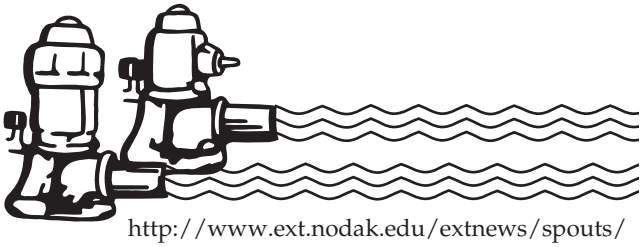
NDSU EXTENSION SERVICE



water spouts

No. 208 MAY 2004

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

Welcome to a New Irrigation Season

Last year in the October issue of *Water Spouts*, we included an insert asking you to update and correct our mail list. We gave you the option of one of the following: continuing to receive a printed copy in the mail, receive an e-mail with a copy of *Water Spouts* attached in PDF format or view the current as well as past copies on the Water Spouts Web site at *www.ext.nodak.edu/extnews/spouts/* .

Thanks to your response, we have pared down our mail list considerably and established an e-mail list. We will continue to send printed copies to all the county extension offices and NDSU Research Extension centers.

If you forgot to send in the form last fall and want to receive a printed or e-mail copy of Water Spouts, you can call (701) 231-7238 or send an e-mail to *dmcdonou@ndsuext.nodak.edu*.

North Dakota Irrigation Caucus is now the North Dakota Irrigation Association

Recently, the North Dakota Irrigation Caucus merged with the High Value Irrigation Crops Task Force (HVICTF) to form the North Dakota Irrigation Association. The purpose of the N.D. Irrigation Association is to strengthen and expand irrigation to build and diversify the state's economy. The association will continue the work of the HVICTF whose purpose has always been to pursue high-value crop alternatives in central North Dakota. Three members from the board of directors of the HVICTF will be on the board of directors of the new N.D. Irrigation Association until new directors are selected for the combined organizations.

Tom Scherer (701) 231-7239
Extension Agricultural Engineer
tscherer@ndsuext.nodak.edu

Crop Production Information on the Web

With all the disease and pest problems that plague crop production, finding helpful information sources is sometimes difficult. To help you better manage your crops, NDSU provides a variety of up-to-date information on the Web. Some new and revised publications you will find useful:

- W-253 2004 North Dakota Weed Control Guide
- PP-622 2003 Field Crop Fungicide Guide
- A-250 Soybean Production
- E-1143 North Dakota Crop Insect Management Guide for 2004

These publications, along with many others, can be found at: ***www.ext.nodak.edu/extpubs***

Other published information that could be useful:

2003 Variety Performance Information
www.ag.ndsu.nodak.edu/aginfo/variety/

Row Crops and Oilseeds
www.ag.ndsu.nodak.edu/plantsci/rowcrops/main.htm
(includes sunflower, soybeans, canola, corn and dry edible beans)

Small Grains Information
www.ag.ndsu.nodak.edu/aginfo/smgrains/

NDSU Research Extension Centers
www.ag.ndsu.nodak.edu/recenthp.htm

USDA-ND Ag Statistics Service
www.nass.usda.gov/nd

NDSU Extension Biotechnology Info
www.ag.ndsu.nodak.edu/biotech/

NDAWN Weather Information
www.ndawn.ndsu.nodak.edu

Soybean production field guide available

NDSU Extension Service publication A-1172 is now available in both pocket guide hard copy and on the NDSU Extension Service Web site: *www.ag.ndsu.nodak.edu/plantsci/rowcrops/soyall.htm* .

This site has numerous links to soybean information. The hard copy of the pocket guide can be obtained by contacting the NDSU Distribution Center at (701) 231-7882 or the N.D. Soybean Office at (701) 888-469-6409.

This field guide has been developed to assist with timely management decisions. However, extensive details on any one area are not provided because of limited space. More detailed and complete discussions of soil fertility, weed, disease, and insect control, variety performance, harvesting and storage are available in other Extension circulars as listed in the back pages.

The pesticide use suggestions in this guide are based on federal label clearances and on some state labels in North Dakota. Also suggestions are based on research information collected in North Dakota State University trials or trials in other states. All pesticides listed had a federal or state label at the time of this publication. Check all pesticide labels at time of use for the most current label registration.

