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Managing Stressed or Damaged Crops for Livestock Feed

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Stressed crops resulting from unfavorable weather conditions require special management considerations. Assessing crop growth and development and determining the best management alternatives for use as feed or forage are important. Yield and quality of frost- and drought-damaged crops usually are maximized when harvested as silage.

This is also true for crops that are immature due to late planting or from poor growing conditions.

Frost

Silage Corn

Frost-damaged corn for silage can be classified two ways:

- **Immature** – If the killing frost occurs before the plant is mature, it will appear drier than non-frosted corn of the same moisture content. Although leaves may brown along the edges and dry rapidly after a few sunny days, the green stalk and ears do not. Make sure the moisture of the whole plant is not greater than the optimum range of 63% to 68%.
- **Mature** – If the killing frost occurs after the plant has reached maturity, indicated by the black

Cows grazing a frost-damaged warm-season cover crop may result in prussic acid poisoning.

(Photo by Miranda Meehan)

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layer on the kernel, the whole-plant moisture content will fall rapidly. A finer chop of ¼ inch should be considered and water added if the corn cannot be ensiled before the moisture drops below 60%. Although yield per acre is reduced, high-quality silage still can be harvested from frost-damaged corn.

Corn Grain

The severity of damage to corn grain is variable based on temperature, length of exposure to freezing temperatures and growth stage. Freezing temperatures for several hours may kill the plant, depending on the location of the growing point. The crop should be assessed three to five days after frost to determine if plants will recover. If new growth is not evident, the plant is likely dead.

Late-season frost damage can affect grain quality and yield. Test weights may be 52 pounds/bushel or less, depending on maturity. In addition, protein and digestibility may be reduced. Low test weight corn is still useful for livestock feed; however, feed analysis is recommended to determine nutrient composition and the potential presence of mycotoxins.

Warm-season Annuals

Forage sorghum that is frost damaged should be managed similarly to frost-damaged corn. Producers should be alert to the problem of prussic acid poisoning and the rapid drying of mature plants.

Grazing of sorghum/sudan grass forages should be delayed 10 days to two weeks to reduce the incidence of prussic acid poisoning. Millets will not accumulate prussic acid; however, there is a potential for nitrate issues. Millets can be grazed or hayed.

Alfalfa

Alfalfa that has received a frost can cause bloat. Bloat occurs when gases created by fermentation cause the rumen (part of the cow's stomach) to inflate or overstretch. Frost ruptures plant cell walls, increasing the potential for bloat due to an accentuated number of small particles and availability of rapidly fermentable material.

If the frost is a killing frost, the highest potential for bloat is directly following the event. However, if it is not a killing frost, the bloat risk is greater a few days following the frost event. This is because a killing frost ruptures all the cell walls, whereas a less severe frost event only ruptures some of the cell walls in the leaves.

Alfalfa is more likely to cause bloat if it is grazed or fed as green chop immediately after a frost. If grazing, wait at least 10 days or until the above-ground portion of the plant has died back following a killing frost. Alfalfa that is mowed, wilted and stored as haylage is not likely to cause bloat.

Extended or slow drying periods can lead to mold and possible mycotoxin growth. Analysis for mycotoxins is advised when molds are observed or when conditions allowing for mold growth are present.

Drought

Drought can be very stressful to crops. Drought stress can result in a variety of issues in forage crops, including inadequate moisture and/or potential toxicities.

Frost-damaged alfalfa can cause bloat, with the greatest risk occurring following a killing frost.

(Photo by Kevin Sedivec, NDSU)

In addition, drought often results in failure of cash crops and the use of these crops for livestock forage. These crops can be toxic and need to be managed properly when feeding.

Corn

Producers have several alternative methods to harvesting drought-stressed corn. Due to the high risk of nitrates ensiling is the best options, as ensiling can reduce nitrates by 20% to 50%. Corn should be harvested for silage at a moisture content of 65% to 70% when using a horizontal bunker. If too wet – above 70% – yield potential is reduced and seepage will occur, resulting in the undesirable presence of clostridia bacterial fermentation.

