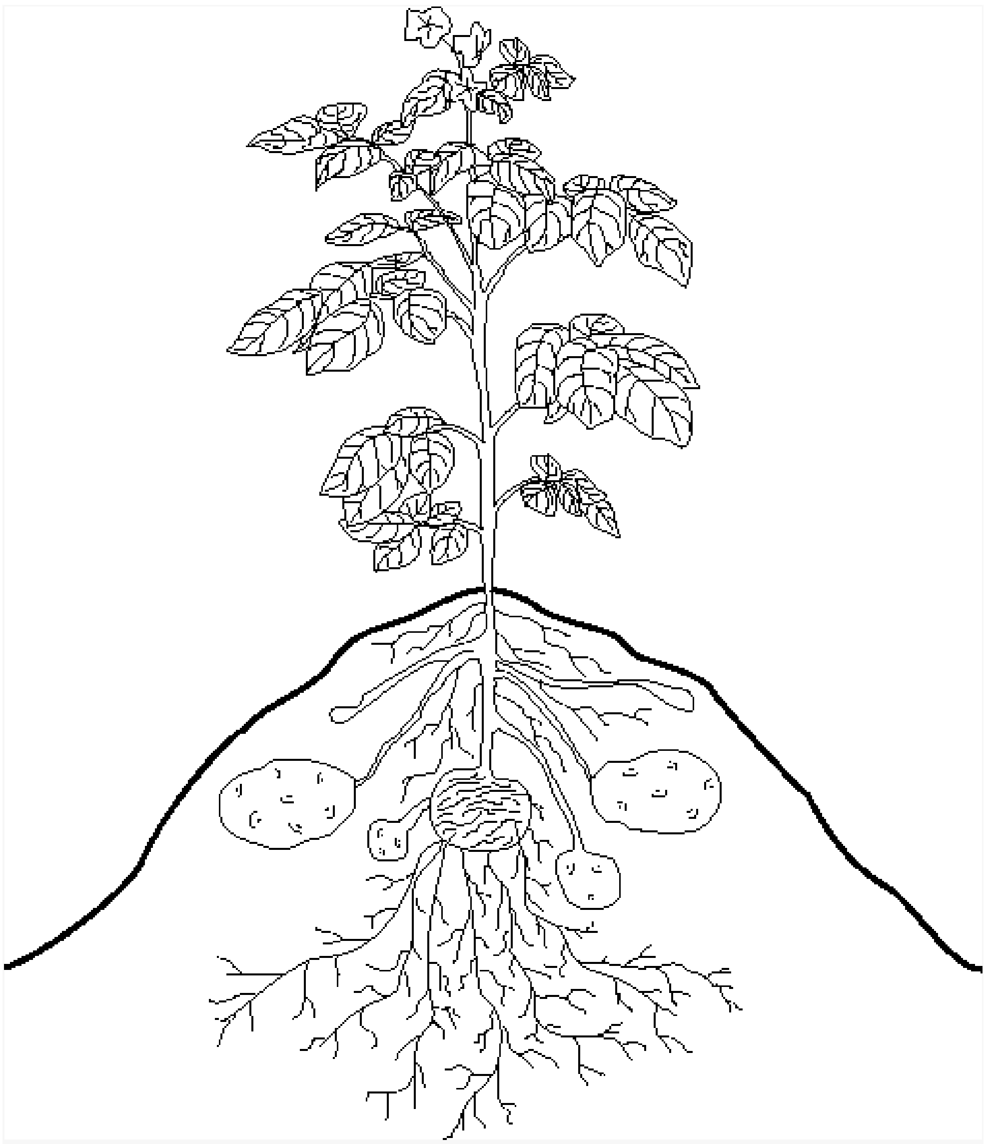
INTERPRETING SOIL TEST RESULTS FOR COMMERCIAL CROPS



MAINE SOIL TESTING SERVICE

INTERPRETING SOIL TEST RESULTS FOR COMMERCIAL CROPS

*******A glossary of terms appears at the end of this document*******

Uses and limitations of a soil test

Soil testing is a quick and inexpensive way to determine the nutrient status of your soil. This helps to determine how much (if any) lime, fertilizer, or other amendments are needed to produce an optimum crop yield. The first step in understanding the information you are receiving and how you can best use it, is to understand the limitations of the system.

Soils, even in a uniformly cultivated field or garden plot, are extremely variable. Because of this, one of the most important steps in soil testing is taking a good *representative sample*. Sample boxes and Field and Soil Sample Information forms are available, free of charge, on request from the lab or from any county office of Cooperative Extension. Sampling instructions appear both on the box and the form. These instructions should be followed closely. This will ensure that the sample you send to the lab is representative of the whole area sampled. This is the single most important step you can take to make sure the system works for you.

