Nitrogen fertilizers for corn

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NITROGEN FERTILIZERS for CORN
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SUMMARY

1. Profitable responses from nitrogen fertilizer are usually obtained on corn following a straight grass sod. (Decaying grass roots may tie up available nitrogen.) Use 40 to 100 pounds of actual nitrogen.

2. Responses are profitable at present prices on second-year corn—especially if past management has been poor. Use 20 to 60 pounds of actual nitrogen—the higher rate on the western Iowa soils and on the light-colored or sandy soils of eastern Iowa. If the field is manured, extra rates of nitrogen may not pay.

3. Corn 3 or more years away from a good legume has good chances for a profitable response. Depending upon the condition of the soil, use 40 to 100 pounds of nitrogen.

4. Usually there's little or no response on corn the first year following a legume. But if the legume stand was poor, 20 to 40 pounds of nitrogen may be profitable.

5. If you're after high yields, don't overlook the possibility of using 20 to 40 pounds of nitrogen on productive corn land. Put more on soils low in nitrogen—up to 100 pounds per acre (equivalent to 300 pounds of ammonium nitrate).

6. There should be a final stand of 12,000 stalks per acre on the lower fertility soils and 16,000 stalks per acre on the higher fertility soils for best utilization of nitrogen fertilizer. This means stands of 3 to 4 plants in 40-inch by 40-inch hills or the equivalent in drilled corn. With side-dressing, adjust for stand—less nitrogen for poor stands and more for good stands.

7. Test your soil and use phosphate and potash if needed. If phosphorus or potassium is very deficient, nitrogen responses may be limited by lack of either one or both.

8. Purchase your nitrogen fertilizers early. This assures you of your supply. It also will help to ease the storage problem of the manufacturers.

9. The above recommendations include the range of rates for profitable responses. Remember that the lower rates of 20 to 40 pounds of nitrogen per acre are more efficient—give you more bushels per dollar spent for nitrogen fertilizers. But on soils really short on nitrogen, more total profit can be obtained with the higher rates.
Nitrogen Fertilizers for Corn

By Lloyd Dumenil

Lack of nitrogen limits corn production on most Iowa soils. Many Iowa farmers can use nitrogen fertilizer profitably, our experiments show. As the supply increases, much more nitrogen fertilizer will be used—on a larger number of acres and at higher rates per acre.

Many of you have used nitrogen fertilizer on corn. But many more of you will be using nitrogen in the future. The Iowa Agricultural Experiment Station has conducted over 200 experiments with nitrogen fertilizer on cornfields over the state since 1943. It is the purpose of this bulletin to give you the information gathered from these experiments along with pointers to help you use nitrogen profitably on your cornfields.

NITROGEN DEFICIENCY SYMPTOMS

Color of growing corn is often a good indication of how much nitrogen the soil is supplying. One field may have the normal, dark green color, while another across the fence may show a sickly, yellowish-green color—a severe nitrogen deficiency.

Nitrogen starvation shows up even more plainly about tasseling time or later when the lower leaves begin to “fire.” The lower leaves turn yellow at the tip and along the mid-rib. Then the yellowing moves out toward the edges of the leaves. These leaves may die. Under severe nitrogen deficiencies, all leaves below the ear may die—stalks may be short and spindly with a high percentage barren and nubbins on the rest.

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1 Project 1189, Iowa Agricultural Experiment Station.
2 Assistant professor of soils, Agronomy Department. The earlier experiments were under the direction of L. B. Nelson and C. A. Black. In recent years the following members of the Agronomy Department have contributed to these studies: R. P. Nicholson, H. R. Meldrum, George Stanford, John Hanway, A. J. Englehorn and Norman Nelson.
These pictures were taken in 1947 on a Clarion loam. Yield without fertilizer was 27 bushels per acre. Corn on right, which received 300 pounds of 0-20-0 plowed under, yielded 38 bushels per acre. Corn on left, which received same amount of phosphate plus 60 pounds of nitrogen plowed under, yielded 47 bushels per acre. Both had received starter fertilizer. Note nitrogen deficiency on lower leaves (right). Also note the leaf-rolling (right) which indicates lack of moisture. The nitrogen increase was limited here by severe drought.