Modern technology, fluctuating export markets, changing USDA farm policies, and environmental regulations all contribute to soybean growers' needs for careful planning and management to assure high yields and profitable production.

The printing of the Soybean Production Field Guide was made possible by a grant received from the North Dakota Soybean Council.

Duane Berglund (701) 231-8135
NDSU Extension Agronomist
dberglun@ndsuext.nodak.edu

Soil Moisture – An Important Part of Irrigation Water Management (Part 1)

The soil in the root zone provides storage for nutrients and water that plants need for growth and development. Monitoring soil moisture amounts in the root zone is a very important part of irrigation scheduling. Not only does monitoring soil moisture indicate when to irrigate, but also the amount to apply.

Measuring soil moisture accurately has always been difficult. The makeup of soil and the way it interacts with water poses many problems. Soil is composed of grains of minerals that can vary in size from less than 8/10,000 of an inch (0.002 millimeter) to over 1/32 of an inch (1 millimeter) and that are all mixed together. Mixed in with the grains are pieces of organic matter (old roots, crop residue, manure, etc.) that act like sponges and can make up from 0.5 to 6 percent of the soil volume in the root zone. Add water to this mixture, either in liquid or vapor form, and you can appreciate why it's difficult to measure soil moisture.

Basic soil moisture concepts

Soil moisture is commonly expressed as *soil water content* or *soil water potential.*

Soil water content

The amount of water in a volume of soil is often expressed as either the percent water by weight, percent water by volume or by the inches of water per foot of soil.

The percent water by weight is determined by obtaining a soil sample, weighing it, then drying the sample in an oven (at 220 degrees F) for 24 hours and weighing it again when it's dry. The weight of water in the sample is the difference between the wet weight and the dry weight of the soil sample. Divide this amount by the dry weight and multiply by 100 to get the percent water content by weight.

The percent water by volume, a more useful value for irrigation design and management, is obtained by multiplying the percent water content by weight by the bulk density of the soil. The bulk density of the soil is the ratio between the dry weight of a soil sample and the volume of the soil sample with units of grams per cubic centimeter (g/cm^3). Agricultural soils can have bulk densities that range from 1.2 to 1.6 g/cm^3.

Soil water potential

How tightly water is held by soil particles and organic matter is a measure of the soil water potential. Soil tension is another term often used to describe soil water potential. Soil tension is a measure of how hard it is for a plant's roots to pull water away from the soil particles. Wet soil gives up water easily and has a low value of tension. Dry soil holds water very tightly because it's bound to the surface of the soil particles and has a high tension. For irrigation purposes, the amount of water available for plant use is the difference between the soil "field capacity" and the "wilting point."

Field capacity is the moisture content where soil holds water against the force of gravity. This is the moisture content where many of the large-pore spaces between soil particles will drain but many of the small-pore spaces will be full of water. For most irrigated soils in North Dakota, field capacity is the water content at a soil water tension of 1/10 of a bar (1 bar is almost atmospheric pressure and is equal to 14.5 pounds per square inch).

Wilting point is where most agricultural crops experience permanent wilting and will not recover. It is the soil water content at a soil water tension of 15 bars.

Subtracting the water content by volume at the wilting point from the water content by volume at field capacity and multiplying the difference by 12 will give you the "inches per foot" of available water for plants (Table 1).

However, not all the available water is easily obtained. For irrigation management, we commonly assume that only 50 percent is readily available for plant use. If the amount of water is depleted by more than 50 percent, the plants will experience water stress. If it happens during the critical growth stage of fruiting, yield potential can be affected.

Measuring soil moisture

Many methods and devices have been developed to measure soil moisture. Some devices measure soil water content and some measure soil water potential. The **standard** for soil moisture measurement is the "gravimetric method" and the procedure is described in the section on soil water content. The gravimetric method is used to calibrate and check all the other soil moisture measurement methods. More details about soil moisture measurement methods and devices will be in next month's issue under Part 2 of this article.

Table 1. Range of available water for plants for different soil textures.

