

What to feed hungry plants

Plants need good nutrition the same as growing children. Learning to recognize early warning signals of malnutrition will help you ward off garden diseases and will insure maximum production.

What is fertilizer and what does it do for the garden? In garden supply stores, you've probably seen bags of fertilizer with three numbers on them. They might read 5-10-5, 10-10-10 or 5-10-10. There might even be a fourth number, so that the bag reads 5-10-10-2. What does all this mumbo-jumbo mean?

There are three things—besides soil, water, air, and sunlight—that plants need to grow and produce fruit. We call these three things major nutrients. They are nitrogen (N), phosphorous (P), and potassium (K), which is sometimes called potash. The home gardener with average soil needs a fertilizer that contains at least these three elements. The numbers on the fertilizer bag describe the percentage of N, P, and K inside. So, 5-10-10 contains 5 percent nitrogen, 10 percent phosphorous, and 10 percent potassium.

Nitrogen (N) is essential to all growing vegetation. It gives a plant its healthy, dark green color. A plant that lacks nitrogen is apt to look yellow and sickly. When nitrogen is added to the soil, plants may suddenly put on tremendous growth. We have to be careful, though, not to provide too much nitrogen, because if a plant grows too fast—getting quite high and putting out a lot of leaves—the fruit will not be so good. What we are looking for is healthy growth, not overgrowth.

Phosphorous (P) is the major nutrient that helps plants grow strong roots. So obviously it is a must. It is especially important for root crops like carrots, beets, potatoes, and turnips.



To side dress crops, make a shallow furrow down both sides of the row and about 6 inches from it. Encircle hills or mounds with a furrow. Place fertilizer in furrows, then cover it.



Then there is potassium or potash (K). This element helps to condition the whole plant. It helps it grow and bear fruit and makes it resistant to disease.

AVOID TOO MUCH OF A GOOD THING

Every home gardener should be careful with commercial chemical fertilizers. Some of the worst gardening failures are the result of adding too much fertilizer. A man might say to himself, "That little handful of fertilizer I used helped me so much last year, I think I'll use two handfuls this year." There are two disastrous things that could happen as a result of this kind of thinking. The plants could be seriously burned and killed by the chemicals in the fertilizer, or the plants could grow large but produce little or no fruit at all.

I use a very simple formula for spreading chemical fertilizer. One day before planting, I take a twelve-quart pail, fill it with 5-10-10 or 10-10-10, and broadcast it over 1,000 square feet of garden space. The fertilizer should be mixed—either with a tiller or by hand—into the top two or three inches of soil. This should be all the fertilizer you need to get plants started. Spreading fertilizer over a broad area like this is safer than putting it down in rows.

Later on, I apply a side dressing—an additional bit of fertilizer that is put into the soil not far from the roots of the plants themselves. If you use this method, you can control the amount of fertilizer that is going into your garden and still have a chance to give individual crops a boost as they need it.

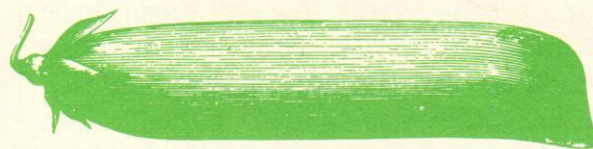
It is probably safe to say that all garden plants benefit from a side dressing just as they begin to blossom. The fertilizer will help the vegetable or fruit to fill out. Vegetables will sometimes let you know when it is time for that extra bit of fertilizer. The cucumber, for example, will stand up and start to blossom just before it lays its vines down along the ground. This brief standing period gives you a chance to reach within three or four inches of the stem so you can get fertilizer right to the roots. Some types of squash will do the same thing.

