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water spouts

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Irrigation Workshop in Bismarck, Thursday, Dec. 9

Unlike last year's virtual irrigation workshop, this year, the irrigation workshop will be conducted in person at the Best Western Ramkota Hotel as part of the North Dakota Water User Association's annual convention. NDSU Extension, the North Dakota Irrigation Association and the North Dakota Water Users Association sponsor the workshop. The convention will include an irrigation and water products exposition. More information about the workshop will be in the October issue of *Water Spouts*.

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NDAWN Web-Based Irrigation Scheduling App is No Longer Available

Due to old and obsolete software, the site-specific, web-based irrigation scheduling program that is part of the North Dakota Agricultural Weather Network (NDAWN) website *(http://ndawn.ndsu.nodak.edu/)* will be discontinued and unavailable for the 2022 growing season. This application was developed in 2007, and over the years, the software that was used to build it has changed considerably. Much of the open-source software is not supported anymore. It could be updated but would take a considerable amount of programming time that is not currently available within the NDAWN team.

We still have two other irrigation-scheduling tools for your use online at *http://www.ag.ndsu.edu/irrigation/irrigation-scheduling*.

1. Extension publication AE792, "Irrigation Scheduling by the Checkbook Method," explains the basics of the checkbook method of irrigation scheduling. The downloadable PDF provides forms to manually enter information for irrigation scheduling.
2. A downloadable Excel spreadsheet with accompanying user guide provides automatic calculations using the checkbook method.

In addition, the crop water use tables on the NDAWN site still will be available for the 10 most-irrigated crops in North Dakota. During the growing season, this application calculates the estimated daily crop water use for each station in the NDAWN system using the data collected from that station. The estimates are updated automatically each day during the growing season. This makes the crop water use estimates site-specific to the geographic area where the station is located.

Using one of these methods will provide guidance for when to irrigate and how much to apply.

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Drought and Center Pivot Sprinkler Packages

This year we have been experiencing a drought in many parts of the state. During a drought, the irrigation system is used more often, and the crops are more reliant on irrigation water than rain. During growing seasons with normal or excess rain, many sprinkler problems are "covered up," and effects of poor water placement in the field are not readily apparent. However, during droughts, sprinkler application problems become quite noticeable, especially on a center pivot.

Some of the more common mechanical problems associated with non-uniform water application under sprinkler systems are a change in the nozzle diameter due to wear, plugged or partially plugged nozzles, sprinklers not rotating properly, pump wear causing a reduction in pressure or flow rate or both, and leaks in the piping. Often, poor water uniformity can be seen in aerial pictures as different colored circles in the field, or lower yields are noticed on combines with yield monitors.

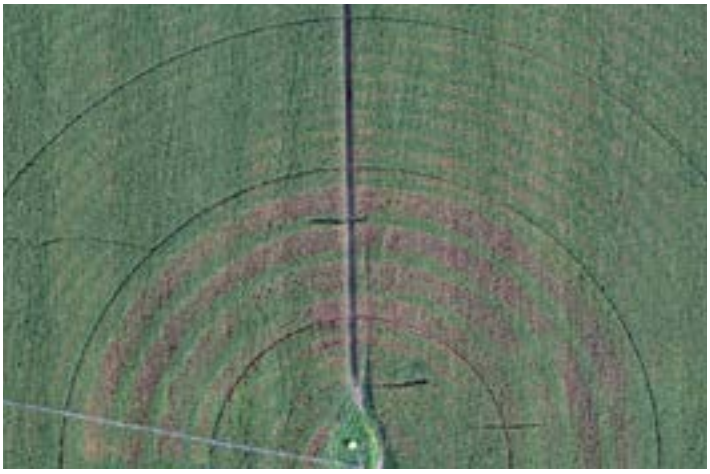
Sprinkler irrigation systems throw water through the air, which makes them susceptible to the vagaries of wind and weather. Ideally, a sprinkler system should apply the same amount of water to every square foot of field surface. However, this does not happen because of the wind, topography and weather, and also because of mechanical problems. We can't do much about the weather, but we can make sure mechanical problems are not affecting the application uniformity of the sprinkler system.

The average application amount of a sprinkler system can be calculated if you know the area of coverage, the duration of water application, the application efficiency and the flow rate. For example, **Table 1** shows the average depth of application in inches for a pivot with different times of rotation and flow rates.

