2-26-2001

Impact of soil management practices on yield

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Abstract
This article covers the impact of different soil management practices on yield, and focuses on plant population and nitrogen (N) fertilizer management for corn planted on sloped soils. The relationship between A horizon (topsoil) thickness, corn population, and nitrogen fertilizer rate is summarized in Figures 1-3, respectively. These data are from a study by Kazemi, Dumenil, and Fenton in 1990 (*Effects of accelerated erosion on corn yields of loess-derived and till-derived soils in Iowa*, unpublished technical report, Department of Agronomy, Iowa State University).

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

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Yield response is greatly affected by the plant population of corn growing on till- or loess-derived soils. Yield increases considerably when a plant population of 24,000 plants per acre is used compared with 18,000 plants per acre on till-derived soils with different topsoil thickness. In general, the increase in yield was positively correlated with the increase in plant population and topsoil thickness (Figure 1). An increase in plant population can minimize soil erosion loss and subsequently nutrient and water losses due to greater plant canopy density compared with lower density plant populations.

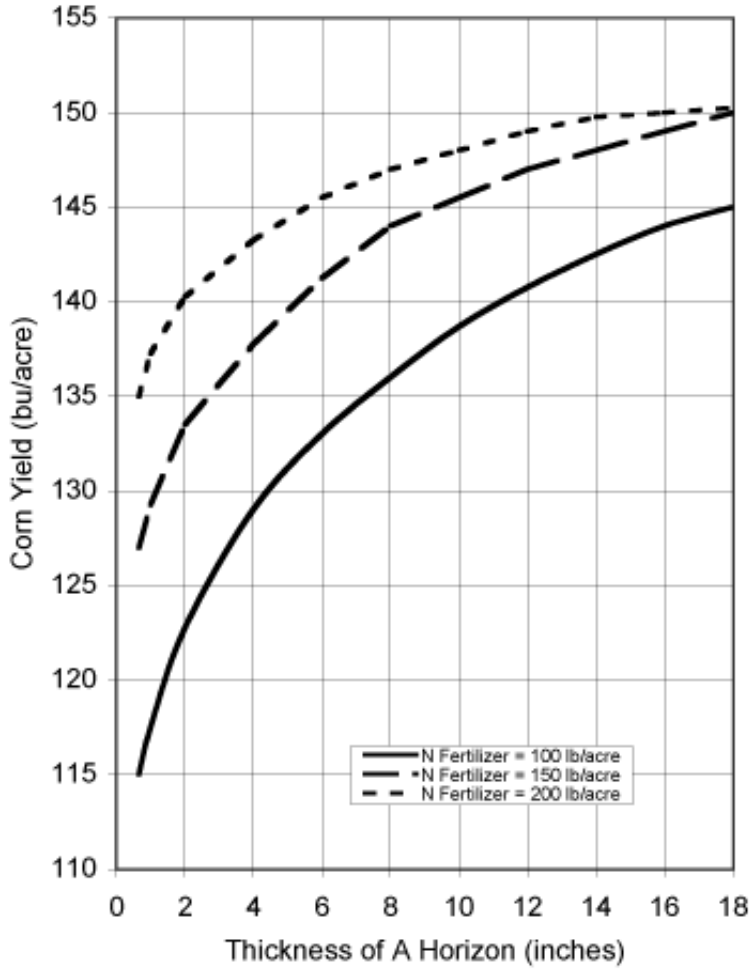

Figure 1. Effect of topsoil thickness on corn yields at plant populations of 18,000 and 24,000 plants per acre for till-derived soils.

The effect of different N rates on yield for till- (Figure 2) and loess-derived soils (Figure 3) was examined by using nitrogen rates of 80 and 180 lb N per acre and 100, 150, and 200 lb N per acre, respectively. The effect of N rate was positive where N partially compensated for yield loss due to erosion and lower water- and nutrient holding capacities associated with till-derived soils. However, the study by Kazemi and coworkers shows that, even at an N rate of 180 lb N per acre, the yield increase with increasing topsoil thickness was not substantial for till-derived soils. Yield loss due to erosion at an adequate N rate could be attributed to changes in soil physical and chemical properties, shallower rooting depth, and perhaps to phosphorus (P) and/or potassium (K) deficiencies on the more eroded soils. However, addition of extra N might solve the yield problem, but create water quality and environmental concerns due to the potential loss of residual soil nutrients to surface runoff and groundwater contamination (Figure 2).