**HOW TO SUPPLY NITROGEN**

There are three ways to supply nitrogen to the soil to meet the needs of your corn crop:

1. Through legumes in the rotation.
2. Through the use of manure and crop residues.
3. Through the use of nitrogen fertilizers.

Inoculated legumes like red clover, alfalfa and sweet-clover take large amounts of nitrogen from the air. If these crops are plowed under or are fed to livestock and the manure returned, the nitrogen becomes available for the following corn crops. Careful handling of manure to avoid losses of fertility will pay good dividends in yield increases.

Not all farmers follow a type of soil management that will maintain a good supply of available nitrogen in the soil. There may be too much corn and not enough legumes in the rotation. Legume seeding failures may upset the rotation.
These pictures show corn grown in an experiment on Marshall silt loam in Carroll County, 1951. On this very nitrogen-deficient field, yield without fertilizer was 28 bushels per acre. Yield increase from 80 pounds of actual nitrogen side-dressed was 48 bushels per acre. The stand level and phosphorus and potassium supply of this field were adequate for a large nitrogen response. Note the small and poorly filled ears on the check (no fertilizer) treatment. The several small ears in the corn receiving 80 pounds of nitrogen show that even more nitrogen was needed for maximum yield. (Two rows of kernels from several ears were removed for a moisture sample.)
Legume yields may be low because of lime, phosphate or potash shortages.

Many farmers have small numbers of livestock on the farm. Very few farmers have enough manure to cover all corn land. But all corn land needs plenty of nitrogen for high yields.

**NITROGEN FERTILIZER**

There's much confusion about nitrogen fertilizer. Nitrogen fertilizer is used on corn in two different ways: (1) through a starter fertilizer—such as 4-16-8—applied

Both plow-under nitrogen and starter fertilizer (160 pounds of 3-12-12) were profitable on this Clarion loam in Greene County in 1951. Since there was a medium level of phosphorus and potassium in this soil, the nutrient balance was not critical. Nitrogen responses were similar with and without starter fertilizer,
with a planter attachment near the hill or in the row at planting time; (2) through a straight nitrogen fertilizer—such as ammonium nitrate—or a high-nitrogen mixed fertilizer, for the purpose of supplying nitrogen to the corn during the latter part of the growing season.

With starter fertilizer, only about 3 to 6 pounds per acre of elemental nitrogen is usually added. That's only enough to help the young corn plants get started. Later on, the plants may "fire" if there isn't enough nitrogen in the soil to supply the needs of a good corn crop. This is where extra nitrogen is needed—at rates above 20 pounds of actual nitrogen per acre.

A straight nitrogen fertilizer such as ammonium nitrate, anhydrous ammonia or ammonium sulfate will fill most of the nitrogen needs of corn. But on some soils which are also very deficient in phosphorus and potassium, high-nitrogen mixed fertilizers, such as 16-20-0 or 10-10-10, can be used.

Pound for pound of actual nitrogen there is little or no difference between different kinds of nitrogen fertilizers. Cost per pound of actual nitrogen is what's important in choosing the kind. To calculate the cost per pound, first multiply the percent nitrogen by 20 to get the pounds of nitrogen per ton. Then divide the price per ton by the pounds of nitrogen per ton. For example, ammonium nitrate has 670 pounds of nitrogen per ton (33.5 percent times 20). If it costs $87 per ton, then $87 divided by 670 gives you 13 cents as the price per pound of nitrogen.

