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Improved Soil Testing Is Here

For several years now we have been making the January issue of the Reporter carry a good deal of agronomy information. It has seemed that the crops and soils material needed to be in your hands at this time so that you could make the most of it.

Iowa State College in January this year opened a new and improved service to Iowa farmers in soil testing. Research in recent years done by the Iowa Station with soil on which there were also crop tests with various fertilizers has permitted improving the chemical tests made in the laboratory.

Previously most of the tests made here at Iowa State College have been for lime石头 requirements. Now we are in position to give much more accurate tests for the soil's needs for phosphorus and potassium. Iowa farmers are buying and using far more commercial fertilizer each year. It is highly important that they buy and use the fertilizer that is needed on each soil and for various crops.

The present plans of the Agronomy Department are to give a report to a farmer on his soil sample within 2 weeks after his sample reaches here to be tested. This report will give definite recommendations on what fertilizer to use.

Those of you who would like to use this new soil testing service can obtain information sheets to submit with your sample from the county extension director, or you can obtain the sheets by writing to Iowa State College, Ames. It is highly important that you get these information sheets and fill them out. Interpretation of these tests and what fertilizer to use depends largely on the information submitted on the sheets.

It is also important that you take the samples properly. You can get information on how to do this from your county extension director or from the College.

This new service on soil testing is being sponsored jointly by the Extension Service and Experiment Station of Iowa State College. The charge for tests ranges from 25 cents to one dollar.

Want the Next Reporter?

Once each year we have to ask you whether you want to get the next and the following issues of Farm Science Reporter. Uncle Sam rules that we must do this with our free mailing list.

So if you have received the Farm Science Reporter for a year (that would be 4 issues) you'd better look in this one for the little card, fill it out carefully, put a 1-cent stamp on it and get it right in the mail back to us if you want the next Reporter. Those who do not tell us they want to continue receiving the Reporter are dropped from the mailing list.
Fertilizer May Boost Oat Yield 20 Bushels An Acre, Tests Show

WE CAN PROFITABLY use commercial fertilizer for oats on many Iowa farms.

That is the conclusion we have reached from tests made by the Iowa Agricultural Experiment Station in the past 2 years. In 1944 and 1945 we had over 30 field experiments with about 1,500 small plots. These were scattered over most of Iowa’s major soil areas.

In noting the good results one should remember that in both 1944 and 1945 the early part of the growing season for oats was cool and moist. Under these conditions nitrogen fertilizer does its best job. We must keep that in mind when we start laying down our dollars to buy commercial fertilizer for Iowa’s second most important crop—oats. In a dry, warm spring, the results might not be so satisfactory.

The results of the last 2 years’ tests show that:

1. Many Iowa soils do not have enough available nitrogen in them to produce the best crop.

2. Certain fertilizers on some of the soils brought increases of over 20 bushels an acre.

3. Some soils do not get the boost from phosphate or potash which they would if they had enough nitrogen in them.

4. Phosphate fertilizer increased oat yields on many fields. The increase from phosphate varied with the different soils studied.

5. Potash increased yields less than nitrogen and phosphate for the state as a whole. Potash gave no increase in western Iowa.

Set-up and Results

In these fertilizer tests, we used nitrogen, phosphate and potash alone on some plots. This gave us a chance to learn which of the fertilizer materials the different soils needed for oats. Then on some plots we used various combinations of nitrogen, phosphorus and potash. This gave a check on the combination that worked best.

The results of these tests are shown in the accompanying table.

The yields for 1944 are averages of 7 experiments, and those for 1945 are averages of 22. We used the various fertilizers at these rates: Nitrogen 20 pounds to the acre in 1944 and 40 pounds in 1945; phosphate 40 pounds to the acre and potash 20. It takes 100 pounds of ammonium sulfate or 20-0-0 fertilizer to put on 20 pounds of nitrogen; 200 pounds to put on 40 pounds of nitrogen. For the phosphate and potash, it would take 200 pounds of 0-20-10. All fertilizer was applied broadcast and disked into the soil before sowing the oats.

The average yields in the test show that in these two years nitrogen increased yields most, phosphate next and potash least. In 1944, 20 pounds of nitrogen to the acre (100 pounds of ammo-

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Oats on the left received nitrogen and phosphate in a mixed fertilizer containing 40 pounds each of nitrogen and phosphate per acre. Oats on the right received no fertilizer. This experiment was on eroded Knox soil in western Iowa. This was on county farm of Crawford County, 1945.

By L. B. NELSON, H. R. MELDRUM, KIRK LAWTON

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Average increase in bushels of oats per acre from use of nitrogen, phosphate and potash during 1944 and 1945.

<table>
<thead>
<tr>
<th>Fertilizer*</th>
<th>1944 Bushels increase (7 experiments)</th>
<th>1945 Bushels increase (22 experiments)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>7.9</td>
<td>15.7</td>
</tr>
<tr>
<td>Phosphate</td>
<td>3.4</td>
<td>3.0</td>
</tr>
<tr>
<td>Potash</td>
<td>2.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Phosphate-potash</td>
<td>3.9</td>
<td>3.2</td>
</tr>
<tr>
<td>Nitrogen-phosphate</td>
<td>10.6</td>
<td>24.4</td>
</tr>
<tr>
<td>Nitrogen-potash</td>
<td>8.0</td>
<td>18.6</td>
</tr>
<tr>
<td>Nitrogen-phosphate-potash</td>
<td>11.2</td>
<td>25.4</td>
</tr>
</tbody>
</table>

*20 lbs. nitrogen were used in 1944 and 40 lbs. in 1945.
A good way to apply fertilizer for oats when the land can be properly prepared is with a combination grain-fertilizer drill such as this one. Nitrogen sulfate or 20-0-0) boosted the yield about 8 bushels. In 1945 when we doubled the amount of nitrogen in the tests, the yield increased 20 bushels to the acre, on the average. In both years phosphate increased the yield 6.6 bushels an acre when nitrogen was also applied. Phosphate alone, potash alone or phosphate and potash together did not increase the yield more than 3 or 4 bushels. It took nitrogen to give the real lift in yields.

Needs of Soils Differ

Iowa soils are greatly different in their fertilizer needs. The recommendations for one area of the state may be entirely wrong for another. We wanted to find out what oats need in the main soil areas. In the chart on page 6 the 1945 data are placed in six groups according to location and soils. The Carrington group represents seven Carrington, Floyd and related soils of northeastern Iowa. There were six Marshall soils of western Iowa. The Grundy-Haig group represents five soils of southern Iowa. The Knox (Ida) group is limited to two eroded, calcareous hillside soils of Monona and Woodbury counties in western Iowa. The data for north central Iowa were obtained on one Clarion and one Webster soil. The number of soils in most of these groups is too small to be representative of the whole area, but the data show what may be expected.

A study of the chart shows these things:

1. Nitrogen gave about an equal increase in yield of oats on all of the soil areas. The increase from 40 pounds of nitrogen (which means 200 pounds of fertilizer) was about 20 bushels to the acre on the average.

2. Phosphate is most needed on the eroded, calcareous Knox (Ida) soils. Here it increased the oat yield nearly 23 bushels to the acre. On the Clarion soil it increased the yield 10½ bushels and on the Carrington 5.7 bushels. The increase in yield from phosphorus on the Grundy-Haig, Marshall and Webster soils was slight and not consistent.

3. Response from use of potash was 4 bushels on the Webster, 3 on the Carrington and 2 on the Grundy-Haig. Potash didn’t increase the oat yield on the Knox and Marshall soils of western Iowa nor on the Clarion.

