

Nutrient Recommendations for Field Crops in Massachusetts

Nutrient recommendations should be based on crop species and expected yields

Nutrient recommendations must be adjusted for past manure applications

Introduction:

Nutrient recommendations for optimum crop growth and yield must be based on frequent soil testing. The University of Massachusetts recommends soil testing every one to three years and when the crop is rotated.

The University of Massachusetts uses a modified Morgan's solution (1.25 M ammonium acetate, pH 4.8) to analyze most nutrients in its soil testing program. Soil test categories and interpretation of the categories are presented in Tables 1 and 2.

Table 1: UMass soil test categories for modified Morgan extractable nutrients

	<i>Very Low</i>	<i>Low</i>	<i>Optimum</i>	<i>Above optimum</i>	<i>Excessive</i>
P, ppm	0-1.9	2-3.9	4-14	14-40	>40
K, ppm	0-49	50-99	100-160	>160	-
Ca, ppm	0-499	500-999	1000-1500	>1500	-
Mg, ppm	0-24	25-49	50-120	>120	-

Nitrogen:

Nitrogen is critical to plant growth and metabolism. Nitrogen is also an important part of protein and chlorophyll molecules in plants; therefore, N is responsible for the green color of plants and plays an important role in photosynthesis. Plants with a yellowish color are often suffering from N deficiency. Since

N is a mobile nutrient, it translocates from older leaves (usually at the lower canopy) to the younger leaves. As a result, N deficiency symptom will be seen first in the lower leaves of a plant.

No soil analysis is used to make the N recommendations on soil lab reports.

Nitrogen fertilizer application rates should be determined based on crop species and expected yield. A summary of the N recommendations for agronomic crops is presented in Tables 3 and 4. Nitrogen recommendations must be adjusted for credits from previous legumes in the crop rotation and from past manure applications.

Table 2. Interpretation of soil test categories

Categories	Interpretation
<i>Very Low</i>	Soil test level is well below optimum. Very high probability of plant response to additional nutrients. Substantial amounts of additional nutrients required to achieve optimum growth. Fertilizer rates based on plant response and are designed to gradually increase soil nutrient levels to the optimum range over a period of several years.
<i>Low</i>	Soil test level is below optimum. High probability of plant response to addition of nutrients. Moderate amounts of additional nutrients needed to achieve optimum growth. Recommendations based on plant response and are intended to gradually increase soil nutrient levels to the optimum range.
<i>Optimum</i>	For most plants, low probability of response to addition of nutrient. Most desirable soil test range on economic and environmental basis. To maintain this range for successive years, nutrients must be retained in the system, or those nutrients removed by plants or lost to the environment must be replaced.
<i>Above optimum</i>	The nutrient is considered more than adequate and will not limit plant performance or quality. At the top end of this range, there is the possibility of a negative impact on the turf if nutrients are added. Additional nutrient applications are not recommended.
<i>Excessive</i>	This soil test level is independent of plant response and, due to environmental concerns, is only defined for soil test phosphorus (P). This P concentration is associated with elevated risk of P loss in leachate and runoff at concentrations high enough to impair surface water quality. No P should be applied and steps should be taken to minimize losses from leaching and runoff.

Nitrogen status of the soil must be determined when crops begin their active growth. This is especially important in areas such as Massachusetts with significant precipitation in the spring. If all of the required fertilizer is applied at time of planting, a significant portion of the N will be lost to leaching.

The pre-sidedress Soil Nitrate Test (PSNT) has been developed for corn in wet regions and fields with high organic matter.

For more information on time and depth of soil sampling for PSNT and to interpret the result use the following fact sheet:

<http://extension.umass.edu/cdle/fact-sheets/nitrogen-management-pre-sidedress-nitrate-n-test-psnt>

In summary, PSNT should be done when corn plants are about 10-12" tall. Nitrogen application rate for sidedressing corn depends on soil test results and expected yield (Table 3).

