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Water Systems for Controlled Grazing

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Intensive controlled or rotational grazing can be an important tool for beef and dairy producers in Kentucky. A key component for success with this type of operation is the availability of adequate drinking water for livestock on pasture.

Quantities, flow rates and location of water for rotational grazing will be considered in this fact sheet. Systems supplying water under pressure through hose or pipe to a tank or water bowl will be discussed in detail.

Cows that drink more water tend to produce more milk or beef. Cows that must wait in line for a drink and then are only able to suck water from the bottom of the tank will suffer from thirst. These cows will be under stress that could have been avoided with adequate water supply. Cows should not have to walk long distances to get a drink of water. A correctly designed water system will supply the quantity of water needed every day of the pasture season and will deliver water at a rate that meets the temporary large demands that occur each day.

Tank Location and Water Demand Rates

The rate of intake and herd drinking pattern is very dependent upon the location of the water source with respect to the pasture. If the source is located outside the fenced pasture area or paddock, that is, if the animals have to leave the confines of the pasture area through an opening in the fenced area, the entire herd will tend to go for a drink at the same time. The dominant animals will get their fill first, leaving the timid to last. If the water supply is not sufficient to provide all water as needed, the last will suffer thirst. This herd drinking pattern is observed even if the water source is only a few feet outside the pasture.

If water is some distance from the pasture, or if it is located under shade, the herd will tend to congregate around the water source and not return to the pasture and grazing as they should. Never locate the water supply more than 500 feet from the nearest corner of the pasture paddock.

On the other hand, if livestock do not have to leave the pasture confines for a drink, they will be more likely to drink one at a time as each individual animal becomes thirsty. In this case, space around the water supply and the supply rate may need only be sufficient for one or two animals at a time. A smaller tank in the fence line can work well. However, the more central the water source to the paddock, the better.

A square paddock is better than a long narrow one if the water source is located in one corner. A tank at the midpoint of a long paddock is better than at one end of a paddock with the same shape. The farther the cows have to go for water, the more they tend to approach water in groups.

Permanent or semi-permanent water stations can become problem areas. Besides the distance cows must walk as the paddocks are rotated, there is the problem of the ground around the tank becoming punched up by hoofs from frequent use unless it is a very well-drained, gravely soil. Frequent moving of the water station will help prevent this problem.

Quantity

Daily water requirements of dairy animals on pasture depend upon the size of the animal, milk production, climatic conditions such as temperature and humidity, number of hours on pasture, time of day, shade, animal health, quality of water, ease of access to water, and amount of moisture in the vegetation consumed. In some situations, the cow will obtain a major amount of water through the vegetation she consumes.

Basic water requirements for a 24-hour period:

- milking cows (dairy): 40 gallons per cwt of milk produced (or, if easier to compute, 25-30 gal per milking cow)
- dry cows, heifers: 10 gallons per 1,000 pounds body weight (or, if easier to compute, 10 to 15 gallons per animal)
- beef cows and stocker animals: 9 gallons per 1,000 pounds body weight in winter, 18 gallons per 1,000 pounds body weight in summer (or, for cows- 10-20 gallons per day; stockers - 7-13 gallons per day).

All water required during a 24-hour period need not be supplied at the pasture for dairy cows. Given the opportunity, milking cows will drink some water at the barn before or after milking. Provide at least 15 gallons of water at the pasture per cwt of milk produced for each half day on pasture, especially if cows are pastured during the daylight hours.

On dairy farms, one indicator of inadequate supply at the pasture would be the haste with which cows make their way to the barn water supply as they are being

brought in for milking.

Drinking Space

There should be room for at least one animal in 20 to drink at the watering station at one time. If the tank is outside the pasture fence, provide as much drinking space as possible to reduce fighting and waiting time at the tank. Plan on 20 inches of perimeter length for circular tanks and 30 inches of length for the straight side of a tank for each animal drinking.

Maximum throat height:

Mature Cows:	30 inches
Heifers:	24 inches
Calves:	18-20 inches

Tank volume: 1 cubic foot for each 7.5 gallons of storage

Supply Rate

The size of the tank (reserve capacity) should be sufficient to supply all water required per herd drinking cycle (the entire herd will tend to drink their fill within a short time period). The other option is to have water flow out of the supply hose at a rate equal to the combined drinking capacity of all the cows that can drink at once.

Individual Cows will drink as much as 2 gallons per minute (gpm) or more if thirsty. Water systems without adequate reserve or flow rate force cows to wait for the tank to be replenished. Boss cows will dominate until they get their fill, and sometimes even then they will not let the more timid cows drink. Timid cows may be forced to wait long periods of time to get any water.

For small pasture tanks with little reserve capacity, try to provide a flow rate of at least 1 gpm for each cow that can drink at one time. When flow rates are less than the rate at which cows drink, large tanks should be used for reserve capacity. The reserve capacity of the tank should equal 2 gallons or more per cow in the pasturing group. The reserve should be replenished in 1 hour or less so that adequate water is available for the next drinking cycle. Larger reserve capacities are a good idea for cows on pasture during the day.

Example: There are 50 cows on pasture. The flow rate from the supply pipe is somewhat less than 2 gpm. There should be room for at least three cows to drink at once (one drinking space per 20 cows). There should be a flow rate in excess of 3 gpm (3 drinking cows multiplied by 1 gpm). However, this is not the case. Therefore, the tank capacity should be in excess of 100 gallons (2 gallons per cow multiplied by 50 cows) for marginally sufficient reserve. The flow rate should be at least 1 2/3 (1.66) gpm to refill the tank in approximately 1 hour (100 gallons divided by 60 minutes).

