Wild Blueberry Fact Sheet A.4.1

Snow Management Using Windbreaks

WINTER AND ITS EFFECTS ON BLUEBERRY PRODUCTION IN NEW BRUNSWICK

In New Brunswick, wild blueberry production is carried out on large areas that are often exposed to high winds. In winter, the wind sweeps away the snow and exposes floral buds to temperatures that may cause considerable damage .

The studies conducted on low sweet blueberries (*Vaccinium angustifolium* Ait.) and velvet-leaf blueberries (*Vaccinium myrtiloides* Michx.) have shown that floral buds are prone to being damaged or killed when temperatures dip below -20°C between November and March. Starting in April, the floral buds are on the verge of blossoming and may be damaged when temperatures dip below -5°C. Floral buds are therefore frost tolerant to varying degrees during the winter and spring seasons.

Any frost damage will reduce fruit production. However, flower and fruit production is abundant when buds are covered by snow and thus protected from frost. One solution to this problem is to manage wind speed using snow fencing or windbreaks. Compared to snow fences, windbreaks evenly distribute snow over a greater distance and are more economical in the long run.

The objective of this information sheet is to discuss windbreaks in blueberry production and characteristics that may offer protection against winter damage.

Snow cover protects floral buds from freezing temperatures.

WINTER DAMAGE

The use of windbreaks can reduce winter damage to blueberry plants. By favouring an adequate snow cover, the plants are shielded from cold temperatures and protected from the wind's effects. Four conditions may cause winter damage: early frosts, extreme minimum temperatures, late frosts, and the wind.

<u>Early frosts</u> occur suddenly during late fall. They are short-lived and always take place before the first snowfall. Losses are therefore not linked to proper snow cover management.

Temperatures that drop <u>below normal seasonal lows</u> are occasionally recorded between November and March. Damage occurs when temperatures fall below the frost tolerance level of floral or leaf buds, in the absence of snow cover protection.

<u>Late frosts</u> occur during the spring. They are believed to cause a fair amount of damage to wild blueberry plants thus reducing production. Late frosts damage buds or even emerging flowers.

<u>Wind damage</u> occurs when plants are not snow covered. Wind mixed with snow and ice is abrasive and can reduce the number of floral buds. Furthermore, wind has a drying effect and thus increases evapotranspiration and the need to draw water from the soil. Since the soil is frozen, stems will die from dehydration once the water they contain has evaporated.

SNOW MANAGEMENT

EFFECT OF WINDBREAK POROSITY ON SNOW DISTRIBUTION

The goal of windbreaks is to lower the wind speed and thus result in even snow distribution across the blueberry field. Wind reduction is maximized when the windbreak is perpendicular to the prevailing winds.

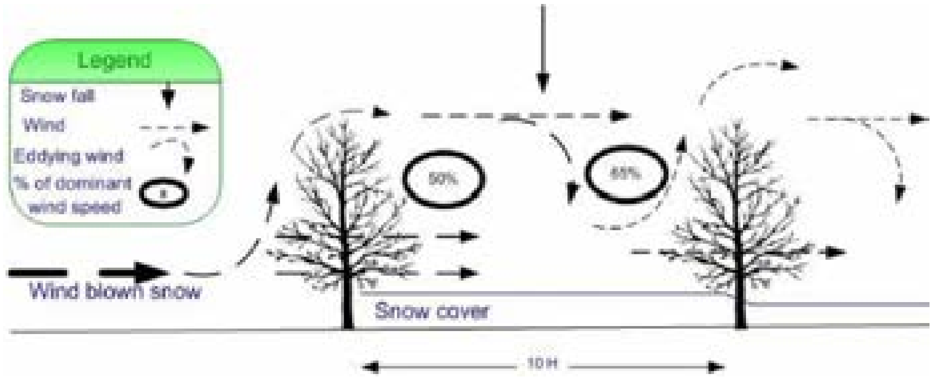

Figure 2. A porous windbreak will distribute snow evenly.