Soil fertility testing should ideally provide consistent, reliable analytical results as quickly as possible. At the Maine Soil Testing Service, we use what is referred to as a "quick test" system of analysis: standardized mass-production procedures giving reproducible results with a minimum of sample handling. This system, monitored by a quality assurance program, provides accurate results in the shortest possible time. However, if you believe there is an error in your test results, call the Maine Soil Testing Service for a free of charge repeat analysis. We store samples for at least one month after processing.

A routine "standard" soil test consists of measuring soil nutrients or other components which most commonly limit plant growth or production in Maine: phosphorus, potassium, calcium, magnesium, pH, and organic matter. Nitrogen also commonly limits plant growth, but can be accurately tested only *during* the growing season. It is not directly measured in a Standard soil test.

Additional tests such as nitrate-nitrogen and total soluble salts are available for an extra charge and *must be specifically requested*. Micronutrients (boron, copper, iron, manganese, zinc) are usually not a problem in Maine soils. Micronutrient analysis is available on request, but because of limited information on their optimum levels in soils, micronutrient problems are usually better diagnosed through plant tissue testing on those crops which warrant the extra expense.

The recommendations that are sent back to you for lime, fertilizer, or other amendments are designed to adjust soil nutrients and other components to a theoretical optimum level and balance for best yield and quality from the crop you plan to grow. These optimum nutrient levels have been determined over the years by greenhouse and field trials in Maine and other northeastern states. It is in this way that the soil testing system is calibrated specifically for Maine soils and cropping conditions. It is further modified with experience in the field and as new research information becomes available.

Soil testing is not the answer to all problems in growing a crop or in maintaining a healthy yard and garden. Poor plant growth or loss of yield may also be caused by insects, diseases, pesticide residues, or excessively wet or dry conditions. When done properly, soil testing is a useful and economical tool for managing crop plant nutrition.

Following is an explanation of each section of your soil test report:

SAMPLE INFORMATION

All the important background information pertaining to your sample appears at the top of the report form. Next to the processing date is the lab number (lab no.). All reference to this sample in our records keys on this number. When referring to your sample for billing purposes or problems with analysis, always reference the lab no. After the lab no. is the field or plot name which you gave to the sampling area. Record keeping is greatly simplified by using a consistent or permanent naming system for all your fields or plots, making it easier to follow nutrient levels over the years and to better monitor your soil fertility program.

RELATIVE SOIL NUTRIENT LEVELS

The test results for your soil are first presented as a series of bar graphs meant to help you visually interpret the actual numerical results which appear at the bottom of the report. Each graph is calibrated so that the ideal level for pH, organic matter, and each of the nutrients falls in the area under the "OPTIMUM" label. The meaning of each of the interpretation levels follows.

LOW - nutrient or pH level listed as "low" has a high probability of limiting plant growth and yield. A recommendation will be made to substantially increase the soil level of this component. If the level is very low, several years of corrective fertilizing or liming may be necessary to achieve an optimum soil level. Close monitoring by yearly soil testing is suggested in this case. Banding of fertilizer near the row becomes critical at this test level to ensure efficient use and maximum nutrient availability within the rooting zone of the crop.

MEDIUM - nutrient or pH level listed as "medium" may be adequate for some low-demand crops in some cases. This is taken into account in the recommendations for those specific crops. A medium nutrient level may limit plant growth or yield by the end of the growing season or in years of very good growing conditions. Corrective fertilizing or liming is usually recommended in moderate amounts to cause a slight increase in soil level after the crop has been removed or to support an exceptional yield in a very good year.

OPTIMUM - soil component listed as "optimum" is in the theoretical ideal range to support plant growth and maximum yield. Corrective fertilizing is not recommended. Any amendments applied for a component listed as "optimum" are to compensate for crop removal, so that this optimum level can be maintained from year to year. A small amount of a starter fertilizer containing this nutrient may also be recommended. When all nutrients fall in the optimum range, not only are they at ideal levels but they are also considered to be in proper balance with each other. This is especially important with calcium, potassium, and magnesium, which compete with each other for binding sites in soil and uptake into plants.

ABOVE OPTIMUM - An above optimum level of a soil component indicates a level higher than needed to support normal crop plant growth. Growth and yield may be inhibited, either because of direct toxic effects to the plant or because the overabundance of one nutrient may interfere with the uptake or availability of others. Additional application of something already at this level will only increase the likelihood of reduced yield. There will be no recommendation for further additions of this component in almost all cases. One exception is the optional application of a very small amount of starter phosphorus on some crops to compensate for cold soils in the spring. Crop removal and other natural losses over time should eventually reduce the nutrient, pH, or organic matter level to optimum after a few years.

