University of Connecticut
Department of Plant Science

Soil Nutrient Analysis Laboratory, 6 Sherman Place, Box U-102, Storrs, CT 06269-5102,
Phone : 860-486-4274, Fax : 860-486-4562.

GROWER'S ADDRESS
Harris Property Community Garden Plot

SAMPLE ID		
HARRIS		
LAB ID	RECEIVED	REPORTED
2951	05/05/15	05/14/15
SALES AGENT		

NUTRIENTS EXTRACTED FROM YOUR SOIL (MODIFIED MORGAN EXTRACTABLE)

		BELOW OPTIMUM	OPTIMUM	ABOVE OPTIMUM
pH	5.1			
Calcium	653 lbs/acre	**************		
Magnesium	65 lbs/acre	***************		
Phosphorus	6 lbs/acre	****************		
Potassium	134 lbs/acre	****************		

Element	ppm	Soil Range
Boron (B)	0.10	0.1-2.0
Copper (Cu)	0.20	0.3-8.0
Iron (Fe)	6.60	1.0-40.0
Manganese (Mn)	3.80	3.0-20.0
Zinc (Zn)	0.70	0.1-70.0
Aluminum (Al)	134	10-300

Estimated Total Lead: Low, typical background levels

LIME AND FERTILIZER RECOMMENDATIONS

CROP OR PLANT : VEGETABLE GARDEN

LIMESTONE (GROUND, GRANULAR, PULVERIZED OR PELLETED):

Apply 90 lbs. per 1000 sq. ft. to raise the pH level.Have your soil re-tested in 3-4 years. Apply half the lime in the spring and half in the fall.

FERTILIZER:

Soil test values for both phosphorus and potassium are below optimum. Before planting, incorporate 40 lbs of 5-10-10 per 1000 sq ft or the equivalent from other sources. If plants develop pale green to yellow color, sidedress with 3 lbs. of 10-6-4 or 10-10-10 per 100 ft. of row in late June or early July. Apply next to the row about six inches from plants avoiding contact with foliage to prevent burning.

See the enclosed information on natural fertilizers for alternatives to synthetic chemical fertilizers.

COMMENTS:

Soil texture classification: Sandy loam

Organic content classification: Medium

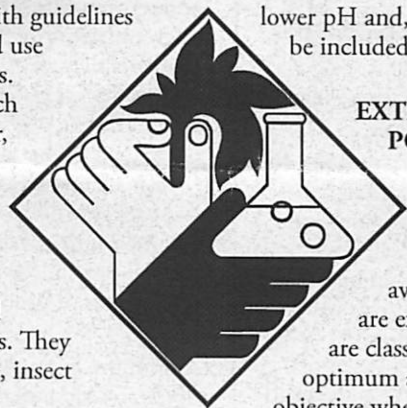
If you have questions about this report or about any other plant or soil problem, contact the University of Connecticut Home & Garden Education Center, Department of Plant Science, U-115, Storrs, CT 06269-4115. Phone: (877) 486 6271 (toll-free).

Soil Nutrient Analysis Laboratory

Soil Nutrient Analysis Laboratory, 6 Sherman Place, Unit 5102, Storrs, CT 06269-5102 • Phone: 860-486-4274, Fax: 860-486-4562
Location: Union Cottage, Depot Campus, Mansfield

INTERPRETATION OF SOIL TEST RESULTS

Soil tests provide homeowners and growers with guidelines for both efficient and environmentally sound use of fertilizers, lime and other soil amendments. Recommendations are based on University research and field studies. Our recommendations, however, are only as good as the sample you collect. Samples should be representative of the area being tested and should consist of a mixture of several subsamples obtained throughout the site. Poor sampling techniques may result in misleading recommendations. Soil test results will detect nutrient deficiencies, excesses or imbalances. They cannot, however, identify problems due to disease, insect pests, pesticides or poor cultural practices.



SOIL PH AND LIME RECOMMENDATIONS

Soil pH is a measurement of a soil's acidity. The pH scale ranges from 1 to 14, with a pH of 7 being neutral. Values below 7 are considered acidic while those above indicate alkaline conditions. The pH of a soil not only affects the availability of necessary plant nutrients but also the solubility of potentially toxic elements such as aluminum and lead.

Most garden plants prefer a pH between 6.0 and 6.8. Notable exceptions include acid-loving blueberries and ericaceous plants like rhododendrons, azaleas and mountain laurel. These plants prefer a pH of 4.5 to 5.3. Varieties of potatoes without scab resistance are also grown at a lower pH (5.2 to 5.4) to inhibit the growth of this disease organism. The majority of Connecticut soils tend to be acidic with pH values ranging from 4.8 and 5.5 due to the geology and climate of the region.

Ground limestone is usually recommended to correct acid soil conditions. Recommendations for lime are based on the crop or plants being grown, soil pH, and soil texture and organic matter estimates. In general, the lower the pH and the greater the clay and organic matter content of the soil, the greater the amount of limestone required to raise the soil pH to a desired level.

Limestone recommendations are located on the computer printout directly below the crop listing. Unless the limestone is to be tilled in, apply no more than 50 lbs/1000 square feet (5 lbs/100 square feet) to the soil surface at one time. Reapply at one- to six-month intervals until the total recommended amount is administered. It will take several months for the pH to increase.

