Irrigation Scheduling Using Soil Moisture Sensors

There is an old saying, “You cannot manage well what you do not measure.” This also applies to managing soil moisture in an irrigated crop. There are several ways to measure or keep track of soil moisture.

One way is to use electrical soil moisture sensors. Another is to calculate water use based on weather sensors from a nearby station. To probe the soil two or more feet deep and estimate moisture by its feel does work, but is generally less accurate and labor intensive. I know, I did this as a crop consultant.

For years Bootheel irrigators have been encouraged to use the University of Missouri Woodruff Charts or the Arkansas Scheduler for scheduling irrigation. The Woodruff Charts use historic averages of crop water use, which the farmer then has to estimate how to vary applications based on current weather. The Arkansas Scheduler software enables a user to periodically account for current weather and irrigation data, so this should be more accurate.

Table 1 shows the increased yields Bootheel irrigators have reported according to their irrigation scheduling method. In this survey, use of soil moisture sensors was only reported by 1% of corn growers and 1% of cotton growers. Most of the yield increase probably resulted from using sensors.

Electrical soil moisture sensors connected to a wireless cell phone transmitter enable an irrigator to remotely monitor the amount of soil moisture in a field. Most sensor and irrigation service companies now offer this wireless capability. Figure 1 shows a typical pattern of soil moisture use and recharge that was recorded by a sensor in an irrigated soybean crop, graphed automatically, and available to the farmer at any time of day.

To properly use soil moisture sensors on center pivots at least three locations should be monitored to account for distribution differences in the pivot. Experts recommend that each location have sensors at 6, 12, and 18 inch depths, and be

<table>
<thead>
<tr>
<th>Crop</th>
<th>Arkansas Scheduler</th>
<th>Woodruff Charts</th>
<th>Soil Moisture Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>11.3 bu/ac</td>
<td>13.7 bu/ac</td>
<td>41.0 bu/ac</td>
</tr>
<tr>
<td>Cotton</td>
<td>29.0 lbs/ac</td>
<td>248.2 lbs/ac</td>
<td>271.5 lbs/ac</td>
</tr>
<tr>
<td>Soybeans</td>
<td>6.0 bu/ac</td>
<td>10.6 bu/ac</td>
<td>No data</td>
</tr>
</tbody>
</table>

Bootheel Irrigation Survey [Henggeler, 2009]
installed early in the season.

There are two types of electrical moisture sensors of modest cost, ease of use, and reliability. One type uses electrical resistance, like gypsum blocks, and the other type uses capacitance sensors. Both types work well.

Other components of a soil moisture sensor station in a field include a datalogger and a cell phone connection to send the data to an internet site periodically through the day. Some companies provide additional, lower-cost sensor stations that send a signal to this datalogger, which reduces cost somewhat. Some companies provide signals that go directly to the farmer’s computer or smartphone.

Loss of this signal or connection to the cell tower has been a problem. Most companies have solved this issue and know the limits of their equipment. Each site needs to be evaluated for signal. Low areas or sites where a signal needs to go through a row of trees may need a longer antenna or other solution.

Information from two local providers indicate a one-station system can be purchased for $1500 to $1700. Spread over three-years, the annual per-acre cost of this setup would be $5 to $5.70 per acre for a 100 acre field, or $3.90 to $4.30 per acre a 130 acre field. One provider will lease a system for $1000 / year for three years, and the farmer owns it at the end. One manufacturer has a sensor and cell phone in a single unit for under $500.

Comparing these costs to the yield increases farmers reported in Table 1 shows that this investment could pay for itself year after year.

A list of soil moisture sensor manufacturers and local service providers in the Bootheel will soon be up on our website: http://extension.missouri.edu/mississippi. Other irrigation management resources can be found at: http://crops.missouri.edu/irrigation/ and http://extension.missouri.edu/scott/Irrigation.aspx

Experts recommend that farmers not rely on just one system for scheduling irrigation. A soil probe to check soil in other locations in the field is always a good back-up. Another is to use a current-weather computer application as has been developed by University of Missouri Extension Specialist Dr. Gene Stevens at the Fisher Delta Research Center at Portageville, MO. This will be explained in a future article.