RECOMMENDATIONS

Below the Relative Nutrient Level bar graphs is a line stating the name of the crop for which you have requested recommendations. Check this carefully to be sure this is the crop you are intending to grow or the closest one listed on the Field and Soil Sample Information form. Be sure the crop code listed is for the correct growth stage or management situation. There are different crop codes for seeding vs. topdressing hay and turf crops. There are also different crop codes for new vs. established beds for some vegetable and fruit crops. The crop code is the key for all the recommendations that follow. If it is incorrect, write or call the Maine Soil Testing Service to receive a corrected report form.

Following is a general overview of the recommendations for all crops. Greater detail on calculating specific nutrient requirements for all crops can be found in the "Soil Testing Handbook", available on our web site.

Lime

The lime recommendation is the amount needed to raise the current soil pH to the optimum level for the crop being grown. This should be the same pH listed in the pH management statement in the Laboratory Results section (see below).

The lime recommendation is based on the assumption that the lime is rated at 100% calcium carbonate equivalence (CCE), a measure of the neutralizing power of the lime. If the lime you are using is guaranteed for less than 90% CCE, you should increase the application rate accordingly.

Lime recommendations for more than one target pH are listed for some crops to make allowances for alternate management practices. Cation exchange capacity calculations are based on only one target pH in any case (see Cation Exchange Capacity, below). If the lime requirement to reach a target pH is more than 6000 pounds per acre, a split application will be recommended over two or more years to adjust the pH gradually and avoid possible nutrient balance problems. If lime is to be topdressed, application should be limited to 2000 pounds per acre in any one year.

An optimum pH should automatically result in an optimum calcium level if the pH has been adjusted using lime. The lime recommendation is usually the only recommendation made to adjust the soil calcium level.

***IMPORTANT NOTE: If you have applied lime or liming material within six months prior to taking your soil sample, it probably has not completely reacted yet. The soil pH level which we report to you should continue to rise, even without further lime application. To correct for this, subtract any recent lime application from our lime recommendation(s) and apply only this reduced amount.

Sulfur

A sulfur recommendation is made in place of a lime recommendation when it is necessary to acidify or lower the soil pH level. Acidifying the soil is necessary to avoid nutrient availability problems for some crops, especially with micronutrients, in those situations where the soil pH exceeds 7.0. Sulfur is also recommended for acid loving plants where soil pH is above the 4.8 - 5.2 range.

Sulfur can be applied as elemental (yellow) sulfur or by using aluminum sulfate at six times the rate recommended for yellow sulfur.

Magnesium

Magnesium is recommended if the present soil level is below 15% saturation or less than double the percent potassium saturation. Saturation levels are explained in the Lab Results section below. The most common and most economical source of magnesium is magnesium lime or dolomitic (high-magnesium) lime. Quite often when lime is not needed, no magnesium recommendation is made. Cases of acute magnesium deficiency are quite rare and the cost of other sources of this nutrient is often prohibitive. In most cases, it is acceptable to wait until lime is needed again and to then apply a magnesium lime. In some cases, other sources of magnesium are recommended. These are suggested if cost and availability are not a problem in your area.

N-P-K Fertilizer

The nutrient levels in the Laboratory Results section (below) are reported in simple elemental form (P, K, etc.). However, the guaranteed nutrient content of all commercial fertilizer blends is reported by law as a three number code in terms of percent N (nitrogen), percent P_2O_5 (phosphate), and percent K_2O (potash) regardless of the actual chemical form of the nutrient carrier(s) in the blend. Note that phosphate and potash are expressed in a molecular form and not in simple elemental form. The recommendations you receive for these nutrients have been adjusted to be in the same terms as those in the fertilizer code.

Nitrogen

Because of ample rainfall in the eastern U.S., there is not an acceptable year-round soil test to predict the amount of nitrogen that will become available to plants over the course of a growing season. A soil's nitrogen supplying capacity depends on the microbial breakdown of organic matter and the conversion of the nitrogen in organic matter to the ammonium and nitrate form (called mineral nitrogen). Since this conversion process depends on the highly variable factors of soil temperature and moisture, it is very hard to predict. Nitrate-nitrogen is the form most commonly used by plants, though some can use ammonium nitrogen for part or all of their requirements. Nitrate is also the most easily leached of all nutrients, since the soil has almost no capacity to hold it. Measurements of mineral nitrogen are useful for some crops during the growing season, but not during the normal spring or fall sampling period. Corn and potato crops have separate nitrogen testing programs run *during* the growing season to address nitrogen management.