On many soils more than just nitrogen or phosphorus applied alone is needed. The other chart brings this out clearly. This shows that on the Knox soils of western Iowa the oat yield from applying just nitrogen fertilizer or phosphorus fertilizer was about the same as on land which received no fertilizer; but when fertilizer containing both nitrogen and phosphorus was applied, the yield jumped from about 13 bushels on the untreated soil to 54 bushels on the fertilized.

Effect of Previous Crops

How much the soil needs nitrogen depends on how many crops of corn it has grown since a legume sod was plowed under or since it was manured. When we grouped the 1945 experiments according to the previous crops grown we found:

1. In fields following clover the most available nitrogen was found where only one year of corn had been grown following the legume. Here an increase of 8 bushels of oats was obtained from 40 pounds of nitrogen.

2. The soils following 3 years of alfalfa still had considerable available nitrogen in them even after producing two crops of corn. On these soils the increase from 40 pounds of nitrogen was nearly 12 bushels of oats.

3. On fields where two or more years of corn followed clover, very little available nitrogen was left in the soil. When we applied 40 pounds of nitrogen to these fields, the yield of oats increased 28 bushels to the acre.

Why Oats Need Nitrogen

Oats must have 1 pound of nitrogen for each bushel. So a 65-bushel oat crop takes 65 pounds of nitrogen from the soil. Some of this nitrogen can come from plant material that is plowed under. Nitrogen also can come from legumes grown, from manure or from nitrogen fertilizer.

Corn is our chief crop in Iowa. It, too, needs a lot of nitrogen, so we usually apply the manure just before the corn crop, and corn is the first crop we grow on land after clover or alfalfa is plowed under. Corn is grown on many farms for 2 years or longer after the land has been in legumes or manured. Thus most of the easily available nitrogen is used up by the corn before the oats get a chance to use it.
Oats must obtain the nitrogen they use in about 3½ months when the weather is often wet and cold. In this weather the micro-organisms in the soil are slowed down and produce less available nitrogen from the organic matter in the soil.

How Legume Seedings Fare

Our experiments with alfalfa and clover during the past 5 years have shown that about 70 fields out of 100 were helped by phosphate fertilizer and 15 out of 100 were helped by potash. It would be poor planning not to consider the new legume seeding in fertilizing the oats. When fertilizing the legume hay crop, it is best to apply all of the fertilizer needed for top hay yield at the time of sowing the oats. We think that 200 pounds of 0-20-0 or 0-20-10 for clovers and 300 pounds for alfalfa are enough. So the phosphate and potash needs of the oats will usually be taken care of in applying fertilizer for the legume crop.

If one adds nitrogen fertilizer for the oat crop, what will it do to the legume seeding? In some trials where oat varieties were being tested, 40 and 80 pounds of nitrogen lowered the stands of the seedings. In our 1945 fertilizer trials where the soil had little available nitrogen in it, applying 40 pounds of nitrogen fertilizer seemed to do no harm to the seeding. The legume hay yields from these fields in 1946 should tell whether hay yields were lowered by the use of nitrogen fertilizer. It is common knowledge that a too heavy growth of oats may hurt the stand of the legume seeding, especially in dry years.

Oats often lodge when grown near farm buildings on fields which have been heavily manured. It would obviously be a mistake to apply nitrogen to such a field, for that would cause still more lodging. The danger of oats lodging from a heavy nitrogen supply in the land will be much less likely with the new stiff-strawed Clinton oats.

To lessen the danger of injuring the legume seeding and at the same time obtain the best oat yield, hold back the nitrogen fertilizer for 2 or 3 weeks after sowing. If the oats appear stunted and light green, with dark green heavy growth occurring over animal droppings, then top-dress the field with nitrogen. If you follow this plan, you would apply the phosphate or phosphate-potash fertilizer at sowing time, then if the oats need nitrogen top-dress later with ammonium sulfate or ammonium nitrate.

In some of our western Iowa tests, where the soils were low in both nitrogen and phosphate, applying only phosphate would cause the sweetclover seeding to grow taller than the oats by harvest time. It was only by applying nitrogen fertilizer to make the oats grow taller that the oat heads could be kept above the clover. Our experience was similar to that of several farmers who used phosphate fertilizer alone on fields where the soil also needed nitrogen—they had trouble with the sweetclover growing taller than the oats.

Recommendations

Just what oat-fertilizer program should one follow? We believe that in average seasons efficient use of nitrogen fertilizer can be made on oats whenever they fol-

Top picture: This is a plot of unfertilized oats on the Arthur F. Hora farm in Washington County in 1945. The yield was 58 bushels per acre. Bottom picture: This is a plot in the same field which was fertilized with 200 pounds ammonium sulfate and 200 pounds of 0-20-10 per acre. The yield on the fertilized plot was 81 bushels, an increase of 23 bushels.
low 2 or more years of a crop that isn't a legume. Also nitrogen fertilizer is likely to give good results on land where the management has included few legume crops and has had little manure. The greatest step-up in yield can be expected on eroded soils and sandy soils. In wet, cold years nitrogen probably will profitably increase the oat yield on land which has not been in legumes for at least a year. No detrimental effects should normally occur from nitrogen applications up to 40 pounds an acre under the above conditions.

Consider Oat Prices

The past 2 years' tests indicate that about 2 pounds of nitrogen will produce 1 bushel of oats. The nitrogen costs approximately 12 cents per pound. One can then decide on the basis of the current oat prices whether it will pay to use it.

Enough phosphate and potash fertilizer should be applied to take care of both the oat crop and the following legume hay crop. The needs of the legume hay crop will determine the kind and amount of these materials. If these needs have not been determined by previous experience with fertilizers, then soil tests may offer a good guide.

Soils samples if properly taken can be used to show whether or not phosphate and potash are needed and the amounts of each that are likely to give good increases in yield. Soil samples may be submitted to the Soil Testing Laboratory at Iowa State College.

On fields where nitrogen and phosphate or potash are needed, 20 or 30 pounds per acre of nitrogen should be used. The nitrogen may be supplied by using 100 to 150 pounds per acre of ammonium sulfate, 75 to 100 pounds of ammonium nitrate, or 100 to 150 pounds of cyanamid. Phosphate and potash may be supplied by applying 200 pounds per acre of 0-20-0, 0-20-10 or 0-20-20 on oats seeded with clover.

For oats and alfalfa seedings, 300 pounds of the phosphate or phosphate-potash fertilizers should be applied. Fertilizer mixtures, such as 10-20-0, 6-12-6 or 6-12-12 (when available), can be used to advantage. These should be applied in amounts to equal the nitrogen, phosphate and potash recommended above.

Fields Well Managed

On fields where better management has been practiced, less than 20 pounds of nitrogen fertilizer with phosphate or phosphate and potash may be used. If preferred, the nitrogen fertilizer may be withheld and applied later as a top-dressing if the oats show nitrogen deficiency symptoms.

On fields which are known to be high in nitrogen, only phosphate and potash should be applied.

On fields where past experience or soil tests indicate that sufficient phosphate and potash are present but where the nitrogen is low, most economical returns will probably be obtained from applying straight nitrogen fertilizer.
FLIES CAN BE controlled cheaply and effectively by DDT properly used.

Farmers in Iowa and other states have given it an experimental trial on livestock, in their barns, in other outbuildings and have okayed it as an efficient fly-fighting weapon.

When the war in Europe ended, more DDT was made available for widespread experimental work. Out of that experimental work has come high promise for DDT, not as a cure-all against flies, but as another efficient means of reducing flies—the Iowa farmer’s most expensive luxury.

