Considerations for Spring Preplant Nitrogen Application for Corn with High Fertilizer Prices

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While many farmers already applied nitrogen (N) for corn last fall, others are getting ready for spring preplant applications. Although the fertilizer supply has improved compared with last fall, the prices of N fertilizers have not changed much and are much higher than normal. And, while cash corn grain prices have increased in recent weeks, they are expected to decline later in the summer and the fall. Therefore, this situation warrants a careful review of N fertilization plans.

The N fertilizer rate that maximizes corn yield or attains the maximum economic yield varies greatly from year to year and among fields. Although the N needed always is higher for corn after corn than corn after soybean, factors that influence this variation the most for either rotation are weather conditions (mainly rainfall and soil temperature) from early spring until crop maturity in the fall. Weather greatly influences soil N supply, N losses by leaching or volatilization, and crop growth and yield. Therefore, suggested preplant N fertilization rates are approximations and often adjustments should be made in-season based on weather or diagnostic tools of N supply.

The Corn N Rate Calculator (CNRC) is a very useful tool to estimate preplant N fertilization rates for corn, because it provides the probability of cost-effective N rates for different scenarios of grain and N fertilizer prices based on past years field response data. The CNRC for Iowa and six other states in the North Central region was updated last week. The previous update was in 2019. Results from 30 site-years of trials conducted at various Iowa State University (ISU) research and demonstrations farms were added; 20 for corn after corn and ten for corn after soybean. Data of ten corn after corn trials were from a study conducted by Dr. Antonio Mallarino from 2013 through 2017 for which data analysis could not be finished on time for the 2019 update. The rest of the new data were from trials conducted in 2020 and 2021 by Dr. Sotirios Archontoulis (Department of Agronomy). As seen with earlier updates for all seven states, corn yields and the N rates that maximize grain yield or the maximum dollar return to applied N (MRTN) continued a slow gradual increase.

Details about using the MRTN concept and the N rate calculator are provided, together with other N management considerations, in the extension publication CROP 3073 Nitrogen Use in Iowa Corn Production and in a 2020 presentation by Dr. John Sawyer Nitrogen Management for Corn Production. The calculator output provides flexibility for choosing a rate because it calculates a range of profitable N rates that attain returns lower or higher than the MTN rate by only one dollar per acre. This range of rates varies greatly according to grain and N prices used but often ranges from 10 to 25 lb N/acre plus or minus the MRTN rate and estimated yield within about 2% of the maximum yield. For most of Iowa (Main region in the CNRC), for example, assuming a corn price of $6.50 per bushel and anhydrous ammonia at $1,400 per ton the MRTN N rate is 180 pounds per acre but most profitable rates within plus or minus one-dollar return are

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171 to 189 pounds of N per acre. For corn after soybean the MRTN rate is 137 pounds of N per acre and the most profitable rates are 127 to 147 pounds per acre. Optimum average N generally rates are higher for southeast Iowa (SEIA region in the CNRC), where rainfall tends to be higher, and MRTN rates are 196 pounds of N per acre for corn after corn (183 to 208 pounds) and 146 pounds per acre for corn after soybean (137 to 156 pounds).

Preplant N rates can be approximated more closely by applying the N as close as possible to planting to account for actual weather. This involves risk, however since rainy weather may delay the N application and planting. Also, how long the N application can be delayed varies greatly with the N source and the spring crop or soil management practices. Producers may use their own weather data, or frequently updated information is provided at the Iowa Environmental Mesonet website.

In addition to spring temperature and rainfall data prior to planting for specific areas of the state, two soil measurements might provide further clues to determine the preplant N application rate.

One measurement is spring nitrate in the soil profile measured before planting because can be useful in areas with deficient rainfall since last year, such as in northwest Iowa and small areas elsewhere. Normally there is little nitrate in the soil profile in areas with average or excessive rainfall during the growing season following good corn or soybean yields. However, in drought-affected areas there could be significant N carryover in the top two or three feet of soil from earlier manure or N fertilizer application. Based on his research, Dr. John Sawyer suggested in a previous article after the 2012 drought not to consider the full profile nitrate amount but first subtract an amount of 50-60 lb nitrate-N that is the typical nitrate-N level in the top two to three feet of soil with normal conditions. Considering the nitrate amounts only in the two top feet would partially avert overestimating the N that would actually be available for the crop However, with normal to excessive rainfall after the soil sampling may require additional in-season N applications.

The other measurement is potential soil N mineralization. This test estimates the soil organic N that can be transformed first to ammonium and then to nitrate at specific laboratory temperature, moisture, and aeration conditions. These are the major N forms plants can absorb, but the transformation of ammonium to nitrate is fast and normally only nitrate is well related to crop yield. The test for N mineralization is expensive and not practical for routine testing and, moreover, given likely changes in soil conditions its value is not useful to determine N fertilization rates. However, a research group in the Department of Agronomy lead by Dr. Sotirios Archontoulis uses previous research and modeling to provide frequently updated estimates of soil N mineralization for various Iowa regions. These estimates for the current year are compared with previous years in the Forecast and Assessment of Cropping systems (FACTS) website (see this information on the Soil Conditions tab of the website). At present there is no way to directly estimate N fertilization rates based on this information, but comparing the progression during the season of the estimates of mineralization with those for previous years can be useful to make "guesses" as of how MRTN estimates from the CNRC can be modified.

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