – Effect of living snow fence will vary as the plants develop, so different growth stages should be considered in the design
  – Interim measures, such as structural snow fences may be required
  – Care in placement is necessary so developing plants do not become buried and damaged by snow drifts
  – Using a mixture of plants with slower and faster growth rates can be effective
First Year Growth of Shrub Willow Double Row Living Snow Fence
Willow Living Snow Fence
One Year Regrowth on Two Year Old Roots
Willow Living Snow Fence
Two Year Regrowth on Three Year Old Roots
Selecting Plants – Growth Characteristics

- Height of the plant where the density is great enough to influence wind speed
  - Effective height of the plant will influence the amount of snow that can be stored
  - Effective height does not necessarily correspond to the general height of the plant

This variety of willow (*S. purpurea*) had prostrate growth when planted in a single row living snow fence.
Selecting Plants – Growth Characteristics

- Plants need to have dense foliage or branching pattern that extends to close to ground level
  - Self pruning species should be avoided
  - Large gaps (> 10 – 15% of snow fence height) at the bottom of the plant can create wind tunnels and exacerbate blowing snow problems
Selecting Plants – Growth Characteristics

- A space between the ground and the bottom of the snow fence minimizes snow deposition close to the snow fence.
- With strong winds and a solid structural (Wyoming) snow fence, larger gaps create a longer distribution pattern and less snow accumulation on the windward side.
- Fences that become buried are less efficient at trapping snow.

Figure 3.47. Comparison of drifts formed by two 3.8-m (12.4-ft) Wyoming fences that have 30- and 90-cm (12- and 36-in.) bottom gaps, respectively (Tabler 1986).
Selecting Plants – Growth Characteristics

- Gaps or openings in living snow fences caused by mortality can result in large drifts downwind
  - Avoid creation of gaps by planting multiple rows and staggering plantings
  - Select plants that are suited to the conditions of the site
  - Gaps that do result should be filled with structural snow fence until replacement vegetation can be established
Continuous Living Snow Fences

◆ Snow fences should be continuous without openings
◆ Access fields and rights-of-way around ends of snow fences
◆ If access lanes are required, place them at an angle to the prevailing wind

![Diagram of prevailing wind direction and snow fence placement.]

Figure 3.5. Access lanes and roads should be at an angle to prevailing or troublesome winds.
Selecting Plants – Growth Characteristics
Optical Density

- Optical Density
  - The amount of area composed of solid material (porosity is the amount of area not covered in solid material)
  - For deciduous woody plants this is all stem and branch material
  - For conifers this includes foliage
  - Solid barrier is 100% density (0% porosity)

- Vary density by species selection, spacing, management, number of rows

- Living snow fences with high density >65% will generally have narrower drift patterns
Effect of Density and Height

- Density and height of snow fences influence the storage capacity and drift size and shape.
- Can vary this feature with species selection, number of rows, spacing and other management decisions.

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Selecting Plants – Plant Characteristics Change Over Time

Figure 7.1. Changes in snowdrift shape and snow storage as a living fence grows. (Tabler 2003)
One Year Old Coppice Growth on a Two Year Old Root System – Single Row

Fish Creek - Density - 47.5%

SV1 - Density – 23.7%
Two Year Old Coppice Growth on a Three Year Old Root System – Single Row

Fish Creek - Density – 50%
SV1 - Density – 53%

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Snow Break Forests

- Dense plantings that act as a solid barrier can be planted closer to the road.
- Shade from plants may affect road conditions.
- Drifts may occur as plants are developing.

**Figure 3.24.**
Snow break forests used in Japan utilize the principle that dense plantings act as solid barriers to induce snow deposition on the upwind side. (Tabler 1994, p. 282)
Selecting Plants – Growth Characteristics

- Ability to withstand wind
- Ability to withstand snow loads
- Native or non native
- Invasive
- Species longevity
- Salt tolerance
- Avoid plants for which a major pest or disease problem is known
  - Elms or hybrid poplar in our region
Beneficial Willow Characteristics

- Easy to establish with unrooted cuttings
  - Easier to handle
  - More tolerant of delays in the field
  - Cheaper than rooted stock
- Tolerates planting at high density (1.5 – 2 ft spacing)
Beneficial Willow Characteristics

- Rapid height growth
  - Can reach >20 ft in 3-years
  - Can reach 50% density in 3 years
- Larger planting stock can be used to accelerate establishment
- Effective in as little as two to three years

