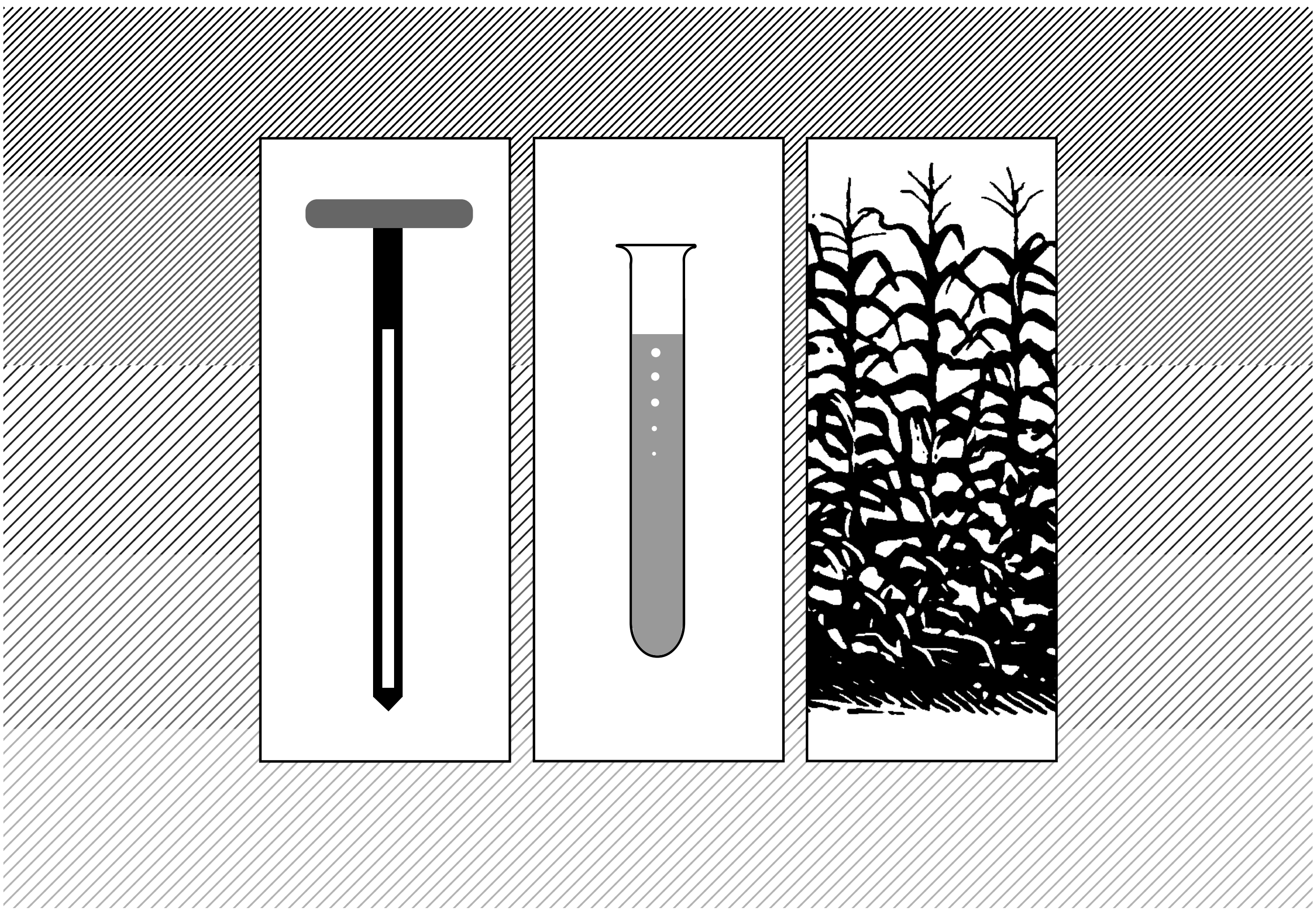
Nutrient Recommendations for Field Crops in Vermont



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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 Questionaire* 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 questionaire 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* NH_4 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.

Table 3. Aglime requirement based on soil pH, reactive Al, and target pH.

Soil pH[1]	Reactive Al	Target pH	
		6.8	6.2
	ppm	tons / acre	
>6.7		0	0
6.2-6.7	0-40	1	0
	>40	2	0
5.6-6.1	0-40	2	1
	41-70	2.5	1.5
	71-100	3	1.5
	101-150	3.5	2
	151-200	4	2.5
	>200	5	3
<5.6	0-40	3	1.5
	41-70	3.5	2
	71-100	4	2
	101-150	4.5	2.5
	151-200	5	3
	201-250	5.5	3.5
	251-300	6	4
	>300	7	5

[1] Soil pH is reported as the equivalent of pH measured in water (approximately 0.6 higher than pH measured in 0.01 *M* $CaCl_2$).

Nitrogen

Nitrogen for Annual Crops

Most annual nonlegume crops are very responsive to application of N. Table 4 shows recommended N application rates for annual crops (without credit for manure or previous crop). If the previous crop was a perennial forage crop or other legume crop, adjust values by subtracting previous crop N credits in Table 5. If manure has been applied in the past two years, subtract manure N credits calculated from Tables 14 to 17. Nitrogen rates are adjusted based on soil drainage class. Soils with poor or excessive drainage receive higher N recommendations because of the higher potential for gaseous N loss (denitrification) or nitrate leaching and / or slower N release via mineralization. The adjustments for previous crop, applied manure, and soil drainage are attempts to make N recommendations more site-specific, but they are estimates based on average weather and soil conditions. For a more reliable recommendation for corn, sidedress N when corn is 12 to 24 inches tall at a rate based on the Pre-sidedress Soil Nitrate Test (PSNT) from a soil sample taken when plants are 8 to 12 inches tall (Table 6).

Nitrogen rates for corn, whether based on a PSNT or on previous crop and manure, are also adjusted for yield level. This is a well-established practice based on the fact that a higher yielding crop takes up more N than a low yielding one. However, evaluation of long-term N response trials on corn in Wisconsin, Iowa, and Pennsylvania has shown poor correlation between yield level and optimum fertilizer N rate. It appears that soil and weather conditions conducive to producing high crop yields are the same conditions that support greater N supply from soils and more efficient use of that N by plants. There is evidence for some variation in optimum N rate based on soil type and climate, resulting in soil yield potential differences. Long-term average yield on a particular soil or field is a better estimate of soil yield potential and optimum N rate than yield goal, or maximum attainable yield, which commonly leads to over-fertilization.

In Vermont we are using a combination of drainage class and a more limited adjustment based on yield level than is used in some states (Table 4). The resulting N recommendation will be more accurate if it is based on a long-term average for the field, rather than a “yield goal” or maximum yield. The best approach is to use the PSNT, which will provide a recommendation based on the specific field conditions in a given year (Table 6).

Following are several application suggestions or adjustments in the recommended N rates:

- Nitrogen rates in Table 4 are total amount of N to apply, both manure and fertilizer, including starter and broadcast or sidedress N. Apply a portion of the recommended N as a starter fertilizer banded with the planter (10-30 lb / acre for corn, 10-20 lb / acre for winter small grains, 10-30 lb / acre for spring small grains). Use the higher rates where no pre-plant N or manure has been applied. Subtract starter N rate to determine application rate for broadcast or sidedressing. (For more information, see UVM Extension Br 1392, *Starter Fertilizer for Corn in Vermont*.)
- The salts in fertilizer—primarily N and K compounds—can cause poor germination and seedling injury if excessive rates are applied near the seed. To prevent these problems, limit the rate of starter fertilizer. For corn, limit combined N + K_2O banded with planter (2" to the side and 2" below the seed) to 80 lb / acre.

Table 4. Recommended nitrogen rates for annual crops (without credit for manure or previous crop).