The windbreak's porosity is responsible for controlling wind speed and snow distribution (Table 1). A windbreak with a porosity level greater than 70% does not sufficiently reduce wind speed and does not help keep snow in the field; the snow is blown away by the wind.

Table 1. Wind reduction in relation to porosity during winter

Species	Porosity	% of open wind speed at 5 H*	% of open wind speed at 10 H*
Deciduous	65-75	50	65
Conifers	40-60	30	50
Conifers	20-40	25	35
Fence	0	25	70

*H is the windbreak's height

A windbreak with a porosity level lower than 60% reduces wind speed too quickly and creates strong wind turbulence. A snow bank forms near the windbreak when eddies carry, and then deposit large volumes of snow (Figure 1). Snow may also be swept away from the windbreak if the width of the field that requires protecting is too great.

A windbreak with a porosity level between 60 and 70% adequately reduces wind speed, the chances of snow being blown away and snow bank formation. Therefore, snow is uniformly distributed over a distance equal to 10 to 15 times the height of the windbreak (10 H to 15 H) (Figure 2).

MULTIPLE WINDBREAKS

Larger blueberry fields may warrant many successive and parallel windbreaks. The distance between the windbreaks is determined by the porosity and maximum height of the windbreak (Figure 3).

...a significant eddy zone is created between 5 H and 8 H, where snow is swept away completely.

Windbreaks should be established at a distance equal to 10 times the height (10 H) of the windbreak if they have a porosity level between 60 and 70%. For example, windbreaks should be spaced 100 m apart if the tallest trees will measure 10 m. At a distance greater than 10 H, there is a gradual return of the initial wind speed, which allows the snow to be carried away. The effectiveness of snow retention is greatly diminished beyond 15 H.

Windbreaks should be set up more closely if the porosity level is below 40% since a turbulent wind zone then forms between 5 H and 8 H, completely blowing away the snow on the ground. The distance between the windbreaks should therefore be no more than 5 H when the porosity is less than 40%. For example, the windbreaks should be 50 m apart if the maximum height of the trees is 10 m and the porosity level is 40%. At this distance, the air mass that flows through and over the second windbreak is not loaded with snow particles, which reduces the chance of snow bank formation (Figure 1).

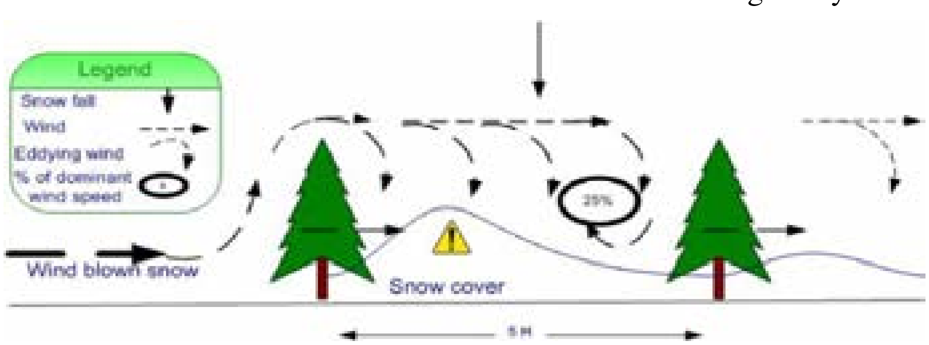

Figure 1. A dense windbreak creates severe turbulences and promotes deep snow drifts.