Here is the list of the most common straight nitrogen fertilizers, their percentage composition and the rates to apply to get on 40 pounds per acre of nitrogen:

<table>
<thead>
<tr>
<th>Kinds</th>
<th>Percent nitrogen</th>
<th>Amount of fertilizer supplying 40 pounds nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anhydrous ammonia</td>
<td>82</td>
<td>49</td>
</tr>
<tr>
<td>Urea</td>
<td>44</td>
<td>91</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>33.5</td>
<td>120</td>
</tr>
<tr>
<td>Ammonium sulfate</td>
<td>21</td>
<td>190</td>
</tr>
<tr>
<td>Calcium cyanamide</td>
<td>21</td>
<td>190</td>
</tr>
<tr>
<td>Imported</td>
<td>20 to 26</td>
<td>200 to 155</td>
</tr>
</tbody>
</table>
On this Clarion loam in Greene County in 1951, the most profitable rate of side-dressed nitrogen without starter fertilizer was 40 pounds of actual nitrogen. In this same experiment where a starter fertilizer (85 pounds of 10-30-10) had been used, the yields were 72, 84, 91 and 101 bushels for the corresponding treatments. On this soil testing low in phosphorus and medium in potassium, the proper nutrient balance was needed to get most efficient use of the highest rate of nitrogen.

**FACTORS AFFECTING NITROGEN RESPONSES**

Nitrogen fertilizer responses (yield increases) vary over the state because of type of soil, amount of erosion, past soil management, seasonal conditions, rate of planting and supply of other nutrients.

**SOIL TYPES**

Some soil types show more nitrogen response than others. Some are naturally lower in organic matter and nitrogen.

The light-colored, forest soils of south-central and eastern Iowa, and the Marshall, Sharpsburg and Monona soils of western Iowa show the largest average responses to nitrogen. The dark-colored, medium-textured soils of central and eastern Iowa show somewhat lower responses on the average. But in this group there are many fields that show large responses.
EROSION

Since most of the organic matter and nitrogen is in the topsoil, erosion cuts down the supply of available nitrogen. Often you can spot eroded parts of your field in late summer by the color of the corn. Unless the physical condition of the soil is poor, you can expect good nitrogen responses on those eroded parts.

PAST SOIL MANAGEMENT

Past soil management—including past cropping pattern and use of manure—affects nitrogen response the most. The effect of the past cropping pattern upon nitrogen responses is shown in Table 1. This is a summary of our experiments since 1948 where different rates of nitrogen were side-dressed on corn.

TABLE 1. EFFECT OF PAST CROPPING UPON NITROGEN RESPONSES OF CORN.*

<table>
<thead>
<tr>
<th></th>
<th>Number of fields</th>
<th>Check yield (unfertilized) (Bu/A)</th>
<th>Increases in bushels per acre over check yield for following rates (pounds nitrogen per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn 1st year after legume</td>
<td>6</td>
<td>76</td>
<td>5   6   7</td>
</tr>
<tr>
<td>Corn 1st year after clover catch crop</td>
<td>5</td>
<td>64</td>
<td>6   9   11</td>
</tr>
<tr>
<td>Corn 1st year after grass sod</td>
<td>5</td>
<td>50</td>
<td>12  16  22</td>
</tr>
<tr>
<td>Corn 1st year after soybeans</td>
<td>9</td>
<td>69</td>
<td>10  14  16</td>
</tr>
<tr>
<td>Corn 2nd year after legume</td>
<td>13</td>
<td>65</td>
<td>10  13  16</td>
</tr>
<tr>
<td>Corn 3rd year after legume</td>
<td>19</td>
<td>55</td>
<td>10  15  20</td>
</tr>
</tbody>
</table>

*The response to the higher rates of nitrogen in several fields was limited by an inadequate stand level or supply of other nutrients.

This summary shows that the largest responses have been on corn following a grass sod, such as brome, timothy or bluegrass, and on corn several years removed from a legume crop. Higher rates of nitrogen are more profitable under these conditions. Generally the longer the time between corn and the preceding legume crop, the larger and more certain is the nitrogen response.

Adding nitrogen to first-year corn following a good stand and growth of a legume, such as clover and alfalfa, usually
is not profitable. But it may pay if the legume crops are poor. Generally, only the lower rates of nitrogen will be profitable on corn following legumes.

Knowledge of the past management of a field is a good guide in making nitrogen fertilizer recommendations. (See table 1.)