Occasionally, it is necessary to lower the pH of a soil. Sulfur is used to lower pH and, if your soil needs sulfur, a recommendation will be included with your results.

EXTRACTABLE NUTRIENTS–PHOSPHOROUS, POTASSIUM, CALCIUMANDMAGNESIUM

The nutrient ions, phosphorus, potassium, calcium and magnesium are extracted from the soil using a modified- Morgan solution. Results provide an estimation of the nutrients available to plants during the growing season and are expressed as pounds per acre. Values on the report are classified as below optimum, optimum and above optimum and reflect the levels found in your soil. The objective when developing a fertility program is to achieve and maintain levels in the optimum range.

PHOSPHORUS

Phosphorus (P) is essential for root development and the production of flowers and fruit. Native Connecticut soils are generally low in phosphorus and much of what is present is bound in both organic and inorganic forms not readily available to plants. Phosphorus is most available at a pH of near 6.5 and by moist, warm conditions. Soil tests provide an estimate of the amount of readily available phosphorus and recommendations are made accordingly.

POTASSIUM

Plants require large amounts of potassium (K), which is sometimes referred to as potash (K2O). It is critical for numerous plant functions and especially aids in hardiness and disease resistance. Potassium is released from rocks and soil minerals as they weather. Often the supply of potassium from the soil is limited and fertilization is required.

CALCIUM

A vital component of the cell manufacturing process, calcium (Ca) also improves the root uptake of other nutrients. Plant growing points are particularly sensitive to an insufficient calcium supply as evidenced by blossom end rot – those black sunken spots often discovered on the bottom of tomatoes and summer squash. Lack of moisture also contributes to this disorder. Soils that are properly limed generally contain adequate calcium because this nutrient is a major constituent of limestone.

MAGNESIUM

A key element in the development of chlorophyll, magnesium (Mg) also is crucial to seed formation. Like calcium, magnesium usually is supplied by liming materials.

University of Connecticut
DEPARTMENT OF PLANT SCIENCE
College of Agriculture and Natural Resources
COOPERATIVE EXTENSION SYSTEM

Dolomitic lime containing about 20% magnesium. Epsom salts (magnesium sulfate) may be recommended where calcium levels are adequate but soil magnesium is low.

NITROGEN

Part of all living cells, nitrogen (N) promotes green leafy growth. Lack of nitrogen commonly limits plant growth. Plants take up nitrogen in the form of nitrate (NO3) or ammonium (NH4) with the nitrate form preferred by many garden plants. Because nitrogen levels fluctuate widely depending on environmental conditions and can change even in shipping, this element is not routinely measured. Nitrogen recommendations are based on crop needs as determined by field studies combined with the presumption that little available nitrogen remains in the soil at the end of the growing season. Even if levels of all other nutrients are sufficient, you will most likely need to add nitrogen to your lawn or garden each year and fertilizer recommendations are made accordingly.

VEGETABLE GARDENERS

If your results state that both the phosphorus and potassium levels are above optimum only a nitrogen recommendation will be provided. For each pound of nitrogen recommended you may use your choice of 8.3 lbs of bloodmeal (12-0-0), 17 lbs of cottonseed meal (6-2.5-1.7), 3.25 lbs of high nitrogen lawn fertilizer (32-3-5) or 2.2 lbs of urea (46-0-0) per 1000 square feet.

SOLUBLE SALTS

Soluble salts are measured by special request for an additional fee. Salt levels may be elevated in areas close to roads where salt compounds are used for deicing or where excessive fertilizer has been applied. High soluble salt levels can cause severe water stress and nutrient imbalances in plants. As measured by this lab, values for mineral soils less than 0.4 mmho/cm are low, values between 0.4 and 0.8 are slightly saline and may cause some injury to salt sensitive plants. Values between 0.81 and 1.2 are moderately saline and will restrict the growth of many plants, while those above 1.2 are considered high and likely to cause damage. Soluble salt levels can be reduced by repeated, thorough irrigation.

ORGANIC MATTER

Organic matter values are considered low if less than 4%, medium from 4% to 8%, and high if above 8%. We visually estimate the organic matter of your soil. Medium levels are desirable for optimal plant growth. Benefits of organic matter in the soil include improved water and nutrient holding capabilities; better soil structure which enhances root growth and increases aeration; a more hospitable environment for soil organisms; and a reserve of plant nutrients. Soils high in organic matter are easier to dig and don't have to be watered or fertilized as often. Sources of organic matter include peat moss, compost, leaf mold, manure, mushroom soil and mycelium.

TEXTURE

The term "texture" refers to the relative proportions of the variously sized mineral soil particles – namely sand, silt and clay. We estimate the texture of your soil by feel. While coarse-textured sandy soils may have good aeration and drainage, they have limited ability to retain water and nutrients. Fine-textured silts and clays are best from the standpoint of nutrient retention but may hold too much moisture and drain poorly. Soils designated as high in organic matter contain such a high proportion of organic matter that the size of the mineral soil fraction can not be determined by our method of hand-texturing. Loams which contain from 7% to 27% clay, 28% to 50% silt and less than 52% sand are usually considered ideal garden soils. Attempting to alter a soil's texture is difficult and not generally recommended. The best way to improve soil is through the addition of organic matter.

