Nebraska Surge Irrigation Results - C. Dean Yonts[1] and Dean E. Eisenhauer[2]

The first surge test in Nebraska was conducted in 1983 and evaluated continuous and surge flow for the first irrigation using surge times necessary to advance the water to 200, 400, 600, and 800 feet. Surge times were 30, 38, 43, and 49 minutes, respectively. The site used for the test was a Hastings silt loam soil with a furrow slope of 0.5%. Flow rates in the furrow were maintained at 30 gpm. Each furrow test was replicated three times across the field. The results from this test are given in Table 1. In this test, surging the water in the furrows did not have any effect on advance times between continuous and surge flow. In addition, surge flow did not affect pumping requirements, runoff, depth infiltrated, or the basic intake rate.

A different site was selected to conduct two tests during the 1985 season. The site was in the Platte River Valley in Buffalo County, near Kearney. The soil was a Hord silt loam with a 0.2% field slope. The first test was conducted during the first irrigation on July 5. The second test occurred on August 30 during the seventh irrigation. The surge times were selected based on the program that was available in the P & R Surge Valve*. Surge times were 21, 28, 36, 43, 50, and 60 minutes. The furrow stream size for both the continuous and surge flow treatments was 48 gpm. The results of these two tests are given in Table 2. The July 5 test is based on four replications of each treatment, while the August 30 test is based on six replications. Although a trend exists, suggesting that total on-time is reduced by surging, a high variability existed between the furrows and no statistical difference could be found between continuous and surge flow.

In 1986-87, two separate sites were selected to compare surge and continuous flow during the first irrigation. The Buffalo County site used in 1985 was again selected and tested on June 17, 1986 and June 24, 1987. The second site was located in Box Butte County near Alliance and was tested on June 25, 1986 and June 30, 1987. The Box Butte County site was a Keith silt loam soil with a field slope of 0.4%. Surge times and furrow stream size for the Buffalo County tests were the same as used in the 1985 test. Surge times for Box Butte County tests were 23, 31, 39, 46, and 35 minutes and furrow stream size was 20 gpm. For these tests, both continuous and surge flows were compared in wheel track (hard) and nonwheel track (soft) furrows.

*Reference to trade names does not imply endorsement by the University of Nebraska.

---

[1]Extension Irrigation Specialist, University of Nebraska Panhandle Research and Extension Center, Scottsbluff, NE.

[2]Extension Irrigation Specialist, University of Nebraska South Central Research and Extension Center, Clay Center, NE.

The results of the Buffalo County tests are given in Table 3. The results of the 1986 and 1987 tests indicate that surge flow had no significant affect on reducing advance times in the hard furrows. However, in the soft furrows, surge flow reduced the advance time by over 50% in 1986. In 1987, surge had no affect on the advance of water in the soft furrows.

Table 4 gives the results of the Box Butte County tests. In 1986, hard furrows had lower advance times than the soft furrows for both surge and continuous. The continuous and surge flow in the hard furrows had similar advance times in 1986. In the soft furrows, surge flow in 1986 reduced the advance time by nearly 30%. In 1987, there were significant differences between surge and continuous of 20 and 35% for both hard and soft furrows, respectively.

In 1988, surge irrigation tests were conducted at the South Central and Panhandle Research and Extension Centers in Clay Center and Scottsbluff, respectively. The Clay Center test was conducted during the first irrigation on a Hastings silt loam soil with a slope of 0.5 percent. Flow rate was 30 gpm. Every other furrow was irrigated with soybean rows spaced 30 inches apart. All furrows tested were non-wheel track, soft furrows. Cycle times, in minutes, were 35, 53, 67, 80 and continuous until all furrows were through to the end. The results of the Clay Center test is given in Table 5. No significant difference between surge irrigation and continuous irrigation advance times were determined.

Three tests were conducted at the Scottsbluff site. All tests were conducted on a Tripp very fine sandy loam soil. Crops were dry beans planted in 30 inch rows. Every other furrow was irrigated. Test furrows were non-wheel track, soft furrows. The first site, tested on July 12, 1988 had a field slope of 1.1 percent. The test was conducted during the first irrigation using 12.0 gpm per furrow. Cycle times were 23, 31, 39 and 46 minutes. The results, given in Table 6, indicate there was no difference between the surge and continuous flow irrigations.

