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Upcoming Irrigation Workshop

Dec. 10, 2015 (Thursday) – Bismarck Ramkota Hotel

This workshop is held in conjunction with the North Dakota Water Users Association's annual convention held on Dec. 9, 10 and 11. The NDSU Extension Service, North Dakota Irrigation Association and North Dakota Water Users Association sponsor the workshop. The convention will include an irrigation and water products exposition.

Soil Sampling for Salinity or Sodicity in Irrigated Fields

One of the negative effects of irrigation is the concentration of minerals in the soil. The degree to which this occurs is determined by the quality of the irrigation water and type of soil irrigated.

The soil and water compatibility limits for all soil series in North Dakota can be found in Extension publication AE1637, “Compatibility of North Dakota Soils for Irrigation.” All soils are listed in one of three categories: irrigable, conditional or non-irrigable. Most of the soils prone to sodicity and/or salinity are in the conditional category. Some problem soils may be irrigated if certain management recommendations are followed and the soils are tested regularly for salinity and sodicity.

Regular soil testing for salinity and sodicity will determine whether irrigation increases soluble salts and sodium. In general, soil salinity will begin to have noticeable effects on crop yields when the electrical conductivity (EC) of the soil saturation extract is 4 deci-Siemens per meter (dS/m) in the root zone.

When the sodium adsorption ratio (SAR) of the soil saturation extract exceeds 13, soil physical conditions deteriorate and cause significant reductions in crop yields. The goal of regular soil testing is to detect and control salinity and sodicity long before these levels are reached.

The most critical layer of soil that must be monitored is a few inches on the surface. Most plants are least resistant to salinity and sodicity during germination and early growth stages. Soil changes due to irrigation are most likely to occur from the surface downward. The topsoil should be sampled more frequently than soil from deeper layers.

Soluble salts may fluctuate substantially among seasons due to water movement; therefore, taking surface samples during germination and seedling emergence is important. The SAR is a reflection of cation exchange complex, so it is not influenced by seasonal changes in water content. Sample timing for SAR is not as important as for salinity.

Sampling should be done prior to the first year of irrigation so that a baseline is established. Sampling for salinity and sodicity under irrigation is different than soil fertility sampling. The goal is to determine where salts or sodium are increasing in the field and at what rate. Composite sampling that’s done for soil fertility does not accomplish this goal. The field should be sampled on a grid that covers the portion of the field that has soils recommended for regular monitoring in AE1637.

Samples should be taken at no more than 500-foot intervals. The sampling grid should include an unirrigated corner to serve as a control for comparison. The grid should be adjusted so that problem areas, such as low spots or areas next to saline or sodic soils, are identified and monitored. Sample locations should be marked on an aerial photo or with GPS so that soil samples are taken from approximately the same location in subsequent years.

The first year of sampling should include a sample from 0 to 6 inches, 6 to 24 inches and 24 to 36 inches at each of the grid nodes. EC should be determined on the saturated extract of all three depth increments and SAR should be determined on the top two increments. Every three years subsequently, EC and SAR should be determined for the 0- to 6-inch increment and EC should be determined for the 6- to 24-inch increment. Every six years, SAR also should be determined on the 6- to 24 inch increment and EC should be determined on the 24- to 36-inch increment.

Monitoring of irrigated fields consisting mostly of irrigable soils with smaller inclusions of non-irrigable saline or sodic soils may be necessary. Irrigation may contribute to the expansion of salinity or sodicity into the field. Monitoring soils along the
edges of these problem areas using the sampling depth increments and intervals suggested above will help determine the rate of encroachment.

Every irrigated field is unique and soil quality monitoring requirements will vary. Many fields are predominantly irrigable soils that require no monitoring. Only small portions of some fields will require monitoring.

Whatever the situation, including soil monitoring in the planning stages of the irrigation system is important. When the soils in your field are listed as conditional, implementation of regular soil monitoring will help maintain the productivity of the soil.

Reprinted from a Water Spouts article written by Bruce Seelig, former water quality specialist with NDSU Extension.