Measuring optical density on a living willow snow fence in Cortland County, NY
Beneficial Willow Characteristics

- Coppicing ability creates good density from the ground to top of the crown
  - Mature willow snow fence has a measured density of 60-70%
- Once established, maintenance is minimal
- Height and density can be modified by selecting willow varieties and changing spacing and/or management

Willow (S. purpurea) living snow fence five months after coppicing
Route 81S
Near Tully, NY

- Planted May 2009
- Excellent initial survival
- Late July 2009
Planted two varieties with different growth characteristics

August 2009
Route 81S Near Tully, NY

August 2009

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Route 81S Near Tully, NY

March 2010

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Route 81S Near Tully, NY

March 2010
Site Characteristics
Influence Plant
Selection
Selecting Plants

First year willow clone breaking under snow load at 81S site near Tully
Concern about snow drift forming around the end of the living snow fence
Site Characteristics
Influence Plant Selection
Installation and Maintenance of Living Snow Fences
Successful Living Snow Fence Installation

Keys for successful installation of living snow fences
- Proper site preparation base on good site assessment
- Careful installation of plants
- Control of grass and broadleaf weeds for 2-3 years after planting
Site Preparation

◆ Site preparation is a one time investment that influences the effectiveness of the living snow fence for years or decades
  – Take the time, make the effort, do it correctly!
◆ An important rule for successful living snow fence establishment is to address weed problems and soil limitations during site preparation BEFORE the living snow fence is planted
◆ Controlling weeds or modifying site conditions after planting is more costly and time consuming!
Site Preparation

◆ Benefits of proper site preparation
  – Control of existing weed pressure
  – Initial control of future weed pressure to minimize future maintenance costs and damage to plants in the living snow fence
  – Improve soil structure in rooting zone
  – Expand soil volume for rooting

◆ Results
  – More effective establishment
  – Reduced maintenance efforts and costs
  – Shorter time for living snow fence to be effective
Weed Control

- Weeds compete for moisture, nutrients and light
- Maintain a weed free area 2-3 ft away from where plants are placed
- Control weeds for 2-3 year establishment period
Site Preparation Flow Chart
Site Preparation - Mechanical

◆ Cultivation to reduce competition of existing grasses and prepare the soil for planting
  – Disking, subsoiling, rototiller
  – Will not provide long term control of perennial vegetation

◆ Disturbs the soil
  – Increase soil permeability and aeration
  – Reduce or remove barriers limiting plant growth
Mechanical Site Preparation
Site Preparation - Mechanical
Site Preparation - Chemical

- Herbicides to control competing vegetation before planting
  - If possible this is best done in the late summer or early fall prior to planting
  - Chemical control of existing perennial vegetation is not as effective in the spring
  - Limitations and restrictions on herbicide use
  - Follow label guidelines
Good weed control for the first two years
- Herbicides for Site Prep fall before planting
  » glyphosate (Round Up - Touchdown)
    - 2 lbs. a.i./Acre
  » Depending on weeds present may also add following in a herbicide mixture:
    » 2,4-D @ .5 – 1 lb a.i./Acre
    » dicamba (Banvel) @ .5 – 1 lb a.i./Acre
    » Mixture of 2,4-D and triclopyr (Crossbow) (.5 – 1 lb a.i./A and ¼ - ½ lb a.i./A)
- Herbicides for Site Prep in spring of planting
  » glyphosate (Round Up - Touchdown)
    ◆ 2 lbs. a.i./Acre
Existing Vegetation – Woody Plants

- Bush hog then apply appropriate herbicide
- Stumps less than 3” can usually be removed during tillage operations
- Stumps >3”
  - Remove if only a few
  - Incorporate plants into the living snow fence
Existing Vegetation – Herbaceous

- Bush hog if greater than 10-12 inches tall because effectiveness of herbicide will be limited
- Determine type of vegetation
  - Perennial – herbicide and mechanical cultivation
    » Check efficacy of post emergent herbicides after use by inspecting above and below ground plant parts
    » Retreat sections that were missed or where herbicide was not effective
  - Annual – mechanical cultivation alone may be effective
Existing Vegetation – Agricultural Crop

- If actively used for cropping then ask for list and rates of recent herbicides used
- Some herbicides have a carry over effect and can influence establishment of new plants
- Annual crop – mechanical tillage
- Perennial crop – chemical and mechanical control
Post Planting Weed Control

