

Nutrient Recommendations for Field Crops in Vermont

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Introduction

Nutrient recommendations based on soil testing and other soil and crop information are the basis for manure and fertilizer management that optimizes economic return while protecting water quality and the environment. This publication documents the approach and specific soil test and crop data used to generate those recommendations at the University of Vermont.

The soil testing program at the University of Vermont is a joint effort of the Agricultural and Environmental Testing Laboratory, which conducts chemical analysis of the soils, and UVM Extension, which interprets and develops nutrient recommendations that are presented in the soil test report. Information provided by the farmer on the *Field Information Questionnaire* is combined with laboratory results to create a computerized soil test report that shows soil test results, nutrient recommendations, and other information about fertilizer application. (See Appendix for sample questionnaire and report.)

The University of Vermont uses a modified-Morgan's solution (1.25 M ammonium acetate, pH 4.8) to analyze most nutrients in its soil testing program. Research in Vermont, New York, and other New England states has shown it to be a good indicator of plant availability. (For more details about the methods, see the Appendix.) Results of recent and ongoing research in Vermont and other states have led to some changes in nutrient recommendations, which are reflected in this publication.

Revisions are primarily in the areas of phosphorus recommendations, availability of nitrogen in manure, and application of nitrogen on perennial forages.

Frequency of Soil Sampling and Time Period for Fertilizer Recommendations

We recommend soil sampling for routine nutrient analysis every one to three years (and when the crop is rotated). Fertilizer rates recommended—except for nitrogen (N)—are to be applied annually for approximately three years unless soil sampling is done more frequently. The recommended rates are intended to gradually build soil test phosphorus (P) or potassium (K) from Low or Medium to Optimum over a period of several years. Situations where annual soil sampling is especially recommended include intensively managed production of high K-demanding crops (e.g., alfalfa or silage corn), especially on sandy soils, and low testing fields where severe deficiency is possible and raising soil test level is critical. For the pre-sidedress nitrate test (PSNT), annual sampling is absolutely required because soil nitrate levels can vary greatly from one year to the next, depending on soil and weather conditions.

Soil Test Levels for Phosphorus and Potassium

Laboratory analysis of a soil sample only has value if it can be interpreted for a meaningful purpose, such as to indicate the availability of essential elements to a crop. To aid in this effort, we place soil test results into categories that are indicative of their

relative deficiency or sufficiency in terms of crop growth (Table 1). Interpretation of the categories in terms of probability of crop response is explained in Table 2. In the UVM soil testing program, results are expressed as parts per million (ppm) of elemental P, K, magnesium (Mg), etc. (Note that milligram/kilogram—mg/kg—is equivalent to ppm.) For categories expressed in other units, see Table 19 in Appendix.

Aglime

Most soils in Vermont need periodic applications of aglime to maintain pH in a range optimum for crop production. Maintaining a good pH level is important for maximizing availability of plant nutrients, for encouraging activity of beneficial soil microorganisms, and for maintaining soil conditions that will support good root growth and crop production. A pH of 6.8 is recommended for alfalfa or if alfalfa is to be seeded within two years. A pH of 6.2 is recommended for all other field crop situations.

Lime requirement is based on a combination of soil pH and reactive Al soil test. The pH tells us whether or not aglime is needed. However, different soils with the same pH may require very different amounts of aglime to reach the optimum pH. The reactive Al level is an indicator of the amount of reserve soil acidity that needs to be neutralized in order to change the pH and is used to determine the application rate of lime (Table 3). Recommendations are given in tons of aglime per acre, assuming a calcium carbonate equivalent (CCE) of 90% or higher. Most aglime sold in Vermont is within this range, but if your liming material has a CCE less than 90%, application rate should be increased accordingly. A common liming material in much of Vermont is aglime-wood ash blend (typically 80% aglime, 20% wood ash). While lime-ash has a slightly lower CCE than pure aglime, it contains some potash and other nutrients and is an excellent liming material.

Table 1. Soil test categories.

	Low	Medium	Optimum	High	Excessive
	ppm				
Available P	0-2	2.1-4	4.1-7	7.1-20	>20
K	0-50	51-100	101-130	131-160	>160
Mg	0-35	36-50	51-100	>100	—

Note: Soil test extractant is the Vermont Buffer, or modified Morgan's (1.25 M NH₄ acetate, pH 4.8).

Table 2. Interpretation of soil test categories.

Low (L)	High probability of crop response to addition of nutrient. Substantial amounts of additional nutrients needed to achieve optimum yields. In the case of phosphorus, the amount of P needed will vary with the level of reactive aluminum (Al)—more P needed with high Al.
Medium (M)	Moderate probability of crop response to addition of nutrient. Moderate amounts of additional nutrients needed to achieve optimum yields.
Optimum (OPT)	Most desirable soil test range on economic and environmental basis. Low probability of crop response to addition of nutrient, but to maintain in this range for successive years, a portion of crop removal needs to be replaced. If crop planning is done on short-term basis (e.g., one-year land rental) recommended broadcast fertilizer can be eliminated with low probability of yield reduction. However, in that case soil testing should be done annually to assure that soil test does not drop below optimum level.
High (H)	Higher soil test than needed for optimizing yields of most crops. Very low probability of crop response to addition of nutrient. No additional nutrients needed except K for high K-demanding crops on high-yielding sites. Low rate of starter fertilizer may be needed.
Excessive (EX)	Soil test higher than desirable for economic and/or environmental reasons. No fertilizer recommended. Addition of nutrients may cause nutrient imbalance.