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Missing the System for the Adoption: Lessons on the Cover Crop Learning Curve, Part 1

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Missing the forest for the trees: the earliest known record of this common idiom is in a collection of proverbs published in 1546 by the English author and playwright John Heywood (Heywood, 1546, at 107; see also, The Idioms.com; Merriam-Webster.com; Britannica.com, "John Heywood"). A tendency to miss the bigger or more complete picture because of an overemphasis on smaller, minor, or specific details is an infinitely adaptable and applicable concept (see e.g., Lawandi, Kadri and Powers, 2023; Barry and Schnitzer, 2021; Jayanti, 2021; Klaiber, Gopalakrishnan, and Hasan, 2016; Grimyser, 2014; Hartung, 2014; Young, 2006; Ane and Sanderson, 2005). A particularly intriguing application is understanding adaptation to change in complex systems with challenging interdependencies (Clement, 2022). Another matter to which the old idiom resonates is the challenge of managing cover crops. We put it to work here to help kick off a series of articles exploring lessons on the learning curve for this critical conservation practice.

Background

Previous articles have discussed cover crops, highlighting a large sample of the voluminous research on the practice, as well as research that is being applied to efforts to provide applications or tools for farmers and researchers (*farmdoc daily*, May 2, 2024; October 21, 2024; October 28, 2024; October 1, 2020; October 28, 2021). In short, there has been no shortage of work on cover crops. Any shortcomings in the uptake and usage of the practice, moreover, should not be attributed to a lack of research effort. And yet, there are shortcomings. Research continues to find that cover crops are consistently implemented on minimal cropland acreage, although cover crop acres have increased (see e.g., Han and Niles, 2023; Zhou et al., 2022; Wallander et al., 2021; see also, Sherrick and Myers, 2023; *farmdoc daily*, February 22, 2024).

If nothing else, the current state of cover cropping begs many difficult questions as to what is or may be missing. Farmers are generally clear about the "complexity of factors that they manage on their farming operation," which tend to be more complex than accounted for by research or policy (Basche and

Roesch-McNally, 2017). It often isn't sufficient to know the benefits of cover crops because the risks can outweigh them, especially in annual production systems (Arbuckle and Roesch-McNally, 2015). Primary among these are concerns (and confusion) about the practice's impact on yield risk for the cash crops that follow (see e.g., Muniz et al., 2025; Silva et al., 2024; Peng et al., 2024; Deines et al., 2022; Deines, Wang, and Lobell, 2019). Critically important in the farmer's perspective is the "readiness and timeliness of field operations due to the limited number of days to conduct field work in the spring" (Gentry et al., 2025). In other words, conservation behavior is "nuanced" and complex (Prokopy et al., 2019; Lu et al., 2022).

The articles in this series will seek to provide additional perspectives on this question, deriving lessons from farmers' learning curves for managing cover crops.

Discussion

The articles in this series will explore the learning curve for managing cover crops using a systems perspective—from early decisions to lessons learned and the keys to success—built from direct experiences of cover cropping farmers in Illinois. We conducted interviews with experienced cover croppers and technical support advisors, asking them a series of questions concerning management decisions made when cover cropping, the evolution of these decisions with experience, the goals and motivations driving their decisions, the challenges and benefits they encountered, and factors promoting continued adoption. Interview participants included three technical support advisors, six farmers, and four individuals whose roles spanned both categories. Farmer participants operated farms ranging from 750 to 3,000 acres, with an average size of approximately 1,600 acres. Their experience with cover crops varied between 5 to 12 years, offering insights from both relatively recent adopters and more seasoned practitioners. Their ages ranged from 29 to 76 years; a majority were between 35 and 60 years old, however, with an average age of approximately 50.

One big picture reality for cover crops is the fact that the environmental benefits of the practice are primarily realized by society at large, rather than by individual farmers (Hsieh and Gramig, 2023). For the farmer, there is an absence of direct, immediate private gains and less of an understanding about the benefits (Miller-Klugesherz and Sanderson, 2023). The agronomic advantages from improved soil health are indirect and take time to materialize. Research has found that it typically takes three or more years for cover crops to become economically viable without financial assistance or special agronomic circumstances, such as deficit soil moisture, soil compaction, herbicide-resistant weeds, and high fertilizer costs (Myers et al., 2019). During these years, farmers will encounter numerous management decisions and challenges that may deter them from continuing given the absence of any immediate benefits. Alongside these farm-level economic challenges, cover crops conflict with the current agricultural market structure, which prioritizes intensification—where maximizing yields is driven by technological advancements and purchased inputs.

