

Nitrate Poisoning of Cattle in Alabama

► Feed or water containing high levels of nitrate nitrogen can lead to nitrate poisoning in cattle. Learn about factors influencing nitrate accumulation, prevention of toxicity, levels of nitrate nitrogen in feed and forage with response, as well as symptoms and treatment.

Nitrate poisoning in cattle is caused by the consumption of feed or water containing high levels of nitrate nitrogen. Under most circumstances, forage crops do not contain levels of nitrates high enough to be toxic. When this does occur, however, it is a serious problem, often resulting in the death of many animals.

Factors Influencing Nitrate Accumulation

Nitrates accumulate during periods of stress in plant growth, such as low soil moisture and high temperatures or low humidity. The accumulation of nitrates is often favored by heavy nitrogen fertilization rates, particularly if the fertilization is timed to coincide with the onset of a drought period.

Under conditions of adequate moisture availability, hay produced in Alabama should pose no threat of nitrate poisoning. Hay cut during or immediately

following a drought period may have potential for nitrate accumulation. This is particularly true in cases when applications of nitrogen were made to forage crops, but little growth was made before hay harvest because of lack of moisture. It is important to note that nitrates degrade little with drying or ensiling of forage and, consequently, may cause toxicity months after harvest.

Some commonly grown forage crops in Alabama that are known for their potential for accumulation of toxic levels of nitrates are sorghum, corn, sudangrass, sorghum-sudan hybrids, soybeans, fescue, pearl millet, and bermudagrass.

In the Southeast, problems are most likely to be encountered with warm-season grass crops such as bermudagrass or a summer annual forage. This is primarily because these species are most likely to receive high levels of nitrogen fertilization that favor nitrate accumulation in plant tissues.

Table 1. Level of Nitrate-Nitrogen or Nitrate Ion in Forages and Expected Level of Feeding Risk

Nitrate-Nitrogen (NO ₃ -N), ppm, DM basis	Nitrate (NO ₃), ppm, DM basis	Level of Risk
0 to 1,500	0 to 6,500	Generally safe to feed. In upper range, use caution when feeding pregnant or young animals, and prevent overconsumption frequently observed in feeding large round bales.
1,500 to 5,000	6,500 to 22,000	Limit to half of the total dry matter intake. Feed a balanced ration with adequate energy. Do not feed with liquid feed or other nonprotein nitrogen supplements.
5,000+	22,000+	TOXIC. Do not use in free-choice feeding situations. Feed containing such levels of nitrates may be ground and mixed if the nitrate-containing feed contributes to no more than 15 percent of total ration by weight.

A sample that contained 1,000 ppm NO₃-N would contain 4,430 ppm NO₃
 Nitrate-NO₃ = 4.4268 x Nitrate-N (mg/L)

It is also possible for weeds to accumulate toxic levels of nitrates. Therefore, weedy hay could pose more of a nitrate toxicity threat than weed-free hay. Some weeds that are known to accumulate nitrates are pigweeds, smartweed, lambsquarter, Canadian thistle, ragweeds, nightshades, and stinging nettle.

Pigweed is associated with nitrate poisoning more frequently than any other weed commonly found in Alabama.

Prevention of Toxicity

A laboratory analysis for nitrates is required to determine these levels. Cattle producers should note that drought stricken hay may contain toxic levels of nitrate, and a test is highly advantageous. Results are usually given in parts per million (ppm). Some laboratories provide the level of nitrate-nitrogen ($\text{NO}_3\text{-N}$) present in the sample, while other laboratories report the actual amount of nitrate ion present (NO_3). Table 1 illustrates a range of values often reported for forages within the southeastern region along with subsequent feeding recommendations.

Other Factors Influencing Toxicity

Nitrate poisoning results from methemoglobin formation due to the absorption of nitrates. Nitrate in the feed is reduced to nitrite by the bacteria of the digestive tract, and if the bacteria do not further reduce the nitrite to ammonia, the nitrite oxidizes the iron in the hemoglobin and prevents adequate oxygen transportation.

Indications are that feeding a balanced ration with a high nitrate nitrogen feed enables the bacterial population to become adapted to the higher level of nitrates. Thus the nitrate nitrogen will be utilized in the same manner as other nonprotein nitrogen. It is, therefore, advisable to feed high energy feeds such as corn or other grain with a high-nitrate feed to reduce the likelihood of toxicity.



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Nonprotein nitrogen sources such as liquid feeds or range pellets containing urea should not be fed with feeds containing high nitrate nitrogen levels.

Feeding large round bales of hay increases the possibility of nitrate toxicity, especially in free-choice feeding situations. Free-choice access to hay increases consumption to amounts higher than normal, which may lead to the occurrence of nitrate toxicity.

Symptoms and Treatment

Symptoms noted are labored breathing, muscle tremors, and a staggering gait, after which the cow falls down, gasps for breath, and dies quickly with little struggle. The membranes of the eyes and mouth are bluish, indicating a lack of oxygen. If a venous puncture is made, the blood is reddish-brown in color but turns a brighter red when exposed to air.

Nitrate toxicity usually results in death within a short period of time, but if prompt action is taken, death can be prevented. Medication consists of giving a 4 percent solution of methylene blue intravenously using 100 cc per 1,000 pounds of body weight.

Summary

- Drought in late summer and fall makes it advisable for producers to analyze late-season hay for nitrates.
- Nitrates in stored forages degrade little with time.
- Bermudagrass and summer annual grasses are more likely than other forages to contain toxic levels of nitrates.
- Nitrate levels can be determined through the Alabama Cooperative Extension System Feed and Forage Testing Program.
- Feeding nonprotein nitrogen with hay containing high nitrate levels increases the likelihood of nitrate poisoning.
- Use of large round bales or hay stack systems increases the danger of nitrate toxicity because in these situations cattle have unlimited access to the hay and overconsumption may result.
- Danger with potentially toxic hay can be reduced by feeding other nitrate-free feeds along with the potentially toxic material.
- There is a wide variation in toxicity level, and these differences can be attributed, in part, to rate of ingestion.
- If administered quickly, it is possible to treat for nitrate poisoning, so in cases of suspected toxicity, contact a veterinarian immediately.