Ten tons of manure per acre will add about 100 pounds of nitrogen—equivalent to 300 pounds of ammonium nitrate. But all of this will not be available to corn the first year. With light application of manure, adding some nitrogen fertilizer will often be profitable.

**SEASONAL CONDITIONS**

Seasonal conditions influence the amount of nitrogen released from the soil. In cool, wet seasons the nitrogen release from the soil or from manure or legumes plowed under may be slow. Under these conditions nitrogen fertilizer gives good results. Or the release may be so rapid in other seasons that nitrogen fertilizer may not be profitable on some second-year cornfields. This is why we can’t determine whether nitrogen is profitable or not just on a 1-year trial. *It's the results over a period of years that count.*

**RATES OF PLANTING**

Rates of planting also influence the nitrogen response. To use the existing soil fertility or added nitrogen most efficiently, there should be more plants per acre than many farmers have.

For the fields fertilized with nitrogen, the final stand at harvest should be between 12,000 and 16,000 stalks per acre. This means 3 to 4 stalks per hill with a 40-inch by 40-inch spacing or 1 stalk each 13 to 10 inches in drilled corn. What you should have will depend upon the fertility level you start with and how much fertilizer you apply. Occasionally the final stand should be less than 12,000 stalks on drouthy or extremely low fertility soils. But if you are aiming for 90 to 100 bushels of corn, the final stand should be between 13,000 and 14,000 stalks per acre.

To get these stands at harvest time you must plant more
kernels than the number of stalks per acre desired. Only 80 to 85 percent of the kernels you plant will be there as stalks in the fall. For example, planting 4 kernels per 40" × 40" hill or drilling 1 kernel every 10 inches on the average will give a final stand of 12,500 to 13,500 stalks per acre (about 3.2 to 3.4 stalks per hill).

Just how stands affect nitrogen responses is shown in fig. 1. Without nitrogen, three stalks per hill at harvest was the best stand. With nitrogen, four stalks per hill was the best. Only at four stalks per hill was the high rate of nitrogen more profitable than the low rate.

Considering all experiments from 1943 to 1946, 40 pounds of nitrogen gave an average increase of 6.2 bushels per acre. The average stand was 9,000 stalks per acre—too low to make the most efficient use of nitrogen fertilizer. But in recent years, with an average stand of 11,800 stalks per acre, 40 pounds of nitrogen has given an average increase of 13.0 bushels per acre. The larger nitrogen responses in recent years were partly the result of higher stands.

**NUTRIENT BALANCE**

For the most efficient use of nitrogen, there must be an adequate supply of other nutrients. The “trick” in the most profitable use of fertilizers is understanding this nutrient balance.

The nitrogen response will be about the same on the soils
Those average ears are from Ida silt loam in Monona County in 1951. On this nitrogen- and phosphorus-deficient soil, the nutrient balance is critical. Heavy rates of both nitrogen and phosphate are needed for top yields. Upper left: 8-bushel yield without fertilizer. Upper right: 11-bushel yield from 80 pounds of nitrogen plowed under. Lower left: 22-bushel yield from 80 pounds P₂O₅ (400 pounds 0-20-0) plowed under. Lower right: 53-bushel yield from these rates of nitrogen and phosphate used together.

testing medium or above in phosphorus and potassium whether these are added or not. But the soils we have to watch are the ones testing low to very low in these nutrients. On many of these, phosphate and/or potash may increase yields and also help give larger nitrogen responses.

Where deficiencies of phosphorus and potassium are not severe, a starter fertilizer in addition to the nitrogen will give a good nutrient balance. (A starter fertilizer is one applied along the row or in the hill at planting time with a fertilizer attachment on the planter.) For example, in one of our tests, nitrogen alone gave a 16-bushel increase; starter fertilizer alone gave an 11-bushel increase. But the two together gave a 38-bushel increase—illustrating the added efficiency of the combination.