MICRONUTRIENTS AND ALUMINUM

Soil test reports indicate the amount of several extractable micronutrients in parts per million (ppm). Micronutrients are elements that are required by plants in very small amounts. Their availability often correlates well with soil pH and organic matter levels. If these two factors are in a desirable range for the crop being grown, the micronutrients, boron (B), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) are compared with typical soil background levels for diagnostic purpose. Recommendations for micronutrient additions to soil are not made because adjusting the soil pH and/or soil organic matter levels usually rectifies any micronutrient problems that may exist.

Aluminum is a common constituent of New England soils. It is not an essential plant nutrient and may cause injury to sensitive plant species like lettuce and beets. High levels of aluminum in the soil can also interfere with plant uptake of phosphorus. As the soil pH decrease, the solubility of aluminum increases. Soil test results often indicate elevated aluminum increases. Soil test results often indicate elevated aluminum levels in soil with pH levels below 5.0. Liming soils to an acceptable level for the crop being grown will reduce the amount of aluminum available to plants. Acid loving plants like rhododendrons, blueberries, and azaleas have high tolerance to soil aluminum levels. Aluminum is also responsible for the blue color of hydrangeas because of its effect on pigment formation, which is why the blue flowering hydrangeas are grown at low soil pH levels.

LEAD

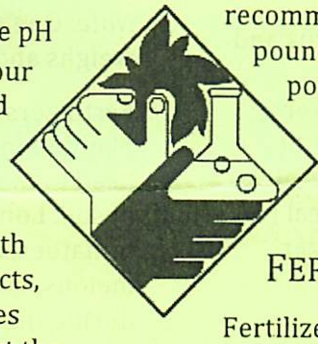
Lead is a natural occurring element in soils and typically is present in soils in the range of 5 to 100 ppm total lead. Only when total lead levels exceed 400 ppm does the Environmental Protection Agency (EPA) list is as an element of concern. Soil test results indicate our estimation of total lead. A correlation has been developed between our routine soil testing methodology and more rigorous EPA testing. If the lead levels are elevated, you will receive appropriate information about potential problems with elevated lead levels and gardening practices to minimize exposure to lead.

Soil Nutrient Analysis Laboratory

Soil Nutrient Analysis Laboratory; 6 Sherman Place, Unit 5102, Storrs, CT 06269-5102 • Phone: 860-486-4274
Fax: 860-486-4562 Location: Union Cottage, Depot Campus, Mansfield

SUGGESTED FERTILIZER PRACTICES FOR VEGETABLES

By Dawn Pettinelli,Manager, Soil Nutrient Analysis Laboratory



The enclosed soil test report provides the pH and available nutrient levels present in your soil at the time of sample collection. Based on these results, lime and fertilizer recommendations are made for the vegetable crops you listed. Soil tests are unable to identify problems associated with poor cultural practices, damage from insects, disease or environmental stress, or injuries caused by the misuse of pesticides. Contact the UConn Home and Garden Education Center toll-free at 877-486-6271 for assistance with these problems.

SOIL PH AND LIMESTONE

The pH measures the acidity or alkalinity of a soil. The majority of vegetables prefer a slightly acidic soil with a pH ranging from 6.0 to 6.8. **Ground limestone** is generally used to correct acidic soil conditions, although some gardeners prefer the less dusty **pelletized limestone.** Cost is the major difference between the two forms; application rates and reactions times are similar.

Most widely available is **dolomitic limestone**, containing both calcium and magnesium carbonates. If reported magnesium levels are high to very high and the addition of limestone is recommended to raise the pH, a **calcitic limestone** which contains only calcium carbonates would be your best choice.

Note: One cup limestone weighs about 3/4 lb.

Hydrated lime (calcium hydroxide) is not recommended because it is caustic to humans, plants and soil organisms.

Wood ashes can be used as a substitute for limestone. Apply at approximately 1.5 times the recommended rate of limestone. For example, 7.5 pounds of wood ashes could be substituted for 5 pounds of limestone. Do not apply wood ashes if the pH is over 6.8.

Note: One cup wood ashes equal about 1/3 lb.

FERTILIZERS

Fertilizer recommendations are based on soil test results and the kinds of vegetables grown. Your soil test report will recommend varying amounts of several widely available fertilizer grades. The fertilizer grade is denoted by the three numbers on the front of the fertilizer bag. These numbers represent the percent of total nitrogen (N), available phosphate (P_2O_5) and water soluble potassium or potash (K_2O) contained in the fertilizer. They will always be listed in this exact order. A fertilizer with the analysis 5-10-10 would contain 5% N, 10% P_2O_5, and 10% K_2O.

Recommendations for most vegetable gardens are for a complete fertilizer which is one that contains the three major plant nutrients: nitrogen, phosphorus and potassium. Occasionally when the soil test indicates very low or very high values for a certain nutrient, an incomplete fertilizer is recommended. Examples would be superphosphate (0-20-0) or urea (46-0-0).