Corn: Expected yield — Silage[1] ton / acre	Grain bu / acre	Somewhat poorly to poorly drained	Well drained to moderately well drained	Excessively drained
		Soil drainage class		
		N to apply, lb / acre		
15	90	90	80	90
20	120	120	100	120
25	150	150	130	150
30	180	150[2]	150	150[2]
Small grains (oats, wheat, barley, rye), millet		70	50	70
Sorghum, sorghum-sudan, sudangrass, sunflower		90	70	90
Dry beans, peas, buckwheat		40	30	40
Soybeans		0[3]	0[3]	0[3]

Note: Reduce N rates for previous crop credits (Table 5) and manure application (Tables 14-17).
[1] Silage yields are wet tons / acre (30-35% DM).
[2] 30 ton / acre (180 bu / acre) yield not considered realistic on these soils. Recommendation for 25 ton / acre yield is provided.
[3] A low rate of N (5-10 lb / acre) may be applied in a 2"x2" placed starter band, but do not apply in direct contact with the seed.

For small grains, limit combined N + K_2O applied with the grain drill to 40 lb / acre.

- For no-till corn, add 30 lb / acre to above rates to account for slower N mineralization and / or greater N losses under no-till conditions.
- For corn grown on sandy, excessively drained soils without manure, split nitrogen into pre-plant and / or starter (50 or more lb / acre) with the remainder applied as a sidedress.
- For small grains on fields where lodging tends to be a problem, reduce N rates by 20 lb / acre.
- Soybeans properly inoculated with N-fixing bacteria seldom respond to N fertilizer. Inoculate with fresh, viable bacteria just before planting. If soybeans have not been grown on the field previously, triple the rate of inoculant.

Credit for Previous Crop

Nitrogen released from the previous year's plowed-down crop residue can supply a significant portion of a crop's N need. Nitrogen tied up in the roots and above-ground regrowth of perennial forages, especially legumes, is released over an extended period of time as soil microorganisms break down the plant tissues and release N in inorganic forms that plants can use. Nitrogen credits

Table 5. Nitrogen credits for previous crops.

Previous crop		Fertilizer N credit: Previous year	Two years ago
		lb / acre	
Alfalfa	>60% legume	120	60
	20-60%	80	40
Red clover, trefoil	>60% legume	90	40
	20-60%	70	30
Grass	Moderate-high level mgmt. (>2 ton / acre yield	70	30
	Low level mgmt. (2 ton / acre or less)	40	20
Soybeans, dry beans / peas		30	0

Note: Subtract N credit from recommended N rates in Table

Table 6. Recommended nitrogen rates for corn based on the Pre-sidedress Soil Nitrate Test (PSNT).

PSNT	Expected corn yield[1]		
	15 ton/acre or 90 bu/acre	20 ton/acre or 120 bu/acre	25+ ton/acre or 150+ bu/acre
ppm	N to apply, lb/acre[2]		
2	80	110	140
4	80	110	140
6	80	105	135
8	75	100	125
10	70	90	115
12	65	80	100
14	60	75	90
16	55	65	80
18	50	60	70
20	45	50	60
22	40	40	45
24	35	35	35
25	30	30	30
26	0	0	0

[1] Silage yields are wet tons/acre (30-35% DM).
[2] If previous crop was a well-managed stand of grass, legume, or mixed forage, subtract 30 lb/acre from above N rates.

for the first and second year after plowdown (Table 5) should be subtracted from the N rates given in Table 4. Because the amount of N released varies with temperature and moisture conditions, as well as the amount and type of initial plant material, the values in Table 5 are estimates and will vary for the specific situation. Use of the PSNT is the best way to reduce this uncertainty when corn is the current crop (Table 6).

Pre-sidedress Soil Nitrate Test (PSNT) for Corn

Until recently, there was no reliable soil test for N in the more humid eastern part of the U.S., and N recommendations were based only on yield goals and average soil and weather conditions. (See Tables 4 and 5.) But with the development of the PSNT by Dr. Fred Magdoff of the University of Vermont, we now have such a tool. The PSNT requires a soil sample (0 to 12 inch depth) taken when plants are 8 to 12 inches tall. Nitrate measured at that time is a good indicator of the N-supplying capacity of the soil, accounting for soil differences among fields and year-to-year weather differences in the same field. Fertilizer N is then recommended to supply adequate N to the corn crop. Applying fertilizer N at sidedress time is also a more efficient use of N, especially under conditions for high leaching potential, because it avoids loss of N between spring and the start of the period of maximum crop N demand in late June and July.

Nitrogen rates based on the PSNT range from a maximum rate at PSNT values of 5 or less to zero at PSNT of greater than 25 ppm (Table 6). Because these are sidedress N application rates they do not include N applied in the starter, assuming a 10 to 20 lb/acre rate. Recommendations in Table 6 are based on the following formulas, depending on expected yield (rounded to nearest 5):

15 ton/acre yield: N Rate=80-2.5 x (PSNT-5); except if PSNT <5, then N Rate=80 lb/acre.

20 ton/acre yield: N Rate=110-4 x (PSNT-5); except if PSNT <5, then N Rate=110 lb/acre.

25 ton/acre yield: N Rate=140-5.5 x (PSNT-5); except if PSNT <5, then N Rate=140 lb/acre.

Soil samples for PSNT are taken between corn rows to avoid starter fertilizer bands so they do not measure starter N. Consequently, starter N rates greater than 20 lb/acre should be subtracted from the recommended sidedress rates. Recommended N rates are reduced by 30 lb/acre where previous crop was a well-managed stand of grass, legume, or mixed forage. Recent research results have shown less yield response to N fertilizer where corn followed a good sod plowdown than the PSNT would indicate. Apparently, this is because N mineralization rate increases proportionally more after PSNT sampling where a perennial forage was plowed down than with a previous crop of corn.

Nitrogen for Perennial Forages

Establishment (Seeding Down)

No N is recommended for establishment of legumes or legume-dominant mixtures without a companion crop because N will favor the grasses and weeds and it may delay development of N-fixing capacity of legumes (Table 7). When the perennial forage species is established with a small grain companion crop, or when grasses are direct seeded (i.e., without a companion crop), some N is

Table 7. Recommended nitrogen rates for establishment of perennial legume or grass forages.

Companion or nurse crop	Legumes, legume-grass	Grasses
	N to apply, lb / acre	
None	0	50[1,2]
Small grain	30	30[2]

[1] For late-summer seeding, reduce to 30 lb / acre.
[2] If a second grass harvest is expected, make a second application of 40-50 lb N / acre after first harvest.

needed to support adequate growth. The higher N rate for direct-seeded grasses is for spring seeding to support a grass harvest later in the season. Nitrogen rate when a companion crop is used must be limited to avoid excessive competition, or even lodging, from the small grain.

Topdressing

Established grass forage species generally show consistent and large yield increases from application of N fertilizer. Economic responses can be obtained from application of as much as 200 lb N / acre on well-managed, high-yielding stands (three- or four-cut system, adequate P and K fertility, etc.). (See Table 8.) For lower level management or yield potential situations, less N is recommended. Because of the potential for leaching and other losses, N should be split into multiple applications of 40 to 75 lb / acre each. An optimum schedule is to apply N before significant regrowth occurs for each crop to be harvested—in early spring and after first, second, and (if a fourth cut will be made) third harvest. The higher rate should be applied in early spring when growth (and N response) potential is the greatest.

If manure is to be applied (or has been applied), reduce fertilizer amounts to account for nutrient contributions from manure (Tables 14 to 17). While manure can provide significant N for a grass crop, volatile losses of N as ammonia can be quite high from surface-applied manure. Consequently, best yields are usually obtained if manure is supplemented with fertilizer N.