The DDT in the experimental trials did a good job of killing flies, bedbugs, wasps, mosquitoes and fleas. And it offers further dividends in controlling lice on cattle and horses.

How to Use DDT

Out of that experimental work have been formulated these recommendations as to how to best use DDT against flies on the farm next spring:

1. Spray the inside of all outbuildings, April 1 and July 1, with 5 percent DDT. Use either the 5 percent solution in oil as it comes, or mix soft water with either the 25 percent oil concentrate or the 50 percent spray powder. Apply 1 gallon of 5 percent spray to each 1,000 square feet of surface. Spray walls, ceilings, light cords, stanchions and floors, if fleas are present.

2. Spray compost heaps, straw piles and other decaying vegetable matter lightly every 2 weeks, or scatter this material in the field. The stable fly breeds in this type of decaying material.

3. Spray large herds of cattle with 0.2 percent to 0.5 percent DDT in water every 2 to 3 weeks throughout the fly season (April 15 until frost). DO NOT USE OIL SOLUTION ON LIVESTOCK. Dust small herds with 10 percent DDT powder every 2 to 3 weeks.

4. Put 1 tablespoonful of 10 percent DDT powder in sulfur into each nest in the laying house.

5. Continue to use all other recommended fly control practices.

First general experimental work with DDT on farms in Iowa got under way in May, 1945. At that time a chemical company in New York wrote Iowa county extension directors, offering to supply a small quantity of their tradenamed Carbola DDT for experimental application on a dairy farm in each county.

Not all counties applied for the material, and a few that applied did not receive it. But many counties did test it, and in November, after the fly season, a questionnaire was sent to every county asking for the opinions of the farmers who used the spray. We hoped that the answers might give us reasons for some of the dismal failures of DDT.

The questionnaire sent out after these tests with Carbola DDT revealed that the selected farmers were more or less in the dark as to how their DDT was to be applied. Many of them experimented cautiously—and some had excellent results.

The particular material sent to these men was a brownish powder with a faint creosote odor. Directions on the sack merely said to “mix 50 pounds of Carbola DDT with 15 gallons of water and spray or paint it on the inside walls of the barn.” Recent inquiry indicates that this company uses “a minimum of 2 percent DDT...” We still don’t know the concentration of DDT applied to barn walls by these farmers in this series of tests.

We felt that definite instructions as to the kind of water to be used in the spray, prepara-
Two methods of applying DDT with small sprayers to poultry house walls.

Public Health Service reports that the longest time DDT has ever been effective was 7½ months on whitewashed walls. Public Health Service has done a great deal of work on wall surfaces. They found that bare boards and concrete absorbed quite a bit of spray, reducing the effective concentration of DDT on the surface. They feel that any covering which will seal the pores is of value in increasing the effectiveness of DDT applied later. They also suggest that on porous surfaces the spray be diluted with additional water and more spray be applied, perhaps 2 gallons per 1,000 square feet.

In the Iowa trials water of all degrees of hardness was used in mixing the spray. We are interested in this because DDT loses its toxicity when mixed with alkaline materials or when mixed with water containing metals. The questionnaires show that 11 farmers used hard or very hard water in mixing the spray.

Of all the farmers who reported on their use of DDT, only eight said that it was effective in killing flies for as short a period as 2 weeks or less. One or two of the eight with these rather poor results used medium hard or soft water in mixing the spray. On the other hand, several farmers who used hard to very hard water in mixing the spray reported that it was effective in killing flies for 3 to 4 months. So while it is probably wise to use soft water, our tests show that it doesn’t appear to be absolutely necessary.

Here’s What It Killed

Now let’s see what happens when we spray the inside of a barn with DDT. In most cases we kill flies—lots of flies. These flies don’t die at once. The usual report was that flies came into the barn in the daytime but were killed during the night. This situation occurs because DDT is not repellent and does not warn the insects away. So they come into the barn, rest on the walls, and absorb enough DDT through their feet to kill them.

Do we kill anything else? Yes, the answers indicate that worms, bedbugs, black bugs, wasps, mosquitoes, moths and spiders are also killed. There may be several reasons for the disappearance of spiders from barns sprayed with DDT. As you know, spiders feed on other insects and would probably find little or no food in barns where DDT has been used. In that case, they would be forced to leave if they didn’t want to starve to death.

DDT also affects other animals. One man had an open stock tank in the barn in which he had bullheads. The spray falling into the tank killed the fish. This agrees with findings of other groups since the U. S. Public Health Service has found that as little as 1 pound of DDT per acre of water surface will kill fish. Several farmers reported that there weren’t as many sparrows or swallows around the barn after spraying with DDT. This also may be explained by the general reduction of insects on which these birds might feed. One
farmer reported that he found a number of dead mice in the barn shortly after he had applied DDT. However, the mice may have died from some other cause.

Does spraying the barn reduce the fly population on the whole farm? Many of the users say, “Yes.” Several of the farmers who applied DDT well after the start of the fly season said, “We had fewer flies around the house after spraying than ever before.” For really effective fly control, we suggest that all outbuildings be sprayed with DDT and that other fly control measures also be used.

DDT applied to barn walls apparently has no injurious effect on livestock. Farmers’ comments were: “Beneficial,” “Cattle and horses quieter and not irritated,” and one man said, “Flies have calmed horses quieter and not irritated,” apparently has no injurious effect on livestock.

In the fall. I sprayed the inside of the barn and the outside of the outbuildings. I sprayed the barn again in the spring. It is the first time in 15 years that we have had a problem with flies. We are satisfied with the results. There was a general story of excellent fly control in most cases. Five percent DDT was used, either in oil solution or in water suspension, on walls, ceilings and floors of farm outbuildings.

The U. S. Public Health Service sprayed 385,000 houses in southern states for malaria mosquito control during the summer of 1945. No injurious effects were noted and in many cases there was a sharp reduction in flies as well as a total disappearance of mosquitoes.

Kansas, cooperating with the U. S. Bureau of Entomology, really put on a large scale demonstration of DDT. Some 6,000 cattle on 30 ranches were dipped, sprayed or dusted with DDT. Dips contained 0.1 percent DDT, sprays applied with a power sprayer contained 0.2 percent DDT, hand operated pressure sprayers or bucket pumps used 0.5 percent to 0.75 percent DDT and dust contained 10 percent DDT. About ½ gallon of spray or 2 to 3 tablespoonsfuls of dust were applied to each animal.

The results of the Kansas tests were remarkable. In many cases there were 1,200 to 1,500 flies per head before spraying and only from 5 to 100 flies per head 16 days after spraying. During this 16-day period, the cattle were in pastures exposed to sun and to heavy rains. The difference in the behavior of sprayed cattle was very noticeable. Unsprayed cattle runched up in the shade, while sprayed cattle scattered out over the pasture and fed. It appears as though spraying dairy and beef herds every 2 to 3 weeks will increase beef and milk production by 10 to 20 percent. In these tests sprayed herds of beef cattle on pasture gained from 1 ½ to 1 pound a day more than unsprayed cattle on similar pasture. Differences in feedlot cattle were as striking.

DDT has also given excellent results in poultry houses. Five percent DDT either in oil solution or as a water suspension applied to walls, ceilings, floors and roosts has given quick and long lasting control of bedbugs. One tablespoonful of 10 percent DDT mixed with sulfur and placed in each nest controls chicken lice. DDT itself has little or no effect on poultry mites, but sulfur will control them.

