Corn after cover crops on the left = resilient! No cover crops on the right = stressed!

RIGHT IMAGE: MICHAEL SWISHER

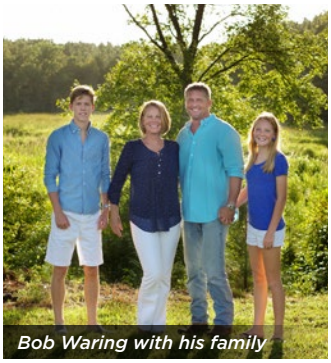
Healthy soil with vetch roots

Soil Health Case Study

Bob Waring, Brandon Farm, VA

JANUARY 2024

Brandon Farms is a third-generation row crop farm located in Essex County, Virginia, along the Rappahannock River, a tributary to the Chesapeake Bay. Bob Waring Jr. manages the farm with his father, Rob, growing 1 year of corn grain and 2 years of soybeans across 450 acres, 100 of which they own. They have implemented no-till since the 1990s. For this study, we analyze their more recent adoption of cover crops and nutrient management on 300 acres, as the other 150 acres are managed using different practices.



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Bob Waring with his family

Bob works as a nutrient management specialist for the Virginia Department of Conservation and Recreation. "Conservation is part of my job, but it's also part of my life," he says. After a back injury from an 11-foot fall in 2013, Bob recognized that by eating correctly, his body was able to withstand that stress and heal. He began applying that philosophy to his farm, believing that "plants are better able to withstand drought, insect pressure, and disease if they get nutrition through natural sources like cover crops."

Bob and Rob began experimenting with cover crops as early as 2010, with help from state and federal cover crop cost-share programs.[1] In 2016, Bob partnered with Virginia Tech and Precision Sustainable Agriculture to implement a long-term field trial, with a side-by-side comparison of cover crops and no cover crops. They are comparing different nitrogen amounts and discovering application timing through extensive soil sampling, discovering that with cover crops, they can reduce synthetic nutrients applied. "Nutrients are staying in the soil that would have been lost to leaching," says Bob. "Cover crops are harvesting potash, nitrogen, and sulfur for release to the next crop."

Based on learnings from this trial, Bob has expanded his nutrient management practices. Bob now completes a Soil Test for Biological Activity (STBA) to determine nitrogen levels in the soil. He also tests soil for pH, nutrients, and organic matter and measures cover crop biomass and leaf tissue nutrients every year on every field. Previously, he used just one representative standard soil test per crop.

Bob and Rob are constantly fine-tuning how best to offset fertilizer costs in crop production with cover crops. They currently use high biomass, single-species cover crops—planting vetch before corn and black oats before soybeans—but are experimenting with cover crop mixes. Bob plants corn and soybeans into green cover, rolling vetch but not oats, as the soybeans didn't mind either way.

Soil Health, Economic, Water Quality, and Climate Benefits

Partial budgeting analysis was used to estimate the marginal benefits and costs of cover crops and nutrient management on Brandon Farms. The study was limited to only those income and cost variables affected by the adoption of these soil health practices. The table on page 2 presents a summary of these economic effects, revealing that, due to the two soil health practices, Brandon Farms' net income increased by $55/ac/yr, or by $16,439/yr, on the 300-acre study area, achieving a 70% return on investment.

The largest increase in net income was due to yield increases from the adoption of cover crops and nutrient management. Using Bob's yield monitor and crop insurance records, we attribute 50% of his corn and soybean yield increases to the adoption of cover crops and change in nutrient management. We calculated a 43 bu/ac of corn and 9 bu/ac of soybean increase in yield when comparing average yield before and after adoption of cover crop and nutrient management. Bob adds,

Farm at a Glance

COUNTY: Essex, VA

WATERSHED: Rappahannock River, Chesapeake Bay

CROPS: Corn & soybeans

FARM SIZE: 450 acres (300-acre study area)

SOILS: Sandy loam 0–2%

SOIL HEALTH PRACTICES: Cover crops & nutrient management

Corn emerging into terminated vetch

Bob Waring, Brandon Farms, Essex County, VA

"I think we are getting a lot more resiliency, which is translating into better and more consistent yields."