Mixed stands with less than 20% legume should be fertilized as grass unless legumes are being encouraged, in which case a reduced rate should be applied in early spring. Stands with higher legume amounts (20 to 60%) may benefit from an early spring topdress of about 40 lb / acre, and in some cases (20 to 40% legume) from a second application later in the season. No N is recommended for hay stands where legumes are dominant (>60%), because N is supplied by N-fixing bacteria.

Table 8. Recommended nitrogen rates for perennial grass and grass-legume forages.

	Nitrogen to apply	
	Per application	Total per year
Grass (<20% legume)[1]	N, lb / acre	
Hay, high level mgmt. (5+ ton / acre)	50-75	200
Hay, medium level (3-4 ton / acre)	50	150
Hay, l ow level mgmt. (2 ton / acre)	40-50	100
Pasture, intensively managed	50	100
Pasture, low-level management	50	50
Conservation planting	40	40
Legume-grass mix (20-60% legume)		
Hay harvest	40	40
Pasture	0	0
Conservation planting	0	0

[1] Yields are dry hay equivalent (12-15% moisture). One ton dry hay is equivalent to 2.5 tons haylage (65% moisture).

Phosphorus

Phosphorus recommendations for agronomic crops in Vermont are based on a combination of the available P soil test (P extracted with Modified Morgan's solution) and reactive Al (Al in the same extractant). Research results from Vermont, New York, and other states support an available P soil test critical level of approximately 4 ppm, which means that economic yield increases from the addition of P fertilizer are unlikely on soils testing above that level. Little or no P fertilizer is recommended for a soil testing higher than 4 ppm (Table 9). Reactive Al is an indicator of a soil's ability to fix, or tie up, added phosphorus. Thus, low P-testing soils with high aluminum levels require greater amounts of added P to provide an adequate P supply to the crop and to raise soil test P. The recommended P fertilizer rates are expected to raise soil test P to the critical level in 4 to 6 years.

Table 9. Recommended base phosphorus rates for selected available P and Al test values. (Adjust for specific crop based on Table 10.)

Reactive Al	Available P soil test: Low		Medium		Optimum[1]	High[2]	Excessive
	ppm						
	0.5	1.5	2.5	3.5	4.1-7	7.1-20	>20
ppm	P_2O_5 to apply, lb / acre						
10	60	60	40	40	20	0	0
20	65	60	40	40	20	0	0
30	75	55	40	40	20	0	0
40	90	65	40	40	20	0	0
50	100	70	45	40	20	0	0
60	110	80	50	40	20	0	0
70	120	90	55	40	30	0	0
80	120	95	60	40	30	0	0
90	120	105	65	40	30	0	0
100	120	115	70	40	30	0	0
110	120	120	75	40	30	0	0
120	120	120	80	40	30	0	0
130	120	120	85	40	30	0	0
140	120	120	90	40	30	0	0
150	120	120	95	40	30	0	0
160	120	120	100	40	30	0	0
170	120	120	105	40	30	0	0
180	120	120	110	40	30	0	0
190	120	120	115	40	30	0	0
200	120	120	120	40	30	0	0

Note: Table shows selected values within each category. Recommended P application rates are based on the equation in the text at right.

[1] The recommended rate (20 to 30 lb P_2O_5 / acre) is best applied as starter / row fertilizer at planting for corn or broadcast as a blend with other nutrients as a topdress on perennial hay forages.

[2] A low rate of starter fertilizer (10 to 20 lb P_2O_5 / acre) is recommended, especially under conditions of early planting, limited drainage, or conservation tillage.

Recommended P application rates for soils testing Low or Medium (4 ppm or less) are determined as follows:

1) Determine base P rate from available P and reactive aluminum (Al) soil tests using the following equation: P_2O_5 to apply (lb / acre) = [(Al+36) x (4 - Avail P)] / 3. (See Table 9 for P rates for selected soil test levels).
2) Adjust these phosphorus rates for specific crops by adding or subtracting amounts given in Table 10. Results are rounded to nearest 5 lb / acre.
3) Apply maximum and minimum limits, as follows: Maximum recommended rate = 120 lb P_2O_5 / acre. If Available P test = Low, then minimum = 60 lb P_2O_5 / acre. If Available P test = Medium, then minimum = 40 lb P_2O_5 / acre.

The adjustments in Table 10 are based on crop management factors and relative crop needs. For example, more P is recommended for seeding down a perennial forage than for topdressing because the tillage in preparation for establishment gives an opportunity to mix P fertilizer throughout the plow layer. Phosphorus that is tilled in is more efficiently taken up by the plant root system than P topdressed on the surface; it is also less susceptible to loss in surface runoff.

Table 10. Phosphorus (P_2O_5) rate adjustments for different crops.

Crop	Available P soil test level	
	Low-medium (0-4 ppm)	Optimum (4.1-7)
	lb P_2O_5 / acre	
Corn	No change	No change
Small grains, soybeans, dry beans / peas, buckwheat, sorghum, sorghum-sudan, sudangrass, sunflower	Subtract 20	No Change
Establishment of perennial forages	Add 40	Add 20
Topdress of alfalfa (>60%)	No Change	No Change
Topdress of other perennial forages	Subtract 20	No change
Conservation planting	Subtract 30	Subtract 20 or 30

Note: Add or subtract from values in Table 9, but note minimum rates for Low and Medium P test.

Example calculation
(See formula and procedure p. 7, and Table 10 above.)

Soil with available P test = 2.2 ppm;
reactive Al test = 62 ppm.

Recommended P rate for corn = (62+36)x(4-2.2) / 3 = (98x1.8) / 3 = 58.8 or 60 lb P_2O_5 / acre.

Recommended P rate for establishment of perennial forage = 60 + 40 = 100 lb P_2O_5 / acre

Minimum and maximum limits are placed on recommended P rates even though the P test-reactive Al combination may indicate a higher or lower rate (see shaded areas in Table 9). A minimum of 60 or 40 lb / acre is recommended for soils testing low or medium because lower rates are sometimes impractical to spread as a broadcast application. A maximum of 120 lb / acre is recommended because higher rates are considered economically prohibitive and the 120 lb / acre rate will adequately meet the current crop need. However, a longer-than-expected time may be required to raise the P test to the optimum range on those soils.

Soils testing in the optimum range receive a recommendation of 20 lb P_2O_5 / acre or (if Al > 60 ppm) 30 lb P_2O_5 / acre. Applying these low rates will help maintain test levels within the optimum range until the next soil testing is done. Except for topdressing of perennials, this P is best applied as a band at planting. Band application of low rates of P near the seed with the planter or drill ("starter fertilizer") is a very efficient method for supplying P to the young plant. This method is especially important with low soil temperatures that occur with early planting, limited drainage, or conservation tillage or with low soil test P. When lower rates of P are recommended (20 to 60 lb P_2O_5 / acre), all the P can be applied in a band at planting. When high rates are recommended, a combination of starter and broadcast fertilizer or manure should be used. The probability of an economic yield increase from the use of starter P decreases as soil test P reaches the high category; and if P test is excessive, none is recommended. (For more information, see UVM Extension Br 1392, *Starter Fertilizer for Corn in Vermont*.)

If manure will be applied, recommended P rates should be reduced based on manure rate and nutrient content (from manure analysis or typical values, Table 14).

