Fact sheet #17

Improving Profitability and Water Quality: Irrigation Water Nitrate Crediting

Low commodity prices combined with higher input costs made 1998 a marginal year for many crop producers. Faced with these realities, crop producers must tighten their operations to remain in business. Unfortunately, many costs in agriculture today (land, water, equipment, labor) are fixed, and cutbacks are hard to find. However, for some producers in Colorado a potential means to reduce fertilizer inputs does exist. This strategy involves taking advantage of the "free fertilizer" supplied as nitrate in irrigation water. CSU Cooperative Extension conducted trials in 1997 and 1998 to help producers understand how to take advantage of this potential cost cutting measure.

Groundwater monitoring in irrigated areas along the S. Platte River, the Arkansas River, and the San Luis Valley has revealed several locations where enough nitrogen (N) as nitrate has accumulated over time in the groundwater to benefit crop production. Producers using this nitrate-enriched groundwater to supply a major portion of a field's water will profit by crediting this N source when determining their fertilizer rate.

Soil testing to determine correct fertilizer rates and to ensure top yields is an accepted practice for many producers, but testing irrigation wells as a source of N is less common. However, irrigation water containing nitrate can supply considerable amounts of N because it is applied during the growing season and is immediately available for crop uptake, thus potentially reducing the amount of fertilizer required. Situations where fields are irrigated with more than 50% well water that has nitrate concentrations greater than 10 ppm are most likely to benefit. Ditch water nitrate is usually low, unpredictable, and consequently not worth crediting.

Crediting the N received in irrigation water is a recommended Best Management Practice (BMP) for N management. Growers that use this BMP are improving water quality by removing nitrate from the groundwater through crop uptake while reducing their fertilizer needs.

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Trial Descriptions

During the 1997 and 1998 growing seasons, 11 trials were held in several locations in the alluvial portion of the S. Platte River valley in Weld County (Table 2). The objective of these trials was to compare crop yields where the fertilizer rate has been reduced by accounting for (or crediting) the nitrate supplied from the irrigation groundwater.

To accurately develop N fertilizer recommendations, all field sites were soil sampled to a depth of two to four feet depending upon the crop and situation. The irrigation well was sampled and analyzed for nitrate prior to and throughout the growing season at each site. The soils were analyzed using field kits or by the CSU testing lab. The soil and water test results were used to develop N fertilizer recommendations according to each field's yield goal with and without an irrigation water N credit. At some sites an additional N rate was included to evaluate a partial water credit.

The amount of irrigation water applied was measured using furrow flumes and rain gauges to determine cumulative water and nitrogen additions.

Table 1. Nitrogen credited and received from

	Max Projected N Credit	Actual N Received	Projected N Credit Achieved?
1997 Site	---------- lb N/Acre ----------		
Moser	40	120	Yes
Fritzler Silage	45	45	Yes
DHAg Wheat	30	40	Yes
LaSalle Corn	50	18	No
1998 Site	---------- lb N/Acre ----------		
DHAg Wheat	30	70	Yes
Fritzler Wheat	40	100	Yes
Fritzler Silage	50	135	Yes
Wiedeman	75	158	Yes
Eckhardt	100	200	Yes
Moser	100	220	Yes
Koehn	40	30	No

Table 1 provides the projected N credits, the amount actually received from the irrigation water, and whether or not the projected credit was made.

Trial Results

Grain and silage yields were obtained from both hand and mechanical harvesting methods. Weigh wagons and portable load scales were used to weigh grain harvested from trials.

