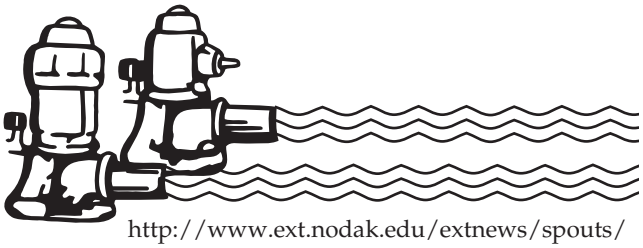

water spouts

http://www.ext.nodak.edu/extnews/spouts/

No. 223 JULY 2006

Upcoming NDSU Field Days and other Crop Related Events

- **Minot – Pulse Crops Day** July 11 (701) 857-7677
  North Central Research Extension Center
- **Hettinger** July 12 (701) 567-4323
  Research Extension Center
- **Dickinson** July 13 (701) 483-2348
  Research Extension Center
- **Outlook, Saskatchewan** July 13 (306) 867-5400
  Canada-Saskatchewan
  Irrigation Diversification Centre
- **Williston** July 14 (701) 774-4315
  Research Extension Center
- **Casselton** July 17 (701) 347-4743
  Agronomy Seed Farm
- **Carrington** July 18 (701) 652-2951
  Research Extension Center
- **Minot** July 19 (701) 857-7677
  North Central Research Extension Center
- **Langdon** July 20 (701) 256-2582
  Research Extension Center
- **Sidney, Montana** July 20 (406) 482-2208
  USDA/ARS Northern Plains Ag Research Lab
- **Mandan** July 20 (701) 663-6445
  USDA/ARS Northern Great Plains Research Lab
- **Oakes** Aug. 2 (701) 742-2189
  Irrigation Research Site
  4 miles south of Oakes on Highway 11
- **Tappen** Aug. 10 (218) 773-3633
  Irrigated Potato Field Day
  I-94, Pettibone exit, north side
- **Staples, Minnesota** Aug. 10 (320) 589-1711
  High Tunnel Vegetable Production (2 to 8 p.m.)
  Central Lakes Agriculture Center
- **Verndale, Minnesota** Aug. 11 (218) 385-3000
  Irrigated Rotational Dairy Pasture (10 a.m. to noon)
  A center pivot with 150 cows located north of Verndale

Oakes Irrigation Research Site Field Day

The NDSU Oakes Irrigation Research Site will conduct its annual Field Day on Aug. 2, at the site 4.5 miles south of Oakes on North Dakota Highway 1. Refreshments and rolls will be served at 9 a.m., with the tour beginning at 9:30 a.m. Joel Ransom, NDSU Extension Service, will discuss corn hybrids in 30-inch rows, 30-inch paired rows and 15-inch rows at three populations. Soybeans in 30-inch, 30-inch paired, and 20- and 10-inch rows at three populations will be compared by Duane Berglund, NDSU Extension Service. Onion variety and onion weed control experiments will be presented by Paul Hendrickson, Carrington Research Extension Center, and Jim Loken, NDSU graduate student. Walt Albus, NDSU Oakes Irrigation Research Site, will discuss a strip-till continuous corn study. Visitors also will view an inoculation study in edible dry beans and soybeans and a sclerotinia study in sunflowers.

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Oakes Irrigation Research Site Supervisor
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Irrigated Potato Field Day at Tappen

The Northern Plains Potato Growers Association will be hosting its annual Irrigated Potato Field Day at the irrigation research site three miles east of Tappen on Thursday, Aug. 10, from 9 a.m. to noon. The research site is on the north side of I-94 at the Pettibone exit. At noon, the Potato Associates will host a lunch.

A tour of research and demonstration plots will include Gary Secor and Neil Gudmestad talking about potato disease trials, Susie Thompson talking about variety trials and Harlene Hatterman-Valenti talking about herbicide trials and potato agronomic trials, including hill configuration, irrigation and fertility.

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Plant Pathologist
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Tour of High-tunnel Vegetable Production Systems

High tunnels are a type of low-cost greenhouse that allows early planting of vegetables and results in earlier production. A tour of high-tunnel systems featuring tomatoes, cucumbers and peppers planted April 25 will be held at the Central Lakes Ag Center in Staples, Minn., on Aug. 10. The tours will take place between 2 and 8 p.m. Contact Jerry Wright, University of Minnesota Extension Service in Morris, at (320) 589-1711 or e-mail at jwright@umn.edu.

