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Nitrates in Irrigation Water: An Asset for Crop Production

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Naturally occurring nitrogen in the form of nitrate in irrigation water helps meet crop N requirements and reduces fertilizer cost for crop production. This nitrogen may be expressed as NO_3, NO_3-N, or nitrate-nitrogen—all actual nitrogen. This nitrogen is free and is readily available to the crop. It should be credited 100 percent toward crop needs if applied just before or during crop growth.

This N in irrigation water can:

- Supply varying amounts of timely N during the growing season;
- Be available to the crop immediately;
- Reduce the amount of N fertilizer the producer must buy;
- Be credited toward crop nitrogen needs as a sound economic and agronomic practice;
- Reduce excess nitrates from entering groundwater from percolation or runoff.

Nitrate content in Texas irrigation waters

Though some waters used for irrigation in Texas contain 20 to 50 ppm nitrate-N, most average 3 to 10 parts per million (ppm) nitrate-N (Fig. 1). Regions that tend to have irrigation water with higher nitrate-N include:

- South of San Antonio
- East of Midland-Odessa and north through most of the Texas South Plains

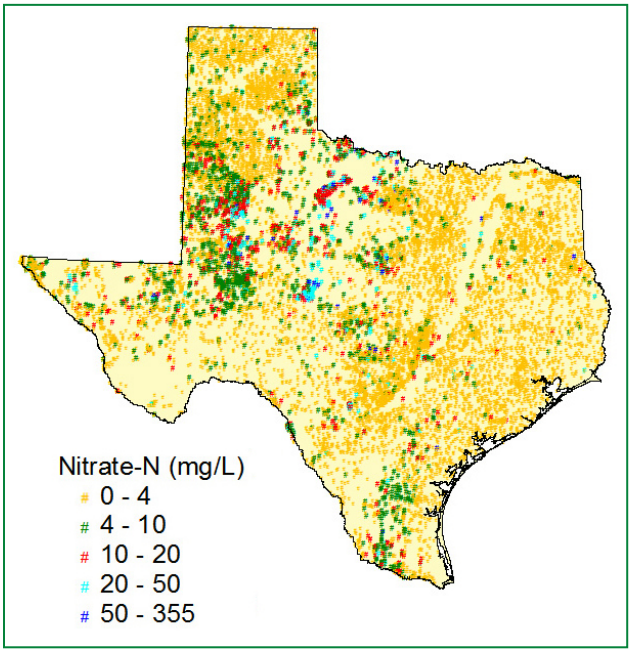

Figure 1. Distribution of NO_3-N in groundwater in Texas (Texas Water Development Board Data)

- Several areas in the Texas Rolling Plains aquifers, especially the Seymour Aquifer—the highest median nitrate-N among major aquifers in Texas

Federal Drinking Water Standards

The public health drinking water standard set by the U.S. Environmental Protection Agency is expressed as 10 ppm NO_3-N or 10 mg/ml NO_3-N. A person who endures prolonged consumption of water containing nitrate-N above this level may

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become ill. Infants less than 6 months old who consume water above the EPA standard are susceptible to serious illness, and if untreated, may die. Symptoms include shortness of breath and signs associated with methemoglobinemia, or blue baby syndrome.

For more information, see http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm

Terms and conversion factors

Nitrate in groundwater is most commonly reported as nitrate-nitrogen or NO_3-N. Some water and lab reports may report nitrate simply as NO_3. The units of concentration are reported as ppm or milligrams per liter (mg/L). These units express the same concentrations: 1 ppm = 1 mg/L.

To convert from nitrate-N (nitrate-nitrogen or NO_3-N) to nitrate (NO_3) only, multiply by 4.4:

10 ppm NO_3-N = 44 ppm NO_3

To convert nitrate only to nitrate-N, multiply by 0.23 for each 1 ppm of nitrate.

10 ppm NO_3 = 2.3 ppm NO_3-N

How much N is irrigation really adding to crops?

For each 1 ppm nitrate-N in water you apply:

- 0.23 pounds of N per acre is applied with each 1 inch of water applied
- 2.7 pounds of N per acre is applied with each foot of water applied

Table 1. Nitrate-N applied through irrigation*

	Inches of irrigation water				
NO_3-N (ppm in water)	6	12	18	24	30
	Lb. N* applied/acre				
5	7	14	21	28	35
10	14	28	40	55	69
15	21	41	62	83	103
20	28	55	83	110	138
25	34	69	104	138	173

*Pounds N/acre = NO_3-N (ppm) × 0.23 × inches of water applied per acre

Table 1 shows the amount of nitrate-N applied to crops based on the ppm of nitrate-N in water and the inches of water applied per acre.

Potential cost savings of credited Nitrate-N

Example: A farmer has an irrigation nitrate-N level of 7 ppm—a modest, but significant level—and plans to apply 10 inches of irrigation to a crop during the growing season. How much N will be applied that can be credited to the crop N requirement?

7 ppm nitrate-N × 0.23 × 10 inches
= 16 lb. N per acre

This is enough for 0.3 bale per acre of cotton lint, 800 pounds per acre of grain sorghum, or 13 bushels per acre of wheat.

In 2012, the price per pound of N fertilizer was about $0.60. At this price, the approximate cash value per pound of actual nitrate-N per acre is $9.60.

($0.60 per 1 lb. of N) × (16 lbs. of N per acre)
= $9.60 per acre

If 1 pound of N per acre is present in irrigation water over a 120-acre center pivot, the farmer will save about $1,150—with no added application costs!

In agricultural production, nitrate-N in irrigation water has essentially the same value as applied N fertilizer. However, the plants may more readily take in N from irrigation water than from forms that are not immediately available to a crop.

A caveat

When you pre-water to build soil profile moisture, nitrate-N in irrigation water may not be as available to plants as when it is applied to actively growing crops. If the irrigation levels are 4 inches or more during pre-watering (especially furrow irrigation), the nitrate-N might seep below the root zone of shallow rooted crops such as corn, wheat, and grain sorghum.

Rainfall or further irrigation might push the N even deeper before the crop can capture it. This percolation of water can reduce the otherwise significant increase in available nitrate-N. Producers

should reduce the N credit by half or more in these cases, and especially for irrigation applied 1 month or more before cropping.

Sample collection and analysis

Research shows that levels of nitrate-N in irrigation water are consistent throughout the year; a single sample before the growing season should give a good estimate for the upcoming year.

For information on collecting water samples to test for nitrate-N, salinity, and other constituents, see the water sample submittal form at http://soiltesting.tamu.edu/files/waterweb1.pdf.

To have a water sample analyzed, consult your local irrigation or water conservation district, private soil and water testing labs, or the Texas A&M AgriLife Extension Service Soil, Water and Forage Testing Laboratory at http://soiltesting.tamu.edu, (979) 845-4816, or e-mail soiltesting@ag.tamu.edu.

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