SOIL NITRATE FATE AND WATER QUALITY IN TILE-DRAINED SUSTAINABLE CROPPING SYSTEMS

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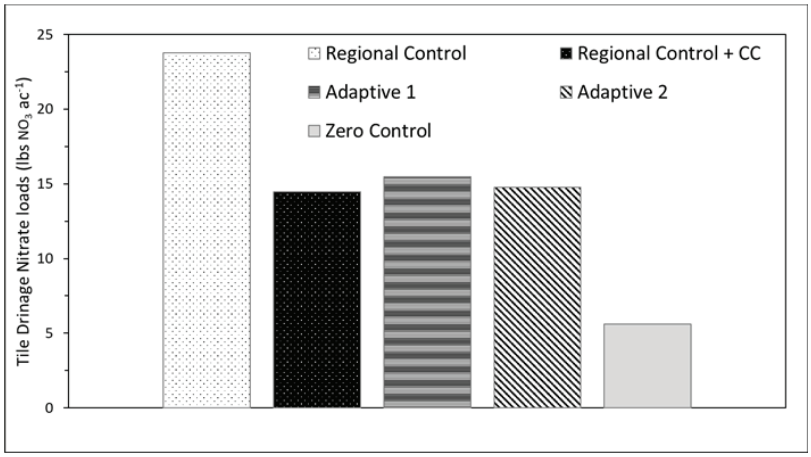
Introduction: The goals of a **Sustainably Intensified Agriculture (SIA)** system are to maximize agronomic production, while minimizing environmental degradation. Thus, fulfilling and aligning with all four pillars of sustainability, human, social, economic, and environmental. The demand for increased agriculture production due a growing human population is a reality within the state and globally. On the same scale, there is a need to develop row crop sustainable agricultural systems that can meet the production demand, while not violating the social, economic, and environmental pillars of sustainability is also pressing and critical. Tile-drained row crop agriculture has been identified as a major contributor of nitrogen (N) from the Upper Mississippi River Basin (UMRB) to the hypoxic zone of the Gulf of Mexico. Cover cropping has been identified as the most effective in-field conservation strategy that can be adopted on a large scale to achieve the non-point nutrient loss reduction goals.

Objectives: The goal of this presentation is to share published and preliminary results from studies.



Only 7 drainage events were recorded in the 2020 cover and cash crop growing seasons and two of the events accounted for an averaged 64% of N lost through the tile-drainage. However, adopting CR continue to result in significant nutrient loss reductions, despite N fertilizer management. The data suggested reductions of 35-39% in nitrate loss via tile drainage relative the not cover crop control. One significant finding is that 30% more fertilizer N was applied to the Adaptive 2 treatment relative to the non-CR Regional Control, yet the Adaptive 2 treatment resulted in 38% less N lost via tile drainage, which was similar to the other CR treatments. This finding suggests that growing CR in the fallow period generates a larger capacity for fertilizer to be applied without the result of greater nitrate loss via tile drainage. This greater capacity could be contributed to the slow release of residue N from both above and below ground CR biomass, greater microbial adsorption of fertilizer N due to the carbon generated from CR biomass, and in terms of the soil physical environment CR could have significantly increased the

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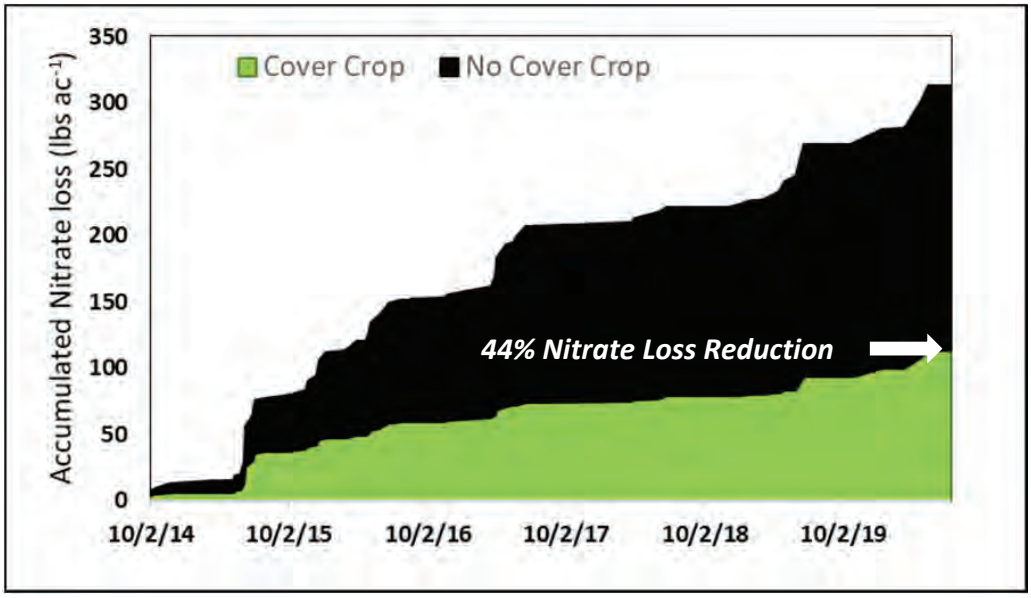
water holding capacity of the soil resulting in a lessor potential to leach. However, it is important to note that applying 60 additional lbs of N fertilizer in a wetter year could have possibly resulted in greater N loss in CR plots.



Since October 2014 to October 2019, the adoption of a CR dominated cover crop mixture has resulted into a 44% (88 lbs ac^{-1}) nitrate loss reduction relative to the non-Cover Crop Control. The figure below illustrates the impact of cover crop adoption on nitrate concentration in the tile water without the effect of tile-water flow volume. Despite the clear positive relationship between precipitation and tile water nitrate-nitrogen concentration, cover crops (green area) consistently resulted in reduced concentrations within cover crop and cash crop growing seasons.

Cereal rye dominated cover crop mixes have demonstrated the ability to significantly reduce nitrate loss by an average of 48%. Thus, it is imperative that we develop Next Generation Management Strategies to generate SIA cropping systems that maximize profit and minimize environmental degradation.