MISSISSIPPI STATE UNIVERSITY EXTENSION

Beef Cattle Water Requirements and Source Management

Water as a Nutrient

Water is the most abundant nutrient in the body and a critical nutrient for all classes of beef cattle. Cattle need access to adequate supplies of clean water at all times and should not have to travel long distances for water. Water is required for a wide variety of body functions in cattle. It is needed for body temperature regulation, growth, reproduction, lactation, digestion, nutrient use, mineral balance maintenance, pH buffering of body fluids, waste removal, joint lubrication, nervous system cushioning, hearing, and eyesight.

Cattle Water Requirements and Intake Levels

Cattle water requirements and consumption depend on several factors, including air temperature, humidity level, water temperature, milk production, pregnancy status, physical activity, growth rate, animal size, breed, diet type, moisture level in the diet, salt intake, and dry matter intake. Lower evaporative losses of water from cattle in high humidity conditions can slightly lower water intake requirements. Diets high in protein, salt, minerals, or diuretic substances that increase urination can raise water requirements of cattle. Brahman-influence cattle have an enhanced ability to adapt to hot, dry conditions and may withstand short-term water deprivation better than other breeds. Water intake studies of Brahmans compared with Herefords revealed lower water intake by Brahmans.

Environmental Temperature

Seasonal differences in water intake occur. Water intake is highest in summer, intermediate in spring and autumn, and lowest in winter. Providing shade in summer can reduce water intake. Temperature increases from 50°F to 90°F can increase daily water requirements by two and a half times. According to the most recent edition of *Nutrient Requirements of Beef Cattle*, a 400-pound growing calf requires approximately 5.8 gallons of water per day when the temperature is 70°F. This increases to 9.5 gallons per day when the temperature reaches 90°F. As the size of the calf increases, water requirements also rise. For a 600-pound calf, daily water intake needs are 7.8 gallons at 70°F and 12.7 gallons at 90°F.

Growing beef calf water intake estimates (gallons) at different weights and temperatures.

Weight, lb	40°F	50°F	60°F	70°F	80°F	90°F
400	4.0	4.3	5.0	5.8	6.7	9.5
600	5.3	5.8	6.5	7.8	8.9	12.7
800	6.3	6.8	7.9	9.2	10.6	15.0

Finishing cattle water intake estimates (gallons) at different weights and temperatures.

Weight, lb	40°F	50°F	60°F	70°F	80°F	90°F
600	6.0	6.5	7.4	8.7	10.0	14.3
800	7.3	7.9	9.1	10.7	12.3	17.4
1,000	8.7	9.4	10.8	12.6	14.5	20.6

Pregnant cow water intake estimates (gallons) at different temperatures.

Weight, lb	40°F	50°F	60°F	70°F	80°F	90°F
900[1]	6.7	7.2	8.3	9.7	NA	NA

Lactating cow water intake estimates (gallons) at different temperatures.

Weight, lb	40°F	50°F	60°F	70°F	80°F	90°F
900	11.4	12.6	14.5	16.9	17.9	16.2

Mature bull water intake estimates (gallons) at different weights and temperatures.

Weight, lb	40°F	50°F	60°F	70°F	80°F	90°F
1,400	8.0	8.6	9.9	11.7	13.4	19.0
1,600+	8.7	9.4	10.8	12.6	14.5	20.6

[1]More data not available.

Adapted from NRC (2000).

Temperature-relative humidity (%) index.