On our soils testing very low in phosphorus and/or potas-
sium, this nutrient balance has been the most critical. In one test in western Iowa on a soil extremely deficient in both phosphorus and nitrogen, 80 pounds of nitrogen per acre alone gave a 3-bushel increase; phosphate alone (80 pounds of available P$_2$O$_5$) gave a 14-bushel increase. But the combination gave a 45-bushel increase. In this extreme case, nitrogen had little value unless used with a heavy application of phosphate.

**NITROGEN EFFICIENCY**

We often think of “nitrogen efficiency” as the number of pounds of elemental nitrogen that it takes to give a 1-bushel yield increase. This will depend upon the previously mentioned factors causing different nitrogen responses and also upon the rate of nitrogen applied.

Heavy fertilization was required for a top yield on this Nicollet loam in Greene County in 1951. And nitrogen was needed before there was any increase from broadcast phosphate or potash. Nitrogen alone increased the yield to 73 bushels. The heavy rates of fertilizer were broadcast and disked in on this field. The starter fertilizer was 85 pounds of 10-30-10. Lack of soil fertility shows up plainly in backward years like 1951.
Table 2 illustrates how the "nitrogen efficiency" is affected by past cropping and by different rates of nitrogen.

**TABLE 2. VARIATION IN NITROGEN EFFICIENCY.**
*(Based on the data in table 1.)*

| Nitrogen efficiency: pounds of nitrogen for each bushel yield increase at following rates of nitrogen |
|-------------------------------------------------|-----------------|-----------------|-----------------|
| 20 pounds | 40 pounds | 80 pounds |
| Corn 1st year after legume | 4.0 | 6.7 | 11.4 |
| Corn 1st year after clover catch crop | 3.3 | 4.4 | 7.3 |
| Corn 1st year after grass sod | 1.7 | 2.5 | 3.6 |
| Corn 1st year after soybeans | 2.0 | 2.9 | 5.0 |
| Corn 2nd year after legume | 2.0 | 3.1 | 5.0 |
| Corn 3rd year after legume | 2.0 | 2.7 | 4.0 |

More efficient use of nitrogen is made on corn following a grass sod, or on second- and third-year corn. Moreover, the lower rates of nitrogen are more efficient than higher rates. When soils are only slightly low in nitrogen, the lower rates are especially advantageous.

An efficiency of 1 bushel increase from each 2 pounds of nitrogen added is good. At the 20-pound rate of nitrogen, the average efficiency is about 1 bushel from each 2 pounds of nitrogen added. Some fields will show an efficiency of 1 bushel from 1 pound of nitrogen added at the 20-pound rate. With the 40-pound rate of nitrogen the efficiency is less, with yields being increased 1 bushel from each $2\frac{1}{2}$ to 3 pounds of nitrogen. But many individual fields will show an efficiency of 1 bushel from 2 pounds of nitrogen added at this rate.

With rates above 40 pounds of nitrogen, the efficiency often decreases rapidly, with the best average at the 80-pound rate being 1 bushel from each 4 pounds of nitrogen added. However, many fields will do better than this at the 80-pound rate of nitrogen if the stand level and other nutrients are adequate.

The first 20 pounds of nitrogen gives the largest increase in yield per pound of nitrogen applied and thus the greatest return on fertilizer. But the higher rates of application with present price relationships often give a higher total return per acre. This is illustrated in table 3, which gives the returns
TABLE 3. RETURNS PER ACRE FROM VARIOUS RATES OF APPLICATION OF NITROGEN FERTILIZERS.
(Data from table 1, "Corn 3rd year after legume.")