There is one kind of fertilizer that can be put right in the rows. This is called "superphosphate" (0-20-0). Superphosphate, or triple phosphate, is an incomplete fertilizer

RECOMMENDED TIMES FOR SIDEDRESSING VEGETABLES

CROP	TIME OF APPLICATION
Asparagus	Before growth starts in spring.
Beans	After heavy blossom and set of pods.
Beets	Additional nitrogen might reduce yield or lower quality.
Broccoli	3 weeks after transplanting.
Cabbage	3 weeks after transplanting.
Cauliflower	3 weeks after transplanting.
Carrots	Additional nitrogen might reduce yield or lower quality.
Cucumbers	Apply 1 week after blossoming begins and same amount 3 weeks later.
Eggplant	After first fruit set.
Kale	When plants are about one-third grown.
Lettuce	Additional nitrogen might reduce yield or lower quality.
Muskmelon	Apply 1 week after blossoming begins and same amount 3 weeks later.
Onions	1 to 2 weeks after bulb formation starts.
Parsnips	Additional nitrogen might reduce yield or lower quality.
Peas	After heavy bloom and set of pods.
Peppers	After first fruit set.
Potato	After tuber formation starts (bloom stage).
Spinach	When plants are about one-third grown.
Squash	Additional nitrogen might reduce yield or lower quality.
Tomatoes	Apply 1 to 2 weeks before first picking and same amount after 2 weeks of first picking.
Turnips	When plants are about one-third grown.
Watermelon	Additional nitrogen might reduce yield or lower quality.

Cooperative Extension Service of the University of North Dakota



Approximate Composition of Fertilizer Materials

Material	Nitrogen (N)	Phosphoric acid (P ₂ O ₅)	Potash (K ₂ O)
		percent	
Chemical			
Ureaform.....	30.0-40.0	...	...
Ammonium nitrate.....	33.5	...	...
Ammonium sulfate.....	20.5	...	...
Nitrate of soda.....	16.0	...	...
Urea.....	42.0-46.0	...	...
Superphosphate.....	...	16.0-20.0	...
Muriate of potash.....	...	...	48.0-62.0
Triple superphosphate.....	...	46.0	...

MEASURING TABLE FOR FERTILIZER

	1 pint or 2 cupfuls weigh approximately
Superphosphate	1 pound
Muriate of Potash	1 pound
Limestone	1 1/4 pounds
Mixed Fertilizer (5-10-5, etc.)	1 pound
Cottonseed Meal	3/4 pound
Nitrate of Soda	1 1/4 pounds
Ammonium Nitrate	3/4 pound
Sulphate of Ammonia	3/4 pound





NITROGEN (N)
PHOSPHORUS (P_2O_5)
POTASH (K_2O)

Fertilizer analysis numbers refer to percentage by weight. The three major elements are always listed by number in this order, nitrogen, phosphorus and potassium.

PHOSPHATE IN OLD GARDENS

If a plot has been farmed or gardened for many years, chances are the soil has a reserve supply of phosphate, which is long-lasting in the soil. This means you can use a fertilizer that is high in nitrogen and potash and save money by not adding more phosphate than is needed. But when planting it is good to use a complete, balanced fertilizer to insure the development of a good root system. The plant needs the roots in order to pick up the reserve phosphate. HP

FERTILIZING RYE

It isn't necessary to broadcast fertilizer when planting rye; it will pick up the nutrients remaining in the soil from the previous garden crops.

LIME

Lime does not move from the surface down through the soil as most nutrients do. For this reason, lime should be thoroughly mixed with the soil. UP

BEST SOIL FOR CORN

If you have a choice of soil types, you'd do well to reserve your heaviest soil for corn. Corn likes soil with more clay than sand.

It's best to change the growing location of most vegetables from season to season. This is known as crop rotation. With corn, rotation is not important. Corn produces a lot of organic matter to till or plow under, so it will actually improve the soil from year to year.