Fertilizers other than those recommended, including various natural organic fertilizers, can be used provided they supply nutrients in about the same amounts and ratios as the recommended fertilizer. For example, a 10-20-20 could be used in place of a 5-10-10, but since it is twice as concentrated you would only use one-half as much. Fertilizers formulated for vegetable gardens generally contain amounts of nitrogen less than or equal to the amount of phosphorus

University of Connecticut
College of Agriculture & Natural Resources
COOPERATIVE EXTENSION SYSTEM
Department of Plant Science

Soil Nutrient Analysis Laboratory

Soil Nutrient Analysis Laboratory; 6 Sherman Place, Unit 5102, Storrs, CT 06269-5102 • Phone: 860-486-4274 Fax: 860-486-4562 Location: Union Cottage, Depot Campus, Mansfield

(i.e. 5-10-5 or 10-10-10). This is because phosphorus promotes flowering and fruiting. Too much nitrogen will stimulate green leafy growth at the expense of vegetable production.

Note: If your results state that both phosphorus and potassium levels are above optimum, only a nitrogen recommendation will be provided. For each pound of nitrogen recommended per 1000 square feet you may use your choice of 8.3 lbs of blood meal (12-0-0), 17 lbs of cotton-seed meal (6-2.5-1.7), 3.25 lbs of high nitrogen lawn fertilizer (32-3-5) or 2.2 lbs of urea (46-0-0).

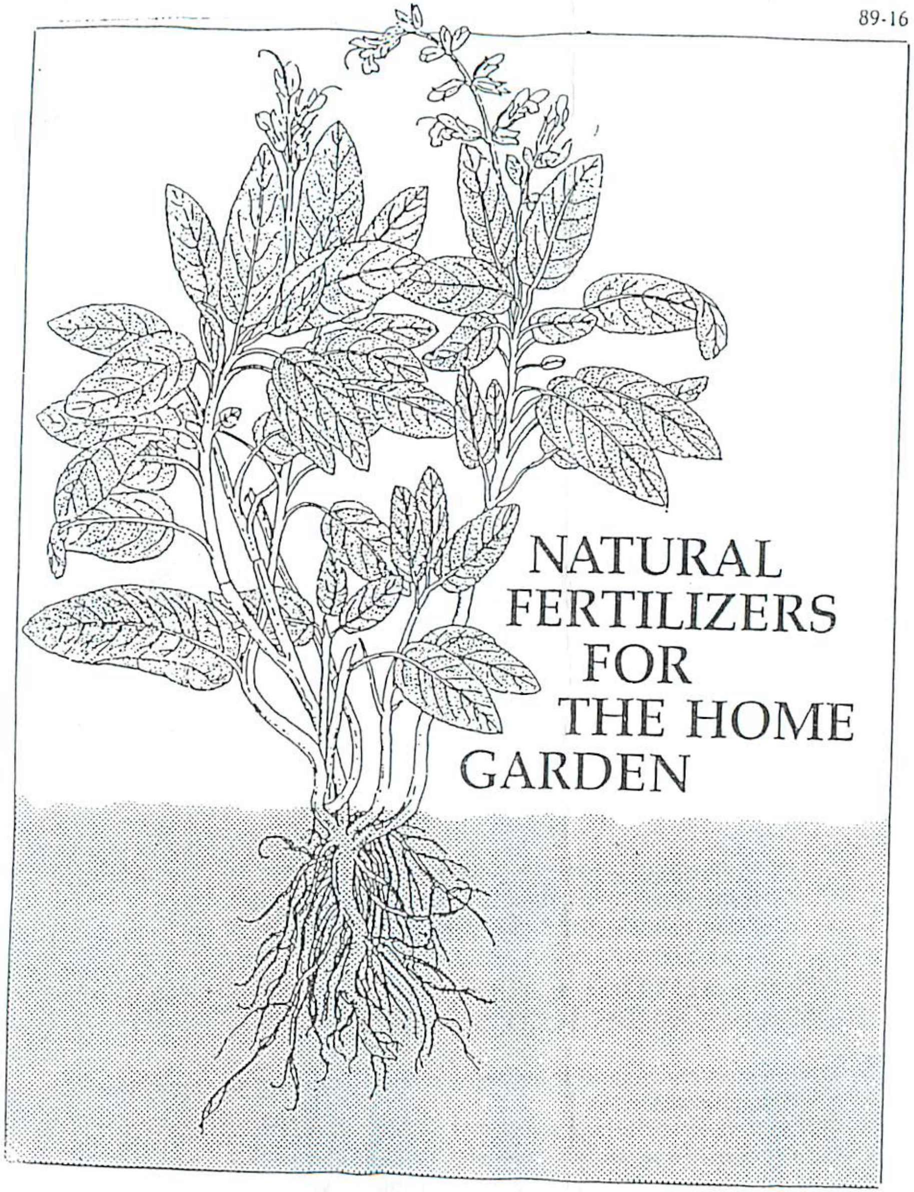
Applying Fertilizers

Fertilizer recommendations are given in increments of 1000 square feet. Therefore, you need to determine the size of your garden before spreading the fertilizer. The length multiplied by the width of the garden will give you the total area. For instance, a garden 25 feet long and 10 feet wide equals 250 square feet. If the recommendation given is for 8 pounds of 5-10-10 per 1000 square feet, you would only use one quarter as much, or 2 pounds in your 250-square-foot garden.

