

Protect Alfalfa from Winter Kill

To ensure your alfalfa stand survives and thrives after the winter months, begin preparation in the spring. Each management decision made between spring thaw and freeze-up either increases or decreases the likelihood of winter kill or injury. While winter kill causes immediate yield losses, winter injury can be equally costly over the long term. Injured plants are slow to recover in the spring and after every cut. Yield will always be limited by winter injury, and stands will begin to thin as injured plants eventually die out.

Avoiding both as much as possible will protect yield potential and maintain the persistence of a stand.

Given Manitoba's notoriously long, cold winters, alfalfa growers should take every opportunity in the growing season to tip the survival odds in the plants' favour. A healthy, productive, persistent alfalfa stand needs balanced nutrition, carefully managed cutting dates and a suitable regrowth period going into winter.

Variety Selection and Stand Health

Ensuring persistence of that continuously productive stand starts with choosing the variety best-suited to Manitoba's climate. Varieties vary in their fall dormancy as a trade-off to productivity. The better fall dormancy rating a variety has, the earlier the variety goes dormant in the fall, limiting total productivity. Dormant varieties, however balance productivity with the higher likelihood of the variety making it through several winters, adding years to the life of the stand.

When choosing an alfalfa variety, look for fall dormancy ratings (1, 2, or 3). Only farmers who plan on managing their stands properly should consider a variety with a higher fall dormancy rating (4). *The Manitoba Seed Guide* (available at your Manitoba Agriculture, Food and Rural Initiatives GO office) lists fall dormancy ratings and also includes the latest winter hardiness ratings established by a new test for additional variety comparisons.

The map on the right illustrates the different winter hardiness zones found in Manitoba. Alfalfa growers should choose varieties adapted to their specific winter hardiness zones.

Farmers should also choose varieties with a good disease package (ex: resistance to bacterial wilt, verticillium wilt and

Alfalfa Winter Hardiness Zones Map



phytophthora root rot). These diseases are often associated with winter kill or injury, having gained access to the plant through broken roots and crowns.

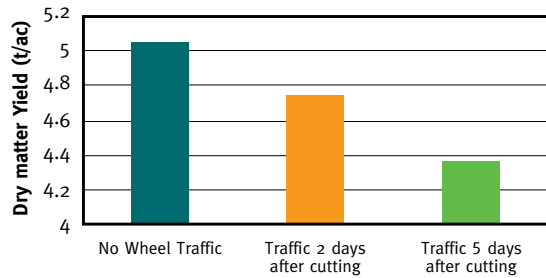
The older the alfalfa stand, the higher the risk of winter kill. An alfalfa stand with three or more years of production is at higher risk to winter kill and injury for several reasons, and not all of them can be managed. Wheel traffic, decreased fertility, increased disease and excessive cuttings in past years can cause gradual decreases in an older stand's persistence. While there's not much you can do about the age of your stand, it's worthwhile noting an older stand may need more careful management, fertilizer applications or longer regrowth periods to maintain its productivity and persistence.

Young stands survive winter better because young plants are usually healthier, free of disease and stand density is at a maximum, so some winter losses won't immediately be evident by yield loss.

Wheel traffic can have a significant impact on stand health, not only because it can cause yield-suppressing physical injury by breaking stems but also because damage creates an opening in the plant tissues where diseases can gain access. Research from Wisconsin estimates that wheel traffic on alfalfa, five days after cutting, versus two days, can significantly affect subsequent yields.



Effect of Wheel Traffic on Alfalfa Yield (2 year average)



Courtesy of D. Undersander, University of Wisconsin

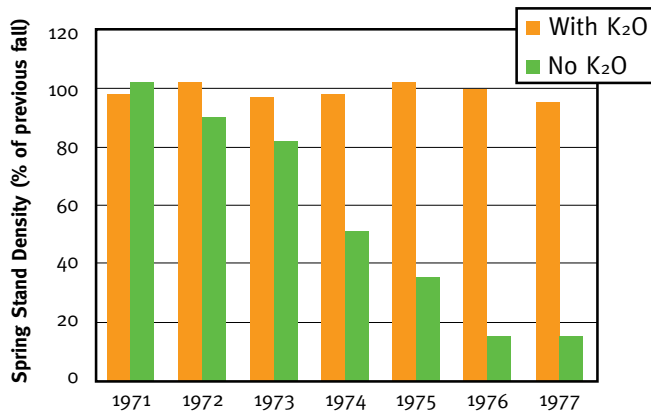
Fertility

Without proper plant nutrition, even the most winter hardy variety can succumb to winter kill or injury. Nutrient deficient plants are more susceptible to disease, regrow more slowly, yield less and die off more quickly.

