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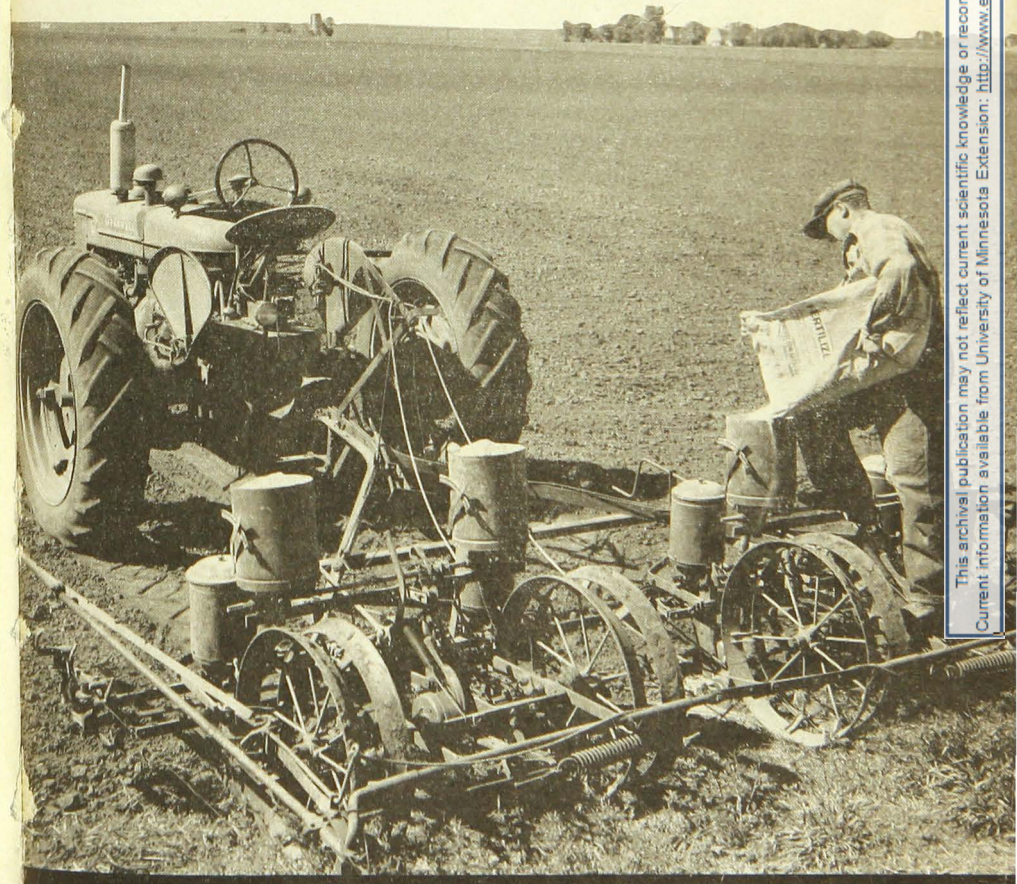
Guide to FERTILIZER USE in Minnesota

by Extension Soils Specialists and Soils Department Staff



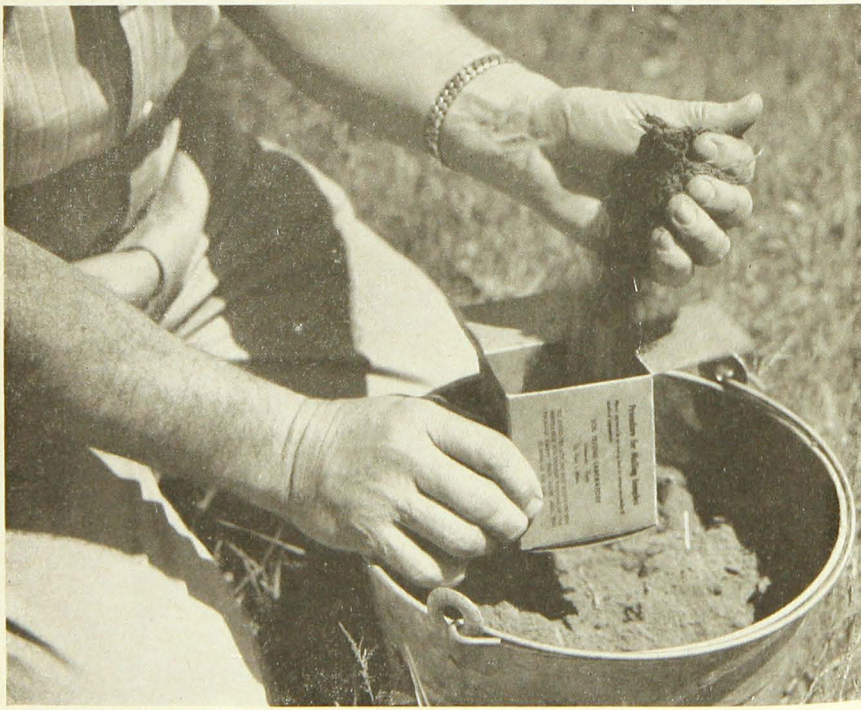
UNIVERSITY OF MINNESOTA
Agricultural Extension Service
U. S. DEPARTMENT OF AGRICULTURE

Looking for a Good Investment?

Are you interested in putting your dollars where they will bring the highest return? Then try an investment in fertilizers for your land.

Of course, the kind and amount of fertilizer to use depends on how fertile your soil is and what crops you want to grow. Naturally there is no best fertilizer for any crop on all soils—nor is there any best fertilizer for all crops on certain soils. Soils that need fertilizers the most are the ones that were originally low in fertility or that have been heavily cropped or poorly managed.

How do you know what the needs of your soil are? This bulletin will be helpful, but it is intended only as a *general* guide. *Specific* information must come from field experiments and soil tests. The Soil Testing Laboratory of the University of Minnesota and the men in the Soils Department always stand ready to help you learn the fertilizer and lime needs of your soil.



Guide to Fertilizer Use

in Minnesota

by Extension Soils Specialists *and* Soils Department Staff

COMMERCIAL FERTILIZERS have an important place in any soil fertility and conservation program in Minnesota. They will not take the place of drainage, liming, good crop rotations, farm and green manures, or erosion control practices, but they should be used in addition to these basic soil management methods. Fertilizers when properly used will increase yields, improve the quality and feeding value of crops, and hasten maturity.

Plant Foods

The three plant foods ordinarily supplied in commercial fertilizer are nitrogen, phosphorus, and potassium.

Nitrogen is found naturally in the organic matter of the soil. To a certain extent the nitrogen needs of crops can be supplied on the farm (1) by applying farm manure and (2) by using crop rotations that include the regular use of inoculated legumes other than soybeans. Properly inoculated legumes can take nitrogen from the air.

A lack of nitrogen for plants results in stunted growth and poor root development. In severe cases the leaves become yellow or yellowish-green instead of dark green. Commercial fertilizers containing nitrogen can be used to supplement the nitrogen supplied by farm manure and legumes.

Phosphorus is an important element that is lacking in most Minnesota soils. Phosphorus encourages both root and seed development and hastens the ma-

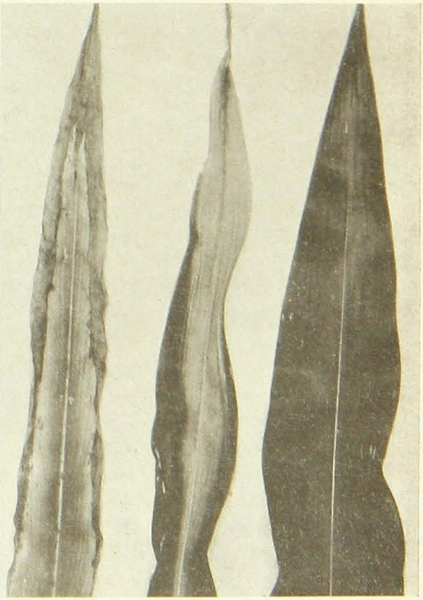


Fig. 1. A poorly fed crop often shows hunger signs. The leaves of this corn, from left to right, are in need of potash, in need of nitrogen, and healthy.

turity of many crops. Symptoms of phosphorus deficiency are stunted growth, poor root and seed development, and in some plants, a bronzing or purpling of the leaves.

Potassium is found in Minnesota soils in much larger quantities than is phosphorus, but recent tests have shown that crop yields are higher on some soils if potassium is included in the fertilizer. The leaves of crops suffering from potassium deficiency may appear yellow or dry and scorched on the edges. On plants such as alfalfa and sweetclover, the scorching is preceded by small, whitish dots arranged more or less regularly around the edges of the leaves.