To cover crop successfully, farmers must "overcome field-level management issues (e.g., proper planting of a cover crop) as well as more structural (e.g., market forces) barriers," while also tackling the critical challenge of managing time effectively within narrow seasonal windows, such as "establishing a crop in the fall and terminating it in the spring" (Roesche-McNally et al., 2017). These stark realities often deter growers from incorporating cover crops, as the economic risks frequently outweigh any immediate benefits. Consequently, in the short-term, most adopters face an unfavorable combination of high additional expenses and the potential for a yield reduction (or drag) that some researchers have found to be around 3.5% to 5.5% (Deines et al., 2022). Losing any yield on the cash crop due to the cover crop will make the practice less profitable and the farmer less competitive, unless policies provide additional support (Schnitkey, Sellers, and Gentry, 2023). Because it is an annual practice, subject to the same weather uncertainties as cash crop production, the challenges discussed here (and in the research) also recur each year. This adds an increased risk that the farmer will discontinue the practice if something doesn't go well; or worse, the farmer working to manage cover crops could lose a lease or the farm, sacrificing both the benefits of the practice and, potentially, the farmer.

The lack of timely benefits to the individual farmer—whether agronomically or economically—contrasts sharply with the large body of evidence on the benefits of the practice to society (*farmdoc daily*, May 2, 2024). This critical reality for cover crops is particularly relevant for policies that seek to encourage the practice by assisting farmers who undertake it. Current policies are limited; with too little funding for the

demand and the need, they can be too cumbersome and complex for the farmer and may provide little more than a partial offset of the costs, while offering nothing for the risks and management challenges. Furthermore, there are no existing market mechanisms to adequately compensate the farmer or recognize the social benefits of cover crops. Without either, taking on the practice brings both direct and indirect costs in the short term, such as expenses for seed, additional labor, and potential yield reductions, without any corresponding changes in income to offset them. Little wonder the practice exists on so few cropland acres.

The articles in this series will take an approach that aligns with important research findings. Cover crops cannot be considered akin to an engineered solution or structural practice, nor like "nitrate remediation techniques" that "only treat the symptom of a declining soil C stock (i.e., tile nitrate loss from soil N mineralization)." A cover crop "adds carbon to the system, directly treating the cause of tile nitrate loss" and "conserve[s] N in the field" which provides a "strategic advantage over remediation techniques that return N to the atmosphere via denitrification" (Gentry et al., 2025). Farmers frequently respond that managing cover crops is more than adoption, that it takes a systems change. Previous researchers have reported that "farmers who had implemented cover crops were thinking about their farms as an interconnected system" (Church et al., 2020). Cover cropping farmers deploy "a 'whole systems' approach to managing their entire operation" that often views "various challenges as management opportunities" from which they "learned how to better integrate cover crops through a kind of trial and error approach" (Roesche-McNally et al., 2017). Implementing conservation practices may build upon itself, with the farmer willing to take on additional conservation while maintaining and managing existing practices (Canales, Bergtold, and Williams, 2023). These systems mindsets are particularly important, incorporating real-world complexities a farmer must manage year-over-year (Davis and Stroink, 2015). Policy, especially, needs to align with this systems thinking and the complex realities of the practice. Research can help.

Concluding Thoughts

For all the good a conservation practice like cover cropping might do—for farms and soils, public water resources and more—it represents a substantial change to the existing system and can only achieve those outcomes if the practice is not only adopted but successfully maintained through effective management. To help farmers with this practice, as well as inform research and public policy, the articles in this series will explore the learning curve for cover cropping to derive lessons from those with experience in the practice. It opens with an understanding that this sudden shift to a new system brings associated risks and challenges that only begin with adoption and carry through each growing season in which the practice is maintained. The learning curve involves a suite of new operational decisions and management responsibilities which disrupt most knowledge of conventionally managed fields—those include matters specific to the practice, as well as adjustments to standard cash crop practices with implications for farm finances, efficiency, and output. Even with experience, each year brings new uncertainties for which lessons learned help navigate the new elements of risk in the system.

Additionally, this series seeks to add to the understanding of those management strategies that lead to optimal, effective, and lower-risk outcomes. Because cover crops operate contrary to conventional cropping systems and current market pressures, including increasingly tight farm economics, proven management strategies help avert negative outcomes. Farmers cannot be expected to embrace this practice in the short or long term, nor at the scale necessary, without effective management strategies; without widespread farmer acceptance, the benefits of the practice to the farmer and to society cannot be realized. Where appropriate, the contributions to existing and foundational knowledge can help farmers tailor management strategies to individual farm goals and support consistent system success.

Finally, much of federal policy and research has centered on the adoption decision. Policy, especially, has been too focused on subsidizing a portion of estimated expenses while overlooking the entire costs of the systemic changes involved, including the additional risks and management challenges. This series seeks to inform both policy design questions and research agendas for cover crops, contributing to a substantial body of work and seeking to help advance this critically important conservation practice.

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