

## *Fertigating with Groundwater Nitrogen*

### *What is "Fertigation"?*

Fertigation is the process of applying commercial fertilizer solutions through an irrigation system while watering the crop. It can be a very efficient means to apply soluble nutrients to crops in a timely manner.

In some situations, however, fertigation can occur with every irrigation, even though commercial fertilizers are not being injected into the irrigation system. This is because some groundwaters used for irrigation can contain plant nutrients, something that should be carefully considered when developing and implementing a nutrient management plan. This can help to save money (e.g., reduce fertilizer costs) and also prevent the over-application of nutrients, especially nitrogen (N) which can pollute ground and surface waters.

### *Why is Groundwater Nitrogen a Concern in Delaware?*

Nitrogen is one of the most important plant nutrients and is vital to successful crop production. The most common sources of N used in Delaware today include commercial fertilizers (e.g., ammonium nitrate, ammonium sulfate, urea, urea-ammonium nitrate solutions) and animal manures. Once added to soils the N in these materials is converted rapidly to nitrate-N by soil microorganisms. Although it is readily available to plants, nitrate-N is also very susceptible to leaching through soils into shallow groundwaters. Preventing nitrate-N leaching has always been difficult in Delaware because of a warm, humid climate, plentiful rainfall, shallow groundwaters, and the extensive use of fertilizer and manure N for crop production. Today, unfortunately, many Delaware groundwaters have elevated concentrations of nitrate-N and some exceed the U.S. Environmental Protection Agency (USEPA) drinking water standard (10 parts per million (ppm) nitrate-N). Given these concerns, there is a need to improve agricultural N use efficiency to protect and improve groundwater quality. One simple method to do this is to test irrigation waters for nitrate-N.

### *Why Test Irrigation Waters for Nitrogen?*

Testing irrigation waters for nitrate-N is important because the N in irrigation waters is just as available to crops as that in fertilizers. Knowing how much plant available-N is provided to crops with each irrigation allows for reductions in the amount of fertilizer and/or manure N applied, thus saving money and reducing the over-application of N to crops. By applying only as much N as is needed to attain economically optimum crop yields, the potential for groundwater contamination by nitrate-N is reduced.

How much nitrogen are crops getting from the nitrates in the groundwater when each irrigation occurs? The only sure way to answer this question is to have the irrigation water tested for nitrate-N, either by state agencies or private testing laboratories. For information on how to have irrigation water tested, contact the University of Delaware Cooperative Extension.

### *How to Interpret Irrigation Water Tests*

The results of irrigation water analyses are usually given in parts per million (ppm) or milligrams per liter (mg/L) of nitrate-N ( $\text{NO}_3\text{-N}$ ). Some laboratories may report the results as ppm of nitrate ( $\text{NO}_3$ ). To convert from  $\text{NO}_3$  to  $\text{NO}_3\text{-N}$ , use the following equation:

$$\text{NO}_3\text{-N (ppm)} = [\text{NO}_3, \text{ppm}] \times 0.222$$

To determine how many pounds of plant available  $\text{NO}_3\text{-N}$  are in an "acre-inch" of irrigation water, use the following equation:

$$\text{NO}_3\text{-N (lbs/acre)} = [\text{NO}_3\text{-N, ppm}] \times 0.227$$

A table summarizing the amount of nitrate-N applied for a range of irrigation water analyses is provided on the back of this fact sheet.

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**CONSIDER GROUNDWATER NITROGEN CONTENT WHEN IRRIGATING  
TO SAVE MONEY AND PROTECT DELAWARE GROUNDWATERS**

<i>Water Analysis Results</i>		<i>Amount of Plant Available N Added per Acre-Inch of Irrigation Water Applied (lbs N/acre)</i>	<i>Economic Value of N Applied per Acre-Inch of Irrigation Water (\$/acre)<sup>†</sup></i>
<i>NO<sub>3</sub>-N (ppm)</i>	<i>NO<sub>3</sub> (ppm)</i>		
1	4.5	0.23	0.05
2	9	0.45	0.09
3	13.5	0.68	0.15
4	18	0.91	0.18
5	22.5	1.1	0.22
6	27	1.4	0.28
7	31.5	1.6	0.32
8	36	1.8	0.36
9	40.5	2.0	0.40
10	45	2.3	0.46
<i>Nitrate-N Concentrations in Groundwaters &gt;10 ppm Exceed USEPA Drinking Water Standard</i>			
11	49.5	2.5	0.50
12	54	2.7	0.54
13	58.5	2.9	0.58
14	63	3.2	0.64
15	67.5	3.4	0.68
20	90	4.5	0.90
25	112.5	5.7	1.14
30	135	6.8	1.36
35	157	8.0	1.60
40	180	9.1	1.82
45	202.5	10.2	2.04
50	225	11.3	2.26
60	270	13.6	2.72
70	315	15.9	3.18
80	360	18.2	3.64
90	405	20.4	4.08
100	450	22.7	4.54

**Example:**

1. Assume the irrigation water contains 20 ppm NO<sub>3</sub>-N and that 10 acre-inches of irrigation are applied per year.
2. From the table above, each acre-inch supplies 4.5 lbs N/acre, so 10 acre-inches provide 45 lbs N/acre.
3. The economic value of the N in the irrigation water is about \$9 per acre [ (45 lbs N/acre) x (\$0.20/lb N) ].

<sup>†</sup>Based on the assumption that fertilizer N costs 20¢ per pound.