Chop the stalks up and work them into the ground as soon as you're through harvesting. Then plant a cover crop (like rye) to be plowed under in the spring. With this kind of program, you can grow corn on the same land year after year. HP

SANDY SOIL

Sandy soil is especially good for garden crops like melons and tomatoes. Surprising as it may seem, sandy soil holds moisture better than heavy soils. The sandy soils and excellent climate along the Chesapeake Bay combine to make it one of the best areas in the nation for truck farming. These conditions are, of course, superb for the home gardener too. HL

because it contains only one of the three major nutrients—phosphorous. Don't be afraid to use superphosphate with root crops if a soil test shows that your garden can use it. You can put it right in a furrow and plant seeds very near it without worrying about the seeds getting burned.

Commercial fertilizers can be combined with or used along with compost, manure, and other kinds of organic matter. In fact, this combination is a very good idea if the quality of your soil is poor. Organic matter can add many nutrients on its own, and by using it, you can reduce the need for chemical fertilizer.

I almost forgot about the fourth number that sometimes appears on a fertilizer package, as in 10-10-10-2 or 5-10-5-1½. The 2 and the 1½ refer to the content of magnesium—one of the sixteen or so minor nutrients that plants also need. Here in the North, our soil is often quite low in magnesium, so a lot of our fertilizers have a high-enough percentage of magnesium to require this last number.

In a 100-pound bag of 5-10-10, by the way, there are five pounds of nitrogen, 10 pounds of phosphorous, and 10 pounds of potassium. All the rest is filler. In other words, if you buy a bag that reads 5-10-10, you are getting twenty-five pounds of fertilizer and seventy-five pounds of soil or some other kind of bulky matter.

NEW LIFE FOR OLD GARDENS

As people get more and more interested in gardening these days, old, forgotten garden plots are being put to use again. A simple rule of thumb seems to work well for a new garden or for one which has lain fallow for four or five years. First, a twelve-quart bucket of lime should be spread over the area and worked into the top four or five inches of soil. Next, a complete fertilizer, such as 5-10-10, should be applied at a rate of one twelve-quart bucket for every 1,000 square feet of garden space. (This is an area measuring twenty-five feet by forty feet.) The fertilizer should be mixed into the top two or three inches of soil. The best time to add fertilizer is a day or two before you are going to plant. If you fertilize too early, much of the nitrogen will be lost. It will drift off into the atmosphere as nitrogen gas if it is not used right away.

MAGNESIUM IN THE SOIL

"I've grown beans on the same land for thirty years. But one year my beans began to die. I had a complete soil test done and found I needed the trace element-magnesium. I added this element by applying Epsom salts, and the problem was corrected immediately. The state university soil test, which I use every year, doesn't break the soil needs down far enough to recognize the lack of these trace elements." JLG

PLANT FOOD ELEMENTS

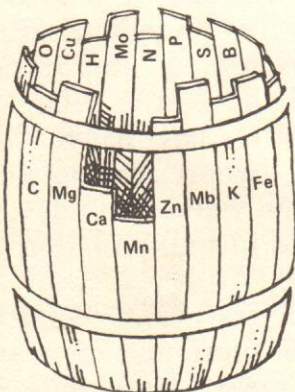
In 1840 the soil scientist Leibig stated his law of the minimum which goes as follows: "Crop yields are determined by the quality of the element that is present in the least abundance."

This means that a plant will not grow properly if the soil is low in one particular element. No matter how much nitrogen you might pour on, if the soil is deficient in magnesium, it still won't show a rich natural green color.

It can be illustrated by this picture of a barrel. If one stave of the barrel is short, the water in the barrel can't rise any higher than the shortest stave.

This is especially important to recognize on some soils. The soil might be rich in all the major food elements, but a deficiency in a minor trace element will stunt the plants. You can guess and add all kinds of fertilizers, but it won't do any good until the soil is brought into balance with the missing plant food element.

This is one important value of organic and natural plant foods. They usually supply a number of trace elements along with the major nutrients nitrogen, phosphorous and potash.



