Considerations for Utilizing Frosted Small Grains for Forage

Chris Teutsch, Carrie Knott, and Roy Burris, University of Kentucky

Once wheat and other small grains harden off in the fall, they are relatively tolerant of cold temperatures and freeze injury. Frost injury in the spring normally occurs when February and March are unusually warm and small grains initiate growth earlier than normal or from a usually late frost event. Freezing temperatures during sensitive growth stages can significantly impact grain yield (Table 1). In some cases, the impact on yield can be moderate to severe. Freeze damage in stands should assessed 5-7 days after the frost event. At this point, damage to the tissue will become more evident. Damaged tissue will be water soaked and starting to decay. In some cases, the seedhead may be damaged, but the stem will continue to elongate. In more severe cases, the stem will be girdled just below the developing seedhead and as it decays, the stem will likely lodge and die.

Table 1. Impact of growth stage and temperature on freeze injury in wheat.

Growth Stage	Feekes	Zadoks	Temp for 2 hrs	Symptoms of Freeze Injury	Yield Reduction
Tillering	1-5	20-29	12°F	Leaf chlorosis, burning of leaf tips, silage odor, blue cast to fields	Slight to moderate
Jointing	6-7	31-32	24°F	Death of growing point, leaf yellowing or burning, lesions, splitting or bending of lower stem, odor	Moderate to severe
Boot	10	41-49	28°F	Floret sterility, spike trapped in boot, damage to lower stem leaf discoloration, odor	Moderate to severe
Heading	10.10 -.50	50-58	30°F	Floret sterility, white awns or white spikes, damage to lower stem, leaf discoloration	Severe
Flowering	10.51 - .54	60 - 71	30°F	Floret sterility, white awns or white spikes, damage to lower stem, leaf discoloration	Severe
Milk	11.1	75	28°F	White awns or spikes, damage to lower stems, leaf discoloration, shrunken, roughened, or discolored kernels	Moderate to severe
Dough	11.2	85	28°F	Shriveled, discolored kernels; poor germination	Slight to moderate

Adapted from "A Comprehensive Guide to Wheat Management in Kentucky", UK Ag Extension, ID-12, Lexington.

If the level of damage to a small grain stand is severe enough to warrant termination of the grain crop, one option to glean some value from the small grain is to utilize it as forage. Frost damaged small grains can be mechanically harvested as hay or silage or grazed by cows and/or calves. Depending on the severity of the frost damage, plant growth may appear normal, but there may not be a viable seedhead in the stem. In more severe cases, main tillers may lodge and die, leaving secondary tillers to develop normally. In the most severe cases,

both the primary and secondary tillers may lodge and die. Understanding the level of damage will help to determine how we manage the crop for forage.

Special Considerations

Nitrate toxicity. Nitrates can accumulate to toxic levels in commonly grown forages, including small grains. This most often occurs when heavy nitrogen fertilization is followed by drought or any factor that slows plant growth. As plant growth slows nitrates are taken up by the plant, but not assimilated into amino acids and protein. After plant growth resumes, nitrates are normally in the safe range in 5-7 days. In cattle, nitrate is converted to nitrite in the rumen, and the nitrite is absorbed into the blood stream. Nitrite interferes with the blood's ability to carry oxygen. Symptoms of nitrate poisoning include trembling, staggering, rapid and labored breathing, rapid pulse, frequent urination followed by collapse, coma, and death. The onset of symptoms and death is rapid and usually occurs within one to two hours. Most often, animals are simply found dead. In animals affected by nitrate poisoning, the blood will take on a brownish chocolate color, giving the non-pigmented skin and mucus membranes a muddy brown color. Forages that are high in nitrates should not be harvested or grazed. Nitrates are stable in dry hay and can kill livestock months after harvest. Ensiling forages will reduce nitrate levels 40-60%. If high nitrates are suspected, ALWAYS test the forage before grazing or harvesting.

