The New York Nitrate Leaching Index

The Nitrate Leaching Index (LI) is an indicator of the potential for nitrate to reach groundwater. Nitrate, because it is water soluble (see agronomy factsheet #2: Nitrogen cycle – the basics), moves downward as water percolates through the soil. The extent of percolation depends on permeability, pore-size distribution, soil depth to a restrictive layer, artificial drainage, and precipitation amount and distribution over the year. For a given precipitation pattern, excessively well drained soils such as Howard, Adams, Hoosic and Tunkhannock, or even well drained soils such as Madrid, Palmyra, Honeoye and Ontario have a significantly greater leaching potential than less well drained soils such as Vergennes, Swanton, Rhinebeck, Lordstown or Volusia. The current LI rates leaching potential based on soil hydrologic group (Table 1) and 10 year average precipitation data from weather stations around NY. Until recently, rainfall data were county-based. The latest version of the LI uses township-based precipitation data, which more accurately reflects precipitation patterns.

Table 1. Soil Hydrologic Groups.

Soil Hydrologic Group	Type	Infiltration Capacity / Permeability	Leaching Potential
A	Deep, well-drained sands and gravels.	High	High
B	Moderately drained, moderately fine to moderately coarse texture.	Moderate	Moderate
C	Impeding layer, or moderately fine to fine texture.	Low	Low
D	Clay soils, soils with high water table.	Very Low	Very Low

Calculating the LI

The Nitrate Leaching Index is calculated by multiplying the Percolation Index and the Seasonal Index for a particular location:

LI = Percolation Index * Seasonal Index

The Percolation Index is a function of the annual average precipitation and soil hydrologic group. Hydrologic group “A” soils have the greatest percolation potential and soils of hydrologic group “D” have the least percolation and lowest risk of leaching. The Seasonal Index is based on the annual precipitation and the sum of the fall and winter precipitation (October through March). When the factors are combined, the LI ranks the well drained soils in areas of high rainfall with a higher potential for leaching.

Fortunately, no calculations are necessary to rate a field. Appendix A of the *New York Nitrate Leaching Index* supplies the hydrologic soil groups and Appendix B provides the LI scores for each hydrologic group in each NY township.

Management Implications

An LI below 2 indicates that the potential for nitrate leaching below the root zone is low. An LI greater than 10 indicates that the potential for nitrate leaching below the root zone is high while LI’s between 2 and 10 are considered intermediate. In order to meet the N leaching requirements of the NRCS Nutrient Management Standard (590), producers are expected to implement best management practices (BMP) if the LI score for a field is high (>10) and to consider the same practices if the LI score for a field is intermediate (2-10). The following BMPs exist for soils with medium to high N leaching indices:

- Unless the New York Phosphorus Index (agronomy factsheet #10: How to calculate the New York Phosphorus Index) identifies the need for P based fertility management, manure and fertilizer application rates should be based on Cornell guidelines for meeting crop N needs.
- For corn, pre-plant (other than starter fertilizer) and early post plant *broadcast* applications of commercial nitrogen without the use of nitrification inhibitors are not recommended.

- Sidedress applications should be made after the corn has at least four true leaves.
- If starter N must be broadcast (e.g., for small grains or new seedings of grass), apply fertilizer as close to expected planting date as possible (ideally within 3 days or less).
- For row and cereal crops, including corn, maintain starter fertilizer N rates below 50 lbs/acre actual N under normal conditions.
- Manure and fertilizer applications should be adjusted based on information provided in "Nitrogen Recommendations for Field Crops in New York" (see additional resources).
- Evaluate the need for sidedress N applications based on PSNT or other soil nitrogen tests (see agronomy factsheet#3: Pre-sidedress nitrate test).
- Sod crops should not be incorporated in the fall. Chemical sod killing may be carried out when the soil temperature at four-inch depth is approaching 45°F. Depending on location, this will not likely take place until early October.
- Minimize fall and/or winter manure application on good grass and/or legume sod fields that are to be rotated the following spring.
- Appropriate ammonia conservation is encouraged. Losses can either be reduced by immediately incorporating manure or eliminated by directly injecting manure as a sidedress application to growing crops.
- Plant winter hardy cover crops whenever possible, especially when fall manure is applied (e.g., rye, winter wheat, or interseed ryegrass in summer).

Figure 1: Plant winter hardy cover crops where/when possible to reduce N leaching.

- Manure may be applied in the fall where there is a growing crop. Judicious amounts of manure can be applied to or in conjunction with perennial crops or winter hardy cover crops. Applications should generally not exceed the greater of 50 lbs/acre of first year available N or 50% of the expected N needs of next year's crop.
- Frost incorporation/injection is acceptable when soil conditions are suitable, but winter applications should be made in accordance with the NY Phosphorus Index.
- Manure N application on legumes is acceptable to satisfy agronomic requirements when legumes represent less than 50% of the stand. When legumes represent more than 50% of the stand, manure application should be limited to no more than 150 lbs of available N/acre.

Other Considerations

In addition to the fields identified with a high leaching potential by the LI, the best management practices should also be applied to fields with any of the situations, below:

- Soils, of any drainage, that are less than 40 inches deep over limestone bedrock.
- Glacial outwash and some well drained alluvial soils, especially over aquifers.
- Soils, of any drainage, that are less than 20 inches deep over other bedrock types.

These cases can be identified with a soil survey and local knowledge and aim to capture those fields with a thin layer of soil over fractured bedrock and course textured soils over aquifers.

Additional Resources

- The New York Nitrate Leaching Index: nmsp.css.cornell.edu/publications/nleachingindex.asp.
- Nitrogen Recommendations for Field Crops in New York: nmsp.css.cornell.edu/nutrient_guidelines
- Cornell University Agronomy Fact Sheets #2 (Nitrogen cycle – the basics), #3 (Pre-sidedress nitrate test), #4 (Nitrogen credits from manure), and #10 (How to Calculate the New York Phosphorus Index) nmsp.css.cornell.edu/ publications/factsheets.asp.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.css.cornell.edu

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