SOIL ANALYSIS REPORT FOR HOME GARDENS 07/07/09

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S090702-102
BAG NUMBER: 86430

SOIL WEIGHT: 5.91 g/5cc
CROP: VEG

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SAMPLE ID: 200 FT GARDEN

RECOMMENDATIONS FOR HOME GARDENS:

SOIL PH ADJUSTMENT:
INCORPORATE 8 lbs of ground dolomitic (magnesium rich) limestone per 100 sq ft as early as possible prior to planting. Avoid mixing in lime when the soil is very wet.

FERTILIZER:
** VEGETABLES: Apply 4-5 lbs 5-10-5 per 100 sq ft in early spring.
OR, ORGANIC FERTILIZER:
If you prefer INSTEAD to provide nutrients from organic sources, apply the following materials per 100 sq ft prior to planting:
NITROGEN: 1-2 bushels well-rotted manure PLUS 1 lb dried blood
PHOSPHORUS: 6 lbs steamed bone meal OR 16 lbs rock phosphate
POTASSIUM: 5 lbs wood ash

** ANNUAL FLOWERS: Apply 2.0 lbs 5-10-5 per 100 sq ft in early spring. Alternatively you may use one-half the ORGANIC recommendation given above.

** ROSE BUSHES: Apply 5 tablespoons of 5-10-5 per bush in early June and early August. None after August 15.

Avoid overfertilizing which can cause plant toxicity and can contribute to insect and disease problems.

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.3	0.1-2.0	Copper	(Cu)	0.4	0.3-8.0
Manganese	(Mn)	1.3	3 - 20	Iron	(Fe)	3.9	1.0- 40
Zinc	(Zn)	17.9	0.1- 70	Sulfur	(S)	23.6	1.0- 40

SOIL pH 6.4
BUFFER pH 6.7

NITROGEN: NO3-N = 10 ppm
ORGANIC MATTER: 4.7 % (Desirable range 4-10%)

NUTRIENT LEVELS:		PPM	Low Medium High Very High
Phosphorus	(P)	4	XXXXXX
Potassium	(K)	78	XXXXXXXXXXXXXXXXXX
Calcium	(Ca)	1273	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Magnesium	(Mg)	9	XX

CATION EXCH CAP
8.2 Meq/100g

PERCENT BASE SATURATION
K= 2.1 Mg= 0.8 Ca=66.1

MICRONUTRIENT LEVELS
ALL NORMAL

EXTRACTABLE ALUMINUM: 36 ppm (Soil range: 10-250 ppm)

The lead level in this soil is low.

VISIT www.umass.edu/plsoils/soiltest FOR FURTHER INFORMATION ON SOIL TESTING AT UMASS.
TO CONTACT THE LAB: EMAIL soiltest@psis.umass.edu PHONE (413-545-2311).

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RESULTS AND INTERPRETATION OF SOIL TEST

The primary goal of soil testing is to provide guidelines for the efficient use of soil amendments, such as lime and fertilizer. Those provided with your soil test are for the crop you have chosen. Problems directly related to disease, insects, and to some extent weather and cultural practices cannot be addressed by a soil test.

The Soil Sample - One of the most important steps in soil testing is obtaining the soil sample. It should represent the soil in which the plants are or will be growing. Instructions for proper sampling may be obtained by calling the lab or by visiting our web site. Remember, a poor sample will result in bad recommendations.

SOIL TEST RESULTS

Soil pH, Buffer pH, and pH adjustments - Soil pH is a measure of the soils acidity and is a primary factor in plant growth. When pH is maintained at the proper level for a given crop, plants nutrients are at maximum availability, toxic elements are often at reduced availability, and beneficial soil organisms are most active. Most plants prefer a soil pH between 5.5 and 7.5 and the majority do best in the middle part of this range. Some notable acid-loving exceptions are blueberries, potatoes, and rhododendrons.

Due to the climate and rock-types in which the soils of New England have formed, soils here tend to be naturally very acidic (4.5-5.5). For this reason they must often be amended with materials capable of raising the pH. Many products are available to accomplish this, but ground limestone is the most common. Lime recommendations are made in its terms.