NDSU Extension Service
North Dakota State University

Tour of Irrigated Dairy Pasture for Rotational Grazing

Irrigated rotational grazing systems are of great interest to many dairy and beef producers. A tour of a dairy operation that rotational grazes 150 cows under a standard quarter-section center pivot will take place from 10 a.m. to noon on Aug. 11. The farm is north of Verndale, Minn., (about 100 miles east of Fargo on U.S. Highway 10). Contact Vince Crary, Otter Tail County Extension educator, at (218) 385-3000 or e-mail at vcrary@co.otter-tail.mn.us.

Missouri Slope Irrigation Development Association (MSIDA) Annual Tour

The annual MSIDA irrigation tour will be Monday, July 10, and hosted by Allen Wahl of Central Irrigation and Excavating in Bismarck. The destination will be irrigation developments along the Missouri River, west of Hazelton, to view irrigated alfalfa, innovative pumping schemes, irrigated potatoes and novel center pivot sprinkler types to reduce erosion and runoff. The event is free of charge. The tour will begin at 2 p.m. at the Sid Nelson farm, about 35 miles south of Bismarck on North Dakota Highway 1804 (just north of the boat dock). Look for the Nelson Farm sign. For people who want to carpool, meet at Kist Livestock in Mandan at 1 p.m. A pitchfork fondue will start at 6 p.m. For more information, call Wahl at (701) 258 3928 or Kenny Miller at (701) 250-4518, ext 3.

Irrigation Day at the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)

The CSIDC, 901 McKenzie St. S., Outlook, Sask., will have its Irrigation Day on Thursday, July 13. Events will include a trade show and field tours (9 a.m., 11:15 a.m. and 1:30 p.m.), presentations and a haying demonstration. Highlights include specialty and field crops; irrigation systems, including a solar-powered pivot; season extension of warm season crops; and potential irrigation expansion in Saskatchewan. Admission is free. For more information, call (306) 867-5400 or visit the center's Web site at *www.agr.gc.ca/pfra/csidc/csidc.htm* .

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Irrigating Corn

To achieve maximum yield potential, corn needs between 18 and 22 inches of soil moisture during the growing season. This amount must be supplied by stored soil moisture, rain and irrigation. Assuming normal rain amounts, irrigated corn will produce 8 to 14 bushels of grain corn and 1.25 to 1.75 tons of silage for each additional inch of applied water during July and August. Generally the farther west, the better the yield returns per inch of water. Corn variety and maturity length will affect seasonal water use. For example, water use for 95-day corn will be greater than for 80-day corn.

The water that evaporates from the soil near a corn plant, plus the soil water used by the corn, is called evapotranspiration (ET) or simply water use. The frequency and amount of irrigation depends on the growth stage of the corn (which determines the daily water use), the water-holding capacity of the soil in the root zone and the prevailing weather conditions.

Corn Root Depth and Water Use

Corn is a relatively deep-rooted crop. Typically, in deep soils with no compaction zones, roots grow laterally 12 to 18 inches from the stalk and downward to a depth of 4 feet or more. About 90 percent of the roots will be found in the top 3 feet, which is considered the effective rooting depth for irrigation purposes. During the course of a growing season, about 40 percent of the water corn uses will come from the first foot of soil, 30 percent from the second foot and 20 percent from the third foot. Less than 10 percent will be obtained from the soil below 3 feet.

Average corn water use will increase from about 0.03 inch per day soon after emergence to more than 0.27 inch per day during ear formation (Figure 1). However, during July and August, hot, windy days can push water use to more than 0.35 inch per day. The water use is given as a depth measurement because it is assumed corn removes soil water from under every square foot of soil surface in the field.

Water-holding Capacities of Soil

The depth and water-holding capacity of soil has a great influence over when and how often irrigations are required. Soil texture determines the amount of available water it will hold (Table 1). Note that the greater the water-holding capacity of the soil in the root zone, the less frequent the irrigations should be (assuming normal rainfall amounts). Producers need to know the soil texture and water-holding capacity of the dominant soil type in a field and use that information for making irrigation decisions.

Irrigation Water Management

Producers should have a soil profile that is near field capacity at planting. Most years, this will happen naturally due to rain in late fall, winter snow and spring rain. Less than a full soil moisture profile to a depth of at least 3 feet at planting could hinder root development later in the season. Also, stored soil moisture in the root zone serves as a supplement during high water use periods. If deep soil moisture is lacking at the beginning of the season, starting to irrigate earlier may be necessary to refill the root zone before the high water use period of July and August.