Minerals such as phosphorus and potassium cannot be produced on the farm and must be supplied from an outside source.

Other plant nutrient elements besides nitrogen, phosphorus, and potassium are needed for crop growth. These include carbon, hydrogen, oxygen, calcium, magnesium, sulfur, iron, manganese, boron, copper, zinc, and molybdenum. Some of these elements may be present in fertilizers. However, most Minnesota soils have these elements available so there is no need for adding them as commercial fertilizers unless you know they are needed.

Carbon, hydrogen, and oxygen come in plentiful supply from air and water.

Calcium and magnesium are usually present in sufficient amounts for crop growth—even on some acid soils needing lime. However, liming soils to correct acidity will also provide these two elements and may make other nutrient elements more usable to plants.

Sulfur is deficient for some crops in some soils of north central and northeastern Minnesota, but applying gypsum (calcium sulfate) or elemental sulfur corrects this problem.

Iron, manganese, boron, copper, zinc, and molybdenum are called "minor" or "trace" elements, not because of their relative importance to crops but because the amounts needed are small. The only trace element needed to any extent in Minnesota is iron, which is not available in many of the high-lime soils of western Minnesota and the Red River Valley. This lack causes chlorosis (yellowing) on many fruits, vegetables, ornamental plants, and tree seedlings.

Fertilizer Grades

MIXED FERTILIZERS

Fertilizer materials are combined to give varying percentages of nitrogen (N), phosphate (P_2O_5), and potash (K_2O). For example, fertilizer materials may be combined to give a fertilizer which contains 6 per cent nitrogen, 24 per cent phosphate, and 12 per cent potash. This is expressed as 6-24-12 and is called a fertilizer grade.

In a fertilizer grade the first figure always represents the percentage of nitrogen, the second figure is the percentage of available phosphate, and the third figure the percentage of soluble potash. If one or more of these are not included in the fertilizer grade, their place in the formula is shown by a zero. For example, an 0-20-10 contains no nitrogen, 20 per cent available phosphate, and 10 per cent soluble potash. Superphosphate, which has 20 per cent available phosphate, is represented by the grade 0-20-0, and ammonium nitrate is 33-0-0 since it contains only nitrogen.

Since the figures in the fertilizer grade represent percentages they also express the number of pounds of available plant food in each 100 pounds of fertilizer. By adding the three figures together the total number of pounds

Fig. 2. This experiment points out that proper fertility balance is very important for legume-grass seedings. The best balanced growth of legume and flax is in the pot that received 20-20-20.

of available plant food in each 100 pounds may be obtained. If this figure is multiplied by 20 it gives the pounds of available plant food in one ton of fertilizer. A 6-24-12 fertilizer contains a total of 42 pounds of available plant food per hundred pounds, or 840 pounds per ton.

The minimum grades of fertilizer which can be sold in Minnesota were set up by the Minnesota State Legislature in 1949. The law provides that "No superphosphate containing less than eighteen per cent available phosphoric acid nor any mixed fertilizer in which the sum of the guarantees for the nitrogen, available phosphoric acid, and soluble potash totals less than twenty-seven per cent shall be offered for sale, sold or distributed in this state except for complete fertilizers containing one-fourth or more of their nitrogen in water-insoluble form of plant or animal origin, in which case the total nitrogen, available phosphoric acid, and soluble potash need not total more than twenty-four per cent."

Under this law **specialty fertilizers** need not be guaranteed to contain at least 27 per cent of nitrogen, available phosphate, and soluble potash. A specialty fertilizer is "any fertilizer distributed solely for use on crops grown for noncommercial purposes such as gardens, lawns, shrubs, and flowers; and may include fertilizers used for research or experimental purposes." Such fertilizer grades as 4-12-4, 5-10-5, and 8-8-6 are examples of specialty fertilizers.

STRAIGHT FERTILIZERS

The term straight fertilizer is usually used to designate fertilizer containing only one of the three major plant foods: nitrogen, phosphate, or potash. These fertilizers are used either as a single nutrient needed for crop growth or as one part of mixed fertilizers.

Nitrogen Fertilizers

Nitrogen fertilizers are offered for sale in three forms: anhydrous ammonia (a gas), nitrogen solutions, and nitrogen solids. All three forms are equally effective pound for pound of nitrogen in obtaining crop yield responses. But because of differences in their properties, methods of handling these materials and the uses made of them will vary.

Anhydrous ammonia (82-0-0) is a gas, but when confined under pressure it is a liquid. This liquid must be stored in pressure tanks and applied at least 4 inches below the surface of the soil with pressure equipment to prevent it from escaping into the air. When applied below the surface the ammonia attaches itself to soil particles or combines with soil water and cannot escape as gas or by leaching.

Soil particles take up ammonia readily but the horizontal movement of ammonia in the soil is slow. Thus it may take some time for the soil to take up heavy applications of anhydrous ammonia, especially if spacings are wide. For this reason, applications for grain or grass crops should be injected no more than 15 to 20 inches apart. Also it is usually best to wait one or two weeks after applying anhydrous ammonia before disturbing the soil. Plowing or deep tillage immediately afterward may cause some nitrogen losses.

Never apply ammonia in dry, cloddy, or very wet soils, since air pockets will form through which the gas may escape.

Anhydrous ammonia will burn plants severely if the gas comes in direct contact with the foliage, roots, or seed. Germination of row crops like corn may be severely damaged if you plant these crops too soon after heavy applications of anhydrous ammonia. It is also harmful to human beings. Be careful not to breathe it or expose any part of your body when transferring anhydrous ammonia from one tank to another.

Nitrogen solutions (20-0-0 to 44-0-0), the second form of nitrogen fertilizers, are nitrogen materials dissolved in water. In general, you can use solutions containing less than 37 per cent nitro-

Fig. 3. This broadcast application of anhydrous ammonia is one of the many new ways of applying fertilizers.

gen the same way as you do solid materials for surface applications. Generally it is best to work them into the soil within a short time.

Usually you must apply solutions containing 37 per cent or more nitrogen under the surface of the soil in the same way as you do anhydrous ammonia. However, if the temperature is below 60 degrees you will not need pressure equipment for distribution.

All nitrogen solutions will corrode ordinary iron and copper alloy equipment, so use equipment made of aluminum or stainless steel.

Since nitrogen solutions burn plant foliage, be very careful when applying them as a broadcast spray to growing crops. Corn and flax are particularly susceptible to burning. Small grains may be injured somewhat in the early stages of growth but generally recover. In the boot stage, however, injury may be permanent.

Solid nitrogen fertilizers, the third form of nitrogen fertilizers, have been offered for sale in Minnesota for many years. Among these are ammonium nitrate (33-0-0), ammonium sulfate (20-0-0), sodium nitrate (16-0-0), calcium nitrate (20-0-0), urea (45-0-0), and calcium cyanamid (20-0-0). All are soluble in water.

The ammonia and organic forms (urea and cyanamid are organic forms) for the most part are changed to nitrates by soil bacteria before being used by plants. The same is true for the ammonia in anhydrous ammonia and both the ammonia and urea in nitrogen solutions. However, plants can use ammonia directly.

Solid nitrogen materials are the most adaptable of the three forms of nitrogen fertilizers, since moderate amounts can be applied topdressed on growing crops if the foliage is dry. These materials can also be applied in the drill with small grains if the rates are low and the weather is dry.

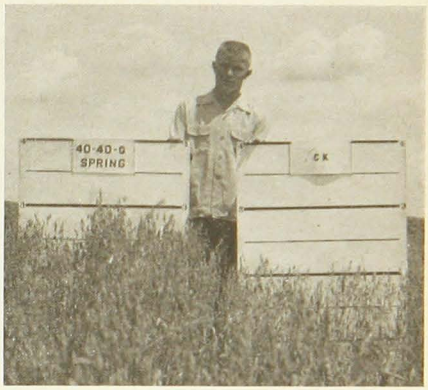


Fig. 4. This experiment with oats shows that the best fertilization for small grains seeded alone is a nitrogen-phosphate combination. If you broadcast the fertilizer, apply it either in the spring or fall.

There is some misunderstanding regarding the so-called acid effects of nitrogen fertilizers on the soil. Ammonium sulfate, ammonium nitrate, urea, anhydrous ammonia, and the common nitrogen solutions are all acid-producing materials—but to a very minor degree.