Soil Texture	Inches of water per foot of soil
Coarse sand and gravel	0.2 to 0.7
Sands	0.5 to 1.1
Loamy sands	0.7 to 1.4
Sandy loams	1.3 to 1.8
Fine sandy loams	1.7 to 2.2
Loams and silt loams	2.0 to 2.8
Clay loams and silty clay loams	1.7 to 2.5
Silty clays and clays	1.6 to 2.2

The "feel method" is the oldest and most common method of checking soil moisture for irrigation management. It involves obtaining a handful of soil from a desired depth and location in the field, then squeezing to see if it makes a ball. Based on how the soil reacts to the pressure, the moisture content can be determined. For finer soils, an additional indicator is how the soil ribbons when pressed between the thumb and forefinger. Table 2 describes the reaction of the ball and ribbon forming for various soil textures and moisture contents. Many crop consultants and experienced irrigators use the feel method but it can be a challenge for new irrigators. For those unfamiliar with the feel method, the University of Nebraska Extension service has a publication entitled "Estimating Soil Moisture by Appearance and Feel." It is no longer available in print but can be found on the Internet at: *http://ianrpubs.unl.edu/irrigation/g690.htm* .

It has pictures of the ball forming process for several soil textures at different moisture contents. If you don't use the Internet, call me and I will send you a copy of this publication.

Where to check soil moisture

It can be time-consuming to check the soil moisture content at many locations in a field so the irrigator has to select representative locations. Selection of ideal locations for soil moisture checking should be based on ease of access, crop and soil types in the field. A field with soil series and a center pivot system is shown in Figure 1. Important soil parameters are shown in Table 3.

Table 3. Important soil parameters for irrigation management of the center pivot shown in Figure 1.

Map ID	Soil Type	Slope	Water Holding Capacity	Field Area
		(%)		(%)
LeB	Lihen loamy fine sand	1 to 6	1.6 inches/ft	37
PhA	Parshall fine sandy loam	1 to 3	1.9 in/ft (top 2 ft) 1.4 in/ft (2 to 5 ft)	23
PhB	Parshall fine sandy loam	3 to 6	1.9 in/ft (top 2 ft) 1.4 in/ft (2 to 5 ft)	40

The best access for soil sampling would be next to the roads or near the pivot access road (not shown). However, the location should also be selected based on the type of soil and crop. If potatoes were grown under the center pivot in Figure 1, four or more soil-sampling locations would be needed. Because potatoes are moisture sensitive, potatoes on the Parshall soil with 3 to 6 percent slope will show moisture stress first. Therefore, at least two sample locations should be in the Parshall soil with 3 to 6 percent slope, at least one in the Lihen and one in the Parshall soil with 0 to 3 percent slope. For most other crops, two sampling locations in the Lihen and two in the Parshall area would be sufficient.

Tom Scherer (701) 231-7239
NDSU Extension Agricultural Engineer
tscherer@ndsuext.nodak.edu

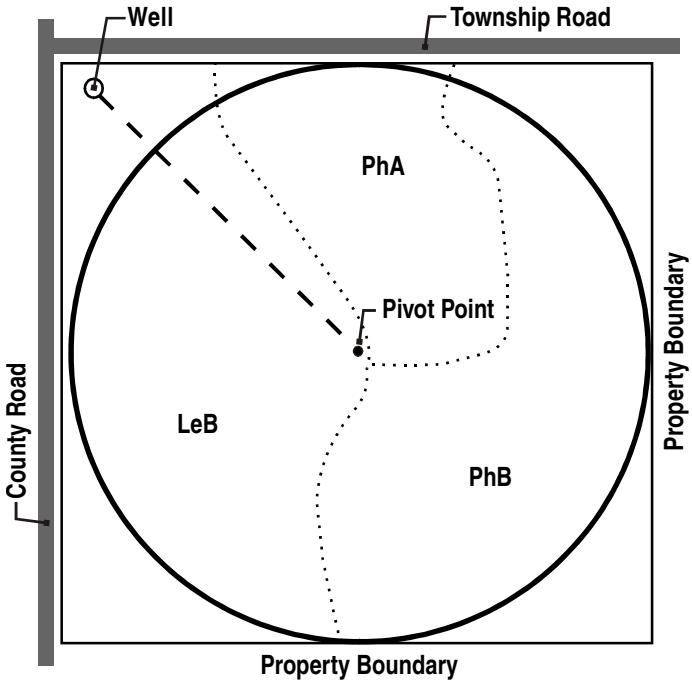


Figure 1. Example of the soil distribution under a center pivot.