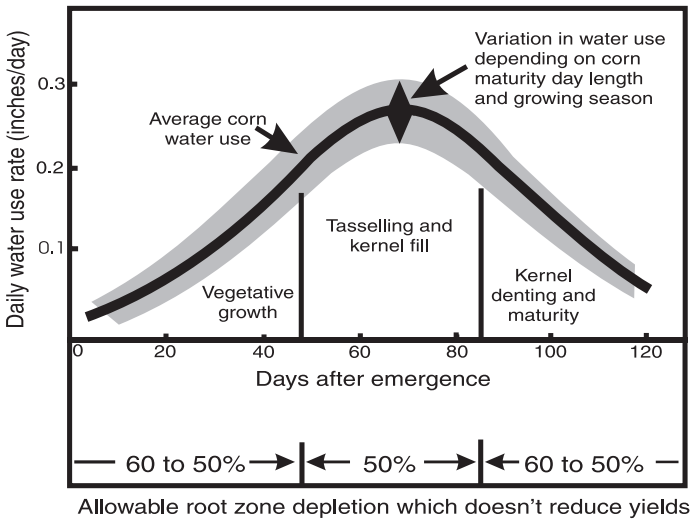

Figure 1. Corn water use and soil moisture management criteria.

Table 1. Plant available soil water holding capacities for various soil textural classifications.

Soil Texture	Available Moisture	
	Inches/Inch	Inches/Foot
Coarse sand and gravel	0.02 to 0.06	0.2 to 0.7
Sand	0.04 to 0.09	0.5 to 1.1
Loamy sand	0.06 to 0.12	0.7 to 1.4
Sandy loam	0.11 to 0.15	1.3 to 1.8
Fine sandy loam	0.14 to 0.18	1.7 to 2.2
Loam and silt loam	0.17 to 0.23	2.0 to 2.8
Clay loam and silty clay loam	0.14 to 0.21	1.7 to 2.5
Silty clay and clay	0.13 to 0.18	1.6 to 2.2

From emergence to the onset of tassels (about 40 days), corn is relatively drought tolerant. It can withstand up to 60 percent soil water depletion in the root zone without a significant impact on yields (Figure 1). In fact, corn should be stressed early in the season on deep soils to force full root zone development. However, from the onset of tasseling to the blister kernel stage (40 to 80 days after emergence), soil moisture levels in the root zone should not be depleted more than 50 percent to achieve maximum yields. After blister kernel development, corn again can withstand 60 percent soil water depletion without much impact on yields.

The period of greatest water stress sensitivity coincides with the time of highest water use demand (July and August). Corn water use will average around 7 to 8 inches in July and 6 to 7 inches in August. With temperatures in the 80s, corn will use about 1.75 inches per week (net). Temperatures in the 90s will increase the water demand to around 2.1 inches per week (net).

Irrigators using center pivots must be more vigilant than irrigators with surface (gravity) irrigation systems. Most center pivots are set to apply from 0.5 to 1 inch of water per revolution. For a center pivot system covering 128 acres with 800 gallons per minute (gpm) of capacity, putting on 1 inch (net) of irrigation water will take about three days. Therefore, when the corn begins to tassel, monitoring the soil moisture profile frequently is critical, or keeping up with corn water use during periods of high temperatures and wind may be difficult. Scheduling of irrigations during these periods is extremely important.

Corn planted on deep soils where the full 3-foot root zone can develop should receive at least 1 inch (net) of water each irrigation event during July and August.

Corn planted on shallow soils (18 to 24 inches of top soil) underlain by coarse sand and gravel can pose irrigation management problems. The roots will be concentrated only where there is topsoil, thus this becomes the management root zone. A shallow root zone means less water is available. For this situation, applying less water (0.5 to 0.8 inches) more frequently would produce better results than applying a larger amount less frequently.

For corn grain, the last irrigation of the season is determined by the maturity of the corn kernels. Corn should be irrigated until sufficient soil moisture is available to ensure the milk layer in the kernel moves down to the tip of the kernel or black layer formation. This generally occurs about 55 days after 75 percent of the plants have visible silks on the ears. Yellow dent corn usually is well-dented at maturity.