Producers struggling with limited access to silage harvest equipment or custom harvesting crews and no nearby market for silage might consider cutting and baling corn as hay or baleage. If drought-stressed corn is going to be hayed, target the moisture content to be less than 20% before baling. Drought-stressed short corn is ideal for haying because of a shorter wilting period and reduced volume for baling; however, it carries an increased risk of elevated nitrate levels. Unlike ensiling, harvesting corn as hay will not reduce the nitrate concentration so be sure to test the hay before feeding to livestock.

If corn is near normal height, grazing or harvesting as silage may be a better option. To improve the wilting process, the hay should be processed mechanically or crimped but it still may require seven to 10 days to cure properly. Leaving the bottom 8 to 10 inches of the corn stalk if possible not only helps reduce the nitrate content of the hay but also allows air to flow underneath the windrow, aiding in the wilting process. Ensiling corn as baleage requires additional management. Unlike silage, baleage should be harvested between 45% and 55% moisture. Excessive moisture will increase the risk of undesirable clostridial fermentation, and baleage that is too dry will not ensile properly.

Grazing drought-stressed standing corn can be done successfully with some additional management. Grazing can reduce costs associated with mechanically harvesting corn but does require additional labor for fencing, watering and monitoring cattle. Harvest efficiency also will be reduced, compared with mechanical harvesting, due to forage losses from trampling.

Here are some basic rules of thumb for grazing standing corn:

- Make sure the animals become adapted to corn before turning them out to graze corn stalks. Start with 2 to 3 pounds daily and move up the desired level of grain consumption during a 10-day period before turnout.
- Stock cattle lightly to allow them to selectively graze upper portions of plant parts that are lower in nitrates. Do not force cattle to eat lower portions of stalks.
- Do not turn hungry cattle out to graze. Provide good-quality hay for two to three days so cattle don't overeat.
- Begin grazing lower nitrate fields and gradually step cattle up to higher nitrate fields. This will allow the microbes in the rumen that degrade nitrates to increase in population and handle greater concentrations of nitrates.

Alfalfa

Drought-stressed alfalfa generally will exhibit lowered yields with reduced stem growth and a higher leaf-to-stem ratio. This produces a crop with above-normal protein content and below-normal fiber levels. Ration adjustments may be required.

Small Grains

Drought-stressed crops can accumulate nitrates to levels that may be toxic to livestock. Small grains such as oats, wheat, and barley may have increased levels of nitrate due to stressors associated with drought, particularly with plants that have been fertilized. This may increase the risk of nitrate toxicity when harvested as forage and fed to livestock. Refer to the nitrate section for more information.

Refer to the herbicide restriction section below for additional considerations prior to utilizing small grains for livestock feed.

Canola

Drought-stressed canola or canola stubble can be used as an alternative forage, but livestock producers need to take certain precautions. Forage rapeseed (canola) has a nutrient content that's similar to alfalfa, with crude protein of 12% to 14% and total digestible nutrients (energy) of 55% to 60%. Crude protein and energy levels will be higher if the crop is cut in the early podded stage rather than after the lower leaves begin to drop.

Bloat and scours can be a concern, and elevated levels of sulfur and nitrates are possible. To reduce the potential for digestive disorders, acclimate cattle for at least seven to 10 days and blend the canola with other feeds so canola hay or

Using drought-stressed canola as feed can lead to bloat, sulfur toxicity and nitrate poisoning.

(Photo by Janna Block)

Follow these recommendations for safely introducing livestock to canola hay or silage:

- Introduce canola hay or silage slowly by replacing a part of the diet for several days.
- Have other types of forage available for cattle in confinement for the first two weeks as canola is being introduced.
- Test hay or silage for concentrations of sulfur and nitrates, and formulate rations or design feeding schemes to reduce the consequences of risky feed components.

silage is less than 50% of the total feed intake.

Sulfur levels in canola can range from 0.5% to 1.3% on a dry-matter basis. Producers should keep total dietary sulfur below 0.4% on a dry-matter basis. Feeding sulfur above this threshold can result in hemolytic anemia, interfere with livestock's use of the trace minerals copper and selenium, and lead to polioencephalomalacia (PEM). Clinical signs of PEM include a lack of muscle coordination, facial tremors, teeth clenching, circling, stupor and cortical blindness, followed by animals leaning or lying, convulsions and death.

Drought stress in canola also can lead to accumulation of nitrates in the plants, which warrants caution when devising feeding plans.