The nitrogen recommendation you receive is usually based on the assumption that there will be little or no net nitrogen release from the soil over the next growing season. The nitrogen recommended is the full seasonal requirement needed to support a high average yield from the requested crop. Adjustments are made in some cases. For instance, plowing down an actively growing legume crop can provide from 50 to 100 pounds nitrogen per acre to the following crop. If you have indicated that the previous crop contained a high percentage of legumes, you will be reminded to decrease the recommended nitrogen by an appropriate amount. Additional information on nitrogen adjustments and nitrogen fertilizer application appear below in the Management Recommendations section.

Phosphate (P_2O_5)

The phosphate requirement is calculated by subtracting the present test level from the optimum soil level for the crop you will be growing and adding the average amount of phosphate removed by that crop:

Phosphate requirement = (optimum P - present P) x factor + crop removal

The factor is to convert from the soil test level (reported as P) to the fertilizer guarantee level (reported as P_2O_5). It also compensates for the partial loss of applied phosphorus to unavailable forms.

A small amount of phosphate may be recommended, even at above optimum soil test levels, as a starter fertilizer. It is meant to promote early root growth and to compensate for limited P availability while the soil is still cold. Above optimum soil phosphorus is not as much a problem as above optimum levels of other nutrients. In most cases, an above optimum soil test level of phosphorus will result in a recommendation for no additional phosphate amendments.

At a very low P test level, the phosphate recommendation may be limited to a maximum amount. This is meant to raise the soil level gradually, prevent possible burn from excess fertilizer salts, and spread the extra cost over more years. Because of this limit, soil phosphorus may not be adjusted to the optimum level in the first year. Additional corrective applications may be necessary in subsequent years.

Potash (K_2O)

The potash recommendation is calculated to raise the soil level from the present (percent saturation) test level to the optimum percent saturation for the crop to be grown. The average amount of potash removed by the crop is also added:

Potash requirement = (optimum % K sat.-present % K sat.) x CEC x factor + crop removal.

The factor in this case serves two functions. It converts from the soil level (reported as K) to the guaranteed fertilizer content (reported as K_2O). It also includes the conversion factor from milliequivalent (percent of CEC) level to pounds per acre. CEC and percent saturation are explained in the Laboratory Results section.

If the potassium level in the soil is above optimum, no further potash amendments will be recommended. The exception to this is a small amount of potash recommended on low CEC soils for heavy potassium feeding crops like potatoes or corn.

At very low potassium test levels or for very high CEC soils, the potash recommendation may be limited to a maximum amount. This will raise the soil level gradually, prevent burn from fertilizer salts, prevent localized nutrient imbalance problems, and spread cost over more years. Because of this limit on application, soil potassium may not be adjusted to the optimum level in the first year. Additional corrective applications may be necessary in subsequent years.

Choosing a Fertilizer Blend

All large scale commercial crops receive recommendations for each of the three nutrients individually. They can be met by any variety of nutrient sources, organic or chemical. If you are using chemical fertilizers on a large area it is best to have a bulk blend custom mixed to closely match the suggested rates. If a bulk blend is not possible, it will be necessary to match the suggested rates with a pre-mixed commercial blend. Choose the commercial blend with the closest *ratio* of N-P_2O_5-K_2O to that in the recommendations and calculate the application rate based on nitrogen.

Example

Recommended fertilizer application rates as follows:
150 pounds nitrogen per acre
100 pounds phosphate per acre
150 pounds potash per acre

1. This recommendation simplifies to a ratio of 1.5 - 1 - 1.5

2. A possible list of available fertilizer grades from a vendor

grade	ratio
10 - 10 – 10	1 - 1 - 1
5 - 10 – 10	1 - 2 - 2
15 - 8 - 12	1.9 - 1 - 1.5

*The closest match to the ratio recommended is the 15-8-12.

3. Calculate the application rate from the Nitrogen recommendation:

150 lb nitrogen per acre ÷ 0.15 (15 % Nitrogen in 15-8-12) =
1000 lb 15-8-12/A

4. Actual nutrient application from 1000 lb 15-8-12/A:

150 lb nitrogen
80 lb phosphate
120 lb potash

Calculating Manure Application Rate

To determine an application rate for manure to meet a specific recommendation for $N\text{-}P_2O_5\text{-}K_2O$ on a soil test report, it is necessary to obtain an analysis of the material to be used. Nutrient content of manure is quite variable, so "average" values should be used with caution. An example analysis of dairy manure is as follows:

10 lb total nitrogen/ton
4 lb ammonium nitrogen/ton
7 lb P_2O_5/ton
11 lb K_2O/ton

