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# CC184 More Corn Profits through Timely Use of Nitrogen and Efficient Irrigation

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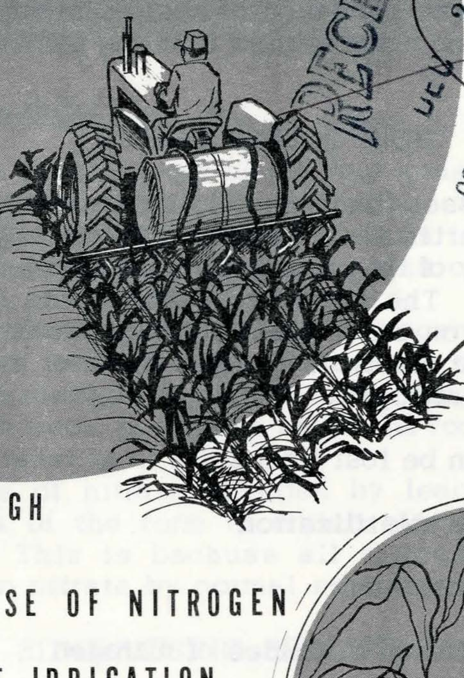
CC 184

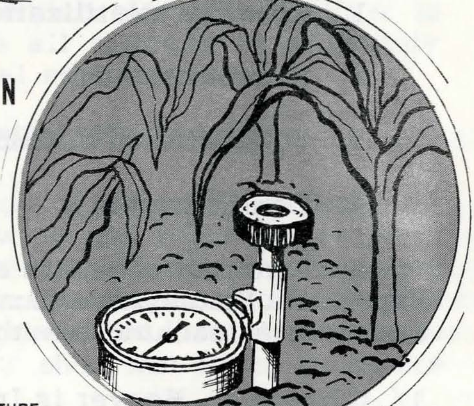


# More Corn Profits



THROUGH

- TIMELY USE OF NITROGEN
- EFFICIENT IRRIGATION



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MORE CORN PROFITS
through
- timely use of nitrogen
- efficient irrigation

by Clinton A. Hoover, Paul E. Fischbach, Paul E. Schleusener1/

The time of year nitrogen fertilizer is applied for irrigated corn can greatly influence the results farmers get from their fertilizer. Losses of applied nitrogen in many cases are keeping down returns from the fertilizer investment.

## HOW LOSSES OCCUR

Nitrogen losses from the soil are not restricted to any one nitrogen fertilizer. Losses may be slight or very serious with any of the common straight nitrogen fertilizers on the market. The extent to which these losses may occur depends on environmental conditions as well as soil management practices, irrigation water management, and the form of nitrogen.

Nitrogen can be lost from soils in at least four ways:

1. Ammonia volatilization

2. Nitrate leaching

3. Volatilization of oxides of nitrogen

4. Denitrification

Research agronomists at the Nebraska Agricultural Experiment Station have found that ammonia volatilization and nitrate leaching are the two more important ways

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nitrogen is lost from soils under most Nebraska farming conditions.

Ammonia Volatilization

This can occur where fertilizers containing the ammonium form of nitrogen, or fertilizers producing ammonia, are left on the soil surface. Losses of nitrogen in this way can be especially serious where these materials are applied to alkaline soils and when rapid drying conditions follow the fertilizer application. Such losses of nitrogen can be minimized by working the nitrogen fertilizers (solid and solutions) into the soil during or immediately following application.

Nitrate Leaching

Nitrate leaching out of the root zone of crops during a wet year and with over-irrigating can represent an economic loss of nitrogen as well as irrigation water. Yields are usually reduced when this occurs.

Research shows that nitrate nitrogen moves with the wetting front as water moves through the soil. This means that nitrate nitrogen is subject to leaching losses in those soils where water penetrates below the root zone of crops.

Losses of nitrate nitrogen by leaching can occur regardless of the form in which nitrogen fertilizer is applied. This is because all nitrogen is ultimately changed to nitrate by normal soil processes.

## SIDEDRESSING REDUCES LOSSES

Delaying the application of nitrogen fertilizer for corn until the crop is growing and roots are actively absorbing nitrogen reduces the time during which applied nitrogen may be subjected to leaching and volatilization losses. Fertilizer experiments on irrigated corn in Nebraska during 1957-1959[2] show that better yields are

2/ R. A. Olson, W. E. Lamke and H. F. Rhoades, "When Fertilizing Irrigated Corn - Time of Nitrogen Application Is Important." Nebraska Experiment Station Quarterly, Spring, 1960.

usually obtained from summer sidedressing than from either fall or spring preplant applications when nitrogen fertilizers are applied at minimum rates. When more nitrogen fertilizer is applied than is needed for top corn yields, the differences between fall, spring, and sidedressing times of application are usually insignificant.

These experiments show that summer sidedressing of nitrogen fertilizer for corn will generally be best for the irrigator (1) attempting to operate with a minimum fertilizer investment, (2) depending on maximum fertilizer efficiency, or (3) irrigating sandy soils. The time of nitrogen application for irrigated corn is of much less importance on medium to fine textured soils so long as above optimum rates of nitrogen fertilizer are applied.

## IRRIGATION RECOMMENDATIONS

Nitrates are soluble and move with the water through the soil. During irrigation, water moves down through the soil carrying the nitrates with it. Some nitrates may move in advance of the wetting front if the wetting front meets soil that already has a moisture content at field capacity.[3]

Excess irrigation water should not be applied unless leaching of harmful salts is required. Irrigation water should not penetrate below the depth from which roots have extracted soil moisture. If it does, the water will move most of the nitrates out of the root zone. This is called nitrate leaching.