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Considerations for Reconditioning Too-dry Soybeans and Other Grain

Producers may want to recondition soybeans that were harvested at lower moisture contents to bring the moisture content up to the market standard of 13 percent. On a 40-bushel-per-acre yield, harvesting soybeans at 9 percent moisture content, rather than 13 percent, is equal to 1.8 bushels of lost weight per acre. At $9 per bushel, that is $16.20 per acre.

Just as grain is dried with bin fans, soybeans can be reconditioned by operating fans during periods with the desired air temperature and relative humidity. Reconditioning requires high airflow rates for several weeks using air with an average relative humidity of about 70 percent to recondition soybeans to 13 percent during normal fall temperatures of 30 to 60 F. Be aware that the air will be heated 3 to 5 degrees as it goes through the fan, which reduces the air relative humidity slightly.

A reconditioning zone develops and moves slowly through the bin in the direction of the airflow, which is similar to a drying zone in natural-air drying. Reconditioning occurs the fastest when the airflow rate, cubic feet of airflow per minute per bushel (cfm/bu), is high and the air is warm and humid. It will be the most successful in a drying bin with a fully perforated floor and a fan that can deliver at least 0.75 cfm/bu. Even with this airflow, moving a reconditioning front all the way through the bin probably would take at least a month of fan operation.

Producers need to compare the cost of fan operation with the benefit of marketing at the desired moisture content. To estimate the cost of operating the fan, assume a 1 horsepower fan motor will use 1 kilowatt (kW) of electricity for each hour of operation.

For example, if reconditioning the soybeans takes 30 days of fan operation, that is 7,200 hours. Achieving an airflow rate of 0.75 cfm/bu on a 42-foot-diameter bin filled 20 feet deep with soybeans would require a 15 horsepower fan. The cost to operate the fan, assuming an electricity cost of 10 cents per kilowatt-hour, is $10,800.

Increasing the moisture content from 9 to 13 percent would increase the quantity of soybeans by 1,019 bushels. At a price of $9 per bushel, this is worth $9,171, which is less than the cost of operating the fan in this example. You would need only a 3 hp fan to provide an airflow rate of about 0.25 cfm/bu, but reconditioning the beans would take about 90 days.

If the fan is operated just in periods of very high humidity, such as during fog or when the relative humidity is near 100 percent, the soybeans in part of the bin would be too wet to be stored safely. Mixing the wet layers with dry layers would reduce the spoilage risk and discounts for marketing wet beans. However, stirring increases the bean damage. Emptying the bin and moving the beans through a grain-handling system will provide only limited mixing because the majority of the grain comes from the top of the bin in a funnel shape with a center unloading sump.

A humidistat can operate the fan when the relative humidity will average about 70 percent. Even though the humidity level varies considerably during the day, it will average about 70 percent if the fan is operated for a time when the humidity is 90 percent and for a time when it is 50 percent. Setting the humidistat to operate the fan when the humidity exceeds about 55 percent would be a reasonable starting point. However, the humidity setting would need to be adjusted based on a measured soybean moisture content.

To avoid wetting the beans to moisture levels unsafe for storage, add a second humidistat to stop the fan when the relative humidity reaches very high levels or use a microprocessor-based fan controller that monitors temperature and humidity, and runs the fan only when air conditions will bring the crop to the desired moisture content. A disadvantage of these options is that the fan does not run as many hours. Controlling the fan manually and operating it during the night and a portion of the day, based on the measured humidity, is another option, but fan and moisture control is not as accurate with this method.

### Soybean Equilibrium Moisture Values

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Relative humidity (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td>(F)</td>
<td></td>
</tr>
<tr>
<td>32</td>
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</tr>
<tr>
<td>60</td>
<td>9.2</td>
</tr>
<tr>
<td>70</td>
<td>8.9</td>
</tr>
<tr>
<td>80</td>
<td>8.6</td>
</tr>
</tbody>
</table>

This table indicates the moisture content at which soybeans are safe for storage. A humidistat can be set to operate the fan when the relative humidity reaches the desired level. A microprocessor-based fan controller can monitor temperature and humidity and run the fan only when air conditions will bring the crop to the desired moisture content.
Soybeans expand when they absorb moisture, so a moisture content increase of more than a point or two could create enough pressure to damage the grain bin’s bolted connections or even cause the bin to rupture. The bin warranty may be voided if damage occurs while reconditioning grain.

