

Surge Irrigation Extension Education Programs

Kelly J. Wertz
Extension Educator
MSEA Water Quality Project
University of Nebraska - Lincoln
Buffalo Co. Extension Office

Introduction

Surge irrigation developed in the late 1970's as a tool to increase the efficiency of furrow irrigation. As groundwater levels declined in Texas, widespread use of surge irrigation began as a tool to reduce water use. As groundwater declines moved into the panhandle of Oklahoma, then Southwest and Northwest Kansas, and into Nebraska, surge irrigation became popular as a way to reduce water use and irrigation costs. In the late 1980's the application of surge valves moved into the Platte Valley of Nebraska.

By 1993, the Central Platte Natural Resources District (CPNRD), which covers parts of four counties in the Platte Valley, had cost shared on about 643 surge valve systems. In a major portion of the CPNRD groundwater levels may average about 10 to 20 feet below the ground surface and many irrigation wells are only 50 to 60 feet deep. The concentration of irrigation wells in the CPNRD Groundwater Quality Management Area is the greatest in the world, averaging one well for every 60 acres. Thus, as a general rule water quantity and irrigation cost is not a major concern for most of the producers in the area.

More than 500,000 acres in the CPNRD are above groundwater that contains over 10 ppm nitrate-nitrogen. One of the major causes of this high level of nitrate-nitrogen is over application of irrigation water that leaches nitrogen below the root zone. With an abundant supply of relatively inexpensive water, many producers do not have an economic incentive to adopt best management practices for irrigation. The CPNRD cost shares on surge systems as a way to provide an incentive for producers to adopt some best management practices for irrigation water.

Saving Water With a Surge System

Producers in the Platte Valley are adopting surge irrigation for many reasons. Most irrigators would say that they feel that surge irrigation does a better job of irrigating by reducing runoff and getting water to the end of the field more uniformly, which saves water and labor. However, many fields in the area are diked at the lower end to prevent runoff so runoff control is not necessary and water is always uniformly distributed at the

lower end. Very few irrigation wells in the area have flow meters installed to enable producers to monitor their gross water applications. So the main reason for the use of surge valves is probably labor savings, the ability to irrigate two sets while returning to the field only once, or an automatic gate changer.

Research trials on surge irrigation have been done by University of Nebraska on many soil types, locations, and different irrigations. The trials compared the advance time of surge irrigation to the advance time of conventional gravity irrigation with the same furrow flow rates. These trials indicated that surge irrigation in Nebraska will reduce advance time on about 50% of surge installations. Of those 50%, the average advance time reduction was only 30%. Reducing in advance time with surge irrigation only provides the opportunity to reduce gross water application.

The installation of a surge valve on a gravity irrigation system alone does not guarantee improved irrigation water management. Many surge systems are operated in such a manner as to actually apply the same amount of water as was done with the conventional gravity irrigation system. Using a surge valve to reduce gross water application also requires a change in the way the irrigation system is managed, either set time, or number of gates opened. If the opportunity time of surge irrigation is the same as conventional systems, no change will occur in the amount of water applied.

Education Programs for Surge Irrigation

Nebraska Cooperative Extension along with several NRD and SCS personnel in the Platte Valley have recognized that many producers have installed surge valves with the perception that the surge valve will improve their irrigation water management. In order to fully utilize the possible benefits of surge, producers must be aware of the principals of surge irrigation and have a basic understanding of gravity irrigation management. Therefore, Nebraska Extension personnel have designed several educational programs to help producers with surge irrigation management.

In the winter of 1991-92 several classroom educational meetings were held for producers with surge valves. These classroom meetings were designed to cover several basic irrigation management topics such as irrigation scheduling and water application calculations. Surge concepts that were covered included fundamentals of surge, applications of surge, the effects of changes in set times and furrow flow rates, and a discussion on how to program surge valves.

Attendance at these meetings was respectable but light. When looking at the results of these meetings, Extension staff did not feel that producers left with much of a change in their attitudes and knowledge of basic irrigation management or surge irrigation. It is very difficult to explain the principals and concepts of surge irrigation with slides or charts and drawings. Because of this we felt that we could not do an adequate job of helping producers fully understand advance cycles and times, soak cycles, etc. We also felt that producers would be more open to learning about surge during the summer when

they are actively involved in irrigation management. And finally, all producers in the CPNRD are required to attend a class on irrigation and nitrogen management (a part of the groundwater quality program), which includes basic irrigation management concepts.

