Magnesium

Magnesium is necessary for chlorophyll production and nitrogen metabolism. High soil potassium levels can lead to reduced uptake of magnesium. Magnesium deficiency is characterized by interveinal reddening on older leaves, beginning at the leaf margin. It is important to maintain a proper balance between magnesium, potassium, and calcium. These three nutrients and phosphorus can be applied in late fall after plants are dormant. Nutrients can then move into the root zone and be available when growth begins again in the spring. Magnesium (Mg) is most economically applied as dolomitic or high-mag limestone (see "Soil pH and Liming"). If liming is not needed, Sul-Po-Mag (11% Mg, 22% K) can be used. You can order blended fertilizer containing Mg.

Minor Elements

Minor elements are difficult to analyze accurately with soil tests. Plant tissue analyses are more reliable for determining whether or not plants are getting sufficient quantities of minor elements. Of the minor elements, boron (B) and Zinc (Zn) are the most likely to be needed to supplement soil levels.

Soil Organic Matter

Soil organic matter (SOM) is a small but critical component of soils. SOM is continuously being produced by plants and animals and broken down by soil microbes that use it is a source of energy. As such it provides food for a diverse population of microbes in the soil and this helps prevent any one type of organism, such as a plant pathogen, from dominating. As microbes break down SOM, nutrients are released which are available for plant growth. This process is called mineralization and can provide some or all of the nutrients needed for successful crop production. Soil microbes are most active in warm soils (over 70½ F) that are moist, but well aerated, with a pH between 6 and 7. Mineralization of nutrients will proceed rapidly under these conditions.

SOM also improves soil structure. It binds individual soil particles together into aggregates. This makes soil friable, allowing for good drainage, aeration, and root growth. SOM also improves the moisture holding capacity of soils. SOM is also the chief contributor to cation exchange capacity in New England soils.

Adding to Soil Organic Matter

Using compost is an effective way to add organic matter to the soil. Small fruit growers can make compost on the farm although most don't have enough raw materials to satisfy their needs. Some are bringing in additional materials such as municipal yard wastes to compost on site. Others are purchasing compost from the increasing number of commercial composters. Regardless of the source, compost should be finished before use. Finished compost has no recognizable bits of matter and will not heat up after turning. Compost should also be tested for nutrient content. Finished compost should have a low ammonium content, high nitrate level and a pH near neutral. Repeated use of a compost high in a particular element could cause a nutrient imbalance. For more information, obtain a copy of On-Farm Composting Handbook (see references on page 105).

Animal manure is an excellent source of nutrients and organic matter. About half of the nitrogen in fresh dairy manure and 75% of the nitrogen in poultry manure is in the form of ammonia. Ammonia is subject to loss through volatilization if not incorporated immediately after spreading. In the soil, ammonia is converted to nitrate and is available for plant use. However, nitrate is subject to leaching and large applications should generally be avoided. There are times when readily available nitrogen is needed, but fresh manure should be applied only with caution. Many people prefer to compost manure before field application. This stabilizes the nitrogen. Manure can be mixed with other materials for composting. Manure samples can be analyzed by several of the laboratories listed on page 2.

Cover crops are used by most growers to protect soil from erosion and to take up unused N. Cover crops also contribute to SOM when they are plowed down, although SOM varies considerably among crops (see cover crop section, page 8).

Carbon-To-Nitrogen Ratio

Organic matter is broken down by microbes which use carbon for energy. They also have a need

Table 4. Typical carbon-to-nitrogen ratios.

Material	Carbon:Nitrogen Ratio
Legume hay	15-19:1
Non-legume hay	24-41:1
Corn stalks	42:1
Oat straw	70:1
Rye straw	82:1
Cow manure	18:1
Finished compost	17-20:1
Agricultural soils	8-14:1
Hardwood sawdust	500:1

for nitrogen. Microbes have a requirement of about one nitrogen atom for each 25 carbon atoms. This is a carbon-to-nitrogen ratio (C:N) of 25:1 or 25. If the organic matter has a higher C:N (more C and less N), microbes will need more nitrogen and will take it from the soil. Microbes are more efficient than crops in obtaining nitrogen from the soil. If there is not enough nitrogen for both the microbes and the crop, the crop will not obtain what it needs. Eventually there will be a net gain in nitrogen, but crops can suffer in the short term. If organic matter with a high C:N is applied to soil shortly before planting a crop, additional nitrogen may be needed to assure the needs of both the microbe and the crop are met. Organic matter with a C:N of less than 25:1 (25) should not be a problem and in some cases can contribute nitrogen for crop use. See Table 5 for examples of C:Ns of some sources of organic matter.

Cover Crops and Green Manures

Cover crops are grown to protect and/or enrich the soil rather than for short term economic gain. When turned into the soil, a cover crop is called a green manure, so the terms are reasonably interchangeable.

When a cash crop is not growing, it is wise to sow something to protect the soil from wind and water erosion, thus the term cover crop. It is also wise to "rest" your fields by occasionally rotating out of cash crop production, while at the same time growing something to improve soil fertility, thus the term green manure. Some green manure crops can also suppress weeds, by "smothering" them and starving them for light. Use high seeding rates if cover crops are grown for weed suppression.

Depending on their growing requirements, cover crops can be sown after vegetable harvest, between a spring and fall crop or by overseeding into a standing small fruit crop after a final cultivation.

In selecting a green manure crop, consider the following: seed cost, winter hardiness (if applicable), ability to fix nitrogen, suppress weeds, and suitability to soil conditions, tillage equipment and the crop to follow. Here is a list of some common cover crops in New England and a description of their uses.

NONLEGUMES

These are selected when nitrogen contribution to the soil is not a priority. They tend to grow more rapidly and thus are better at short-term weed suppression than legumes. Late-season grasses are useful for recovering leftover nitrogen after crops have been harvested.

Winter Rye is a common winter cover crop, sown after cash crops are harvested in the fall. It is very hardy, adapted to a wide range of conditions, and seed is inexpensive. The latest-sown cover crop, it produces a lot of biomass in the spring. This adds organic matter to the soil but may be difficult to incorporate prior to crop planting.

Oats are used as a winter cover crop to protect the soil without requiring intensive management in the spring, because they are frost-killed. Shallow incorporation of residues may still be necessary before crop planting. Enough growth is needed before first frost to adequately protect the soil, so plant by late August, at a rate of about 100 lb/acre. Oat residues left on the soil surface may chemically suppress weed growth, and act as a physical barrier. Oats are also a good cover crop to plant any time during the spring or summer when land is out of production. Unlike winter rye, oats grow vigorously and upright when seeded in the spring or summer and compete effectively with weeds. Can grow in soils with low pH (5.5).

Ryegrass is a low-growing cover crop that produces an extensive root system good at capturing leftover nitrogen. It is well suited to undersowing, after last cultivation of a cash crop, in order to establish a winter cover prior to harvest. Annual ryegrass is less expensive than perennial ryegrass, and is more likely to winterkill; however, it may overwinter in milder areas, and perennial ryegrass may winterkill in harsher zones. These crops form a dense sod that reduces erosion.

Sudangrass and Sorghum-sudangrass (Sudex) are fast-growing, warm season crops that