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Water for Beef Cattle

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Livestock require the proper balance of water, carbohydrates (energy), protein, vitamins and minerals for optimal levels of performance. Of these nutrients, water is the most critical for all classes of livestock.

Cattle have little ability to adapt to water restriction, and feed intake will be greatly reduced following only short periods without water. Because of this, a plentiful supply of good quality water is necessary for profitable beef production.

Water Requirements

Many factors influence the amount of water required by cattle. Table 1 shows average water needs for various classes of beef cattle. Note that water consumption varies considerably, depending on the temperature and stage of production. These allowances are not absolute requirements and should only be used as a guide in developing water sources, or as a starting point for supplying water to penned cattle.

Water consumption is influenced by other factors, such as moisture and protein level of the feed, salt intake, relative humidity and the breed of cattle. When high moisture feeds such as silage or fresh forages are used, water intake as drinking water is reduced. Because of the need to excrete more urine, high levels of salt or protein in the feed increase water needs. In areas with high humidity, animals require somewhat less water because of lower losses to evaporation. Brahman cattle have a greater ability to adapt to hot, dry conditions than the temperate breeds of cattle, so they better withstand short-term water restriction. Because of the importance of water to body function and the difficulty in estimating requirements, cattle in all circumstances should have free access to all the quality water they will consume.

Water Quality

Quality of drinking water for both humans and livestock is a growing national issue. Some water supplies have been contaminated by agricultural chemicals or contain naturally occurring contaminants that interfere with animal performance. The purpose of this fact sheet is to provide an outline for maximum tolerable levels

Table 1. Estimated Daily Water Intake of Cattle, Gallons/Day (adapted from a table prepared by Paul Q. Guyer, University of Nebraska)

Daily High Temp (F°)	Cows Nursing Calves[1]	Dry and Bred Cows	Bulls	Growing and Finishing Cattle			
				400 lb	600 lb	800 lb	1000 lb
	Gallons/Day						
35	11	6	7	4	5	6	8
50	13	7	9	5	6	7	9
65	16	8	11	6	7	9	11
80	18	11	13	7	9	10	14
95	20	15	20	11	15	17	19

[1]First four months of lactation.

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of contaminants in water, and to promote practices that help to maintain water quality and prevent pollution of water sources by beef cattle.

Salinity. Waters that contain high levels of dissolved salts (TDS) can result in depressed performance of beef cattle. These waters are normally found in wells in coastal regions of the southeast. The following guidelines should be used with water high in TDS. In general, the type of salt (whether it is primarily sodium chloride or a complex mixture) has little influence on the acceptable levels. Cattle prefer water containing some salt, but increasing levels to about 5,000 ppm TDS reduces intake and average daily gain by about 10 percent for feedlot cattle. Water containing from 5,000 to 7,000 ppm TDS is safe for cattle in most cases but likely results in depressed performance. Water containing from 7,000 to 10,000 ppm TDS is safe only for dry cows under low levels of environmental stress, and water containing more than 10,000 ppm TDS should not be used for cattle.

When use of a water source high in TDS is necessary, gradually adapt animals rather than rapidly switch water sources. It is also important to consider the fact that consumption of salty feeds, such as a salt-limited protein or mineral supplement, is influenced by TDS in drinking water. When animals are fed salt-limited supplements and the water supply is highly saline, intake of the supplement is reduced and protein or mineral deficiency could result. Individual salt compounds may be measured to determine TDS, or electrical conductivity may be used to estimate salinity of water.

Nitrates. Nitrate in drinking water is rapidly becoming the most predominant water problem for livestock in the southeastern United States. A guide to evaluating water contaminated with nitrates is given in Table 2. Water test results generally have nitrates and nitrites combined and may report levels as nitrate nitrogen, nitrate ion or sodium nitrate. This can greatly affect interpretation of the results. Levels in Table 2 are expressed in the three major forms that may be reported.

Nitrate is not poisonous to livestock, but it can be converted in the gastrointestinal tract to nitrite, which impairs oxygen transport by the blood. Nitrite converts the hemoglobin (which binds oxygen) in red blood cells into methemoglobin, which is brown in color and does not bind oxygen. Excessive nitrate intake (acute toxicity) may result in a lethargic animal and sudden death. Animals may adapt to high levels of nitrate if levels are raised gradually, but chronic exposure either in feed or water may result in depressed feed intake, depressed growth rate and abortions. In some situations, nitrate levels in water will be below maximum tolerable levels, but because of substantial levels of nitrate in forages, the water may contribute to a nitrate toxicity problem.

Nitrates in runoff from agricultural fields are quickly dissipated from rapidly flowing surface waters through volatilization, so nitrate is normally a problem met when using well water, especially shallow wells in agricultural areas. Avoid ditches and ponds as water sources because ditches and ponds on poorly drained land can collect runoff from cropland which may contain high levels of nitrates as well as other agrochemicals. Failure to test soil over many years results in excessive nitrogen fertilization in some areas. The nitrogen then leaches into the soil and enters shallow groundwater.