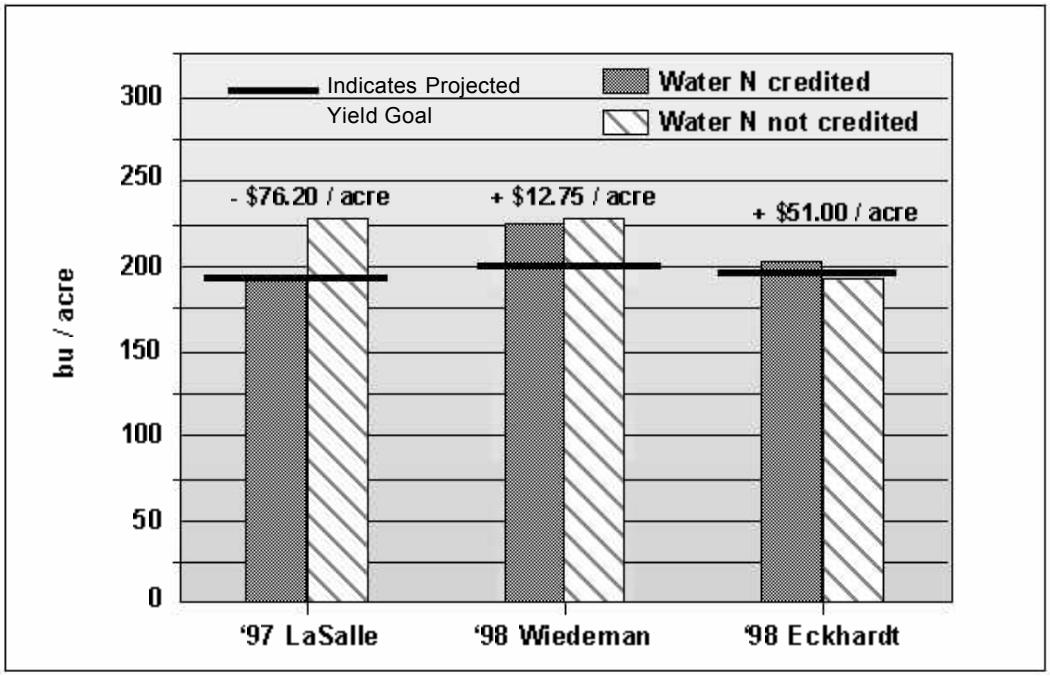
The figures on the next two pages illustrate the results broken down by crop type and location. Two years of trials have shown that irrigation nitrate crediting is a sound economic and agronomic practice. Significant yield loss from reducing N fertilizer applied occurred only when the expected water nitrate credit was not actually received from the applied irrigation water (Table 1). When properly used, growers can maintain yields, reduce fertilizer costs and help clean up groundwater by crediting nitrate in irrigation water. However, the trial results also show that growers should be cautious when crediting N from wells that supplement ditch water. Wells that are only used in dry years should not be counted upon to supply N to a crop.

Because profit margins in irrigated agriculture continue to shrink, growers using groundwater containing nitrate should seriously consider implementing this BMP to improve their bottom line. The final page of this document provides detailed information on how to start using this BMP.

Graph Interpretation

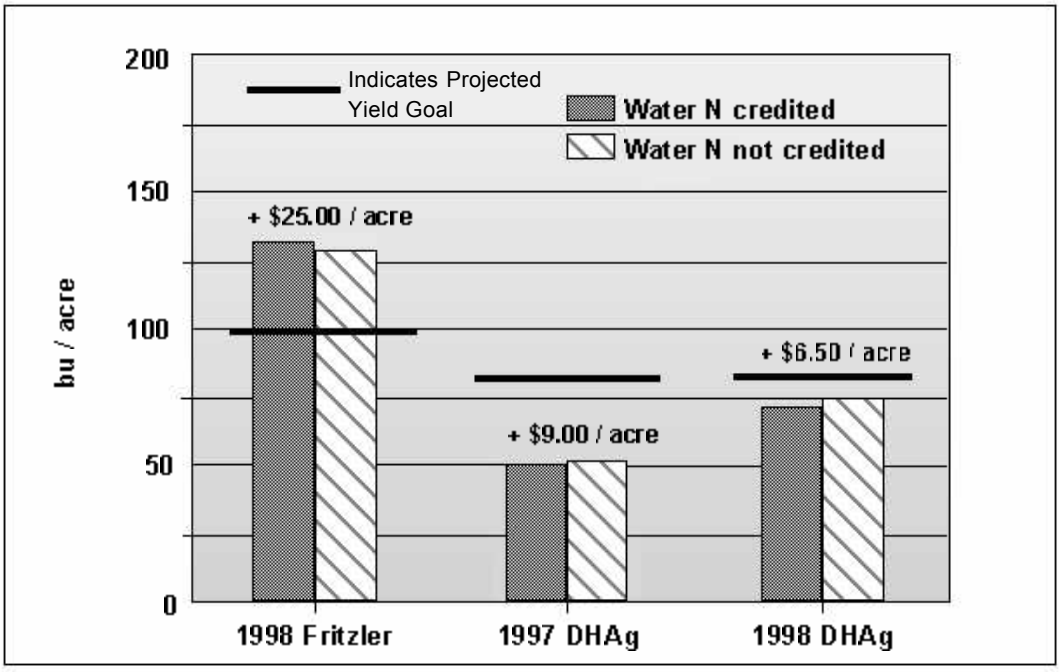
The following graphs compare the recommended fertilizer rate without an N credit to the recommended fertilizer rate with the highest N credit tested. The positive or negative dollar amount provided above each set of bars is the per acre return on crediting the N from irrigation water. Commodity and fertilizer prices on the date of this writing were used for 1998 trials. Differences in yield were used to make economic comparisons whether or not the yields were statistically significant.

