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Nitrogen Management in Minnesota as Influenced by Soil Drainage and Tillage

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ABSTRACT

Tile-draining, conventional tillage and pre-plant applications of nitrogen (N) fertilizer are prevalent practices among Minnesota corn growers. However, climate change and increasingly warmer and wetter spring conditions have called for a re-evaluation of the appropriateness of these practices for continued sustainable corn production. The objectives of this study are to determine the influence of drainage, tillage and N application timing on (1) corn grain yield and N uptake, (2) corn N demand and grain N recovery (GNR), and (3) post-harvest soil N content. The study was conducted starting in 2017 near Wells, MN on a corn-soybean rotation. The experiment followed a split-split-plot design replicated four times, with drained and undrained conditions as main plot, conventional tillage (CT), strip tillage (ST), and no-till (NT) conditions as sub-plot, and six N rates pre-plant applied (PP) (0, 40, 80, 120, 160, 200 lb urea-N ac^{-1}) and four N rates split-applied at pre-plant and V6 stage (PP/V6) (40/40, 40/80, 40/120, 40/160 lb urea-N ac^{-1}) as sub-sub-plot. Soil N content was measured at post-harvest as total inorganic N (TIN) (ammonium-N + nitrate-N) at 0-36 inches. Corn grain yield and N uptake were determined at harvest. The economic optimum N rate (EONR) was determined considering a N-to-corn price ratio of 0.1. Fertilizer N recovery in grain was calculated. The preliminary data from 2017 showed no statistical difference in corn grain yield, N uptake and GNR across the different drainage, tillage, fertilizer application timings or their interactions. However, trends observed in the response collected on the first year of data deserve our attention and continuation of the study, as they closely match our hypotheses. Numerically, grain yield and N uptake were consistently greater under drained conditions (191 bu grain ac^{-1} and 100.3 lb N ac^{-1}) than in undrained conditions (175 bu grain ac^{-1} and 90.3 lb N ac^{-1}). Grain yield and N uptake were similar under CT (185 bu grain ac^{-1} and 97.0 lb N ac^{-1}) and ST conditions (186 bu grain ac^{-1} and 97.2 lb N ac^{-1}), but slightly less under NT conditions (178 bu grain ac^{-1} and 91.2 lb N ac^{-1}). Grain yield and N uptake based on time of N application were similar (<5 bu grain ac^{-1} and 2.7 lb N ac^{-1}, respectively). Corn N demand tended to be greater with split N applications (PP/V6) with average EONR of 192 lb N ac^{-1}, compared to 177 lb N ac^{-1} with a single PP application. Further, the lowest EONRs tended to be obtained under NT conditions, which also had low yields. The greatest GNRs in the study were obtained under NT conditions (44%), likely because of the low yields obtained with those treatments. Post-harvest soil N values were generally greater with split-applications of N (79 lb N ac^{-1}) than with the PP applications (74 lb N ac^{-1}). Additional years of data collection in this ongoing project will likely provide valuable information to determine the effect of soil drainage and tillage on N management for corn production in the Upper Midwest.