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CROPS & SOILS

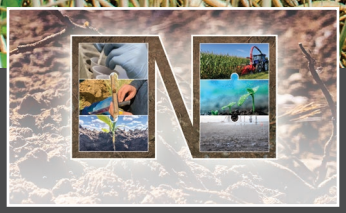
The magazine for certified crop advisers, agronomists, and soil scientists.

Changes in Soils and Crops along a Transformational Journey

PAGE 3

Moldboard Plowing in Wheat–Fallow in the Pacific Northwest

PAGE 48



Solving the Nitrogen Mineralization Puzzle

PAGE 10

Beneficial Predators in the Cotton Belt

PAGE 52

Can Banding Reduce P Rates and Environmental Losses?

PAGE 20

ASSESSING SOIL HEALTH SERIES

Economics of Soil Health: Contributions of Reduced Tillage and Cover Cropping

By Archie Flanders, Agricultural Economist, Soil Health Institute

Data from 100 farmers indicate increased net farm income as a result of adopting soil health practices. Soil health practices are marginal changes from conventional production methods with most seasonal activities and inputs remaining unchanged. Changes in management do require considerations for local soil and climate. Transitioning to soil health systems can be a gradual process, and it may take many years to achieve full benefits of reduced inputs and increased productivity. The Assessing Soil Health Series is part of a larger Soil Science Society of America webinar series produced in partnership with The Soil Health Institute and sponsored by The Walton Family Foundation. Earn 0.5 CEUs in Soil & Water Management by reading the article and taking the quiz at https://web.sciencesocieties.org/Learning-Center/Courses.

Soil health is the continued capacity of a soil to function as a vital living ecosystem that sustains plants, animals, and humans. Measurements of soil health include physical properties, chemical properties, and biological properties and processes. Farmers have familiarity with these general concepts as components of agricultural production, but detailed examination of soil health is not a practical component of farm management. Soil disturbance, cover crops, crop diversity, nutrient management, and water management are typical farm management concerns that have impacts on soil health.

The Soil Health Institute, with the support of Cargill, conducted 100 interviews of corn and soybean farmers who had adopted no-till,

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Grass cover crop in corn. Photo by David Lamm/Soil Health Institute.

reduced tillage, and/or cover cropping for at least five years. The farms were located across nine states (Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, Ohio, South Dakota, and Tennessee) that represent 72% of U.S. corn acreage and 68% of U.S. soybean acreage. Average farm size was 1,870 ac, indicating that the sample represented commercial-sized operations. All farmers had adopted no-till or reduced tillage, with 63 farmers planting cover crops before corn production and 64 farmers planting cover crops before soybean production.

During the interviews, the farmers were asked about perceived changes due to adoption of soil health management practices. More than 90% of the 100 farmers reported that soil health management practices had improved crop resilience and field access. These improvements were attributable to improved water infiltration that allowed seasonal moisture to remain in the crop root zone during periods of drought and limited water pooling on the soil surface during planting and harvesting periods. All farmers reported an increase in water quality with some reports based on quantitative tests and others based on observations.

Economics of Adopting Soil Health Management Systems

Adopting practices for enhancing soil health entails marginal changes in production without a complete overhaul of currently applied farm management practices. Even slight changes in farming methods may add risks to an inherently risky enterprise. Partial budget analysis of adopting soil health practices includes only the changes in net farm income that are due to changing production methods (Soil Health Institute, 2021). Thus, partial budget results attempt to determine expected changes in net farm income due to adopting soil health practices.

Farmer interviews collected management, input, and yield data that allowed partial budget analysis for comparison of alternative production systems. This analysis quantified differences in production expenses and revenue for each crop produced. The expense categories considered were seed, fertilizer and amendments, pesticides, fuel and electricity, labor and services, post-harvest costs, and equipment ownership. Change in revenue was calculated using the farm-reported yield change due to adopting soil health practices and U.S. long-term average price for each crop.