Buffer pH is a measure of the soil's capacity to resist pH change after lime has been added. Two soils with the same soil pH may have quite different buffer pH's, and thus one will require significantly more limestone than the other to obtain an optimal soil pH. The extent to which the buffer pH is lower than 6.8 is proportional to the amount of limestone needed.

Occasionally soil pH must be lowered, because either the plant requires acid soil, or the soil was previously over-limed. Incorporating elemental sulfur is the most effective way to lower soil pH. In the soil the sulfur oxidizes to sulfuric acid. One to two pounds of sulfur will lower the pH of most New England soils about 0.5 unit. Unfortunately, sulfur is rarely available in garden centers. Contact the Soil Lab for other options.

Cation Exchange Capacity and Percentage Base Saturation - Cation exchange capacity (CEC) is an important measure of the soil's ability to retain and to supply nutrients. The bulk of this capacity in limed New England soils resides in finely divided soil organic matter. A smaller contribution comes from the soil's clay particles. The basic nutrient cations (positively charged ions) of Calcium (Ca++), Magnesium (Mg++), and Potassium (K+), and the acidic cations of Aluminum and Hydrogen account for nearly all the adsorbed cations in the soil. Very sandy soils, low in organic matter, commonly have CEC's less than 5. New England soils with very high CEC's (greater than 40) are invariably rich in organic matter. A CEC between 10 and 15 is typical and usually adequate.

CEC is important because it represents the primary soil reservoir of readily available Potassium, Calcium, Magnesium and several micronutrients. It also helps to prevent their leaching. The ease with which a plant gains access to these nutrients depends somewhat on the relative percentages of the adsorbed cations. For this reason it is suggested that percentage saturation levels be held within loosely defined ranges. For example, a soil with base saturations of Calcium 70%, Magnesium 12% and Potassium 4% would is considered balanced for most crops and has a soil pH of about 6.5.

Individual Nutrients

Nitrogen (N) - Nitrogen is **essential** to nearly every aspect of plant growth. Nitrogen is absorbed from the soil as nitrate (NO3-) and ammonium (NH4+). This soil test estimates their current levels. Fertilizer recommendations are not generally made on the basis of these measurements because their levels can fluctuate greatly with soil and weather conditions over short periods of time. Instead, they are used to assess extremes of nitrogen fertility. For example, very high ammonium levels can be toxic to the roots of many plants, particularly if the soil pH is above 7. Very high levels of either form may coincide with fertilizer "burn." Recommendations are made on the presumptions that very little nitrogen remains in the soil after the growing season and that most crops require between 1 and 4 lbs of nitrogen per 1000 square feet per year. Adjustments are often made for soils recently or continuously supplied with manure or compost, which contain nitrogen that will be released during the growing season.

Phosphorus (P) or Phosphorus Pentoxide (P2O5) - Among other important functions, phosphorus provides plants with a means of using the energy harnessed by photosynthesis to drive its metabolism. A deficiency of this nutrient can lead to impaired vegetative growth, weak root systems, and fruit and seed of poor quality and low yield. Soil phosphorus exists in a wide range of forms. Some is present as part of soil organic matter and becomes available to plants as the organic matter decomposes. Most inorganic soil Phosphorus is bound tightly to the surface of soil mineral particles. Warm, moist, well-aerated soils at about pH 6.5 optimize the release of both these forms. Plants require fairly

large quantities of phosphorus, but the levels of phosphorus available to plant roots at any one time is quite low. Soil tests attempt to assess the soil's ability to supply phosphorus from bound forms during the growing season.

Potassium (K) or Potash (K2O) - Potassium rivals nitrogen as the nutrient element absorbed in greatest amounts by plants. Like nitrogen, crops take up a relatively large proportion of plant-available potassium each growing season. Plants deficient in potassium are unable to utilize nitrogen and water efficiently, and are more susceptible to disease. Most available potassium exists as an exchangeable cation (see above). The slow release of potassium from native soil minerals can replenish some of the potassium lost by crop removal and leaching. This ability, however, is limited and variable. Fertilization is often necessary to maintain optimum yields.

