Cover Crops | No-Till or Low-Till | Nutrient Management

Piedmont Ag, VA
SOIL HEALTH CASE STUDY

APRIL 2024

Joe Gray discussing soil health

Joe Gray, a fourth-generation farmer, operates Piedmont Ag, a 1500-acre row crop farm in the Chesapeake Bay watershed of northern Virginia. Prior to Joe assuming management of the farm, it was a dairy operation using heavy tillage. This case study will focus on the 500 acres of row crops (90 owned, the remaining rented) with a rotation of 1-year corn and 3-years soybeans where Joe has implemented cover crops, no-till, and nutrient management. Since 2018, 200 acres of the study area have been protected by an agricultural easement held by the county.

Joe was motivated to adopt soil health practices in response to the extremes he experienced on his cropland after decades of conventional tillage, with soils that were always too wet or too dry and hard to work. He began no-till planting corn and soybeans in 2012 and followed that in 2013 with cover crops, finding that together, these practices greatly loosened up his soils and helped them hold moisture during dry periods, allowing his crops to thrive and yields to improve. The farm received financial and technical support from the local John Marshall Soil and Water Conservation District to implement cover crops.[1]

Joe is most enthusiastic about the effects he has seen from adopting cover crops. Although he's experimented with different mixes over the years, his use of rye has remained consistent. Joe uses his high-boy fertilizer spreader to seed his rye cover crop into standing soybeans, which is more cost-effective than drilling or aerial seeding and allows him to get his cover on sooner. Joe has found that cover crops have been especially effective in reducing weed pressure. He says, "There is no better weed suppressant than rye after that third year in beans." Fewer weeds have resulted in reduced herbicide applications, a substantial cost savings, though Joe notes it took about four years of cover cropping before he could significantly lower herbicide rates.

Joe's adoption of cover crops has not been without some hurdles. As Joe says, "Whether it's getting the cover established or terminating it before it gets too large before planting the following cash crop, the weather is always against us. The cover crop may not get the desired results in one location or one year, but with proper management, the risks are minimized."

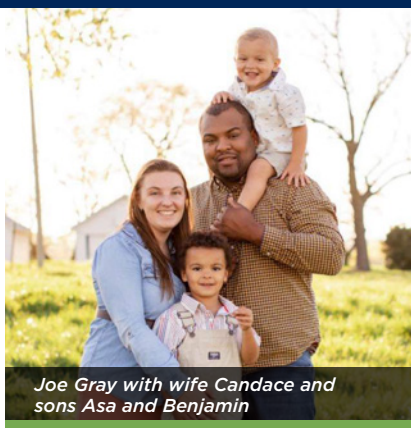
For Piedmont Ag, the risks have been worth it. They have seen a jump in the organic matter of their soils, moving from under 3% in 2012 to an average of over 4.5% in 2023. As a result, the water holding capacity and resiliency of the farm's soils have improved, a great help during very wet or dry weather.

Soil Health, Economic, Water Quality, and Climate Benefits

Partial budgeting analysis was used to estimate the marginal benefits and costs of cover crops, no-till, and nutrient management soil health practices on Piedmont Ag. The study was limited to only those income and cost variables affected by the adoption of these practices. The table on page 2 presents a summary of these economic effects, revealing that, due to the three soil health practices, Joe Gray's net income increased by $209/ac/yr on the 500-acre study area, achieving a 208% return on investment.

The largest per-acre increase in net income is due to the significant yield increases of 30 bu/ac in corn and 11 bu/ac in soybeans, which Joe attributes to the implementation of his soil health practices, recognizing that other factors influence yield. This has resulted in a $174/ac/yr increase in income for the farm. The farm's largest savings comes from decreased machinery costs, the result of switching from conventional tillage to no-till, a $43/ac/yr decrease in cost.[2]

Joe has replaced annual commercial phosphorus (P) applications with chicken litter every three years for his corn and soybean crops, resulting in 69 lbs/ac less P applied on average



Joe Gray with wife Candace and sons Asa and Benjamin

Farm at a Glance

COUNTY: Fauquier, VA

WATERSHED: Rappahannock/ Chesapeake Bay

CROPS: Corn & soybeans

FARM SIZE: 1500 acres (500-acre study area)

SOILS: Silty loam on rolling hills of 5–10% slopes

SOIL HEALTH PRACTICES: Cover crops, no-till, & nutrient management

Joe showing his healthy soil in a rye cover crop shovel sample

annually. Although this change in nutrient management only saves him $374/yr, Joe believes the switch to chicken litter contributes to the increased organic matter and tilth in his soils in tandem with the farm's no-till and cover crop adoption.

The farm applies less herbicide on corn and soybeans since their cover crop now suppresses most weeds. Healthier soils have also led to healthier, more disease-resistant crops, allowing Joe to eliminate the use of insecticides, resulting in a decrease in pesticide costs of $26/ac/yr. "We don't want to kill the beneficial insects," says Joe. "I just let the bugs work." Cover crops have also helped maintain more consistent soil pH levels, thereby reducing average lime applications every year, saving the operation $5/ac/yr.