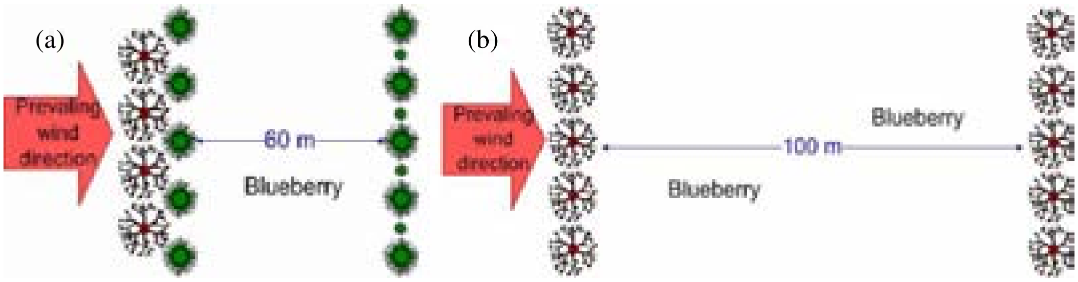

Figure 3. Ideal spacing between dense (low porosity) windbreaks (a) or porous (high porosity) windbreaks(b).

Recommendations for New Brunswick state that 60 m should be left between low porosity (coniferous) windbreaks and 120 m should be left between high porosity (deciduous) windbreaks. Theoretically, these distances are effective for 20 year old trees at a windbreak spacing of 5 H for low porosity windbreaks and 10 H for high porosity windbreaks.

MOVING AND RETAINING SNOW

The snow in a field obviously comes from precipitation but also from nearby areas. The amount of snow that is moved by the wind varies according to the type of snow and the length of time since the last snowfall. Fresh snow is light, while older snow is more compact and heavier. A study looking at snow movement in relation to wind speed showed that wind speeds of 14 km/h were sufficient to carry snowflakes that had fallen to the ground.

In very windy fields, windbreaks can retain and accumulate snow from nearby bare areas and thus protect the blueberry plants. Incidentally, it is this external snow supply that allows for the retention of a sufficiently thick layer of snow, even during winters with little snow accumulation.

In areas where snow accumulation is low, dense windbreaks help keep the fallen snow on the ground since they retain a greater volume of snow than porous windbreaks. This type of windbreak is also adequate for blueberry fields with no nearby source of snow, for example, a field at the edge of a forest.

SPECIES AND SPACING

While planning a windbreak, it is important to consider the types of trees that will be planted and their spacing in relation to management practices, the urgency associated with the need for protection, and site characteristics.

Management practices undertaken by the producer, such as herbicide application, directly impact the choice of tree species since many desirable species are sensitive to hexazinone, a herbicide frequently used in blueberry fields. Hybrid poplars, for example, are an attractive choice because of their narrow tree tops, rapid growth, and adequate porosity in winter and summer. However, they have the disadvantage of being sensitive to hexazinone.

The urgency with which protection is required correlates with the time when the windbreak will be most effective, that is to say, in five, ten or twenty years. The windbreak will be effective earlier if rapidly growing trees are used. However, these trees usually do not last as long and will have to be replaced earlier. The best option is to set up a windbreak using a mix of rapidly growing species and slower growing species so that it will be effective earlier and last longer.

...setting up natural windbreaks is a wise business decision, choice of species is just as important...

Site characteristics such as regional climate, plant hardiness zone and soil fertility, will reduce the number of suitable species. Each species is associated with a specific plant hardiness zone and is adapted to a type of soil and a variable acidity gradient. You can easily find this type of information in illustrated horticulture and tree identification guides.

The spacing in between trees depends on species characteristics at maturity such as crown width and shade tolerance. For instance, a sun-loving or shade intolerant species (e.g. poplar, red pine or tamarack) will not grow well with tight spacing. Without any maintenance, the needles or leaves deep inside the crown will die and the porosity will increase by too much. In contrast, shade tolerant species (e.g. black or white spruce) will require fewer interventions and will grow well with tight spacing. Some maintenance is still required however, since otherwise the porosity would decrease to almost zero with time.

The best option is to plant trees 2 m apart in two rows in an alternating pattern in order to reduce the time required to end up with an effective windbreak

(Figure 4). Trees that average 30 cm of growth per year will be about 2 m high after 5 years (Table 2), thus protecting an area 20 to 30 m deep. Maintenance of the windbreak over time is required in order to keep it healthy and to maintain the desired porosity level.