In most situations, the behavior of cows around the tank will indicate whether cows are getting water at a sufficient rate. Actual flow rate can be measured by noting how long it takes to fill a container of known size. Make this measurement at the end of the hose with the outlet control attached, not at the barn connection. The flow rate can be significantly less at the outlet due to pressure losses as water flows through the pipe and through the outlet.

Water Quality

Water should be potable and reasonably fresh. The quality should equal that of water normally supplied in the barn. The tank should be kept free from algae growth. Water should be kept cool, but that may be difficult. One thousand feet of 3/4-inch diameter hose contains 23 gallons of water. A few minutes in the sun can heat this water to lukewarm temperatures. Keep the supply hose covered as much as possible. (Vegetation growth around the hose will help.) A shade over the water tank will help keep the tank cool, but don't provide so much shade that cows stay around the tank for relief from the sun.

Delivery Pipe Size and Pump Pressure

The water system must be able to generate pressure sufficient to:

- overcome friction in the piping
- push water around elbows, couplings, kinks and other constrictions in hose or pipe
- lift the water if the tank is at a higher elevation than the pump
- push water through the outlet and into the tank at the desired rate

Keep in mind that:

- More pressure (energy) is required to deliver more water through the same pipe.
- More pressure (energy) is required to deliver the same amount of water through a smaller pipe.
- More pressure (energy) is required to deliver water uphill.

Table 1 can be used to size plastic piping not to exceed approximately 5, 10, or 15 psi pressure loss on level ground. (A standard recommendation for plumbing in and around the farmstead is that the pressure loss in the piping not exceed 10 psi to any

isolated fixture.)

Table 1. Pressure Loss in Plastic Hose or Pipe for Pasture Water Systems.

Diameter (in)	Flow Rate (gpm)	Maximum Distance (ft) for Pressure Loss of:		
		5 psi	10 psi	15 psi
½	1	1000	2000	3000
½	2	250	500	800
3/4	1	5000	10000	15000
3/4	2	1200	2500	3500
3/4	3	500	1000	1500
3/4	4	300	600	900
3/4	5	200	400	600
1	2	5000	10000	15000
1	3	1500	3000	5000
1	4	1000	2000	3000
1	5	600	1200	1800
1	6	450	900	1300

If the water tank elevation is higher than the pump source, provide one extra psi for every 2 1/3 feet of elevation difference. For example, if the tank is located 25 feet above the pump, it will take a little more than 10 psi just to lift the water to that level. This means that starting with a given pressure, there will be 10 pounds less pressure available for pushing water through the pipe. On the other hand, if the tank is 25 feet lower than the pump, there will be 10 pounds more pressure to work with.

Outlet Pressure and Controls

Simple float valves are often used to control water flow at the tank. However, without sufficient pressure at the outlet, water flow will be restricted. Pressure required at the outlet depends on the type of outlet and control. Use the manufacturer's rating, if available, for outlet pressure. If unknown, use 3 psi per gallon of flow rate as an approximation.

For example, if a flow rate of 3 gallons/minute is desired, 9 psi of pressure should be available at the outlet. With a 20-40 pound pressure range at the pump and a long

run of pipe, pressure at the outlet may be so low at the tank that water will flow out of the pipe very slowly.

Continuous flow and tank overflow without control is not recommended. Water is a resource that should not be wasted. Sometimes this system is used with large tanks and low flow rates in well drained areas. Anticipation of needs by manually turning water on and off will not work very well, either.

Calculating Pressure Requirements

What is the approximate pressure required to deliver 6 gpm through 1,000 ft of 3/4-inch diameter hose to a tank at an elevation 20 feet above the pressure tank at the well? From Table 1, note that the pressure loss of 3 gpm through 1,000 feet of 3/4-inch hose is about 10 psi. There should be about 9 psi at the outlet for water to flow out at 3 gallons/minute (3 psi for each gallon). The pressure required to lift water 20 feet is about 9 psi (1 psi for each 2 1/3 feet). Total pressure requirement is about 28 psi (10 + 9 + 9). Pressure loss through couplings, other connections and fittings should be relatively small compared to other losses in this system. The total pressure required at the pump for this situation should be about 30 psi.

Many older farm water systems operate in the 20-40 psi pressure range. In many situations, 20 psi will not be sufficient to deliver moderate amounts of water to the end of a long hose. Probably the easiest solution for inadequate pressure is a larger tank with more reserve capacity. More recent farm water installations have pressure ranges of 30-50 - or even 40-60 psi - which are more adequate for pasture watering.

Piping

The pipe or hose should be rated for at least 80 psi. Piping should be rated for use with temperatures ranging from that of ground water to those over 100 degrees F. (to allow for solar heating of standing water in pipe).

Polyethylene (PE) and polyvinyl chloride (PVC) pipe are suitable for cold water only. Chlorinated polyvinyl chloride (CPVC) is similar to PVC but is suitable for hot or cold water lines. Polybutylene (PB) can be used for hot and cold water lines. Manufacturers make a number of hoses with different physical characteristics; make sure the one selected meets your needs.

Check the manufacturer's maximum stress and temperature limitations before purchasing.

Pipe Protection

Piping may be exposed to vehicular traffic, animal traffic, and sunlight. Sunlight will heat stagnant water in the pipe, and will degrade certain types of

plastics. Piping laid on the ground and not moved during the summer will soon be overgrown with vegetation. This helps keep water from heating in the hose but would not sufficiently protect hose not rated for outdoor use.

Run hose along fence lines when possible. Most plastic hose will not stand up to the stress of repeated vehicular crossing. Bury pipe under roadways or use parallel planking to protect hose from heavy vehicular traffic.

For further information on water systems for farm and home, refer to Midwest Plan Service handbook, "Private Water Systems," available for purchase through the Farm Plan Service of the Univ. of Kentucky Department of Biosystems and Ag. Engineering.