Table 7 gives the results of the other tests at Scottsbluff. The soil type was again a very fine sandy loam but with a field slope of 0.8 percent. The first test was conducted on July 13, 1988 during the first irrigation using 19.0 gpm in each furrow. Cycle times used were 23, 31, 39, and 46 minutes. The second test was conducted on July 22, 1988 during the second irrigation. Furrow flow rate was 14.0 gpm. Cycle times were 10, 20, and 30 minutes. There were no field operations between the two irrigation tests. In both cases, surge irrigation had significantly shorter advance times to 1000 feet.

The results of these test indicate that advance times for both surge and continuous flow in hard furrows were the same in three out of four tests and in addition had advance times equal to or less than surge in soft furrows. This would imply that continuous flow in hard furrows gave similar results to surge in soft furrows. In soft furrows alone, which is the bulk of a field, surge flow improved the advance times for furrow irrigation in five out of ten tests that were conducted.

Similar to other studies on surge, Nebraska surge tests have had mixed results. Surge appears to be beneficial under some conditions and is felt the advantage occurs primarily during the first irrigation. It is not completely understood whether the difference between test results occur due to cropping patterns, soil type or conditions, or in climatological conditions. Regardless, if the advantage of reduced advance times are not realized every year or with every irrigation, the advantage of better water management will be gained during each irrigation.

ACKNOWLEDGEMENT

The authors would like to thank Harold Klingman of Klingman Irrigation Services and P & R Surge systems for supplying a valve for our work in Buffalo County. The assistance from the Central Platte and Upper Niobrara-White Natural Resources District and the Soil Conservation Service was appreciated. The support of the Ag Energy Conservation Project is also acknowledged. Finally, a special thanks goes to Roger Wolford from Kearney and Jim Irwin from Alliance for allowing us to conduct experiments on their farms.

Table 1. Surge test, University of Nebraska South Central Research and Extension Center, 1983.

	Continuous Flow	Surge Flow
Total on-time required to advance water to 800 feet	161 min.	160 min.
Gross depth applied	1.9 in.	1.9 in.
Depth of runoff	.3 in.	.3 in.
Depth of infiltrated	1.6 in.	1.6 in.
Basic intake rate	.3 in.	.2 in.

No significant differences at the 5% probability level.

Table 2. Surge test, Buffalo County, Nebraska, 1985.

	Continuous Flow	Surge Flow
July 5 - Total on-time required to advance water to 800 feet	174 min.	104 min.
August 30 - Total on-time required to advance water 600 feet	98 min.	69 min.

No significant differences at the 5% probability level.

Table 3. Surge test, Buffalo County, Nebraska.

Furrow Type	Total on-time required to advance water to 900 feet	Total on-time required to advance water to 1200 feet
	1986	1987
Hard furrow		
Continuous flow	92 b*	186 a
Surge flow	96 b	180 a
Soft Furrow		
Continuous flow	227 a	188 a
Surge flow	110 b	193 a

*Means followed by the same letter indicate no significant difference at the 5% probability level using Duncan's Multiple Range Test.

Table 4. Surge test, Box Butte County, Nebraska.

Furrow Type	Total on-time required to advance water to 800 feet	
	1986	1987
Hard furrow		
Continuous flow	55 c*	167 b
Surge flow	53 c	134 c
Soft Furrow		
Continuous flow	207 a	213 a
Surge flow	147 b	137 c

*Means followed by the same letter indicate no significant difference at the 5% probability level using Duncan's Multiple Range Test.

Table 5. Surge test, University of Nebraska South Central Research and Extension Center, 1988.

Furrow Type	Total on-time required to advance water to 1285 feet
Continuous flow	371 a*
Surge flow	284 a

*Means followed by the same letter indicate no significant difference using the LSD test at a 20 percent probability level.

Table 6. Surge test, University of Nebraska Panhandle Research and Extension Center, 1988.

Furrow Type	Total on-time required to advance water to 800 feet
Continuous flow	98 a*
Surge flow	96 a

*Means followed by the same letter indicate no significant difference using the LSD test at a 5 percent probability level.

Table 7. Surge tests, University of Nebraska Panhandle Research and Extension Center, 1988.

Furrow Type	Total on-time required to advance water to 1000 feet
First Irrigation	
Continuous flow	202 a*
Surge flow	122 b
Second Irrigation	
Continuous flow	80 a*
Surge flow	65 b

*Means followed by the same letter within an irrigation indicate no significant difference using the LSD test at a 5 percent probability level.