Nitrogen availability from manure depends on the season of application and how soon the manure is tilled in after application. Ammonium nitrogen is the part of the total nitrogen which will be available early on in the growing season and which can also be lost due to volatilization (evaporation) if not immediately tilled in. As an example, for solid dairy manure applied in the spring and immediately tilled in, 95% of the ammonium nitrogen, plus 25 % of the remaining total nitrogen (organic N) is assumed to be available the first year. From the above analysis, nitrogen availability would be calculated as follows:

[4 lb ammonium-N x 0.95] + [(10 - 4) lb organic-N x .25] =
3.8 + 1.5 =
5.3 lb available N/ton

Phosphate is assumed to be 90 % available and potash is assumed to be 100 % available the year of application. From the above analysis, phosphate availability would be calculated as follows:

7 lb P_2O_5 x 0.90 = 6.3 lb available P_2O_5/ton

To match the recommended 150-100-150 ($N\text{-}P_2O_5\text{-}K_2O$) used in the fertilizer example, calculate the tons of manure needed to supply each nutrient, then apply the lowest of the three calculated rates:

150 lb N per acre / 5.3 lb available N/ton = 28 tons/A
100 lb P_2O_5 per acre / 6.3 lb available P_2O_5/ton = 16 tons/A
150 lb K_2O per acre / 11 lb K_2O/ton = 14 tons/A

The lowest rate is 14 tons/A to completely fill the potash requirement. The actual nutrients applied from a 14 ton application would be as follows:

75 lb available N
90 lb available P_2O_5
155 lb K_2O

The remaining 75 lb of nitrogen and 10 lb of P_2O_5 would have to be met with some other source, such as urea and superphosphate. Realistically, a deficit of 10 lb P_2O_5/acre would probably have no significant effect on crop yield or quality. If manure is applied at 28 tons/A to meet the full N requirement, more phosphate and potash will be applied than is required to meet the crop needs. This is acceptable in many cases, especially where available P and K levels in the soil do not test above optimum. However, repeated applications in excess of crop requirements can result in above optimum soil test levels after only a few years.

More information on nitrogen availability and loss from manures and calculation of application rates can be found in "Developing Nutrient Management Plans for Maine Farms Guidance Document", available from the University of Maine Cooperative Extension and from the Maine Department of Agriculture.

MANAGEMENT RECOMMENDATIONS

The management tips which appear below the lime and fertilizer lines contain general information on the placement, timing, or other modifications of the lime and fertilizer recommendations. They also contain specific information for some crops or management situations and warnings of common problems. This information is often just as important as the lime and fertilizer recommendations themselves. Be sure you read all the information on the report form.

Useful information for all crops

Banding of fertilizer or other amendments in the root zone ensures the most efficient use of these materials by the crop plants. It is especially critical if one or more nutrient levels is listed as "LOW".

If you are not topdressing an existing crop, be sure to till or harrow in any organic material, lime (or sulfur), and phosphate amendments to be sure of complete reaction and better availability. These materials and nutrients do not readily move from the surface through the root zone when topdressed and will not move deeper than an inch or two during the growing season.

Because soils have a poor capacity to hold available nitrogen, a split application of nitrogen fertilizer is desirable for many crops, whether you use a chemical or organic nitrogen source. Plants need most of their seasonal nitrogen requirements during the period of rapid stem and leaf growth in early to mid-summer. Nitrogen applied just before this rapid growth stage is less likely to be lost from the root zone before the plant actually needs it. This is particularly important during years of heavy rainfall. Problems can also occur if nitrogen fertilizer is applied too late in the growing season. Specific recommendations for split application of nitrogen fertilizer will appear for those crops which will most benefit from it. Supplemental mid-season nitrogen tests will also be recommended for all corn and potato crops.

Organic matter management

Active management of soil organic matter is essential, whether you use chemical or organic practices. Soil organic matter is very important in determining soil nutrient holding capacity, water holding capacity, structure, tilth, drainage, aeration, buffering capacity, and overall health. It should be monitored and actively managed, just as you would soil pH. Soil tillage of any kind will tend to speed the natural breakdown process of organic matter in soil. Soil organic matter should be replenished with yearly applications of animal manure, compost, cover crops, leaves, or other organic material. The establishment of a sod cover, as with hay land or turf, will tend to increase and maintain soil organic matter over time, even if no other sources of organic material are applied.

If organic matter is at an optimum level, only moderate quantities should be added each year. If organic matter is above optimum, none should be applied for a year or two to allow the level to decline through normal breakdown. An above optimum organic matter level can, in some cases, result in the release of too much available nitrogen, causing excessive height and foliar growth, delayed fruiting and ripening in vegetable crops, or lodging of grain crops.