Temperature	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%
100°F	84	85	86	87	88	90	91	92	93	94	95	97
98°F	83	84	85	86	87	88	89	90	91	93	94	95
96°F	81	82	83	85	86	87	88	89	90	91	92	93
94°F	80	81	82	83	84	85	86	87	88	89	90	91
92°F	79	80	81	82	83	84	85	85	86	87	88	89
90°F	78	79	79	80	81	82	83	84	85	86	86	87
88°F	76	77	78	79	80	81	81	82	83	84	85	86
86°F	75	76	77	78	78	79	80	81	81	82	83	84
84°F	74	75	75	76	77	78	78	79	80	80	81	82
82°F	73	73	74	75	75	76	77	77	78	79	79	80
80°F	72	72	73	73	74	75	75	76	76	77	78	78
78°F	70	71	71	72	73	73	74	74	75	75	76	76
76°F	69	70	70	71	71	72	72	73	73	74	74	75

Adapted from LCI (1970).
Livestock Weather Safety Index Guide to Various Levels of Cattle Heat Stress.
Normal: <74; Alert: 75-78; Danger: 79-83; Emergency >84.

High humidity levels are common in Mississippi. The combined effect of temperature and humidity on cattle is important to consider. Humidity can intensify the effects of environmental temperature on livestock comfort, water intake, feed intake, and performance.

The Temperature-Humidity Index (THI) serves as a useful indicator of the simultaneous temperature and humidity conditions livestock experience. The Livestock Weather Safety Index classifies THI values as normal, alert, danger, or emergency conditions for cattle. Water intake increases when the THI goes above 75.

Body Water Losses

Anything that influences body water losses increases a calf's water intake requirements. Cattle lose water through urine, feces, sweat (to a limited degree), and by evaporation from the lungs and skin. Diet influences water losses in feces; lush diets and diets high in mineral content result in higher fecal water output. Health conditions causing diarrhea or loose feces impact water losses from the animal.

Cattle cannot adapt to water restriction very well. Providing less water than cattle need results in decreased feed intake and reduced performance. Water deprivation for extended periods can result in death. Thirst is a result of water need, and cattle drink to fill this need. Thirsty cattle may indicate water needs are not being met. Cattle should be given all the water they can drink to avoid stress, production losses, and possible dehydration. Reduced water consumption may be a sign of illness in cattle. Observe water consumption changes closely.

Water Sources Other than Drinking

Not all water must come from drinking. Feeds and forages contain water, and digestion of feeds can produce water in the body, particularly high-energy feedstuffs. Water intake usually refers to free-drinking water plus water from feedstuffs. Pasture forages, green chop, and silage generally contain large amounts of water, while hay and feed grains tend to contain lower amounts of water. Lush forage may be approximately 75 percent water, while forage in the form of hay may be closer to 10 percent water. Water is listed as moisture on a forage or feed analysis report. Subtracting the dry matter percent of a feedstuff from 100 percent yields the moisture percent. High-energy feedstuffs supply more body water during digestion than low-energy feedstuffs.

Water Temperature

Water temperature has been identified as affecting animal preference to water. Warm water can reduce intake, and cool water can increase both water and feed intake. Cool water helps cattle maintain a proper body temperature. A recent study found that water intake by cattle increased when water temperatures were below 77°F. This increased water intake is often associated with improved feed intake and cattle weight gains. (There are also production benefits to maintaining cool drinking water supplies for cattle.)

Most groundwater supplies to cattle operations are naturally cool. Ponds generally maintain a constant temperature during the day, but the temperature rises with direct sunlight exposure throughout the day. Deep ponds do not usually warm up to the point they will affect intake. Small water troughs in the summer and shallow sloughs and ponds

may be a concern. Trough water heats up by late afternoon but then cools down during the night. Cattle water intake typically peaks in mid-morning hours and also during the hottest period of the day. Cattle tend to graze during early morning hours, then seek water, and finally seek shade or graze less intensively during hot afternoon hours.

Water Source Management

Both water accessibility and quality are important in maintaining adequate water intake. Water placement in pastures impacts grazing distribution, particularly if cattle have to travel long distances to water. Design pasture systems to provide water sources within approximately 650 to 1,000 feet of all areas of the pasture for optimum uniformity of grazing. For intensive grazing systems, plan strategic water placement. Using centralized watering stations in a fence line, lane, or wagon-wheel location allows one water trough to serve multiple paddocks.

