NDSU EXTENSION SERVICE

water spouts

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No. 189 JUNE 2001

Field Days and Irrigation Tours for 2001

MDT – Mountain Daylight Time

Location	Date	Time	Phone
Streeter Central Grasslands Research Extension Center	June 13	6 p.m.	(701) 424-3606
Hettinger Research Extension Center	July 10	2:30 p.m. MDT	(701) 567-4323
Dickinson Research Extension Center	July 11	8:30 p.m. MDT	(701) 483-2348
Williston Research Extension Center	July 12	9 a.m.	(701) 774-4315
Langdon Research Extension Center	July 17	9 a.m.	(701) 256-2582
Minot North Central Research Extension Center	July 18	9 a.m.	(701) 857-7679
Sidney, Montana Eastern Ag Research Center	July 18	8:30 a.m. MDT	(406) 482-2208
Carrington Irrigation Research Extension Center	July 19	9 a.m.	(701) 652-2951
Casselton Agronomy Seed Farm	July 25	5:30 p.m.	(701) 347-4743
Staples, Minn. Central Lakes Ag Center Commercial Blueberry Clinic	Aug 1	6 p.m. to 9 p.m.	(218) 894-5196
Staples, Minn. Central Lakes Ag Center Dry Bean, Soybean Diseases Horticulture Tour	Aug 2	8:30 a.m.	(218) 894-5196
Dawson 2 miles north of I-94 exit Irrigation Potato Research	Aug. 7	10 a.m.	(701) 742-2189
Williston Mon-Dak Ag Field Tours *Irrigation Demo Fields*	Aug 8	9 a.m.	(701) 572-8880
Oakes Irrigation Research Site	Aug. 14	9 a.m.	(701) 742-2189

Harlene Hatterman-Valenti Joins NDSU Plant Sciences as the High Value Crops Researcher

To explore opportunities for raising and marketing new and existing high value crops, NDSU has hired Harlene Hatterman-Valenti as a high value crops researcher. Harlene, joined the Plant Sciences department as an assistant professor last fall. She has a BS in biology from Kearney State College of Nebraska, an MS in horticulture from the University of Nebraska, Lincoln and a PhD in agronomy and horticulture from Iowa State.

Harlene has over 18 years of experience working with various aspects of high value crops. She has researched weed control in ornamentals, vegetables, and turfgrass. Her dissertation research dealt with spray drift from turfgrass applications and ornamental injury from sub-lethal rates of auxin type herbicides. She has published extension articles and worked for FMC Corporation as a research associate responsible for primary herbicide discovery and field coordination of new corn/soybean herbicides for North and South America.

We welcome Harlene to her new position and to the NDSU Irrigation Task Force. Harlene's address is NDSU Plant Sciences, 166 Loftsgard Hall, Box 5051, Fargo, ND 58105.

Now is the Time to Start Scheduling Irrigation

With variable rainfall events it sometimes becomes difficult to determine when to irrigate and how much water to apply. As the crop approaches the high water use period

(July and August) it is important to keep track of the amount of soil moisture in the root zone.

A system of scheduling irrigation must be followed. Irrigation water management should begin in June. Many irrigators wait until July to begin scheduling, but often they have waited too long, especially on sandy soils.

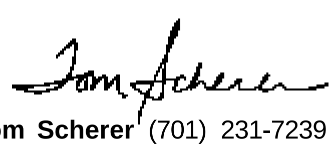
Scheduling using the “checkbook” method requires the irrigator to measure rainfall amounts, record irrigation amounts, and obtain an estimate of daily crop water use. Using these data, a soil moisture balance sheet is used to determine the daily soil moisture deficit. This method is called the checkbook method because it is very similar to how you balance your bank checkbook. If you think of rain and irrigation amounts as deposits and crop water use as withdrawals from the “soil water bank,” then you have the idea. The procedure is outlined in NDSU Extension circular AE-792, Irrigation Scheduling by the Checkbook Method, available from your county extension office.

The most difficult part of the process is obtaining the daily crop water use values. Fortunately, there are two relatively easy ways to obtain these numbers. AE-792 contains tables that provide estimates of the daily crop water use for the most common irrigated crops in North Dakota. All you need is a record of the daily maximum temperature and the number of weeks past emergence. If you have an Internet account, more accurate estimates of daily crop water can be obtained at:

www.ext.nodak.edu/weather/ndawn

At this site you can obtain crop water use in numerical tables or maps for alfalfa, turf grass, corn, drybean, wheat, barley, potato, sugarbeets, sunflowers and soybean. The crop water use estimates from the website are more accurate than the values in the crop water use tables of AE-792 because local daily weather is used to calculate the crop water use. At the website, you can either select crop water use tables for any of the 52 NDAWN weather stations and a particular crop or you can view maps of North Dakota with crop water use values superimposed at the location of each weather station. All you need to do is select the nearest emergence date of the crop of interest and a color-coded map will appear. Summary maps for the previous 2,3,4,5,7 and 10 days are available.

Knowing crop water use, using the checkbook method and monitoring soil moisture on a regular basis (every two weeks) will help you optimize your irrigation water management and provide the best yield possible.