Table 3. Nitrogen fertilizer recommendation for corn based on Pre-sidedress Soil Nitrate Test (PSNT)

Soil test level (ppm NO ₃ -N)	Expected yield (Tons/acre)			
	17	21	25	>25
	<i>Sidedress N recommendation (lbs N/acre)</i>			
0-10	100	120	150	170
11-15	75	90	120	140
16-20	50	70	90	110
21-25	30	50	70	90
25+	0	0	0	0

Table 4. Nitrogen recommendations for field crops (other than corn)

Crop	lbs N/unit yield	Unit of yield	Upper yield limit	Lower yield limit	Default yield
Soybeans	0				
Oats, Barley, Rye, Wheat, Triticale, Millet	1	bu	90	45	60
Dry Beans, Peas, Buckwheat	40	-	-	-	1
Sorghum-sudan, Sudangrass, Sunflower	100	-	-	-	1
Alfalfa; 20-60% legume-Establishment	0	0			
Alfalfa; 20-60% legume-Maintenance	10	ton	6	2	4
Alfalfa; 60-100%	0	0			

legume-Establishment					
Alfalfa; 60-100% legume-Maintenance	0	0			
Clover/Trefoil; 20-60% legume-Establishment	0	-	-	-	1
Clover/Trefoil; 20-60% legume-Maintenance	10	ton	6	2	4
Clover/Trefoil; 60-100% legume-Establishment	0	0			
Clover/Trefoil; 60-100% legume-Maintenance	0	0			
Orchard, Reed Canary, Tall Fescue, Rye grasses - Established	50	-	-	-	1
Orchard, Reed Canary, Tall Fescue, Rye grasses - Maintenance	50	ton	6	2	4
Timothy & mixtures-Establishment	50	-	-	-	1
Timothy & mixtures-Maintenance	50	ton	6	2	4
Grass Pasture - Establishment	50	-	-	-	1
Grass Pasture - Maintenance	50	-	-	-	0
Grass Pasture - Intensively Managed	100	-	-	-	1
Horse Pasture - Establishment	50	-	-	-	1
Horse Pasture - Maintenance	100	-	-	-	1

Table 5. Recommended base phosphorus rates for selected available P and Al test values (adjust for agronomic crops with Table 6).

Reactive Al ppm	Available P ppm						
	Low	Medium		Optimum High		High	
	.5	1.5	2.5	4	7	14	>15
P ₂ O ₅ to apply, lb/acre							
10	60	60	40	30	20	20	0
20	65	60	40	30	20	20	0
30	75	60	40	30	20	20	0
40	90	65	40	30	20	20	0
50	100	70	45	30	20	20	0
60	110	80	50	30	20	20	0
70	120	90	55	40	30	20	0
80	130	95	60	40	30	20	0
90	140	105	65	40	30	20	0
100	150	115	70	40	30	20	0
110	150	120	75	40	30	20	0
120	150	130	80	40	30	20	0
130	150	140	85	40	30	20	0
140	150	140	90	40	30	20	0
150	150	140	95	40	30	20	0
160	150	140	100	40	30	20	0
170	150	140	105	40	30	20	0
180	150	140	110	40	30	20	0
190	150	140	115	40	30	20	0
200	150	140	120	40	30	20	0
210	150	140	120	40	30	20	0

Table 6. Adjustments to base P recommendations for field crops

Crop	Available P ppm	
	<4	4 to 7
Corn for Silage (25 ton/acre yield with 70% moisture)	0	0
Corn for Grain, (160-180 bu/acre with 15.5% moisture)	0	0
Soybeans	-10	0
Oats, Barley, Rye, Wheat, Triticale, Millet	-10	0
Dry Beans, Peas, Buckwheat	-10	0
Alfalfa; 20-60% legume-Establishment	+40	+20
Alfalfa; 20-60% legume-Maintenance	-10	0
Alfalfa; 60-100% legume-Establishment	+40	+20
Alfalfa; 60-100% legume-Maintenance	0	0

Nitrogen is a mobile nutrient in the soil thus split application of N fertilizer for fall planting including: canola, wheat, triticale, and barley is highly recommended.

For grass hay, divide the N recommendation and apply fertilizer based on the expected yield for each cutting. For grass-legume mixtures, if the legume is more than 50% of the stand, the field should be managed as legume; therefore, no nitrogen is recommended.

For more information on nitrogen management for corn production visit: <http://ag.umass.edu/fact-sheets/nitrogen-management-for-corn-production>

Phosphorus:

Phosphorus recommendations for agronomic crops are based on a combination of the available P soil test and active Al. UMass P soil test categories for modified Morgan extractable nutrients and interpretations of categories are presented in Tables 1 and 2. Table 5 recommends base P rates for selected available P and Al test values. The recommended rates should then be adjusted for a specific agronomic crop using Table 6.