One problem with lane locations of waterers is that lanes to waterers become high-traffic areas subject to trampling and concentration of nutrients from manure and urine. Couplers, pipes or hoses, and inexpensive water troughs such as halved plastic drums can be used for temporary water supplies off of existing water sources relatively quickly and easily.

Examples of Strategic Water Placement in Intensive Grazing Systems

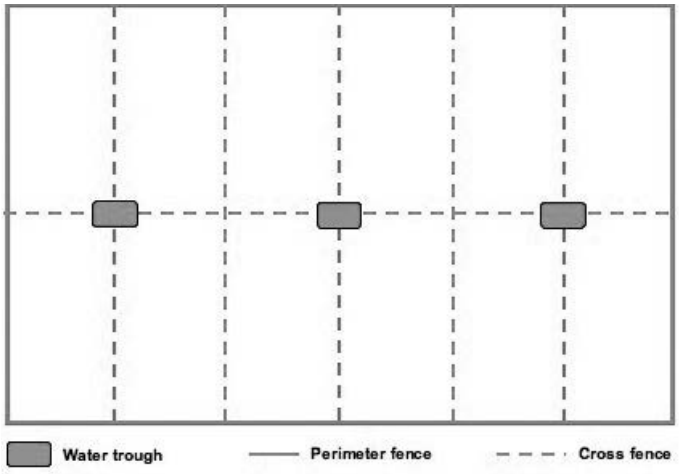
For newly arrived feeder or stocker calves, water placement in receiving pens should be along a fence line so calves find the water trough while walking the perimeter of the pen. Placing water troughs on the fence line in receiving pens encourages calves to consume water shortly after arrival. Allowing waterers to run over may also help by attracting calves' attention to water sources.

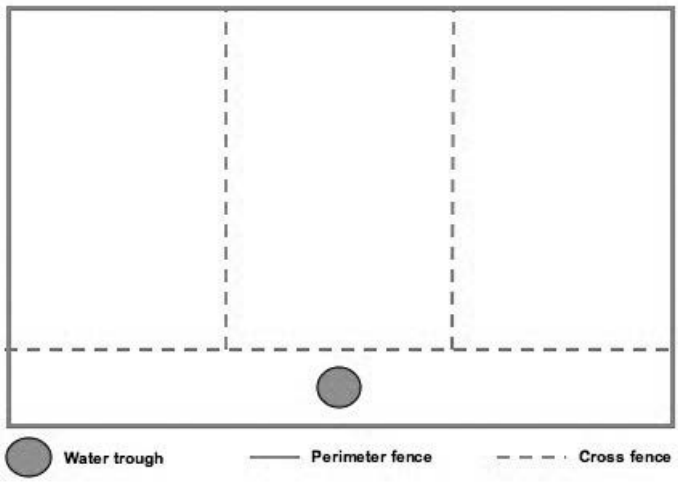
Water Supplies

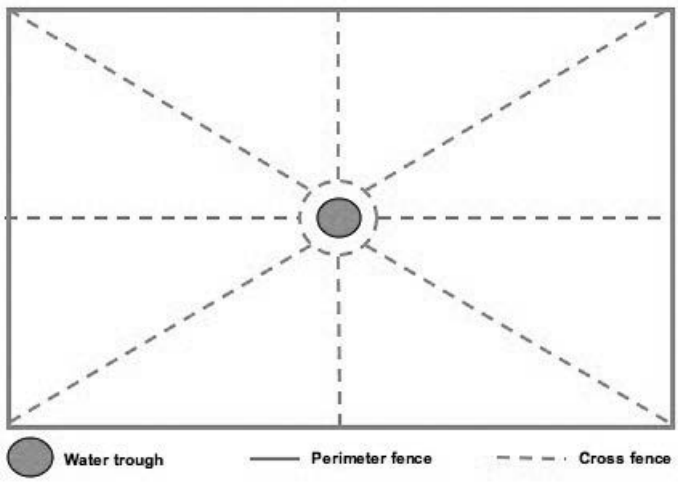
Groundwater sources for cattle include ponds, lakes, streams, and creeks. Wells, springs, and community water supplies can provide water to cattle watering troughs. The most common water sources for cattle operations in the southeastern U.S. are ponds and streams. Approximately one-third of operations in this region use deep wells or municipal water sources.