Figure 1. Trial Results at Gilcrest and LaSalle Corn Grain Sites



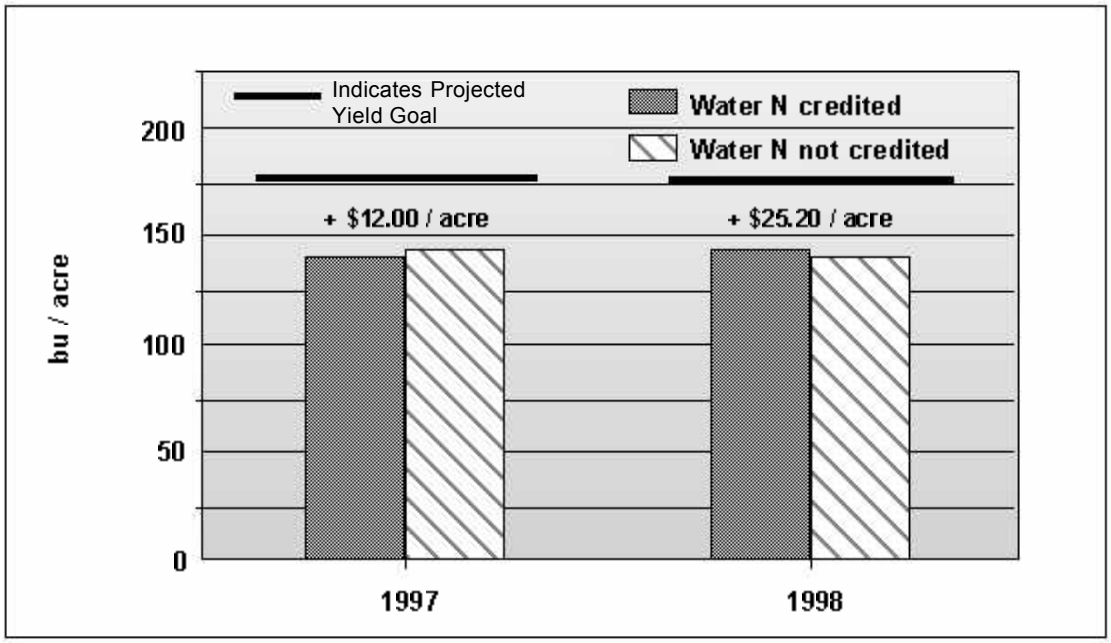
- The dollar amount provided above each set of bars indicates the economic gain or loss from crediting irrigation water nitrate.
- When irrigation N credit was received, no yield loss was measured and an economic benefit resulted. Note: Yield decrease at '97 LaSalle resulted partially from estimated irrigation N credit not being met due to type of water received. Only ditch water was applied, no groundwater (see Table 2.)
- Economic analysis for 1997 computed using $2.70/bu corn price and $0.28/unit N and for 1998 computed using $1.95/bu corn price and $0.28/unit N.