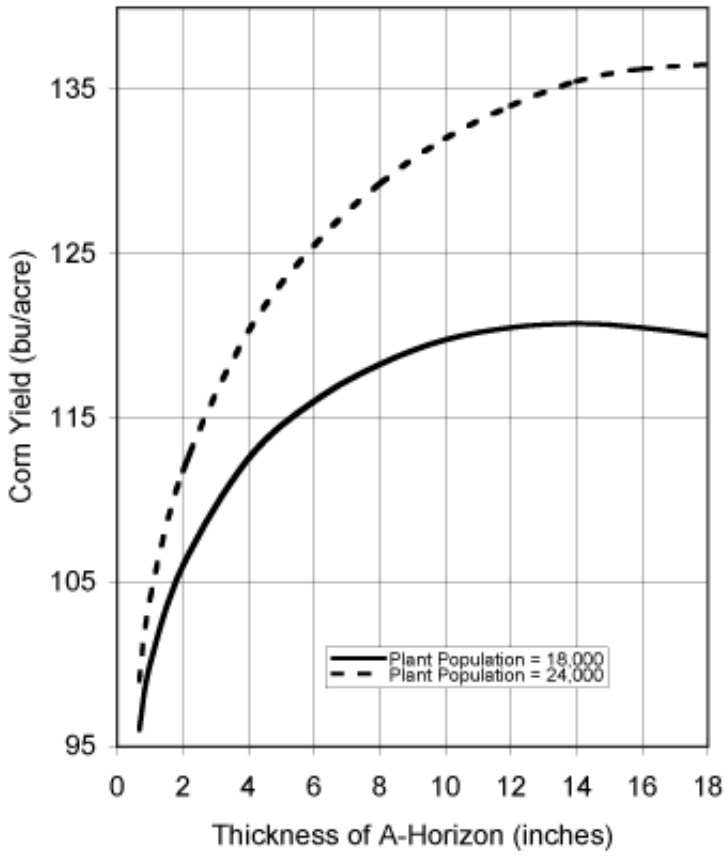

Figure 2. Effect of topsoil thickness on corn yields with two different N rates for till-derived soils.

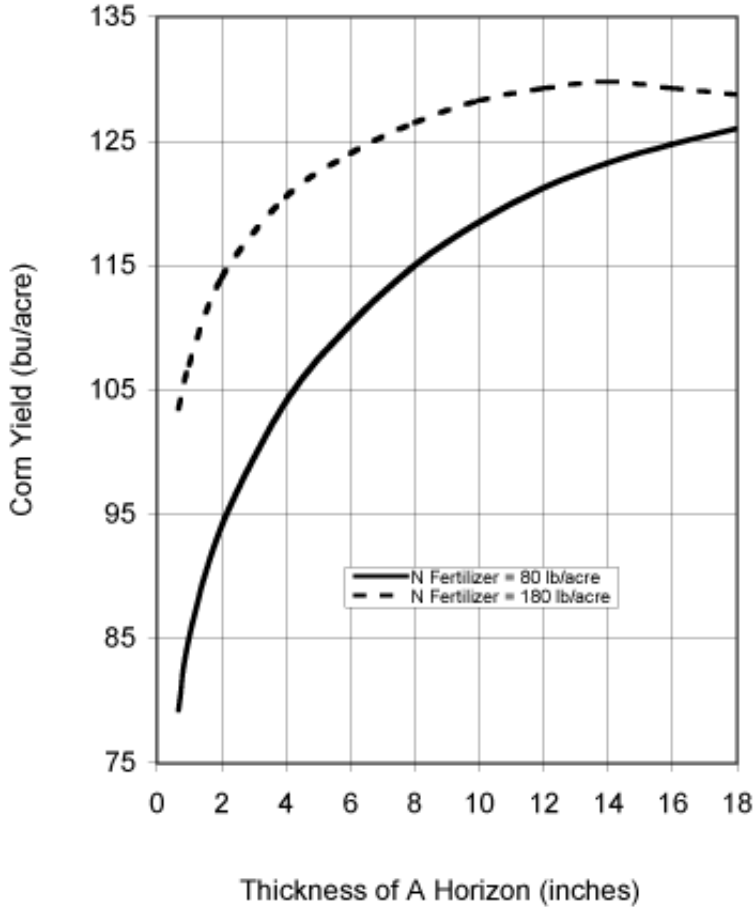

Figure 3. Effect of topsoil thickness on corn yields with three different N rates for loess-derived soils.

In contrast, yield of corn grown on loess-derived soils has a much greater response with different N rates than till-derived soils (Figure 3). The rate of yield increase is much greater regardless of topsoil thickness compared with till-derived soils. This increase can be attributed to better soil conditions under loess-derived soils for high water and nutrient availability compared with till-derived soils. The addition of N fertilizer to soil greatly increases yield. The addition of N up to adequate fertility levels increases plant canopy growth, thus providing better cover and reducing soil erosion. However, adding more N and P fertilizers increases the risk of N and P losses with surface water runoff. The amount of N and P loss is highly dependent on soil erosion, which is directly related to the amount of plant residue, tillage practice, slope, placement of fertilizers, timing of fertilizer application, and duration and intensity of rainfall. Therefore, soil testing for N, P, and K is essential to avoid overapplication of fertilizers.

Conclusion

Erosion is caused by several factors. Slope and crop rotation play a significant role in erosion control. On moderate slopes, the reduction in erosion from uphill and downhill planting is estimated to be approximately 50 percent less than on steep slopes, where the hazard of rill erosion is increased.

Row spacing is another practice, along with conservation tillage practices, that is effective in reducing soil erosion on sloping areas. Reduced row spacing can provide dense surface

cover and decrease the area of soil surface exposed to water impact. Strip cropping, terracing, and grassed waterways are other ways to control erosion by dividing the slope into discrete segments. Although there is soil movement within the terrace, the majority of the detached soil stays on the terrace. These practices help remove sediment and some nutrients from the water before it leaves the field. The contribution of such practices to improving productivity and water quality is significant.

This article originally appeared on pages 17-18 of the IC-486 (2) -- February 26, 2001 issue.