Phosphorus Index to Assess Runoff Potential

Increasing concern in recent years about the contribution of nutrients in surface runoff to lake eutrophication makes it important to avoid excessive application of P in fertilizers and manure. For both environmental and economic reasons, application of P is not recommended when soil test P is above the level at which an economic yield response is likely

(Table 9). However, assessment of the potential for P runoff loss from an agricultural field requires evaluation of a number of factors, of which soil test P is only one. The Phosphorus Index was developed as a tool to combine various soil and management factors into an index that can serve as a management tool as part of the nutrient management planning process. The revised P Index for Vermont uses several parameters, including erosion, soil hydrologic group, P soil test, rate and method of P application, and buffer characteristics, to estimate the potential for runoff of phosphorus from a given field. The results of the P Index calculation for each field are expressed as an index (0 to 100+) and are assigned a low, medium, high, or very high rating. Recommended management practices for each category can then be used as a guide to prioritize fields and to determine those on which P application should be limited or additional conservation practices implemented. The 2004 version of the Vermont P Index can be downloaded from the Web at: *http://pss.uvm.edu/vtcrops/?Page=nutrientmanure.html#Phosphorus*

Potassium

Plant-available soil K is primarily in the exchangeable form; that is, it is adsorbed to organic matter and clay surfaces but can be readily exchanged with ions in soil solution and taken up by plants. It is exchangeable K that is measured by the Modified Morgan's extractant (NH_4 acetate, pH 4.8). The rate of potash recommended is based on soil test K level and on crop need, as determined by crop type and yield level (Table 11). Recommended K rates for low-testing soils are quite high, especially for corn silage and perennial forages in which the whole plant is harvested. Even for soils in the optimum range, a substantial amount of potash is recommended because soils can be more quickly depleted of K than of P.

Potassium rates for corn silage and hay forages are adjusted based on yield level and on whether corn is harvested for silage or grain because these factors affect plant uptake and removal of K. Less potash is recommended for grass forage than for legumes because the fibrous rooting system of grasses is more efficient at scavenging for K than is the tap root system of legumes. In the case of a legume-grass mix, an adequate K supply is important to maintain the competitiveness of the legumes relative to the grasses. Less potash is recommended for establishment of a perennial forage than for topdressing to minimize any possible fertilizer injury to seedlings. Lower establishment-year yields mean lower K uptake, as well.

A portion of the K recommended for corn (10 to 20 lb K_2O/acre) should be banded with the planter, especially on low- and medium-testing soils. (For more information, see UVM Extension Br 1392, *Starter Fertilizer for Corn in Vermont*.)

If manure will be applied, recommended K rates should be reduced based on manure rate and nutrient content (from manure analysis or typical values, Table 14).

Secondary and Micronutrients

Magnesium Recommendation - All Crops

Magnesium can be deficient on some Vermont soils. Because the available form of both Mg and K is a cation (positively charged ion), there is competition between the two for plant uptake. As a result, Mg deficiency is more likely to occur on high K-testing soils. Therefore, we have different recommendations for two situations—those with K test lower and higher than 200 ppm. For the higher K-testing soils, Mg critical level and recommended rate are adjusted for the K test level.

Situation 1: K soil test is 200 ppm or less.

Mg soil test of 50 ppm is considered adequate.
Mg recommendation, lb/acre = 100 - (2 x Mg soil test)

Situation 2: K soil test is greater than 200 ppm.

Mg recommendation, lb/acre = (0.6 x K test) - (2 x Mg soil test).

Zinc for Corn

Zinc (Zn) deficiency is not a consistent problem in Vermont, but it has caused serious production problems, primarily in corn, in some fields in some years. The Zn soil test provides a guide for Zn fertilizer need, but is best combined with field observations (Table 12). Zinc deficiency is more likely on fields with no recent manure application or on soils with very high soil test P (or excessive P application), low organic matter, or relatively high pH (approaching 7 or higher). Weather conditions are also a factor—with problems more likely under cool spring conditions. Zinc deficiency symptoms generally appear in young corn (6-12 inches tall) as interveinal chlorosis (light color between veins) or wide bands on either side of the midrib of younger

Table 11. Recommended potassium rates for field crops.

	K soil test						
	Low		Medium		Optimum	High	Excessive
K, ppm:	<25	26-50	51-75	76-100	101-130	131-160	>160
	K_2O to apply (lb / acre)						
Corn for silage[1]							
15 or 20 ton / acre	200	160	120	80	60	0[2]	0
25+ ton / acre	240	200	160	120	80	30	0
Corn for grain							
90 or 120 bu / acre	140	100	60	40	30	0[2]	0
150+ bu / acre	180	140	100	60	30	30	0
Alfalfa (>60%)[3]							
Topdress							
2-4 ton / acre	280	240	200	160	100	40	0
5 ton / acre	320	280	240	200	140	60	0
6+ ton / acre	360	320	280	240	180	80	0
Establishment	240	200	160	120	80	40	0
Clover, trefoil, grass, alfalfa (20-60%)[3]							
Topdress							
2-4 ton / acre	220	180	140	100	60	0	0
5+ ton / acre	260	220	180	140	100	0	0
Establishment	180	140	100	80	60	0	0
Small grains, soybeans, buckwheat, dry beans / peas, millet	120	100	80	60	40	0	0
Conservation planting	80	60	40	0	0	0	0

[1] Corn silage yields are wet tons / acre (30-35% DM).
[2] 10-20 lb K_2O / acre recommended as row-applied starter under conditions of early planting, limited drainage, or conservation tillage.
[3] Yields are dry hay equivalent (12-15% moisture). One ton dry hay is equivalent to 2.5 tons haylage (65% moisture).

(upper) leaves. The chlorotic bands do not extend to the tip of the leaf (as they do in Mg-deficient plants). Plants are often stunted in growth. Zinc deficiency usually occurs in spotty, irregularly shaped areas in the field.

Where Zn test is low or deficiency symptoms have been observed in the past, a broadcast application of Zn incorporated with tillage has been more effective than starter Zn and is generally sufficient for five or more years. Zinc sulfate (36% zinc) is the most common fertilizer material and should be applied at a rate to supply 8 to 10 lb / acre of actual Zn (25 lb / acre of $ZnSO_4$). Under less immediate deficiency situations, a low rate (about 2 lb / acre) can be applied annually with starter fertilizer.

Boron on Perennial Legume Forages

Boron (B) deficiency has historically been a problem in Vermont on alfalfa and, to a lesser extent, red clover and birdsfoot trefoil. In fact, some of the early research that showed that serious alfalfa production problems were caused by B deficiency was done by Professor Midgley at the University of Vermont in the 1930's and '40's. Unfortunately a soil test is not reliable for diagnosing the need for B, so B is routinely recommended for topdressing and seeding down alfalfa, trefoil, and red clover—except where B was applied the previous year (Table 13). Care should be taken to avoid excessive rates, especially on legume-grass combinations, because of the potential for B toxicity.

Table 12. Zinc recommendations for corn.

Zn test	Zn level	Deficiency symptoms?	Zn recommendation
ppm			
<0.5	Low	yes / no	8-10 lb / acre, broadcast and incorporated[1]
0.5-0.9	Medium	yes	8-10 lb / acre, broadcast and incorporated[1]
0.5-0.9	Medium	no	8-10 lb / acre, broadcast and incorporated[1] *or* 2 lb / acre in starter annually for 2-3 yrs; then retest
1.0+	Optimum / High	no	None

[1] Adequate for five or more years.

Table 13. Boron recommendations for perennial forages.

Species	Seeding year[1]	Topdress
	lb / acre	
Alfalfa (20-100% stand)	2	1-2
Red clover (20-100% stand)	2	1-2
Trefoil (20-100% stand)	2	1
Grass	0	0

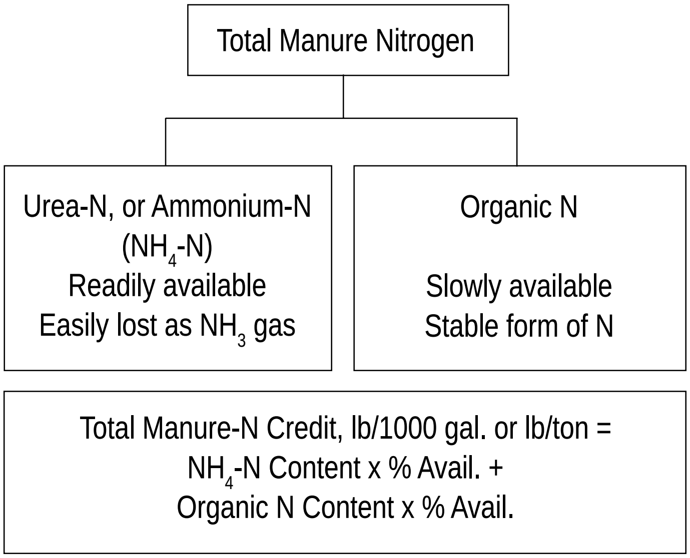
[1] If B applied within past year, none is needed at seeding.