For more information on many issues you are dealing with, call Mississippi County Extension at 573-683-6129. To find research-based information on the internet, always include the word "Extension" in the search line. Mississippi County Extension office is at 109 N. First St. in Charleston. The University of Missouri is an equal opportunity/access/affirmative action/pro-disabled and veteran employer. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the University of Missouri is implied.

Rick DeLoughery, Agronomy Specialist, University of Missouri, Charleston, MO.
Heat Stress in Sheep

Heat stress is a concern for all livestock producers as temperatures increase and the hottest months of the year approach. High temperatures are even more problematic when accompanied with high humidity. The heat index, a combination of temperature and humidity, is a more accurate measure of heat stress or hyperthermia, than temperature alone.

Different species of animals and breeds within species tolerate heat better than others. While sheep and goats tend to be less susceptible to heat stress than swine, cattle, llamas, and alpacas, it can still occur. Goats tend to be more tolerant than sheep and horned animals dissipate heat better than polled animals. Hair sheep tend to tolerate heat better than breeds of sheep with wool. Dark-colored animals are more susceptible to heat stress, while light-colored animals may be more prone to sunburn. Consider the following:

Signs of heat stress: Clinical signs of heat stress include continual panting, rapid breathing, weakness or inability to stand, and/or elevated rectal temperature (>105° F). Animals should be moved to a cool shaded area with good air circulation and access to water. Evaporative cooling will occur by rapid breathing; however, as the humidity increases, cooling by this method will become less effective. Rubbing alcohol can be applied to the area between the back legs where there is no wool and an increase in vasculature system exposure. Wooled sheep should not be sprayed with cool water. If the wool gets wet, air will not pass over the skin and virtually no cooling will occur. Cool water can be sprayed on woolless areas to aid in heat transfer. The most effective areas for heat transfer are on the belly and between the rear legs. Make sure the water temperature is not too cold, which could cause a temperature shock to the animal's system.

Water: During the warmer months it is imperative animals have an abundant supply of cool, clean and fresh water readily accessible. The temperature of water plays a role in the amount of water the animal will consume. Avoid placing water tanks with standing water in the direct sun. The temperature of the water will increase, causing the animals to drink less. The average water consumption during non-heat stress periods is approximately one to two gallons per day and will increase with the increased heat and humidity. Water consumption increases from 9-11% of body weight during the winter to 19-25% during the summer months. Young animals need more water on a percentage of body weight bases than adults, because a larger portion of their body weight is water. Younger animals also need to drink more frequently because they drink less at a time and have a more rapid metabolism.

Shade: Shade increases animal welfare and may also improve weight gain, milk production and reproduction. Mature trees provide excellent natural shade and are less expensive if they are already a part of the pasture. Other options include: Quonset huts, plastic calf hutches, polydomes, and carports. Shade structures can be constructed from shade cloth, mesh fabric, tarp, canvas, or sheet metal. Shaded areas provide cool spots on the ground to lie on and can provide additional relief. Under normal circumstances, livestock are able to maintain their body temperatures within a safe range, as long as they have shade and plenty of water.

Diet: Increased temperatures cause an increase in the amount of maintenance energy required to keep animals cool. This, added to the decreased appetite, causes significant decrease in average daily gain and feed efficiency. Increased temperatures are often accompanied by dry weather, resulting in lower moisture content in grazed forages. This decrease in moisture content will cause an increase in water consumption. Animals will graze less during the day and increase their evening and early morning grazing time. Do not overgraze pastures. Typically, the taller the grass, the cooler the pasture will be. More nutrient dense diets are preferred during periods of increased heat and or humidity. Although grains are considered a “hot” ration in other respects, less body heat is produced when livestock digest grain as compared to forage, especially poor quality forage.

Wool Cover: Research has shown sheep with one-inch fleece are more comfortable than sheep with less wool, as wool fibers dissipate heat more rapidly. Animals with some wool cover are also less likely to sun burn. Woolly and hairy animals should be sheared prior to the onset of hot weather and not during extreme heat. Spring shearing allows sheep to have adequate wool growth to keep them cool in the summer (and avoid sun burn) and a full wool coat by the winter to keep them warm.