So DDT does point the way to effective fly control on the farm. And the farmer who applies it in the spring will find that he isn’t going to need expensive equipment to use the spray—another point in its favor. Equipment needed for applying DDT to walls and livestock is simple and usually available on every farm. A 3-gallon sprayer or a bucket pump is adequate. If a power sprayer is available the job of spraying can be done more quickly and with less work.

### DDT Questionnaire

<table>
<thead>
<tr>
<th>Date sprayed:</th>
<th>May 15-30</th>
<th>June 1-15</th>
<th>June 16-30</th>
<th>July 1-16</th>
<th>July 16-31</th>
<th>Aug. 1-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of times barn was sprayed:</td>
<td>Once—36</td>
<td>Twice—4</td>
<td>More than twice—1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kind of surface:</td>
<td>Bare boards—24</td>
<td>Whitewash—11</td>
<td>Paint—3</td>
<td>Concrete—2</td>
<td>Hollow tile—1</td>
<td></td>
</tr>
<tr>
<td>Kind of water used:</td>
<td>Very hard—4</td>
<td>Hard—10</td>
<td>Medium hard—17</td>
<td>Soft—10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of time spray was effective:</td>
<td>Weck or less 2 weeks—1 month</td>
<td>2 months</td>
<td>3 months</td>
<td>4 months</td>
<td>5 months</td>
<td></td>
</tr>
<tr>
<td>Was a general reduction of flies noticed following spraying:</td>
<td>Yes—25</td>
<td>No—12</td>
<td>No comment—4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the spray affect birds or animals:</td>
<td>Yes—17</td>
<td>(included worms, bedbugs, black bugs, wasps, flies, mites, mosquitoes, bugs and moths.)</td>
<td>No—6</td>
<td>No comment—18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was there any effect on livestock:</td>
<td>Yes—1 (quieter, less irritation.)</td>
<td>No—36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the farmer satisfied:</td>
<td>Yes—30</td>
<td>No—5</td>
<td>(too expensive)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Going to Use FERTILIZER?

Make Sure It's the Kind Your Crops and Soils Need to Make the Largest Returns

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 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 that 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 phosphorus 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 a large yield potential, and 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—to 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* |
|---------------------------------|-----------------|------------------|-----------------|------------------|-----------------|-----------------|
| Crop                            | Soil area       | Kind of soil     | Fertilizer      | Rate and method  | Rate of application (lbs./acre) |
|                                 | (See map)       |                  | grade (1)       | of application   | Drilled or       | In hill or row  |
|                                 |                 |                  |                 |                  | broadcast       |                 |
| **CORN**                        | Areas I-II-V    | Well-drained     | 0-20-0 (2)      | 0-20-10 (2)      | 200 (2)         | 100 (2) (2)    |
|                                 |                 | soil (no tile    | 0-20-0 (2)      | 0-20-10 (2)      | 200 (2)         | 100 (2)        |
|                                 |                 | needed)          | 0-20-10 (2)     | 0-20-10 (2)      | 200 (2)         | 100 (2)        |
|                                 |                 | Slowly-drained   | 0-20-20 (2)     | 0-20-20 (2)      | 200 (2)         | 100 (2)        |
|                                 |                 | soil or sandy    | 2-12-6          | 330 (2)          | 165 (2)         |                 |
|                                 |                 | soils           | 3-12-12         | 330 (2)          | 165 (2)         |                 |
|                                 |                 | High-lime or     | 0-10-20 (2)     | 300 (2)          | 150 (2)         |                 |
|                                 |                 | so-called        | 0-9-27          | 300 (2)          | 150 (2)         |                 |
|                                 |                 | “alkali” soils   | 0-0-50          | 150 (2)          |                 |                 |
|                                 |                 | (mainly in Area I) |               |                 |                 |                 |
|                                 | Areas III-IV    | Peat and muck    | 0-20-20 (2)     | 200 (2)          | 100 (2)         |                 |
|                                 |                 | soils (Mainly in Area I) | 0-20-20 (2)     | 200 (2)          | 100 (2)         |                 |
|                                 |                 | Slowly-drained   | 4-16-0          | 250 (2)          | 125 (2)         |                 |
|                                 |                 | sandy soil       | 0-20-10         | 200 (2)          | 100 (2)         |                 |
|                                 |                 | 2-12-6           | 330 (2)         | 165 (2)          |                 |                 |
|                                 | Area VI         | All soils except | 0-0-20 (2)      | 200 (2)          | 100 (2)         |                 |
|                                 |                 | sandy soil       | 4-16-0          | 250 (2)          | 125 (2)         |                 |
|                                 |                 | Sandy soils      | 0-0-20 (2)      | 200 (2)          | 100 (2)         |                 |
|                                 |                 | (See recommendations for sandy soils under Area I-II-V) | | | | |
| **OATS and CLOVER**             | Areas I-II-V    | Typical          | 0-20-0 (3)      | 200 (3)          | 100 (3)         |                 |
| **SEEDING (3)**                 |                 | well-drained     | 4-16-0          | 250 (3)          | 125 (3)         |                 |
|                                 |                 | soils            | 0-20-0 (3)      | 200 (3)          | 100 (3)         |                 |
|                                 | Areas III-IV-V  | Slowly drained,  | 4-16-0          | 250 (3)          | 125 (3)         |                 |
|                                 |                 | sandy or high    | 0-20-10         | 200 (3)          | 100 (3)         |                 |
|                                 |                 | lime soils       | 0-20-20         | 200 (3)          | 100 (3)         |                 |
|                                 | Areas III-IV-VI | All soils except  | 4-16-0          | 250 (3)          | 125 (3)         |                 |
|                                 |                 | sandy soils      | 0-20-10         | 200 (3)          | 100 (3)         |                 |
|                                 | All areas (in   | Soils without    | 20-0-0           | 150-250          |                 |                 |
|                                 | addition to     | legumes or       | 32-0-0          | 100-150          |                 |                 |
|                                 | fertilizers     | manure in past 2 | years.           |                  |                 |                 |
|                                 | recommended    | years.           |                  |                  |                 |                 |
|                                 | above)          |                  | 20-0-0           | 150-250          |                 |                 |
|                                 |                  |                  | 32-0-0          | 100-150          |                 |                 |
| **PASTURE**                     | All areas       | Eroded soils or  | 20-0-0          | 150-250          |                 |                 |
|                                 |                  | soils without    | 32-0-0          | 100-150          |                 |                 |
|                                 |                  | legumes or       |                  |                  |                 |                 |
|                                 |                  | manure within    |                  |                  |                 |                 |
|                                 |                  | past 2 years.    |                  |                  |                 |                 |
| **SOYBEANS**                    | All areas       | Where legumes are | 0-20-0 (3)      | 300 (3)          |                 |                 |
|                                 |                  | seeded           | 0-20-10         | 300 (3)          |                 |                 |
|                                 |                  | Grass sod on     | 20-0-0          | 150 (3)          |                 |                 |
|                                 |                  | soils needing    | 32-0-0          | 100 (3)          |                 |                 |
|                                 |                  | nitrogen         | 0-20-10         | 200 (3)          |                 |                 |
|                                 |                  | Sandy, high-lite | 0-20-20         | 200 (3)          |                 |                 |
|                                 |                  | or low producing |                  |                  |                 |                 |

*These recommendations are based on the results obtained from the use of fertilizers in field experiments. 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 fertilizer 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 obtainable 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 800 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-drained 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.
Pastures and Hay lands were plowed up during the war to make room for more corn and soybeans. On many farms it's time to get land back into clover and grass, to meet the needs for pasture and hay and to help build up depleted soils.

What should we be planning now to get better pastures in the season ahead?