What was needed was a way to physically show surge irrigation in operation during a field demonstration. Since standing in the middle of a corn field watching a surge valve operate for 12 hours was not feasible, a portable surge demonstrator was built. This surge demonstrator had to accomplish two major tasks, show the actual interaction of water on soil, and take less than 30 minutes to demonstrate. With this type of demonstration, producers could actually see the soil sealing effect of surge irrigation. This would allow a greater understanding of the proper setup and operation of the surge system which would be discussed during the demonstration.

The Surge Demonstrator

A portable trailer mounted surge irrigation demonstrator was built in the late summer of 1992 as illustrated in Figure 1. Since construction of this type of demonstrator had never been attempted before, the total length and width was determined by the availability of the trailer it was to be mounted on. However, it was felt that at least 10 to

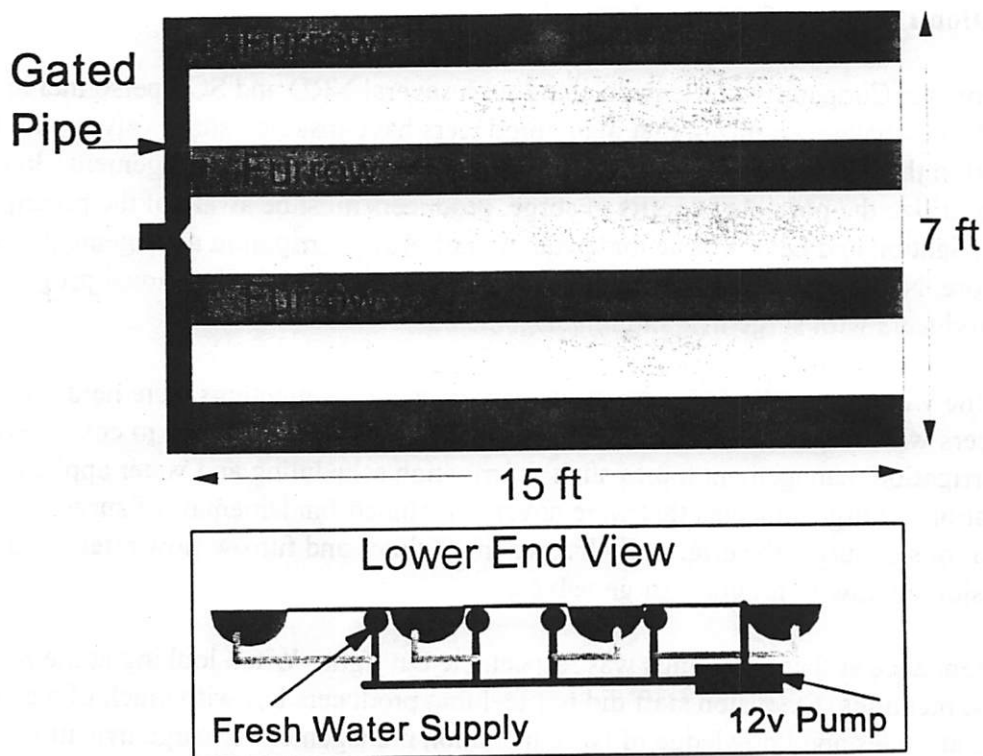


Figure 1. Top view and end view of portable surge demonstrator.

15 feet of run was needed to show at least four advance cycles. Four furrows were used to enable running two furrows on each side of the surge valve at a time.

The furrows were built from 10 PVC pipe that was capped and then cut in half. The furrows were bolted to a steel tubing frame, and plywood was bolted to the frame to fill the space between the furrows. The sizing of the furrows was a trial since we did not know how wide and how deep the furrow needed to be to show the sealing action from the surges. We found that the 10" pipe was plenty large, when completely filled with soil, advance times tended to be too slow. We then layered gravel on the bottom of the furrow, then sand and a 3" to 4" layer of soil on top. This combination worked very well in that we could complete a demonstration in 20 to 30 minutes, less water and soil was needed, and excess water would drain out of the soil. To facilitate setup and cleanup of the demonstrator, perforated bin flooring was later placed in the furrows to allow a 3 to 4 inch layer of soil to be used. The only problem with the bin flooring was that it occasionally allowed too much water to drain through the thin soil layer and stop furrow flow.