The calculations were made using an application efficiency of 85% and 128 acres of irrigated coverage. The application efficiency is the ratio of the volume of water that actually gets into the soil for plant use

Table 1. Average application amounts in inches for a 128-acre pivot with an application efficiency of 85%.

Hours for One Rotation	Flow Rate (gallons per minute)					
	500	600	700	800	900	1000
	Applied amount in inches					
10	0.07	0.09	0.10	0.12	0.13	0.15
15	0.11	0.13	0.15	0.18	0.20	0.22
20	0.15	0.18	0.21	0.23	0.26	0.29
25	0.18	0.22	0.26	0.29	0.33	0.37
30	0.22	0.26	0.31	0.35	0.40	0.44
35	0.26	0.31	0.36	0.41	0.46	0.51
40	0.29	0.35	0.41	0.47	0.53	0.59
45	0.33	0.40	0.46	0.53	0.59	0.66
50	0.37	0.44	0.51	0.59	0.66	0.73
55	0.40	0.48	0.56	0.65	0.73	0.81
60	0.44	0.53	0.62	0.70	0.79	0.88
65	0.48	0.57	0.67	0.76	0.86	0.95
70	0.51	0.62	0.72	0.82	0.92	1.03
75	0.55	0.66	0.77	0.88	0.99	1.10
80	0.59	0.70	0.82	0.94	1.06	1.17
85	0.62	0.75	0.87	1.00	1.12	1.25
90	0.66	0.79	0.92	1.06	1.19	1.32
95	0.70	0.84	0.98	1.12	1.25	1.39
100	0.73	0.88	1.03	1.17	1.32	1.47



Aerial image of a center pivot showing streaks where the sprinklers are partially plugged near the pivot point.

(Drone operated photo by Paolo Flores, ABEN Precision Ag)

to the volume of water that is pumped. An application efficiency of 85% was selected based on research showing that this was a representative value for most irrigation events. However, weather conditions during the day can affect this value significantly. At night and into the morning, when the wind speed is very low, the application efficiency might be more than 90% for a pivot. But by mid-afternoon, when the air temperature is high, the relative humidity is low and the wind is greater than 15 miles per hour, the application efficiency might drop to below 50%. Therefore, the average application amount is the ideal amount that we want applied to every square foot of the surface of the field, assuming that the mechanical aspects of the sprinkler system are not creating any problems.

The easiest way to identify malfunctioning sprinklers or find leaks is to walk the length of the center pivot and observe each sprinkler head and tower. Most of the time, the worst mechanical problems are easy to see. If you want to see the actual uniformity of water application under a center pivot sprinkler system, do a "can test" (see the next article about a video showing a can test). The test involves putting containers (cans), which are identical and have an opening diameter greater than three inches, under the sprinkler system in a set pattern. While the system is running, the flow rate, pressure and area of coverage of the center pivot are measured. For moving systems, such as travelling big guns and pivots, the cans are put out in one or more lines that are perpendicular to the direction of movement of the system. Along the lines, the cans are equally spaced, typically 10 feet to match the sprinkler spacing on new pivots.

After the center pivot system passes over the cans, the catch in each can is measured and recorded. Then they are totaled, and the average catch amount is determined.

The individual can amount is then compared with the calculated average depth. Catch amounts with a large variation from the average will often identify sprinkler application problems. If you are chemigating through a pivot, the uniformity of application can have a significant effect on how much benefit is derived from the chemical as well as the water.

Frequently, irrigators judge application depth based on a single rain gauge either near the end of the pivot or near the pivot point. Neither of these locations is desirable. A mini can test may be performed by using 14 to 18 identical containers. Plastic cups available in grocery stores make good "cans." For a typical eight- to 10-tower pivot, two catch cans should be located under each span starting with the second span from the pivot point. The cans should be located at random places between the towers, but not too close to the tower. Stay at least 10 feet from the tower. To continually monitor the application amounts of the pivot, the cans could be left in place throughout the growing season.

If your sprinkler package is more than five years old, and you have noticed problems in variable yield or seen rings on aerial pictures of the field, this winter would be a good time to visit an irrigation dealer to look at updating the sprinkler package. It will pay big dividends if the drought continues into next year.