Renovating Bluegrass

Much of our land in bluegrass pasture has become relatively unproductive, with weedy sods. Continuous close grazing, starved grass roots, depleted fertility and an acid condition are largely responsible for the low returns obtained from such pasture land.

The results obtained by the Iowa Station through a period of years from bluegrass renovation studies at Mt. Pleasant, Iowa, and later at Albia, are fairly well known.

The term “renovated bluegrass” has come to mean introducing clover into the grass by disking or other cultivation, with the use of lime and phosphate if the soil needs them. This procedure feeds the grass roots and results in a thick, heavy sod. The vigorous grass growth largely eliminates weeds. The growth of clover provides succulent, nutritious, palatable pasturage in midsummer when bluegrass usually becomes dormant, hard and unpalatable. Usually a good renovation job greatly increases the productivity and carrying capacity of the pastures. There are few communities in which the practicability of renovating bluegrass pastures has not been demonstrated.

The essentials of a successful renovation job seem to include the following:

1. If possible lime in the fall before spring seeding if the soil is acid. Then you can get a good stand and vigorous growth of sweetclover or alfalfa. These legumes are excellent in pasture renovation seedings.

2. Disk or tear up the grass some other way in the fall if possible. The lime can then become active immediately, and it reduces the seedbed work in the spring.

3. Apply 200 to 300 pounds of 20 percent superphosphate (or its equivalent) in the spring and work in well when fitting the seedbed.

4. Do a thorough job of tearing up the grass sod when fitting the seedbed. Don't worry about hurting the grass, for it will come back quickly and better than ever.

5. Seed in the early spring or not at all—not later than April 15.
and as much earlier as possible.

6. Seed a mixture of adapted legumes. The mixture most widely used in Iowa consists of 5 pounds of sweetclover, 3 of red clover and 2 of alsike per acre, with 10 pounds of lespedeza also included for extreme southern Iowa counties.

Lime Helps Pastures

At the Pasture Improvement Farm in southern Iowa, near Albion, we used a series of six experimental pastures several years to compare the production of untreated native bluegrass pastures with that obtained from the same land when renovated, both with and without lime. The seeding mixture we used was that already referred to as in general use. The pastures were grazed with native steers. The pounds of beef gained per acre for the various treatments for the seasons 1941 through 1943 are shown in table 1.

Considering both tillage and seed costs it is quite obvious that under these soil conditions reseeding without the use of lime is not effective. Such increase in production as we obtained on pastures reseeded without lime was due largely to the acid-tolerant Korean lespedeza, with some help from red clover. But where we included lime, both the stand and growth of all legumes were much better. Renovation, including reseeding and use of lime, increased the average number of pounds of beef produced per acre from 108 to 193, an increase of approximately 80 percent.

Phosphate Aids Legumes

Many farmers know that the growth of legumes usually is greatly stimulated with phosphate fertilizers.

One of the most striking observations on the experimental pastures at Mt. Pleasant was the much thicker and more vigorous growth of the sweetclover on the pasture which received 150 pounds per acre of 20 percent superphosphate in addition to lime, as contrasted with the pasture limed but not phosphated.

Beginning with the 1944 season, we modified the bluegrass renovation experiment at Albia to include phosphorus with lime. The sod was torn up with a weighted spring-tooth harrow in the fall of '43, thoroughly disked in the spring of '44 and 250 pounds of 20 percent superphosphate applied to two of the four limed pastures.

The phosphate was thoroughly mixed with the soil during the diskng operation in the early spring. Two other pastures were handled in identically the same manner except that no phosphate fertilizer was used. The seeding mixture was the same as for the preceding years. Native steers were turned into all pastures in mid-May and remained on them until about the middle of October, both in 1944 and 1945. The results, in pounds of beef per acre, are shown in table 2.

In all previous renovated pasture seedings within our experience satisfactory gains in production have been obtained in the seeding season. Such was not the case in 1944, though it will be observed that for the 1945 season, when the legumes were in their second year, good increases from the phosphate resulted. The effect of the phosphate fertilizer was evident in 1944 in the markedly thicker stand and more vigorous growth of the clovers.

The failure to obtain benefit from the phosphate in '44 can be attributed only to the accidental inclusion on these pastures of animals which did not gain satisfactorily. Individual steers show great differences in gains under the same pasture conditions. For this reason experiments of this kind must be continued several years before reliable results can be obtained.

Manage the Grazing

You can benefit from pasture renovation for several years only if you manage the grazing properly. A common fault is to graze so heavily in the second season following renovation that the biennial clovers fail to reseed. Re-seeding is essential to success and can only be accomplished through controlled grazing during those weeks when seed heads are forming.

After the seed is developed then graze heavily for the remainder of the season and even into the fall,
Biennial clovers may be maintained in bluegrass pastures only if allowed to reseed. This renovated pasture was grazed lightly during late May and early June to permit reseeding, after which it was heavily grazed to remove top growth and bring shattered seed in contact with the soil. So that all the accumulated growth of grass and clover is gone from the surface by winter. This close grazing permits the legume seed to be shattered and brought in close contact with the soil. It also weakens the grass so that its competition with the seedling legumes the following spring will be reduced. This is desirable.

Solve Renovation Problems

Some farmers have had difficulty in maintaining good stands of clovers in bluegrass pastures through a period of years. Experienced and observing livestock men are overcoming this difficulty through good grazing management. We have seen renovated pastures in various parts of Iowa which showed good stands of sweetclover in the grass 6 and 7 years after seeding.

Pastures which have been closely grazed the season through show a rather weak sod which can be fitted for the renovation program without excessive disk ing or other cultivation. When the bluegrass sod is thick and heavy the cost of preparing the seedbed has been excessive. The disk has been used almost altogether in Iowa in pasture renovation, not because this is the best tool but because it is the only available tool which has been thought suitable.

Some Iowa farmers know that several implements are better for renovation than the disk. Shallow plowing to set back the grass and give the clover seedings a chance to become established is preferred in some areas. Plowing also helps control weeds. Tractor-mounted corn cultivators and subsurface tillers also have given excellent results.

We compared four methods of seedbed preparation at Albia in 1943. These included (1) disk ing, (2) plowing shallow in the fall, (3) plowing shallow in the spring and (4) tilling with a rigid, mounted, subsurface tiller, especially constructed for the purpose. The sod was very heavy and dense.

The fall-plowed plots were plowed about 4 inches deep in mid-November (1944), while the spring plowing was done the last of March at about the same depth. The plots which were fall-plowed were left rough over the winter with the result that there was little or no erosion. The plowed plots were disked twice with the tandem disk just before seeding on March 28. The sub-tilled plot was disked twice in the spring with tandem disk and the disked plot four times.

The degree to which bluegrass was set back or killed varied greatly between the different treatments. The grass was almost entirely killed on the fall-plowed plots. The average stand of clover obtained on these plots was estimated at 96 percent. Considerable bluegrass came back on the plots spring-plowed. The average stand of clover seedings was 78 percent on these plots. Kentucky bluegrass came back very strong and vigorous, both on the disked plots and on those sub-tilled and disked. Clover stands on these plots averaged 65 and 59 percent, respectively.