Nutrient Credits from Manure

Nutrient Content

Manure is a very important source of nutrients for crop production in Vermont, supplying more nutrients than purchased fertilizer on most dairy farms in the state. Proper application of manure can result in substantial reductions in fertilizer costs. As with fertilizer, however, careful management is necessary to minimize any adverse effects on water quality. For both economic and environmental objectives, it is important to know the content of nutrients in the manure so that the quantity applied matches crop need. Because the nutrient content of manure is highly variable, sampling and lab analysis are strongly recommended. If the customer provides actual manure analysis, it will be used to calculate available nutrients in manure. Otherwise, estimates will be based on "typical" values shown in Table 14. (Note: If dry matter—DM—content of manure varies greatly from the values in Table 14, nutrient content estimates should be adjusted accordingly.) In either case, recommended fertilizer rates are adjusted for the availability of nutrients from manure applications that have been applied or are planned. Because the nutrients in manure are not fully equivalent to those in fertilizer, the total nutrient content, especially of N, is reduced to account for losses and inefficiency of plant uptake relative to fertilizer. In terms of availability, N in manure consists of two fractions—the ammonium portion, which is potentially equivalent to fertilizer N but is also susceptible to large losses, and the more stable organic fraction, which releases N in an available form over a longer time period (Figure 1).

Figure 1. Forms of manure nitrogen.



Availability of Ammonium Nitrogen

The ammonium N (NH_4^+-N) fraction of manure N (or urea or uric acid, which quickly converts to ammonium) represents a form of N that is essentially equivalent to fertilizer N if managed properly. However, it can volatilize quite quickly as ammonia (NH_3) gas if left on the surface after spreading. This gaseous loss of N can be prevented by incorporating manure into the soil, either by tillage or by significant rainfall (about 1/2 inch). Incorporation brings NH_4^+ in manure into direct contact with soil organic matter and clay, which can adsorb NH_4^+. Loss of ammonium via volatilization is also a function of manure dry matter content. Manure or slurry that is more liquid infiltrates the soil more readily so that more of the ammonium N is conserved. These phenomena are illustrated in Figure 2, which is based on an approach developed by researchers in England (K. Smith, 1997, personal communication) and modified to better fit Vermont research results.

Table 14. Typical values for total nutrient content of manure.

Species/type	Dry matter	Total N	NH_4-N	Organic N	P_2O_5	K_2O	Mg	Ca
	%	lb/1,000 gal.						
Dairy, liquid	7	25	12	13	8	20	4	10
	%	lb/ton						
Dairy, semi-solid	17	9	3	6	4	7	2	4
Dairy, solid (>20%DM)	26	9	2	7	4.5	7	2	6
Beef	23	12	3	9	6	12	1.5	—
Hog	9	14	8	6	11	11	1.5	—
Sheep	25	23	7	16	8	20	2.5	—
Poultry, layers	55	50	10	40	50	34	8	10
Poultry, broilers	70	73	19	54	63	46	13	30
Horse	37	9	1	8	6	11	4	—

Note: Dairy and layer manure values are from samples analyzed by the UVM Agricultural and Environmental Lab, 2000-2003. Values for other manures are from *Penn State Agronomy Guide* (2004), Univ. of MD Ext. Fact Sheet 512, and Ontario Ministry of Agric. and Food Factsheet No. 85-109.

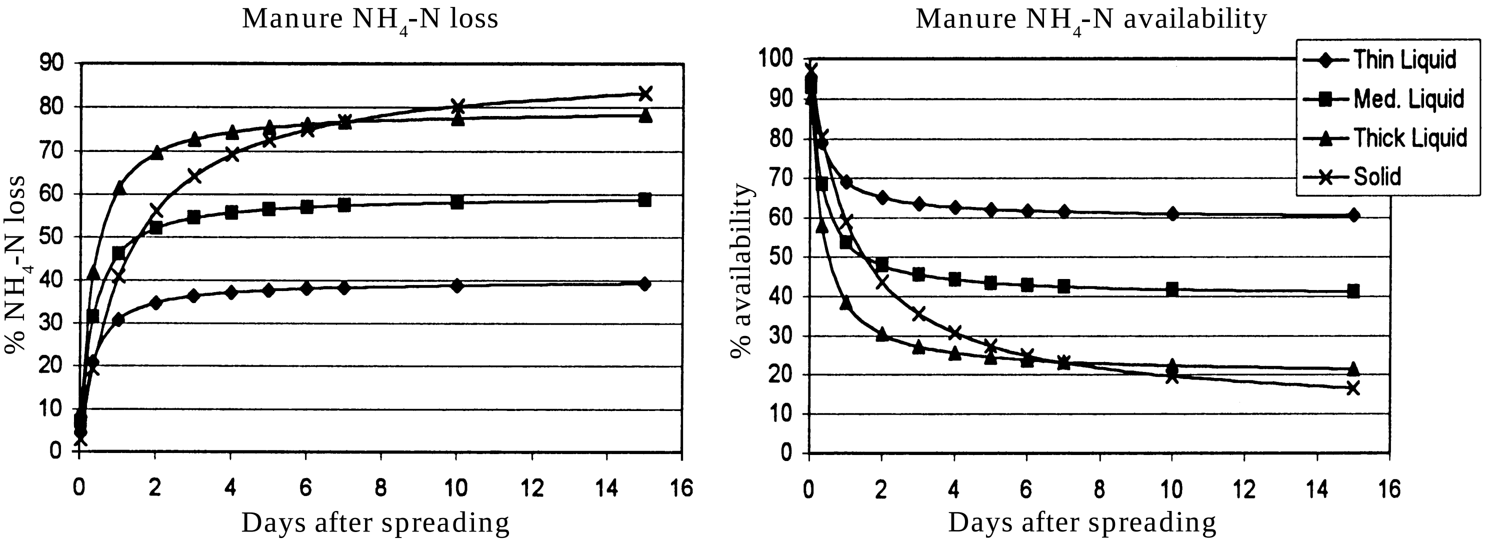


Figure 2. Loss (left) and resultant availability relative to fertilizer N (right) of ammonium N from manure as a function of manure dry matter content and time after spreading.

Values for NH_4^+-N availability of spring-applied non-poultry manures are based on the following formulas:

- Liquid manure: %N availability = 100 - [(20 + 5xDM) x (days / (days+0.3))], where DM ranges from 4% to 12%.
- Semi-solid manure: same as liquid manure, using 12% DM in formula.
- Solid manure: % N availability = 100 - 90 [days / (days+1.2)].
- If time to incorporation is >7 days (or nonincorporated), %N availability = 60, 40, 20, and 10% for thin, medium, thick (or semi-solid), and solid manure. (See Table 15.)

If the farmer provides a value for % DM (same as % solids) of manure (from analysis or reliable estimate), then an estimate of N availability will be given based on the above formulas and the specific DM content. If a DM content is not given, then availability of ammonium-N in manure will be based on approximate values from different categories of DM content—thin (0-5%), medium (5-10%), and thick (>10%) liquid manure, semi-solid manure, or solid (>20% DM) manure (Tables 15 or 16). Availability for the three liquid manure categories are calculated using DM percentages of 4, 8, and 12. Semi-solid is treated as "thick liquid," using a DM value of 12%. If manure is applied in the fall, estimates of NH_4^+-N availability are reduced to 40% of spring-applied manure to account for overwintering losses due to leaching, denitrification, and runoff (Table 16). Values in Tables 15 and 16 have been rounded to the nearest 5%.