While Manitoba farmers are blessed with highly productive soils across much of the province, alfalfa still needs an excellent source of phosphorus and especially potassium to improve its odds of making it through the winter. Because it is a legume, alfalfa will do its own nitrogen fixing, but insufficient levels of phosphorus and potassium can spell disaster. Phosphorus is a key nutrient in plant structures, such as stems and flowers, and plays a role in several plant functions, such as root development, disease resistance, even maturity and improved nitrogen fixation.

Phosphorus is important to overall plant health, but when avoiding winter kill or injury is the goal, special attention needs to be paid to potassium levels in the soil. Potassium (K) is essential to alfalfa growth and over-wintering capability. Potassium acts as a plant's natural antifreeze within the cells, and it naturally begins to accumulate potassium in the fall to protect itself at freeze-up. Figure 1 shows the effect of potassium fertilization on preventing winterkill of alfalfa on a sandy loam soil over an eight year period. Most Manitoba soils are naturally high in soil potassium, however, levels are often low in sandy or sandy loam soils and on side slopes.

Stand Density vs Previous Fall



Based on research conducted by L. Bailey – Agriculture and Agri-Food Canada, Brandon, Manitoba.

High yielding alfalfa uses a lot of nutrients. Although potassium levels may seem adequate for a grain or oilseed crop, it's important to realize that each tonne of alfalfa produced draws up to 45 pounds of K from the soil. A regular soil testing routine will help to monitor if all nutrients are available in sufficient quantities. Fall application of potassium on low K soils is recommended if establishing a new stand the following spring. And good fertility isn't just about avoiding winter kill – a balanced fertility plan ensures a stand has the potential to maximize annual yields, keep weeds at bay and prolong the productive life of the field.

Harvest Timing

Harvesting alfalfa is an inexact science balancing good yields and high quality. Quality (measured by relative feed value (RFV)) is highest when leaves are plentiful in relation to stems with no blooms present. However, yields are far too low at this immature stage to justify harvesting. Farmers usually target that brief period when quality is still very good (150+ RFV) and yield is substantial enough to justify the cost of harvesting, usually around late bud or first-bloom stage. This timing however isn't necessarily an accurate measure of maximum quality and quantity. Manitoba Agriculture, Food and Rural Initiatives has developed a Predictive Equation for Alfalfa Quality (PEAQ) measuring stick to help farmers decide when to harvest.

The interval between cuttings is critical to the overall productivity and eventual longevity of a stand. Alfalfa plants' energy reserves are lowest two to three weeks after cutting as the plant has mobilized root reserves to regrow shoots and leaves to this stage. Once the plant has enough leaf area to sustain itself, it will begin to replace root reserves.

If plants aren't allowed ample time to regrow plant matter and replenish root reserves before a second or even third cut, the overall longevity of the plant is compromised. Think of it as mining the plant's nutritional reserves – reserves necessary to regrow not only after each cutting, but also in the spring.

In Manitoba, it's recommended that stands be left at least four to five weeks in between cuttings, depending on environmental conditions. This is the length of time it takes for plants to build root reserves back up to pre-harvest levels – this is often around 10 per cent bloom. Cutting at pre-bud or bud stage depletes root reserves faster than they can be replenished.