Seeding mixtures compared on

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1941</th>
<th>1942</th>
<th>1943</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>99</td>
<td>98</td>
<td>126</td>
<td>108</td>
</tr>
<tr>
<td>Reseeded, without liming</td>
<td>138</td>
<td>136</td>
<td>156</td>
<td>143</td>
</tr>
<tr>
<td>Limed and reseeded</td>
<td>195</td>
<td>184</td>
<td>200</td>
<td>193</td>
</tr>
</tbody>
</table>

Table 1. Acre production in pounds of beef on untreated pastures and pastures reseeded with and without lime.
Table 2. Acre production in pounds of beef from (1) untreated pastures; (2) reseeded pastures which were limed; and (3) reseeded pastures limed and phosphated.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pounds gained per acre</th>
<th>Average daily gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1944</td>
<td>1945</td>
</tr>
<tr>
<td>(1) Untreated</td>
<td>98</td>
<td>112</td>
</tr>
<tr>
<td>(2) Limed and reseeded</td>
<td>143</td>
<td>150</td>
</tr>
<tr>
<td>(3) Limed, phosphated and reseeded</td>
<td>107</td>
<td>203</td>
</tr>
</tbody>
</table>

Each of the plots receiving the different tillage treatments included (1) a mixture of 5 pounds of sweetclover, 3 of red clover and 2 of alsike; (2) Ladino clover 4 pounds per acre; (3) birdsfoot trefoil 6 pounds per acre; and (4) bromegrass 8 and alfalfa 10 pounds per acre.

The clover mixture produced the heaviest growth in the first, or seeding, year. The Ladino clover also made a very heavy, vigorous growth, particularly late in the season. The birdsfoot trefoil, as is characteristic of this legume, made very little growth the first year, particularly on the plots where the bluegrass had not been sufficiently killed back. We expect this legume will do well the second year.

The bromegrass-alfalfa combination made an exceptionally good growth on the plots which had been plowed in the fall so that the bluegrass was largely killed out. The conversion of bluegrass pasture to a bromegrass-alfalfa pasture appears to be a relatively simple job. Changing bluegrass pasture into a bromegrass-legume pasture would seem to be a desirable step and entirely feasible on many farms.

Conversion Feasible

It will be simpler and the labor and power costs will be less, in many cases, to prepare a seedbed from bluegrass sod by shallow plowing than by disking. The plowing job can be done in the late fall at a time when other farm operations are not particularly pressing, whereas the disking procedure must be carried out in the spring in a crowded interval. Little soil loss may be expected from shallow plowed bluegrass sod if it’s plowed on the contour and left rough over the winter. Oats will be seeded in the spring with the clover, all to be grazed. On long slopes, where the possibility of erosion may offer a problem, sod buffer strips at intervals are desirable. Any small areas particularly subject to erosion can be left unplowed.

Bromegrass yields much more feed in pasture than Kentucky bluegrass. For a long-time pasture either grass should be grown with a legume. The production of the two grasses, each grown without a legume, is shown in table 3.

The average yield of the five varieties of bromegrass was 63 percent greater than that of Kentucky bluegrass. When it becomes hot and dry, Kentucky bluegrass stops growing, dries up and is unpalatable in the midsummer months.

Long Rotation Pastures

Undoubtedly many pastures in Iowa which are left permanently in bluegrass would be helped by cultivation, where this can be done without erosion. Such pastures can be plowed and put into corn for 1 year, after which the field would be seeded down to bromegrass-alfalfa with oats as a nurse crop. Such a seeding should remain productive for several years, but after it becomes sodbound it can again be plowed and another crop of corn produced while re-establishing the bromegrass-alfalfa. The grass portions of such fields which cannot or should not be plowed are allowed to grow up during the year and are grazed off in the early winter after the corn has been harvested.

Mow the Pasture

Some pastures, because of their steepness or because of trees,
Table 3. The yield of five strains of Kentucky bluegrass and five varieties of bromegrass, 1943 through 1945, inclusive.

<table>
<thead>
<tr>
<th>Bluegrass strain</th>
<th>Tons per acre green hay 3-year av.</th>
<th>Bromegrass variety</th>
<th>Tons per acre green hay 3-year av.</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1—Kentucky selection</td>
<td>2.83</td>
<td>Fischer</td>
<td>4.41</td>
</tr>
<tr>
<td>K3—Denmark 2230</td>
<td>2.96</td>
<td>Lincoln</td>
<td>4.81</td>
</tr>
<tr>
<td>K4—Swedish selection</td>
<td>2.84</td>
<td>Achenbach</td>
<td>4.99</td>
</tr>
<tr>
<td>Commercial</td>
<td>2.37</td>
<td>Commercial</td>
<td>3.96</td>
</tr>
<tr>
<td>Iowa selection</td>
<td>2.45</td>
<td>Iowa brome</td>
<td>3.77</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>2.69</strong></td>
<td><strong>Average</strong></td>
<td><strong>4.39</strong></td>
</tr>
</tbody>
</table>

Mow Brush, Weeds

Perennial weeds can best be controlled by mowing when in the bud stage, which usually is early July. Pastures with perennial weeds need to be mowed several seasons to eliminate them. Annual weeds, such as ragweed, are easily controlled by mowing before they have made seed. The best time to mow such weeds is about August 1.

Buckbrush has become a serious problem on many southern and western Iowa pastures. This shrub can be controlled by mowing once each summer. The most difficult job is removing the first heavy growth. The growth in succeeding years then can easily be mowed with an ordinary horse-drawn mower. Surprisingly heavy brush can be mowed by the tractor mower with power take-off, operating the tractor in low gear with considerable speed on the sickle.

Annual mowing of pastures should become a general practice because it so greatly improves the production.

New, Better Pasture Crops

The list of new and improved varieties of forage crops is increasing. The superior southern types of bromegrass, Fischer, Lincoln and Achenbach, are already finding a permanent place on many Iowa farms. The Ranger and Buffalo varieties of alfalfa, with their high resistance to bacterial wilt, undoubtedly will have an important bearing on the use of this crop in seeding with bromegrass for hay and pasture.

Other new forage varieties are just around the corner. These include such varieties as L6 and L39 lespedeza, Madrid sweetclover, Emerson red clover, Foreed canarygrass, Ladino clover and birdsfoot trefoil, all of which are giving very promising results in pasture seedings.

Vitamin C in Apples

Some study has been made of the vitamin C content of apples at the Iowa Station. Vitamin C is the vitamin sought in oranges and tomatoes.

Ten varieties of apples were tested for vitamin C content and one of these was found to be much richer than the rest. That variety was Willow Twig. The vitamin C content of Willow Twig not only was high at ripening but it stayed up well through storage.

Work at other stations indicates that apple varieties differ considerably in vitamin C content. As a result of this research, new varieties probably will be bred that are high in vitamin C.

An apple like the Willow Twig furnishes about as much vitamin C as an equal quantity of tomato.

Heavy grass sods can be most easily renovated by plowing on the contour in the fall. If left rough over winter there’s a little danger from erosion. This field at the Albia Pasture Farm was plowed in late November for seeding in the spring to a mixture of adapted grasses and legumes.
eral groups: (1) Faulty construction, (2) personal carelessness and (3) extraneous and miscellaneous causes.

Faulty Construction

An analysis made in our study showed that where the causes are known, faulty construction accounted for 85 percent of the waste from fires; personal carelessness, 11 percent; and extraneous and miscellaneous causes, 4 percent.

A trained inspector can spot faulty construction. If this is corrected, we avoid a fire. This largely accounts for the decline in loss by fire of Iowa farm buildings.

