

Managing Frost Damaged Alfalfa Stands

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Wide fluctuations in springtime temperature are common in Kentucky. Late freezing temperatures in the spring can cause damage to alfalfa depending on how far along it is in breaking dormancy. This publication provides information on the effect of low spring temperatures on both established and new alfalfa stands that have begun growth, as well as a method of predicting sensitivity to late frosts or freezes.

Alfalfa breaks dormancy in the spring due to increasing temperatures. These warming periods cause biochemical changes and plant growth. In most years, this warm-up in temperatures is relatively steady and growth occurs normally. Late spring frosts on alfalfa that has begun growing can set back and even kill the developing stems. The sensitivity of the alfalfa plant to late frosts depends on many factors including the date and severity of the freeze as well as the degree to which alfalfa has broken dormancy. A freeze event on alfalfa that has just broken dormancy will likely have less impact on the plant than the same freeze event on alfalfa that has fully broken winter dormancy.

Data collected from two years with late spring freezing (2007 and 2017) in Kentucky, combined with previous research (see list of sources at the end of the publication) was used to assess alfalfa sensitivity to low temperatures and prepare a set of management recommendations. In the remainder of this article, we will discuss the impact of light, moderate, and heavy frost on spring growth of alfalfa stands and management options.

Limitations to application of these recommendations

Determining the temperature that alfalfa stands were exposed to during a frost event is not an exact science. Sensors to measure air temperature are normally installed four to six feet above the soil surface and in a radiation shield. In contrast, the height of alfalfa exposed to spring frosts is likely to be 6 to 12 inches above the soil surface. In addition, conditions at the soil surface in a vegetated field can be quite different compared to the air temperature at five feet above the soil. Couple all this with variations in topography and you can have many “microclimates” within a single field. Interpret the following information with the realization that the temperatures that alfalfa plants were exposed to within a single field can vary greatly.

Established Alfalfa Stands (alfalfa stands of > 1 year)

Light frost damage: Alfalfa leaves may be impacted when temperatures drop below 28° F. This will present itself as the loss of some trifoliolate leaves and twisting of stems ends near the top of the canopy. In this temperature range, alfalfa buds and growing points will not likely be damaged and will continue to grow as normal. Alfalfa will normally outgrow this damage and no changes in management practices are warranted.

Moderate frost damage: Freezing causes significant injury in the terminal growing point near the end of the stem, however the entire stem is not killed. Axillary buds at each leaf position lower on the stem and crown buds will begin to develop into new stems. Stems lower in the canopy that were not impacted by the frost will continue to grow normally. The net result is a mixture of mature and vegetative growth that can make harvest decisions difficult. If high quality forage is the number one priority, then harvest based on the maturity of the undamaged stems. If a lower feed quality can be tolerated, then harvest can be delayed for a week or so to allow maximum accumulation of carbohydrates in the taproot. Avoid cutting moderately frosted alfalfa early. Early cutting decreases both yield and regrowth rate of the stand due to the stress of early cutting.

Severe frost damage: Stems that were growing at the time of the frost will not regrow. Regrowth will come from crown buds at the base of the plant. Alfalfa stands with sufficient growth to justify harvest should be cut immediately after the severe frost. Cutting will help to maintain forage quality and allow regrowth to occur from the crown buds. If stands do not have enough growth to warrant harvest, frost damaged plant material can be left in place. However, leaving damaged or killed plant material in place may delay regrowth.

If alfalfa fields are fenced, frost damaged plants could be grazed. Graze these fields carefully to reduce the chance of bloat. Waiting for frosted alfalfa to dry will significantly reduce the chances of bloat, but will take approximately one week. Animals should never be turned into alfalfa hungry and should have free access to a high quality dry hay at all times. For more information on managing bloat, see ID 186, Managing legume-induced bloat in cattle (<http://www2.ca.uky.edu/agcomm/pubs/id/id186/id186.pdf>).

Flash grazing damaged stands with a high livestock density for a short period of time is highly recommended. Since severe frost has the same effect on the alfalfa plant as early harvest, regrowth will likely be slower. If possible delay the second harvest until 50% bloom to allow the plant to recover its stored carbohydrates.

Predicting Sensitivity to Late Freezes

Comparison of temperature data from the springs of 2007 and 2017 provides insight into predicting sensitivity of Kentucky alfalfa to late frosts. Severe frost events (<26 degrees F) were experienced in both years; April 6-9 in 2007 and March 14-16 in 2017 (Table 1). Stands of alfalfa were generally killed back to the crown in 2007 (Figure 1) but not in 2017 (Figure 3) even though the absolute temperatures experienced were lower in 2017. Alfalfa stands in 2017 were able to recover even though first cutting was delayed (Figure 4).

An obvious difference in these years was that the date of the freeze was three weeks later in 2007, allowing greater growth in the alfalfa stand compared to 2017. In 2017, alfalfa had less growth by the time of the late freeze, and subsequent growth was not as affected as in 2007, even though absolute temperatures were lower.

Comparison of the number of growing degree days accumulated using a base temperature of 50 degrees F (GDD50) provides some ability to explain the differential damage between 2007 and 2017. At the time of the respective freezes, significantly more GDD50 had accumulated in 2007 than 2017 (Table 1). After reaching 300 GDD50 units in 2007, alfalfa was very sensitive to freeze damage (Figure 1). Lower temperatures did not cause severe damage in 2017, but GDD50 was an average of 159 units less (Figures 2, 3 and 4).