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High Value Irrigated Crop Research Projects

As a high-value crop specialist, my research emphasis deals with production aspects of various crops including herbs, small fruits, turfgrass, and vegetables. Currently I am involved in:

- Vegetable variety research.
- Juneberry cultivar evaluations. Initially, information on establishment and growth will be obtained. By year four or five plants begin to produce fruit, enabling fruit yield and quality comparisons.
- Juneberry weed management trials that will compare chemical and non-chemical methods.
- Onion weed management trials.
- Turfgrass research evaluating the effect of seeding date on stand establishment and seed production.
- Crop sequence trials that will compare potato yield and quality following 10 vegetable and agronomic crops with and without cover crops.
- Annual herb screening trials.
- Potato fertility trials that will compare nitrogen rate and application timings, phosphorus additions, and two irrigation levels on potato yield and quality.
- Potato research that will evaluate the influence of a water deficit during tuber initiation with nitrogen rates/applications timings on potato yield and quality namely sugar-ends.
- Two additional sugar-end trials include a trial that evaluates conditioning treatments and a trial that imposes a water deficit during different growth stages.
- Potato vine desiccant trial.
- Potato planting configuration trial.

Other research interests include the use of cover crops, nitrogen use efficiency, and ground water quality issues. If you have encountered high-value crop production problems or have questions/suggestions please feel free to contact me.

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Long-term Water Quality under Irrigated Agriculture: Observations and Trends

For the past 11 years, subsurface water quality has been monitored in the root zone, groundwater and subsurface drainage under the Best Management Practices (BMP) irrigation research field located near Oakes. In 1989, researchers from soil science and agricultural and biosystems engineering, cooperating with the US Bureau of Reclamation, installed water quality monitoring instruments in the BMP field. This field had never been irrigated prior to its conversion from nonirrigated land to pivot irrigation. Other long-term water quality monitoring was done at the MSEA research site also located near Oakes. At each location it was found that the initiation of irrigation resulted in elevated nitrate-nitrogen concentrations in the root zone and shallow groundwater, sometimes well above the Environmental Protection Agency's drinking water standard or maximum contamination level (MCL) of 10 mg/L.

The elevated nitrate is likely due to an increase in biological activity called mineralization, which results from higher soil moisture contents. The mineralization process transforms nitrogen in organic matter to plant-available forms such as nitrate, which is very mobile in the soil profile. The flush of mineralized nitrate moves through the soil profile and it takes some time for nitrate concentrations to decrease to levels that were present before the land was irrigated. We have developed a mathematical model of nitrate concentration versus time to describe the flush of nitrate moving through the soil profile. The model has shown similar trends in the observed water quality data in the root zone, groundwater, and subsurface drainage. There is a general three-phase trend of nitrate concentrations through time where nitrate concentrations 1) increase, 2) then decrease, and 3) finally reach levels that were present before irrigation, which are maintained provided proper nitrogen fertilizer management practices are observed. **Nutrient best management practices become more important for maintaining low levels of subsurface nitrate after the flush of mineralized nitrate passes through the soil profile.**

The root zone water quality was monitored with instruments called lysimeters that collect water at depths from 1 to 5 feet below the soil surface. Figure 1 shows the nitrate concentrations through time, indicating a clear increase in concentrations after the initiation of irrigation in 1989. Levels of nitrate are well above the 10 mg/L MCL but begin to decrease after two years of irrigation. The mathematical model (see the curve in figures) used to describe the data shows three distinct periods or phases of nitrate concentrations in the root zone. The first period, Phase 1, is indicated by the increase in nitrate levels, perhaps because of the mineralization. The second period, Phase 2, is indicated by a decrease of nitrate levels, which may be a result of lower mineralization rates from lower organic matter resources. Finally, the third period, Phase 3, is signified by nitrate concentrations reaching and maintaining levels present before irrigation was established. The isolated nitrate peak in 1998 was likely caused by an increase in applied nitrogen fertilizer. This isolated peak signifies the importance of the use of nitrogen fertilizer BMP's to maintain low nitrate concentrations in subsurface water during Phase 3.

Groundwater was sampled at shallow (8-11 ft), intermediate (10-12 ft), and deep (18-20 ft) depths using wells. There was no significant increase in the nitrate levels observed in the deep wells because of irrigation. However, there was an increase in nitrate concentrations observed in the shallow and intermediate wells. Figures 2 and 3 show average nitrate concentration observed through time at the shallow and intermediate wells, where the same three-phase trend of nitrate concentrations observed in the root zone was also observed. In addition, as the observation depth increased from root zone, to shallow groundwater, to intermediate groundwater, the nitrate peak concentration decreased. Furthermore, the length of phases 1 and 2 increased as the sampling depth increased. More than half of the observed concentrations of the 18 wells were above the 10 mg/L MCL for considerable lengths of time (indicated by the hatched

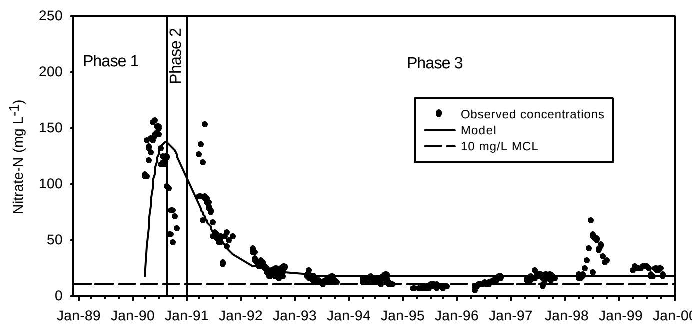

Figure 1. Average nitrate-N concentrations in the drainage water of 20 undisturbed lysimeters over an 11-year period.