For each pound of nitrogen applied, 1.8 pounds of calcium carbonate (lime) are needed to neutralize the acid. In the case of ammonium sulfate, 5.35 pounds of calcium carbonate are needed for each pound of nitrogen. Thus, with the usual applications of these nitrogen fertilizers, many years would elapse before one ton of lime would be needed to correct the soil acidity produced.

Actually, some nitrogen fertilizers—sodium nitrate, calcium nitrate, and calcium cyanamid—have alkaline or "base" producing effects when applied to the soil.

Phosphate Fertilizers

Phosphate fertilizers find their beginning in the phosphate rock of Florida, Tennessee, and some of the western mountain states. The various phosphate

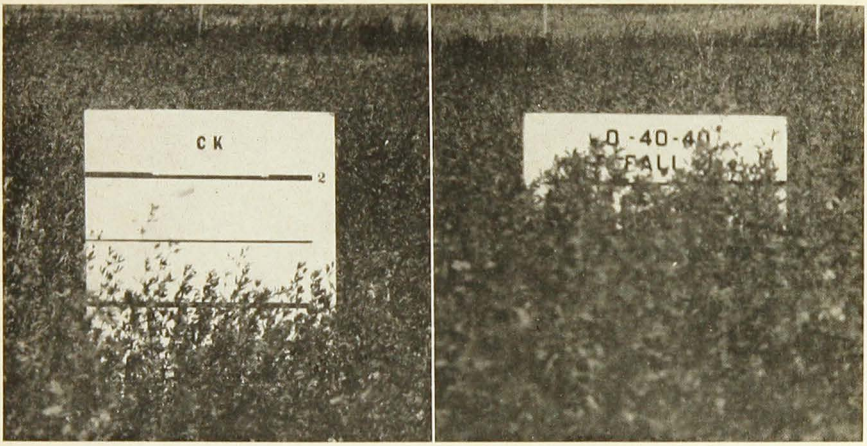


Fig. 5. Remember that fertilizer—applied either in the fall or spring—is often necessary on pastures as well as on corn and small grains.

materials differ in their properties because of their composition and the way they are processed.

Superphosphate (0-20-0) is manufactured by treating phosphate rock with sulfuric acid. While superphosphate does not contain an added "filler," it does have a high percentage of calcium sulfate (gypsum) as a result of the treatment with sulfuric acid. This sulfur content makes it valuable in the sulfur-deficient soils in north central and northeastern Minnesota.

In the usual process of manufacture it is not possible to obtain a product that contains more than 20 per cent available phosphate. Superphosphate was formerly termed "acid phosphate," the name arising from its method of manufacture, but now it is more commonly called "ordinary superphosphate." It is slightly acid but at the usual rates of application has little or no effect on soil acidity.

Triple superphosphate (0-43-0 to 0-48-0) more correctly could be called double or concentrated superphosphate. It is made by treating phosphate rock with liquid phosphoric acid. This treatment increases the available phosphate content and eliminates much of the gypsum contained in ordinary superphosphate. It is just as effective as ordinary superphosphate and can be used wherever phosphate is needed.

Triple superphosphate is widely used in making mixed fertilizers, especially those of high analyses. For example, 4-24-12, which can be made with triple but not with ordinary superphosphate, has a high analysis of plant food in comparison to 3-12-12, which can be made by using ordinary superphosphate. Because of its high available phosphate content, its freight costs are lower.

Liquid phosphoric acid (approximately 0-54-0) has not been used commercially in Minnesota, though it has proved to be as effective as superphosphate in the western states. Its content of phosphate varies considerably according to its method of manufacture and dilution before marketing.

Calcium metaphosphate (0-62-0 to 0-64-0) is manufactured by treating

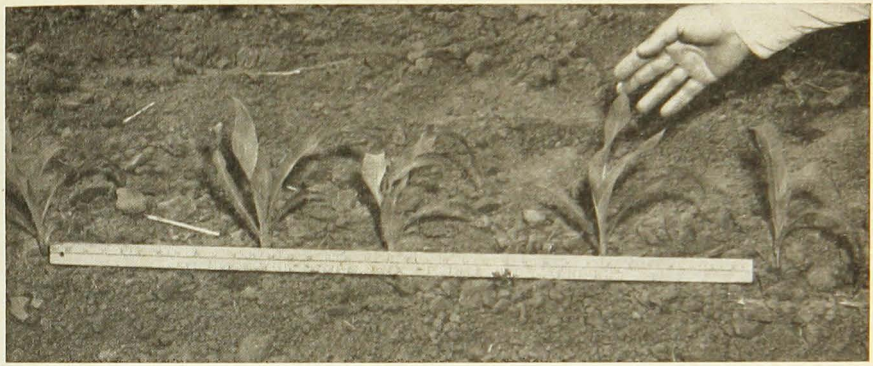


Fig. 6. Your stand of corn must be good in order for you to get increases from fertilizers. This stand would average about 16,000 plants per acre—the recommended rate for fine-textured soils.

phosphate rock with gaseous phosphorus at a high temperature. After cooling, the product is ground and ready for distribution. It dissolves easily in ammonium citrate but not in water. Extensive tests in Minnesota have found it a good source of phosphate.

Fused rock phosphate is obtained when phosphate rock is heated with 5 to 10 per cent silica and the melt rapidly cooled. This treatment increases the availability of the phosphate. However, none of the material is now sold in Minnesota.

Rock phosphate is phosphate rock which is finely ground. Though it contains from 30 to 34 per cent total phosphate, the reports from the Minnesota Department of Agriculture, Dairy and Food show that only 2 to 4 per cent of this phosphate is in an available form. Rock phosphate contains considerable fluorine, which makes phosphate less available.

Rock phosphate gives best results on acid soils that are high in organic matter. Legumes generally give better response than other crops. Before using rock phosphate, consider such factors as fineness of grinding, fluorine content, need for very high rates to furnish enough available phosphate, and high transportation costs. Experimental work to date in Minnesota has shown that rock phosphate is inferior to the phosphates which have their phosphorus in water-soluble and citrate-soluble forms.

Colloidal-type phosphate is a low-grade rock phosphate or phosphatic clay. This material is sometimes described as "waste pond phosphate" since it is usually obtained from the settling ponds used in the hydraulic mining of phosphate rock. When water has drained away or evaporated from these ponds, the phosphatic clay is scooped up and finely ground.

This product contains 18 to 23 per cent of total phosphate. Reports from the Minnesota Department of Agriculture, Dairy and Food show that the content of available phosphate is usually 1 to 3 per cent, but generally no claim is made for availability.

Potash Fertilizers

Potash fertilizers come mainly from natural deposits in the southwestern part of the United States and in California. Two potash materials, both of which dissolve easily in water, provide

Table 1. Recommended Fertilizer Ratios and Minimum Grades for Minnesota

Recommended fertilizer ratio	Recommended minimum grade*	Examples of other grades
1:0:0	20-0-0	82-0-0, 45-0-0, 41-0-0, 33-0-0, 32-0-0, 22-0-0
0:1:0	0-20-0	0-46-0,† 0-63-0‡
0:0:1	0-0-50	0-0-60
0:1:1	0-20-20	0-30-30
0:1:3	0-10-30	0-12-36
0:2:1	0-20-10	0-30-15
1:1:0	15-15-0	.....
1:1:1	10-10-10	12-12-12, 15-15-15, 20-20-20
1:2:0	10-20-0	15-30-0
1:2:1	10-20-10	12-24-12
1:2:2	8-16-16	10-20-20
1:3:6	3-9-18	4-12-24
1:4:0	8-32-0	9-36-0, 11-48-0
1:4:2	5-20-10	6-24-12
1:4:4	5-20-20	6-24-24

* Using high-analysis fertilizers means less material to handle, lower freight costs, lower cost per pound of plant food, and less filling of hoppers on the machines that apply the fertilizer to the soil.

† This grade includes all grades of triple superphosphate fertilizer ranging from 43 per cent to 48 per cent phosphate.

‡ This grade includes all grades of calcium metaphosphate fertilizer ranging from 62 per cent to 64 per cent phosphate.

most of the potash used in Minnesota. These are muriate of potash (0-0-60) and sulfate of potash (0-0-50).

On some crops, especially where high rates are used, muriate of potash is less satisfactory than sulfate of potash because of the large amount of chlorine in the muriate. This high content of chlorine may interfere with the refining of the sugar in sugar beets and may harm the cooking quality of potatoes.