It is relatively difficult to build and maintain soil organic matter level in very sandy soils, since the normal breakdown rate of organic matter in these soils is very rapid. Certain sources of organic material provide a more lasting effect on soil organic matter than others. For sandy soils, organic materials which break down slowly, such as plowed-down mature cover crops or a sod cover in the rotation, are preferable to applying animal manure or other materials which break down more rapidly.

LABORATORY RESULTS

The laboratory results and the associated calculations are probably the most confusing part of the report form. The numerical results are listed at the bottom of the report form as incidental information, since they have already been interpreted for you in the Relative Nutrient Level section of the report form. Directly underneath each of the levels found or calculated, there is an explicit listing of the optimum numerical range for each of these values for the crop being grown. This can be used as a further aid to interpreting your test results. An explanation of each of the numerical terms follows:

Soil pH is the traditional measurement of the intensity of the acidity (or alkalinity) of your soil. A pH below 7.0 is acidic. A pH above 7.0 is alkaline. pH is measured in a soil/water paste made with distilled water. It is very useful as an index of relative acidity, but does not by itself predict lime requirement with great accuracy. Optimum pH level is 6.0 - 7.0 for most agronomic and commercial vegetable crops. Ideal pH is 6.0 for turf grass, Christmas trees, corn, and beans. The optimum soil pH for potatoes is 5.5 to 6.0.

Lime index is a pH measurement taken in a buffered solution which has been allowed to react with the soil's acidity. It is used to measure the total exchangeable or reserve acidity in the soil. It can be thought of as a simulated liming of the soil to measure it's response to a lime application. The lime index, together with the current soil pH measured in water, is used to accurately calculate the quantity of soil acidity to be neutralized and the lime application necessary to raise your soil pH to the optimum level for the crop you plan to grow. In 2001, the lime index method was recalibrated on Maine soils using a new buffer solution, to improved accuracy and precision of results. Results from the new procedure are labeled "Lime index 2".

Pounds per acre extractable Phosphorus (P) is an index or scale for determining phosphorus availability. It is not a direct measure of plant P uptake, but corresponds directly to the amount of phosphorus that plants will be able to take in from this soil over the next growing season. The per acre estimation assumes a 6 - 7 inch plow layer or rooting zone. Most soils have about the same capacity to hold and supply phosphorus, so test levels are reported on a pounds per acre basis only. The optimum level for most crops is from 10 to 40 pounds per acre (0.25 to 1 lb per 1000 sq. ft.) or the equivalent on a smaller area. Any phosphorus test level over 40 lb per acre is considered above optimum.

Pounds per acre exchangeable Potassium(K), Magnesium(Mg), and Calcium(Ca) is an index or scale for determining the availability of these three nutrients over the next growing season. As with the phosphorus level, the pounds per acre estimation assumes a 6 - 7 inch plow layer or rooting zone. The available portion of these three nutrients are held by the soil and are taken into plants as positively (+) charged particles called cations. The optimum level of these nutrients depends very much on the ability of the soil to hold these cations. This will be explained in more detail next.

Cation Exchange Capacity (CEC) is an estimation of the soil's ability to hold cations. It is a measure of the total amount of negative (-) charge in the soil. Since opposite charges attract, these (-) charged sites in the soil selectively hold the (+) charged cations. CEC varies according to soil texture, organic matter content, and pH. The (-) exchange sites hold most of the available potassium, magnesium, and calcium in the soil as well as exchangeable or reserve acidity (mostly aluminum).

The CEC which appears on the report form is not directly measured. Instead, it is estimated by converting the exchangeable Ca, K, Mg, and acidity levels found to equivalent amounts of (+) charge. All the (+) charges can then be added together. The sum of the (+) charges is assumed to equal the net (-) charge or CEC of the soil. Soil charges are expressed in terms of milliequivalents per 100 grams of soil (me/100 gm). In most soils, the net negative (-) charge or CEC will increase as the pH is increased. Because of this it is necessary to take into account the change in CEC after a recommended lime application. CEC is estimated at a *projected* pH, which varies depending on the crop to be grown. This projected pH or pH management level is explicitly stated for your crop in the first line of the Laboratory Results section. Because of this variation in nutrient holding capacity, a single soil can have two entirely different CEC estimates if recommendations are requested for two crops with different optimum pH levels.

By estimating the CEC, the optimum level of the three nutrient cations can be determined relative to the total capacity of the soil to hold them. In fact, the CEC is the basis for reporting the levels of and making the recommendations for calcium, potassium, and magnesium. There is no interpretation of relative level (low-medium-optimum) for CEC. In general, a CEC of 7 to 15 me/100 gm is a sufficient nutrient holding capacity for most crop production systems. A CEC value below 5 me/100 gm can become a limiting factor to plant growth and production.