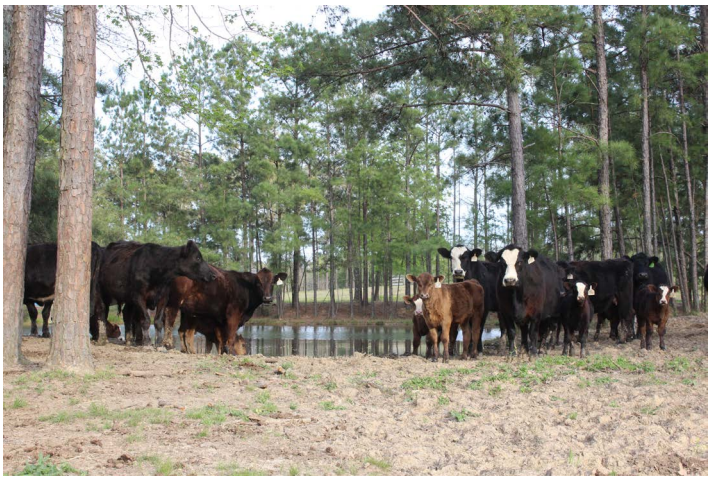
A continuous supply of clean water is essential for cattle. When streams, creeks, springs, or ponds are used as water sources for cattle, it is important to assess the reliability and quality of these water supplies. During times of drought, streams, creeks, and ponds experience low water levels. The possibility of low water levels means that these water sources cannot be relied upon as the sole water source for cattle.

Monitor how much water you or your cattle take from streams and creeks so your water use does not negatively affect neighbors downstream. Always check current local, state, and federal regulations to determine the restrictions on or permit requirements, if any, for removing water from public or shared waters.









Surface water sources for cattle.

Example water troughs for cattle.

Water tanks are another option for providing drinking water. Capacity should match the number and size of cattle it will serve. Associated pipes and water sources should be capable of consistently supplying needed water quantities. If water tanks are not large enough, pipes and water sources will not be able to keep pace with water consumption. Timid cattle are at most risk of water deprivation in this situation.

If the water tank empties enough, cattle attempting to drink may be able to move or damage the tank. In some cases, the float may need to be protected from cattle to prevent damage or an overflowing trough. A float visible from a distance can make checking water supplies easier.

Cattle congregate around water sources, especially if they are in shaded areas in warm weather. The areas immediately surrounding these water sources are high-traffic areas and suffer damage from cattle hooves. Soil erosion, pasture damage, and mudholes can follow. Placing water troughs on concrete pads or other surfaces may help.

Geotextile fabric topped with gravel, concrete washout, or something similar can provide a solid, stable surface for cattle around water troughs. Install pads with coarse surfaces that will not cause cattle to slip and fall. Consider elevating a concrete pad above the surrounding gravel or other material so cattle have room to place their front feet on the elevated water trough pad but not their back feet. This may reduce the risk of cattle defecation and urination in water troughs.

Drought and Hot-Weather Concerns

Periods of drought and extended hot weather can lead to reduced surface water supplies. Decreased water levels lead to increased concentrations of contaminants that reduce water quality. Freshwater ponds may recede to levels that greatly reduce water quality or may dry up altogether. Stagnant water sources may also serve as breeding grounds for mosquitoes.

Cattle often seek to cool themselves by standing in ponds and creeks. They spend more time near waterers in the afternoon, often the hottest part of the day. The resulting hoof action, urination, and defecation can lower water quality. Pesticides sprayed on cattle or impregnated in ear tags can be transferred to water supplies when cattle are allowed to loaf in surface water sources.

The visibility of the float in this water tank indicates an adequate water level in the tank.

Placement of a trough on a concrete pad with soil erosion and pasture damage occuring around the base of the pad.

