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Going to Use Fertilizer?

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Above is an aerial view of some of the soil fertility and crop rotation plots on Agronomy Farm, Ames.

By W. H. PIERRE and H. R. MELDRUM

For every ton of commercial fertilizer that Iowa farmers used 6 years ago, they are now using 9 tons—a nine times increase in 6 years. It's likely that still more fertilizer will be used in the coming years.

We need to make sure that we know when to use fertilizer, what the fertilizer needs of our soils and crops are. We need to know and understand commercial fertilizers if we are to get all that we can from our fertilizer dollars.

Most Iowa farmers know that commercial fertilizers are not a substitute for the use of lime, contouring, manure and good crop rotations. Instead of being a replacement, commercial fertilizer is a supplement to manure and soil-building crops such as clovers and alfalfa. By following these other good soil-building practices, we can then make the best use of commercial fertilizer.

The Iowa Station for many years has been testing commercial fertilizers on the leading Iowa soils. Most of these tests have been in cooperation with Iowa farmers. From these tests we have found that these things in general are true:

1. The need for fertilizers varies considerably in the different general soil areas of the state. In general, the greatest response is in Area II in northeastern Iowa and the least response in Area VI in western Iowa. (See map.)

2. Most of the nitrogen which crops need can be supplied most economically by growing legumes such as clovers and alfalfa. In many cases, however, nitrogen fertilizers can be used to supplement the “home-grown” nitrogen.

3. Soils which are eroded, or where little manure has been used or few legume crops grown, are low in nitrogen. Nitrogen fertilizer added to these may show a profit for corn and oats.

4. Phosphate fertilizers are needed in most soil areas of the state, especially for clovers and alfalfa.

5. Potassium fertilizers give marked increases in crop yields on the high-lime or so-called “alkali” soils of northern Iowa. (Area I on map.)

6. Mixed fertilizers containing potassium are needed mostly for corn, although on some soils legume crops and oats have given yield increases from them.

7. The best way to apply fertilizer for legume crops and small grains is with a grain-fertilizer drill at the time of seeding.

8. The best method of applying fertilizer to corn is in the hill or row at planting time with a fertilizer attachment on the planter.

Know Your Fertilizers?

As far as the plant or the crop is concerned, commercial fertilizers may differ as much as sugar and beefsteak. We need to know fertilizers to make the right selection for the crop and soil.

Three different plant foods are sold in commercial fertilizers—nitrogen, phosphorus and potassium. All of these elements are found in the soil, but sometimes there is too small an amount in a form that the plant can use to get the best growth and yield. In that case we can often add commercial fertilizer of the right kind with profit. Each of the three elements has a certain job to do in producing the crop. One cannot substitute for the other. No amount of
phosphate added will correct a soil that is too low in potassium or nitrogen.

**Nitrogen.** This is the element crops need in largest quantity. Plenty of nitrogen in the soil gives the plants a dark green color and helps them make rapid growth. A lack of it causes plants to be spindly and light green in color—often yellow.

The most practical way of supplying nitrogen to plants usually is through the growth of legumes such as clovers and alfalfa. These crops, if inoculated, can get their nitrogen from the air through the bacteria in the root nodules. They also pack an abundant supply of nitrogen in their roots for the use of other crops that follow. But we are finding that nitrogen fertilizers are sometimes needed as a supplement to the nitrogen supplied by legumes and manure.

**Phosphorus.** This is the element used in largest quantities in fertilizers. A lack of phosphorus often gives plants a slightly purplish to light green color and results in poor growth. Clovers and alfalfa often show the largest yield increases and improved quality from phosphorus fertilizers.

**Potassium.** Soils contain relatively large amounts of potassium, but only a small portion of the total becomes available to the crops each year. Some Iowa soils are low in potassium and give good response to additions of potassium fertilizer, especially for corn. If a fertilizer contains only one of the three fertilizer elements it is usually referred to by name. For example, the most common fertilizers sold in Iowa containing only phosphorus are superphosphate and rock phosphate; the most common fertilizers supplying only nitrogen are ammonium sulfate, ammonium nitrate and cyanamid; and the most common fertilizer supplying potassium is muriate of potash.

Fertilizers are often mixed and may contain any two or all three of the fertilizer elements. These are called mixed fertilizers. Fertilizers are bought on the basis of the plant food they contain. For example, two of the common fertilizer grades sold in Iowa are 0-20-10 and 3-12-12.

The figures in each case show the analysis of the fertilizers. The first figure refers to the percentage of nitrogen, the second to phosphorus (expressed as phosphoric acid), and the third to potassium (expressed as potash). This means, then, that an 0-20-10 fertilizer contains no nitrogen, but 20 percent phosphoric acid and 10 percent potash.