Figure 2. Trial Results at Gilcrest Wheat Sites



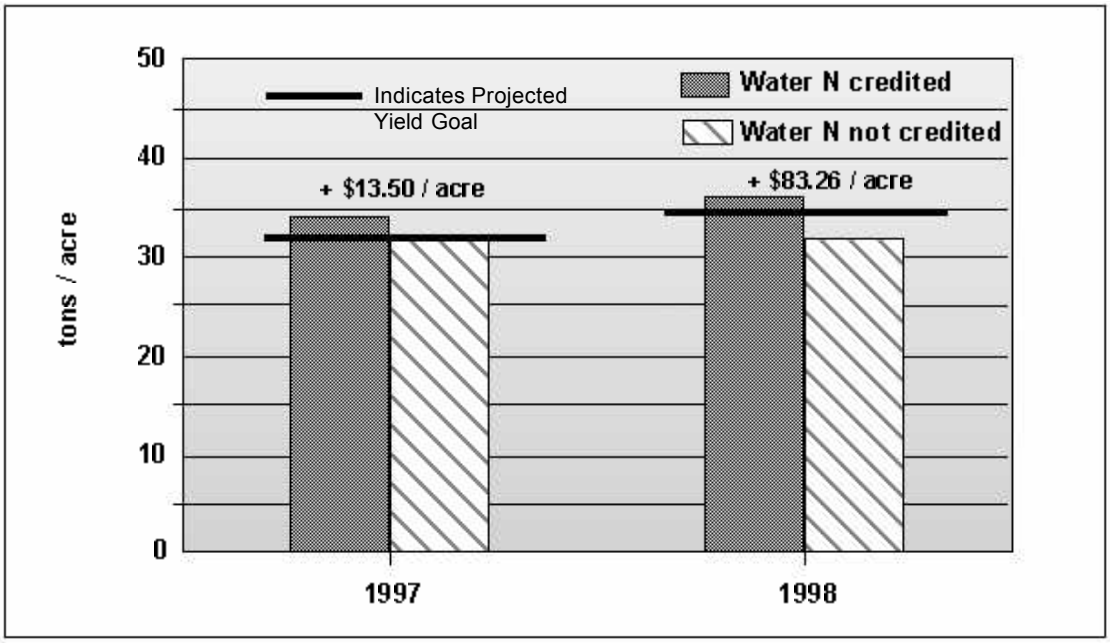
- The dollar amount provided above each set of bars indicates the economic gain or loss from crediting irrigation water nitrate.
- Higher N rate at the 1998 Fritzler produced more lodging reducing yield.
- 1998 economic analysis computed using $2.80/bu wheat price and $0.30/unit N + $4.00/acre application cost (1998 DHAg). 1997 used $3.50/bu wheat.

Figure 3. Trial Results at Moser Corn Grain Sites



- The dollar amount provided above each set of bars indicates the economic gain or loss from crediting irrigation water nitrate.
- Yield on this field is limited by highly saline irrigation water.
- Economic analysis computed using $1.95/bu corn price and $0.28/unit N for 1998 and $2.70/bu corn for 1997.

Figure 4. Trial Results at Fritzler Corn Silage Sites



- The dollar amount provided above each set of bars indicates the economic gain or loss from crediting irrigation water nitrate.
- Yield goal was met by all but one treatment.
- Economic analysis computed using $57.12/dry ton silage price and $0.30/unit N.

Table 2. Summary of practices and results for 1997 and 1998 trials.