To minimize water-quality problems, producers can restrict access points to groundwater supplies and create stream crossings that handle high cattle traffic rates with minimal impact on water quality. The National Resources Conservation Service can provide construction designs and specifications for restricted access points and stream crossings. Providing off-stream water sources can discourage cattle to spend time near or in streams when stream access is limited. Consider factors such as water and air temperature, relative humidity, and forage and shade availability when cattle have free access to a stream.

Winter Weather Concerns

In the southeastern United States, freezing water troughs is not a major concern. However, extreme winter weather can occasionally cause problems with water supplies on beef cattle operations. Carefully observe cattle water sources when subfreezing temperatures occur. Outdoor water supplies in shaded areas are typically slower to thaw than water supplies housed away and insulated from environmental temperatures or exposed to direct sunlight. If water supplies are turned off during extremely cold conditions, it is important to monitor cattle water tanks and to resume water flow in a timely manner. Some water troughs are designed to better withstand freezing conditions. Strategic water trough automatic valve and pipe placement can eliminate the need for electric water heaters in freezing temperatures.

Water Quality and Contamination Issues

Water sources can become contaminated to the point that water intake and animal performance or health is impacted. Maintaining clean water supplies for cattle is imperative for avoiding production losses. In addition to physical cleaning of cattle water troughs, a diluted bleach solution can be useful for disinfecting troughs. Apply bleach to cattle water sources at a rate of 8 ounces of household bleach per 1,000 gallons of water. This supplies 3 to 5 ppm of chlorine to the water, which should be acceptable for cattle to drink and help control bacterial growth in the water. Alternatively, apply 1 part bleach to 32 parts water and let this disinfectant solution stand in the water tank for 15 minutes. Drain the tank, and refill it with water.

Cattle are sensitive to water taste and odor and may not drink as much less-palatable water. This lowered water intake could lead to reduced feed intake and depressed weight gain. Newly arrived calves may refuse water supplies at first because of differences in palatability or water quality. It is possible to have decreases in water consumption and animal weight gain if cattle drink from a water source contaminated by feces and urine. This is common with unrestricted access to ponds. In addition to effects on water quality, cattle can cause physical damage (such as soil erosion) to stream banks and water areas.

Water Source Effects on Water Quality

Water source can have a significant impact on the quality of water for livestock use. Possible water quality problems may include high concentrations of minerals or salt, high nitrogen, contamination with fertilizers or other chemicals, bacterial contamination, or algae growth. Take steps to avoid pesticide and herbicide contamination of cattle water supplies. Watch for any potential disease problems where water serves as a carrier.

Researchers have documented a 9 percent higher weight gain in nursing calves where the drinking water of the cow-calf pairs came from a trough compared to cattle drinking directly from a pond. Steers in the same study with access to water troughs instead of ponds demonstrated a 16 to 19 percent increase in weight.

Another study found that consumption of pond water treated by aeration or coagulation (addition of aluminum sulfate and chlorine) and pumped to a trough improved cattle weight gain by ⅓ pound per day compared to untreated water consumed directly from a pond. The aeration and coagulation treatments removed many contaminants, thus improving taste and odor and increasing intake. Simply pumping water from the pond without further treatment produced no difference in weight gains. Improved cattle weight gains appeared to be related to improved water palatability and potentially increased water and feed consumption as a result. Cattle drinking directly from the pond spent less time grazing and more time resting than those drinking from all other water treatments, suggesting feed intake fell when direct pond access was the water source.

Water pH

The pH is a measure of acidity or alkalinity. Water with a pH below 7 is acidic, and above 7 is alkaline or basic. An acceptable pH range for water consumed by cattle is from 6.5 to 8.0. Water pH influences palatability, corrosiveness, and chlorination efficiency. Water with a pH less than 5.5 may cause acidosis in cattle and lead to lowered feed intake and performance. Excessively alkaline water can cause digestive upset in cattle and increase the laxative effect of high sulfate consumption.