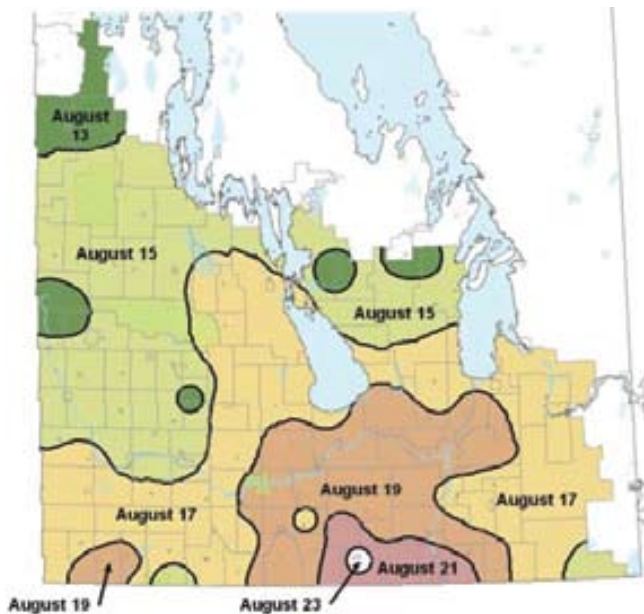
The timing between cuttings is most critical later in the season, especially for the last cut of the year. Alfalfa is a perennial and is constantly respiring and using stored energy, even during the winter months. In spring, these energy reserves are heavily drawn on to produce the first shoots and leaves of the season. Then, through photosynthesis, this top growth begins moving nutrients and energy back into the root system to help it grow and develop. This, in turn, feeds the top growth.

As the season wears on and the days start to shorten, a perennial begins to reverse the net flow of nutrients downward, storing enough energy to last the winter and to feed next spring's growth. If the plant is cut too late in the year, its root

reserves are depleted trying to regrow shoots and leaves. The plant would not have enough growing degree days left to accumulate enough reserves for the spring. These plants are most susceptible to winter kill and injury. They are also more likely going to struggle to regrow in the spring.

Alfalfa needs about 450 to 500 growing degree days between the last harvest and freeze-up. This time is called the Critical Fall Harvest Period and is equivalent to about the last six weeks of growing season in Manitoba. Because of climate variations, this can mean a different start to the critical fall harvest period between regions within the province. For example, the critical fall harvest period for farmers in the Red River Valley begins around August 17 through 19, but as late as August 23 for farmers in the south-central areas of the province. The map below illustrates the various start times in Manitoba of the critical harvest period. It is recommended to not harvest alfalfa between the date listed below and the first killing frost.

Beginning of the Critical Fall Harvest Period for Alfalfa



There is growing evidence that suggests that allowing at least one cut of alfalfa to reach 50 per cent bloom or more, can increase the plant's ability to withstand winter. These research findings from North Dakota also suggest that this benefit is greatest if it's the last cut of the season that has been allowed to mature this far. Plants allowed to mature to 50 per cent bloom or more have had ample time to put down root reserves. If this occurs later in the year, plants will likely keep growth short and leafy, maintaining more RFV than if the same maturity stage were reached on first or second cut.

Ultimately, economics will always influence how many and how often cuts are taken throughout the growing season and into the fall. Any decision on late season or after frost cutting must be

balanced against the overall value of longevity. Farmers should make the decision to either cut before the critical fall harvest period or as close to a killing frost as possible. Keep in mind dry down time is significantly reduced this late in the season. Cutting after a killing frost can speed the drying. It also works well if the alfalfa is taken as baled silage.

Farmers who plan to take a last cut of alfalfa at or after a killing frost should keep in mind that an alfalfa plant is very hardy and can withstand very cool temperatures without actually being affected by frost. One night of zero degrees Celsius is not a killing frost for alfalfa. The tops of the plants don't die at any set temperature. In fact, in a late fall, without a killing freeze, it takes colder and colder temperatures to actually kill alfalfa tops. It could be prudent to wait until air temperatures dip down to minus five degrees Celsius before considering a late cut.

One poorly timed late season harvest could ruin next year's yield beyond the value of that badly timed harvest. Not taking a final fall cut is often balanced by the following spring. Cutting during the critical harvest period but before a killing frost, leaves the stand vulnerable to winter kill and injury.

Heading Into Winter

Weather is the one variable every farmer wants to control. Snow cover that comes on fast and thick first thing after freeze-up is best for alfalfa plants that are already dormant. But farmers can't rely on that. The critical fall harvest period is important to ensure ample root reserves for spring regrowth and time for the alfalfa plants to slowly go dormant in preparation for freeze-up. However, the harvest period is also important to ensure there are at least eight inches of plant matter standing to trap snow. Ideal plant and snow cover insulate the soil and the plant's root system, reducing soil temperature fluctuations.

