

APPLICATION OF SURGE IRRIGATION IN COLORADO

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The number of acres irrigated by surge irrigation is growing continuously in Colorado. Approximately 1.3 million acres are irrigated by graded furrow in Colorado, and the portion of acres converted to surge is growing as a result of educational and demonstration projects conducted by Colorado State University Cooperative Extension. These educational and demonstration projects promoted the use of more efficient irrigation practices. Surge irrigation was the main irrigation method promoted among surface irrigators. This paper describes the results and experiences gained from three of these projects.

PATTERSON HOLLOW HYDROLOGIC UNIT AREA WATER QUALITY PROJECT

**Otero and Pueblo Counties
1991 through 1994**

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Demonstration work was completed in 1993 at the two Allen Farm sites west of Rocky Ford with a butterfly T-type surge valve in gated pipe at the North Site and a check dam surge valve in a concrete ditch at the South Site. Grain corn was grown on both sites in 1993.

At the North Site, the conventionally irrigated area produced 162.5 bushels per acre, and the surge irrigated areas produced 164.2 bushels per acre; similar yields as shown in Table 1, but the surge irrigated area used 7.2 inches per acre LESS irrigation water, 42.5 vs. 37.3. Runoff was similar, 8.4 inches per acre on the surge irrigated as compared to 8.5 inches per acre on the conventionally irrigated areas (Table 2). Salts as total dissolved solids (TDS), nitrate-nitrogen, and sediment amounts in the water applied to the land were reduced by surge irrigation; however, since runoff amounts were similar, TDS, nitrate-nitrogen, and sediment amounts were similar (Table 3).

**TABLE 1. Yield, irrigation amounts, and efficiency on grain corn.
Surge vs. Conventional Irrigation
North Site, Otero County, 1993**

Irrigation method	Yield at 15.5% moisture bu/A	Irrigation amounts in/A	Irrigation efficiency bu/in-water
Surge	164.2	37.3	4.4
Conventional	162.5	42.5	3.8

**TABLE 2. Amount and timing of irrigation and runoff on grain corn.
Surge vs. Conventional Irrigation
North Site, Otero County, 1993**

State of growth	Irrigation amounts in/A		Runoff amounts in/A	
	Surge	Conventional	Surge	Conventional
Germination	4.9	6.7	0.9	0.8
6-leaf	5.9	7.0	0.6	0.7
9-leaf	4.7	6.4	0.6	0.7
11-leaf	4.6	5.0	1.0	1.3
Tassel	6.1	5.5	3.1	2.4
Silk	3.6	3.4	0.9	0.8
Milk	3.0	3.0	0.8	0.9
Hard dough	4.5	5.5	0.5	0.9
TOTAL	37.3	42.5	8.4	8.5

**TABLE 3. Total irrigation and runoff water, total dissolved solids, nitrate-nitrogen, and sediment¹.
Surge vs. Conventional Irrigation on Grain Corn
North Site, Otero County, 1993**

Irrigation method	Irrigation amount in/A	Percent less than conventional	Total dissolved solids lbs/A	Nitrate-nitrogen lbs/A	Sediment lbs./A
Surge	37.3	12.1	3373	21.7	17,157
Conventional	42.5	---	3868	24.7	19,183
	Runoff in/A				
Surge	8.4	0.0	811	5.5	4219
Conventional	8.5	---	756	5.3	4138

¹ **Rainfall during growing season, 5-6 through 10-9: 5.03 inches.**

1991-93 RESULTS

Based on results from three years at the North Site and two years at the South Site, the surge irrigated and conventionally irrigated areas yielded an average of 186.5 and 186.2 bushels per acre, respectively (Table 4). However, the surge irrigation used an average of 6.9 inches per acre or 24.1 percent LESS water than the conventionally irrigated areas (28.6 vs. 35.5) with 1.1 inches per acre or 20.4 percent LESS runoff water (5.4 vs. 6.5). As a result of using less irrigation water, 28.8 percent LESS TDS, 24.5 percent LESS nitrates, and 9.5 percent LESS sediment was applied to the surge irrigated areas. Also, because of lower runoff amounts, 18.6 percent LESS TDS and 15.2 percent LESS nitrate-nitrogen was eroded from the surge irrigated areas than from the conventionally irrigated areas. Sediment loss from the surge irrigated areas was increased 19.8 percent due to the significantly higher amounts lost during the 1992 season.

**TABLE 4. Yield, irrigation amount, and efficiency on grain corn.
Patterson Hollow Water Quality Project, 1991-93, Two Sites**

Irrigation method	Yield bu/A	Irrigation in/A	Irrigation efficiency bu/A
Surge	186.5	28.6	6.5
Conventional	186.2	35.5	5.2

**TABLE 5. Total irrigation and runoff water, total dissolved solids, nitrate-nitrogen, and sediment on surge irrigated and conventional irrigated grain corn.
Patterson Hollow Water Quality Project, 1991-1993, Two Sites**

Irrigation method	Irrigation in/A	Total dissolved solids lbs/A	Nitrate- nitrogen lbs/A	Sediment lbs/A
Surge	28.6	3006	13.9	14,775
Percent less than conventional	<u>24.1</u>	<u>28.8</u>	<u>24.5</u>	<u>9.5</u>
Conventional	35.5	3872	17.3	16,182
	Runoff in/A			
Surge	5.4	542.4	3.3	5,761
Percent less than conventional	<u>20.4</u>	<u>18.6</u>	<u>15.2</u>	<u>-19.8</u>
Conventional	6.5	643.4	3.8	4,809

SUMMARY

Results at the North and South Sites from 1991 through 1993 and the Walter Family Farm in 1994 indicate that surge irrigation can reduce the amounts of irrigation and runoff water and, as a result, reduce the total dissolved solids, nitrate-nitrogen, and sediment being applied to the land and returning to the Arkansas River while maintaining yields and returns (Table 5).