Total Dissolved Solids (TDS) and Salinity

Total dissolved solids is a measure of all constituents dissolved in water. It serves as a useful index for whether or not water is suitable for livestock to drink. Water containing high levels, 4,000 parts per million (ppm) or more, of dissolved solids (such as salt) can lower beef cattle feed intake and daily gains. Never use levels surpassing 10,000 ppm as water sources for cattle. Target a recommended TDS level of 3,000 ppm or less for cattle water supplies.

Wells in the coastal region of the southeastern United States are where high TDS levels in water supplies are normally found. In addition, hurricanes and tropical storms can alter the TDS levels of inland cattle water supplies. Be diligent about testing water supplies for acceptability as drinking water for livestock in the aftermath of these storms, and carefully observe cattle for any signs of dehydration. Recommended water sample analysis should include tests for total coliform bacteria, pH, total dissolved solids, total soluble salt, salinity, nitrates, sulfates, and other factors as appropriate, such as toxicity problems with specific minerals, pesticides, or blue-green algae growth. Obtain sample bottles and sampling instructions from a certified laboratory.

Under specific conditions, water may contain levels of minerals that are potentially toxic to livestock. Toxic elements commonly found in water supplies are lead, cadmium, and mercury. High iron and sulfate levels in water can contribute to copper and zinc deficiencies in cattle. Sulfur, iron, and manganese can decrease cattle intake of water by causing foul flavors and odors. Salt is a common TDS component in cattle water sources and can contribute to the total dietary salt intake. High salt content of drinking water (as indicated in TDS levels) can lead to reduced intake of salt-limited protein and mineral supplements.

The tolerance level for salt (sodium chloride) in beef cattle drinking water is between 1 and 2 percent salt. However, cattle were found to be more sensitive to salt water in the summer compared to the winter. Water with 2 percent salinity has been shown to be toxic to cattle. The signs of salt toxicity are similar to those of dehydration or lack of water, with severe anorexia, diarrhea, and weight loss being apparent. Signs of dehydration also include skin tightening and drying of mucous membranes and eyes. The eyes of a water-deprived animal may appear sunken and dull.

Nitrates

Nitrates in drinking water are one of the most prevalent water quality problems on southeastern United States beef cattle operations. Nitrates from manure or fertilizers can enter water supplies and create water quality problems for cattle. Water supplies from shallow wells in agricultural areas and surface water sources prone to fertilizer runoff are more likely to contain problematic nitrate levels than other water supplies. Water contamination with nitrates becomes an even more serious concern when feed or forage supplies contain high levels of nitrates and when water levels in surface ponds recede during drought and concentrate nitrate levels. Water may not contain toxic levels of nitrates, but when consumed in combination with feedstuffs containing nitrates, it can contribute to nitrate poisoning.

Nitrates are converted to nitrites in the rumen of cattle and can interfere with oxygen transport in the nitrite form. Chronic cases of nitrate poisoning are most common and can result in reduced feed intake, lowered growth rates, and abortions. Water nitrate-nitrogen levels of 100 ppm or less are generally considered safe, while levels between 100 and 300 ppm are questionable for livestock consumption. Nitrate-nitrogen levels in cattle drinking water more than 300 ppm are generally considered unsafe. Use these recommendations with caution when high nitrate levels are present in feeds or forages or during periods when hot weather induces high water intake.

Sulfates

Over periods of greater than 1 week, high-sulfate water results in reduced feed consumption, lowered weight gains, scours, tissue separation, and suboptimal production. High levels of dietary sulfur, which can result from water containing sulfate, have been implicated in reducing

net energy values, interfering with mineral status, and developing polioencephalomalacia. Adverse effects of high concentrations of sulfate in water may be more extreme for younger cattle and with high environmental temperatures. Sulfate concentrations of 500 milligrams (mg) per liter may negatively affect calves.

