MINNESOTA - Soil Tests to Predict Nitrogen Availability in First-Year Corn Following Alfalfa

Zane Walker, Jeff Coulter, Michael Russelle, University of Minnesota; Matt Yost, Rodney Venterea, USDA-ARS; Antonio Mallarino, Iowa State University; Joe Lauer, University of Wisconsin

Although most fields of first-year corn following alfalfa do not need fertilizer nitrogen (N) to optimize yield, we still have no tool to reliably identify which fields will need supplemental N and what N rate is required. This uncertainty may result in excessive fertilizer use, lowering profits and increasing risk of N loss. The N requirement for first-year corn following alfalfa can vary based on soil texture, alfalfa stand age, time of alfalfa termination, and weather, but these have not proven sufficient to predict N supply in the coming crop season.

The pre-sidedress soil nitrate test (PSNT) and Illinois soil N test (ISNT) are commonly used to determine whether sidedressed N will increase corn yield, but these tests have correctly predicted the need for N fertilizer in only 60% of published field trials for first-year corn following alfalfa. To further assess the utility of the PSNT and ISNT, the relationship between these tests and estimates of soil N mineralization were evaluated using soil samples from field trials where first-year corn followed alfalfa.

In early June, soil samples were collected from the top foot of non-N-fertilized plots in first-year corn following alfalfa from 17 trials across Iowa, Minnesota, and Wisconsin. Soil samples were analyzed for PSNT and ISNT concentrations. Soil from these samples was also incubated in a laboratory for 17 weeks to estimate in-season soil N mineralization from the V6 corn growth stage to corn maturity. During the incubation period, soil moisture was maintained at about 75% of field capacity and the incubation temperature was adjusted weekly to mimic in-season soil temperature. Soil nitrate-N measured at the end of the incubation period provided an estimate of in-season soil N mineralization.

Across the 17 locations, soil-test values ranged 5-29 ppm for the PSNT, 125-440 ppm for the ISNT, and 60-177 ppm nitrate-N for in-season N mineralization, which provided a wide range of scenarios for evaluation. Independently, the PSNT explained only 6% and ISNT explained only 20% of the variation in soil N mineralization among locations.

Several variables known to influence soil N mineralization were evaluated as additional predictors, such as soil clay content, soil organic matter, alfalfa stand age, and alfalfa termination time (fall vs. spring). A combination of soil clay content, alfalfa termination time, PSNT, and ISNT explained 39% of the variation in in-season soil N mineralization among locations – a large improvement, but still inadequate to use for N recommendations.

We suspect the pattern of soil N mineralization may be more important than the total amount mineralized, so we are estimating the sizes of different soil N pools and the rates at which they mineralize. Ideally, we will find a way to predict these soil characteristics, but if a soil incubation is needed to characterize N availability in a field, it could be done in a soil testing lab during winter, with results made available before spring or sidedressing N applications. Our ultimate goal is to better predict which fields or areas within fields will respond to N fertilizer where first-year corn is following alfalfa, which will produce great economic and environmental benefits.