Calculating Growing Degree Days

Growing degree days are calculated by taking the average daily temperature and subtracting a reference temperature, in this case 50. The accumulated GDD50 is the sum of the daily GDD50. If the average temperature on a given day is less than 50, the GDD50 for that day is zero.

Although precise conclusions are not possible from this simple comparison, it is reasonable to use a GDD50 value of 300 as threshold for freeze susceptibility for Kentucky alfalfa. In other words, expect damage to alfalfa stands when freezing (<26 degrees F) temperatures are predicted after a GDD50 value of 300 is reached.

New Alfalfa Seedlings

Immediately after emergence, alfalfa seedlings have fair to good tolerance to cold injury. However, once they reach the second trifoliate leaf stage, tolerance to cold injury decreases markedly. Four or more hours of exposure to 26° F can kill seedlings at this growth stage. Before reseeding, the extent of damage in new stands should be assessed. Normally alfalfa is seeded at rates much higher than the final stand density needed for optimal yields. This results in a high initial number of seedlings per unit area. During establishment and the first growing season alfalfa stands self-thin. The ideal stand density at the end of the first production year is 12-20 plants per square foot. If this number of healthy seedlings per square foot is present following frost damage, then no reseeding is needed. If stands do not consistently have 12-20 healthy plants

per square foot, then thickening stands as soon as possible with a no-till seeding is the best option. In most cases, seeding rates in the range of 10-12 lb/A should be sufficient for thickening frost damaged stands.

For more information on alfalfa and forage management, contact your local extension agent or visit <http://www.uky.edu/Ag/Forage/>.

The following sources were used in the preparation of this article:

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Undersander, D., M.H. Hall, P. Vassalotti, and D. Cosgrove. 2011. Alfalfa germination and growth. University of Wisconsin Cooperative Extension, R-08-2011, Madison. Available at https://www.alfalfa.org/pdf/Alf_GerminationGrowth.pdf.

Managing Frosted Alfalfa at a Glance

- Late spring frost can damage alfalfa stands
- Alfalfa stands that have broken dormancy are more susceptible to freeze damage
- **LIGHT FROST**: alfalfa plant exposed to 27 to 31°F
 - Loss of some trifoliolate leaves and twisting of stem ends near top of canopy
 - Alfalfa growing points and buds are not likely damaged
 - Alfalfa will outgrow damage and no changes in management warranted
- **MODERATE FROST**: alfalfa plant exposed to 26 to 27°F
 - Significant injury to terminal growing point at end of stem
 - Whole stem is not dead
 - Axillary buds at each leaf position on stem and crown buds will begin to grow
 - Stems in lower canopy will continue to grow as normal
 - Results in mixture of new and mature tissue
 - To optimize FORAGE QUALITY harvest based on maturity of undamaged stems
 - If lower quality can be tolerated, delay harvest for week or more
 - Delaying harvest allows maximum carbohydrate storage
 - Avoid cutting moderately frosted stands early
- **SEVERE FROST**: alfalfa experience temperatures below 26°F
 - Stems are killed and will not regrow
 - Regrowth will come from crown buds
 - If sufficient growth exists, harvest immediately following severe frost
 - If growth does not warrant harvest, graze stands off or all dead material to remain in place
 - Allowing dead plant material to remain in place may delay regrowth
- New alfalfa seedlings
 - Newly emerged alfalfa seedling have good cold tolerance
 - Cold tolerance decreases markedly at 2nd trifoliolate leaf stage
 - Four hours of 26°F can kill seedlings
 - Before reseeding, evaluate stand density
 - If 12 to 20 seedlings per square foot are present, no reseeding is needed
 - If <12 seedlings per square foot are present, no-till alfalfa into remaining stand
- Limitations/considerations for interpretation of these management recommendations:
 - Temperature is usually measured 4 to 6 ft above soil surface

Table 1. Comparison of accumulated Growing Degree Days, base 50 (GDD50-ACC) on the date of late freeze events on alfalfa stands at four Kentucky locations in 2007 (severe damage) and 2017(moderate damage).

Location	2007			2017		Temp. (°F)
	Date of freezing event	GDD50-ACC	Temp. (°F)	Date of freezing event	GDD50-ACC	
Lexington, KY	8-April	303	22	16-March	156	16
Bowling Green, KY	8-April	368	23	16-March	209	19
Paducah, KY	8-April	371	21	16-March	213	19
Jackson, KY	8-April	356	21	16-March	184	18
Average	8-April	350	22	16-March	191	18



Figure 1. Close up of alfalfa after experiencing minimum temperatures in the low 20's F for four days in early April 2007, Lexington KY. Notice the limp and twisted stems, which were laying horizontal on the ground. Taken April 9, 2007.



Figure 2. Alfalfa from an established stand prior to late freeze, Lexington KY. Taken March 14, 2017.



Figure 3. Alfalfa from the same established stand five days after experiencing minimum temperatures of 16 and 17 °F on consecutive days at Lexington KY. Taken March 21, 2017.



Figure 4. Alfalfa from the same established stand, 40 days after late freeze, Lexington KY. Taken April 28, 2017. Although first cutting was delayed, this alfalfa stand was able to recover.