Water sulfate sources include sodium, magnesium, calcium, and iron sulfate, all of which act as laxatives. While sodium sulfate is the strongest laxative, cattle may become resistant to laxative effects after a few weeks. Hydrogen sulfide is the most toxic form of sulfate, and hydrogen sulfide amounts as low as 0.1 ppm may reduce water intake. Water intake starts to fall at sulfate concentrations of 2,500 to 3,000 mg of sulfate per liter and continues to drop as sulfate concentrations increase beyond these levels. Cattle reduce their consumption of water containing high (4,000 mg of sulfate per liter) concentrations of magnesium sulfate, even after given time to adjust to the high levels. Iron sulfate may reduce water intake more than other sulfate forms. The maximum tolerable concentration of sulfur for cattle is 0.4 percent on a dry matter basis.

Microorganisms

Bacteria, viruses, and parasites are regularly found in ponds and other surface water supplies that collect runoff from a manure source or that allow direct cattle access. While most microorganisms in cattle water supplies are quite harmless, some organisms can contribute to reduced cattle health and performance. A contaminated water source can spread a pathogen (disease-causing agent) quickly throughout the herd. Leptospirosis is a disease affecting cattle that can be spread through water supplies.

Coliforms are bacteria that normally inhabit the digestive tracts of humans, cattle, and other animals. Ponds where cattle have free access can reach coliform concentrations exceeding 15,000 counts per milliliters (mL). Maximum levels of coliforms should not exceed 1–500 counts per 10 mL of water, with the lower end of this range for calves and the higher end for mature cattle.

Blue-Green Algae

Blue-green algae are bacteria that, under certain conditions, can produce toxins such as nerve toxins and liver toxins that can kill cattle quickly. Muscle tremors, difficult breathing, and collapse are signs of nervous system toxins, while weakness, pale mucous membranes, and bloody diarrhea are signs of liver toxins. Cattle surviving blue-green algae poisoning may become chronic poor-doers and can develop photosensitization (increased risk of sunburn). Contact a veterinarian for treatment options if you suspect blue-green algae poisoning.

Nutrient enrichment of surface water may lead to blue-green algae (cyanobacteria) growth, which can be a water quality problem. Cattle can contribute to nutrient loads in water supplies when allowed unrestricted access to them. Additionally, warm water is ideal for blue-green algae growth, so summer is the season when these algae are most likely to appear in cattle water supplies. Toxicity problems most often occur when cattle consume large amounts of the algae in the summer or early fall following a rapid bloom of algae. Wind can concentrate blue-green algae along the downwind banks of ponds.

Blue-green algae cannot be picked by hand from the water like green algae. Toxins produced by blue-green algae appear as an oily substance on the water surface. Eliminating sources of nutrients entering the water, aerating the water, pumping water to a trough, or eliminating cattle access to the contaminated water and providing an alternate water source are methods to combat blue-green algae problems. When surface water contaminated with blue-green algae is pumped with the intake pipe at least 3 feet below the surface, intake of blue-green algae toxins is minimal. Keeping water troughs clean from debris and away from sunlight can also help control algae growth.

Copper sulfate (an algaecide also called blue stone) can be added to water sources contaminated with blue-green algae where algae growth is dramatic or toxicity problems are occurring. A recommended maximum concentration is 1 ppm of copper sulfate in the water. Treatment should be applied evenly across the body of water, and it usually lasts for 2–3 weeks. It is important to consult an aquaculture specialist before treatment if the body of water to be treated contains fish. Keep cattle off treated water supplies for at least 5 days after the last algae bloom. Sheep are very sensitive to high copper levels. The maximum tolerable level of copper sulfate in water is 2.7 (sheep) and 6.8 (cattle) pounds of copper sulfate per acre foot of water.

Summary

Water is the most important nutrient for cattle. Providing adequate and high-quality water supplies to cattle at all times is a must for beef cattle operations. If poor cattle performance or health arises, consider evaluating drinking water quality. Testing water for anti-quality factors can help diagnose suspected problems. Producers can strategically manage water sources to best provide for cattle water needs, promote water use efficiency, and mitigate environmental impacts. For more information on water or beef cattle nutrition or for water sampling instructions and submission information, contact your local MSU Extension office.

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