Soil Health for Improved Productivity

Declining soil health and soil erosion are intergenerational issues for Iowa farmers. Average soil loss to erosion in Iowa is estimated to be six tons per acre every year. At this rate, each generation over a typical 40-year farming career will hand down one inch less topsoil to the next generation of farmers. Soil erosion clearly is a threat to farming resiliency, as topsoil cannot be replaced at these rates of soil loss.

To help farmers better manage their soil health, the On-Farm Network (OFN) conducted a series of tillage and cover crop trials. Some trials were conducted with checkoff funding while most were supported by funding from Bayer Crop Science, Environmental Tillage Systems and public grants.

Soybean Tillage Trials

At three locations in 2018, farmers partnered with OFN to understand the value of tillage in soybean production. Across the locations was a small but significant 1.4-bushel average yield advantage for no-till soybeans when compared to full-width tillage. Of more importance is the $42.6/acre profit advantage for no-till soybeans (Figure 1). This is assuming a soybean price of $9.00 per bushel and tillage costs at $30/acre. Naturally, no-till soybeans also have the benefit of protecting soil from erosion.

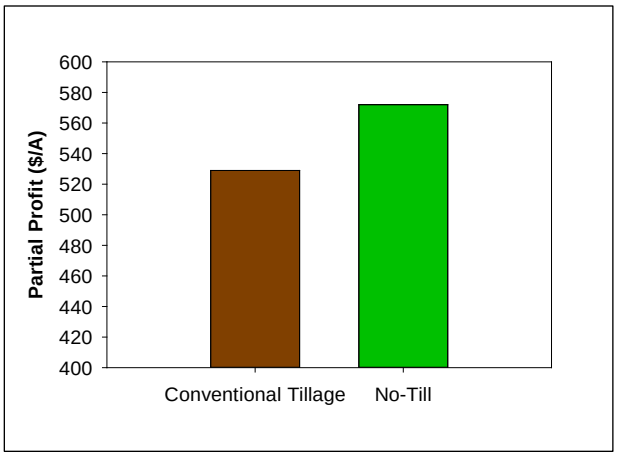

Figure 1. Partial profit for no-till soybeans compared to conventional two-pass tillage.

Strip Tillage Trials in Corn

In strip-tillage, the soil is tilled in rows of 6- to 10-inch strips in the fall or spring, leaving areas of crop residue in between the exposed rows (Figure 2). Because the crop residue has been moved away from the rows, this system has the advantage of faster soil drying in the spring and less residue in the tilled strips. This reduces residue-impairing planting operations. In many cases, strip-till allows placement of nutrients around 6 inches below the strip of planted seeds.

Strip-till represents a system that protects the soil from erosion compared to full-width tillage as residue cover is maintained on 66 percent of the field. In addition to reducing erosion, keeping residue cover on the field improves soil health through increased aggregate stability and water infiltration and a reduction of bulk density.

In most of the OFN trials, a Soil Warrior manufactured by ETS was used to till the strips. To simplify the comparisons, there was no deep placement of fertilizer in these trials. Field-length strip-tilled rows were replicated four times and compared with conventionally tilled or no-till rows.

Figure 2. Strip-tilled corn field. Strip-tillage can be completed in the spring or fall.

At six locations in 2018, the study compared strip-tillage to full-width conventional tillage in corn (Table 1). The average yield advantage for strip-tillage was a surprising 6 bu/acre with a range of response from 1–20 bu/acre. Sites with the largest responses were characterized by spring tillage. At some locations conditions may have been too wet for optimized tillage. All locations showed a positive advantage for strip-till versus conventional tillage. At four locations, strip-tillage was compared to no-till with an average yield response of 5.2 bu/acre.

Table 1. Yield advantage for strip-tillage versus conventional tillage across six locations in 2018.

Treatment	Yield
Strip-Till	215.2
Conventional Tillage	209.4
Pr>t	0.008

Table 2. Yield advantage for strip-tillage versus no tillage across four locations in 2018.

Treatment	Yield
Strip-Till	216.1
No-Till	210.9
Pr>t	0.004

The economics of strip-tillage are difficult to quantify. Creating strips requires slightly less labor, fuel and tractor horsepower when compared to conventional tillage. Strip-tillage requires high-end GPS; and RTK capability is recommended to assure the planter stays on the strips. Table 3 shows a cost comparison for various tillage practices. Note that the highest cost "strip-till pass, variable rate P and K + N" is still less than the cost of "chisel plow + field cultivate." With the conventional tillage option, a farmer still needs to pay for P, K and N applications. Finally, a 6-bushel yield advantage for strip-till equates to an additional profit advantage of $22.50.

Table 3. Comparisons of costs for implementing strip tillage system.

Practice	Cost/A ($)
Chisel Plow + Field Cultivate	32.3
Straight Strip-Till	17.0
Strip-Till with Variable Rate P and K	20.0
Strip-Till with Variable Rate P and K + N	25.0
Profit from Yield Advantage	22.5

Long-Term Cover Crop Trials

In 2016, the OFN began a series of cover crop trials with the aim of understanding how soil health improves in cover crop systems over five years of cover cropping. The fall and winter of 2017-2018 were not conducive to good cover crop establishment and growth. Yield results from 2018 are not reported as there was little difference in residue between the cover crop and no cover crop comparisons. This study will be repeated in 2019.