Soil Testing Helps Forecast N Response in First-Year Corn After Alfalfa

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Alfalfa is the third or fourth most widely grown crop in the Upper Midwest and corn is the first crop following alfalfa on about three-quarters of these acres. When rotated, alfalfa enhances yield and reduces nitrogen (N) fertilizer requirement of following corn crops. An analysis of 259 trials of first-year corn following alfalfa found grain yield response to N was related to soil texture, alfalfa termination stand age and timing, and weather conditions from fall of alfalfa year through spring of first-year corn. On medium-textured (loamy) soils, first-year corn yield was rarely increased with N except when following young alfalfa stands and in some cases when alfalfa was terminated in spring. On fine-textured (clayey) soils, first-year corn responded to N in one-half of cases. Uncertainty of which fields show an N response can lead to excessive fertilizer use. Improved methods will more accurately identify cases of non-N-responsiveness in first-year corn on fine-textured soils and predict the economically optimum N rate (EONR) in N-responsive cases, improving economic net return and reducing N losses.

We investigated two common soil tests for predicting N need in first-year corn after alfalfa. The Illinois soil nitrogen test (ISNT) measures organic fractions of soil N, which may be more capable of estimating mineralizable N following alfalfa, while the pre-sidedress soil nitrate test (PSNT) measures nitrate-N at sampling. Research was conducted in 21 trials with fine-textured soils across the Upper Midwest. In early June, soil samples were taken from the top foot of non-N-fertilized plots of first-year corn following alfalfa and analyzed for ISNT and PSNT. Across locations, test values ranged from 5-29 ppm for PSNT and 125-440 ppm for ISNT. The ISNT (with ≤230 ppm projecting corn response to applied N) and PSNT (with ≤21 ppm projecting corn response to applied N) accurately predicted N-responsiveness in 52% and 67% of trials, respectively. Adjusting ISNT's threshold value of 230 ppm for soil organic matter, as done in the northeastern U.S., did not increase prediction accuracy.

Complex approaches integrating soil characteristics, PSNT, ISNT, alfalfa termination stand age, and weather conditions were also evaluated for abilities to predict corn yield response to N. Combined use of PSNT and alfalfa stand age correctly predicted corn N response in 19 of 21 trials in this study and in 13 of 15 previous trials. No N response was likely when PSNT (ppm) × alfalfa stand age (including establishment year) exceeded 42. On fine-textured soils, this method identifies fields where additional N may be profitable in first-year corn following alfalfa. More research is needed to predict soil N supply after alfalfa termination to estimate EONR in N-responsive cases.