<table>
<thead>
<tr>
<th>Rate of application (lbs. of nitrogen per acre)</th>
<th>Yield increase (bu. per acre)*</th>
<th>Cost of fertilization</th>
<th>Value of increased production†</th>
<th>Net increase in return from fertilizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10</td>
<td>$4.10</td>
<td>$15.00</td>
<td>$10.90</td>
</tr>
<tr>
<td>40</td>
<td>15</td>
<td>6.70</td>
<td>22.50</td>
<td>15.80</td>
</tr>
<tr>
<td>80</td>
<td>20</td>
<td>11.90</td>
<td>30.00</td>
<td>18.10</td>
</tr>
</tbody>
</table>

* The check yield without fertilizer was 55 bushels per acre.
† The cost of fertilizer includes nitrogen at 13 cents per pound and $1.50 per acre for cost of application.
‡ Corn is valued at $1.50 per bushel.

from various rates of nitrogen fertilizer on corn based on current costs. You can use your own costs of fertilizer and application with the data in table 1 to calculate the returns under other conditions. As pointed out in the next section, the carry-over value may pay much of the cost of the fertilizer.

NITROGEN CARRY-OVER

Our recent experiments have shown that when 40 to 60 pounds of nitrogen is applied to corn, part of it carries over and increases the yield of the following oat or corn crop. The residual carry-over from 60 pounds of nitrogen applied to

This picture shows the effect of nitrogen carry-over at the Southern Iowa Experimental Farm in Davis County, 1951. Oats on the right which followed unfertilized corn yielded 44 bushels. Oats on left which followed corn that was side-dressed with 30 pounds of nitrogen in 1950 yielded 52 bushels. The nitrogen increased corn yields in 1950 by 9 bushels.
Due to Residual Carry-over of Nitrogen

Fig. 2. The increases due to residual carry-over of nitrogen fertilizer on oat yields compared with increases from nitrogen applied at seeding time.

corn increased the yields of the following oat crops from 3 to 16 bushels per acre. On these same fields, 20 pounds of nitrogen applied at the time of oat seeding increased yields of oats from none to 18 bushels per acre. Approximately one-fourth of moderate to heavy rates of nitrogen applied to corn carries over to the next year on the medium- to heavy-textured soils. The increases in oat yields from the nitrogen carry-over and from nitrogen applied the same year are shown in fig. 2.

When carry-over is considered, the risk involved in using nitrogen fertilizer is decreased. If responses on corn are low due to drouth, low stand levels or other nutrient deficiencies, the carry-over will help to pay for the fertilizer or show a larger profit in its use.

If the corn has been fertilized with 40 to 80 pounds of nitrogen, the nitrogen fertilization of the following oat crop should be reduced or eliminated. Too much nitrogen on the oat and legume seeding may decrease legume stands and subsequent yields.

Straight nitrogen fertilizer generally will give larger returns if applied to corn rather than to oats. Then we can let the carry-over take care of part or all of the nitrogen needs of the oat crop.
HOW AND WHEN TO APPLY

There are several ways to apply the solid forms of nitrogen fertilizer:

1. Broadcasting and plowing under in the spring.
2. Broadcasting and diskin before planting corn.
3. Broadcasting after the corn is up.
4. Side-dressing with a corn-planter attachment, cultivator attachment or deep-placement machine.

Our experiments have shown there's little difference in the results from using the different methods of applying nitrogen fertilizer. Here's a comparison between the methods using 40 pounds of nitrogen per acre:

<table>
<thead>
<tr>
<th>Comparisons</th>
<th>Average increase (bushels per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Broadcast and plow under</td>
</tr>
<tr>
<td>10 (1943-1946)</td>
<td>12</td>
</tr>
<tr>
<td>3 (1946, only)</td>
<td>10</td>
</tr>
</tbody>
</table>

Some people have erroneous ideas about nitrogen application. One is that the fertilizer must be worked into the soil immediately after application to prevent evaporation losses. There is no loss in this way. Another is that if the nitrogen fertilizer is applied before planting, it will be leached out of the soil so rapidly that little will be left later in the season. Our results, as given above, plus the excellent responses we have obtained from spring plowing-under of nitrogen, even in the wet seasons of 1950 and 1951, indicate that leaching losses are small on the loams, silt loams and heavier-textured soils. Since leaching losses may be high on sandy soils, side-dressing may give better results on these soils in most seasons.