Irrigation Scheduling

Determining when to start and stop an irrigation system is a very important part of water management. Since irrigation is used to supplement rain, having at least two rain gauges for each irrigated field is extremely important with center pivots. The gauges should be on opposite sides of the field to provide an accurate estimate of the amount received over the entire field. They should be located so they measure only rain, not applied irrigation water. Additional rain gauges should be placed under the last two spans of the center pivot to measure irrigation application amounts.

Soil in the root zone is the reservoir that stores the water for use by corn. Soil moisture levels in the root zone determine the criteria for when to start and stop irrigations. Several soil moisture monitoring tools are available to determine the soil moisture level at a particular time, place and depth in a field.

Direct soil moisture measurement can be done several ways. The "soil feel" method is the most widely used. It involves using a soil probe to obtain a soil sample from a certain depth in the root zone, then determining the amount of soil moisture by squeezing the soil in the palm of your hand. For corn, soil samples should be checked at 1 and 2 feet below the soil surface. Using the soil feel method requires considerable experience with

Table 2. Average corn water use based on maximum daily air temperature, week after emergence and growth stage (inches/day).

Week After Emergence	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Date																	
Maxmimum Temperature																	
50 to 59 °F	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.06	0.04	0.03
60 to 69 °F	0.02	0.03	0.05	0.06	0.08	0.10	0.12	0.14	0.14	0.13	0.13	0.13	0.12	0.11	0.09	0.07	0.06
70 to 79 °F	0.03	0.04	0.06	0.09	0.12	0.14	0.17	0.19	0.19	0.19	0.18	0.17	0.17	0.16	0.13	0.10	0.08
80 to 89 °F	0.04	0.06	0.08	0.11	0.15	0.19	0.22	0.24	0.25	0.24	0.23	0.22	0.21	0.20	0.17	0.13	0.10
90 to 99 °F	0.05	0.07	0.10	0.14	0.18	0.23	0.27	0.30	0.30	0.29	0.29	0.27	0.26	0.25	0.20	0.16	0.12

3 Leaf — 12 Leaf — Tassel — Silk — Pollinate — Blister Kernel — Early Dent — Dent — Black Layer

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a variety of soil textures. For those unfamiliar with the feel method, a complete description, including photos, can be found on the Internet at *www.oneplan.org/Water/soil-moisture1.shtml* .

Soil moisture also can be measured with mechanical devices such as tensiometers and soil moisture blocks. Either reading a gauge or using a hand-held meter determines the amount of soil moisture. When these are used, one or more of the devices are buried at different levels in the root zone and at several locations in the field. For corn, each soil moisture monitoring location should have two sensors, one buried at 1 foot and the other buried at 2 feet below the soil surface. These devices only indicate the soil moisture status at that particular location. Electronic devices that measure soil moisture levels based on the changes in measurable electrical properties of the soil also are available.

Using just soil moisture measurement for irrigation scheduling can create more work during the growing season for the irrigation manager. Soil moisture measurements must be made at regular intervals, two or three times a week, and at several locations in the field. The best way to use the measurements is to plot them on a graph so you can see the change in soil moisture. Sampling the most common soil types in the field is important. Consulting the county soil survey will show where these soils are in the field.

Another form of irrigation scheduling is to use estimated water use values for corn. This method, sometimes called the "water use replacement method," is based on obtaining daily estimates of corn water use and accurately measuring the amount of rain received on the field. Irrigations are scheduled to replace the amount of soil moisture the corn used, minus the amount of rain received since the last irrigation. Many irrigators with gravity systems use this method. Estimates of water use for corn can be obtained several ways. Table 2 provides corn water use for the season based on weeks past emergence and maximum daily temperature. More accurate corn water use values, based on measured weather variables from the North Dakota Agricultural Weather Network (NDAWN), are available during the growing season at this Web address: *http://ndawn.ndsu.nodak.edu/applications.html* .

The best choice of tools for irrigation scheduling is one that uses in-field soil moisture measurement and daily crop water use values. This method, called the "checkbook" method, also has been used successfully for many years in North Dakota. The checkbook method is a soil moisture accounting method that uses daily corn water use values and the soil water-holding capacity to predict the time and amount of water needed to replenish what has been removed from the root zone since the last irrigation or rain. A publication, AE-792, "Irrigation Scheduling by the Checkbook Method," is available from any county Extension office in North Dakota. A computerized version of the checkbook method can be obtained for $30 by calling (701) 231-7261.

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