Percent saturation is the portion of the estimated CEC which is occupied by the three exchangeable nutrient cations and exchangeable acidity, at their present levels. Optimum levels vary by crop, but for most crops grown in Maine, optimum nutrient level and balance to support maximum yield are at the following saturation levels:

3 - 5% Potassium
10 - 25% Magnesium
60 - 80% Calcium
<10% acidity

Percent saturation provides information regarding nutrient balance, as well. Since potassium, calcium, and magnesium compete with each other for exchange sites in the soil and for uptake into plants, it is important that they be in balance with each other. These three nutrients will be balanced when each falls within the ideal percentage ranges listed above.

Percent exchangeable acidity is reported to show the portion of the total nutrient holding capacity occupied by acidity under present conditions. Acidity is primarily composed of exchangeable aluminum, which is not an essential nutrient. Acid-loving plants require a low pH (high acidity) soil, but have no specific requirement for aluminum. Lime is recommended where necessary to reduce acidity to near zero. After liming, the exchangeable acidity will be displaced and those exchange sites occupied by the more useful nutrient cations calcium and magnesium.

CEC adjustment - When a sample is taken after a recent lime application, there will still be a certain amount of unreacted lime in the soil. In these cases, the laboratory nutrient extraction procedure will dissolve some of this unreacted lime. The amounts of calcium and magnesium found will be partly from exchange sites and partly from dissolved lime. This will produce a false estimation of CEC. To correct for this situation, an additional test is run on all high pH samples to find those calcium and magnesium levels which are inflated from dissolved lime. Milliequivalent levels of calcium and magnesium are corrected where necessary during the summation process for the purpose of estimating CEC. The reported lb/A values remain unchanged. In those cases where an adjustment has been made, this symbol will appear to the right of the CEC value: (A). This adjustment ensures that a reasonable estimation of CEC has been made, which will in turn give a more accurate assessment of the saturation levels and balance of the three nutrient cations and acidity.

Organic matter is the amount of decayed or humified organic material (crop residues, compost, manures, etc) in the soil. There are actually several techniques used to measure soil organic matter level. There is a simple ignition technique where the soil is heated to a very high temperature to burn off the organic matter. The other major technique is to chemically digest or oxidize the organic carbon in the soil. Both techniques are equally valid for monitoring organic matter content, but give different numerical results.

In the past the Maine Soil Testing Service reported organic matter in terms of "loss on ignition". Since 1995, organic matter has been reported in terms of the chemical oxidation method. Most soil management books, reference manuals, and pesticide labels reference soil organic matter level in terms of the chemical oxidation method. The conversion of organic matter to this basis makes our test results more compatible with current reference manuals and labels.

The ideal soil organic matter level from the nutrient cycling and fertility standpoint is 5 - 8 %. If organic matter level falls below 2 - 3 %, the nutrient and water holding capacity of the soil becomes very limited and may not be sufficient to support normal plant growth during some growing seasons.

Available zinc is reported and interpreted only for field corn, sweet corn, and commercial potato crops. Zinc is a micronutrient which is only occasionally limiting to plant growth. It is reported for corn and potatoes, since a response to added zinc has been shown in some cases with these two crops only.

The optimum range for both crops is 1 - 2 ppm (parts per million) of available zinc. If the available zinc level is less than 1 ppm, there is a reasonable probability of a yield response to added zinc. If the available zinc level is greater than 2 ppm, there is very little chance of a yield response to added zinc.

If the zinc level is above 2 ppm, zinc should not be used in a banded fertilizer, which would be concentrated in the root zone. As with most micronutrients, if too much is applied, the resulting soil level may actually be toxic to plants growing in it. The exact level where toxicity will occur depends on soil texture, pH, organic matter, and the plant species and variety. To be safe, it is best not to purposely apply zinc where a need is not indicated.

When zinc is needed, a typical application rate is only 1 to 2 pounds actual zinc per acre if it is banded and 4 to 8 pounds per acre when broadcast. Specific application rates will be suggested when zinc is recommended.

BILLING INFORMATION

If you have paid in advance for the analysis of your sample(s), this will be indicated on the very bottom line of the report form for each sample. If our records indicate that full payment was not received, you will also receive an invoice with your report(s) indicating the amount still due.

Be sure that you have received credit for any payment you sent in with the sample(s). If there is an error in our records, please write, call, or email us so that we can correct our records of your account. Statements will be sent out monthly on any unpaid balances over two months old.

PROBLEMS

If you have a problem or question on the interpretation of your results or recommendations, please contact the nearest county office of Cooperative Extension listed below. An Educator or crop specialist can help you with most general problems concerning soil testing.

