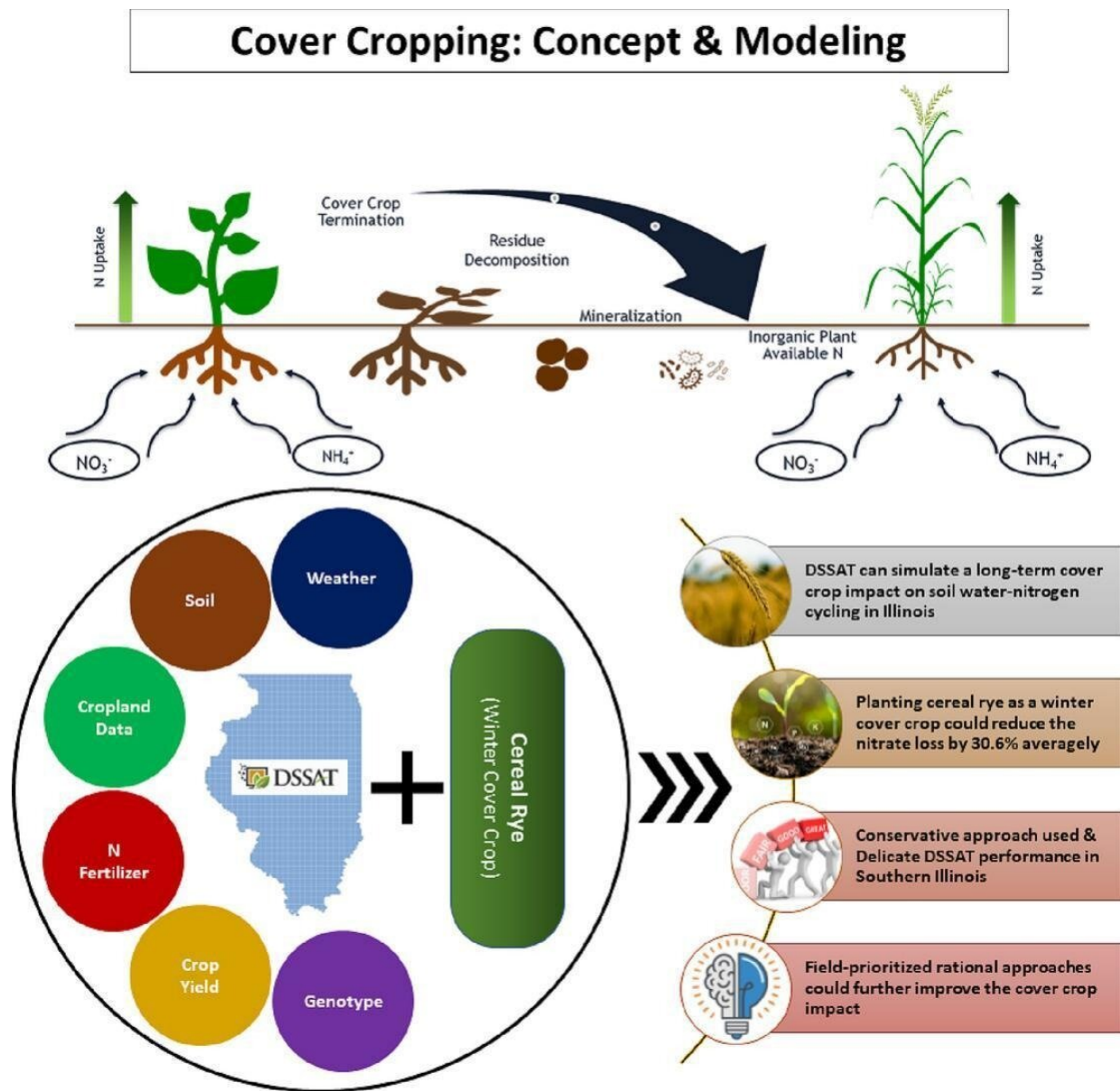


Winter cover crops could reduce nitrogen in Illinois drainage water by 30%

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Graphical abstract. Credit: *Science of The Total Environment* (2023). DOI: 10.1016/j.scitotenv.2023.162956

As Corn Belt states seek ways to curb nitrogen flow from farms into the Gulf of Mexico, new University of Illinois research adds evidence for winter cover crops as an important part of the solution. A simulation study published in *Science of the Total Environment* finds widespread planting of cereal rye in Illinois could reduce nitrate in the state's tile drainage water by 30%.

The research team, part of the College of Agricultural, Consumer and Environmental Sciences (ACES) and The Grainger College of Engineering at Illinois, knew from small-scale studies that cover crops are capable of sucking nitrate out of [soil water](#), with long-lasting effects throughout the growing season. Their new study is the first to estimate cereal rye's potential on a statewide level.

The team simulated both cover crop planting (yes or no) and fertilizer timing (fall or spring) under real climatic conditions in Illinois between 2001 and 2020. They used a crop simulation model known as Decision Support System for Agrotechnology Transfer (DSSAT), which allows multi-year growth projections for more than 42 crops. Although cereal rye wasn't among them, the researchers adapted the model's parameters for winter wheat, the most similar crop in DSSAT.

"Two management implications were revealed in this paper. One is that farmers should apply a winter cover crop, such as cereal rye, to reduce tile water flow and nitrate loss by 25 and 30%, respectively. Our data also reinforced that farmers should switch to spring fertilization, if possible. We compared spring versus fall fertilization with and without the cover crop, and fall was worse for nitrate loss in both scenarios," says

study co-author Rabin Bhattarai, associate professor in the Department of Agricultural and Biological Engineering, a shared unit of ACES and Grainger.

The model also simulated cover crop effects on cash crop yield and found, overall, that cereal rye had a slight positive impact on corn and soybean under both fertilization schedules. Bhattarai says there was some variation among years and locations across the state, but over the 20-year simulation, there was no evidence of a yield penalty.

Cover crop adoption remains low in Illinois and the Midwest despite the availability of cost-sharing programs and growing evidence touting benefits to soil health, water quality, and more.

"Our research shows cover crops work," Bhattarai says. "They have the potential to reduce erosion as well as nutrient loss from our fields, especially with tile drainage. We wanted to explore the benefits on the whole-state level to show what could happen if thousands of farmers adopted this conservation practice simultaneously," he says. "The water quality benefits would be significant."

No simulation model is perfect, and Bhattarai's struggled a little in the hillier southern section of Illinois. But when compared with real-world corn and soybean yields, the yields forecast by the model were a close match, suggesting the model was likely accurate overall.

Early phases of the project began with small-scale field experiments to understand cover crop and fertilizer timing effects on nitrate loss in tile and runoff water. These early experiments were used to develop the modified DSSAT model capable of scaling up to the entire state. They also informed an online decision-support tool, funded by the Illinois Nutrient Research and Education Council, for farmers considering cover crops in their own fields.

"Using our dashboard, farmers can get simulated results of cereal rye growing as a cover crop in their actual fields. At different dates within a two-week window of expected planting for the cash crop, farmers can compare potential biomass in the field, C:N ratio in that biomass, nitrogen uptake, and nitrogen loss reduction. To improve results further, farmers can provide more specific information for their fields, including cropping history and management programs," says co-author Jonathan Coppess, associate professor in the Department of Agricultural and Consumer Economics in ACES.

More information: Rishabh Gupta et al, Evaluation of long-term impact of cereal rye as a winter cover crop in Illinois, *Science of The Total Environment* (2023). [DOI: 10.1016/j.scitotenv.2023.162956](https://doi.org/10.1016/j.scitotenv.2023.162956)

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