Snow cover of at least four inches is ideal for protecting and insulating plants over winter. Farmers can't control how much snow will fall, but can ensure enough stubble is left standing each fall to trap what does. No matter when the last cut is taken, farmers should leave at least six to 10 inches of stubble to trap snow. Alternating rows of cut and un-cut swaths can help but may leave plants in cut rows more susceptible to winter kill or injury.

A warm snap in the fall can cause alfalfa to break dormancy. Temperatures of 10 degrees Celsius for three to four days can be all it takes for the plant to begin mobilizing root reserves for new growth. Plants that break dormancy are at risk of using up stored energy, especially if this happens more than once in a season.

Alfalfa, once dormant, can survive in soil temperatures up to minus 12 degrees Celsius, however if the plant is not fully dormant, or if the variety is less winter hardy, it can be injured or killed at these temperatures. As little as four inches of snow can mean soil is kept as much as 10 degrees Celsius warmer than the air temperature.

Just as snow insulates the plant against extreme cold, it also acts as a buffer to warmer temperatures, reducing the likelihood of the plant breaking dormancy.

Excessive soil moisture can also contribute to winter kill. Wet soils in the fall or early spring can lead to ice sheets forming or frost heaving (more common in clay soils), which can break roots and lift and expose crowns to weathering. While there's little farmers can do about excess moisture, it's important to note early wheel traffic can cause excessive damage to crowns and plants exposed by heaving frost or those already weakened by winter injury.

Identifying Winter Injury

Surprisingly, winter injury can be as damaging to yield and persistence as winter kill, it just takes longer to see the damage. A thorough spring evaluation is needed to assess any damage. A field that is greening shouldn't be assumed to have no winter injury. An injured plant will green but can then die off within a week or so. It could be severely damaged and can limit yield for the entire season.

In order to evaluate how a field survived winter, individual plants should be pulled or dug up. Often, a winter injured or diseased plant will break off just below the surface when

tugged. After pulling several plants, split open crowns and roots. Healthy plants will have firm, white roots, winter injured plants may start off as gray right after spring thaw, but they become yellow or brown and are stringy rather than firm.

Each plant that didn't make it through winter or that won't survive the season due to winter injury affects the overall yield and persistence of the stand. Keeping a close eye on plant populations can help gauge each winter's effect and can signal when to take out a stand, because of age or injury. Plant population is a good indication of the general productivity of a stand. Monitoring plant populations lets a farmer know when a stand is beginning to thin.

Plant densities, measured in plants per square foot, are highest in the first year of establishment, usually around 25 plants per square foot. By the second fall, the stand will have naturally thinned to roughly half that number. In the third and subsequent years of an alfalfa stand it's more important to count stems rather than number of plants per square foot as mature plants can produce a lot of yield all on their own.

A good rule of thumb when assessing a field is to strive for 40 to 45 productive stems per square foot. Anything less than 30 to 35 stems per square foot, means yield potential is compromised and the stand may need to be taken out. This assessment, done every spring, should give a good indication of productivity and longevity of the field.

Protecting alfalfa stands from winter kill and injury takes careful management of the elements farmers control. A healthy, pest-free stand allowed ample time to rest between cuttings and before freeze-up will have the best chance of making it through winter. Ensuring as many plants as possible make it through winter will maintain yields and add years of life to an alfalfa stand.

Healthy Plant



Winter Injured



For More Information

- Your local Manitoba Agriculture, Food and Rural Initiatives Growing Opportunities Centre.
- Manitoba Agriculture, Food and Rural Initiatives website: www.manitoba.ca/agriculture.
- Forage Beef website: www.foragebeef.ca
A forage and beef production website that contains information gathered from Manitoba, Alberta and Saskatchewan.
- Your local Agriculture and Agri-Food Canada (PFRA) office.
- Manitoba Forage Council website: www.mbforgecouncil.mb.ca.

The following agencies worked collaboratively and provided funding for this publication:

- Manitoba Agriculture, Food and Rural Initiatives
- Agriculture and Agri-Food Canada
- Manitoba Forage Council

Partial funding for this publication was provided by the Greencover Canada Program, a five-year, \$110-million Government of Canada initiative to help producers improve grassland-management practices, protect water quality, reduce greenhouse gas emissions and enhance biodiversity. For more information please visit www.agr.gc.ca/env/greencover-verdir or phone 1-866-844-5620.