Refer any problems of questionable results, additional analysis, incorrect crop codes, billing problems, etc. to the Maine Soil Testing Service lab. Soil samples are stored as long as space permits after they are initially processed in case it is necessary to run additional analysis. All results, recommendations, and customer information are permanently stored on computer for easy retrieval, reprinting, or modification.

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GLOSSARY OF TERMS

Amendment : any material added to the soil to enhance or increase nutrient content or availability. Lime, fertilizer, manure, compost, etc.

Ammonium-nitrogen : a form of mineral nitrogen commonly used in commercial fertilizers which is ultimately converted to nitrate-nitrogen by microbial action. (see Nitrogen section)

Available : the quantity of a nutrient element in the soil which is accessible for plant uptake at some point in the growing season.

Banding : the practice of placing fertilizer or other soil amendment in a strip below and to the side of the row when planting or in a circle around transplants.
Blend (fertilizer) : the specific combination of nutrient materials used to produce a fertilizer of a guaranteed grade.

Calcitic lime : ground limestone containing less than 6% magnesium.

Calcium carbonate equivalence (CCE): rating of the acid-neutralizing value of a liming material, depending on the purity and chemical composition of the material.

Cation exchange capacity : measurement of a soil's ability to hold cations against leaching. A measure of the soil's potential nutrient holding capacity. (see Cation Exchange Capacity section)
Corrective fertilizing : applying nutrients in excess of the total needs of the crop being grown, for the purpose of raising the residual soil nutrient level after the crop has been removed.

Dolomitic lime : ground limestone containing about 10% or more magnesium.
Exchange (exchangeable) : removing nutrient cations from exchange sites in the soil during measurement or plant uptake.

Exchange sites : locations on clay or organic matter particles with negative (-) charges which can hold nutrient cations. All exchange sites taken together make up the total negative charge or cation exchange capacity (also called the exchange complex). (see Cation Exchange Capacity section)

Exchangeable (reserve) acidity : the total quantity of acidity held by the soil which must be neutralized to raise the soil pH. It is comprised mostly of aluminum. At lower pH's it occupies a significant portion of the exchange sites in the soil. (see Lime Index section)

Extraction (extractable) : a general term for the removal of nutrients from the soil during measurement or plant uptake.

Grade (fertilizer) : the guaranteed percent content by weight of a commercial fertilizer in terms of percent nitrogen, phosphate(P_2O_5), and potash(K_2O). The same grade can be produced with entirely different sources of each nutrient.

Humification : the initial breakdown or decay of organic material in soil to form organic matter or humus.

Leaching : the removal of nutrients from the surface layer of soil by the actions of water percolation through the soil or by flooding with ground water.

Magnesium lime : ground limestone containing (by law) 6 % or more magnesium.

Major nutrient : any nutrient necessary for plant growth in relatively large amounts - nitrogen, phosphorus, potassium, calcium, magnesium, sulfur.

Micronutrient : any nutrient necessary for plant growth in relatively minute amounts - boron, copper, iron, manganese, molybdenum, zinc.

Nitrate-nitrogen : a form of nitrogen which is easily leached from soils. The primary form of nitrogen used by most plants. (see Nitrogen section)

Nutrient balance : the ideal condition of exchangeable calcium, potassium, and magnesium being present at the same relative level. (see Relative Soil Nutrient Level section and Percent Saturation section)

Nutrient imbalance : a situation where nutrient cations are present at greatly different relative levels, usually caused by an excess of one of them. (see Relative Soil Nutrient Level section and Percent Saturation section)

Organic matter : a mixed and variable component of the soil, composed primarily of plant residues, manures, and composts in various stages of decomposition. (see Nitrogen section and Organic matter section)

Phosphate (P_2O_5) : the chemical representation of any and all phosphorus sources in commercial fertilizers.

Potash (K_2O) : the chemical representation of any and all potassium sources in commercial fertilizers.

Projected or target pH : the optimum pH level of the soil for the crop being grown, achieved after a recommended lime application has completely reacted. (see Cation Exchange Capacity section)

Relative nutrient level : classification of a particular nutrient or other soil component level as low, medium, optimum, or above optimum for a given soil and crop.

Split application : the practice of applying a total recommendation of lime or fertilizer over two or more separate applications spaced months or years apart, to gradually increase nutrient levels in the soil.

Starter fertilizer : typically a high phosphorus fertilizer applied at planting or transplanting to stimulate rapid root growth and early establishment of seedlings.

Topdressing : the even distribution of a soil amendment (lime, fertilizer, manure, etc.) on an established crop or sod without tilling it in.