*No method provides 100% guarantee*

*Periodic monitoring of site is necessary*

*Be prepared to respond quickly to weed pressure before it becomes a serious issue*
  - i.e. smaller weeds are easier to control and will have less effect on the plants you are trying to establish*
Post Planting Weed Control – Mechanical

Mechanical cultivation

- Various types of equipment are available
  - Disks
  - Spring tooth harrows
  - Cultivators
  - Specialized cultivators
- Work best on young weed seedlings that are not well established
- Less aggressive cultivation will not be effective on perennial weeds
Post Planting Weed Control – Mechanical

◆ Mowing of adjacent weeds
  – Important for areas beyond immediate 2-3 foot zone around living snow fence plants
  – Will not effectively reduce weed competition for water and nutrients in the immediate zone around establishing plants
Post Planting Weed Control - Mechanical

◆ Mechanical cultivation alone not recommended
  – Timing is essential and hard to ensure
  – Up to 4 – 5 cultivations per year required for effective control
  – With each cultivation there is potential for damage to living snow fence plants
  – Difficult to mechanically control weeds near and in between plants
    » Often requires manual weed control to be effective
Post Planting Weed Control - Chemical

- Can be effective in combination with proper site preparation
- Requires proper selection and use of herbicide
- Monitoring still required to ensure that weed control goals are being met
Post Planting Weed Control - Premergence

- Proper follow up weed control after planting is essential for success
  - Pre-emergence herbicides:
    » oxyfluorfen (Goal)
      ◆ 1 – 2 lbs a.i./Acre
    » simazine (not in sandy soils)
      ◆ 2 – 4 lbs a.i./Acre
    » pendimethalin (Prowl – Pendulum)
      ◆ 2 lbs a.i./Acre
  - Other pre-emergence herbicides that look ok
    » norflurazon (Solicam) (.8lb a.i./A)
    » flumioxazin (Sureguard) (.25lb a.i./A)
    » imazaquin (Scepter) (.125lb a.i./A)

Establishing a living snow fence in Cortland County in the spring of 2001.
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**Post Planting Weed Control – Post Emergence**

- Proper follow up weed control after planting is essential for success
  - **Post-emergence herbicides:**
    - glyphosate (Round Up - Touchdown)
      - 1- 2 lbs. a.i./Acre shielded/directed spray
    - paraquat (Gramoxone) (burn down only)
      - 0.5 - 1 lbs. a.i./Acre shielded/directed spray
    - clopyralid (Stinger) (not in Nassau & Suffolk Counties – max of 0.25 lb a.i./A/year in NY)
      - 0.125 - 0.25 lb a.i./Acre
    - Any grass only herbicide
      - Fusilade or Poast, etc.
Post Planting Weed Control – Organic Mulches

◆ Can help with weed control but will need to be maintained over time if it is the primary weed control method
  – Annual addition of mulch as material degrades and weeds become established on the surface

◆ Additional benefits include
  – Moisture retention
  – Moderated soil temperatures which can potentially extend root growth into the fall but slows soil warming in the spring
Post Planting Weed Control – Organic Mulches

◆ Wood chips are the preferred mulch
  - 3 – 4 inch layer of chips
  - If possible the lower layer should be composted

◆ Limitations
  - Potential for introduction of additional weed seeds
  - May enhance rodent damage in the winter
  - Labor cost associated with spreading mulch
Post Planting Weed Control – Landscape Fabric

- Can be effective for 1 – 6 years or more depending on type of fabric and use
- Mats or rolls available
- Select material that has a projected lifespan of 3 – 5 years
  - Breakdown will be slower if not exposed to sunlight
- Recommended width is 6 ft, but comes in 3 – 6+ ft widths

Establishing a willow living snow fence in Lewis Co., NY in the spring of 1999.
Fabric Barrier

Fabric Advantages
- Applied only once
- Improved tree and shrub establishment and survival
- Increases growth rates immediately following planting
- Easier and more timely weed control
- Long lasting weed control
- Comparable cost to other weed control methods averaged over several years
Fabric Barrier

Fabric Disadvantages

- Initially expensive
- Requires specialized machinery to install or done by hand
- Proper installation is critical to prevent pulling loose in winds
- Does not break down, especially within the shade of plants or under mulch
- Stems may be girdled by fabric as trees and shrubs grow
- Dense sod can become established on top of fabric, negating benefits and complicating future maintenance
- Ideal habitat for ground hogs, voles and mice