Average Change in Net Farm Income

Adopting soil health management systems leads to reduced expenses as well as additional expenses due to change in production methods. For each crop, average reduced expenses, additional expenses, and change in revenue were aggregated among farms in each state and averaged across all states. For corn, reduced expenses were $20.70/ac greater than additional expenses. Soybean reduced expenses were $15.64/ac greater than additional expenses. For both crops, the net reduced expenses (reductions minus additions) of fertilizer and amendments were the expense category with the greatest net reduction. Corn net reduced expenses for fertilizer and amendments were $21.22/ac, and soybean net reduced expenses were $8.95/ac. Greater expense reductions in corn production compared with soybean are attributable to reduced nitrogen applications.

As soil health improves from reduced tillage and cover cropping, soil structure improves, allowing greater plant-available water storage, improved root exploration, improved cycling of organic matter, and improved timing/efficiency of plant-available nutrients. Most farmers maintained established programs of soil testing to monitor soil nutrients. Not only does decreasing nutrient application reduce fertilizer expenses, but it also reduces the risk of nutrients leaving the farm through surface water, groundwater, and the atmosphere. Soil health practices are key to providing cleaner air and water.

Increased yields due to soil health practices were reported by 58% of the

With reduced-tillage practices, such as strip tillage shown here, soil structure improves, allowing greater plant-available water storage, improved root exploration, improved cycling of organic matter, and improved timing/efficiency of plant-available nutrients. Photo courtesy of Flickr/MPCA Photos.

farmers for corn and by 56% of the farmers for soybean. Yield decreases were reported only for corn by 2% of farmers. Average yield increases for all farmers were 7.34 bu/ac for corn and 2.91 bu/ac for soybean. Thus, average revenue increase was $30.90/ac for corn and $29.25/ac for soybean. Adding corn net reduced expenses of $20.70/ac and increased revenue of $30.90/ac results in a net farm income increase of $51.60/ac. Adding soybean net reduced expenses of $15.64/ac and increased revenue of $29.25/ac results in net farm income increase of $44.89/ac.

Transition in Soil Health Management Systems

Farmers participating in the interviews had practiced no-till\reduced tillage for an average of 19 years, and those planting cover crops had done so for an average of nine years. Reported changes in production inputs and potential yield increases were for two time periods, the initial period of conventional tillage and the current period with adoption of soil health practices. Increases in net farm income are from differences between the two time periods and do not provide information for incremental changes that lead to increased net farm income of $51.60/ac for corn and $44.89 for soybean. Farmers typically adopt soil health practices by initially reducing tillage and subsequently adding cover crops. Improved soil health due to adopting reduced tillage and cover crops is a transitional process that is gradual as physical, chemical, and biological properties respond to these farm management practices.

Reducing tillage has immediate benefits of eliminating expenses related to field activities with equipment such as labor, fuel, repairs, and fixed costs of equipment ownership. Potential additional expenses for chemical applications that replace tillage are comparatively less than reduced expenses. Farmers adopting no-till\reduced tillage without planting cover crops reduced expenses by $27.28/ac and $13.98/ac more in corn and soybean, respectively, than additional production expenses.

Planting cover crops adds expenses for cover crop seed, planting, and termination. For farmers planting cover crops, seed costs were $19.95/ac prior to planting corn and $17.29/ac prior to planting soybean. Planting cover crops increased corn yield 2.80 bu/ac more than no-till\reduced tillage without cover crops and increased soybean yield 1.45 bu/ac more than no-till\reduced tillage without cover crops. For corn, reduced expenses with cover crops were $17.80/ac more than additional expenses, and additional revenue with increased yield resulted in a $52.20/ac net farm income increase. For soybean, reduced expenses with cover crops were $20.72/ac greater than additional expenses, and additional revenue with increased yield resulted in a $59.37/ac net farm income increase.