**Soil Areas Differ**

Just as soils differ greatly in appearance and productivity, so do they also differ in the kind of fertilizers they need. This is the main reason why the amounts of fertilizer used by farmers in the different soil areas are so different.

In the general soil area map, page 12, we show the amount of fertilizer used in each county in 1944. Each dot on this map represents 100 tons of fertilizer. The soil area which uses the most fertilizer is Area II, located in northeastern Iowa. The main soils of this area are the Carrington, Floyd and Clyde. Experiments have shown that these soils have in general given the greatest response to fertilizers of any soils in the state.

Next in order in amounts of fertilizer used in 1944 are Area I and Area V, respectively. The general soil area that has used the least fertilizers is Area VI, which is located along the western side of the state and consists largely of Marshall, Monona, Marcus and Lamoure soils. This is the area where the least increase in crop yields has been obtained from the use of phosphate and practically no increase from potassium fertilizers. Recent experiments have shown, however, that where little manure is used or legumes grown, the upland soils of western Iowa are usually low in nitrogen.

**General Recommendations**

As a guide to efficient fertilizer use, general fertilizer recommendations have been developed by soil areas for the major field crops grown in Iowa. (See table.) These recommendations are based on the results of many field experiments and on studies of the chemical properties of the various soils.

**Crops Differ**

This fertilizer recommendation table shows the needs of various crops are quite different. Let us examine these briefly.

**Clovers and Alfalfa:** These leguminous crops form the "core" of the crop rotation, for they add organic matter to the soil and supply nitrogen to the crops that follow. On soils that are low in plant food, therefore, they should be well fertilized. They are helped most by phosphate fertilizers,
although on soils low in potassium they also respond to potassium.

Our field experiments show that the greatest response to phosphate fertilizers on clover and alfalfa is in Areas I, II, and V (see map), while the smallest response is in Area VI, in western Iowa.

**Small Grains:** Oats ordinarily show less increase in yield to phosphate and potassium than do clover and alfalfa. Like the legumes, small grain crops respond to phosphate fertilizers on many of our soils but to potassium fertilizers on relatively few.

Unlike the legume crops, however, oats and other small grains must get their nitrogen from the soil. And recent experiments with nitrogen fertilizers show that on many soils the small grain crops respond well to nitrogen fertilizers. This is especially true (1) in cool, wet seasons, (2) on soils that are eroded and (3) on soils that have had little manure or that have not grown legume crops in the previous 2 years.

Under such conditions nitrogen fertilizers in amounts that will supply 20 to 40 pounds of nitrogen to the acre are likely to be profitable. Larger amounts than this may cause the small grain to lodge or may so increase its growth as to ruin the stand of the legume seeding, especially in dry seasons.

The most efficient method of applying fertilizer for small grain and legume seedings is with a combination grain-fertilizer drill at the time of seeding. This distributes the fertilizer much more evenly than when it is broadcast. Moreover, the fertilizer is placed deep enough into the soil so that it is near the plant roots.

Top-dressing of phosphate fertilizers for small grains after the crop is up is not recommended, for phosphates move down into the soil very slowly. If you broadcast phosphate, distribute as evenly as possible, then thoroughly disk it in. Top-dressing of nitrogen fertilizers is satisfactory provided it is done within 3 weeks or so after seeding.

**Corn:** Unlike small grain and legumes, corn often responds as much to potassium as to phosphate fertilizers. This is especially true on the level, slowly-drained soils of Areas I, II and V (see map) where a phosphate-potash fertilizer such as 0-20-20 is often recommended. In general the soils of Area VI (in western Iowa) have shown little response to potassium, while the soils of Areas III and IV are intermediate.

The most efficient method of applying about 100 to 200 pounds per acre of phosphate or mixed fertilizers to corn is in the hill or row at the time of planting with a fertilizer attachment to the corn planter. Where broadcast about twice as much is needed.

In cool seasons or on soils where a quick start of the corn is important, a mixed fertilizer containing nitrogen, such as a 3-12-12, may be used at planting time. The small amount of nitrogen contained in 150 to 200 pounds of such a fertilizer applied in the hill or row, however, supplies only a small part of the needs of a 75-bushel corn crop.

When corn follows legume sod or manuring, the nitrogen needs of the crop are usually met. But much corn, in the past few years especially, has been grown on fields that have not been in legumes for several years and have had little or no manure. Under such conditions we have got yield increases averaging about 11 bushels to the acre from using nitrogen fertilizers that supply 40 pounds of nitrogen to the acre. Equally satisfactory results have been obtained from plowing the nitrogen fertilizer under in the spring or by applying it as a side-dressing in a furrow along the corn row after the corn is up.