Note: One cup of a granular synthetic fertilizer weighs about 1/2 pound.

Fertilizers are spread over the garden area before planting in the spring. A spade or rototiller can be used to mix the fertilizer into the top 4 to 6 inches of soil. Long season crops like sweet corn and tomatoes, and vine crops such as pumpkins and melons, benefit from a side dressing of fertilizer during the growing season. Apply the recommended rate in a band along rows. Do this by placing fertilizer 6 inches on each side of a row of crops. Scratch in lightly to avoid root damage and water thoroughly.

89-16

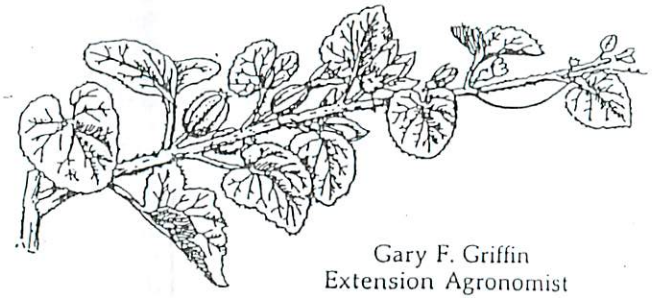


NATURAL FERTILIZERS FOR THE HOME GARDEN

UNIVERSITY OF CONNECTICUT
COOPERATIVE EXTENSION SYSTEM

Helping You Put Knowledge To Work

NATURAL FERTILIZERS FOR THE HOME GARDEN



Gary F. Griffin
Extension Agronomist
and
Edmond L. Marrotte
Consumer Horticulturist

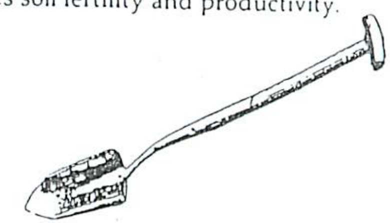
Natural fertilizers are materials other than synthetic "chemical" fertilizers, which, when added to the soil, provide plant nutrients and often improve the soil's physical condition in relation to plant growth. Natural fertilizers can be either organic (e.g. compost, manure and dried blood) or inorganic (e.g. wood ashes and granite dust). The purpose of this publication is to provide information to gardeners who have had their soil tested and want to use solely natural fertilizers or a combination of natural fertilizers and chemical fertilizers.

ADVANTAGES OF NATURAL FERTILIZERS

The decomposition of natural organic fertilizers added to the soil results in three important products: (1) nutrients available for plant use; (2) carbon dioxide, which is used by plants in photosynthesis, and (3) soil humus.

Nutrients are released more slowly from natural organic materials than from most chemical fertilizers. Therefore, the nutrients are available to plants for longer periods of time and are less likely to be lost from the soil.

Soil humus greatly increases the water holding capacity of soil, supplies nutrients as it slowly decays and increases the capacity of soils to hold nutrients in forms available to plants. Humus also breaks up heavy, fine textured soils, which tend to compact. This improves air and water movement in these soils and makes them easier to work and easier for roots to penetrate. Natural organic materials also promote the growth of soil organisms, including earthworms. This activity, in turn, improves soil fertility and productivity.



DISADVANTAGES OF NATURAL FERTILIZERS

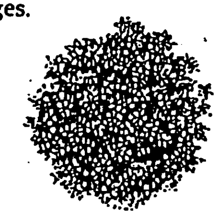
One difficulty in working with natural fertilizers is the high variability of their nutrient contents. The nitrogen (N) content of cow manure, for example, varies with the animal's diet, the moisture content of the manure, method of storage and handling and the amount of litter in the manure. The same kind of variability exists for inorganic natural fertilizers. Wood ashes, for example, vary in phosphorus content from one to two percent P_2O_5 and in potassium content from four to ten percent K_2O. This variability makes it impossible to know exactly how much natural material to apply to furnish sufficient amounts of N, P_2O_5 and K_2O.

While the slow release of nutrients from natural materials is advantageous in important ways, it can also be disadvantageous. For example, most natural organic materials do not furnish N rapidly enough for plant needs when these materials are sidedressed (placed close to plants on the soil surface when plants are four to six weeks old). Also, materials like rock phosphate and granite dust, unless applied at very high rates, often release phosphorus (P) and potassium (K) too slowly to provide plants with sufficient amounts of these nutrients.

Another potential problem with many natural fertilizers is the balance of nutrients they furnish. In some instances, insufficient amounts of P and K are supplied when enough natural organic material is added to meet plant N requirements. (In the sections that follow, we describe ways to make up P and K deficits using either natural or synthetic fertilizers.)

Finally, some natural fertilizers and soil amendments are difficult to obtain, and most are more expensive than commercial chemical fertilizers. The average cost of N in dried blood, for example, is more than ten times the cost of a pound of N in urea.

Most of the disadvantages of natural fertilizers listed above are not serious and can be overcome with careful management. In most instances, the advantages of these materials, especially the beneficial effects on soil physical properties, outweigh the disadvantages.