NRCS's soil erosion calculation software, RUSLE2, estimates that Piedmont Ag has achieved their goal of preventing further soil erosion, saving a significant 7.3 tons of soil/ac/yr[3] and reducing mechanical erosion repair costs ($2,000/yr) as a result of their implementation of cover crops and no-till across their entire acreage, a savings of $19/ac/yr.[4]

The largest cost increase involves cover crop adoption at $53/ac/yr; however, this cost is at least $29/ac/yr less than if Joe were purchasing his rye seed from local dealers. Instead, Piedmont Ag has been growing 50 acres of their own rye for seed since 2021.

Based on soil tests, Joe has started applying zinc to enhance crop nutrient uptake and yields, which has added a slight cost of $5/ac/yr. Finally, Joe estimates that he spends approximately 16 hrs/yr enhancing his knowledge of soil health practices equating to $459/yr.

Closing Thoughts

Joe has hosted several field days at his farm to showcase the benefits of implementing no-till and cover crops and to encourage surrounding farmers to make the switch. While recognizing the variability between fields, he sees the positive impacts cover crops and no-till have had on his soils. Joe says, "When you grab that soil, it's so mellow; it's just as fluffy as can be. It's actually a joy planting into it."

Writers: Lia Raz & Kent Bohnhoff

ECONOMIC EFFECTS OF SOIL HEALTH PRACTICES ON PIEDMONT AG (2023 PRICES)[5]

Increases in Net Income

Increase in Income

ITEM	PER ACRE	ACRES	TOTAL
Yield improvements by 33% for corn & 37% for soybeans due to soil health practices	$174	500	$86,970
Total Increased Income			**$86,970**

Decrease in Cost

ITEM	PER ACRE	ACRES	TOTAL
Machinery cost savings due to no-till	$43	500	$21,743
Reduced phosphorus applied by 69 lbs/acre on average due to soil health practices	$42	500	$21,206
Herbicide (-26%) & insecticide (-100%) savings due to soil health practices	$26	500	$13,175
Lime reduction due to cover crops	$5	500	$2,640
Value of decreased erosion due to soil health practices (7.3 tons soil/ac/yr)	$19	500	$9,558
Total Decreased Cost			**$68,321**
Annual Total Increased Net Income			**$155,081**
Total Acres in this Study Area			**500**
Annual Per Acre Increased Net Income			**$310**

Decreases in Net Income

Decrease in Income

ITEM	PER ACRE	ACRES	TOTAL
None identified			
Total Decreased Income			**$0**

Increase in Cost

ITEM	PER ACRE	ACRES	TOTAL
Added chicken litter application to corn (4 tons/ac once every 3 years)	$67	125	$8,333
Added chicken litter application to soybeans (2 tons/ac once every 3 years)	$33	375	$12,499
Rye cover crop establishment & termination costs	$53	500	$26,621
Added zinc due to soil health practices	$5	500	$2,500
No-till and cover crop learning activities (16 hrs/yr)			$459
Total Increased Cost			**$50,411**
Annual Total Decreased Net Income			**$50,411**
Total Acres in this Study Area			**500**
Annual Per Acre Decreased Net Income			**$101**

Annual Change in Total Net Income = $104,670

Annual Change in Per Acre Net Income = $209

Return on Investment = 208%

[1]Joe Gray received $50/ac/yr from 2013-2021 and $90/ac in 2022-2023 for cover crops. This is not included in the analysis because cost-share is temporary and not received by all. Readers can assume that during the contract years, Joe Gray's net income was higher than presented in this analysis. [2]Machinery costs include the cost of equipment, custom hire, labor, depreciation, interest, insurance, housing, repairs, and fuel (Univ. of IL at Urbana-Champaign, 2023, Farm Business Management Machinery Cost Estimates: Field Operations). [3]RUSLE2 results prepared by Rex Rexrode of NRCS Culpepper Service Center. [4]Value of decreased erosion is based on the estimated N & P content of the soil (2.32 lbs N/ton, 1 lb P/ton) and fertilizer prices (USDA NRCS, May 2010, Benefit-Cost Analysis for the EQIP), and Joe Gray's estimate of reduced mechanical erosion repair costs. [5]This table represents estimated average costs and benefits attributed to adopting no-till and cover crops over the entire study area of 500 acres where corn and soybeans are grown, as reported by the farmer. • All values are in 2023 dollars. • Prices are stated as per acre values for items that vary by area. Prices such as learning costs, which don't vary by area, are only given as total costs. • Prices used: Corn Grain: $6.29/bu, Soybeans: $13.42/bu (USDA NASS, Crop Values: 2023 Summary); Phosphate: $.61/lb (ISU, 2022, Ag Decision Maker: Estimated Costs of Crop Production in Iowa). • Return on investment is the ratio of Annual Total Change in Net Income to Annual Total Decreased Net Income as a percent. • For information about the study methodology, see farmland.org/soilhealthcasestudies • This material is based on AFT's work supported by a USDA NRCS Cooperative Agreement #NR223A750010C003.

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