Small Grains Unlock Profit Potential of Low-Carbon, Biological Nitrogen

The landscape across the Corn Belt is dominated by just two crops – corn and soybeans. Extending crop rotation by at least a year with a cool-season small grain like barley, oats, rye or wheat is a low cost, high impact practice. Small grains are harvested much earlier than corn or soybeans (July vs October) which provides the opportunity to grow a nitrogen-fixing, leguminous cover crop and apply animal manures on fields under optimal conditions. If farmers harness these biological sources of nitrogen, *there is great potential to **improve water quality** by holding nutrients in the field with cover crops and **decrease GHG emissions** from the synthesis of fertilizer products (Appendix A) and manure storage systems*.

Through the Small Grains in the Corn Belt project, Practical Farmers of Iowa (PFI) and Sustainable Food Lab (SFL) have been partnering with food and beverage companies since 2016 to design on-farm pilots, feasibility studies and research that has quantified the GHG impact and farmer-economic proposition of growing and feeding small grains as part of an extended rotation. (See Appendix B-C and enclosed slide deck for details.) We've built more market opportunities and risk sharing mechanisms, such as cost share, for small grain crops grown in the Corn Belt with a legume cover crop. The program has found great success with farmers who are eager to try a different crop. However, only 50% of the farmers who planted corn in 2019 following a legume cover crop took the opportunity to reduce their fertilizer application. Fertilizer products are cheap today, and act as insurance for a good corn crop.[1] *This demonstrates a need to directly **incentivize and risk-share the fertilizer reduction** to corn following a small grain and legume cover crop.*

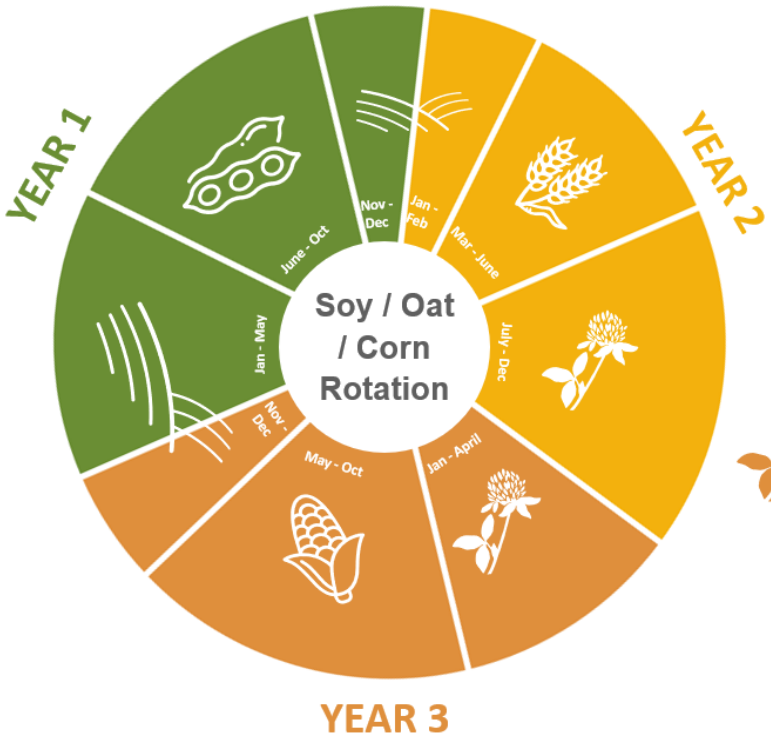
Developing livestock feed markets for small grains has been a particular focus. Pilot projects and business case analyses for the feed value of small grains have revealed a key barrier: readily available corn and its inexpensive byproduct, DDGs. However, small grains can provide financial and management benefits to farmers and supply chains. If grown near livestock buildings, small grain crops expand the livestock manure field-application window, creating lower manure storage and handling costs and may reduce manure storage GHG emissions (Appendix D). To fully understand the cost-competitiveness of small grains compared to other feed ingredients, *we need to take a closer look at the **integration of the livestock manure into these crop rotations**.*

To address these questions and opportunities, this proposed Conservation Innovation Grant project will:

- **Test a split payment cost share incentive** that pays farmers (1) after the legume cover crop is planted and (2) after fertilizer is reduced to the following corn crop.
- **Test cost-shared small grain production co-located with livestock buildings where manure is applied** in August-September to a cover crop when it would usually be stored.
- Capture data in small grain and corn years to **estimate greenhouse gas, water quality and economic benefit from both split payment and manure application pilots.**
- **Create a manure greenhouse gas calculator** that can estimate changes to emissions from manure application after a small grain to a living cover crop as compared to the status quo.
- **Assess the business case for scalability and impact of pilot approaches** and continue to convene supply chain partners through our Small Grains in the Corn Belt Community of Practice.
- **Support farmer implementation** with technical assistance and peer network.
- **Convene a network of manure researchers and experts** to assess and further research water quality and greenhouse gas implications of manure management in extended rotations.