One way to reduce the pressure is to unload some beans from the bin periodically. Another way to reduce the damage potential is to use a negative pressure system to pull humid air down through the soybeans and remove the soybeans from the top of the bin as they are reconditioned. An additional way to reduce the pressure is to use a vertical-stirring auger to mix the beans periodically. Unfortunately, these methods of reducing pressure have not been well researched and are based on field experience primarily with smaller bins.

For more information about reconditioning, drying, handling and storing soybeans, visit the NDSU Extension Service’s soybean production guide at http://tinyurl.com/ndsusoybeanproduction and NDSU’s grain drying and storage website at http://www.ag.ndsu.edu/graindrying.

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Estimating the Volume of Pumped Water

If you have an irrigation water permit, sometime this winter, you will receive a notice from the North Dakota State Water Commission requesting a report of the quantity of water you pumped for irrigation this past growing season. Here are three methods you can use to determine the volume of pumped water, depending on your equipment.

1. Do you have a working flow meter?
   A working flow meter with a volume totalizer makes filling out the postcard easy to do. The volume totalizer is a counter similar to the odometer in a car. Some meters record the volume in hundreds or thousands of gallons. Determining which one usually is easy because the manufacturer will show zeros on the left of the counter. If the volume totalizer records hundreds of gallons, you will see two extra zeros; if it records thousands of gallons, you will see three zeros.
   If you wrote down the numbers on the volume totalizer at the start of the season, then all you need to do is read the meter again and subtract the numbers to obtain the volume pumped. You can report water use in gallons or acre-feet. Just remember, an acre-foot of water covers an acre 1 foot deep in water and is equal to 325,800 gallons. An acre-inch is equal to 27,150 gallons.

2. Do you have an hour meter on a center pivot or pump?
   For a center pivot system, you can estimate of the quantity of pumped water using the hour meter in the pivot control panel. However, you need to have written down the hour-meter reading at the beginning of the growing season or the end of last season. Subtract the current reading from the previous reading to get the number of hours the pivot operated this year.
   You then need to know the approximate flow rate to your center pivot. This can be obtained from the center pivot sprinkler chart. Now that you know the flow rate, use the following formula to calculate the acre-feet of water that was pumped:
   \( \text{Volume pumped} = \text{(hours of operation)} \times \frac{\text{gallons per minute}}{5,430} \)
   For example, say your center pivot ran for 895 hours and the sprinkler flow rate is 800 gallons per minute, then the volume pumped is approximately:
   \( \frac{(895 \times 800)}{5430} = 131.9 \text{ acre-feet} \)
   You also can use this method if you have a diesel or gasoline engine with an hour meter or an hour meter in the pump electrical control panel and know the average flow rate being pumped.

3. No water meter or hour meter?
   If this is the case, estimating the volume pumped will be difficult. However, for electrically driven water pumps, you can obtain an estimate of the number of hours of operation using the electric meter. Modern electric meters not only record the total energy use in kilowatt-hours (kWh) but also other parameters such as peak kWh and average kW use.
   You can estimate total hours the pump was operated by dividing the total kWh used during the growing season by the average kilowatt load while pumping. The seasonal total and average electric draw for each meter can be obtained from your electrical supplier.
   For example, if you call the electric utility and it reports that your pumping plant used a total of 43,937 kWh this summer and that the average pumping load was 43 kW. Then, dividing 43,937 kWh by 43 kW shows the pump operated for 1,021.8 hours.
   Again, you need an estimate of the flow rate to calculate the total volume used. The calculated hours will be correct, even if the meter is recording the electricity used by the pump and center pivot or if it is recording electrical use of just the pump. The extra electrical load of the center pivot is recorded in the average draw and the total, so it doesn’t affect the calculated hours of operation.

Estimating the volume of pumped water becomes very difficult where irrigation systems have one pump that supplies multiple pivots or multiple wells that supply a single or multiple center pivots. If you have difficulty estimating pumped water volume, consider installing a flow meter, or if you have a center pivot, write down the reading on the hour meter.

Other ways of estimating the volume of pumped water from electrical use are available, but they involve a few more calculations. Contact me if you have questions.

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