1997 Cooperators	Location	Crop	Water Source	Fertilizer Rates (lb N/acre)	Yield
Wes Moser & Sons	Platteville	Grain Corn	100% groundwater	0 + Ami*	140 bu
				40-no Ami	147 bu
				40 + Ami	146 bu
				80 + Ami	140 bu
				TC** + Ami	144 bu
Diamond Hill Ag.	Gilcrest	Winter Wheat	100% groundwater	60	53 bu
				30	51 bu
Glen Fritzler	Gilcrest	Silage Corn	50% groundwater	0	27 ton
				90	34 ton
				180	32 ton
LaSalle Producer	LaSalle	Grain Corn	70% groundwater	90	192 bu
			(Assumed)	160	228 bu
1998 Cooperators					
Diamond Hill Ag.	Gilcrest	Winter Wheat	100% groundwater	0	72 bu
				30	75 bu
Glen Fritzler	Gilcrest	Winter Wheat	60% groundwater	105	132 bu
				150	129 bu
				190	114 bu
Glen Fritzler	Gilcrest	Silage Corn	50% groundwater	140	36 ton
				190	32 ton
Terry Wiedeman	Gilcrest	Grain Corn	100% groundwater	100	224 bu
				125	227 bu
				175	229 bu
Steve Eckhardt	Gilcrest	Grain Corn	100% groundwater	55	203 bu
				135	190 bu
				195	192 bu
Wes Moser & Sons	Platteville	Grain Corn	100% groundwater	0	143 bu
				TC**	140 bu
				TC + 25 lb	134 bu
				TC + 65 lb	135 bu
				TC + 105 lb	141 bu
Orlan Koehn	Lucerne	Grain Corn	70% groundwater	100	NA
				140	NA

*Amisorb is a nutrient uptake enhancement product
**TC = Turkey compost applied at approximately 15 tons/A suppling an estimated 70-80 lb N/A
*** 110 rate = CSU recommendation with 25 lb water credit
150 rate = Western lab recommendation with 40 lb water credit
190 rate = Western lab recommendation with no water credit

We greatly appreciate the help, input, and generosity of all our cooperators. Without their assistance these results would not be available to help other producers make sound decisions regarding this practice.

Using Irrigation Nitrate Crediting on Your Farm

Implementing this BMP on your farm requires two important pieces of information:

1. *The nitrate-nitrogen content of the irrigation well water (reported as ppm NO_3-N):*
   Direct analysis of well water by field test kits or laboratories is the only reliable way to accurately determine nitrate content. A nitrate test from a commercial lab generally costs about $10 to $20. Sample the well twice during the first year to account for possible seasonal variability. In subsequent years a single sample should be sufficient.

2. *An estimate of the amount of water to credit:*
   Because crops take up the majority of the N required during the vegetative growth stages, only water applied during the early part of the growing season can be credited. Consumptive use during this time period, often referred to as evapotranspiration (ET), can be used to estimate the amount of water to credit. You should only credit about 60% to 70% of seasonal ET for most crops (no more than 15 inches for corn). Local NRCS personnel, water districts, or Cooperative Extension offices can provide local values for crop water use (ET) for your area. With this information, multiply the NO_3-N content of the water by 0.23 (an acre-inch of water contains 0.23 lbs of N for each ppm of NO_3-N) by the inches of water to obtain the amount of N to credit.

Remember that reducing a fertilizer rate by crediting irrigation water N should not be practiced without using soil testing to initially determine a crop's N needs. We advise testing this practice on only a small portion of a field before cutting back N fertilizer applied over a large acreage. For more information contact Troy Bauder with CSU Cooperative Extension at (970) 491-4923.

AN EXAMPLE SITUATION:

Crop: corn
Water supply: 60% well (groundwater), 40% ditch
Well test results: 18 ppm NO_3-N
Seasonal consumptive use for area: 21 inches of water
Inches of water to credit = 21 inches ET x 70% of seasonal (.70) x 60% by well (.60) = 9 inches
Water Credit = 18 ppm x 0.23 x 9 inches/acre = 37 lb N /acre

Table to determine irrigation nitrate credit (equation is provided below).

Well Water NO_3-N (ppm)	Inches of Water to Credit				
	---5---	---7.5---	---10---	---12.5---	---15---
	lb N/Acre				
10	11	17	22	28	34
15	17	25	34	42	51
20	22	34	45	56	70
25	28	42	56	70	84
30	34	51	67	84	101
35	39	59	79	98	118

Calculation: ***lbs N/acre = NO_3 - N (ppm) x 0.23 x Inches Applied Water/acre***