THE NITROGEN PROBLEM

The total N in natural organic materials (and in a few synthetic N fertilizers) is converted to plant-available forms at rates that vary from one material to another. Nitrogen in poultry manure, for example, is converted relatively rapidly, while the N in compost is released slowly. Conversion speed depends on environmental conditions, such as soil temperature, moisture and aeration.

When carbonaceous organic materials (e.g. sawdust, woodchips, straw and horse manure with a lot of bedding) are added to and mixed with the soil, plants and the soil microorganisms that decompose the added organic material compete for available soil N. The microorganisms invariably win this competition, and the plants often develop N deficiency symptoms. Gardeners should apply additional N from either natural or synthetic sources to prevent or correct this deficiency.

APPLICATION RATES OF NATURAL AND CHEMICAL FERTILIZERS

Step 1: Have Your Soil Tested

If you have not already done so, have your soil tested. The results provide a chemical inventory of the soil and furnish a scientific basis for lime and fertilizer recommendations. Especially important are results for pH, available P and available K. Call your local Cooperative Extension System Office or the Department of Plant Science at The University of Connecticut (Tel. 486-2928) for instructions.

Step 2: From the soil test report, determine recommended rates of P_2O_5 and K_2O.

Fertilizer recommendations on the soil test report are usually given in pounds of fertilizer per 1,000 square feet or 100 square feet. The fertilizers specified are generally readily obtainable "standard grades." Examples are:

10-10-10   5-10-10   5-10-5   10-6-4   15-15-15   10-20-10

The grade is the three-number combination printed on the fertilizer bag. It indicates the nitrogen content (expressed as % N), the phosphorus content (expressed as % P_2O_5) and the potassium content (expressed as % K_2O), respectively, of the fertilizer. A 10-6-4 fertilizer, for example, contains 10% N, 6% P_2O_5 and 4% K_2O.

EXAMPLE 1: How many pounds of N, P_2O_5 and K_2O are needed for an 8,000 sq. ft. garden if the recommendation calls for 20 lbs. of 10-10-10 per 1,000 sq. ft?

The *rates* of N, P_2O_5 and K_2O recommended are:

20 lbs fertilizer x 10% N = 2 lbs N/1,000 sq. ft.
20 lbs fertilizer x 10% P_2O_5 = 2 lbs P_2O_5/1,000 sq ft
20 lbs fertilizer x 10% K_2O = 2 lbs K_2O/1,000 sq ft

With an area of 8,000 sq. ft., the *total nutrients* needed are
8 x 2 lbs or 16 lbs N, 16 lbs P_2O_5 and 16 lbs K_2O.

Step 3. Determine how much natural organic material is needed to supply the total recommended N.

To do this, you need an estimate of the N content of the natural material. If the material came in a bag and the bag has a grade printed on it, use the first number of the grade. Otherwise, refer to Table 1, which shows *average* N, P_2O_5 and K_2O contents of various natural organic materials. Keep in mind that the percentage of plant nutrients in most of these materials is highly variable. The mean values listed in Table 1 may not be quite the same as the N, P_2O_5 and K_2O contents of the material you use.

Determine the amount of natural material to apply by using the following equation:

$$\text{Material needed (lbs)} = \frac{\text{lbs of N needed}}{\text{\% N in the material}} \times 100$$

EXAMPLE 2: For the garden in EXAMPLE 1, how much fresh cow manure (.25% N, Table 1) is needed to supply 16 lbs of N?

$$\text{cow manure needed} = \frac{16 \text{ lbs N}}{0.25\% \text{ N}} \times 100 = 6400 \text{ lbs manure.}$$

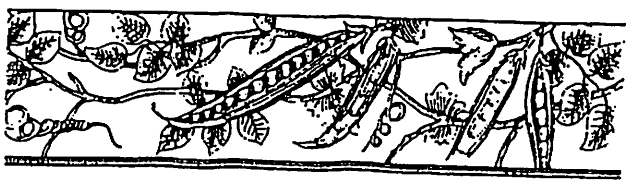
The 6400 lbs of manure also supplies:
9.6 lbs P_2O_5 (0.15% of 6400) and
16.0 lbs K_2O (0.25% of 6400).

This is a large amount (over three tons) of cow manure. Many gardeners at this point may consider a higher analysis natural organic N source to cut down on the sheer weight of material needed.

EXAMPLE 3: How much cottonseed meal (6% N, Table 1) is needed to supply 16 lbs N?

$$\text{cottonseed meal needed} = \frac{16 \text{ lbs N}}{6\% \text{ N}} \times 100 = 267 \text{ lbs.}$$

The 267 lbs of cottonseed meal also supplies:
6.7 lbs P_2O_5 (2.5% of 267) and
4.5 lbs K_2O(1.7% of 267).



STEP 4: Determine if the natural organic material used to furnish N supplies all of the recommended P_2O_5 and K_2O.