Availability of Organic Nitrogen

Organic N is the manure N fraction that is part of large organic compounds, a form that can not be taken up directly by crop plants. But as microorganisms utilize these carbon compounds to derive energy, some of the N is mineralized, or released, as ammonium and is available for plants. While the greatest portion is mineralized in the first season, the process continues at a slower rate for one or more additional years and is affected by several factors (Table 17). Because mineralization is carried out primarily by aerobic bacteria, the rate is reduced in poorly drained soils compared to well-drained (well-aerated) soils. Large amounts of high-carbon bedding material (as indicated by high DM content, greater than 20%) decrease the net release of N because more of the inorganic N mineralized is immobilized, or utilized directly by the soil microbes to supply their N needs. Available N values for manure left on the soil surface, as in perennial forages and no-till corn, are reduced (by approximately a third) to account for slower mineralization of organic N that is not mixed with the soil (Table 17).

Availability of N from composted manure has not been well researched in Vermont or the region. It is expected to be less than uncomposted manure because most of the available N has been either lost to volatilization or immobilized during the composting process. Penn State (*Agronomy Guide*, 2004) uses a first-year availability of 10% of the total N, with 5% and 2% availability in the second and third years after application.

Other Nutrients

The approach for estimating the availability of other nutrients in manure is much less complex. Potassium in the plant cell (and, thus, in manure) is not tied up in complex organic compounds but exists in the K^+ ionic form. Therefore, it is equivalent in availability to K in fertilizers. Phosphorus in manure is a combination of organic and inorganic compounds and is sometimes considered less plant-available than fertilizer P. However, manure P is not as readily tied up in unavailable forms in the soil as soluble P fertilizers. Consequently, manure and fertilizer are very similar in building soil P and supplying crop needs. In the current Vermont program we consider manure P equivalent to fertilizer. Manure also contributes significant amounts of magnesium, calcium, sulfur, and various micronutrients for crop growth.

Table 15. Availability of ammonium nitrogen from spring- or summer-applied manure (% fertilizer N equivalent).

Time to incorporation by tillage or rain	Dairy cattle or other livestock				Poultry
	Liquid or slurry			Solid	
	Thin (<5% DM)	Medium (5-10% DM)	Thick or semi-solid (>10% DM)	(> 20% DM)	
	% available				
Immediate/1 hr	95	95	90	95	95
<8 hr	80	70	60	80	90
1 day	70	55	40	60	85
2 days	65	50	30	45	80
3-4 days	65	45	25	35	70
5-7 days	60	40	25	25	60
>7 days (or non-incorporated)	60	40	20	10	50

Table 16. Availability of ammonium nitrogen from fall-applied manure (% fertilizer N equivalent).

Time to incorporation by tillage or rain	Dairy cattle or other livestock				Poultry
	Liquid or slurry			Solid	
	Thin (<5% DM)	Medium (5-10% DM)	Thick or semi-solid (>10% DM)	(> 20% DM)	
	% available				
Immediate / 1 hr	40	35	35	40	40
<8 hr	30	25	25	30	35
1 day	30	25	15	25	35
2 days	25	20	10	20	30
3-4 days	25	20	10	15	25
5-7 days	25	15	10	10	25
>7 days (or non-incorporated)	25	15	10	0	20

Table 17. Availability (% fertilizer N equivalent) of organic N from manure applied in current and past years.

		Current year		1 year ago	2 years ago
Dry matter	Soil drainage	Tilled	Surface		
%		% available			
20 or less	Well to moderately well drained	36	24	12	5
	Somewhat poorly to poorly drained	24	16	10	4
>20	Well to moderately well drained	30	20	12	5
	Somewhat poorly to poorly drained	20	14	10	4

Appendix

Soil Testing Lab Methods

Soil samples that come to the lab are assigned a lab number and a subsample is dried overnight at 130 degrees F in a large oven. The soil is then put through a 2 mm sieve to remove coarse fragments. All of the available nutrients are measured in an extract of this sample. Four milliliters (mL) of soil (about 1 tsp) is shaken for 15 minutes with 20 mL of modified-Morgan's solution (1.25 *M* ammonium acetate at pH 4.8). The original Morgan's extract was developed at the University of Connecticut in the 1940's. The modified- Morgan's solution, which improves the extract's ability to remove potassium from fine textured soils, was developed in the 1960's by Dr. J. McIntosh at the University of Vermont. While our extraction process is similar to these methods, we use more modern methods for the determination of the nutrients in the extract. Calcium, K, Mg, Zn, and Al are measured on an ICP, an analytical instrument capable of accurately determining many elements simultaneously. We still run P by visible spectroscopy—basically adding chemicals to make a blue P compound and measuring the intensity of blue with an analytical instrument. Reserve P is determined in a separate extract by the same blue method. This extraction uses the modified-Morgan's solution with added fluoride, which removes some of the "fixed"—or reserve—P from the soil samples.

Soil pH is measured in 10 mL of a weak calcium chloride "salt" solution (0.01 *M*), using 5 mL of soil. Using a weak salt ensures a more accurate reading with less seasonal fluctuation. This pH reading averages 0.6 pH units less than a pH measured in water and we adjust our "salt" pH readings upwards to be comparable with results from other labs. Organic matter is determined by "weight-loss-on-ignition." A dry, weighed sample of soil is brought to 700 degrees F until all the soil organic matter is burned off. After reweighing, % organic matter is calculated from the weight loss.

Soil Test Categories Expressed in Alternative Units

Soil test results can be expressed in different units. The UVM lab reports results as parts per million (ppm), but some labs use units of pounds per acre (lb / acre). Multiply ppm by 2 to get lb / acre, assuming the soil plow layer weighs 2 million pounds. See Table 18 for UVM soil test categories expressed as lb / acre.

Table 18. Vermont soil test categories expressed as pounds per acre (lb/acre, or pp2m) in elemental form.

	Low	Medium	Optimum	High	Excessive
			lb / acre		
Available P	0-4	4-7	8-15	16-40	> 40
K	0-100	101-200	201-260	261-325	>325
Mg	0-70	71-100	101-200	>200	—

Conversion Factors for Soil Test Units

- ppm x 2 = lb / acre in plow layer
- P_2O_5 x .44 = P (phosphorus, elemental form)
- P x 2.27 = P_2O_5
- lb P_2O_5 / acre x .22 = ppm P
- ppm P x 4.6 = lb P_2O_5 / acre
- K_2O x .83 = K (potassium, elemental form)
- K x 1.2 = K_2O
- lb K_2O/acre x .42 = ppm K
- ppm K x 2.4 = lb K_2O/acre

Crop Nutrient Removal

While nutrient removal does not enter directly into UVM nutrient recommendations, it is an important consideration in some cases. For example, the potassium recommendation for corn harvested for silage, in which the entire above-ground plant is removed, is much greater than for grain corn. Typical nutrient removal for common field crops is shown in Table 19.

Fertilizer Nutrient Sources

Crop nutrient need not met by manure and / or previous crop residue can be supplied by various fertilizer materials (Table 20). Most local fertilizer suppliers can provide blends of these materials to accomadate a range of N, P, K, and other nutrient requirements.

Table 19. Typical crop nutrient removal.