To avoid leaching, the irrigator must know when to start and when to stop irrigating. This can be done by using tensiometers. Tensiometers will show the depths from which moisture has been used by the plants. The depth of water penetration can then be determined from the tensiometer readings during irrigation.

3/ Unpublished data by P. E. Fischbach, Associate Professor of Agricultural Engineering (Agricultural Extension), and Delno Knudsen Assistant Professor of Agronomy (Agricultural Extension), University of Nebraska College of Agriculture.

1. Off-season Irrigation

On deep, medium-textured soil the profile should be filled to a depth of six feet before planting time. This can best be done with the last irrigation of the previous season. At this time most of the nitrates have been used by the crop and nitrate leaching will be at a minimum. Some soil moisture may be used before frost, but fall and spring rains will probably replace this moisture.

Irrigation water may also contain soluble salts, other than nitrates, which, if left to accumulate in the root zone, may have a harmful effect on the soil. If the root zone was filled to field capacity at the last irrigation, the chance of rainfall leaching these salts out of the root zone is also good. If the root zone is not refilled to a depth of six feet at the last irrigation, it is best to wait until after harvest to irrigate. Irrigation can also be accomplished satisfactorily in the spring of the year. Always refill the root zone with water prior to applying nitrogen fertilizer.

On clay pan soils off-season irrigation can be accomplished after harvest but before the soil freezes. A heavy irrigation before harvest or in the spring may hamper field operations because of slow water movement through the clay pan.

On shallow sandy soils off-season irrigation is impractical.

2. First Irrigation

Install tensiometers soon after planting to determine soil moisture use at various soil depths. Since irrigation may be needed before the last cultivation, place tensiometers in the row. Irrigation water penetration into the soil should not exceed the depth from which moisture has been used by the plants.

After the last cultivation or ridging operation, corn roots will have penetrated to a depth of about 18 inches. During the early tassel stage, corn is in the critical stage for water and nitrogen. Water penetrating below the root zone will not only waste water but will also leach the nitrates and reduce yields.

An eight day delay of irrigation at this critical stage may reduce the yields as much as 34 bushels per acre. 4/ Applying too much water in this stage may also reduce yields from 10 to 50 bushels per acre, depending on the amount of water applied. In extreme cases of over-irrigation, the yield may be reduced as much as 70 bushels per acre. Therefore, the first irrigation is the most critical and should penetrate only to the depth of soil moisture extraction.

3. Later Irrigations

On a deep, medium-textured soil, the later irrigations should wet the soil to a depth not to exceed three feet except for a last irrigation in late August or early September. This last irrigation should refill the root zone to six feet.

On claypan soils, care should be taken not to keep the topsoil above field capacity for too long a time. Using a small stream of water and applying it for several days may keep the topsoil above the claypan saturated too long. Under saturated soil conditions (water-logged), some nitrogen may be lost to the air by de-nitrification. Tensiometer demonstrations on claypan soils have also shown that excessive irrigation also causes poor root penetration. Excessive water displaces the soil air. The oxygen in the air is essential for the roots to develop and penetrate normally.

On shallow sandy soils, nitrate leaching is a critical problem, because the root zone is limited to the soil depth. In some cases the root zone is only 18 inches. Sandy soils also hold less water per foot of depth. Under these conditions, most all of the nitrate nitrogen may be leached if too much water is applied.

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4/ Orlando Howe, "When Applying Irrigation Water, Timing is Important," Nebraska Experiment Station Quarterly, Spring, 1955.

On the other hand, nitrogen in the ammonium form would not be leached by an excessive irrigation of these soils. But all fertilizer, regardless of the form in which it is applied, will ultimately be changed to nitrate nitrogen by normal soil processes. The depth of irrigation water penetration is extremely critical on these soils and the use of tensiometers is recommended to determine the depth of soil moisture extraction.

## UNIFORM PENETRATION OF IRRIGATION WATER OVER THE FIELD

The nitrate leaching problem also emphasizes the need for uniformity of irrigation water penetration over a field. Ideally, water should penetrate as deep on the lower end of the irrigation run as on the upper end. On silt loam and silty clay loam soils, a good rule is to get the water through the field in about one-fourth the total irrigation time, then reduce the stream size. On sandy soils with very little slope down the row, use a large, non-erosive stream of water to get the water across the field quickly, then stop irrigating.

The irrigation time will vary according to soil texture, amount of soil compaction, moisture condition of the soil, and the depth of penetration needed to replace the soil moisture extracted by the plant roots. Place tensiometers in the field to determine the soil moisture penetration on the upper and lower end of an irrigation run. If too much penetration occurs on the upper end of the run in comparison to the lower end of the run, the stream size should be increased to get the water through the field faster. An excellent penetration pattern during the first irrigation is 24 inches on the upper end, 21 inches in the middle and 18 inches on the lower end of the run.

## WATER QUALITY

Irrigation water may contain various kinds and amounts of salts. Most of these salts are beneficial for plant growth, but can also be harmful if in excess amounts. Others, particularly sodium, are detrimental to the physical state of the soil. If there is any question about salt content, a water quality test should be made of the irrigation supply.

Some soils that have been irrigated for several years show an increase in pH due to the liming effect of the irrigation water used. On the other hand, some waters containing high sodium concentrations have caused alkali problems. Where irrigation water of high soluble salt content is used, it is a good practice to apply a heavy application of water in the late fall or early spring to leach the harmful salts out of the root zone. This should be done only on deep, well-drained soils.