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UTAH WATER QUALITY

FERTILIZER IMPACT ON GROUNDWATER IN UTAH

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Water quality has become the focal point of many decisions involving crop production. Crop production depends on specific inputs including fertilizer application. Without proper fertilization a farmer cannot achieve maximum **economic** returns. Crop yields in Utah have been increased over 50% by nitrogen fertilizer application alone. However, increasing nitrogen application beyond that needed for optimum economic return does more harm than good. This is especially true when groundwater concerns are [illegible]ressed.

Increased public awareness of the need for groundwater purity raises important questions concerning fertilizer nitrogen application and the specific role of **nitrate**. Nitrate is the primary form of nitrogen used by plants. Nitrogen itself is the most limiting nutrient element in plant development. Because of this limitation large amounts of nitrogen are applied to agricultural and urban soils. Homeowners will often use over 200 pounds per acre nitrogen for lawns. A primary concern involving nitrogen and groundwater quality is related to the mobile nature of nitrate through the soil system and its potential for groundwater contamination. Elemental nitrogen cannot be used by plants, but must first be converted to either ammonium or nitrate. Nitrogen in the ammonium form is relatively immobile and attaches to clay particles. Unfortunately, ammonium is converted to nitrate naturally in the soil system. This conversion is rapid during hot summer months. Nitrate, unlike ammonium, is mobile within the soil system. In coarse-textured soils (sand and gravel) nitrate may move completely out of the crop root zone in a single year depending on irrigation practices, precipitation and nitrogen appli-[illegible]ion management.

Many Utahans are concerned about the impact of nitrates in drinking water. Fertilizer nitrogen is only one potential source of nitrate pollutants. Other potential sources include sewage disposal systems, livestock facilities, land-applied manure, municipally digested sewage sludge, and even naturally occurring geologic materials which may have high concentrations of nitrates. All of these sources may contribute to the problem of nitrate in groundwater. Frequently, agriculture is not the source of nitrate-contaminated groundwater.

The U. S. Public Health Service and U. S. Environmental Protection Agency have established a drinking water standard of 10 ppm nitrate nitrogen as the maximum allowable level for public water systems. This standard is applicable to systems which have 15 connections and serve more than 25 persons and was based on the best information available to the Public Health Service, the EPA and other agencies. However, some people feel that even 10 ppm nitrate nitrogen poses a health hazard, especially to infants.

Infants (under six months of age) are susceptible to a condition referred to as methemoglobinemia, sometimes called the blue baby syndrome. This condition is exemplified when, because of nitrate being converted to nitrite after ingestion, the blood is unable to carry sufficient oxygen to individual body cells. This condition, however, has never been documented in Utah and only very rarely in the U.S. Adults can tolerate considerably higher nitrate levels than infants, with no deleterious effects. In fact, 25 ppm is the European standard. Nevertheless, if your particular water supply has levels higher than 10 ppm it is suggested that you use an alternative water source, especially for infant formula and food preparation.

FERTILIZER USE TO AVOID CONTAMINATION PROBLEMS

Nitrogen management throughout the crop year is critical to crop performance. However, attention is now being focused on fertilizer nitrogen as a potential contributor to groundwater contamination in many areas of the country. Whether this is right or wrong, the perception lingers that inefficient nitrogen fertilizer use and unacceptable nitrate levels in groundwater are correlated.

Managing nitrogen fertilizer for efficient plant use is good for the environment as well as the farmers' economic well-being. The goal of every farmer and fertilizer retailer should be to optimize the uptake of each fertilizer nutrient by the plant. This management consideration will result in high yielding, healthy crops with less nitrogen left in the root zone at the end of the growing season. This approach will maximize economic return to the grower and will minimize potential groundwater contamination.

A primary concern for growers has always been net economic return per acre. Since this is the case, a profit-motivated fertilization program should be based on an understanding of the productive capacity of a given soil environment. This can be done by basing crop fertility needs to the soil it is being grown on through research, soil testing, and observed crop responses.

An optimal nitrogen management program efficiently supplies nitrogen to the crop when it is needed and in amounts sufficient to maintain yield and profitability. Every cropping system differs. No single fertilization program fits all situations. However, several management practices exist which may aid in increasing plant uptake of applied nitrogen and reducing losses due to leaching which can effect groundwater quality.

NITROGEN MANAGEMENT GUIDELINES

In developing a nitrogen management program, one should first establish realistic yield goals for each field based on soil characteristics, irrigation practices, and crop history. This information, coupled with soil test results, provides a good basis for proper nitrogen fertilizer recommendations.

Nitrogen use by corn or small grains is commonly expressed as the ratio of applied nitrogen per bushel produced. For example, in Box Elder Co., Utah, a 160 bu/ac grain corn yield would require 200 lbs/ac Nitrogen as a base. For every bushel produced above this amount it will require another 1.6 pounds of additional fertilizer nitrogen. Therefore, the total required amount includes soil residual nitrogen as well as applied fertilizer nitrogen. To determine how much nitrogen a farmer needs to apply the top two feet of soil are analyzed. The difference between the total nitrogen requirement and residual soil nitrogen is the amount of fertilizer needed. The USU Extension Service provides information (Utah Fertilizer Guide) on nitrogen application rates required to achieve target yields for common Utah crops. Also provided are adjustments needed to account for non-commercial nitrogen sources, such as manure.

Soil incorporation of nitrogen fertilizers will reduce nitrogen losses caused by surface runoff and erosion. Incorporation also decreases the loss of nitrogen through volatilization (loss to the atmosphere) following surface application of urea.

When nitrogen applications are made well advance of crop use, ammonium forms of nitrogen, such as anhydrous ammonia, may prevent losses. Since ammonium forms of nitrogen tend to bind to clay soil particles the risk of leaching may be reduced. Nitrification inhibitors may be used in conjunction with ammonium fertilizers when soil type, moisture conditions, and temperatures are conducive to leaching or denitrification (conversion of nitrate to gaseous nitrogen).

All elements of crop production, including nutrients other than nitrogen, should be managed to meet yield goals. In this way low yields that tend to result from inefficient nutrient use and increased nitrate contamination of groundwater can be avoided.

Nitrogen management is only one portion of a total cropping system that affects crop growth and waste management. Efficient use of all resources can enable growers to improve profitability and environmental quality.

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