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Video on Center Pivot Sprinkler Uniformity

The sprinklers on a center pivot are the most important part of the irrigation system but are sometimes the least understood by irrigators. The set of sprinklers on a pivot are called the sprinkler package. A quarter section center pivot will often have more than 100 sprinkler heads. As you move farther from the pivot point, the area irrigated increases for each sprinkler thus the diameter of the nozzle in each sprinkler becomes larger.

There are many different designs of sprinkler heads, some have moving parts like impact sprinklers and some have no moving parts like spray heads. They all have one thing in common, a nozzle. Over the years, the nozzle can become worn due to particulates in the water or due to age. Also, the nozzle can become partially plugged due to corrosion or the sprinkler head can become damaged. Many sprinkler packages on center pivots have pressure regulators for each sprinkler head. This is another item that can develop leaks or become plugged.

A properly designed and installed sprinkler package will apply water uniformly over the entire length of the pivot. If you have installed a variable rate sprinkler package, uniformity becomes even more important.

Each growing season the possibility of worn or plugged nozzles, poorly-working pressure regulators, damaged sprinkler heads or leaks increases. These will affect the water application uniformity. Therefore, if your sprinkler package has been in place more than five years, it is time to check the water application uniformity.

NDSU Extension has created a video to show you how a typical sprinkler uniformity test is conducted for a center pivot sprinkler system. The video is available by searching "NDSU Extension sprinkler" on YouTube. The NDSU video will be at or near the top of the list. If you would like to request a DVD copy of the video, send me an email or a note by regular mail with your name and mailing address.

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Pressure Gage and Flow Meter

During drought conditions, flow from wells and surface water bodies can vary throughout the growing season. These fluctuations usually show up as a change in flow rate and/or a drop in pressure. To manage irrigation water during a drought, accurate measurements of flow and pressure can become critical information.

The day-to-day indicators of irrigation system performance are an accurate flow meter and pressure gage(s). The performance of irrigation systems that use wells for their water supply can vary during the growing season. Recording the pressure and flow readings will indicate how much the performance may change.

However, flow meters appear to be equipment that many irrigators do not use or repair, and constantly overlook when managing their irrigation systems. Over the years, I've conducted pumping plant efficiency tests on many irrigation systems, and it is common to find pumping plants where one was never installed. Or it was installed but is not working. North Dakota winters are hard on flow meters, and the freeze/thaw cycles quickly cause the bearings and other moving parts to wear out. This also is true for the other parts of the irrigation system. If this drought continues, it is time to either repair the old flow meter (if that is possible) or purchase a new flow meter.

An accurate, working flow meter provides very valuable irrigation management information.

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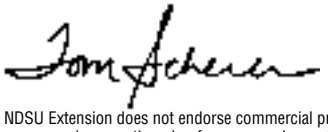

Accurate flow measurement is important for chemigation, selection and modification of sprinkler nozzles, calculating the application rate of the pivot, checking the production of the well and tracking the performance of the pump. However, the most important reason for an accurate flow meter is that it records the amount of water pumped during the growing season. This is necessary for reporting to the North Dakota State Water Commission.

It is not uncommon for some irrigation wells to be valved-back due to seasonal changes in aquifer levels. When the well is valved-back, without a flow meter there is no way to measure how much water is being applied to the crop.

If your flow meter is working properly, to maintain its accuracy, consider removing it this fall and storing it in a warm place for the winter. During fall maintenance, an extra 15 minutes to remove the flow meter and cover the hole in the pipe is worthwhile.

Pressure Gages

The pressure gage is an often overlooked and neglected instrument on many irrigation systems. Yet, it is probably the most important indicator of irrigation pump operation readily available to you. Every time you turn the pump on, the pressure gage receives a "shot" due to pressure fluctuations from filling the pipeline. In addition to the bounce at turn on, while the pump is operating there are often pressure fluctuations and vibrations. Because of these conditions, pressure gages (even liquid-filled types) lose their accuracy after a couple of growing seasons.

If your pressure gages are old and you question their accuracy, this winter would be a good time to purchase new ones to install next spring. Many center pivots have a pressure transducer connected to the control box. The pressure is displayed in the panel along with other operations parameters. Having an accurate pressure gage at the pivot point provides a check on the accuracy of the pressure transducer.

Since a pressure gage only conveys useful information when you are looking at it, why not install a shut-off valve between the gage and the pipeline. When you want to check the pressure, just open the valve. This will extend the life of the pressure gage and ensure you are getting accurate readings. Plus, it makes it easy to remove the pressure gage at the end of the season.

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