early spring or late summer at 15 to 20 lb/acre. Heavy growth is produced in spring after overwintering. Incorporate in late spring or mid-summer at flowering. May deplete soil of moisture, which can be a problem for subsequent crops in dry years.

Hairy Vetch has become increasingly popular as a cover crop. It can fix tremendous amounts of nitrogen. Generally this cover crop is seeded in the fall after August 15 or before mid September in most areas. It should be allowed to grow at least until mid May before plowdown. It is advisable to seed winter rye (30-40 lbs/acre) or oats (40-50 lbs/acre) with the vetch when seeded in the fall to take up unused nitrogen and to ensure a good ground cover for erosion control. Most growers prefer oats to winter rye because the oat will not overwinter and the vetch alone is easier to manage the following spring. Hairy vetch can also be seeded in early spring or summer. When seeded in early April it will produce significant nitrogen in time for a late seeding of sweet corn or brassica. When seeded in the summer it will usually winter kill and the following spring the nitrogen will become available for an early crop. Treat seed with a pea-type inoculant.

Alfalfa requires deep, well-drained soil with a pH near neutral for good growth. It is a long-lived perennial that is probably not worth the expense in a short-term rotation. Fixes large amounts of nitrogen if maintained for several years. Seed early spring or late summer at 15 to 25 lb/acre.

Mixtures

Legumes and grasses are often mixed as cover crops to hedge against failure of one and to get some of the benefits of both. The grass will usually establish quickly, holding soil in place and "nursing" the legume along. By taking available soil N, the grass promotes N-fixation by the legume. Fertilization with N or the absence of mowing favors growth of grass over legume. Some common mixtures, in addition to vetch and rye described above, are red clover and oats (combine or mow oat heads, leaving established clover); ryegrass and white clover for mowed alleys. Timothy is often used as a nurse crop for alfalfa. It is advisable to trial unfamiliar cover crops or mixtures on a small scale to determine if they are suited to your climate and management resources before growing them widely.

Note: N fixed in root nodules moves to the leaves and stems of legumes. If hay is harvested from the field prior to plowing, very little N will be contributed to the subsequent crop.

Guidelines for Organic Fertilization

Soil fertility is a function of the biological, physical and chemical characteristics of soil. An organic fertility program should consider all of these interrelated factors in order to optimize and sustain crop production.

Soil tests are useful for monitoring soil organic matter content, which influences the physical and biological quality of soil. Soil tests also estimate the level of chemical nutrients in the soil that are available to plants. This helps determine the quantity and type of soil amendments needed for good crop yields.

Organic Matter management is an essential part of organic agriculture. Generous additions of compost, animal or green manures are needed to fuel soil microbes, the by-products of which bind soil particles together to improve the physical condition, or structure of soil. Good structure promotes root growth and thus enhances plant retrieval of soil nutrients.

Decaying organic matter releases a slow, steady supply of nutrients to a crop so long as soil temperature, moisture, and aeration support microbial activity (as when soil is properly drained and well warmed). When this release of nutrients, or mineralization, is low, as when soils are cool, fertilizing with soluble forms of nutrients may benefit crops. This is why some soluble phosphorus (P) and nitrogen (N) should be banded, or placed near the roots of crops early in the growing season. For example, use bone meal and dried blood to provide soluble P and N, respectively, or use a commercial organic fertilizer blend. Check with your local Organic Certification organization or Extension specialist for information on the nutrient content of various organic fertilizer sources.

Nitrogen Up to half the N contained in manures and immature compost can become available to plants during the season following incorporation. Each ton of compost containing 1% N can provide a crop with 5 to 10 lb of N per acre. Similarly, there is a release of about 20 lb/acre or more of N for each 1% soil organic matter. These releases of N vary

with drainage and other soil conditions, and may not be well timed to crop needs, especially early, short season crops. Annual crops need N most intensely about three to four weeks after emergence or transplanting. Therefore, sidedressing, or spreading soluble N along the crop row, at this time is most efficient. Because soluble organic N fertilizers are expensive, it is advisable to use lower rates than recommended for synthetic fertilizers. A sidedressing of 25 lb/acre of actual N is reasonable for many crops growing in a fairly fertile soil. That requires 200 lb dried blood, 400 lb soy or cottonseed meal, or the equivalent from other sources of N.

Rock powders can be used, along with organic matter, to build up and balance soil reserves of plant nutrients. However, these are not very soluble nutrient sources, and are not effective for treating short-term nutrient deficiencies. Using some soluble fertilizers may be advisable while building soil reserves of plant nutrients with rock powders and organic matter.

Limestone is a widely used rock powder. It raises the soil pH and provides calcium (Ca) and varying amounts of magnesium (Mg). When Mg tests below about 100 lb/acre, high-Mg limestone, or dolomite, should be used for liming. If Mg is above about 150 lb/acre, use calcite, or low-Mg lime. Choose your fertilizer materials considering the desired 20:4:1 base saturation ratio of Ca:Mg:K in the soil, but remember, this goal is only a ballpark figure and is definitely secondary to establishing the proper pH of 6 to 7 for most crops and supplying nutrients shown to be deficient by a soil test (see page 1).

Magnesium is best applied as dolomitic lime, but when liming is not required, other Mg sources

Table 6. Nutrient recommendations for small fruit crops.