(PNW 2003)
Post Planting Weed Control – Landscape Fabric

◆ Should remove or till in weeds before use
◆ Fabric needs to be secured at time of installation to avoid abrasion of planted material
  – Plastic pegs, cover edges with soil (but will promote weed growth), cover with mulch
◆ Create openings in fabric using X-shaped cuts to avoid girdling as plants grow
Post Planting Weed Control – Landscape Fabric

- Improper installation can result in significant damage to plants
  - Broken stems and branches
  - Girdling from abrasion
  - Plants covered and smothered
  - Excessive temperatures under the fabric
Post Planting Weed Control – Landscape Fabric

- Can be very effective and beneficial

- **BUT**
  - When installed improperly it can cause extensive damage
Fabric Barrier Recommendations

Fabric Management

- Inspect as part of monitoring in first 1 – 2 years
- Ensure edges are firmly anchored
- Ensure openings are large enough to avoid stem damage
- Control aggressive weeds that may establish in fabric openings
- Enlarge openings as needed to prevent stem girdling
- Cover with mulch but leave area immediately around plants uncovered

Proper mulching of landscape fabric is important for success.
Effect of Terrain

Figure 7.9. Shrubs planted at the top of a cut can be used in place of taller barriers placed farther upwind. Snow transport must be accurately determined, however, if the risk of drift encroachment is to be acceptable. (Drawing from Tabler 1994).

(Tabler 2003)
Corners and Roundabouts

Figure 7.21. "Minnesota Snowtrap" used to reduce drifting at grade separations (Left from Tabler 1994).
Edge or End Effect

- Areas of turbulence are created around the ends of snow fences creating areas for potential snow drifts.

Figure 3.4. Locating of lanes and roads adjacent to windbreaks. Typical snow drift pattern near end of windbreaks.
Edge or End Effect

- Areas of turbulence are created around the ends of snow fences creating areas for potential snow drifts
- Length of drift is reduced by rounding effect at the ends of snow fences
  - reduces storage capacity and snow trapping efficiency
- Extend snow fence beyond the area that needs to be protected

(From Tabler 2003)
Edge or End Effect

- Fences can be parallel to the road if the prevailing wind is within 35° of being perpendicular (attack angle > 55°)
  - Often limited by site conditions
  - Living snow fences are three dimensional so they may be effective at a smaller attack angle
- Proper extension of the snow fence is more important than the orientation

(Gullickson et al. 1999)
Edge or End Effect

(Gullickson et al. 1999)

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Planting Rooted Stock

- Different types available
  - Bare root or plug
- Small sized material is lower cost and easier to handle and plant
- Available from commercial nurseries or from DEC or Soil and Water Conservation Districts
Planting Rooted Stock
Planting Rooted Stock

- Proper care of rooted stock is essential
  - Keep plants moist and in a cool location
  - Roots must never dry out!
- Make the hole deep enough for all roots.
- Cut long roots back to 10 or 12 inches.
- Remove one tree at a time from bucket only after hole is ready for the tree.
- Keep foreign matter (leaves, sticks, rocks, and dry soil) out of hole.
- Place all tree roots in a downward position.
- Place tree in center of hole.
- Hold treetop upright while working soil around roots.

(adapted from PNW 2003)
Planting Rooted Stock

- Firm soil around roots by hand while filling hole, leaving no air spaces. Make sure to use moist soil.
- Bring soil level to root collar (look for color change on stem) above the first roots. Too deep is better than too shallow.
- Firm soil all around tree by hand to give good compaction.

(adapted from PNW 2003)
Planting Rooted Stock

Trees and shrubs planted improperly have little chance to survive. Take an extra moment with each plant and make sure they are planted properly.

(adapted from PNW 2003)
Proper Planting is Essential

1. 'L' Roots (Hole shallow)
2. 'U' or 'J' Roots (Hole shallow, root ends often exposed to air)
3. Jammed Roots (Hole too narrow and shallow)
4. Compacted Roots (Hole too narrow)
5. Too Shallow Roots (Exposed, hole too shallow)
6. Too Deep Needles buried, hole OK, tree position poor

7. Inadequate Tamping (Roots drying likely due to depression left)
8. Planted in Rotten Wood (Roots not in damp mineral soil)
9. Planted on Mound (Roots apt to dry out)
10. Not Vertical (Tree not planted vertical to the soil surface)
11. Air Pocket (Showing improper tamping)
12. A Satisfactorily Planted Tree