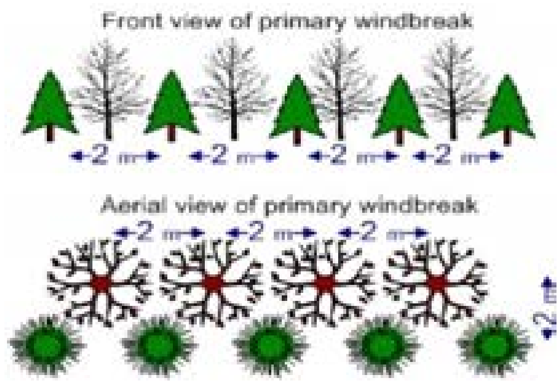

Figure 4. In-row tree spacing

Table 2. Characteristics of potential windbreak species

Species	Winter porosity	Height at 5 years (m)	Width at 5 years (m)
Green ash	Moderate	2.8	1.9
Lombardy poplar	Porous	3.6	0.5
Paper Birch	Porous	3.2	2.3
Red maple	Porous	2.8	2.1
Siberian elm	Porous	3.2	1.8
Willow	Porous	1.6	1.6
European larch	Porous	1.6	0.6
Tamarack	Porous	1.6	0.8
Jack pine	Moderate	2.4	1.1
Red pine	Moderate	2.4	1.2
Scotch pine	Dense	2.4	1.6
Black Spruce	Dense	1.6	0.7
White Spruce	Dense	2.4	1.1

WINDBREAK MAINTENANCE

Windbreak maintenance is essential to maintaining porosity, even snow distribution, and the field's productivity, as well as decreasing winter damage. With proper monitoring of the windbreak's effectiveness, the producer will be able to conduct one or more of the following treatments during the windbreak's lifespan.

Thinning consists of removing trees in order to reduce the windbreak's density. Without any maintenance, the windbreak can become too dense and create a turbulent wind zone between 5 H and 8 H in which snow will be swept away. This treatment is generally considered during the windbreak's planning stage and takes into account the trees' growth rates as well as crown width at maturity. The desired effect can be obtained within a short period by using a tight planting pattern. However, thinning must be undertaken to maintain the windbreak's desired porosity. This can be done by removing every second tree.

Pruning is used to increase the porosity of a windbreak which is too dense. This is done by removing the branches at a height of one metre above the ground or by removing certain branches that are perpendicular to the windbreak (pointing towards the field). Pruning will avoid snow accumulation right beside the windbreak and increase the distance over which snow will be distributed next to it.

Root trimming is an attractive management technique used to reduce the spread of the root system and to reduce water competition. Studies have shown that many tree species react well to this practice. Root trimming, used in conjunction with good herbicide management, may allow for the use of hexazinone-sensitive trees by limiting the trees' root zone on the side of the blueberry field. However, no studies have been undertaken in blueberry fields regarding the use and effectiveness of this method.

Fertilization should not be required since the choice of species in the windbreak should be based on the site's fertility. However, to obtain the desired effect as quickly as possible, it is possible to fertilize the seedlings during the first few years. The proper rate and formulation can easily be calculated by a specialist. The fertilization needs are based on soil analysis results from the blueberry field and the requirements for the chosen species.

Efforts in windbreak maintenance that are similar to those in crop production will guarantee results .

Management of weeds and shrubs in the windbreak is very important during the first few years to ensure proper establishment and adequate growth. This type of management is also required after the windbreak has been established, especially as it pertains to the growth of shrubs in the understory, because shrubs reduce the windbreak's porosity and effectiveness. When dealing with herbicide sensitive species, caution should be used when choosing a control method for use beside the windbreak.

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For more information on windbreaks, please contact a Land or Crop Development Officer with the New Brunswick Department of Agriculture, Aquaculture and Fisheries (1-888-NBAGRIC or 1-888-622-4742) or other agrologist.

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