Fertilizer Ratios

A fertilizer ratio is the relationship between the percentages of nitrogen, available phosphate, and soluble potash in a fertilizer grade. To get this ratio divide the figures in the formula by the smallest figure in the fertilizer grade. For example, the ratio for 6-24-12 is 1:4:2, the result of dividing the figures by 6, the smallest figure in the formula. A 5-20-10 is also a 1:4:2 ratio and is obtained by dividing the figures by 5.

Thus a number of fertilizer grades may have the same ratio. The only difference between them is the total number of pounds of available plant food they contain. Table 1 gives the fertilizer ratios and minimum grades recommended for Minnesota soils.

AREAS OF LIME NEED IN MINNESOTA

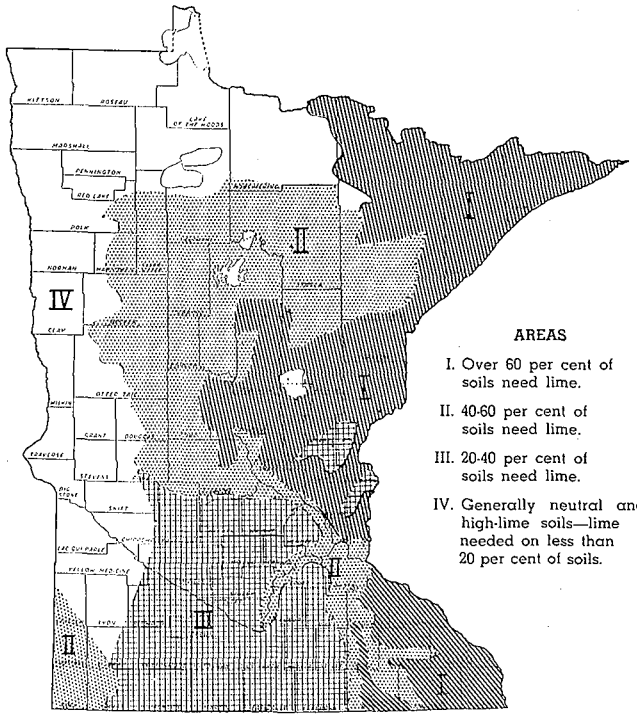


Fig. 7. Areas of lime need in Minnesota.

Minnesota Lime and Fertilizer Needs

Fertilizer and lime needs vary widely over the state because of differences in soil texture, original soil composition, past cropping, fertility treatments, and moisture conditions. Because of these variations fertilizer recommendations are now made only for a given field and are based on specific soil tests and crop management. However, it is possible to outline areas in the state where soil tests and fertilizer trials suggest a uniform need for certain plant nutrients.

LIME

Lime needs depend on *p*H (acidity), soil texture, the crop to be grown, and, to some extent, the depth to lime in the subsoil. Soil tests are necessary to determine the lime needs of any specific field. In general, lime is needed if the *p*H of the surface soil is below 6.3 for mineral soils and below 5.4 for organic soils. The rate of application may range from a high of 3 to 3½ tons per acre on coarse-textured soils such as sandy loams up to a high of 6 tons on fine-textured soils like the silt loams and clay loams. Figure 7 divides the state into four areas according to liming recommendations.

In Area I over 60 per cent of the soils need lime, since most of the soils are acid in both surface and subsoil. Lime should be applied before legumes are seeded, except on fields that have been limed recently or on low spots high in lime. In this area lime also increases yields of crops other than legumes because it helps make more phosphorus and nitrogen available.

In Area II between 40 and 60 per cent of the soils need lime. Some of the subsoils may be high in lime even though the surface soils show pH readings below 6.3. Such soils may show little response to lime.

In Area III only 20 to 40 per cent of the soils are acid. Actually, many of the subsoils may be high in lime even though the surface soils are acid. Thus, it is best to use field trials as well as soil tests if you are to determine your lime needs accurately. Even though the surface soil may test acid, fields should not be limed if the subsoil contains plenty of lime and no trouble occurs in getting legume stands.

The soils of Area IV generally do not need lime. In fact, many of these soils may contain enough lime and gypsum to hurt crop growth and thus reduce yields.

NITROGEN

Nitrogen fertilizers have generally given good responses on small grains and corn over the entire state during the last few years. However, there is often a big difference in response within a given locality, depending on the organic matter content of the soil, its texture, and past soil management.

Recommendations for nitrogen on corn may vary from none on the more fertile soils to as much as 100 pounds per acre where corn follows corn on fields very low in nitrogen. Response to nitrogen is usually associated closely with good phosphate and potash levels in the soil. Figure 9 shows the areas in the state where nitrogen fertilizers may give responses.

Area I has predominantly sandy soils very low in nitrogen and they respond to nitrogen fertilizer more than any other soils in Minnesota. Recommendations for nitrogen generally are limited by the low supply of soil moisture.

Area II has soils with variable textures. Practically all of these soils had forests on them at one time and are naturally low in nitrogen. They are very responsive to nitrogen fertilizers

Fig. 8. If your pastures look like this, they need nitrogen. The nitrogen in animal droppings produced spotty added growth in this pasture.

AREAS OF NITROGEN NEED IN MINNESOTA

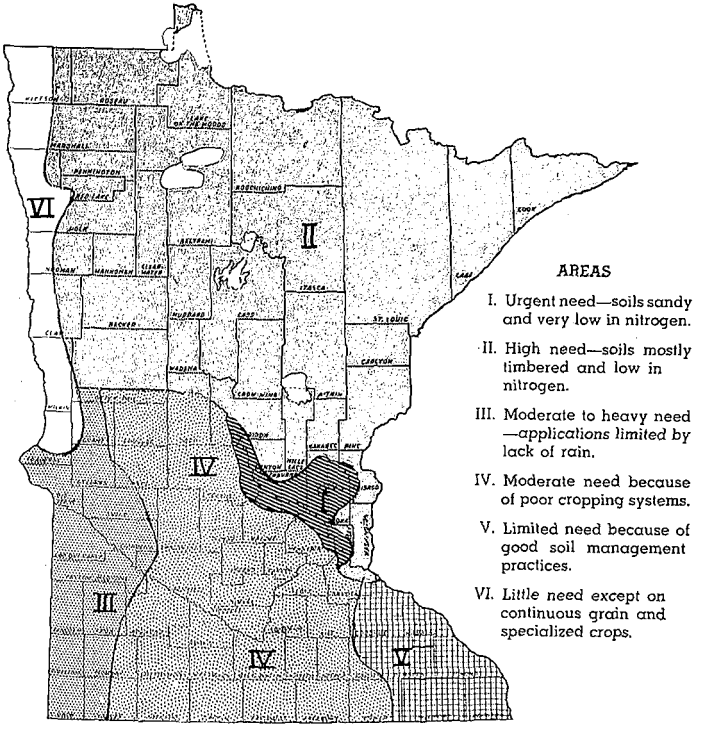


Fig. 9. Areas of nitrogen need in Minnesota.

unless this need has already been met by legumes or barnyard manure.

Area III differs from Area IV in having somewhat lighter colored soils, less rainfall, and more cash grain farming. The need for nitrogen on these soils is heavy—especially on those that have lost some of the surface soils by erosion or that have grown few legume crops. However, lack of rain limits the top recommendations to approximately those of Area IV.

Area IV has less livestock farming than Area V and less legumes are grown. Even the heavy, dark-colored Webster soils of south central Minnesota need nitrogen fertilizer when legumes and barnyard manure do not come before nonlegume crops.

Area V has both light- and dark-colored soils. Ordinarily soils in this area, particularly the light-colored ones, could use much nitrogen fertilizer. However, the nitrogen needs on many of the fields are largely met by legumes in the rotation and the use of barnyard manure. Small grains and corn need nitrogen when they do not follow legumes and barnyard manure.

Area VI includes the heavy, dark-colored soils of the Red River Valley. Nitrogen is needed mainly on farms where continuous grain, potatoes, and sugar beets are grown and where legumes are seldom seeded.

PHOSPHATE

Phosphate fertilizer is needed in most areas of Minnesota. There are two main reasons for this: For one thing the soils of Minnesota started out relatively low in phosphorus in comparison to other plant foods like potassium. The second reason is that added phosphates have the unfortunate property of becoming unavailable or "fixed" in most soils. And at the same time crops are taking out phosphorus and increasing the need for phosphate fertilizers.

There is some relationship between acidity level and phosphate availability in the soil, at least in soils that have a high *p*H (high lime) or a low *p*H (acid). Soils with a high *p*H may have enough lime to tie up the phosphorus originally in the soil. Furthermore, the effect of phosphate fertilizers added to these soils lasts a shorter time because the lime ties up the phosphate.