Pasture bloat. Pasture or frothy bloat can occur when grazing legume or lush grass pastures, including small grains. It occurs when a stable foam is formed in the rumen. This foam prevents the animal from eructating gases formed during normal rumen function. Intraruminal pressure builds and the left side of the rumen becomes distended. As the intraruminal pressure increases, the ability of the animal to breath is restricted, followed by heart failure, and death. When hungry animals are given unrestricted access to lush pasture, bloat can occur in less than one hour, but a more common time frame is one to three days. Hungry animals should never be given unrestricted access to small grain pasture. Animals should be filled up with a high quality dry hay before being introduced to small grain pasture. Once grazing small grain pasture, animals should have access to a high quality dry hay at all times. Poloxalene, an antifoaming agent, is effective at preventing frothy bloat. It can be mixed with grain supplement or drinking water, drenched, or fed as a pasture block. However, its effectiveness is dependent upon daily intake. Therefore, mixing it with supplemental feed that is palatable tends to be more effective than supplying it in a pasture block. Animals that chronically bloat on high quality pasture should be culled.

Grass tetany. Grass tetany or hypomagnesemia is associated with low levels of magnesium in the blood. It most commonly occurs with cows and ewes in early lactation, that are grazing lush perennial pastures, annual ryegrass, and small grains in late winter or early spring. Grasses fertilized with moderate to high levels of nitrogen that are growing on soils that are low in magnesium are most commonly associated with grass tetany. In this case, potassium

is taken up instead of magnesium, resulting very low levels of magnesium in the plant. Pastures with soils low in magnesium should be limed with dolomitic lime and excessive fertilization with potassium and nitrogen should be avoided. Providing a palatable free choice mineral that is high in magnesium (15%) is the best approach to preventing grass tetany when grazing small grain pastures.

Grazing and hay harvest restrictions. Herbicide use in small grains grown for grain could impact how and when small grains can be used for hay and grazing. In addition, rotational intervals for subsequent crops should also be considered. Detailed information on grazing and haying restrictions and rotational restrictions can be found in Table 1. In is important to remember that herbicide labels should always be consulted and followed.

Table 1. Feeding and rotational restriction for commonly used wheat herbicides. Always consult the herbicides' label to confirm restrictions.

Herbicide	Grazing and Haying Restrictions	Field Corn	Soybean
Anthem Flex	7 days for grazing or feeding	0 day	0 day
Axial XL	30 days	90 days	90 days
Axiom	30 days for grazing	0 day	0 day
2,4-D	2 weeks	7-14 days	7-30 days
Clarity	37 days for lactating animals	0 days	14 days Consult label for details.
Finesse	0 day for grazing	18 months	- 4 months for BOLT soybean - 6 months for STS soybean - 18 months for non-STS soybean
Finesse Grass & Broadleaf	0 day for grazing. Observe label for additional comments.	Conduct field bioassay the following year.	9 months for STS soybean
Harmony Extra SG	-Allow 7 days before grazing. -Allow 30 days for hay. -Harvested straw may be used for bedding or feed.	14 days	7 days
Harmony SG	-Allow 7 days before grazing. -Allow 30 days for hay. -Harvested straw may be used for bedding or feed.	0 days	0 days
Metribuzin	Do not graze within 14 days.	4 months	4 months
PowerFlex	-7 days for grazing -28 days for hay	9 months	3 months when applied in February or later. See additional comments.
Prowl	-11 days for forage -28 days for hay	Next Cropping Season.	0 days
Quelex	-21 days for hay -Do not graze for 7 days -Do not compost plant material	3 months	3 months

Osprey	-30 days for forage -60 days for hay	90 days	90 days
Valor SX	Do not graze until wheat reaches 5 inches	7 to 30 days depending on rate & tillage system	0 day
Zidua	7 days for forage and hay	0 day	0 day

Adapted from Jim Martin, Herbicide Label Restriction for Feeding and Planting Rotational Crops in Wheat Science News, Special Freeze Issue. March 21, 2017, Volume 21, Issue 2. UKREC, Princeton, KY.