Calcium (Ca) - Calcium is essential in the proper functioning of plant cell walls and membranes. Sufficient calcium must also be present in actively growing plant parts, especially storage organs such as fruits and roots. Properly limed soils with constant and adequate moisture will normally supply sufficient calcium to plants. High humidity and poor soil drainage hinder calcium movement into these plant parts and should be avoided.

Magnesium (Mg) - Magnesium acts together with phosphorus to drive plant metabolism and is part of chlorophyll, a vital substance for photosynthesis. Like Calcium, Magnesium is ordinarily supplied through liming. Low magnesium levels in many soils will normally not cause problems provided the exchangeable cations (see above) are in good balance. If Mg levels are low and lime is required, dolomitic lime (rich in Mg) will be recommended. If Mg is low and lime is not required, Epsom salt (magnesium sulfate) may be incorporated at a rate of 5-10 lbs/1000 square feet.

Micronutrients - The micronutrients are elements essential to plants, but required in very small amounts. In most properly limed soils they are available in sufficient quantities. Five of these (iron, manganese, zinc, copper, and boron) are tested routinely. Micronutrient fertilizer recommendations are not available. Extremely high values, however, are noted.

Aluminum - Aluminum is not an essential nutrient for plants. At elevated levels it can be extremely toxic to plant roots and limit the plant's ability to take up phosphorus. Extractable aluminum increases greatly at soil pH's below 5.5. Proper liming, however, will lower aluminum to acceptable levels. Aluminum sensitivity varies greatly with plant type. Acid-loving plants, such as rhododendrons, can tolerate very high aluminum levels. Lettuce, carrots and beets are very sensitive. Hydrangea, a non-sensitive plant, produces blue flowers at low pH and pink flowers at high pH due to the effect of aluminum on pigment formation.

Toxic Heavy Metals - This laboratory routinely tests lead (Pb) and cadmium (Cd). Lead is naturally present in soils in the range of 15 to 40 parts lead per million parts soil (ppm). At these levels it presents no danger to people or plants. Soil pollution with lead-based paints and the tetraethyl lead of past automotive fuels have increased soil lead levels to several thousand ppm in some places. Unless the total lead level in your soil exceeds 150 ppm, it is simply reported as low and can be considered safe (assuming the sample submitted was representative of the area of concern). Values above 300 ppm are potentially dangerous to people. In such cases consult the separate insert on soil lead levels.

Cadmium is extremely toxic to both plants and animals. It is naturally present in soils at safely low levels (less than 1 ppm). Industrial discharges of cadmium, however, often cause municipal sewage sludge to contain elevated levels of cadmium. Composted sludges are often used as soil amendments. Although safe upper limits of cadmium for both plants and animals have not been established, monitoring soil Cd levels helps avoid excesses when such materials are used. Unless the cadmium in your soil exceeds 1 ppm it is not reported.

Soluble Salts - Soluble salts (SS), such as those used on roads to promote melting and those present in many commercial (and some natural) fertilizers, can cause severe water stress and nutritional imbalances in plants. Generally, seedlings are more sensitive than established plants to elevated SS levels and great variation exists between plant species. Most soils have values between 0.08 and 0.50 by the method used by this lab. The middle of this range is typical of most fertile mineral soils. Values higher than 0.60 may cause damage to sensitive plants (such as onions, etc.). A SS level can change rapidly in the soil due to leaching (washing out), so evaluating its significance must consider the effects of time and growing conditions. Excessive SS levels can often be corrected by leaching with liberal amounts (2 to 4 inches) of fresh water. Normal off-season precipitation will usually correct salt problems resulting from over-fertilization.

GENERAL COMMENTS- Implementing the recommendations given in the enclosed report will correct the nutrient status of your soil for the plant type indicated. It may or may not solve a given horticultural plant growth problem. Other cultural factors may need to be evaluated. Many reports provide both "natural and organic" and "synthetic chemical" fertilizer alternatives.