On the high lime or "alkali" soils of southern and western Minnesota and the Red River Valley, very heavy rates of phosphate fertilizers are often needed to supply crop needs. As a group, the soils of western Minnesota other than the "alkali" soils also have a relatively high *p*H and thus need phosphate.

Soils which have a low *p*H are also low in phosphate because the phosphorus may be tied up by iron and aluminum and thus is not easily available to crops. The phosphorus in most acid soils can be made more available to crops if the soil is limed to the proper *p*H.

Soils which are neither highly alkaline nor strongly acid may or may not need phosphate. Soil management prac-

Fig. 10. Use fertilizers along with other good management practices in order to get the greatest returns. Here a farmer grows corn on the contour to save soil and water on his sloping land.

AREAS OF POTASSIUM NEED IN MINNESOTA

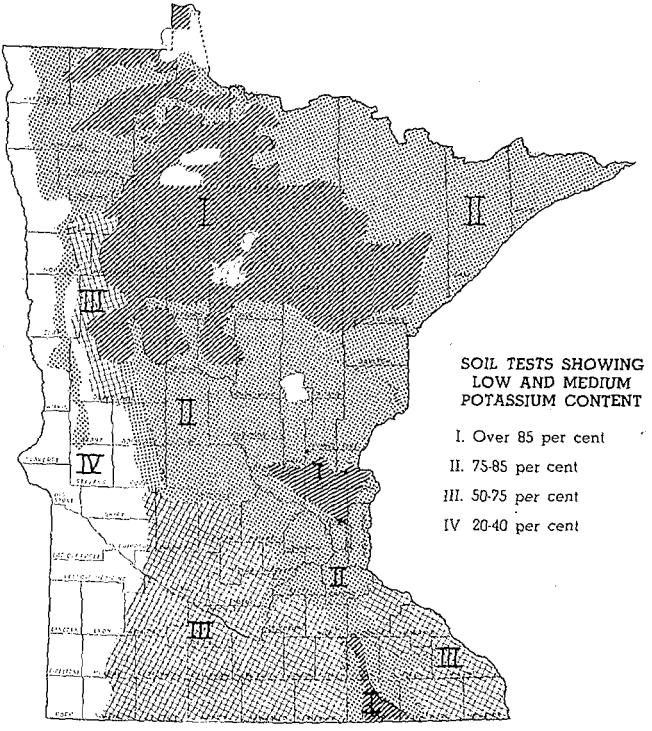


Fig. 11. Areas of potassium need in Minnesota.

tices, cropping history, and erosion (particularly as it has affected organic matter content) are factors which influence the need for phosphate fertilizers.

POTASH

Potassium needs of Minnesota soils, as indicated by soil tests and fertilizer trials, have increased markedly in the past few years. Figure 11 shows a summary of soils with low and medium tests for potassium.

The least need for potassium is in the extreme western part of the state (Area IV). Here only 20 to 40 per cent of the soils show low or medium soil tests for potassium, and only a few of these are so low that all crops respond to potash. Most of the soils in this area give responses only on such crops as legumes, potatoes, and sugar beets.

Area I shows the greatest need for potassium, with over 85 per cent of its soils having a low or medium soil test for potassium. In many cases potassium is more limiting than is phosphorus.

Areas II and III are less responsive to potassium than Area I. However, potash fertilizers produce good results on most soils that have consistently grown crops like alfalfa, potatoes, sugar beets, and truck crops.

Fig. 12. Not all soils are as low in plant food as this field in Mower County, but the picture does show how important starter fertilizer is to good corn growth.

OTHER PLANT FOODS

Other plant foods are needed only in certain parts of the state and by specific crops. Sulfur is needed by legumes on the Nebish-Rockwood and Menahga soil associations of north central Minnesota. Boron has been proved necessary for rutabagas near Askov, Minnesota and for celery on both mineral and peat soils around the Twin Cities.

On the peat soils in the Hollandale area in Freeborn County recent trials on 10 fields with manganese for onions indicated a response in only one field. Minor elements have not produced any real yield increases in field crops.

Application of Fertilizer

The best methods of fertilizer application are (1) broadcasting, (2) hill or row applications, and (3) sidedressing.

Broadcasting fertilizers seems to be most effective on fields that are low in fertility and in need of heavy basic application. Generally you should broadcast this application before plowing and then turn it under, but you may broadcast the fertilizer and disk it in if the field is already plowed.

Recent experiments have shown that fall application of the fertilizer is almost always as effective as spring application. The only exception is nitrogen applied to sandy soils.

The broadcast fertilizer treatment seems very effective when seeding legume or legume-grass mixtures and also for topdressing old stands of legumes and permanent pastures.

Hill or row application of what are often called "starter fertilizers," is done to give the crop a good start at planting time. These starter fertilizers can be applied in the row or hill for such crops as corn, potatoes, and sugar beets or

they may be applied with small grain drills. This type of fertilizing is especially effective in providing a high level of available phosphate needed for root development of all crops, stooling of grain, and stalk growth of corn.

On most soils, two to three times as much fertilizer must be broadcast as applied in the row to give the same starter effect. However, the starter type of fertilization, particularly on corn, may not carry the crop through to a good harvest unless the general fertility level of the soil is high.

In most cases, recommendations for starter fertilizers are limited to not more than 150 pounds per acre of the common mixed fertilizers because of danger of burning the seed. This applies especially to fertilizers relatively high in nitrogen and potash. You can easily avoid this danger by adjusting the fertilizer attachment so as to leave a narrow band of soil between the seed and the fertilizer.

Sidedressing has most generally been recommended for nitrogen fertilizer on corn. Sidedressing is generally recommended not later than the second cultivation. It is not effective, however, in dry weather since rain is necessary to carry nitrogen down to the roots.

High-Lime and Alkali Soils

Soils high in lime are widespread throughout western and south central Minnesota. In addition, some soils, particularly in the Red River Valley, contain large amounts of gypsum or soluble salts. Farmers use the term "alkali soils" in describing all of these soils.

You can tell high-lime soils by the free lime at or near the surface. Their *p*H usually ranges from 7.4 to 8.2, and they will fizz when you drop dilute hydrochloric acid (muriatic) on the surface of the soil. The light-gray or almost white soils with snail shells in the surface that occur along the rims of slight hollows are high in lime.

Where large amounts of soluble salts are present they prevent plant growth.

Fig. 13. If you are bothered by "alkali spots" like these on this Red River Valley farm, use plenty of fertilizer and improve the drainage to get good crops.

In most of these soils there is also a high lime content so that the pH is high. Where gypsum is present alone the soils are not high in pH.

Since "alkali soils" are the result of poor drainage, you can improve crop growth on these areas only by furnishing proper drainage. To do this the first step is to remove surface water by installing drainage systems. If the layer of soil in the upper subsoil is tight, you may find a deep tillage implement helpful. Follow this with a heavy application of manure or residues and plant a deep-rooted legume.

Most of these soils are in need of available phosphate. Many of the "alkali soils" in south central Minnesota are also deficient in potash.

Irrigated Crops

The costs of irrigation are usually quite high. Thus, a good nutrient supply is especially important to prevent low fertility from limiting plant growth. Often more fertilizer is needed on irrigated land.

Unless you are careful to avoid overirrigation, nitrogen and some potash may be lost by leaching. Therefore, be sure to supply plenty of these plant foods during the growing season.

Fertilize irrigated crops the same as the crops listed in tables 2 to 12 using the rates recommended for the low soil-test levels. You may apply nitrogen through the irrigation water instead of the sidedressing indicated by the tables. You may get special recommendations from the Soil Testing Laboratory, University of Minnesota.

Fertilizers for Individual Crops

General guides for the use of fertilizer on individual crops are presented in the following tables. These recommendations are given on the basis of "high," "medium," and "low" soil test levels and in terms of pounds per acre of each of the plant foods: nitrogen, phosphate, and potash.

Note that a soil test for nitrogen has not yet been made in Minnesota, and laboratory reports for this plant food merely indicate how much organic matter is in the soil. This information, combined with information on any legume or manuring program in effect before the crop receiving nitrogen, is used as a guide for the nitrogen needs of the crop.

Recommendations are also made for two groups of soil based on texture of the surface soil. Group I consists of loams, silt loams, and clay loams; Group II includes loamy sands and sandy loams. The first group contains more clay and therefore can hold more plant nutrients than the second group. Furthermore, it can hold more water and thus can carry the crop through short dry periods.

