

University of Kentucky

UKnowledge

Soil Science News and Views

Plant and Soil Sciences

1991

Managing Soil Content of Nitrate Nitrogen

Kenneth L. Wells

University of Kentucky

Follow this and additional works at: https://uknowledge.uky.edu/pss_views



Part of the [Soil Science Commons](#)

[Right click to open a feedback form in a new tab to let us know how this document benefits you.](#)

Repository Citation

Wells, Kenneth L., "Managing Soil Content of Nitrate Nitrogen" (1991). *Soil Science News and Views*. 150.
https://uknowledge.uky.edu/pss_views/150

This Report is brought to you for free and open access by the Plant and Soil Sciences at UKnowledge. It has been accepted for inclusion in Soil Science News and Views by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.



Department of Agronomy

Soil Science News & Views



Vol. 12, No. 1, 1991

Managing Soil Content of Nitrate Nitrogen

K. L. Wells

The concerns about leaching of fertilizer nitrogen (N) into groundwater which were raised in the late 1960's were largely silenced during the 1970's as our agricultural economy was massively expanded. But since the early 80's they have been raised again to the point that national legislation (the Clean Water Act) was put into place to bring purity of the nation's water supplies into compliance with EPA-established standards. Beyond the apprehension largely about nitrate (NO_3) levels in groundwater, the groundwater issue today also includes concerns about pesticides. At the current time, the public is apprehensive about drinking water and this is being fanned by the media with information from various sources. Some of this information is reliable and some isn't, but all of it is pressing our governmental agencies toward more restrictive use of agricultural chemicals. This is coupled with advances in analytical techniques by which some substances can now be measured accurately in parts per trillion. It hasn't been many years since parts per million was the acceptable norm.

Agronomics of Efficient Fertilizer Nitrogen Management

The reason plant available N in the soil is so mobile is that it occurs largely in the NO_3 form, and $\text{NO}_3\text{-N}$ reacts so little with soil that there is very little capability for soil to buffer NO_3 movement against the forces of water movement through soil. And, if water leaches deeply enough, both water and the accompanying NO_3 enter the groundwater. So, the management objective is to prevent NO_3 movement below the rooting depth of a soil. It would seem that if a N fertilizer was used that didn't contain any $\text{NO}_3\text{-N}$ (urea, anhydrous ammonia, ammoniated phosphates, or ammonium sulfate), or one which didn't contain much $\text{NO}_3\text{-N}$ (nitrogen solutions), there shouldn't be any problem with leaching. However, the soil contains bacteria which, if the soil is warm enough for them to be active (ground 50°F), rapidly convert non- $\text{NO}_3\text{-N}$ to $\text{NO}_3\text{-N}$. So, if non- $\text{NO}_3\text{-N}$ is applied to soils which are warm enough for this to happen, the bacteria rapidly (in a few days time) convert most of the non- $\text{NO}_3\text{-N}$ to NO_3 . Thus, the same concern exists for managing ammonium forms of N as it does for NO_3 in the soil.

The ultimate objective in applying fertilizer N to soil would be to have all the fertilizer N taken up by the crop. Although this should be the objective, it's never achieved, largely because there's already some N present in the soil and the plant takes this "residual" N up along with fertilizer N. About the best technique to maximize crop uptake of fertilizer N, thereby minimizing NO₃ leaching to the groundwater level, is to apply it as closely as possible to the time the crop takes up N most rapidly. This is usually during the first half of the growing period. It does take a crop a few weeks after planting to grow large enough to absorb N in substantial amounts, so that delayed or split application of N fertilizer is the most effective method of increasing crop efficiency of fertilizer N and in lowering the probability of groundwater pollution. It also doesn't require as much N as a preplant application since losses of fertilizer N below the rooting zone are less probable with at-planting or post-planting applications.

Drainage characteristics of soil can also exert a sizable influence on crop use efficiency of fertilizer N. As already explained, much of the residual soil N, as well as that applied as fertilizer, is rapidly transformed to the NO₃ form during the growing season. And, once present as NO₃, there is a potential for N loss from the rooting zone by denitrification as well as by leaching. Since leaching losses result from a large amount of water flushing through the rooting zone, it generally occurs only in well drained soils following excessive rainfall. On the other hand, denitrification losses can reduce N use efficiency where drainage is a problem or where soil water percolates through the soil slowly following rainfall. Denitrification is a biochemical process which occurs when soil air (oxygen) is limiting. This situation most generally is found in soils with poor or slow drainage. Under waterlogged soil conditions (porespace largely saturated with water), losses of N due to denitrification may be great.

Studies have been conducted in Kentucky on both tobacco and corn to test management practices to minimize such losses. These studies have conclusively shown that the best practice to follow is either delay N application for 4-7 weeks after planting corn (1-2 weeks after transplanting tobacco) or to split the application by using 1/4 to 1/3 at planting and the remainder 4-7 weeks after planting corn (1-2 weeks after transplanting tobacco). This practice provides N when the plant is large enough to use large amounts and lowers the risk of early season losses of fertilizer N. The following table shows the results from this practice for corn growing on a high clay soil which tends to waterlog following rainfall.

Effect of Delayed N on Yield of No-till Corn Grown on Faywood Soil						
lbs N/A applied		Yield (bu/A)				
at planting	7 weeks after planting	1972	1973	1974	3-yr. Av.	
0	0	91	78	60	76	
150	0	100	106	105	104	
0	150	123	142	127	131	

Another scenario is potential overwinter leaching of carryover NO₃-N from fields which were fertilized with N during the preceding cropping season.



COOPERATIVE EXTENSION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
UNIVERSITY OF KENTUCKY
COLLEGE OF AGRICULTURE
LEXINGTON, KENTUCKY 40546

AN EQUAL OPPORTUNITY EMPLOYER

**BULK RATE
POSTAGE & FEES PAID
USDA
PERMIT No. G268**

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

In Kentucky, this is most likely to be corn, grain sorghum, and tobacco fields. The best method to minimize overwinter leaching of $\text{NO}_3\text{-N}$ from these fields is to fall seed a small grain such as rye, wheat, or barley. This scheme is inherent in the corn-wheat-soybean rotation. The practice also has use in other situations since the small grain not only takes up much of the carryover N from the previous crop, but also serves as winter cover to provide for erosion control.

Summary

Agriculture is coming under increasing fire to lower the likelihood of fertilizer N contamination of groundwater. Such practices as more timely application of fertilizer N and the seeding of small grain crops on fields likely to contain carryover N can greatly reduce overwinter leaching of soil NO_3 to groundwater.



Extension Soils Specialist