The numerical results of this soil test reflect the properties of your soil and the analytical procedures used by the U Mass lab. One cannot directly compare the extracted nutrient levels of one laboratory to those of another, because different labs may use different procedures. However, the evaluation of the results (whether they represent low, medium or high levels) and the accompanying recommendations should be consistent between labs if all other factors of crop production are the same.

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Questions regarding soil testing may be directed to the Soil and Plant Tissue Testing Laboratory at (413) 545-2311.
Web: http://www.umass.edu/plsoils/soiltest/

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Using Lime and Fertilizer in the Home Landscape

The recommendations provided on your soil test have hopefully been written in a way that is both understandable and convenient for you to use. It is difficult to express these in a way that matches every individual's preference. Some wish to use only natural soil amendments. Others request recommendations in terms of soluble synthetic fertilizers. Most soil tests state the number of pounds of nutrient to apply per given area (to be incorporated through a specified depth). In home gardens the small amounts recommended may be difficult to weigh accurately. It is often much easier to apply a volume of fertilizer (cup, liter, etc.). Your soil test will state the amounts of Nitrogen, Phosphorus, and Potassium recommended for your crop in terms of lbs per specified soil area (or volume). It will then provide you with one way of supplying these nutrients. Use the following tables as an aid in implementing this recommendation or to devise alternatives based on your basic N, P, K soil test recommendation.

Fertilizer Products and Their Properties

Table 1 converts weights to volumes for several fertilizer groups. For example, if your soil test recommendation calls for 3 lbs Bone Meal, under Organic Meals and Blends you find that a one cup measure holds 1/3 lb of Bone Meal. That means 3 cups would hold 1 lb, and 9 cups would hold 3 lbs. One could measure out 9 cups or use a cut-off 2 liter soda container, which also holds 3 lbs of Bone Meal. When measuring volumes scoop the material and level the container top (do not pack).

Table 1. Density Equivalents

	Density Units			
Fertilizer Groups	grams/cc	lbs/cup	lbs/2 liters	lbs/gal (oz/cup)
Organic Meals, Blends, and Wood Ash	0.7	1/3	3	6
Ground Rock Dusts (ex. Lime, Rock Phosphate, Greensand)	1.4	3/4	6	12
Coarse and Medium Granulated Synthetic Blends (ex. 5-10-10 graden fertilizer)	1.0	1/2	4.5	8.5
Fine Granulated and Flaked Synthetic Blends (ex. many turf fertilizers)	0.7	1/3	3	6
Composts	0.35	1/6	1.5	3
Powdered Sulfur	1.0	1/2	4.5	8.5
Urea and Other High Nitrogen Fertilizers	0.80	1/3	3.5	7

Some Convenient Containers for Measuring Fertilizers

12 oz Coffee Can = 1 liter
Cut-off 2 liter Soda Bottle = 2 liters
Dry Wall Compound Bucket = 5 gallons
Cut-off 1/2 gallon Milk Container = 1/2 gallon
Kitchen Measuring Cup = Graduated

SUPPLYING INDIVIDUAL NUTRIENTS

If your soil test calls for a quantity of nitrogen, phosphorus, or potassium expressed in fractions of a pound per 100 square feet, you may use one of the combinations listed below to meet that recommendation.

1/4 lb nitrogen (N):

1 bushel (1.25 cubic feet) well-rotted or composted manure plus 1 lb dried blood (12-0-0)
OR
3 to 4 lbs dried blood (12-0-0)
OR
1/2 lb urea (42-0-0)

1/4 lb phosphorus (P2O5)

3 to 4 lbs bone meal (0-12-0)
OR
1/2 lb triple superphosphate (0-45-0)

1/4 lb potassium (K2O)

4 to 5 lbs wood ash (0-0-5) (use only if soil pH is les than 6.3 and reduce lime recommendation by 3 to 4 lbs)
OR
1/2 lb muriate of potash (0-0-60) or potassium sulfate (0-0-50) (potassium sulfate is preferred but is more difficult to find)

If recommendation calls for 1/2 lb of nutrient, simply double the quantity recommended for 1/4 lb.

For annual flowers use 1/2 the amount recommended for vegetables.