Broadcasting and Plowing Under. Broadcasting and plowing under in the spring can be handled with broadcasting equipment that most farmers have. Mixed fertilizers such as 16-20-0 or 10-10-10, where needed, will likely give better results, especially in the drier seasons, if plowed under rather than disked in before planting. Where fall plowing is done,
The low-down broadcast spreader above is often used for applying fertilizer. It gives an even distribution. The newer models deliver a wide range of amounts, and many are adapted for other uses. Other types of broadcast equipment, such as endgate spreaders or centrifugal fan type spreaders, are also being widely used. They often give uneven distribution although they may save time and labor.

Applying nitrogen or mixed fertilizers then may not be as efficient as applying either in the spring.

**Broadcasting and Disking In.** Broadcasting and disking in can be handled with the same equipment as for broadcasting and plowing under. The main advantage of this method is more leeway in the time of application. The disadvantage is that early weed growth is stimulated.

**Broadcasting After Corn Is Up.** Broadcasting soon after the corn is up can be handled with a low-down broadcast spreader. Fertilizer should be kept off corn plants by the use of shields or by plugging the holes over the corn rows. Less injury results if the fertilizer is applied in the afternoon when the corn leaves are drier. This method can be used if fertilizer becomes available after planting and other methods of application aren’t available.
Side-dressing. There are several ways of side-dressing. The fertilizer attachment on a corn planter can be used by offsetting the planter and straddling the rows. The common method of side-dressing nitrogen calls for special equipment mounted on the cultivator. Fertilizer tubes are placed behind the second or third shovels so that the fertilizer is placed a few inches in the soil. A third method is with one of the deep-placement machines now on the market. They may have some advantage for later side-dressing in drier seasons.

Advantages of side-dressing are that you can apply lower rates of fertilizer easier; fertilizer rates can be varied according to stands; and supplies of straight nitrogen fertilizer may be more plentiful at the time of side-dressing.

It has two disadvantages, depending upon the method. The corn planter attachment or deep-placement machine takes an extra operation in a busy season. The cultivator attachment slows down cultivation. And, if the application is late and July and August rainfall is low, the corn won’t get full use of the added nitrogen.

Side-dressing should be done at least by the time of the second cultivation or around the middle of June. However, if there’s plenty of rain, you may get good results as late as the middle of July.

Anhydrous Ammonia Application. Anhydrous ammonia requires special application equipment and storage tanks. It is a liquid under pressure which changes to a gas when released in the soil. The price of the material usually includes its cost of application. It can be applied before planting (preferably after the soil has been plowed and disked) or it can be side-dressed.
Anhydrous ammonia is new to most Iowa farmers. It requires special application equipment and careful handling because of the high pressures involved. The price usually includes the cost of application by custom operators. However, farmers who fertilize a large corn acreage with nitrogen can afford to purchase the application equipment.

The pull-type equipment shown at left is being used for a pre-plant application of anhydrous ammonia. The basic equipment can also be mounted on a tractor. This equipment includes the 100-gallon tank, metering pump which regulates the rate of application, connecting hoses and applicators which are inserted into the soil to a depth of 4 to 7 inches.

This shows liquid ammonia changing to a gaseous vapor when the applicators are lifted out of the ground. When the applicators are put into the soil, this ammonia gas is absorbed by the clay particles of the soil. Under proper soil conditions, none or very little is lost. The metering pump is controlled by the handle the operator is holding. The chain drives calibrate the metering pump to the ground speed of the equipment.
This is a close-up of the applicators which place the ammonia to a depth of 4 to 7 inches in the soil. The outlets, shown by the arrow, are just behind the base of the applicator points.

All of the necessary field equipment for anhydrous ammonia application is shown here. The 100-gallon tank of the tractor-mounted equipment is being filled in the field from the 1,000-gallon portable supply tank. Safety precautions are necessary here, since most accidents occur when transferring from one tank to another. Note that the operator is wearing a gas mask and rubber gloves. A bucket of water is available for washing exposed skin surfaces in case of accident. Other safety equipment includes pop-off valves on the tanks and bleeder valves in the hoses. The equipment must be strong enough to withstand high working pressures.

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