Benefits, Adoption, and Value of Cover Crops

- Improving soil health is important for current and future productivity.
- Cover crops offer indirect and direct benefits to growers including reducing erosion and nutrient losses and increasing soil organic matter.
- Adoption of cover crop practices is increasing and universities are supporting cover crop research.
- Cover crop adoption offers commercial and environmental value.

Conservation and Sustainability

Currently, there is increased public and private interest in cover crops. Farmers adopt cover crops because the use of cover crops is linked with soil and water conservation and soil health, all important factors in sustainable productivity. Additional interest in cover crops has developed from information on crop yield sustainability, enhanced crop performance, and livestock feed value. Enhanced crop performance was demonstrated in 2012, when corn and soybeans following cover crops had a reported average yield increase of 9.6 and 11.6 percent, respectively.[10] These yield improvements came during a drought that negatively affected yield in many states. The weather resiliency of the cash crop is attributed to better rooting and a reduction of moisture loss from evaporation.

Environmental benefits from cover crops include reduced erosion and protection of water quality. Cover crops can also help fields rebound from intensive farming and tillage practices that have led to erosion, compaction, and soil structure damage. Agronomic benefits from some cover crops can be measured by a reduction of inputs and/or increased crop productivity. Cash crop productivity may improve with additional years of cover crop experience. In 2012, growers with more than three years of cover crop experience had greater corn yield increases compared to growers with less cover crop experience.[10]

Benefits to Producers

Direct benefits. Direct benefits to producers can be related to reduction of inputs such as fertilizer and pesticides. In addition to reduced inputs, early spring growth of cover crops can provide protection of young cash crop seedlings. In some cases, the cover crop may be killed, and the cash crop is seeded into cover crop residue.

Indirect benefits. Indirect benefits include relief of compaction and erosion problems. Cash crop root growth in soils with subsoil compaction can be improved by increasing the presence of active living roots. For example, soybean roots can grow into root channels created by deep-rooted annual ryegrass.[1] Many growers have tried to relieve compaction with tillage machinery. Use of machinery with loads of 20 tons/axle can lead to deep soil compaction and long-term annual corn yield losses of five to six percent on Minnesota clay loam soils.[4] Corn and soybeans can be more sensitive to surface compaction in the top foot of soil caused by equipment weighing less than 10 tons/axle. In a two-year Minnesota study, corn yields on silt loams were reduced by an average of 7.5% from 4 and 6 ton axle loads. Yield loss from machinery used to relieve compaction is an important reason for some growers to consider cover crops as a biological relief for compaction.

Reduction of erosion. Reducing erosion is one of the main goals of growing cover crops and is dependent on how much the cover crop reduces the forces responsible for soil detachment and transport. Soils are susceptible to erosion when they lack cover from crop canopy and residues. Above-ground biomass from cash crops may only last four months, but cover crops can be used to supplement additional soil surface cover. Cover crop growth extends the period of biomass production and can build soil organic matter (SOM). Increasing SOM creates larger, more stable soil aggregates near the soil surface, which reduces soil detachment and erosion potential.

Soil Organic Matter. Soil organic matter is one of the best indicators of soil health and productivity. Soil structure, soil fertility, and soil health are associated with SOM as are many physical and chemical characteristics of soils. Climate and vegetation are two of the most important factors influencing the amount of SOM in the soil surface. As mentioned earlier, cover crops that produce biomass that remains in the soil can help build SOM levels. No-till practices help preserve SOM gained from cover crop growth. Conversely, tillage quickly breaks down SOM. A no-till corn and soybean rotation in Illinois had approximately nine percent SOM increase in the top foot of soil from rye and hairy vetch cover crops.[6] Agricultural top soils have SOM levels ranging from one to greater than five percent with the potential to release 10 pounds of nitrogen (N) per acre per year for each one percent of SOM.[5]

Additional soil fertility benefits related to cover crop use include increased rates of infiltration, nutrient cycling, and residue decomposition. Cover crops can reduce nutrient loss by increasing soil water infiltration. By keeping precipitation in fields, sediment detachment and transport can be reduced, which is important for the retention of phosphorus (P). Phosphorus is attached to soil sediment, and P losses in runoff were reduced by 54 to 94 percent with various cover crops and different site years.[6]

Nutrients. Nitrate leaching can be reduced by extending the period of active growing roots on cropped soils. Winter cover crops of rye or winter wheat reduced nitrate N loss by 13 to 61 percent in Minnesota, Indiana, and Iowa.[6] This is due to the extended period of active N and water uptake compared to growing cash crops alone. Cover crop selection can be important for N management goals. Non-legume cover crops are better suited than legumes to reduce N leaching; however, legume crop residue more readily decomposes and releases N for subsequent crops.

Termination of cover crops should be timed so N release coincides with active periods of cash crop growth. Soils prone to erosion may require an inter-seeded or an additional cover crop species mixed with legume seed (biculture) because of the relatively rapid decomposition of legume residue. Bicultures can help moderate both rapid release of N from legumes and slow release of N from

Benefits, Adoption, and Value of Cover Crops

grass cover crops (Figure 1). Cover crops that survive a winter freeze and regrow in the spring are important for nutrient retention in the spring and can be especially important in areas where spring runoff is a concern.

