DISSERTATION DEFENSE

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1:30 pm | meet.google.com/hdn-uikq-tik

EVALUATING THE IMPACT OF CONTINUOUS COVER CROPPING AND KERNZA®
ON NITRATE AND ORTHOPHOSPHATE RETENTION IN CORN-SOYBEAN
ROTATIONS: IMPLICATIONS FOR DRAIN WATER QUALITY AND ENVIRONMENTAL
SUSTAINABILITY

The purpose of this study was to determine the role of continuous cover crops (CC), in reducing nutrient leaching, particularly nitrate (NO_3^-) and orthophosphate (PO_4^{3-}), from drain waters. Due to their significance to the economies of Illinois and neighboring states, corn and soybean cultivation was the focus of this work. Additionally, drain water characteristics of Kernza®, a perennial grain of emerging interest to farmers in North America, to establish baseline characteristics for future work. This replicated, controlled, field-scale study was conducted over three growing seasons (2021-2023) at WIU's Kerr Farm in the Upper Midwest, USA. The primary objective was to assess the environmental benefits of these practices in mitigating nutrient runoff, improving water quality, and promoting environmental sustainability. Field trials involved monthly water sampling from 16 tile drains. Nitrate (NO_3^-), orthophosphate (PO_4^{3-}), pH, specific conductivity, and water temperature were measured. Paired t-testing, ANOVA, and Principal Component Analysis (PCA) were used to evaluate the significance of nutrient retention across different treatments and the correlations between physicochemical factors.

In this study, cover crops significantly reduced nitrate leaching in corn plots, with average reductions up to 15.09 mg/L and higher nitrate retention in CC corn ($p < 0.01$), particularly during periods of higher precipitation ($r = 0.676$, $p = 0.016$). However, reductions in PO_4^{3-} were less consistent across the study; the apparent relationships PO_4^{3-} data were not statistically significant ($p = 0.12$). Kernza® plots demonstrated mixed results, with reduced NO_3^- concentrations in 2022 but variable PO_4^{3-} outcomes over the three years. PCA revealed strong correlations between NO_3^-, PO_4^{3-}, pH, and conductivity, reflecting the complex dynamics of nutrient cycling in agroecosystems. Overall, the study confirms that cover crops and Kernza® have the potential to mitigate nutrient runoff, especially nitrate leaching, and contribute to sustainable agricultural practices. However, further research is needed to optimize these strategies and understand their long-term impacts on water quality and nutrient management. This research provides critical insights for agricultural policy and practice, particularly in regions prone to nutrient pollution and high rainfall. The findings underscore the importance of incorporating cover crops and perennial grains as part of an integrated nutrient management approach to balancing agricultural productivity with environmental conservation.