Here are the kinds of things which trained inspectors find:

- Cracks or holes in chimneys, or chimneys falling apart because of mortar failing to hold, defective heating systems, sparks allowed to fall upon easily ignited roofs, and no lightning rods or defects in the lightning rod system.
- Defective flues and heating systems can be found easily by a trained inspector as can also split, frayed or curled shingles which ignite easily. Correction of these possible fire causes is not so much a matter of knowledge as it is of getting people to do something about them.
- A non-clogging spark arrester, developed in connection with our study, will prevent sparks from the chimney falling on roofs which are in questionable condition. Properly installed lightning rods provide almost perfect protection against fire from lightning. Inspectors have taken pains to see whether or not the lightning rods and cables were properly installed and in good condition.
This fire started from a cracked chimney. Regular inspection can easily locate this kind of hazard so that it can be corrected before it has caused the house to burn.

Loss From Other Causes

The fires that start from causes classified as "extraneous and miscellaneous" are such as those that spread from adjoining buildings on fire; those set by man and those of miscellaneous causes coming from the outside. Causes of this kind, of course, cannot be prevented by inspection.

Among the causes of fires from human carelessness are: Careless handling of flammable liquids such as gasoline and kerosene; oil and gasoline stoves; matches; smoking; and spontaneous ignition of oily rags. These fires are unnecessary but cannot readily be prevented by inspection.

Oil and gasoline stoves have been placed in this group of causes. Even though the stove may appear to be in good condition when it is inspected, if it is not properly cleaned, if the operator is careless in filling it or if its construction is faulty in a way that may not easily be detected on inspection, the stove may cause a fire.

Our study showed clearly that the main causes of the fires on farms were from faulty construction—all causes that could be corrected. Furthermore, our study showed that the fires which resulted from faulty construction were the costly ones.

In the 15-year period from 1930 to 1944, dwelling fires resulting from human carelessness cost their owners $1,484 each; those resulting from extraneous and miscellaneous causes cost $1,750 each; those from defects in construction cost $2,190 each.

Inspection Aids Prevention

A complete fire control program includes two distinct operations. The first is prevention. If this part of the program could be made 100 percent effective there would be no need for the second part, which is to put out the fire. One need not worry about being able to stop a fire which never starts.

Prevention involves several problems. The removal of con-
struction hazards was given first consideration not only because it resulted in the largest waste but also it appeared more easy to handle. The sponsoring organizations, composed almost exclusively of Iowa farmers, provided an inspection service at very low cost to the county mutual fire insurance associations of Iowa. This

Farmers' mutual insurance associations have accumulated a large surplus even though their income has been on the decrease recently.

Country dwelling fires have decreased markedly and consistently since 1936, as this graph shows.

inspection was carried on first by Earl D. Anderson and later by L. G. Keeney.

Thousands of hazards were discovered and many corrected on the job by inspectors. From a modest beginning, the inspection service grew rapidly until it was curtailed by the manpower shortage during the war. The accompanying summary prepared by Mr. Keeney, now secretary of the Farmers' Mutual Reinsurance Association, shows the many hazards found in the inspection work.

Mr. Keeney has also indicated that extensive repairs were made after the inspectors left and that reinspection several years later showed the property was maintained in good condition. Mr. Keeney has this to say:

“Nearly 10,000 farm dwellings were inspected in 1940. Thirty-nine percent were found to have wood shingle roofs in hazardous condition. Sixty-five percent of these hazardous roofs were protected by spark arresters which were actually installed by the inspectors. The 1944 summary shows only 21.4 percent of the dwelling roofs to be weathered and in danger of roof fires. The inspectors corrected 63 percent of the hazardous roofs found in 1944.

Here are the remains of a “fireproof” farm dwelling the morning after it burned down. House fires account for 7 out of each 10 dollars loss.

This fire, the result of a spark lighting on weathered shingles, is one of the most common causes of the fires of Iowa farm dwellings.

“In 1940 the inspectors found 26 defective chimneys for each 100 dwellings inspected. In 1944 the percentage dropped to 15.2. We have no record of chimney repairs actually made by the inspectors. We are finding that the percentage of defective chimneys is nearly as high now as in earlier years, in localities where inspections were not made previously. In 1944 the inspectors completed several jobs which had been inspected previously. In other words, the reduction in the number of defective

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chimneys found last year was more than likely due to past influence of the inspectors.

"Because smoke pipes, flue stops and temporary heating equipment are short-lived at best, it is difficult to form any conclusion about the permanent influence of the inspectors. In 1940 there were 17 defective heating systems for each 100 dwellings, whereas 1944 averaged 10.5.

"Thirty-seven buildings in each 100 inspections were found to have defective lightning protection systems in 1940. Thirty-nine percent of these defects were actually corrected by the inspector. In 1944 this figure had dropped from 37 to 26 percent, with 40 percent of the defects being repaired.

"According to the 1940 summary, 44 percent of the farms inspected had electrical service. This figure is very much higher than would have been the case in the early and middle 30's. The 1944 summary shows 65 percent of the farms wired. On the basis of farms having electrical service, 33 percent of the systems were found to be defective in 1940 and only 7 percent in 1944. Overload protection was found to be lacking on 60 percent of the wired farms in 1940 and on only 25 percent in 1944. Incidentally, the inspectors correct most of the overload hazards at the time the inspection is made unless there are cases where the circuits carry entirely too much current."

Extension Service Helps

The Agricultural Extension Service of Iowa State College for about 10 years has supplemented the professional inspection service with an extensive program with farm youth organizations and public schools. This work was first under the direction of Byron T. Virtue and later Harold H. Beatty. The inspections made by the youth and school children were largely of their own homes, though sometimes they included neighboring farms. Close cooperation was maintained with the State Fire Marshal, the Superintendent of Public Instruction and radio stations WOI and WHO.

It is not possible to get an adequate measure of the work done on this program because much of it was not reported. In 1942, some work was undertaken in 93 counties, 70 of which reported completion of the program laid out. More than 17,000 persons participating inspected the buildings on 73,664 farms. Work was continued at lower levels in 1943 and 1944.

If the hazards were identified and removed, it is only reasonable to expect that this work helped reduce the number of farm fires. The marked and consistent reduction in the number of farm dwelling fires is shown graphically on page 21.

Collect Less—Surpluses Up

If the measures of results accomplished are essentially accurate, it is to be expected that they should be evident in the business experiences of the county mutual insurance associations of the state. The accompanying chart shows this rather strikingly. These figures are shown in terms of dollars per thousand at risk to eliminate complications arising from the total coverage. The total income of the county mutual insurance associations has dropped markedly in recent years. On the other hand, the surplus has increased from $1,448,663 at the beginning of 1933 to $5,046,254 at the close of 1944, an increase of $3,597,591.

Prevention First

We have long known that fires are largely unnecessary. We now know that personal carelessness is not a major factor in causing fires in country dwellings in Iowa. The principal causes can be found by a qualified inspector.

There is little glamor in fire prevention, and we cannot say that inspection and removal of hazards in any one case have actually prevented a fire. But we do know that Iowa farmers' fire losses are becoming smaller since inspection began.

Prevention cannot be complete, so we must back it up with the best protection methods. Prevention, however, certainly should get our first attention.

Lincoln Soybeans Lead

LINCOLN soybeans are pleasing the first farmers who tried them. This is shown in a survey made of the 115 growers in the southern two-thirds of the state to whom seed was sent in 1944.

There were 54 of these men who reported on comparisons in yield between Lincoln and other varieties they had been growing. Of these 54, 47 said the Lincolns outyielded their home-grown varieties in 1945. The average advantage was about 5½ bushels an acre. This is approximately the same difference as obtained in tests at the Iowa Station.

The average yield of the Lincoln soybeans was 31.4 bushels an acre and of the home-grown varieties 25.8.

In ability to stand up, or lodging resistance, about half of the 51 who reported said the home-grown variety stood up better than Lincolns. There were 7 who said Lincoln was superior in lodging resistance and 19 farmers could see little difference. The results and reports of these farmers agree pretty well with the results of the Station.