Harvesting for Hay or Silage

Frosted small grain can be harvested as hay or silage. Ideally, the small grain should be allowed to reach the boot-stage. This optimizes the combination of forage quality and yield. In a normal year, wheat should reach the boot-stage around mid-April. If lodging is an issue, small grain could be harvested before the boot-stage. In this case, the estimated yield should be assessed to determine if there is enough biomass to justify mechanical harvest. To estimate yield, determine the average height of the small grain stand, subtract your mowing height, and multiple the lb DM/A/in of sward (Table 1). For example the if the average height of a small grain stand is 18 inches, the cutting height is 3 inches, and are small grain stand is in fair condition. So 18 in - 3 in = 15 in x 150 lb DM/A/in = 2250 lb DM/A.

Table 1. Approximate pounds of forage per inch of sward.

Species	Stand Condition			
	Poor	**Fair**	**Good**	**Excellent**
	lb DM/A/in of sward			
Small Grain	100	150	200	250
Annual Ryegrass	100	200	300	400

Adapted from Southern Forages, Third Edition.

Small grains can be harvested as dry hay, but curing may be difficult due to poor drying conditions and a heavy crop. The following best management practices will help to enhance field curing.

- Evaluate small grains for nitrates. Small grains can accumulate nitrates when plant growth is slowed, especially if moderate or high levels of nitrogen fertilizer have been applied. Nitrates in dry hay do NOT decrease over time and can kill livestock months later.

- *Mow early in the day*. Mow as soon as the dew is gone. This will maximize drying time.

- *Use a mower-conditioner*. Crushing the stems will allow moisture to escape and shorten curing time.

- *Adjust mower-conditioner for maximum swath width*. Making the mower swath as wide as possible will increase the surface area of forage exposed to the air and radiant energy from the sun.

- *Ted or rake hay at 50% moisture*. This will expose green hay below to air and radiant energy from the sun.

- *Bale hay at 18% moisture*. Baling at 18% moisture will minimize mold growth and heating in the bale.

- *Store under cover and off the ground*. Small grain hay harvest at the boot-stage can be very high in nutritive value. Storing it under cover and off the ground will maintain that quality by reducing storage losses.

A better option for conserving small grains is silage or balage. This option allows small grains to be mowed one day and chopped or baled the next, greatly reducing the chance of rain damage. The following best management practices will help to optimize the ensiling process.

- *Evaluate small grains for nitrates*. Small grains can accumulate nitrates when plant growth is slowed, especially if moderate or high levels of nitrogen fertilizer have been applied. Nitrates in silage or balage are decreased during fermentation by approximately 40 to 60%. If nitrates area concern, always evaluate silage before feeding and adjust the ration so that nitrates are in the safe range.

- *Mow early in the day*. Mow as soon as the dew is gone. This will maximize wilting time.

- *Use a mower-conditioner*. Crushing the stems will allow moisture to escape and shortening wilting time.

- *Adjust mower-conditioner for maximum swath width*. Making the mower swath as wide as possible will increase the surface area of forage exposed to the air and radiant energy from the sun.

- *Rake and bale/chop forage at 50-60% moisture*. Wilted forage can be chopped at 60% moisture, but baling should be delayed until 50%.

- *Chop at correct theoretical cut length*. Haylage should be chopped to a TLC of 3/8". This will aid in silage compaction and exclusion of oxygen.

- *Fill silo rapidly and compress*. Filling silos rapidly limits exposure to oxygen. Compressing silage in bunker silos or bags help to exclude oxygen and enhance fermentation.

- *Seal silos carefully*. Care should be taken to properly seal silos once filled. This excludes oxygen and enhances fermentation.

- *Do NOT open silos for at least 2 weeks*. Fermentation takes approximately 14 days until a stable pH is reached.

- *Consider using an inoculant*. Under less than ideal ensiling conditions, inoculating silage with a homofermentative lactic acid bacteria can increase the rate of pH decline and final stable pH. Inoculants are best applied at chopping or baling in a liquid form.

