Ridin' Herd

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Test for nitrates in summer annuals

In most parts of the United States, we enjoyed a pretty nice fall with some moisture. There were opportunities to graze dormant winter range and corn residue. In many places, there is no opportunity to develop a beef cow-calf system where cows can graze year-round. Feeding harvested hays adds expense to the operation — not only because of the hay costs, but also the costs associated with feeding hay, such as equipment, labor and fuel. Producers may have bought or raised a summer annual this summer and fall and harvested it as a forage to feed this winter.

Nitrate risks

Plants vary in the amount of nitrate that accumulates in various tissues. Weeds, such as pigweed, kochia, puncture vine and lamb's-quarter, often are high in nitrate. Oats and millet cut for hay at an immature stage often have high nitrate concentrations. Sorghum and Sudan grasses often store high amounts of nitrates. Brome and orchard grass store very little nitrate under normal growing conditions. Legumes, like alfalfa, generally do not contain high nitrate concentrations.

Nitrate toxicity

Almost all forages contain some nitrates. When feeds containing nitrates are consumed by ruminants, nitrates are changed to nitrites and finally to ammonia by the microbes in the rumen. Nitrite is one of the intermediate products in the breakdown of nitrate to ammonia and is the cause of nitrate poisoning.

Nitrite can be absorbed into the bloodstream. Nitrite in the bloodstream changes hemoglobin to methemoglobin. Hemoglobin carries oxygen from the lungs to other tissues, but methemoglobin is incapable of carrying oxygen. Thus, nitrates become a problem when enough methemoglobin is produced that the oxygen-carrying capacity of blood is reduced to a critical level. If enough methemoglobin is produced, the animal will die.

Besides the chocolate-colored blood, other physical signs of nitrate poisoning include difficult and rapid breathing, muscle tremors, low tolerance to exercise, incoordination, diarrhea, frequent urination, collapse and death.

The level of toxicity depends on the amount of nitrate in the feed and how fast the feed is consumed.

Table 1: Feeding considerations based on nitrate concentration

Nitrate Ion (NO_3) ppm	Nitrate-N (NO_3-N)ppm	Recommendation
<4,400	<1,000	Safe, non-toxic level
4,400-9,300	1,000-2,100	Safe for non-pregnant animals
		Adapt pregnant animals slowly or mix with low-nitrate feed
9,300-15,000	2,100-3,390	Limit to less than 50% of ration dry matter. Do not feed to pregnant animals without mixing with low-nitrate feed. Adapt animals to mixture.
>15,000	>3,390	Limit to less than 25% of ration dry matter. Do not feed without diluting with low-nitrate feed. Adapt animals to feed mixture.

How to identify nitrate toxicity

Brownish discoloration of the blood, due to the presence of methemoglobin, is a sign of nitrate poisoning. Besides the chocolate-colored blood, other physical signs of nitrate poisoning include difficult and rapid breathing, muscle tremors, low tolerance to exercise, incoordination, diarrhea, frequent urination, collapse and death. Nitrates in blood also may cause blood vessels to dilate and are responsible for peripheral circulatory failure. Lack of oxygen to the fetus probably causes abortions that sometimes occur following nitrate poisoning in pregnant beef females.

Conditions that cause high nitrates

Not all drought conditions cause high nitrate concentrations in plants. Some moisture must be present in the soil with nitrate for absorption and accumulation. If the major supply of nitrates for the plant is in the dry surface soil, very little nitrate will be absorbed by plant roots. In plants that survive through drought, nitrates often are high for several days following the first rain.

Frost, hail and low temperatures all interfere with normal plant growth and can cause nitrates to accumulate in the plant. Frost and hail may damage, reduce or completely destroy the leaf area of the plant.

If growing conditions affected growth of summer annuals, then testing for nitrates is a must. Fertilizing with nitrogen is a common practice when growing summer annuals. Nitrates in the soil are the source of nitrate in plants. While a positive relationship exists between soil nitrates and nitrate in the plant, the effect of nitrogen fertilization, unless excessive, appears to be less important than weather conditions during the growing season.

Feeding considerations

Forages that contain high nitrate levels can be diluted in the ration with other forages low in nitrates and then can be fed (see Table 1). This can be accomplished easily in feedlot rations for which grain is fed and forages are chopped and mixed in as a complete ration.

Feeding grain in combination with high-nitrate feeds helps reduce the effect of the nitrate content. Energy from the grain apparently helps complete the conversion of nitrate to bacterial protein in the rumen.

Frequent intake of small amounts of a

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high-nitrate feed increases the total amount of nitrate that can be consumed daily by livestock without adverse effects and helps livestock adjust to high-nitrate feeds.

Cattle losses to nitrate toxicity usually occur in hungry cattle that have not had time for adjustment to feeds with potentially toxic levels of nitrates. For example, cattle that go without feed for a day or longer during snowstorms often rapidly eat a large amount when finally gaining access to feed. If the feed they receive is high in nitrates, cattle losses may occur.

If cattle are allowed to adjust to feeds that have potentially toxic levels of nitrates, they will develop a population of microbes in the rumen that convert nitrates to a non-toxic form.

Care must be taken when feeding feeds that contain nitrates. Feed long-stem forages such as wheat, oat and cane hay that contain high amounts of nitrate in limited amounts several times daily rather than feeding large amounts once or twice daily. In addition, long-stem hays suspected of nitrates can be fed in combination with hay low in nitrate to dilute the nitrate intake with little risk of nitrate problems. Livestock should have access to clean water at all times. Follow management practices that result in a successful feeding program when high-nitrate feeds are fed.

Final thoughts

Summer annuals are good feeds and work well in rations for beef cattle when grazing opportunities are not an option. Test summer annuals for quality, mainly percent crude protein, total digestible nutrients (TDN, energy) and moisture. Also test summer annuals for nitrate concentration. It is an economical test. Feeds that have higher-than-acceptable nitrate levels can be diluted to a safe level by mixing with feeds that are not high in nitrates. Usually this will require that forages be ground and mixed to a safe level. The most common cause of deaths in cows due to nitrates is when hungry cows have unlimited access to a forage source that is high in nitrates.

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