TRACE ELEMENTS

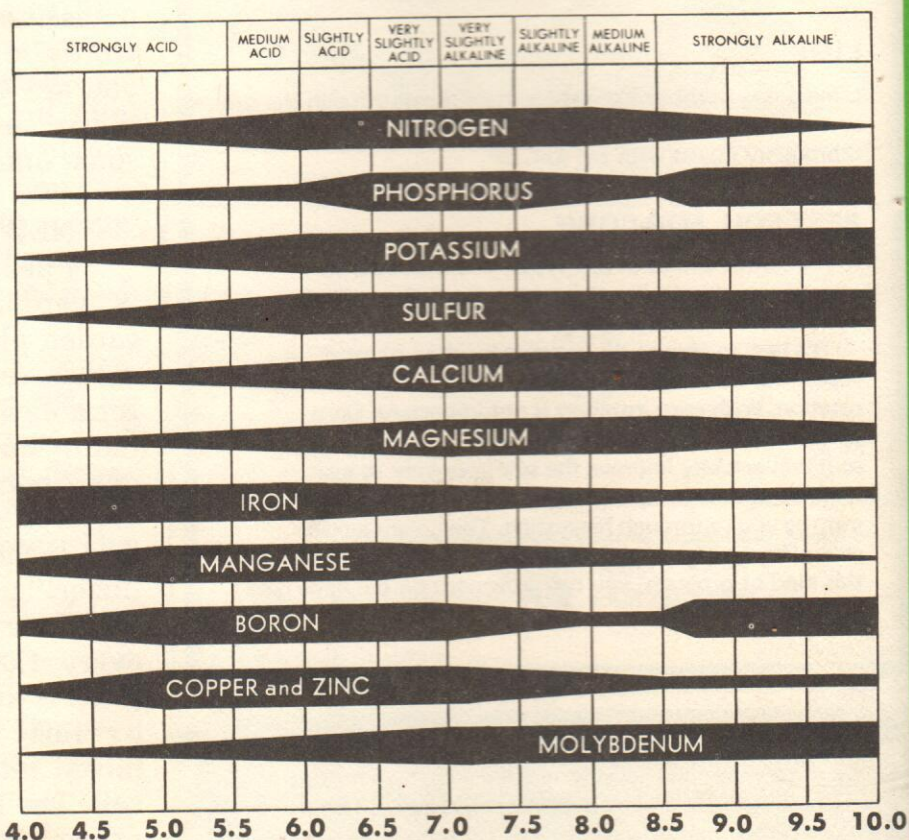
Chemical analysis shows that a plant may contain as many as 40 elements; however, only 15 are necessary to its normal functioning. Three elements, carbon, oxygen, and hydrogen, account for about 90 percent of the dry weight of an average plant. Nitrogen, phosphate, and potash are the primary plant foods found in all complete commercial fertilizers. Though they occur in much smaller quantities than the three essential elements (nitrogen is only 1.5 percent of total dry plant weight), the primary plant foods have tremendous effect on growth and general health. The secondary plant foods (magnesium, manganese, copper, zinc, iron, sulfur, calcium, and molybdenum) occur in even more minute quantities, but they too are very important. For example, a lack of iron, which acts as a catalyst in the enzyme system, causes leaves to turn yellow except for the veins, which stay green. For symptoms of other trace-element deficiencies, see the chart on the facing page. If you suspect your soil of being deficient in elements which don't show up on ordinary soil tests, you might want to send a sample to one of the laboratories listed below.

Prescription Soil Analysis
P.O. Box 80631
Lincoln, Nebraska

Soil and Plant Laboratory, Inc.
P.O. Box 153
Santa Clara, California 95052



HOW SOIL pH AFFECTS AVAILABILITY OF PLANT NUTRIENTS



Availability of above nutrients to plants decreases as width of bar decreases. Soil pH is a key factor in regulating nutrient supply.