The ability of cover crops to retain nutrients in the upper soil profile can be beneficial after a drought-stricken growing season when unused nutrients remain in the soil profile. Deep tap-rooted cover crops such as radish, draw up nutrients from deep in the soil profile (up to 140 lb N/acre accumulated from Michigan soils).[7] Consequently, the N is made more available near the soil surface as cover crops decompose. Fibrous root systems, such as those from rye, typically hold 25 to 50 lbs N/acre until spring. Consider soil N levels deep in the soil profile, and deep-rooted cover crop species to recover the nutrient.

Adoption of Cover Crop Practices

Successful cover crop demonstrations, university research, and technical support promote cover crop adoption across the country. Interest from public and private organizations is raising awareness among farmers. A survey over the 2012-2013 winter reported a steady and dramatic increase of cover crop use. In 2012, growers using cover crops for three years or more reported greater corn yields than growers using cover crops for shorter periods of time.[10] Predictable yield and economic benefits helps grower adoption of cover crops.

Universities across the country are supporting incorporation of cover crops into current rotation practices within research and demonstration projects. Studies at the University of Illinois predict economic and environmental benefits from the adoption of at least 10 percent of the possibly 27 million Illinois farmland acres to cover crops.[2] Despite the potential economic and environmental benefits, cover crop adoption may be limited by the perception of higher seed costs as well as management complications, such as timing of planting and termination, and moisture availability.

Farmers in Illinois, Indiana, Iowa, and Minnesota were surveyed in 2006 and 40 percent of respondents from the survey reported that cover crops fulfilled requirements for conservation plans.[3] Funding and technical assistance are available from the Environmental Quality Incentives Program (EQIP) carried out by the USDA Natural Resources Conservation Service (NRCS). Assistance is granted to producers with conservation plans that rank high enough for funding. Some states have held a special sign up for cover crop funding through EQIP, due to the heavy loss of hay and forage caused by drought.

Figure 1. Biculture of Austrian winter pea and radish cover crops grown in the fall.

Economic and Environmental Value

Economic. Producers with livestock in Illinois, Indiana, Iowa, and Minnesota harvest cover crops for animal feed approximately 27 percent of the time.[3] Some cover crops grow into the winter months for extended grazing and continued savings on feed costs. Growers have also received some seed sales income from successful cover crop species that were harvested for seed.

Environmental. Conservation practices, including cover crops, are being funded through the USDA NRCS Mississippi River Basin Healthy Watersheds Initiative in an effort to reduce nutrient loading associated with water quality problems in local waters and the Gulf of Mexico. A significant proportion of nitrate and P in local surface waters of the Upper Mississippi River Basin (Minnesota, Wisconsin, Illinois, Iowa, and Missouri) is reported to have originated from agricultural soils.[11]

The environmental value of productive soils, or soils restored by cover crops, can be difficult to estimate; however, cover crops can reduce soil erosion and the direct losses of water and nutrients on agricultural soils. Reduction of direct losses may also mitigate off-site damages to recreation areas, human health, personal property, water storage, etc. In 1995, off-site damages were estimated to amount to $44 billion per year in the United States.[8]

Summary

Soil health and production goals will be different for each producer considering cover crop species. Benefits of cover crops accumulate over time. It is recommended that cover crops be incorporated to the productive system after a testing and learning process. Adopting cover crops can be done with less risk on low productivity fields, by selecting a single species or a mix that matches the productivity concerns. Fields with marginal productivity may be the first place for an interested grower to observe the beneficial effects of cover crops. When overall productivity is increasing in a sustainable way, cover crops can become an important contributor to production agriculture.

Sources: [1] Bennett, D. 2013. Cover crop use growing as corn/soybeans acreage on upswing. Delta Farm Press; [2] Levey Larson, D. 2003. The crop destined to die. News and Perspectives Agro-Ecology. Vol. 12 No. 2. University of Illinois at Urbana-Champaign; [3] Morrison, J. 2009. Cover crops. University of Illinois. http://web.extension.illinois.edu (verified 7/29/2014); [4] Winsor, S. 2009. Compaction squeezes yields. Corn & Soybean Digest. http://cornandsoybeandigest.com (verified 6/10/2014); [5] Mitchell, C.C. and J.W. Everest. 1995. Soil testing & plant analysis. SERA-IEG-6*1; [6] Kaspar, T.C. and J.W. Singer. 2011. The use of cover crops to manage soil. Soil Management Practices. American Society of Agronomy and Soil Science Society of America. Chapter 21; [7] Sustainable agriculture research and education. 2012. Managing cover crops profitably (3rd edition); [8] Daily, G.C. 1997. Ecosystem services supplied by soil. Nature's Services. Island Press, United States. P127; [9] Oldeman, L.R. et. al. 1991. World map of the status of human-induced soil degradation (Explanatory Note). International Soil Reference and Information Centre. United Nations Environment Programme; [10] Myers, R. et. al. 2013. 2012-2013 Cover Crop Survey. Conservation Technology Information Center and Sustainable Agriculture Research & Education; [11] Kaspar, T.C. et. al. 2008. Potential and limitations of cover crops, living mulches, and perennials to reduce nutrient losses to water sources from agricultural fields in the Upper Mississippi River Basin. p. 129. Final Report: Gulf Hypoxia and Local Water Quality Concerns Workshop.

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology, Development, & Agronomy by Monsanto.