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Public Abstract

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Title: An Environmental Assessment of Sensor-Based Variable-Rate Nitrogen Management in Corn

Nitrogen (N) fertilizer use in agricultural production systems has increased dramatically over the past 50 years. N fertilizer unused by the crop is left to the fate of the processes of the N cycle, and can eventually lead to detrimental effects to the environment. As a result, an issue of increasing concern in the U.S. Midwest is nitrate contamination of surface and ground waters. A likely contributing factor to contamination is that crop N need varies spatially across whole fields. In order to address this problem, various methods have been used to try to account for spatial variability of N within agricultural fields. One approach to account for this variability and thereby reduce nitrate pollution is in-season site-specific N application according to economic optimal N rate (EONR). Active-light reflectance sensors have been successfully used for site-specific N applications in wheat. Recently, these sensors have been tested for mid-season, on-the-go N fertilizer application in corn. This 2004 and 2005 study was conducted on 12 Missouri producer corn fields to (1) evaluate the relationship between EONR and active-light reflectance sensor readings, and (2) evaluate the relationship between environmental measurements and EONR. N treatments were arranged in a randomized complete block design at rates of 0-235 kg N ha^{-1} at 34 kg N ha^{-1} increments. Measurements included EONR, crop N yield efficiency (YE), N fertilizer recovery efficiency (NFRE), and post-harvest soil inorganic N levels. A quadratic-plateau function was used to determine EONR for 68 different treatment sets obtained from the 12 fields. Crop response to N was significant (i.e. EONR was calculable) for nearly all treatment sets in 2004 because of very good growing conditions. Nearly the opposite was found in 2005 because of a droughty growing season. In 2004, EONR was significantly related to active-light sensor indices, but with regression model coefficients of determination (r^2) $\leq$ 0.35 for all sensor indices evaluated. However, including soil electrical conductivity (EC) in the regression model improved the r^2 to 0.47. Sensor measurements were found to be significantly related to delta yield. However, delta yield was not a good predictor of EONR ($r^2 = 0.34$). A relationship between EONR and the indices could not be established for 2005 data. In 2004, YE at EONR was not the same between fields, and ranged from 19-47 kg grain (kg N)$^{-1}$. As N rate approached EONR, both YE and NFRE declined, while post-harvest inorganic N levels increased. These preliminary results show promise for using active-light reflectance sensors to achieve EONR and reduce N loss off fields.