Summary

Data from 100 farmers indicate increased net farm income as a result of adopting soil health practices. Soil health practices are marginal changes from conventional production methods with most seasonal activities and inputs remaining unchanged. Changes in management do require considerations for local soil and climate. Transitioning to soil health systems can be a gradual process, and it may take many years to achieve full benefits of reduced inputs and increased productivity.

References

Soil Health Institute. (2021). Partial budget analysis methodology used by the Soil Health Institute. https://soilhealthinstitute.org/wp-content/uploads/2021/02/Partial-Budget-Methodology-used-by-SHI-v.-02-08-2021.pdf

SELF-STUDY CEU QUIZ (goes with article on pages 36–38)

Earn 0.5 CEUs in Soil & Water Management by taking the quiz for the article at https://web.sciencesocieties.org/Learning-Center/Courses. For your convenience, the quiz is printed below. The CEU can be purchased individually or you can access as part of your Online Classroom Subscription.

1. **Of 100 farmers responding to survey questions about benefits of soil health practices such as no-till\reduced tillage and cover cropping, most farmers reported all the following EXCEPT**
   - **a.** improved field access during wet field conditions.
   - **b.** improved water quality.
   - **c.** decreased production expenses that compensated for decreased crop yield.
   - **d.** improved crop resilience to weather conditions.

2. **Aggregated over the 100 farmers interviewed, corn and soybean production with soil health practices such as no-till\reduced tillage and cover cropping decreased average net expenses compared with conventional tillage.**
   - **a.** True.
   - **b.** False.

3. **A benefit of adopting soil health management practices reported by farmers was**
   - **a.** reduced expenses for seed drying.
   - **b.** elimination of soil testing.
   - **c.** shortened growing season for optimal production.
   - **d.** decreased expenses for fertilizer and amendments.

4. **Benefits of adopting soil health practices are**
   - **a.** realized soon after implementing cover crops.
   - **b.** gradual as soil transitions with improved health.
   - **c.** decreased moisture content of corn for grain harvest.
   - **d.** increased oil content of soybean for harvest.

5. **Cover crops are planted only in areas with abundant rainfall so that the cover crops do not take soil moisture away from crops intended for harvest.**
   - **a.** True.
   - **b.** False.

SELF-STUDY CEU QUIZ (goes with article on pages 32–35)

Earn 0.5 CEUs in Nutrient Management by taking the quiz for the article at https://web.sciencesocieties.org/Learning-Center/Courses. For your convenience, the quiz is printed below. The CEU can be purchased individually or you can access as part of your Online Classroom Subscription.

1. **Investment into manufacturing of green ammonia aims to**
   - **a.** reduce loss of ammonia to the atmosphere.
   - **b.** produce ammonia without emitting carbon dioxide.
   - **c.** replace use of urea with ammonia.
   - **d.** reduce economic costs to farmers.

2. **By reducing emissions of nitrous oxide, nitrification inhibitors can**
   - **a.** reduce nitrate contamination of groundwater.
   - **b.** improve water quality.
   - **c.** reduce the greenhouse gas footprint of crop production.
   - **d.** substantially improve nitrogen use efficiency.

3. **In the principles of 4R Nutrient Stewardship, updated for the context of Responsible Plant Nutrition, use of climate-smart fertilizers represents one of the principles of**
   - **a.** right source.
   - **b.** right rate.
   - **c.** right time.
   - **d.** right place.

4. **The 4R Nutrient Stewardship framework and principles are focused on decisions made by**
   - **a.** fertilizer manufacturers.
   - **b.** food companies.
   - **c.** grain buyers.
   - **d.** farmers.

5. **A "smart fertilizer" is one that**
   - **a.** reduces greenhouse gas emissions by blocking nitrous oxide formation.
   - **b.** releases nutrients in response to signals from the crop.
   - **c.** is made with a low carbon footprint.
   - **d.** contains microchip technology.