As with small grains, producers also need to be aware of any withdrawal periods associated with pesticides or herbicides that were applied to the standing plants.

If canola is hayed, drying time is critical to avoid moldy feed later. Typically, the plants take four to six days to dry to proper moisture levels (16% to 18% moisture content) for baling. Canola tends to turn dark as it cures, but this shouldn't affect palatability.

Ensiling may be a better option if it is leafy and has some height, although canola is high in moisture (75% to 80%) and wilting it to 65% moisture will take time. Harvesting a mixture of the mature stand and the regrowth will reduce the moisture, and crimping will hasten the drying process. Seepage and ensiling problems may occur if canola is ensiled at moisture contents greater than 70%.

Excess Moisture Corn

Corn can be harvested as silage, earlage, high-moisture grain, dry corn and stover. Many options are available based on varying degrees of moisture content.

Ear mold issues can occur during a wet fall. Several fungi can colonize corn. They include nonmycotoxin-producing fungi (such as Cladosporium, which is black) and mycotoxin-producing fungi (such as Fusarium, which is white to pink).

Different Fusarium species produce different mycotoxins. *Fusarium graminearum* can lead to the production of deoxynivalenol (vomitoxin) and zearalenone. Other Fusarium species produce fumonisins. If high levels of mold growth are observed on corn, it should be tested for mycotoxins. Refer to *www.ag.ndsu.edu/publications/livestock/harvesting-storing-and-feeding-high-moisture-corn*

Corn ear molds caused by high moisture can produce mycotoxins.

(NDSU photos)

Cool-season Cereal Crops

Vomitoxin is one of the most concerning issues with wheat, barley, oats and rye. If Fusarium head blight is found in a small-grain field, it likely will have vomitoxin, but the levels are difficult to predict. High vomitoxin levels have been found in wheat throughout North Dakota, with levels ranging from one to more than 20 parts per million (ppm).

The U.S Food and Drug Administration has set advisory vomitoxin levels for beef and feedlot cattle 4 months or older at 10 ppm, and feed with vomitoxin cannot exceed 50% of their total diet. Research conducted at NDSU and the University of Minnesota suggests that beef and feedlot cattle can tolerate vomitoxin levels up to 18 and 21 ppm, respectively.

Wheat makes excellent livestock feed but ferments rapidly in the rumen, which greatly increases the potential for digestive issues such as acidosis, bloat and founder. This risk may be decreased slightly when grazing whole grain due to its fibrous material and a hard seed coat.

If much of the wheat has significant sprout damage, it will reduce but not eliminate the risk of acidosis significantly. If sprouts are visible on standing grain, much of the starch has been used as a food source that allowed the seedling to grow. Any remaining grain still could contribute to the potential for acidosis, but the overall starch level will be reduced significantly.

Limit wheat to 0.4% of body weight when used as a supplement for beef cows, or 5 to 6 pounds per head per day for hard wheat and 3.5 to 4.5 pounds per head per day for durum.

If grazing, fields should be strip grazed to limit grain intake. Yield needs to be determined so producers can use that number to evaluate how many acres should be available to livestock on a daily basis.

Some of the fields may have shelled out, but others may have significant grain remaining. For more information on yield estimates, visit *https://tinyurl.com/EstimatingWheatYield*

Strip grazing should be limited to no more than three days, with one to two days preferred, to reduce digestive issues.

Ergot is another concern in high-moisture small grains. Ergot is well adapted in the state, with a very large grass host range, including quackgrass, brome grass and small grains. Ergot is common in cool, wet conditions that support the pathogen.

Ergot bodies contain toxic ergopeptide alkaloids that have a higher toxicity in cattle, compared with vomitoxin. Ergot poisoning may result in tail and ear losses, lameness, loss of hooves and even abortions. Specialists recommend sampling grain and having it analyzed for ergot. Check out *https://tinyurl.com/ErgotinSmall-Grains* for more information.

Nitrates

The potential for high nitrate levels occurs when crops such as corn and small grains are exposed to stress situations, including drought, hail, frost, cloudy weather and fertility imbalance. Nitrates accumulate in the lower portion of the plant when stressors reduce the crop yield to less than the supplied nitrogen fertility level. Nitrates are responsible for lethal silo gas and interfere with the ability of blood to carry oxygen when fed to animals.

