NUE AND POTENTIAL ENVIRONMENTAL OUTCOMES ASSOCIATED WITH N APPLICATION TIMING FOR CORN

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Interest in improving nitrogen (N) use efficiency of corn production to increase farm profitability and reduce the deleterious effects of N on water quality has resulted in a greater focus on N application timing. A Midwestern study conducted in Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, North Dakota, and Wisconsin from 2014 to 2016 was designed to evaluate the profitability, potential N loss, and N use efficiency associated with at plant and split N application timing. In each year, two sites were selected in each state representing a high and medium/low productivity soil. Missouri had three sites in 2016. Selected sites had no manure history in at least the three previous growing seasons. The previous crop was soybean at 43 sites, corn at 5 sites, and sunflower at 1 site. The tillage system was either reduced tillage or no-till. All sites followed a standardized research protocol with regard to N treatments as well as soil and plant sampling. Nitrogen was applied at either planting or in a split application (40 lb N/a at plant plus sidedress), with N applications ranging from 0 to 280 lb N/a in 40 lb N/a increments. The economic optimum N rate (EONR) was calculated for each N application timing at each site.

At the EONR, 18 lb/a more N remained in the three-foot soil profile after corn harvest with split applications (55 lb N/a) compared to at plant (37 lb N/a); however, there was no difference in N uptake in the above-ground biomass at physiological maturity. These data suggest that some N will always be lost when producing corn; it's just a matter of when it will be lost – early or late in the season. When N applications were no more than 25 lb/a over the EONR, the amount of N remaining in the soil after harvest was similar to when N was under applied by 50 lb N/a or more. These data suggest that profitable N application rates do not necessarily lead to greater potential for N loss to the environment. We found split applications tended to be more profitable on sandy soils and more poorly drained soils in years with excess precipitation. On poorly drained, but tiled soils, there was a greater return on investment (ROI) when N was applied at planting. In other situations, split applications did not always have a greater ROI.

For each site and N application timing, N use efficiency (NUE) was calculated at a given N rate as the yield increase over the zero N plot divided by the N application rate. NUE was calculated in this manner to take into consideration the yield obtained

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from N supplied by the soil. At the EONR, NUE was highly variable, ranging from as little as 0.27 bu/a per pound of N to as much as 0.93 bu/a per pound of N. NUEs under as 0.27 bu/a per pound of N were typically, but not exclusively, associated with sites that were non- or minimally responsive to N (EONRs from 0 to 40 lb N/a). NUEs greater than 0.93 bu/a per lb of N were always associated with under application of N relative to the most profitable rate for a site and N application timing; while NUEs under 0.93 bu/a per lb of N were associated with both very large under and over application of N (more than 100 lb N/a over or under the EONR). These data suggest that NUE is not a suitable measure for determining the adequacy of an N rate with respect to profitability or potential N loss.