KNOW YOUR PLANT FOOD ELEMENTS



PRIMARY PLANT FOOD ELEMENTS

ELEMENT	SYMBOL	FUNCTION IN PLANT	DEFICIENCY SYMPTOMS	EXCESS SYMPTOMS	SOURCES
Nitrogen	N	Gives dark green color to plant. Increases growth of leaf and stem. Influences crispness and quality of leaf crops. Stimulates rapid early growth.	Light green to yellow leaves. Stunted growth.	Dark green, excessive growth. Retarded maturity. Loss of buds or fruit.	Urea Ammonia Nitrates
Phosphorus	P	Stimulates early formation and growth of roots. Gives plants a rapid and vigorous start. Is important in formation of seed. Gives hardness to fall-seeded grasses and grains.	Red or purple leaves. Cell division retardation.	Possible tie up of other essential elements.	Superphosphate Rock phosphate
Potash	K	Increases vigor of plants and resistance to disease. Stimulates production of strong, stiff stalks. Promotes production of sugar, starches, oils. Increases plumpness of grains and seed. Improves quality of crop yield.	Reduced vigor. Susceptibility to diseases. Thin skin and small fruit.	Coarse, poor colored fruit. Reduced absorption of Mg and Ca.	Muriate or Sulphate of Potash

SECONDARY PLANT FOOD ELEMENTS

Magnesium	Mg	Aids photosynthesis. Key element in chlorophyll.	Loss of yield. Chlorosis of old leaves.	Reduced absorption of Ca and K.	Magnesium Sulphate (Epsom Salts) Dolomite is 1/3 Mg.
Manganese	Mn	In enzyme system.	Mottled chlorosis of the leaves. Stunted growth.	Small dead areas in the leaves with yellow borders around them.	Manganese Sulphate (Tecomangam)
Copper	Cu	Enzyme activator.	Multiple budding. Gum pockets.	Prevents the uptake of iron. Causes stunting of roots.	Copper Sulphate Neutral Copper

MINOR (OR MICRO) ELEMENTS

Zinc	Zn	Aids in cell division. In enzymes and auxins.	Small, thin, yellow leaves. Low yields.	None known.	Zinc Sulphate
Iron	Fe	A catalyst. In the enzyme system. Hemoglobin in legumes.	Yellowing of leaves, the veins remaining green.	None known.	Iron Sulphate (Copperas) Chelated Iron
Sulphur	S	Helps to build proteins.	Looks like Nitrogen deficiency.	Sulphur burn from too low pH.	Sulphur Superphosphate
Calcium	Ca	Part of cell walls. Part of enzymes.	Stops growing point of plants.	Reduces the intake of K and Mg.	Lime Basic Slag Gypsum
Molybdenum	Mo	Helps in the utilization of N.	Symptoms in plants vary greatly.	Poisonous to livestock.	Sodium Molybdate
Boron	B	Affects absorption of other elements. Affects germination of pollen tube.	Small leaves. Heart rot and corkiness. Multiple buds.	Leaves turn yellowish red.	Borax

ELEMENTS FROM AIR AND WATER

Carbon	C	Keystone of all organic substances.	None known.	None known.	Air (Carbon Dioxide)
Oxygen	O	Respiration.	White areas at leaf veins. High Nitrates.	None known.	Air and Water
Hydrogen	H	Necessary in all plant functions.	Wilting.	Drowning.	Water

These charts will help you to adapt fertilizer recommendations for large acreage to a small garden.

For small amounts of fertilizer it is easier to measure by volume than by weight. To convert charts that call for pounds you can figure one pound of common garden fertilizer is equivalent to 2 cupfuls.

Rates of Application of Different Fertilizer Formulas as Recommended for 1,000 Square Feet, for 10 Feet of Row, or for Individual Plants

Fertilizer formula	1,000 sq. ft.	10 ft. row	Single plant
5-10-5	40 lbs.	2 cups	3 Tbsp.
8-32-16	25 lbs.	1½ cups	2 Tbsp.
10-6-4	20 lbs.	1 cup	1½ Tbsp.
12-12-12	17 lbs.	1 cup	1½ Tbsp.

