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Early season losses of nitrogen

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Abstract
It is generally recognized that spring rainfall can result in losses of fertilizer nitrogen (N) from soils, but there is little agreement concerning the importance of these losses. Surveys of nitrate concentrations in Iowa cornfields over the past decade provide new information on this matter. The surveys were conducted as part of the N-Check Program, in which the late-spring test for soil nitrate and the end-of-season test for cornstalk nitrate were used to assess N-sufficiency levels in fields managed by producers.

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The surveys were conducted as part of the N-Check Program, in which the late-spring test for soil nitrate and the end-of-season test for cornstalk nitrate were used to assess N-sufficiency levels in fields managed by producers. Fertilizer N was applied only before or at planting as usually done by the producers. The producers provided information about their N management practices. The study was conducted to evaluate outcomes of management practices across years rather than to guide fertilization within a year.

More than 3000 samples were collected over an 11-year period. Average concentrations of nitrate for the soil and stalk samples were calculated for each year. Separate averages were calculated for fields that received animal manure and fields that did not receive animal manure.

Yearly averages for nitrate showed a strong relationship with regional averages for rainfall during March through May (Figure 1). Soil nitrate concentrations substantially decreased with increasing amounts of rainfall. This trend suggests that rainfall often resulted in substantial losses of nitrate from the surface foot of soil before plants began rapid growth in June.

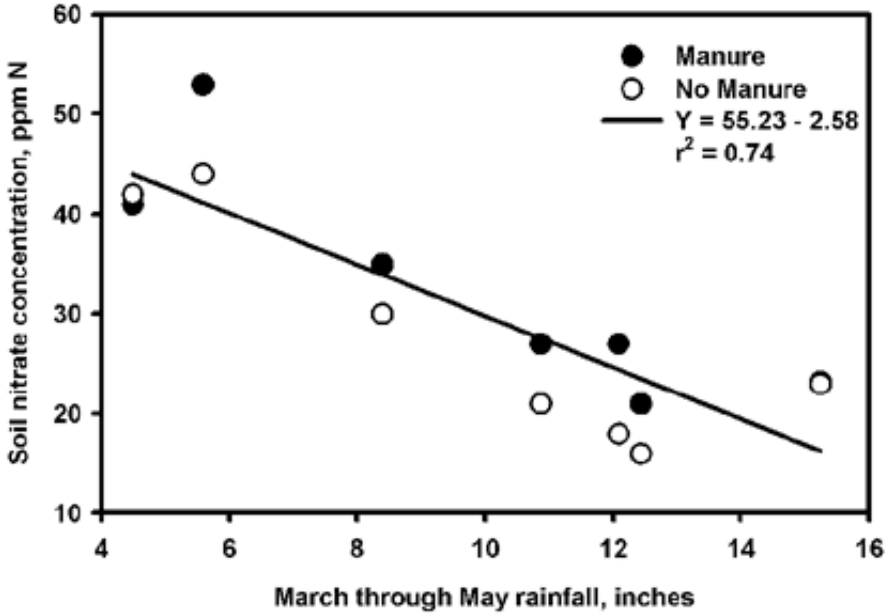

Figure 1. Relationship between early season rainfall and annual averages for soil nitrate concentrations measured in early June.

A similar trend was observed between early season rainfall and concentrations of nitrate in cornstalks at the end of the season. Because the stalk test indicates N sufficiency levels in plants, this trend indicates that early season rainfall often resulted in substantial losses of nitrate from the corn's rooting zone. This observation indicates that early season rainfall was a major factor affecting sufficiency of N for plant growth during the growing season.

Spring rainfall is important because soils usually are saturated with water and, therefore, this rainfall is especially effective at promoting movement of water through soils (Figure 2). The importance of this effect is illustrated by the finding of a good relationship between concentrations of nitrate in cornstalks at the end of the season and early season flows of water in key rivers that drain much of Iowa (Figure 3). It is obvious that movement of water through soils, rather than rainfall or river flows, should be considered the primary factor responsible for early season losses of N from Iowa cornfields.

Figure 2. Spring rainfall often causes losses of N from soils.

The results help explain why less N usually is needed to maximize yields on relatively dry years than on relatively wet years. They also explain why delaying fertilization until late May tends to decrease N fertilizer needs and variability in N fertilizer needs. These observations support the conclusion from other studies that amount of N lost early in the season is a major factor determining the amounts of fertilizer N that must be applied to maximize yields.

The results of this study demonstrate the value of using the late-spring test for soil nitrate in situations where all fertilizer N is applied at or before planting. This use of the test minimizes risks of yield loss on wet years. It also can be used to compare alternative management practices to identify which actually delivers more N for plant growth. This use of the soil test was described in the article N recommendations addressing weather [1] that appeared in this newsletter on June 9, 1997.

High N prices, possible shortages of fertilizer N, and low grain prices provide strong incentive to reexamine the potential benefits of delaying applications of N until late May or early June this year. Additional incentive is provided by environmental concerns related to nitrate concentrations in rivers.

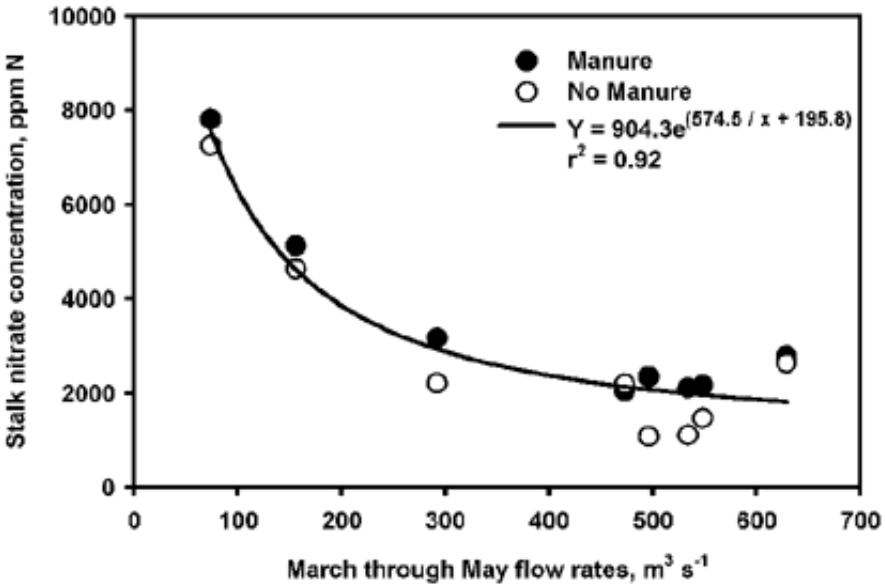

Figure 3. Relationship between early season flows of water in key Iowa rivers and annual averages for stalk nitrate concentrations measured at the end of the season.

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