**Soils Differ Within Areas**

In addition to the major differences in fertilizer needs among the five general soil areas, the soils within any soil area also differ markedly in their fertilizer needs. Part of this is due to differences in soil types while part is due to differences in past management. How then can the recommendations be applied more specifically to any given soil or field? Since fertilizer experiments cannot be carried on by farmers on every field, the best method is to have a chemical test made of the soil.

Information obtained from such tests together with other information concerning the kind of soil and its past management makes possible much more accurate fertilizer recommendations. You can also learn more about the fertilizer needs of your soil by leaving an unfertilized strip in the field wherever you use fertilizer and by checking the results obtained.

*Information on how you can get your soils tested is available at the office of your County Extension Director.*
If we are to get the best results from fertilizers, we should not consider them a “cure-all.” The use of fertilizers forms only a part of a sound soil management program; it is not a substitute for other important practices such as liming, the frequent growth of legumes in the rotation, growing crops on the contour and proper use of farm manures.

Surely there is little benefit from using fertilizers if the soil is allowed to erode or wash away with every heavy rain. And there is little point in buying commercial fertilizer and at the same time allowing the home-produced fertilizer on the farm—the manure—go to waste. In other words, fertilizers should be used not as a substitute for, but as a supplement to, other good soil management practices.

### General Fertilizer Recommendations for Field Crops in Iowa

<table>
<thead>
<tr>
<th>Crop</th>
<th>Soil area (See map)</th>
<th>Kind of soil</th>
<th>Fertilizer grade (1)</th>
<th>Rate and method of application (lbs./acre)</th>
<th>Drilled or broadcast</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In hill or row</td>
</tr>
<tr>
<td>CORN</td>
<td>Areas I-II-V</td>
<td>Well-drained soils (no tile needed)</td>
<td>0-20-0 200</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slowly-drained soils or sandy soils</td>
<td>0-20-10 200</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High-lime or so-called “alkali” soils (mainly in Area I)</td>
<td>0-10-20 300</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Areas III-IV</td>
<td>Peat and muck soils (Mainly in Area I)</td>
<td>0-0-60 150</td>
<td>75 (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>All soils except sandy soil</td>
<td>0-20-20 200</td>
<td>100</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>4-16-0 250</td>
<td>125</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>0-20-10 200</td>
<td>100</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>2-12-6 330</td>
<td>165</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area VI</td>
<td>Certain soils</td>
<td>Eroded soils or soils without legumes or manure in past 2 years</td>
<td>0-20-0 200</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-16-0 250</td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OATS and CLOVER</td>
<td>Areas I-II-V</td>
<td>Typical well-drained soils</td>
<td>0-20-0 (3) 200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEEDING (3)</td>
<td></td>
<td>Slowly drained, sandy or high lime soils</td>
<td>4-16-0 250</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Areas III-IV-V</td>
<td>All soils except sandy soils</td>
<td>0-20-0 (3) 200</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>4-16-0 250</td>
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<tr>
<td></td>
<td></td>
<td>Sandy soils</td>
<td>0-20-10 200</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>All areas (in addition to fertilizers recommended above)</td>
<td>All areas (in addition to fertilizers recommended above)</td>
<td>0-20-0 200</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-16-0 250</td>
<td>125</td>
<td></td>
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<tr>
<td>PASTURE</td>
<td>All areas</td>
<td>Soils without legumes or without manure within past 2 years, Where legumes are seeded</td>
<td>0-20-0 (3) 200</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grass sod on soils needing nitrogen</td>
<td>20-0-0 300</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>SOYBEANS</td>
<td>All areas</td>
<td>Sandy, high-lime or low producing soils</td>
<td>0-20-10 200</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0-20-20 200</td>
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</tbody>
</table>

*These recommendations are based on the results obtained from the use of fertilizers in field experiment. They should be modified on the basis of more specific information about the soil. Where manure has been used less potassium is needed; on 0-20-0 fertilizers will usually be sufficient. Soil tests and "hunger signs" give added information which will modify these general recommendations. (1) The fertilizer grades listed are those most likely to be obtained in 1946. High analysis grades cost less per unit of plant food and should be used where available. When grades of similar ratio are substituted for those suggested, adjust the rate per acre so as to add the same amount of plant food. (2) For side-dressing with cultivator attachment on alkaline areas. (3) Rock phosphate may be used for legume seedings in place of superphosphate in Areas II, III, IV and V. The recommended rate is 500 to 600 pounds per acre per rotation. (4) Although a top-dressing cannot take the place of fertilizer applied at the time of seeding alfalfa, it is recommended on neutral or well-tilled soils where alfalfa is making very poor growth due to lack of available phosphorus. At least 300 pounds per acre of 0-20-0 should be used in such cases.

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