Converting Rate of Fertilizer Application from Pounds Broadcast per Acre to Pounds per Square Feet

Area in Square Feet	Fertilizer to apply, where amount to be applied per acre is:		
	100 lbs.	400 lbs.	800 lbs.
	pounds	pounds	pounds
100	.25	1	2
500	1.25	5	10
1,000	2.50	10	20
1,500	3.75	15	30
2,000	5.00	20	40

Converting Rate of Fertilizer Application from Pounds Broadcast Per Acre to Pounds Per Row

Distance Between Rows in Feet	Row Length in Feet	Fertilizer to apply, where amount to be applied per acre is:		
		100 lbs.	400 lbs.	800 lbs.
		pounds	pounds	pounds
2 feet	50 feet	0.25	1.0	2.0
2	100	0.50	2.0	4.0
2½	50	0.30	1.2	2.4
2½	100	0.60	2.4	4.8
3	50	0.35	1.4	2.8
3	100	0.70	2.8	5.6

ORGANIC SOIL BUILDING

Donald Roberts of Kilmarnock, Virginia, hauls in crab shells when they are available from commercial watermen and spreads them on his garden. The shells contain lime and many trace minerals that would be expensive to buy in a bag. He spreads anything on his garden that rots — leaves, straw, manure, all his garbage and grass clippings.

Under his corn this year, he put twenty bushels of frozen fish that had gone bad in a freezing locker. He opened up a furrow, spread the fish down the row, covered it over and planted his corn. He needed very little commercial fertilizer and had a bumper productive crop.

At planting time, Mr. Roberts opens up a double row with his plow, fills the furrow with plenty of cow manure and throws the dirt back over it. That's what he plants his tomatoes, cucumbers, squash, and eggplant on. They take off fast and don't know when to quit growing.



SOME ORGANIC SUBSTITUTES FOR CHEMICAL FERTILIZERS

Most commercial fertilizers are made with chemicals. But there are other kinds of fertilizer, and they do not come from a garden-supply store in a bag. I mean natural, organic fertilizers. They are easy to find and are usually cheap, sometimes free. I am talking about manures, compost, soybean and cottonseed meal, seaweed, decomposed hay and straw, crop residues, leaves, and grass clippings. As I have said before, when you mulch with these materials, you are adding fertilizer to your garden at the same time.

Anyone knows that there are as many kinds of manure as there are animals. Cow manure is one of the most common, but horse manure, rabbit manure, chicken manure, duck manure, sheep and goat manure are sometimes available too. Some manures are very strong. Cow manure, for instance, should be aged before it is put on the garden. It should be piled up outside for three to six months. If you can't wait this long, spread fresh manure over the garden a couple of weeks before planting, and then mix it into the top two or three inches of soil very, very thoroughly—either with a tiller or with a plow and harrow. It's best not to use fresh manure in a row or as a side dressing. If you do, you are likely to burn your seeds or injure your plants. Fresh manure has a very high percentage of water, so a bushel of aged and dried manure contains more organic matter and more nutrients than a bushel of fresh.

Cow manure is available to more people than any other kind. You can use quite a bit of it without worrying about over-fertilizing.

I like to put aged cow manure in the bottom of a furrow and plant seeds on top of it. The only drawback is that cow manure contains some weed seeds. Whenever you broadcast it over the entire garden, you are making work for yourself by planting some extra weeds. But I have found that putting it in furrows virtually eliminates this prob-

lem, possibly because the weed seeds are too deep to germinate successfully.

Chicken manure is very high in nitrogen because chickens have a high-protein diet. Use it very sparingly. If you use too much, it will either burn your plants or make them grow huge tops with few good vegetables. Chicken manure from poultry farms is usually mixed with sawdust or wood chips, and this dilutes the potency of the manure. Even so, the safest way to use it is to sprinkle it lightly over the soil and work it in.