Missouri is known for its hot and humid summers which can lead to concerns of heat stress in livestock. While sheep are more heat tolerant than other species, there is still concern. Management practices can be used to reduce the problem when hot and humid weather is in the forecast.

Heather Conrow, Livestock Specialist, University of Missouri Extension, Fulton, MO.
In very general terms, corn requires nitrogen (N) for growth, phosphorus (P) for root development and potassium (K) for strength and kernel quality. It also needs calcium (Ca), magnesium (Mg), sulfur (S), and Micro’s such as zinc (Zn). Deficiency from the secondary nutrients may be observed on sandy, low organic matter and low cation exchange capacity (CEC) fields. Uptake of nutrients is reduced when pH falls below 5.8. When in doubt a soil test will help determine levels. Corn begins rapid growth at V6 (6 leaf) and utilizes 65% of N from V6 through VT (tasseling), it uses an additional 20% for grain formation.

Research by Peter Scharf has shown that late season applications of N through silking has increased yield potential, especially when plants were showing signs of N stress. Visual assessment above crop canopy along with tissue tests mid–to late-season could help determine a need for additional N to help the crop reach full yield potential. If concerned, collect leaf samples for analysis from upper leaves on plants over 12 inches. Collect ear-leaf tissue on tasseling plants in order to get an accurate assessment of plant needs.

More information is available on the Missouri nutrient management website, http://nmplanner.missouri.edu/, including best management practices, timing, rate and loss of nitrogen. There is a nitrogen monitoring site that helps identify danger areas for nitrogen loss titled “Nitrogen Watch 2016” found at http://plantsci.missouri.edu/nutrientmanagement/Nitrogen/Nitrogen_watch_2016/nitrogen_watch_2016.htm.

Anthony Ohmes, Agronomy Specialist, University of Missouri Extension, Jackson, MO.
Following the rain, corn fields may be experiencing some ponding soil conditions. The concern with flooding or saturated soils is oxygen depletion. Small seedlings are most vulnerable and information on germinating seeds is limited. In either case, survival will be dependent on length of flood, air temperatures, and in the case of germinating seeds to some level - corn hybrid. Germinating and emerging corn requires oxygen. Soil oxygen in flooded fields is depleted within approximately 48 hours. In general, air temperatures below 77 degrees F will aid in survival during the flooded period of time. Research indicates emerged corn, prior to 6th leaf stage, can survive up to 4 days when air temp is less than 77 degrees F. As air temps increase, this time period can be reduce from 4 days to 1 day. In addition to oxygen depletion, concerns associated with flooding are seed rots, seedling blights and crazy top.

Once water recedes, growth will resume approximately within 3 to 5 days, this is the time to begin evaluating corn stand and plant survivability. Healthy radicle root and coleoptile should be white to cream color. Conduct stand counts and utilize replant decision guides to make a determination whether to keep the existing stand. Refer to MU guide 4091: “Corn and Soybean Replant Decisions” at the following link: [http://extension.missouri.edu/p/G4091](http://extension.missouri.edu/p/G4091) for more information.

For more information on flooded corn contact your local MU Extension center. A helpful resource is Iowa State’s IPM article: “Corn Survival in Flooded and Saturated Fields” at the following link: [http://www.ipm.iastate.edu/ipm/icm/2007/4-30/flooded.html](http://www.ipm.iastate.edu/ipm/icm/2007/4-30/flooded.html).

Anthony Ohmes, Agronomy Specialist, University of Missouri Extension, Jackson, MO.
Missouri Department of Natural Resources has divided the state into 66 separate land areas for the purpose of doing water quality planning on a very local level. The areas are called watersheds. A watershed is an area where all the water that falls onto the land drains to a point in the creek or river. Watershed planning on the local scene is a process that is already started in Missouri. Folks in the first set of watersheds have been working nearly a year to list those characteristics that are important to their communities. This program is not to be confused with the Waters of the United States (WOTUS), the EPA initiative. Our Missouri Waters wants the people within the individual watersheds to make the decisions on how we maintain/improve the good quality water that we have. The program has divided the watersheds into 5 groups. They are going to start the work in these groups in successive years.