All of the growers were pleased with the Lincolns in 1945, and 86 percent said that in their opinion Lincolns would replace all other varieties of their areas of the state. The remaining 14, while having a good opinion of the Lincolns, felt that many growers would continue to plant a portion of their soybean acreage to varieties that mature earlier than Lincoln.

More than 21,000 bushels of seed were produced by the 73 growers in 1944 who gave rather accurate data on the way they sold or disposed of the crop. These men said that they kept 19 percent for their own planting, sold 63 percent to neighboring farmers, 13 percent to growers outside the neighborhood and 3 percent to concerns for resale in Iowa. Only 1 percent was sold outside the state.

The farmers who got seed in 1944 had agreed to sell at least 50 percent of their crop to neighboring farmers for planting. They actually sold 63 percent and kept 19 percent for their own planting.
FARMING ROUND the hills instead of up and down them pays.

We are convinced of that after 4 years of comparing yields, measuring soil and water losses and observing the difference in power that contouring takes as compared with up-and-down hill farming.

These 4 years of tests show that you can expect to get about 7 1/2 bushels more corn to the acre from contouring on land that washes. The increase in soybean yield has been nearly 3 bushels to the acre and nearly 5 1/2 for oats. These are the average increases we have actually got in the 4 years from 1942 through 1945.

The tests on which these figures are based were made cooperatively by the Iowa Agricultural Experiment Station, Soil Conservation Service and the Iowa Agricultural Extension Service. In the 4 years we had 153 fields of corn, 79 of soybeans and 21 of oats.

Saves the Soil

From a long-time standpoint, the saving of soil from contouring is probably more important than the immediate larger yields. We have found that only about half as much soil has been washed away as with up-and-down hill farming. From our tests, we estimate that on the 3 million acres of corn grown on the contour in 1942 through 1945 there has been a saving of about 15 million tons of soil. Put into terms of depth, the 15 million tons of surface soil saved would equal 6 inches of topsoil on 120 average sized Iowa farms.

In a 3-year rotation of corn, oats and meadow, 10 tons of soil have been lost per year in a test at the Soil Conservation Experimental Farm in Page County. This was Marshall silt loam with a 9 percent slope. At this rate of loss, the 6-inch plow layer would be lost in 75 years. The crops in this test were not grown on the contour, but with ordinary up-and-down hill farming.

The Increased Yields

Why does farming round the hill on the contour increase yields? Because it helps hold the fertile soil in place, holds the needed moisture and improves the stand. Just how much fertility is lost by erosion depends on the steepness and length of the slope, the kind of soil and the type and amount of vegetation.

Studies in Iowa for several years show that corn yields go down as soil is lost by erosion. Just how much the yield drops with loss of surface soil varies widely. The kind of soil and the way it is managed have much to do in determining that. Let's assume for comparison that an average loss of 1 inch of soil reduces the yield of corn 5 bushels an acre. If we take the soil losses previously referred to, then the yield...
would drop about \( \frac{1}{2} \) bushel each year because of fertility loss. If we can cut this in half by contour farming, the yield would amount to a great deal over a long period.

It takes between 9 and 15 inches of water to produce a 50-bushel corn crop. The average annual rainfall in Iowa for July and August is 7.3 inches. During July and August alone, corn needs about 70 percent of its total water, so that means 6 to 10 inches of rainfall are needed in those 2 months. If we can conserve some of the early rainfall by contouring, then the corn crop is more likely to get the amount needed. When rows run around the hill on the level, the ridges and furrows made by the planter and cultivator act as small dams, allowing from 2 to 3 inches more water to soak into the soil for use later.

If fertility and moisture are well supplied, then the number of bushels of corn we harvest will depend largely on the stand. We found that up-and-down hill rows had 6.4 percent fewer stalks than corn on the contour grown beside them. That's one reason contoured corn outyields the up-and-down hill corn—there are more stalks per acre in the contoured fields.

Sometimes it has been necessary to replant the up-and-town hill rows when rainfall has been heavy with much washing. The contoured corn in these years has had some siting in of the rows, but the damage to the stand never was enough to make it necessary to replant. Rains later in the season also have affected yields by washing gullies between the up-and-down hill rows so that the roots were damaged by the sun and cultivating. When the roots are injured the plant cannot gather the food necessary to make a good crop.

**Saves Power, Fuel**

Our information shows that one saves about 10 percent in the fuel and power when the tractor and other machinery are operated on the contour. There is also less wear and tear on the machinery since there are fewer gullies to cross. Fields with seep spots in them usually have these spots at about the same elevation on the slope. By contour farming, one can avoid working through these places until they have dried up enough to be worked properly.

**Not a Cure-All**

Although farming round the hill—on the contour—is one of the most convenient and easily started of soil conservation practices, it's not a cure-all. In general we know that contouring alone on slopes steeper than 5 percent and longer than 200 feet will not give enough control of erosion. The control is not enough to keep the soil producing at top capacity and prevent gullies from starting in our usual Iowa farm cropping systems.

To help in erosion control, we need not only to farm the sloping land on the contour, but to do these other things: (1) Keep the land in legume meadows longer. (2) Strip crop. (3) Terrace. One or more of these should support contour farming on many Iowa farms where contouring alone will not do the job.

**The 4-Year Count**

As we look back over the past 4 years, we find that Iowa farmers have contoured about 3 million acres of corn. With a yield of nearly 7½ bushels more than would have been obtained with up-and-down hill farming, that means these farmers put a bit over 22 million bushels more corn in their cribs. Those 22 million bushels of corn, in terms of pork, were enough to fatten 1½ million 250-pound hogs.

Contouring is on the increase. There were 400,000 acres contoured in 1942 and 1,000,000 acres in 1945. We have about 7,000,000 acres in Iowa that should be farmed on the contour, so we still have a long way to go, but we are on our way.

**DDT Helps Potatoes**

In small plots of potatoes at the Iowa Station treated with 3 percent DDT dust in 1944, the yield was about twice that of potatoes which received no treatment.

Five applications of DDT dust were made at 10-day intervals during the summer. The DDT effectively controlled the leafhopper, aphids and potato flea beetle.

When 1 percent DDT dust was used there were light infestations of these three insects.

The potatoes which were dusted with 3 percent DDT showed unusually heavy blossoming.

The Minnesota Station has reported favorable results with the use of DDT on potatoes. In fact the dust first gained some of its fame in saving the potato crop from the Colorado potato beetle in Switzerland during the war.

Plots were treated at the Iowa Station in 1945, but the seed was infected with blight virus so that the results had to be discarded.

**Cutting Alfalfa Late**

Cutting alfalfa after September 1 may injure the stand seriously. Work at the Iowa Station has shown this as have experiments at Michigan and Wisconsin.

If the second crop is cut about the middle of July and growing conditions are good afterward, then a third cutting may be made about September 1 without hurting the stand, the work at the Iowa Station indicates. If the second crop is cut late, however, and the growth is not rapid, a September cutting is likely to injure the stand considerably.

September cutting probably injures the stand because the reserves in the roots are used up by the growth of the new crop and there is not time for the root reserves to be built up again. October cuttings are less injurious because cold weather comes on so quickly that there is not an opportunity for a new growth to be made and use up the root reserves of plant food.

In a fall cutting at the Iowa Station in 1944, the varieties Ladak, Cossack and Ranger were compared to see whether there was any difference in them concerning fall cutting. There seemed to be no noticeable difference.

In 1944 the highest yield was obtained from plots which had not been cut the previous fall.