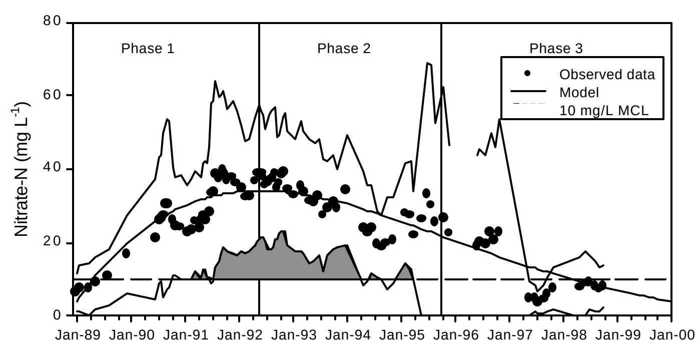

Figure 2. Average nitrate concentrations observed from 18 shallow wells. The jagged lines are the 50% confidence limit and the hatched area indicates a period where 50 % of the well samples tested above 10 mg/L.

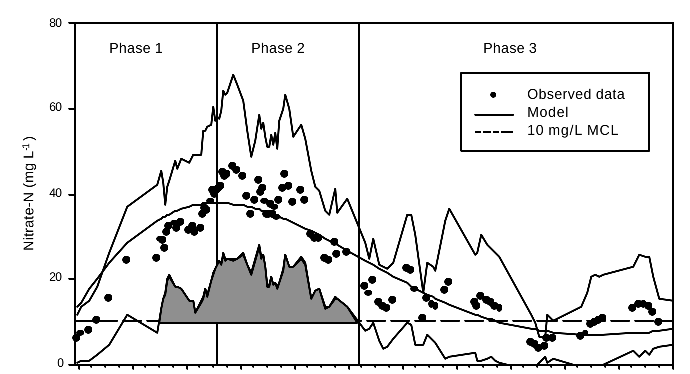

Figure 3. Average nitrate concentrations observed from 18 intermediate wells. The jagged lines are the 50% confidence limit and the hatched area indicates a period where 50 % of the well samples tested above 10 mg/L.

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areas in figure 2 and 3). Nonetheless, the concentrations approached pre-irrigation levels and were maintained after several years. The three-phase trend in nitrate concentrations was also observed in the groundwater under the MSEA irrigation research field (data not shown). The replication of this research in other areas will help to develop trends in water quality impacts as a result from the initiation of irrigation.

The tile drainage nitrate concentration also followed the same three-phase trend observed in the root zone and groundwater at the BMP site; however, the concentrations were surprisingly low (Figure 4). Only one data point (May 1991) tested above the 10 mg/L MCL and corresponded to a heavy rainfall of 3.5 inches. Another spike in the tile drainage data on July 1994 also corresponded to a heavy rainfall of nearly 5 inches. It is uncommon to find nitrate concentrations this low in tile drainage under intensively farmed areas. The average decrease in nitrate concentration between the shallow groundwater and tile drainage was 77% for each sampling date. The decrease in nitrate concentrations was attributed to a film that coated the tile line. The film contained microorganisms and minerals that made it possible for the biotic and abiotic reduction of nitrate. The reduction was so great that there was little impact on the water quality in subsurface drainage resulting from the initiation of irrigation.

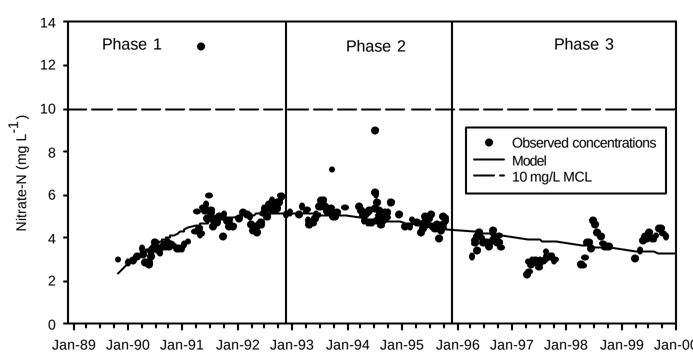

Figure 4. Nitrate concentrations observed in the subsurface drainage of the BMP research field.

Long-term irrigation water quality research is unique. Little is known about the trends of water quality beneath irrigated fields in this area, but this ongoing research provides much needed information. The observations and trends may be useful in developing nitrogen fertilizer credits to producers and help to maintain water quality after the initiation of irrigation.

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