The texture of the subsoil must also be considered in planning a fertilizer program. See the footnotes to the tables for individual crops.

The general fertilizer recommendations have been outlined in terms of pounds per acre of the individual plant foods so that the dealer can supply you from the grades of mixed fertilizers and the "straight goods" he normally handles. In most cases one or more of the fertilizer grades and ratios in table 1, page 10, are recommended. In some cases your dealer may not be able to supply exactly the amounts of plant food recommended. In this case try to get the closest possible combination.

It is especially important that the proper balance of plant foods are supplied if the crop is to receive any benefit from fertilizers. Be careful that the level of phosphate and potash in the soil is high enough to make the nitrogen effective.

Table 2. Guide to Fertilizer Use for Soybeans[1]

Soil texture group (2)	Soil test	Nitrogen (3)	Phosphate (4)	Potash (4)
		pounds of plant food to apply per acre		
Group 1—	High	.....	.....	.....
Loams and	Medium	10	20	20
finer	Low	40	40	60
Group 2—	High	.....	.....	.....
Sandy loams	Medium	20	20	20
and coarser	Low	40	40	60

(1) Soybeans seem to do best following crops such as corn that have been heavily fertilized. Response to fertilizers by soybeans is doubtful if soil tests show more than 15 pounds per acre of available phosphorus or 125 pounds of available potassium.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 20 to 28 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within 20 to 28 inches of the surface should be included in Group 1.

(3) Apply nitrogen in fields where soybeans follow a nonlegume crop or where manure has not been used. Soybeans should be inoculated; otherwise they may not have enough nitrogen. Even when inoculated, soybeans on acid soils suffer from a lack of nitrogen if no lime is applied. In such cases, sidedressing 40 to 60 pounds per acre of nitrogen will often increase yields.

(4) Since soybeans are susceptible to fertilizer damage, do not apply more than 150 pounds of fertilizer per acre in the row. The limit for nitrogen is 10 pounds per acre and for potash, 20 pounds per acre. If more is recommended, either broadcast the rest before planting or apply it as a sidedressing.

Example of Recommendations

Situation:	A silt loam soil with soybeans following corn; no manure. Soil tests show organic matter medium, phosphorus medium, and potassium medium. The soil is not acid.
Fertilizer needed according to soil tests:	10 pounds of nitrogen 20 pounds of phosphate 20 pounds of potash
Use these fertilizers to meet the needs:	125 pounds of 8-16-16 or 145 pounds of 7-14-14 per acre in the row at planting time.

Table 3. Guide to Fertilizer Use for Good Corn Yields[1]

Soil texture group (2)	Soil test	Nitrogen (3) First year after legumes or manure	Nitrogen (3) More than one year removed from legumes or manure	Phosphate (4)	Potash (4)
		pounds of plant food to apply per acre			
Group 1— Loams and finer	High	10	40	20	.....
	Medium	10	55	40	40
	Low	30	70	60	60
Group 2— Sandy loams and coarser	High	10	40	20	10
	Medium	15	50	30	40
	Low	20	60	40	60

(1) These recommendations are based on the following yields: Soils of Group 1—80 to 90 bushels per acre; soils of Group 2—60 to 65 bushels per acre. Recommended stand of corn is 16,000 plants per acre for the soils of Group 1 and 12,000 plants per acre for the soils of Group 2.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 24 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within 24 inches of the surface should be included in Group 1.

(3) If the legume-grass mixture is more than 50 per cent grass or if the legume is cut for hay just before it is plowed under, use the column headed "More than one year removed from legumes or manure." If you grew soybeans before the corn, use about 25 pounds per acre more nitrogen than is shown in the column headed "First year after legumes or manure." About 10 pounds per acre of nitrogen is the maximum recommended for application in the row as a starter and not more than 60 pounds for sidedressing. In cases where the total amount recommended is more than this, broadcast the rest before planting.

(4) Apply up to 40 pounds per acre of phosphate but not more than 20 pounds of potash in the row or hill at planting time. If recommendations are for more, broadcast the rest, then disk it in or plow it under. Even on soils with very high phosphate tests (up to 50 pounds of available phosphorus per acre), phosphate in the row usually benefits corn.

Example of Recommendations

Situation:	A silt loam soil with corn following corn and no manure. Soil tests show organic matter medium, phosphorus medium, and potassium high.
Fertilizer needed according to soil tests:	55 pounds of nitrogen 40 pounds of phosphate No potash
Use these fertilizers to meet the needs:	1. 125 pounds per acre of 8-32-0 or 85 pounds of 11-48-0 in the hill or row at planting time. 2. 140 pounds per acre 33-0-0 or 55 pounds 82-0-0 sidedressed at about second cultivation.

Table 4. Guide to Fertilizer Use for Extra Corn Yields[1]

Soil texture group (2)	Soil test	Nitrogen (3) First year after legumes or manure	Nitrogen (3) More than one year removed from legumes or manure	Phosphate (4)	Potash (4)
		pounds of plant food to apply per acre			
Group 1— Loams and finer	High	10	40	20	.....
	Medium	30	80	80	80
	Low	60	120	120	120
Group 2— Sandy loams and coarser	High	10	40	20	10
	Medium	20	60	40	40
	Low	30	100	60	80

(1) These recommendations are set to produce top yields provided there is plenty of moisture during the growing season. Top yields would be 100 bushels and above for the soils of Group 1 and about 75 to 90 bushels per acre for soils of Group 2. Recommended stands: 16,000 to 18,000 plants per acre on Group 1 soils and 12,000 to 14,000 for Group 2 soils.

(2) See footnote 2 of table 3.

(3) See footnote 3 of table 3.

(4) Apply up to 40 pounds per acre of phosphate but not more than 20 pounds of potash in the row or hill at planting time. If recommendations are for more, broadcast the rest, then disk it in or plow it under. On soils with very high phosphate tests (up to 50 pounds of available phosphorus per acre), phosphate in the row benefits corn. Soils in Group 2 with very low potash tests (less than 75 pounds per acre of available potassium) should receive 100 to 120 pounds per acre of potash for extra yields.

Example of Recommendations

Situation: A silt loam soil with corn following corn and no manure. Soil tests show organic matter medium, phosphorus low, and potassium medium.

Fertilizer needed according to soil tests:
80 pounds of nitrogen
120 pounds of phosphate
80 pounds of potash

Use these fertilizers to meet the needs:

1. 400 pounds per acre of 5-20-20 or 335 pounds 6-24-24 broadcast and disked in or plowed under before planting.
2. 125 pounds per acre of 8-32-0 or 170 pounds 6-24-0 in hill or row at planting time.
3. 150 pounds per acre 33-0-0 or 60 pounds 82-0-0 side-dressed at about second cultivation.

Table 5. Guide to Fertilizer Use for Small Grains and Flax Seeded Without Legumes[1]

Soil texture group (2)	Soil test	Nitrogen (3) After legumes, legume fallow, or black fallow	Nitrogen (3) After nonlegume crops	Phosphate	Potash
		pounds of plant food to apply per acre			
Group 1— Loams and finer	High	.....	10	20	.....
	Medium	.....	40	40	.....
	Low	.....	60	40	20
Group 2— Sandy loams and coarser	High	.....	20	20	.....
	Medium	.....	30	40	.....
	Low	.....	40	40	20

(1) The rates recommended are for application with a fertilizer attachment on the grain drill. If you broadcast the fertilizer, double the amounts of phosphate. Do not double the nitrogen or potash rates when broadcasting.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 18 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within about 18 inches of the surface should be included in Group 1.

(3) Do not put more than about 20 pounds of nitrogen down the grain drill spout at seeding time. When more nitrogen is indicated, broadcast it before seeding, then disk it in or plow it under.

Example of Recommendations

Situation: A silty clay loam soil with barley following wheat. Soil tests show organic matter medium, phosphorus low, and potassium high.

Fertilizer needed according to soil tests:
40 pounds of nitrogen
40 pounds of phosphate
No potash

Use these fertilizers to meet the needs:
1. 90 pounds per acre of 33-0-0 or 150 pounds of 20-0-0 broadcast and disked in or plowed under before seeding.
2. 125 pounds per acre of 8-32-0 or 85 pounds of 11-48-0 with the grain drill at seeding time.