The leaching of nitrate from improper waste management facilities around livestock, especially heavy concentrations of swine operations on sandy soils, may contaminate shallow surface water.

When planning a forage system that may lead to high forage nitrate levels, it is strongly recommended that cattle drinking water be tested for nitrates.

Blue-green algae. Stagnant waters may contain excessive levels of blue-green algae, which may be toxic and result in death of cattle. Because of their stagnant, nutrient rich nature, small ponds and streams in late summer can have toxic algae blooms. Toxicity is most common following a rapid bloom in late summer when cattle are consuming a substantial amount of the algal surface scum. The problem is difficult to predict, and the first sign may be sudden animal death. Because of this, it is advisable to restrict cattle access to stagnant waters, especially when a substantial amount of algae scum is visible. Algae blooms can be controlled in ponds through the use of copper sulfate (blue stone), but the rapid die off of algae may result in a fish kill.

Table 2. A Guide to the Use of Waters Containing Nitrate for Cattle (National Academy of Sciences, 1974)

Acceptability	Form of Nitrogen Reported (ppm)[1]		
	Nitrate Nitrogen (NO_3-N)	Nitrate Ion (NO_3)	Sodium Nitrate ($NaNO_3$)
Safe	Less than 100	Less than 443	Less than 607
Questionable[2]	100-300	443-1329	607-1821
Unsafe[3]	Over 300	Over 1329	Over 1821

[1] Water analysis labs will report values in one of these three ways. Values are reported in parts per million (ppm).
[2] These waters should be used with caution. High nitrate in forages, or high temperatures (high water intake), could result in problems.
[3] Cattle should not have access to these waters.

The best method to control algae is to eliminate the source of nutrients entering the pond. If copper sulfate is used, the recommended application rate to water depends on the alkalinity (total carbonates and bicarbonates) of the water. Copper ions can kill fish if the water's total alkalinity is below 40 ppm. Copper sulfate treatment may be ineffective if alkalinity of the water is greater than 300 ppm. *The maximum tolerable level of copper sulfate in water is 2.7 (sheep) and 6.8 (cattle) pounds of copper sulfate per acre foot.*

The formula to calculate the pounds of copper sulfate needed is as follows:

$$\frac{\text{Total alkalinity (ppm)}}{100} \times 2.04 \times \text{acre-foot volume} = \text{Pounds of copper sulfate needed}$$

Do not exceed the application limits for livestock, especially sheep. Livestock (especially sheep) should not be watered for at least five days after the last visible evidence of the algae bloom. Care should be taken to avoid water that has algae cells, either from treatment with algicide or natural aging of the bloom, because most toxin is freed in the water only after breakdown of the intact algae cells.

Substances in water. Other substances in water that may cause problems for beef cattle are listed in Table 3, along with maximum safe levels. Problems that are common are high or low pH, or excessive levels of sulfates, hydrogen sulfide, iron or manganese. These factors may result in decreased water intake because of off flavors. In addition, excessive levels of some minerals may interfere with normal trace mineral absorption, especially of copper and zinc, and lead to nutritional deficiencies.

In some situations, shallow groundwater or surface water may be contaminated with agricultural chemicals such as pesticides. Any shallow well, stream or pond adjacent to cropland with a long history of agricultural chemical use should be tested for major chemicals before being used as the water source for cattle. Guidelines for pesticides and herbicides in water for beef cattle have not been established, so allowable levels in drinking water for humans are given in Table 4. Because of the possibility that these chemicals in water could lead to residues in meat, take every effort to prevent water contamination.

Sampling water for analysis. Water supplies should be taken for analysis if a producer suspects water is causing a problem, or when a new source of water is developed. If sampling will be done only once, take samples when water is at its lowest quality. Quality shouldn't vary much for springs and wells, but ponds and streams will normally be lowest in quality during late summer. Test streams and ponds when water is highest (winter) and lowest (summer) in quality. Care should be taken to get a sample representative of what the cattle are drinking.

Maintaining water quality and preventing water pollution. Because of the importance of high quality water to beef production, producers should do everything possible to maintain the quality of their water sources. If a well is used as the primary water source, it should be properly graded and capped to prevent contamination by runoff surface water, and fertilizer and other chemical applications to adjacent pasture or cropland should be closely controlled.

Apply nitrogen fertilizers only according to soil test results. Forage systems decreasing the need for added nitrogen should be used. In addition, keep waterers as clean as possible. A waterer with excessive algal growth or other filth can decrease water intake and performance, even though the water is apparently of high quality.