© The Research Foundation of SUNY (PNW 2003)
Planting – Unrooted Cuttings

- Used for establishing willow and hybrid poplar
- Lower cost and easier to handle
- Quality of material is important
- Recommend 10 – 20” cuttings
- Keep frozen until just before planting
- Store in cool location and do not allow them to dry out after being delivered
- Plant with buds pointing up with at least one bud above ground
Planting – Unrooted Cuttings

- Plant 10 to 20 in. long cuttings between late April and early June
- Use high quality planting stock that has been properly stored and cared for

Planting of unrooted hardwood cuttings is easy and relatively quick
Post Planting Care

- Regular monitoring is needed to quickly identify problems before they become serious issues
  - Weed pressure
  - Browsing damage
  - Pest and disease problems
  - Herbicide damage from improper use or drift
  - Other factors that may be limiting growth

Weed control is probably the single largest factor for the failure of living snow fences

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Post Planting Care

◆ Weed control will be necessary for 2-3 seasons at least
  – Longer for sites where growth of shrubs or trees is slow
◆ Replanting
  – Even under the best conditions some plants will not survive
  – Gaps will create additional problems in the future
◆ Coppicing
  – For willows coppicing after the first year of growth is recommended to promote the development of multiple stems
◆ Fertilizer may be applied after the plants are established
  – Fertilizer on young or poorly established plants will just feed the weeds
  – Spring application of fertilizer based on soil analysis or plant tissue analysis
Successful Installations

Willow snow fence three months after planting.

First year of growth after coppicing.
Successful Installations

Willow snow fence two months after planting
Successful Installations
Successful Installations
Lessons Learned/Shared Experiences
Field Installation Activities
Soil Survey Information
Route 10

Map: Beerston Route 10 Snowfence
Town of Walton
Delaware Co., NY

Soil Sample Locations

Legend:
- Roads
- Soil Boundaries
- Snowfence

Map by: Philip J. Castellan
Date: Apr. 19, 2011
Planning and Site Preparation

- Not a typical blowing snow situation
- Site inspection and interaction with NYS DOT staff responsible for this section of road
- Revisited site and assessed conditions and decisions this spring
- Soil samples collected and analyzed
Site Preparation

- Sprayed site to kill existing vegetation
- Subsoiled site due to concerns about restrictive layers
- Rototilled site and laid landscape fabric
Site Preparation

- Mark landscape fabric with one double row
  - 2.5 ft between double rows
  - 2 ft along the rows in a staggered design
  - Result is a plant about every foot
  - Slit fabric with X style cut
Planting

- Plant 20 inch long cuttings for most of the site
- Add mulch and spread to a depth of 2-3 inches
  - Be sure to cover the fabric so it does not get picked up by the wind
Planting for Near Snow

- Similar site preparation
- Concern about salt levels in soil and from road side spray
- Selected native plants with salt tolerance and limited height growth so they don’t extend above the top of the bank
- Add mulch and spread to a depth of 2-3 inches
### Semi-evergreen shrub holds fruit and some foliage through winter. Highly tolerant of salt spray, drought, and poor soils. Used as a hedge and roadside planting throughout the northeast and down the Atlantic coast. Occurs naturally on sea shores and near wetlands. Nitrogen fixing, adapts to a wide range of stressful conditions. Aromatic waxy fruit and leaves. Spreads slowly by root suckers.

### Compact evergreen shrub holds dense foliage through winter. Tolerant of high planting density and salinity making it a good candidate for functional road side plantings. Tolerates wet sites as well as drought and all soil textures.
**Aronia arbutifolia**

Native shrub occurring naturally in a variety of conditions from dry hillsides to wet lowlands. Recommended for naturalistic plantings and borders. Colonizing habit and salt tolerance make it a good candidate for roadside bank stabilization and living snow fence applications. Year-round ornamental properties with white spring flowers, bright red fall foliage, and red fruit held through winter.

- Wide geographic range and adaptability. Tolerates variety of conditions including salinity, drought, and wet soils. Thicket forming habit, numerous stems, and various tolerances make this small woody shrub a good candidate for specialized roadside applications and naturalistic plantings.

**Prepared by Justin Heavey. Research Assistant, SUNY ESF**

**Sources:**
- UCON Plant Database [http://www.hort.uconn.edu/plants/]
- USDA Plant Database [http://plants.usda.gov/]
Questions and Discussion

“We cannot keep it from snowing, but we can influence the wind that carries tons of blowing and drifting snow” — Gullickson et al. 1999.