Table 6. Guide to Fertilizer Use for Small Grains and Flax Seeded with Legumes or Legume-Grass Mixtures(1)

Soil texture group (2)	Soil test	Nitrogen: After legumes, legume fallow, or black fallow	Nitrogen: After nonlegume crops	Phosphate	Potash
		pounds of plant food to apply per acre			
Group 1—	High	.....	10	20	.....
Loams and	Medium	.....	20	40	40
finer	Low	.....	40	80	80
Group 2—	High	.....	10	20	.....
Sandy loams	Medium	.....	20	40	40
and coarser	Low	.....	40	80	80

(1) Fertilizer applications consisting of up to 20 pounds of nitrogen and 40 pounds of potash may be applied safely with a fertilizer attachment on the grain drill. Anything over those amounts should be broadcast and disked in or plowed under before seeding.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 18 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within about 18 inches of the surface should be included in Group 1.

Example of Recommendations

Situation:	A loam soil with oats and a legume-grass mixture following corn. Soil tests show organic matter low, phosphorus low, and potassium medium.
Fertilizer needed according to soil tests:	40 pounds of nitrogen 80 pounds of phosphate 40 pounds of potash
Use these fertilizers to meet the needs:	400 pounds per acre of 10-20-10 or 335 pounds of 12-24-12 broadcast and disked in or plowed under before seeding.

Table 7. Guide to Fertilizer Use for Legumes or Legume-Grass Mixtures Seeded Without a Companion Crop[1]

Soil texture group (2)	Soil test	Nitrogen	Phosphate	Potash
		pounds of plant food to apply per acre		
Group 1—	High	10	20	.....
Loams and	Medium	20	40	40
finer	Low	30	80	80
Group 2—	High	10	40	.....
Sandy loams	Medium	20	60	40
and coarser	Low	30	80	80

(1) The rates recommended are for application with a fertilizer attachment on a seeder. If you broadcast the fertilizer, double the amounts of phosphate. Apply up to 40 pounds per acre of phosphate or potash with a fertilizer attachment; broadcast the rest and disk it in or plow it under.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 18 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within about 18 inches of the surface should be included in Group 1.

Example of Recommendations

Situation:	A loamy sand soil. Soil tests show organic matter medium, phosphorus high, and potassium medium.
Fertilizer needed according to soil tests:	20 pounds of nitrogen 40 pounds of phosphate 40 pounds of potash
Use these fertilizers to meet the needs:	250 pounds per acre 8-16-16 or 325 pounds 6-12-12 broadcast and plowed under or disked in before seeding.

Table 8. Guide to Fertilizer Use for Topdressing Established Stands of Legumes or Legume-Grass Mixtures[1]

Soil texture group (2)	Soil test	Phosphate	Potash
		pounds of plant food to apply per acre	
Group 1—	High	.....	.....
Loams and	Medium	40	40
finer	Low	60	60
Group 2—	High	.....	.....
Sandy loams	Medium	30	30
and coarser	Low	50	50

(1) Apply topdressing annually as a broadcast treatment. Nitrogen is not recommended for established stands of legumes or legume-grass mixtures if the amount of grass in the mixture is less than 50 per cent and the hay is to be taken from the field. If it is the last year before plowing the sod and the field is to be pastured, use nitrogen. Apply 30 pounds per acre of nitrogen broadcast if the soil organic matter is medium and 50 pounds if it is low. In this case, do not apply phosphate and potash unless soil tests are low. The nitrogen will stimulate the growth of grass in the legume-grass mixture.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 18 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within about 18 inches of the surface should be included in Group 1.

Example of Recommendations

Situation 1: A silty clay soil. Soil tests show organic matter medium, phosphorus medium, potassium medium.

Fertilizer needed according to soil tests: No nitrogen, 40 pounds of phosphate, 40 pounds of potash

Use these fertilizers to meet the needs: 200 pounds per acre 0-20-20 or 135 pounds of 0-30-30 topdressed.

Situation 2: A silty clay soil. Soil tests show organic matter medium, phosphorus medium, potassium medium. Last year of sod, more than 50 per cent grass, to be pastured.

Fertilizer needed according to soil tests: 30 pounds of nitrogen, No phosphate, No potash

Use these fertilizers to meet the needs: 150 pounds per acre 20-0-0 or 90 pounds 33-0-0 topdressed.

Table 9. Guide to Fertilizer Use for Permanent Grass Pastures(1)

Soil texture group (2)	Soil test	Nitrogen (3)	Phosphate	Potash
		pounds of plant food to apply per acre		
Group 1—	High	30	20	.....
Loams and	Medium	60	40	20
finer	Low	100	60	30
Group 2—	High	30	20	.....
Sandy loams	Medium	50	40	20
and coarser	Low	80	60	30

(1) Topdress the phosphate and potash in the fall if erosion is no problem or as early as possible in the spring.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 18 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within about 18 inches of the surface should be included in Group 1.

(3) In the northern half of Minnesota, you can extend grazing periods by splitting the nitrogen applications. Apply half in the fall or early spring and half in July. In the southern half of Minnesota, there is generally no advantage in splitting the nitrogen application because high temperatures and lack of moisture prevent the growth of the grass. Apply all the nitrogen in the fall or in early spring.

Example of Recommendations

Situation: A silt loam soil. Soil tests show organic matter medium, phosphorus low, and potassium low.

Fertilizer needed according to soil tests:
60 pounds of nitrogen
60 pounds of phosphate
30 pounds of potash

Use these fertilizers to meet the needs:
300 pounds of 10-20-10 plus 90 pounds of 33-0-0 broadcast.

OR

200 pounds per acre of 0-30-15 plus 180 pounds 33-0-0 broadcast.

Table 10. Guide to Fertilizer Use for Potatoes(1)

Soil texture group (2)	Soil test	Nitrogen (3) First year after legumes or manure	Nitrogen (3) More than one year removed from legumes or manure	Phosphate	Potash
		pounds of plant food to apply per acre			
Group 1— Loams and finer	High	20	40	40	40
	Medium	40	60	80	80
	Low	60	100	120	120
Group 2— Sandy loams and coarser	High	20	40	40	40
	Medium	30	60	80	80
	Low	40	80	120	120

(1) Potatoes need plenty of plant food. The recommendations in this table are for *nonirrigated potatoes.* You can get special recommendations for irrigated potatoes from the Department of Soils, University of Minnesota.
Starter fertilizers containing phosphate and potash should be limited to 250 pounds per acre or less in the row at planting time. Do not apply more than about 40 pounds per acre of nitrogen in the row at planting time. If you need more nitrogen, either broadcast it before planting or sidedress it shortly after the potato plants come up. Soils which are medium or low in phosphorus or potassium usually need fertilizer broadcast and disked in or plowed under before planting.

(2) Fine-textured surface soils with coarse-textured, droughty subsoils within about 24 inches of the surface should be included in Group 2. Coarse-textured surface soils with fine-textured subsoils within about 24 inches of the surface should be included in Group 1.

(3) If last year's legume stand was poor or more than half the vegetation was grass, use the column headed "More than one year removed from legumes or manure" for nitrogen recommendations.

Example of Recommendations

Situation:	A silt soil with potatoes after red clover. Soil tests show organic matter medium, phosphorus medium, potassium medium.
Fertilizer needed according to soil tests:	40 pounds of nitrogen 80 pounds of phosphate 80 pounds of potash
Use these fertilizers to meet the needs:	300 pounds per acre of 8-16-16 broadcast before planting plus 200 pounds 8-16-16 in the row at planting time.

Table 11. Guide to Fertilizer Use for Sugar Beets[1]

Soil texture group (2)	Soil test	Nitrogen (3) After legumes, legume fallow, or black fallow	Nitrogen (3) After nonlegume crops	Phosphate	Potash
		pounds of plant food to apply per acre			
Group 1— Loams and finer	High	10	30	40	.....
	Medium	20	60	60	40
	Low	30	80	80	80

(1) Fertilizers may injure germinating beets if applied at more than about 150 pounds per acre in the row. Where more fertilizer is recommended, broadcast this extra amount and work it into the soil before planting.

(2) Sandy soils are not recommended for sugar beets.

(3) If last year's legume stand was poor or more than half the vegetation was grass, use the column headed "After nonlegume crops" for nitrogen recommendations.

Example of Recommendations

Situation:	A silty clay loam soil with sugar beets following sweetclover fallow. Soil tests show organic matter medium, phosphorus medium, potassium medium.
Fertilizer needed according to soil tests:	20 pounds of nitrogen 60 pounds of phosphate 40 pounds of potash
Use these fertilizers to meet the needs:	1. 200 pounds per acre of 5-20-20 or 250 pounds of 4-16-16 broadcast before planting. 2. 65 pounds per acre of 15-30-0 or 100 pounds per acre of 10-20-0 in the row at planting time.