Neither the cow manure (EXAMPLE 2) nor the cottonseed meal (EXAMPLE 3) furnishes all of the recommended P_2O_5 and K_2O. Calculate the P_2O_5 and K_2O deficits by subtracting the amounts of P_2O_5 and K_2O in the natural fertilizer from the recommended amounts, as follows:

	N	P_2O_5 (lbs)	K_2O
Recommended nutrients (EXAMPLE 1):	16	16.0	16.0
Nutrients from cow manure (EXAMPLE 2):	16	9.6	16.0
P_2O_5 and K_2O deficits:		6.4	0.0
Recommended nutrients (EXAMPLE 1):	16	16.0	16.0
Nutrients from cottonseed meal (EXAMPLE 3):	16	6.7	4.5
P_2O_5 and K_2O deficits:		9.3	11.5

STEP 5: Consider ways to deal with P_2O_5 and K_2O deficits.

There are several approaches gardeners can take to deal with these deficits. Three options follow:

A. Do nothing. Hope that the P and K supplied by the natural organic material will be sufficient to meet plant needs. This approach can be risky, especially when soil test P and K are low and a fertilizer such as 5-10-10 or 10-20-20 is recommended. If soil test P and K are high or very high, the P_2O_5 and K_2O deficits will be small or zero. Do not add anymore P_2O_5 or K_2O.

B. Make up the deficits with chemical fertilizers.

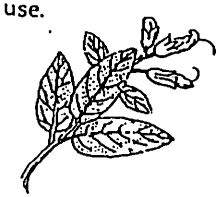
EXAMPLE 4: How much superphosphate (0-46-0) and muriate of potash (0-0-60) should be added with cottonseed meal (EXAMPLE 3)?

The P_2O_5 and K_2O deficits (from STEP 4) are 9.3 lbs P_2O_5 and 11.5 lbs K_2O.

$$\frac{9.3 \text{ lbs } P_2O_5}{46\% \ P_2O_5} \times 100 = 20 \text{ lbs 0-46-0}$$

$$\frac{11.5 \text{ lbs } K_2O}{60\% \ K_2O} \times 100 = 19 \text{ lbs 0-0-60}$$

C. Make up the deficits with natural inorganic materials.
Refer to Table 2 for a list of some of the natural inorganic materials that contain P and/or K but no N. Keep in mind that the P and K contents of many of these materials are highly variable. The mean values listed in Table 2 may not be exactly the same as the P_2O_5 and K_2O contents of the material you use.



EXAMPLE 5: How much rock phosphate and greensand should be applied with cottonseed meal (EXAMPLE 3) to supply all of the recommended P_2O_5 and K_2O?

1. rock phosphate (26% P_2O_5):

$$\frac{9.3 \text{ lbs } P_2O_5}{26\% \ P_2O_5} \times 100 = 36 \text{ lbs rock phosphate}$$

2. greensand (7% K_2O):

$$\frac{11.5 \text{ lbs } K_2O}{7\% \ K_2O} \times 100 = 164 \text{ lbs greensand}$$

Note in Table 2 that the nutrient release rates for rock phosphate and greensand are both "very slow." This means that the P and K in these materials may not be released quickly enough to meet plant needs when the greensand and rock phosphate are applied at rates designed for the more soluble, synthetic fertilizers like 5-10-10, 10-10-10, 0-46-0 or 0-0-60. Alternatives include applying "very slow release" natural fertilizers at about 2 to 3 times the calculated rates (e.g. 300-500 lbs. greensand in EXAMPLE 5 above) or using a natural material that releases nutrients more rapidly.

WOOD ASHES AS A LIMING MATERIAL AND SOURCE OF P_2O_5 AND K_2O

A better choice for supplying P and K in many cases is wood ashes. The nutrient release rate is rapid, and wood ashes are cheap and easily obtainable.

Wood ashes are also highly alkaline and can be used as a substitute for lime. Do not apply wood ashes if the soil pH is above 6.8; do not apply wood ashes if ALL of any recommended lime is added as ground limestone or some other liming material other than wood ashes. Every 100 lbs of wood ashes is equivalent in neutralizing power to about 65 lbs of ground limestone. (Multiply the recommended rate of ground limestone by 1.5 to determine the rate of wood ashes needed to raise soil pH the desired amount; also, divide the rate of application of wood ashes by 1.5 to determine the equivalent ground limestone application rate.)

If wood ashes *are* added in place of some or all of the recommended ground limestone to raise soil pH, they may supply all of the P_2O_5 and K_2O needed to eliminate deficits of these nutrients. Estimate the amounts of P_2O_5 and K_2O supplied. For example, 80 lbs of wood ashes furnish about 1.2 lbs of P_2O_5 (1.5% of 80, Table 2) and 5.6 lbs of K_2O (7% of 80, Table 2).

Do not overapply wood ashes; the resulting soil pH may be too high, and, in extreme cases, the soluble salt level in the soil may be raised to levels that are injurious to plants. *We recommend that no more than 120 lbs of wood ashes per 1,000 sq ft be applied in any one year.*

Wood ashes contain both P and K. The best approach to eliminating P_2O_5 and K_2O deficits is to apply enough wood ashes to take care of both deficits. In most cases, either K_2O or P_2O_5 will be added in excess. This is not a problem, because calcium and magnesium are also added, potassium does not pollute the environment, and most of any excess P_2O_5 will be immobilized in the soil. Again, do not apply the wood ashes at a rate which exceeds the equivalent rate for any recommended ground limestone. (That is, do not apply wood ashes at more than 1.5 times the recommended rate for limestone.)