Four 6" PVC pipes were capped and mounted under the demonstrator as a water supply. Drains were placed at the bottom of the furrows and plumbed into the water supply to remove excess water from the furrows. Ball valves were installed in the furrow drains as shutoffs. Water is pumped from the bottom of the demonstrator to the top with a 12 volt pump. The water supply is split at the top of the demonstrator before entering the gated pipe. The gated pipe is 2" PVC pipe with 1" threaded holes over each furrow for gates. Hose connections were later added with pressure reducing valves to allow connection to an external water supply.

Soil is placed in the furrows and formed so that water will run down the center of the furrow. The soil is formed by a piece of plywood cut to form a slight depression in the center of the furrow. Soil requirements with the perforated bin flooring in place are only 2 to 3 five gallon buckets of soil per furrow. Generally soil moisture content of the soil placed in the furrows should be about 60 to 70% depleted. If the soil is too wet, the sealing effect will not be very apparent. If the soil is too dry, it is very difficult to work with. Silt loam soil seems to work the best, sandy loam may be used if a layer is packed in place on top of the perforated bin flooring.

Four advance surges are used during the demonstration. Lines have been painted on the plywood flooring between the furrows to mark the 1/4 points. Surges are manually controlled with ball valves on each of the gated pipes.

Surge Demonstrations

The surge demonstrator has been used in 10 producer meetings with an attendance of 250. Over 300 high school students have participated in irrigation workshops using the surge demonstrator. Comments at the end of producer meetings indicate that this type of

demonstration is very effective in showing the concepts of surge irrigation and how surge irrigation works to apply water uniformly and reduce gross water application.

The producer meetings are scheduled to last about 1 hour. At the beginning of the meeting about 20 to 30 minutes are used to explain the advantages of surge irrigation and how surge irrigation compares to conventional furrow irrigation. A comparison of set times and gate changes when moving to surge irrigation is also covered. An erasable marker board on an easel is used to draw infiltration profiles and other items as needed.

After the discussion which is used as an introduction to surge irrigation, we move to the actual demonstration. The demonstrations usually last about 20 to 30 minutes which is about enough time to explain the following items.

1. Advance cycle times. Increase as water advances down the furrow.
2. Soil sealing effect. Decreased infiltration at top which improves uniformity.
3. Total advance time. Must have water at end of field at end of advance time for soak cycles to be effective.
4. Soak cycles. Used to fill root zone at bottom of field and to control runoff.
5. Use of soil probe. Use probe to check infiltration at top and bottom of field.
6. How to set controller. Initial settings, Measured Advance Method, non-uniform fields.
7. Change gates and set times. How to make changes in sets to influence amount of water applied.

The advantage is that the audience can actually see the operation of each of the topics of discussion and the reasons why each of these topics is so important to surge irrigation management. In explaining advance cycles and the soil sealing effect we have found that it helps to have a member of the audience use a stopwatch to record the amount of time it takes for water to advance the same distance over dry soil, and then wet soil.

If most of the producers in the audience have used a surge valve before, many good questions and comments will come up. This of course is advantageous in that it allows discussion of actual field situations and problems, and other irrigation management practices.

The major theme during the demonstration is to explain that just the installation of a surge system does not guarantee better irrigation system performance. As the audience is watching the surge operation, we feel that it does become evident that the surge valve is more than just an automatic gate changer. As they watch and discuss the processes, they also realize that in order to get the most benefit from the system, they will have to make some changes in their irrigation management decisions and practices.

Summary

The use of surge irrigation in the central Platte Valley has seen an increase in the past 4 to 5 years. Several cost share programs are available to producers as an incentive to adopt practices to improve irrigation system efficiencies. It is generally felt that most surge valves are not being used in a manner to take full advantage of their possible benefits.

Classroom educational programs were developed to help producers use their surge valves to apply water more uniformly, and reduce their gross water application. Although some success was accomplished with these programs, a model and demonstration of a surge irrigation system was needed to help fully explain the operation and management of surge irrigation systems.

A trailer mounted surge demonstration unit was developed to show the actual operation and processes of surge irrigation. Because the demonstrator uses water surging down furrows of soil, many producers finally understood the concept and management practices needed to successfully operate a surge system.