[1] Plastina, 2019 https://www.extension.iastate.edu/agdm/articles/plastina/PlaDec19.html

Appendix A: Small grains extended rotation system and GHG benefits



Ground covered with diverse roots in soil ~70% of the time, storing nutrients & holding water

Oat timing enables legume cover crop that fixes nitrogen in the soil

Legume cover crop displaces 40-100 lb N / ac with farmer-grown fertilizer

So farmers can reduce synthetic N by 1/3 to 1/2 in corn year

*Source: PFI Small Grains in the Corn Belt Farm Production Data

Appendix B: Small shifts in livestock feed rations can drive big GHG benefits across the landscape

Reduced Feed Footprint

PIGS 40% GHG Savings

- 10% oat inclusion
- Save 5.47 billion lbs CO2e
- ~75 lbs CO2e per hog

Beef CATTLE 70% GHG Savings

- 15% oat inclusion
- Save 2.25 billion lbs CO2e
- ~350 lbs CO2e per cow

Savings from across the rotation

- Decreased N fertilizer on corn yield
- Carbon sequestration from cover crops
- Decreased corn in animal diet (oats lower emitter)
- *Manure benefits* not included in analysis

*Modelled via U of MN FOODS3 and Cool Farm Tool

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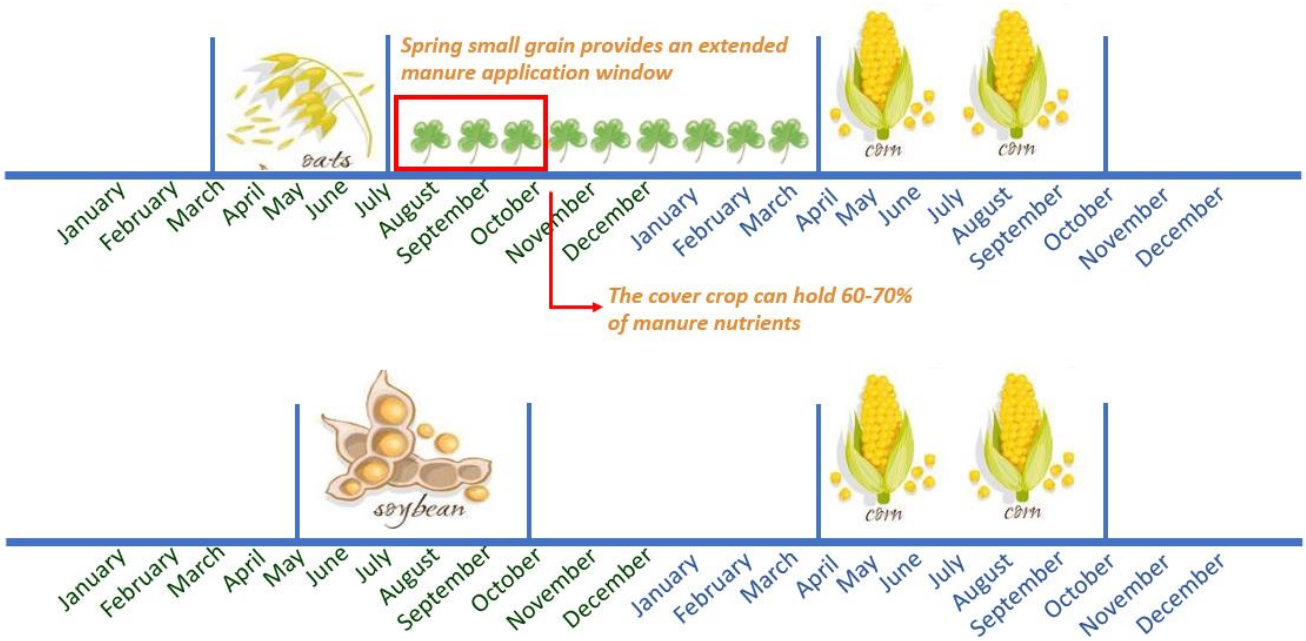
Appendix C: Small Grains in the Corn Belt supply chain partners

Appendix D: GHG impacts of manure management in small grains extended rotation system



Including small grains into a corn-soybean rotation adds earlier manure application windows, allowing for reduced storage time of manure which may result in reduced methane and nitrous oxide emissions of manure storage systems.

- Both methane and nitrous oxide emissions can be reduced when time of storage in liquid or dry manure storage systems is reduced.
- Planting small grains would open a manure application window that is earlier and longer than a traditional corn / soybean or corn / corn rotation. Subsequently, July and August have high amounts of suitable field days allowing for more opportunities to apply manure, and potentially reducing manure storage time.
- Future research is needed to fully understand GHG emissions reductions if small grains were incorporated into a corn-soybean rotation (e.g., shorter manure storage period, application more rapidly, etc.).

*Above conclusions from literature review research study sponsored by PFI in Fall 2019.