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# Factors Affecting Soil Nitrate Concentrations in Spring

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The nitrate concentrations in spring vary from field to field and from one year to the next, making it difficult to predict. Annual sampling is therefore needed. The following factors contribute to the variability of soil nitrate levels:

- **Winter precipitation, pre-irrigation:** In aerated soils, ammonium originating from fertilizers or the mineralization of organic material is quickly nitrified to nitrate. Nitrate, being a negatively charged ion, is easily leached from the soil profile with percolating water. Therefore, after a winter with heavy rainfall, the amount of nitrate found in the rooting zone in spring is lower than after a winter with little precipitation, with other factors being identical. Nitrate can also be leached below the root zone with excess irrigation.
- **Soil texture:** Soils with a high clay and or organic matter content retain more water than sandy soils and soils with low organic matter contents. Therefore, leaching is more pronounced in sandy soils and so are nitrate losses.
- **Soil organic matter content:** The nitrogen (N) mineralization rate tends to be higher in soils with high soil organic matter contents.
- **Spring weather:** Nitrogen mineralization generally proceeds faster under warm and moist conditions. Therefore, after a warm spring, the nitrate level in the soil is likely higher than after a cold spring.
- **Previous crop:** After the harvest of the previous crop, soil microorganisms start degrading crop residues and roots. How much N is being mineralized during the weeks following harvest of residue incorporation depends on the properties of the residues left in the field, especially their carbon to N ratio, and on climatic factors. The decomposition of crop residues with a high N content, such as legume residues, results in high net N mineralization rates and the accumulation of mineral N, namely nitrate (in aerated soils) and ammonium (in flooded soils). In contrast, when residues with a low N content are being incorporated, such as straw or corn stover, microorganisms may have to supplement the N in the residues with mineral N taken up from soil solution to cover their N needs, thus decreasing the concentration of mineral N in soil solution. This process is known as net N immobilization.
- **Fertilization level of the previous crop relative to the plant uptake:** If fertilizer application exceeded plant uptake, N, mainly in the form of nitrate, will be left in the soil profile after the harvest of the crop. How much of the nitrate will still be available in spring depends on factors such as winter precipitation and residue management. In the San Joaquin Valley, residual N levels in spring have been found to be low when the previous crop was cotton or wheat and high after corn, processing tomato or alfalfa [1].
- **Management of plant residues**: As mentioned above, the N content of the residues strongly affects whether net N mineralization or immobilization will take place. Decomposition of incorporated plant residues proceeds faster when they are incorporated into the soil instead of being left on the soil surface. Thus N mineralization or immobilization rates are accelerated when residues are incorporated. In addition, the amount of crop residues

available and the time of incorporation determine how much nitrate will be present in the rooting zone when the next crop is being planted.

## References

1. Hutmacher, R. B., Travis, R. L., Rains, D. W., Vargas, R. N., Roberts, B. A., Weir, B. L., Wright, S. D., Munk, D. S., Marsh, B. H., Keeley, M. P., Fritschi, F. B., Munier, D. J., Nichols, R. L., Delgado, R., 2004. Response of recent Acala cotton varieties to variable nitrogen rates in the San Joaquin Valley of California. Agronomy Journal 96, 48–62.

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