Table 2. How to estimate soil moisture based on the feel method. A PRESSURE TEST involves grabbing a handful of soil, holding it in the palm and squeezing firmly with the thumb and fingers. A SLICK TEST involves trying to form a ribbon by pushing the soil between the thumb and forefinger.

	Soil Texture			
Soil Moisture Available in the Sample	**Coarse Texture:** *Sand and Loamy Sands*	**Moderately Coarse Texture:** *Sandy Loam, Fine Sandy Loam*	**Medium Texture:** *Loam and Silt Loam*	**Fine and Very Fine Texture:** *Clay Loam, Silty Clay and Clay*
0 %	Dry, loose, single grained, flows through fingers	Dry, loose, flows through fingers	Powdery, dry, sometimes slightly crusted but easily breaks down into powder	Hard, baked, cracked, sometimes has loose crumbs on surface
50% or less	Appears to be dry, will not form a ball with pressure	Appears to be dry, will not form a ball with pressure	Somewhat crumbly, but will hold together with pressure	Somewhat pliable, will ball under pressure
50 to 75%	Appears to be dry, will not form a ball with pressure	Forms a ball under pressure but doesn't hold together	Forms a ball, somewhat plastic, sometimes will slick slightly with pressure	Forms ball, will ribbon between thumb and forefinger
75% to Field Capacity	Tends to stick together slightly, sometimes forms a very weak ball under pressure	Forms a weak ball that breaks easily and will slick	Forms a ball and is very pliable, slicks readily if high in clay	Easily ribbons between thumb and forefinger
At Field Capacity	After squeezing, no free water appears on soil but wet outline of the ball is left on the hand	After squeezing, no free water appears on soil but wet outline of the ball is left on the hand	After squeezing, no free water appears on soil but wet outline of the ball is left on the hand	After squeezing, no free water appears on soil but wet outline of the ball is left on the hand
Above Field Capacity	Free water appears when the soil is bounced in hand	Free water will be released by kneading the soil	Can squeeze out free water	Puddles and free water forms on the surface

North Dakota State University
Extension Service
PO Box 5437
Fargo ND 58105-5437

Non-Profit Org.
U.S. Postage
Paid
Permit No. 818
Fargo, N.D.

Water Spouts is a Production of the NDSU Irrigation Task Force

Water Spouts is published once per month during the growing season. The purpose of this newsletter is to provide you with information to help better manage irrigation systems and water resources. We try to select topics for each issue that are timely and applicable to that month to address problems or provide information you can use. The task force is comprised of the following individuals:

Tom Scherer, Extension Agricultural Engineer

Mike Liane, Extension Area Irrigation Agent

*Duane Berglun*d, Extension Agronomist

Dwain Meyer, Professor, Forage Management

Bob Henson, Assistant Agronomist, Carrington Research Extension Center

Blaine Schatz, Director, Carrington Research Extension Center

Paul Hendrickson, Research Specialist - Irrigation, Carrington Research Extension Center

Harlene Hatterman-Valenti, Assistant Professor, Plant Sciences

Gary Secor, Professor, Plant Pathology

Richard Greenland, Supervisor, Oakes Irrigation Research Site

Dean Steele, Associate Professor, Agricultural and Biosystems Engineering

Dave Kirkpatrick, Research Specialist, Agricultural and Biosystems Engineering

Dwight Aakre, Extension Agricultural Economist

Dave Franzen, Extension Soils Specialist

Bruce Seelig, Extension Water Quality Specialist

Kevin Sedivec, Extension Rangeland Management Specialist

Rudy Radke, Extension Area Agriculture Diversification Specialist

Frank Casey, Assistant Professor, Soil Science Department

Chet Hill, Extension Area Value-Added Specialist, Williston Research Extension Center

Jim Staricka, Soil Scientist, Williston Research Extension Center

Larry Cihacek, Associate Professor, Soil Science Department

Craig Kleven, Extension Agent, Kidder County

At the end of each *Water Spouts* article, the author's name, telephone number and e-mail address (if the author has one) are listed. If you have any questions about any article, please contact the author by whatever means is convenient. If you prefer, contact me for help. If you want to look at past issues of *Water Spouts*, they are available on the Internet at the address shown at the top of this newsletter (under the pumps).

Tom Scherer (701) 231-7239
Extension Agricultural Engineer
tscherer@ndsuext.nodak.edu