There is no danger of burning your plants when you till old hay, grass, leaves, and similar organic substances into the soil. In fact, it is impossible to use too much of these things. They will use up some nitrogen in the soil for a while as they continue to decay, but this debt will be repaid as soon as the microorganisms have had a chance to do their work.

Compost is a wonderful fertilizer, although it varies in strength depending on the ingredients put into it. Most plants will thrive in compost. It may be all the fertilizer they need.

A garden which has been fertilized only with manures, compost, or organic matter will probably show a lack of phosphorous before too long. A light application of rock phosphate, an organic fertilizer, or a sprinkling of superphosphate, a chemical fertilizer, will be helpful from time to time. On the other hand, if you are careful about making compost from a wide range of different things, you may be producing a more or less complete fertilizer capable of fulfilling all your plants' needs.

It all boils down to this: adding natural fertilizers makes your soil healthy. If your soil is healthy, your plants are going to be healthy too. It is just that simple. It is a fact that diseases and insects are less likely to attack strong, healthy plants than weak, spindly ones. If you use commercial fertilizers year after year without putting in any organic matter, you are making a serious mistake. You are sapping the soil and are leaving yourself open to all sorts of trouble. You are providing the immediate chemical nutrients but not doing anything for the texture and structure of your soil or providing a favorable environment for the important soil organisms.



APPROXIMATE COMPOSITION OF NATURAL FERTILIZER MATERIALS

Material	Nitrogen (N)	Phosphoric acid (P)	Potash (K)
BULKY ORGANIC MATERIALS			
Alfalfa hay	2.5	.5	2.0
Bean straw	1.2	.3	1.2
Grain straw	.6	.2	1.0
Olive pomaces	1.2	.8	.5
Peanut hulls	1.5	—	.8
Peat	2.3	.4	.8
Sawdust	.2	—	.2
Seaweed (kelp)	.6	—	1.3
Timothy hay	1.0	.2	1.5
Winery pomaces	1.5	1.5	.8
MANURES			
Bat guano	10.0	4.5	2.0
— Cow manure, dried	1.3	.9	.8
Cow manure, fresh	.5	.2	.5
Hen manure, dried, with litter	2.8	2.8	1.5
Hen manure, fresh	1.1	0.9	.5
Horse manure, fresh	.6	.3	.5
Pig, fresh	.6	.5	.4
Sheep manure, dried	1.4	1.0	3.0
Sheep manure, fresh	.9	.5	.8
ROCK POWDERS			
Basic slag	—	8.0—17.0	—
— Greensand (Glauconite)	—	1.4	4.0—9.5
Hybro-tite	—	.002	—
— Rock phosphate (apatite)	—	38.0—40.0	4.5
VEGETATIVE & ANIMAL CONCENTRATES			
— Bonemeal, steamed	2.0	22.0	—
Castor pomace	6.0	1.9	.5
Cocoa shell meal	2.5	1.5	2.5
— Cottonseed meal	6.0	3.0	1.0
— Dried blood meal	13.0	1.5	.8
Fish meal	10.0	6.0	—
Fish scrap	5.0	3.0	—
Garbage tankage	1.5	2.0	.7
Hoof & horn meal	12.0	2.0	—
Sewerage sludge	2.0	1.4	.8
Sewerage sludge, activated	6.0	3.0	.1
— Soybean meal	7.0	1.2	1.5
Tankage, animal	9.0	6.0	—
Tankage, processed	7.0	1.0	.1
Tobacco dust and stems	1.5	.5	5.0
Wood ashes	—	1.8	5.0

WINTER LETTUCE

"I plant lettuce along with the turnip greens about the end of September. The cold hardy turnip tops protect the more tender lettuce from the frost. Our winters are mild enough that I have small lettuce plants among the turnips to transplant in early spring." DR