Table 3. Recommended Limits for Some Potentially Toxic Substances in Drinking Water for Beef Cattle

Substance	Safe Upper Limit mg/L (ppm)
Arsenic	.2
Cadmium	.05
Calcium	500
Chloride	1500
Chromium	1.0
Cobalt	1.0
Cyanide	NE[1]
Fluoride	2.0
Iron	NE
Lead	.1
Magnesium	250
Manganese	NE
Mercury	.01
Molybdenum	NE
Nickel	1.0
Nitrate nitrogen	See Table 2
Salinity (total soluble salts)	3000
Sodium	1000
Sulfate	500
Total dissolved solids	2500
pH	Range 5.5 to 8.5
Vanadium	.1
Zinc	25.0

[1]No upper limit established because of limited experimental data.

Table 4. Maximum Allowable Concentrations of Pesticides in Human Drinking Water (From "Water Quality for Livestock," T. L. Carson, 1987)

Pesticide	Maximum Concentration mg/L (ppm)
Aldrin	.001
DDT	.05
Dieldrin	.001
Chlordane	.003
Endrin	.0002
Heptachlor	.0001
Lindane	.004
Methoxychlor	.1
Toxaphene	.005
2,4-D	.1
2,4,5-T	.01

Cattle should not have unlimited access to ponds and streams. In addition to using these water sources for drinking, cattle will also loaf in water, especially in hot weather. This results in both fecal and urinary contamination. In ponds and slow flowing streams, this results in deteriorating water quality as summer progresses. Cows can also contract diseases such as mastitis and leptospirosis from lounging in dirty water.

When cattle have recently been sprayed with insecticides or tagged with fly tags, they should not be allowed to loaf in water. Allowing free access to ponds can result in fish kills, or possibly complete sterilization of a pond. Ponds can be kept clean and provide good quality water if they are fenced, and cattle have access to only a small area in one corner, or if water is run through a pipe to a tank at the base of the dam. Quality of the pond for recreational uses such as swimming and fishing will also be improved by keeping the cattle out.

Weeds and algae may be a problem in ponds, especially if they get drainage water from cropland, or if cattle have free access to the ponds. To control such problems, first find and eliminate the source of nutrients if possible. Herbicides can be used to kill off the weeds, and copper sulfate can be used to control algae.

When open streams are the water source, cattle cause stream bank erosion and contaminate the water with manure and urine. The sediment and nutrient-polluted water then flows to the next farm, and eventually enters rivers and lakes where it can cause algae blooms and fish kills. Likewise, water contaminants may enter the farm from upstream, and the contaminated water can result in spread of diseases such as leptospirosis. For these reasons, preventing cattle access to streams is advisable to protect the producers and their neighbors, as well as the general public.

Developing Water Sources for Beef Cattle

In many situations, a new beef cattle operation is developed, or an attempt is made to upgrade existing water sources for more intensive grazing management. In these situations, a common question is, "What kind of water source should be developed?" This is usually a question of economics, but the all-around best options are establishing a deep well or pond, developing a spring or diverting flow from a perennial stream.

Ponds. If a new pond is to be built, plans should include fencing around the pond and a pipe to run drinking water to a tank at the base of the dam. Older ponds should also be fenced, and a drinking tank installed at the base of the dam. Freeze-proof tanks work very well in these situations. Ponds used for cattle in this manner provide a very high quality year-round water source.

Wells. Wells provide excellent quality water in most areas if they are deep enough to prevent contamination from leaching of chemicals and nitrates from agricultural fields. Wells should be located away from cropland, animal confinement areas and lagoons or septic systems. The biggest problem with wells is that they are relatively expensive to drill, and you still may end up with a dry hole. Be careful to ensure that there will be an adequate volume of water even in dry weather. In many cases, a deep well with a good production rate will be the safest, most reliable source of water for beef cattle.

Springs and streams. Springs and streams are relatively inexpensive sources of water for beef cattle if developed properly. Fence the water source (the spring head or stream) from cattle. Pipe the water to drinking tanks, or make water available at a stream crossing. Consider the reliability of the water flow from springs and streams before developing pastures. Using intermittent sources may leave you without water during the times when water requirements are highest – in hot, dry weather.

Water for intensive grazing systems. Most intensive grazing systems have utilized a centralized watering station with a lane(s) leading to the grazing paddocks. Under this system cattle must travel frequently between the grazing area and the watering station. This leads to excessive trampling of pastures, and transfer of nutrients off the paddocks and into the lanes and watering area.

Experience has shown that individual waterers in each paddock increase the amount of time animals spend grazing, improve animal performance and keep recycled nutrients in the pastures where they belong, reducing the inputs necessary to maintain adequate plant nutrition. Relatively inexpensive systems for moveable waterers utilizing quick-couplers and high density burst-proof pipe have been developed. Waterers can be constructed of inexpensive materials (such as plastic drums cut in half) equipped with float valves and can be moved along with the cattle with very little additional labor.

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