We have been working in the program for a couple of years in Perry County, due to the finding of a rare fish in our watershed. The watershed that covers most of Perry County, a good part of Cape and Ste. Genevieve counties, and a bit of Scott and Mississippi counties is in the first group. Our southeast corner of the state has a watershed or two in each of the 5 groups. Below is a map of our southeast region clipped from the statewide map for you to see those watersheds. As you can see, watersheds do not follow the political lines that we are accustomed to work.

It is important for us and our neighbors to participate in this effort. There are several groups that feel passionate about the issues surrounding our streams and water. Some of them supported EPAs efforts in WOTUS. To have a balanced watershed plan, our whole community needs to be represented and play their part. Our experience with this process in Perry County has been good. The plan is truly a community plan. The state and federal agencies are satisfied with the results.

For more information contact Frank Wideman, Natural Resource Engineer Specialist, University
Management of Over-mature and/or Rain Damaged Hay

The first step in dealing with over-mature or rain damaged hay is forage testing. Forage testing results provide the information needed to accurately balance animal rations. When taking hay samples, be sure to get a core sample and not a grab sample. If possible avoid end bales, also.

Low quality grass hay can be baled and treated with ammonia in a procedure known as “ammoniation.” Ammonia treatment should only be applied to low quality grass hay. Ammonia breaks linkages in the fiber that prevent forage digestion; the result of ammonia treatment is increased fiber digestibility and high energy.

According to research at the University of Missouri, ammonia treatment also degrades ergovaline and other ergot alkaloids produced by the tall fescue endophyte. Ammonia-treated fescue is far less toxic than untreated fescue.

The procedure for ammoniation can be found at the following link: [http://extension.missouri.edu/p/AGW1003](http://extension.missouri.edu/p/AGW1003). Take note that this bulletin shows bales stacked as 2 on the bottom and 1 on top. Some of our producers have stacked 4 on the bottom and 3 on the top. Also, please be aware of that this bulletin does not account for changes in cost of anhydrous ammonia over recent years.

Another option is to provide grain or grain by-product supplements to meet the nutritional needs of the animals. There are lots of good supplemental feed options, but best results require knowledge of forage nutritive value.

Recent work at MU showed that for those with the equipment to do it, treatment with calcium hydroxide or calcium oxide can work. Here is a link to an article from North Dakota State: [https://www.ag.ndsu.edu/news/columns/dairy-focus/dairy-focus-improve-low-quality-forages/](https://www.ag.ndsu.edu/news/columns/dairy-focus/dairy-focus-improve-low-quality-forages/).

Lastly, fertilize cool-season grass hay fields in mid-August. Good quality cool-season grass pastures this autumn can be used to "supplement" poor quality hay. Following a strip grazing program where a few days of grass and a few bales of hay are fed at the same time can stretch the good quality pasture while using some of the hay. Move stock to a new strip of grass and provide a new bale or two when the original hay bales are 80% consumed.

Anthony Ohmes, Agronomy Specialist, University of Missouri Extension, Jackson, MO.
Future Meetings & Events -

**Community Emergency Response** - June 7-9, 2016. Take care of family first, neighborhood next, then the community. Perryville Higher Education Center in Perryville, MO. This is the best way to get your feet wet in emergency preparedness and understanding the emergency management community. 8am - 4pm day one and two, day three 8am - noon.

**MCA All-Breeds Junior Show** - June 10-12, 2016, Missouri State Fairgrounds, Sedalia, MO. Early entry deadline is May 13, 2016.

**Oregon County Fair** - June 17 to 19, 2016. Information and a copy of the fair book can be found on the 4-H website at [http://extension.missouri.edu/oregon/4h.aspx](http://extension.missouri.edu/oregon/4h.aspx) and on the Oregon County Fair facebook page. This will be the first Oregon County Fair in over 20 years.

**Commodities and markets** - [http://extension.missouri.edu/scott/crop-budgets.aspx](http://extension.missouri.edu/scott/crop-budgets.aspx)