Clover/Trefoil; 20-60% legume-Establishment	+40	+20
Clover/Trefoil; 20-60% legume-Maintenance	-10	0
Clover/Trefoil; 60-100% legume-Establishment	40	+20
Clover/Trefoil; 60-100% legume-Maintenance	0	0
Orchard, Reed Canary, Tall Fescue, Rye grasses - Established	+40	+20
Orchard, Reed Canary, Tall Fescue, Rye grasses - Maintenance	-10	0
Timothy & mixtures-Establishment	+40	+20
Timothy & mixtures-Maintenance	-10	0
Grass Pasture - Establishment	+40	+20
Grass Pasture - Maintenance	-10	0
Grass Pasture - Intensively Managed	-10	0
Horse Pasture - Establishment	+40	+20
Horse Pasture - Maintenance	-10	0
Sorghum-sudan, Sudangrass, Sunflower	-10	0
Conservation Planting-Warm Season Grasses-Establishment	-10	0
Conservation Planting-Warm Season Grasses-Maintenance	-10	0
Conservation Planting-Wildlife Food Plot-Establishment	-10	0
Conservation Planting-Wildlife Food Plot-Maintenance	-10	0

Resources:

Agronomy fact sheets. Cornell University nutrient management spear program.
nmsp.cals.cornell.edu/guidelines/factsheets.html

Nutrient recommendations for field crops in Vermont. University of Vermont Extension.
pss.uvm.edu/vtcrops/articles/VT_Nutrient_rec_field_crops_1390.pdf

The Agronomic Guide 2013-2014. College of Agricultural Sciences, Penn State.
extension.psu.edu/agronomy_guide

For more information visit:

<http://extension.umass.edu/cdle>

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Potassium:

Recommendations for potassium application rates are presented in Table 7 (next page)

Table 7. Potassium recommendations for field crops and conservation planting (lbs K₂O/acre)

Crop	Expected Yield (ton)	K ₂ O Concentration in soil						
		<25	25-50	50-75	75-100	100-130	130-160	>160
Corn for Silage	25	180	140	100	60	40	20	0
Corn for Grain	160 bu	120	80	40	30	30	20	0
Soybeans	-	120	100	80	60	40	0	0
Oats, Barley, Rye, Wheat, Triticale, Millet	-	120	100	80	60	40	0	0
Dry Beans, Peas, Buckwheat	-	120	100	80	60	40	0	0
Sorghum-sudan, Sudangrass, Sunflower	-	200	160	120	80	60	20	0
Alfalfa; 20-60% legume (Establishment)	-	180	140	100	80	60	0	0
Alfalfa; 20-60% legume (Maintenance)	<4	220	180	140	100	60	40	0
Alfalfa; 60-100% legume (Establishment)	-	240	200	160	120	80	40	0
Alfalfa; 60-100% legume (Maintenance)	<4	280	240	200	160	100	40	0
Clover/Trefoil; 20-60% legume (Establishment)	-	180	140	100	80	60	0	0
Clover/Trefoil; 20-60% legume (Maintenance)	<4	220	180	140	100	60	0	0
Clover/Trefoil; 60-100% legume (Establishment)	-	220	180	140	100	60	0	0
Clover/Trefoil; 60-100% legume (Maintenance)	<4	220	180	140	100	60	0	0
Orchard, Reed Canary, Tall Fescue, Rye grasses (Establishment)	-	180	140	100	80	60	0	0
Orchard, Reed Canary, Tall Fescue, Rye grasses (Maintenance)	<4	180	140	100	80	40	0	0
Timothy & mixtures (Establishment)	-	180	140	100	80	60	0	0
Timothy & mixtures (Maintenance)	<4	180	140	100	80	60	0	0
Grass Pasture (Establishment)	-	180	140	100	80	60	0	0
Grass Pasture (Maintenance)	-	120	100	80	60	40	0	0
Grass Pasture - Intensively Managed	-	180	140	100	80	60	0	0
Horse Pasture (Establishment)	-	180	140	100	80	60	0	0
Horse Pasture (Maintenance)	-	120	100	80	60	40	0	0
Conservation Planting-Warm Season Grasses (Establishment)	-	80	60	40	0	0	0	0
Conservation Planting-Warm Season Grasses (Maintenance)	-	80	60	40	0	0	0	0
Conservation Planting-Wildlife Food Plot (Establishment)	-	80	60	40	0	0	0	0
Conservation Planting-Wildlife Food Plot (Maintenance)	-	80	60	40	0	0	0	0