Crop	Age	Amount/Timings (actual N)	N source	Comments
STRAWBERRIES				
	0	30 lb/A early June, 30 lb/A early Sept.	calcium nitrate ammonium nitrate or calcium nitrate	Be sure plants are growing well prior to application
	1+	70 lb/A at renovation, 30 lb/A early Sept.	ammonium nitrate or urea	Adjust fall amount based on leaf analysis
RASPBERRIES (summer bearing)				
	0	25-35 lb/A 4 weeks after planting	calcium nitrate	Avoid touching plants with fertilizer
	1	35-55 lb/A in May, or split between May and June	urea, ammonium nitrate	Use higher amount on sandier soils or if irrigation is used
	2+	40-80 lb/A in May, or split between May and June	urea, ammonium nitrate	Use higher amount on sandier soils or if irrigation is used
RASPBERRIES (fall bearing)				
	0	25 lb/A 4 weeks after planting and 25 lb/A in August	calcium nitrate	Avoid touching plants with fertilizer
	1	50-80 lb/A split between May and June	urea, ammonium nitrate	Use higher amount on sandier soils or if irrigation is used
	2+	70-100 lb/A split between May and June	urea, ammonium nitrate	Use higher amount on sandier soils or if irrigation is used Adjust with leaf analysis
BLUEBERRIES				
	0	Do not fertilize newly planted blueberries		
	1	15 lb/A	ammonium sulfate or urea	Soil should be adjusted to pH=4.5 prior to planting
	2	20 lb/A		
	3	25 lb/A		
	4	35 lb/A		
	5	45 lb/A		
	6	55 lb/A		
	7+	65 lb/A		

Source: Cornell University

are Sul-Po-Mag or Epsom salts. Sul-Po-Mag is the better choice if potassium is also required, as it is less expensive than Epsom salts. However, Epsom salts can be applied as a foliar spray to alleviate Mg deficiency. Dissolve 1.5 lb per 10 gal water and spray at weekly intervals.

Phosphorus is low in many New England soils, and can limit crop growth, especially early in the season. Soils testing less than 10 lb/acre available phosphate (P_2O_5) usually require substantial applications of phosphate. Hard rock phosphate contains about 2% available P_2O_5, soft, or colloidal, rock phosphate contains 3% available P_2O_5. Thus, a ton of these materials provides only 40 to 60 lb available P_2O_5/acre. Bone meal contains about 20 times more available P_2O_5 by weight, but is more expensive. With soils low in P, it can help crops to place proportionally more P fertilizer in the crop row than to broadcast it evenly. Maintain a pH of 6 to 7 with limestone to maximize P_2O_5 availability. Compost and manures tend to contain P_2O_5 than N or K_2O, but repeated applications will raise P levels substantially.

Potash is very slowly available from granite dust or greensand, which are applied at 3 to 5 tons to the acre to build up K reserves. Wood ashes contain soluble K, but must be used with caution because they will raise the pH rather rapidly and can be caustic. The liming effect of 1 pound of ashes is roughly equal to 2/3 of a pound of limestone. No more than 1/2 ton of ashes per acre should probably be applied at once, and only then if called for by low pH, low K and sufficient Mg. Sul-Po-Mag is the K fertilizer of choice when Mg is also needed.

Minor elements are generally sufficiently supplied to plants by regular additions of organic matter to the soil. Some seaweed extracts may also supply trace minerals. In soils low in boron (B), remedial applications are widely recommended for crops that readily suffer from B deficiency, such as crucifers. In this case, 1 to 2 lb/acre of B is applied to the soil with other fertilizers. Several forms of B are organically permitted, including Solubor (20% B) and Borax (11% B). It is advisable to monitor B levels with soil tests and tissue tests (for perennial fruits). Excess levels of B are toxic to plants, and some crops are quite sensitive to boron.

Organic Certification

Some small fruit growers choose organic production methods. Consumers of organic produce represent a growing market niche. This market is increasingly looking for certification to substantiate product claims. Federal legislation will soon require certification of food products that are labeled as organic except for producers who gross under $5,000.

It is likely that many state groups currently administering organic certification programs will continue to do so with USDA approval in the future. In New England, NOFA (Natural Organic Farmers Association) and MOFGA (Maine Organic Farmers and Gardeners Association) have certification programs; in some cases, these programs are operated in conjunction with the cooperation of a state agriculture department. If you are considering organic production, you should obtain and examine the written standards that detail the allowable practices and materials. These are available from your state certification contact, listed below.

CT	Pat Beardsley, P.O. Box 11, Gaylordsville, CT 06755 (203) 929-3080
MA	Ed McGlew, 140 Chestnut St., W. Hatfield, MA 01088 (413) 247-9264
ME	MOFGA, P.O. Box 2176, Augusta, ME 04338 (207) 622-3118
NH	Vickie Smith, NHDAMF, P.O. Box 2042, Concord, NH 03302-2042 (603) 271-3685
RI	Dan Lawton, Div. of Ag., 22 Hayes St., Providence RI 02908 (401) 222-2771
VT	NOFA, P.O. Box 697, Bridge St., Richmond, VT 05477 (802) 434-4122

About Pest Management

Effective fruit crop production depends on the grower developing a system of crop management that is appropriate for each farm. Decisions need to be made for how to manage all of the normal cultural practices such as planting, fertility, harvesting, and pruning as well as managing the insect, disease, and weed problems that occur either regularly or sporadically. The information in this guide will address management issues related to both common, expected pest problems as well as the occasional appearance of minor pest problems.

Effective management of a pest problem depends on:

- correct diagnosis of the problem and correct identification of the pest causing it.