When chopping stressed plants, a 6-inch stubble should be left. If rain falls during chopping, allow three days before resuming chopping.

Table 1. Analysis of drought stressed crops completed by NDSU Extension during the 2017 drought.

Feed	No. of Samples	Crude Protein	TDN	Potassium Nitrate	Min. Nitrate	Max. Nitrate
		percent				
Barley	8	11.0	67.4	0.3	0.25	0.4
Canola	3	18.5	63.7	1.9	1.1	2.5
Flax	1	12.5	57.0	0.3	0.25	0.25
Millet	3	12.0	62.2	0.9	0.25	1.4
Oats	9	10.8	61.4	0.5	0.25	0.9
Pea	9	7.1	52.9	0.3	0.25	0.25
Silage	3	8.1	82.7	0.3	0.25	0.25
Soybeans	1	16.9	59.5	0.3	0.25	0.25
Sudan	3	9.7	72.3	0.6	0.25	1.1
Wheat	6	11.2	67.9	0.3	0.25	0.25
Prairie Hay	–	6.2	48.0	–	–	–
Corn Silage	–	9.0	70.0			

Table 2. Interpretation of laboratory results for nitrate content.

Form of Nitrate Measured						
Potassium Nitrate (KNO_3)		Nitrate Nitrogen (NO_3-N)		Nitrate (NO_3)		Recommendations for use in livestock
ppm	%	ppm	%	ppm	%	
Forage (DM basis)						
0-7,220	0-0.72	0-1,000	0-0.10	0-4,430	0-0.44	Generally considered safe for livestock
7,220-10,830	0.72-1.08	1,000-1,500	0.10-0.15	4,430-6,645	0.44-0.66	Safe for nonpregnant animals; limit to 50% of ration dry matter for pregnant animals
10,830-14,440	1.08-1.44	1,500-2,000	0.15-0.20	6,645-8,860	0.66-0.88	Limit to 50% of ration dry matter for all animals
14,440-25,270	1.44-2.52	2,000-3,500	0.20-0.35	8,860-15,505	0.88-1.55	Limit to 30% to 35% of ration dry matter; do not feed to pregnant animals
25,270-28,880	2.52-2.88	3,500-4,000	0.35-0.40	15,505-17,720	1.55-1.77	Limit to 25% of ration dry matter; do not feed to pregnant animals
>28,880	>2.88	>4,000	>0.40	>17,720	>1.77	Danger: do not feed
Water (as received basis)						
0-720	0-0.072	0-100	0-0.01	0-443	0-0.04	Generally considered safe for livestock
720-2,166	0.072-0.21	100-300	0.01-0.03	443-1,329	0.04-0.13	Caution: Possible problems; consider additive effect with nitrate in feed
>2,166	>0.21	>300	>0.03	>1,30	>0.13	Danger: Could cause typical signs of nitrate poisoning

Plants that recover from stress situations eventually will convert nitrates into a nontoxic form. As a general recommendation, feeding programs should be modified if feed contains more than 1,000 ppm of nitrate nitrogen. Feeding stressed crops as silage rather than green chop is best because fermentation can reduce nitrate levels by approximately 50%.

Ruminants can be fed higher-nitrate feeds if the rumen bacteria are given time to adapt by gradually increasing the volume of high-nitrate feed in the ration. Problems also can be reduced by diluting the high-nitrate feeds with other feeds and avoiding the use of nonprotein nitrogen sources, such as urea or ammonia.

For a more detailed discussion on nitrate poisoning, see NDSU Extension publication V839, "Nitrate Poisoning of Livestock." It's available online at *www.ag.ndsu.edu/pubs/ansci/livestoc/v839.pdf.*

Prussic Acid

Sorghum and sudangrass produce cyanide. Following stress, cyanide is converted to prussic acid, which is toxic to livestock.

Sorghum plants are poisonous after a frost that kills the tops but not the crown, or when new growth is brought on by a rain following a drought. If new shoots develop after a light frost, grazing should not occur until after a killing frost.

Minimum plant growth for safe grazing, green chopping or silage making is 18 inches for Piper sudangrass and 30 inches for sorghum-sudangrass. Forage sorghums should be headed out. If crops are hit by a frost at these stages, producers should wait seven to 10 days before grazing or ensiling. If the plants are frosted before these maturity stages, two weeks should be allowed before ensiling.