- *Make dense and uniform bales*. Slowing ground speed during baling will result in a denser bale. High density bales exclude oxygen and promote fermentation. Uniform bales allow for uniform wrapping and less air space between bales when using a tube wrapper.

- *Use either plastic twine or netwrap when baling*. Do NOT use treated sisal twine when making balage. The chemicals that the twine is treated with interact with the ultraviolet inhibitor in the plastic film causing it breakdown prematurely.

- *Wrap bales the same day as baling*. Never bale more hay than can be wrapped that day. Allowing bales sit overnight will result in squatting, making them more difficult to wrap.

- *Wrap bales at final storage location*. If possible always wrap bales where they will be stored. Handling and moving wrapped bales often results in damage to the plastic film, allowing aerobic deterioration to occur.

- *Use high quality plastic film designed for bale wrapping*. Plastic film used for balage contains ultraviolet inhibitors that keep the plastic from being broken down by sunlight. Since the entire ensiling process is dependent on excluding oxygen from the bale, do NOT skimp on film quality.

- *Apply at least 4 layers of plastic*. Four layers of plastic film is the absolute minimum that should be applied. Six layers is preferred and if the bales will be maintained for a longer period, use eight layers.

- *Inspect bales at least weekly and patch any holes immediately*. One air is introduced into a wrapped bale, aerobic deterioration starts almost immediately. It is very important to check bales for holes or tears regularly and to patch those holes immediately with special

tape designed for silage wrap. Unlike duct or packaging tape, this tape that contains an ultraviolet inhibitor.

- *Feed balage by the next growing season*. While round bale silage can produce a quality feed for both beef and dairy cattle, it is not the ideal ensiling package due to its high surface area to volume ration. In addition, the plastic film does NOT completely exclude oxygen. Over time, oxygen diffuses through the plastic film, albeit very slowly.

Graze Out Small Grain

Frosted small grain can be grazed, especially if fields are fenced and a water source is available. Generally speaking, grazing is the least expensive way to harvest forage. Light weight calves grazing small grains would be expected to gain approximately 1.5 to 2.0 lb per day. In addition, small grains that may be marginal for having enough biomass to justify mechanical harvest, could be grazed. The following best management practices will help to efficiently and safely graze small grains.

- *Evaluate small grains for nitrates*. Small grains can accumulate nitrates when plant growth is slowed, especially if moderate or high levels of nitrogen fertilizer have been applied. Do Not graze small grains high in nitrates. Allow plant growth to resume and recheck nitrate levels in 5-7 days.

- *Fill animals up with a high quality dry hay before grazing small grains*. Never allow hungry animals unrestricted access to small grain pasture. The abrupt introduction of large quantities of a very quality forage can cause bloat.

- *Allow animals access to a high quality dry hay at all times*. Access to dry hay will help to prevent nutritional disorders.

- *Supply high magnesium mineral mix*. Grazing small grain pastures can result in grass tetany or low blood magnesium (hypomagnesemia). This is best prevented by allowing cattle free access to a high quality mineral mix that contains approximately 15% magnesium.

- *Stock small grains at appropriate density*. The amount of available forage per acre can vary greatly and should be considered when setting a stocking density. Spring stocking densities normally range from 1 to 2-500 lb calves per acre or 0.5 to 1 mature cows per acre. Higher stocking densities are sometimes desired if forage is to be grazed out in a relatively short period of time.

- *Subdivide or strip graze small grain pastures*. Increasing the animal density per unit area improves forage utilization and nutrient distribution. Strip grazing can be accomplished by starting at the water source and allocating a new strip of forage every one to three days.

- *Supply supplemental forage when forage availability is below 1200 lb DM/A*. When forage availability is low, dry matter intake decreases and animals are unable to meet their nutritional needs, even when forage quality is high.

- *Avoid grazing small grains during wet periods*. When soil moisture is high, grazing animals can cause pugging and surface compaction. Simply removing livestock from small grain pastures during wet periods will minimize soil damage.

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