Crop (units)	Per unit of yield N	P_2O	K_2O	Typical yield / A	Removal for given yield N	P_2O	K_2O
Corn (bu)	.75	0.4	0.3	120 (bu)	90	50	35
Corn silage (T)[4]	9	5	11.	20 (T)	180	100	220
Grain sorghum (bu)	0.5	0.6	0.8	120 (bu)	60	70	95
Forage sorghum (T)[4]	9	3	10	15 (T)	135	45	150
Sorghum / sudangrass[4]	8	7	7	15 (T)	120	105	105
Alfalfa (T)[2,5]	50[1]	15	50	5 (T)	250	75	250
Red clover (T)[2,5]	40[1]	15	40	3.5 (T)	140	55	140
Trefoil (T)[2,5]	50[1]	15	40	3.5 (T)	175	55	140
Cool-season grass (T) [2,5]	40	15	50	4 (T)	150	60	200
Bluegrass (T)[2,5]	30	10	30	2.5 (T)	75	25	75
Wheat / rye(bu)[3]	1.5	1	1.8	60 (bu)	90	60	110
Oats (bu)[3]	1.1	0.9	1.5	80 (bu)	90	70	120
Barley (bu)[3]	1.4	0.6	1.5	75 (bu)	105	45	110
Soybeans (bu)	3.2[1]	1	1.4	40 (bu)	130	40	56
Small grain silage (T)[4]	17.0	7.0	26	6 (T)	100	40	160

Note: Adapted from Beegle, 2003.
[1]Legumes fix all their required nitrogen. However, they also are able to use nitrogen as indicated.
[2] For legume-grass mixtures, use the predominant species in the mixture.
[3] Includes straw.
[4] 65% moisture.
[5] 10% moisture.

Table 20. Nutrient content and other properties of fertilizer materials.

Fertilizer material	Chemical formula[1]	%N	$\%P_2O_5$	$\%K_2O$	Other nutrient, %[2]	Equiv. acidity[3]	Salt index[4]
Nitrogen sources							
Anhydrous ammonia	NH_3	82	0	0		148	47
Urea	$(NH_2)_2CO$	46	0	0		84	75
Ammonium nitrate	NH_4NO_3	33-34	0	0		63	105
Urea-ammonium nitrate (UAN)	$(NH_2)_2CO + NH_4NO_3$	28-32	0	0		54	74
Ammonium sulfate	$(NH_4)_2SO_4$	21	0	0	24 S	112	69
Phosphorus sources							
Diammonium phosphate (DAP)	$(NH_4)_2HPO_4$	18-21	46-53	0		74	34
Monoammonium phosphate (MAP)	$NH_4H_2PO_4$	11-13	48-52	0		65	30
Ammonium polyphosphate		10	34	0		53	-
Ordinary superphosphate	$Ca(H_2PO_4)_2 + CaSO_4$	0	20	0	14 S, 20 Ca	0	8
Triple superphosphate	$Ca(H_2PO_4)_2$	0	46	0	1.5 S, 14 Ca	0	10
Potassium, magnesium, sulfur sources							
Muriate of potash	KCl	0	0	60-62		0	116
Potassium sulfate	K_2SO_4	0	0	50	18 S	0	46
Potassium nitrate	KNO_3	13	0	45		-26	74
Potassium hydroxide	KOH	0	0	70		-89	-
Magnesium sulfate	$MgSO_4$	0	0	0	10-16 Mg, 14-21S	0	
Magnesium oxide	MgO	0	0	0	45 Mg		
Sufate of potash magnesia (Sul-Po-Mag or K-Mag)	$K_2SO_4MgSO_4$	0	0	22	11Mg, 22 S	0	43
Calcium sulfate (gypsum)	$CaSO_4$	0	0	0	15-18 S, 19-22 Ca	0	
Micronutrient sources							
Borate	Na_2BO_4				20 B		
Solubor	Na_2BO_4				21 B		
Iron (ferrous) sulfate	$FeSO_4$				20 Fe, 12 S		
Manganous sulfate	$MnSO_4$				28 Mn, 16 S		
Zinc sulfate	$ZnSO_4$				36 Zn, 18 S		
Zinc oxide	ZnO				50-80 Zn		
Zinc chelate	Zn chelate				6-14 Zn		

Note: Adapted from Beegle, 2003, Cornell Guide for Integrated Field Crop Management, 2003, and other sources.
[1]Water of hydration (H_2O) not included in formula.
[2]Actual analysis varies with specific product formulation. B = boron, Ca = calcium, Fe = iron, Mg = manganese, Zn = zinc.
[3] Pounds of calcium carbonate equivalent / 100 lb of fertilizer material. Positive numbers indicate that the material increases soil acidity, that is, lowers soil pH. Negative numbers indicate that the material reduces acidity, that is, raises soil pH.
[4] Salt index of equal weights of the fertilizer material compared to sodium nitrate which equals 100. Useful for comparing the salt effect of different fertilizer materials.

Field Information Questionnaire

Soil Test for Field Crops — Revised 6/98

uvmEXT — University of Vermont Extension and University of Vermont Agricultural and Environmental Testing Lab

Farm/Name: Mountain View Farm
copy to: Industry Rep: M. Green
Mailing Address: RD 2
Company: Trusty Crop Consulting
City, State: Hillsville, VT — Zip: 05001
Phone: 975-2560
VT County where farm is located: Addison
Field Name: North Corner — Size: 14 acres

Check only one box for each question.

1. Soil Drainage: [1] Excessive (droughty) — [2] Well-drained — [✓] Moderately well-drained — [4] Somewhat poorly to poorly drained

2. Primary tillage (for annual crops only): [✓] Conventional (moldboard) — [2] Minimum tillage (chisel or disk) — [3] No-till

Fill out shaded area COMPLETELY if you have applied or plan to apply manure.

3. Kind of manure: [✓] Dairy — [2] Beef — [3] Chicken, layer — [8] Chicken, broiler — [4] Horse — [5] Hog — [6] Sheep/goat — [7] Sludge or septage

4. Application rate for this year (upcoming season), previous year, and 2 years ago:

Liquid/Slurry

	Enter rate		
This year	6,000	gal/A	[1] Thin (<5% dry matter)
Previous year	3,000	gal/A	[✓] Medium (5-10%)
2 Years ago	0	gal/A	[3] Thick (>10%)

OR

Solid/Semi-solid

	Enter rate		
This year		T/A	[4] Solid
Previous year		T/A	[5] Semi-solid
2 Years ago		T/A	

5. Time of soil sampling: [1] After manure spread — [✓] Before manure spread

6. Season of spreading: [✓] Spring — [4] Summer — [1] Fall — [2] Winter

7. Field management - Time from spreading to incorporation:
[7] 1 hour or less — [✓] 1 - 8 hours — [2] 1 day — [3] 2 days — [4] 3 - 4 days — [5] 5 - 7 days — [6] more than 7 days or unincorporated

8. Current manure analysis (if available)

UVM Sample ID: M 204

Choose correct unit

[✓] lbs./1000 gal. or [ ] lbs./ton

% dry matter	6.4
Total N	23.6
NH_4-N	10.9
P_2O_5	10.9
K_2O	18.7
Mg	4.3

Payment Must Be Enclosed (unless otherwise arranged)

Basic Test (includes pH, P, K, Ca, Mg, Zn, CEC, & recommendations for one crop)	$9.00	✓
Recommendations for other crops	each @ $2.00	
Organic matter %	$2.00	
Micronutrients (Boron, Copper, Iron, Manganese, Sodium)	$5.00	
Heavy metals (Cadmium, Chromium, Copper, Nickel, Lead, Zinc)	$10.00	
Total Enclosed		9 –

(make check payable to UVM Testing Service Fund)

Other tests available on request

v.4/98 — Crop information on reverse side must be completed for recommendations. — OVER ➔

Crop Information

Fill out *either* the right or left

Check only one:

- [✓] 1 corn
- [ ] 2 Sorghum-sudan, sudangrass, or sunflower
- [ ] 3 Oats, barley, rye, wheat, triticale, millet
- [ ] 4 Dry beans, peas
- [ ] 9 Soybeans