EXAMPLE 6: What quantity of wood ashes should be applied with cottonseed meal (EXAMPLE 3) to supply all of the recommended P_2O_5 and K_2O if the limestone recommendation is 75 lbs per 1,000 sq ft?

First, calculate the amount of wood ashes needed to eliminate the P_2O_5 deficit:

The P_2O_5 deficit (from STEP 4) is 9.3 lbs P_2O_5:

$$\frac{9.3 \text{ lbs } P_2O_5}{1.5\% \ P_2O_5} \times 100 = 620 \text{ lbs wood ashes.}$$

Next, determine if this quantity of ashes also eliminates the K_2O deficit:

620 lbs wood ashes x 7% K_2O (Table 2) = 43.4 lbs K_2O.

This quantity is more than enough to eliminate the 11.5 lb K_2O deficit calculated in STEP 4.

Finally, make sure that the 620 lbs of wood ashes per 8,000 sq ft exceeds neither the recommended rate of lime nor the suggested maximum of 120 lbs per 1,000 sq ft. The 620 lbs is about 78 lbs of ashes per 1,000 sq ft (620 lbs per 8,000 sq ft ÷ 8 = 78 lbs per 1,000 sq ft).This is equivalent to about 52 lbs of ground limestone per 1,000 sq ft (78 ÷ 1.5). This application rate is less than the 75 lbs of ground limestone per 1,000 sq ft recommended.

If the wood ashes are indeed applied, they substitute for 52 of the 75 lbs of ground limestone recommended per 1,000 sq ft (EXAMPLE 6). Apply 20-25 lbs of limestone per 1,000 sq ft to supply the balance.

TABLE 1. Mean Contents of N, P_2O_5 and K_2O in Natural Organ Materials.*

Material	%N	%P_2O_5	%K_2O	Rate of Nutrie Release
Animal Tankage (dry)	7	10	0.5	Medium
Bonemeal (raw)	4	21	0	Slow
Bonemeal (steamed)	2	26	0	Slow-Medium
Castor Pomace	5	2	1	Slow
Cocoa Shell Meal	2.5	1	3	Slow
Compost (not fortified)	2.5	1	1.5	Slow
Cottonseed Meal (dry)	6	2.5	1.7	Slow-Medium
Cow manure (composted)	1	1	1	Slow
Cow manure (dehydrated)	2	1	1	Slow
Dried Blood (dry)	12	1	1	Medium-Rapid
Fish Meal (dry)	10	6	2	Slow
Fish Scrap (dry)	6	3	1	Slow
Grass Clippings	2.2	1.1	2	Medium-Rapid
Kelp	1.7	1	13	Slow
Leaves (freshly fallen)	0.8	0.1	0.4	Slow
Linseed Meal	6.	2	1	Slow-Medium
Manures (fresh)				
Cow	0.25	0.15	0.25	Medium
Horse	0.30	0.20	0.35	Medium
Poultry				
60-80% water	1.0	1.0	0.6	Medium-Rapid
40-59% water	1.4	2.0	1.2	Medium-Rapid
20-39% water	2.0	3.0	1.8	Medium-Rapid
Rabbit (home grown)	2.0	1.0	0.5	Medium
Sheep and Goat	0.6	0.3	0.8	Medium
Mushroom Compost	0.5	0.6	1.0	Slow-Medium
Peat Moss	1.0	0.1	0.1	Slow
Sawdust	0.2	0.1	0.2	Very Slow
Soybean Meal	6.5	1.4	1.9	Slow-Medium
Wood Chips and Shavings	0.2	0.1	0.2	Very Slow

*Mean contents are based on published values from several sources. For most materials, the percentage of nutrients is highly variable from one sample or lot of the material to another.

TABLE 2. Mean Contents of P_2O_5 and K_2O in Natural Inorganic Materials.*

Material	%P_2O_5	%K_2O	Rate of Nutrient Release
Colloidal Phosphate	25	0	Slow
Granite Dust	0	4	Very Slow
Greensand	1.3	7	Very Slow
Kainite	0	12	Medium
Marl	2	4.5	Very Slow
Rock Phosphate	26	0	Very Slow
Wood Ashes	1.5	7	Rapid

*Mean contents are based on published values from several sources. For most materials, the percentage of nutrients is highly variable from one sample or lot to another.

REFERENCES:

Cadwell and Jones. 1986. *Dealer Catalog*, Cadwell and Jones, Inc., Manchester, CT 06040. 101 pp.

Marrotte, E.L. 1987. *Soils, Fertilizers and Plant Nutrition*. The University of Connecticut, Cooperative Extension System. 22 pp.

Moore, J.A. and T.L. Willrich. 1982. *Calculating the Fertilizer Value of Manure from Livestock Operations*. Oregon Cooperative Extension System, EC 1049. 5 pp.

Poincelot, R.P. 1975. *The Biochemistry and Methodology of Composting*. The Connecticut Agricultural Experiment Station, Bulletin 754. 18 pp.