The ensiling process will allow much of the prussic acid to escape as gas when properly fermented. Silage should not be fed for at least three to four weeks after harvest. If hay is properly cured and dried before baling, prussic acid levels should be reduced by 50 to 70%. Suspect forages should be analyzed for cyanide content prior to feeding to livestock.

For a more detailed discussion on prussic acid, see NDSU Extension publication V1150, "Cyanide Poisoning." It's available online at *www.ag.ndsu.edu/pubs/ansci/livestoc/v1150.pdf*

Herbicide Restrictions

Another concern with using nonharvested crops as feed is herbicide restrictions. Previous herbicide usage may influence using small-grain crops as livestock feed. Most herbicides have grazing and feeding restrictions stated on the label. However, the labels are often vague regarding specific information on use of grain crops as forage for livestock because this is not the normal use.

Grazing and harvesting a crop for feed following herbicide use often is prohibited because research on residue levels in the crop is inadequate. The effect of the chemical or its breakdown products on livestock or retention in the animal's body may not be known. Livestock that consume crops treated with such herbicides may become ill from the chemicals and/or retain the chemicals in their systems.

Other concerns include the risks of abortions in pregnant animals or passing the herbicide to offspring through the milk of lactating animals. The chemical also may have potential to be retained by the animals and be present in the slaughtered carcass. Because the likelihood of these issues are unknown, all labeling restrictions regarding use of a crop as livestock feed must be followed. The presence of foreign chemicals in milk or meat of animals can result in confiscation and destruction of the products and loss of income from these animals.

The herbicide label is always the final authority on herbicide uses and precautions. Information on the toxic effects of herbicides on animals is not readily available. However, the "North Dakota Weed Control Guide" contains grazing and feeding restrictions for herbicides commonly used on small-grain crops, *https://www.ag.ndsu.edu/weeds/weed-control-guides*

Other Management Considerations for Stressed Crops

- Soil fertility with high nitrogen/low phosphorus increases the risk of high nitrates and prussic acid.
- Drought or stressed silage should ferment a full three weeks before feeding.
- Cattle consuming nitrate-containing feeds should be fed smaller, more frequent meals. In addition, energy supplement can assist with conversion of nitrate to amino acids and protein in the rumen.
- Silo gas is most common in high-nitrate silage, but caution always should be exercised. Silo gas can be brownish, yellowish, reddish or colorless and is lethal to humans and livestock. Silo gas is heavier than air and it often descends silo chutes. The blower should be run for 15 minutes before entering a silo. If a person is exposed to silo gas, a doctor should be consulted immediately.
- Laboratory analysis for nutrient content and/or potential toxicities is recommended for any damaged and/or stressed crop prior to feeding to livestock. A nutritionist or Extension professional should be consulted to assist with developing feeding recommendations.
- Do not feed green chop that has heated after cutting or that has been held overnight. Heating favors the formation of nitrite, which is more toxic than nitrate.
- Drought-stressed small-grain forages and other forages suspected of being high in nitrates should be tested before feeding.

If you have questions about submitting samples to a laboratory for analysis, you can contact the North Dakota State University Veterinary Diagnostic Laboratory at 701-231-8307 or visit *www.vdl.ndsu.edu*

NDSU Extension materials noted in this publication

- If you see high levels of mold growth on corn, we recommend you get it tested for mycotoxins. Refer to *www.ag.ndsu.edu/publications/livestock/harvesting-storing-and-feeding-high-moisture-corn*
- For more information on yield estimates, visit *https://tinyurl.com/EstimatingWheatYield*
- Specialists recommend sampling grain and having it analyzed for ergot. Check out *https://tinyurl.com/ErgotinSmallGrains* for more information.
- "Nitrate Poisoning of Livestock" is available online at *www.ag.ndsu.edu/pubs/ansci/livestoc/v839.pdf*
- For a more detailed discussion on prussic acid, see NDSU Extension publication V1150, "Cyanide Poisoning." It's available online at *www.ag.ndsu.edu/pubs/ansci/livestoc/v1150.pdf*
- "North Dakota Weed Control Guide" contains grazing and feeding restrictions for herbicides commonly used on small-grain crops, *https://www.ag.ndsu.edu/weeds/weed-control-guides*

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