9. CROP TO BE GROWN:
<u>PICK ONLY ONE CROP</u>
and fill out only the box below that crop

A crop must be selected for recommendations

Check only one:

- [ ] 5 Alfalfa or alfalfa with grass
- [ ] 6 Trefoil or trefoil with grass
- [ ] 7 Clover or clover with grass
- [ ] 8 Grass

Annual Crop Information

Check only one answer for each question

20

10. Use of crop: [✓] 1 Silage; [ ] 2 Grain; [ ] 3 Green Chop

11. Expected Yield/acre (corn only): [ ] 1 15 tons 90 bu; [✓] 2 20 tons 120 bu; [ ] 3 25 tons 150 bu; [ ] 4 30 tons 180 bu

12. Was a sod crop or bean crop plowed down (or killed for no-till) within the last two years or last two growing seasons?
[✓] 1 No; [ ] 2 Yes - within last year; [ ] 3 Yes - two years ago

13. If yes, what was that previous crop:
[ ] 1 Alfalfa; [ ] 2 Clover, trefoil; [ ] 3 Grass; [ ] 4 Soybean, Dry bean

14. If yes, what was the proportion of legume:
[ ] 1 <20% legume with 2 ton yield or less; [ ] 4 <20% legume with >2 ton yield; [ ] 2 20% - 60% legume; [ ] 3 >60% legume

15. Will you be seeding alfalfa within two years? [✓] 1 Yes; [ ] 2 No

OR

Perennial Crop Information

Check only one answer for each question

16. Proportion of legume in the crop stand:
[ ] 1 Less than 20% legume; [ ] 2 20-60% legume; [ ] 3 60-100% legume

17. Situation (must be answered for perennial crop recommendations)
[ ] 1 Seeding Down without nurse crop; [ ] 2 Seeding Down with nurse crop; [ ] 3 Seeding legume into living grass sod; [ ] 4 Conservation planting
[ ] 5 Topdressing hay or silage 1 or 2 cuts; [ ] 6 Topdressing hay or silage 3 or 4 cuts; [ ] 7 Conventional continuous pasture; [ ] 8 Intensively managed pasture

18. Expected Yield (Hay equivalent per acre):
Note: If seeding down, select expected yield of first full harvest year.
[ ] 1 two tons or less; [ ] 2 three tons; [ ] 3 four tons; [ ] 4 five tons; [ ] 5 six tons or more

If you are undecided about which crop to plant for the upcoming season and would like recommendations for both an annual and perennial crop, check here. ____
Include $2.00 for the extra recommendation, then select your second crop choice and fill in the other boxes above.

PLEASE CONTACT YOUR EXTENSION REGIONAL SPECIALIST IF YOU NEED ASSISTANCE WITH THIS FORM

SAMPLE DESCRIPTION
M. Green Trusty Crop Consulting

REPORT FOR:
Mountain View Farm RD 2 Hillsville, VT 05001

SOIL TEST REPORT

AGRICULTURAL & ENVIRONMENTAL TESTING LABORATORY
AND UVM EXTENSION

UNIVERSITY OF VERMONT

LAB NUMBER	DATE
B988888	received 04/20/98 complete 04/27/98

COUNTY

ADDISON

FIELD NAME

North Corner 14

SAMPLE

SOIL TEST RESULTS

			LOW MEDIUM OPTIMUM HIGH
pH		6.4	
Available Phosphorus	(ppm P)	5.0	*********************************
Reserve Phosphorus	(ppm P)	56	**
Potassium	(ppm K)	48	****************
Magnesium	(ppm Mg)	65	*********************************
Aluminum	(ppm Al)	74	
Calcium	(ppm Ca)	1477	
Effective CEC	(meq/100g)	8.0	
Zinc (medium)	(ppm Zn)	0.8	

LIME AND FERTILIZER RECOMMENDATIONS

(1) Corn, Yield of 20 tons/A (120 bu) expected
Dairy manure at 6000 gal. per acre

	LIME TONS/ACRE	NITROGEN (N) lbs./ACRE	PHOSPHATE (P_2O_5) lbs./ACRE	POTASH (K_2O) lbs./ACRE	MAGNESIUM (Mg) lbs./ACRE
LIME & NUTRIENTS NEEDED:	2.0	100	30	160	0
CONTRIBUTION FROM MANURE:		80	50	110	25
BALANCE NEEDED FROM FERTILIZER:	2.0	20	0 **	50	0

If seeding alfalfa within 2 years, apply 2.0 tons per acre for future target pH 6.8.
Broadcast lime before or during seedbed preparation and harrow in.
For pH of 6.2, apply 0.0 tons per acre.

N rate given above is an estimate. For a more accurate recommendation, use Presidedress Nitrate soil test when corn is 8-12 inches tall. Contact your Ag.Extension agent for more information.
Nitrogen is most effective side or top dressed when crop is 12 to 24 inches tall.
To prevent fertilizer burn, limit combined N + K2O to 80 lb/A applied using a planter with sideband fertilizer placement (2" x 2"). Limit N + K2O to 40 lb/A with split-boot planter.
To avoid ammonia toxicity, Limit N in planter to 25 lb/acre when using urea or DAP blend.
CAUTION: NEVER APPLY BORON, UREA, OR DIAMMONIUM PHOSPHATE IN DIRECT CONTACT WITH SEED!
** No broadcast P is needed. However, a low rate of N-P-K row or starter fertilizer is recommended, especially with limited drainage, cool soil temperatures, or reduced tillage.
If zinc deficiency symptoms have been observed, broadcast 8-10 lbs Zn/A and till into soil. Or, apply 2 lbs Zn/A annually with starter fertilizer and retest in 2-3 years.

FOR ADDITIONAL INFORMATION ABOUT THIS TEST, CONTACT YOUR UVM EXTENSION AGENT → Jeffrey Carter 388-4969

FIELD INFORMATION FROM QUESTIONNAIRE

1. Moderately well-drained [3]
2. Conventional tillage (moldboard plow) [1]
3. Dairy manure [1]
4. Amount this crop: 6000 gal. Past year: 3000 gal. 2 years: 0 tons Medium thickness [2]
5. Soil sampled before manure spread [2]
6. Spread in spring (after snow melt) [3]
7. Manure incorporated same day [1]
8. 6.4% DM, Total-N=23.6, NH4-N=10.9, P=10.9, K=18.7, Mg= 4.3 lb/1000 gal.
10. Crop to be used for silage [1]
11. Yield of 20 tons/A (120 bu) expected [2]
12. Sod not plowed down within the last year [1]
13. (Previous crop info is not used in this case)
14. Legume proportion less than 20%, < 2T yield[1]
15. Will be seeding alfalfa within 2 years [1]

The University of Vermont

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DEPARTMENT OF PLANT AND SOIL SCIENCE
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March 09, 2004

Mountain View Farm
RD 2
Hillsville VT 05001

MANURE ANALYSIS REPORT

Sample ID: M2178

% Dry Matter: 6.8

Density (lbs per gal): 8.5

	lbs/wet ton	lbs/1,000 gal	Dry Wt. Basis (%)
Total Nitrogen	5.8	24.8	4.26
Ammonium Nitrogen (NH4-N, part of total)	2.5	10.5	1.81
Organic Nitrogen (part of total)	3.3	14.3	2.46
Phosphorus as P2O5	2.0	8.7	1.50
Potassium as K2O	5.4	23.2	3.98
Calcium	1.7	7.4	1.28
Magnesium	0.8	3.6	0.62
Micronutrients			(ppm or mg/kg)
Copper	<0.01	0.06	98
Zinc	0.02	0.09	151
Iron	0.17	0.74	1280
Manganese	0.02	0.10	177
Boron	<0.01	<0.01	4

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