Table 12. Guide to Fertilizer Use for Truck and Canning Crops[1]

Crop	Soil test	Nitrogen (2) First year after legumes or manure	Nitrogen (2) More than one year removed from legumes or manure	Phosphate (3)	Potash (4)
		pounds of plant food to apply per acre			
Sweet corn	High	.....	15	20	10
	Medium	10	40	40	40
	Low	30	70	60	60
Peas and string beans	High	.....	.....	20	.....
	Medium	.....	10	40	40
	Low	.....	20	60	60
Root crops (5)	Medium (7)	10	40	80	80
Tomatoes	Medium (7)	20	80	120	80
Onions	Medium (7)	20	80	80	80
Leafy vegetables (6)	Medium (7)	40	100	60	60

(1) For row crops, limit row application of fertilizer to about 175 pounds per acre. If recommendations are for more phosphate and potash, broadcast the rest and disk it in or plow it under. If more nitrogen is needed, it may be broadcast before planting or applied as a sidedressing. If you are planning to grow vegetables on peat soils, see the recommendations in table 16 on page 32.

(2) If soybeans were the last crop, apply about 25 pounds per acre more nitrogen than is shown under the column headed "First year after legumes or manure." If the legume-grass mixture was more than 50 per cent grass, use the column headed "More than one year removed from legumes or manure."

(3) Sweet corn should have some phosphate in the row—about 20 pounds per acre even though the soil test runs "very high" (up to 50 pounds per acre of available phosphorus). Fertilizer needs of sweet corn probably run lower on Clarion-Webster soils than on soils farther east in the state.

(4) When soil tests for potassium are "very low" (less than 75 pounds of available potassium per acre) potash rates for sweet corn and peas should be increased by 20 to 40 pounds per acre above those recommended when the soil tests run "low."

(5) Root crops include beets, carrots, parsnips, radishes, and similar crops.

(6) Leafy vegetables include lettuce, cabbage, broccoli, cauliflower, spinach, and similar crops.

(7) If soil tests are "low," use about 50 per cent more plant food than is shown here. If tests are "high," use about 50 per cent less.

Table 13. Guide to Fertilizer Use for Home Gardens[1]

Kind of vegetable (2)	Examples of fertilizer materials (3)	Rate per 100 square feet at these fertility levels		
		High	Medium	Low
All	Manure or compost	2 bushels	3 bushels	4 bushels
Root	4-12-4, 5-20-20, 6-24-12	2 pounds	3 pounds	4 pounds
Leafy	8-16-16, 8-8-6, 16-20-0	2 pounds	3 pounds	4 pounds

(1) Other materials on the market for gardens are equally as good as those listed. When using commercial fertilizer, spread it on top of the plowed or spaded soil before planting and work it to a depth of 1 to 2 inches with a hoe, rake, or other tool.

(2) Root vegetables include such vegetables as carrots, radishes, beets, onions, turnips, and parsnips. Leafy vegetables include lettuce, cabbage, broccoli, cauliflower, spinach.

(3) Use the commercial fertilizer in addition to the manure or compost recommended. For root crops apply less nitrogen than for leafy vegetables to avoid too much top growth.
Well rotted manure is one of the best garden conditioners. It supplies not only organic matter, which every garden soil needs, but also some nitrogen and potash. However, it is low in phosphate. Apply manure or compost annually to all gardens, spading them or plowing them into the soil before planting.

Table 14. Guide to Fertilizer Use for Fruit Crops

SMALL FRUITS

Strawberries and raspberries

a. Broadcast 400 to 500 pounds per acre of a complete fertilizer in the spring when preparing the soil for planting. (1)
b. Sidedress 40 pounds per acre of nitrogen in the spring of fruiting years.

TREE FRUITS

Apples, plums, and cherries

a. Broadcast annually 300 to 500 pounds per acre of a complete fertilizer in the orchard and disk it in.(1)
b. Broadcast 1/6 pound of nitrogen per inch of tree diameter each spring. (2)

(1) The complete fertilizer (examples: 3-18-9, 6-12-12, 4-16-16, 10-10-10) will vary in grade according to the soil tests for phosphorus and potassium.

(2) Use ammonium nitrate, urea, or ammonium sulfate. Here is an example of application: An apple tree with a trunk 10 inches in diameter would require 1⅔ pounds of nitrogen (10 x 1/6). This could be supplied by applying 3¾ pounds of urea or 5 pounds of ammonium nitrate or 8¼ pounds of ammonium sulfate. Broadcast the fertilizer the same distance away from the trunk as the tips of the branches.

Table 15. Guide to Fertilizer Use for Lawns(1)

Lawn condition (2)	Suggested fertilizer (3)
1. In poor tilth, either quite sandy or heavy and compacted or a new lawn being prepared for sodding or seeding	Well rotted manure, compost, black soil
2. In need of nitrogen primarily	Soybean meal, ammonium nitrate, ammonium sulfate, 6-2-0
3. In need of complete fertilizer	4-12-4, 5-10-5, 8-8-6, 10-10-10, 6-24-12, 8-16-16, 5-20-20

(1) Additional information on starting and caring for lawns may be obtained from University of Minnesota Agricultural Extension Folder 165, *The Home Lawn.*

(2) Lawns respond to fertilizers high in nitrogen. Spread any one of the lawn fertilizers in no. 3 early in the spring and follow this with a nitrogen fertilizer (one of those under no. 2) in late July or August. Spread the fertilizer broadcast over the lawn and then wash it in with the hose.
In many cases weeds are responsible for the poor appearance of lawns. You may improve your lawn by using a chemical weed killer along with good seed, fertilizer, and black soil as a topdressing.

(3) Fertilizer manufacturers and dealers have other grades of lawn fertilizers that may be applied at the rates shown here.

- Apply manure or compost in the fall at the rate of about 3 bushels per 100 square feet (10 feet x 10 feet). In the spring remove the coarse material from the lawn. Apply black dirt early in the spring. A covering of ¼ to ½ inch would be enough for most lawns.
- Apply soybean meal or 6-2-0 at about 4 pounds per 100 square feet. These materials will give a fairly slow growth. Apply ammonium nitrate at ⅓ to ½ pound per 100 square feet and ammonium sulfate at ½ to ¾ pound. These two materials give a very rapid growth.
- Apply the fertilizers in no. 3 at about 3 pounds per 100 square feet.

Table 16. Guide to Fertilizer Use for Peat Soils[1]

Crops (2)	Nitrogen	Phosphate soil test			Potash soil test		
		Low	Medium	High	Low	Medium	High
		pounds of plant food to apply per acre					
Corn	15	80	40		100	60	
Red and alsike clover		80	60	40	100	60	40
Small grain		40	20		40	20	
Permanent pasture		40	20		60	20	
Potatoes	30	80	60	40	160	80	40
Onions, carrots, celery, lettuce, and other truck crops	40	120	80	40	200	160	80

(1) Peat soils may be low in both phosphate and potash, and fertilizers for these soils should make up for these lacks. Sometimes, in spite of the large amount of organic matter they contain, peats can use some nitrogen fertilizer. This generally happens on newly broken or raw peat or on peat that has been farmed heavily for many years. Add a little nitrogen under these conditions to help break down the peat and release the nitrogen.

(2) Apply 125 to 150 pounds per acre of starter fertilizer to corn and potatoes along the row or hill at planting time. If more fertilizer is recommended, broadcast it and work it in before planting.

Deep-rooted legumes such as alfalfa or sweetclover are not good crops for peat soils. The fertilizer rates recommended for red and alsike clover are intended for broadcasting in order to establish new seedings. For annual top-dressing after the legume is established, use half the rates shown in the table. The rates for small grains are for seeding these grains without legumes. Apply the fertilizer with a fertilizer attachment on the grain drill. If broadcast, the rates given in the table should be doubled. Wheat is not recommended on peat soils, and flax does not do well on recently burned peat.

Recommended rates for truck crops are intended for broadcasting before seeding.

Example of Recommendations

Situation:	Corn on peat. Soil tests show phosphorus medium and potassium low.
Fertilizer needed according to soil tests:	15 pounds of nitrogen 40 pounds of phosphate 100 pounds of potash
Use these fertilizers to meet the needs:	1. 300 pounds per acre of 3-9-27 or 225 pounds of 4-12-36 broadcast and disked in before planting. 2. 125 pounds per acre of 3-9-18 or 95 pounds of 4-12-24 in the row at planting time.

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