Additional increases in net income are attributed to decreases in cost. With the adoption of cover crops, pesticide application costs have been reduced by $16/ac, as Bob no longer applies an insecticide on soybeans and has reduced his herbicide costs on corn. The largest savings that Brandon Farms attributes to cover crops and nutrient management is a $37/ac reduction in fertilizer applications. On corn, they reduced nitrogen inputs by 85 lbs/ac, reduced phosphorous inputs by 25 lbs/ac, and reduced potassium inputs by 20 lbs/ac. For soybeans, they reduced their phosphorous inputs by 15 lbs/ac and potassium inputs by 5 lbs/ac. Additionally, with the pH buffering effects of the cover crops, they have reduced lime applications to one ton every 6 years, instead of every 3 years, for an annualized savings of $8/ac/yr.

The largest cost incurred by the farm is for cover crops at about $63/ac/yr, or a total of $18,950/yr, including seed, establishment, and management. This cost estimate does not include termination because a pre-plant herbicide spray was already part of the farm's no-till system. The chemical costs for burndown are $13/ac for corn and $7/ac for soybeans. Another cost increase is the additional soil, tissue, and grid sampling costs, which total $7/ac/yr.

Bob is a lifelong learner and estimates he spends 100 hours annually on learning activities related to soil health practices valued at $2,618/yr. This estimate does not include the additional time that Bob spends at work learning about and presenting on nutrient management to help other Virginia farmers.

AFT used USDA's Nutrient Tracking Tool to evaluate Bob's use of nutrient management and cover crop practices on a 77-acre field and found that the practices reduced N, P, and sediment losses by 84%, 76%, and 93%, respectively. The USDA's COMET-Planner Tool estimates that Bob's soil health practices resulted in a reduction of 129 metric tons of CO_2-equivalents/yr, corresponding to taking 29 cars off the road for one year.

Closing Thoughts

As a soil health advocate and innovator, Bob is now an executive member of the Southern Cover Crops Council and the Innovation Roundtable, a farmer-led group of soil health leaders. Bob's passion is palpable in his presentations. As he puts it, "I grew up on the river. My heart is in saving the waterways and being a good steward of the land."

WRITERS: *Kent Bohnhoff & Ellen Yeatman, American Farmland Trust*

Economic Effects of Soil Health Practices on Brandon Farms (2021 Prices)[2]

Increases in Net Income

Increase in Income

ITEM	PER ACRE	ACRES	TOTAL
Yield increase of 15% for corn and 10% for soybeans	$71	300	$21,289
Total Increased Income			**$21,289**

Decrease in Cost

ITEM	PER ACRE	ACRES	TOTAL
Reduction in pesticides due to cover crops (reduced weed pressure on corn & stopped insecticides on soybeans)	$16	300	$4,917
Reduction in N, P, & K on corn and P & K on soybeans	$37	300	$11,210
Lime application reduced by 50% due to nutrient management	$8	300	$2,502
Total Decreased Cost			**$18,629**
Annual Total Increased Net Income			**$39,918**
Total Acres in this Study Area			**300**
Annual Per Acre Increased Net Income			**$133**

Decreases in Net Income

Decrease in Income

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

Increase in Cost

ITEM	PER ACRE	ACRES	TOTAL
Cover crop costs for vetch before corn and black oats before soybeans	$63	300	$18,950
Soil Test for Biological Activity (STBA) on every field once a year	$3	300	$801
Increased nutrient testing costs due to soil, tissue, & cover biomass sampling on every field	$2	300	$510
Grid sampling in lime application years and applying lime on grid	$2	300	$600
Learning activities (100 hrs/yr)			$2,618
Total Increased Cost			**$23,479**
Annual Total Decreased Net Income			**$23,479**
Total Acres in this Study Area			**300**
Annual Per Acre Decreased Net Income			**$78**

Annual Change in Total Net Income = $16,439

Annual Change in Net Income Per Acre = $55

Return on Investment = 70%

[1] Bob received $75/ac ($10,157/yr) through the NRCS EQIP program (2014-2016) and $40/ac ($10,000/yr) from the Virginia Department of Agriculture (1999-2023) for cover crops; and $37/ac ($9,323/yr) through EQIP (2014-2016) for nutrient management. This is not included in the analysis because cost-share is temporary and not received by all.

[2] This table represents estimated average costs and benefits attributed to adopting cover crops and nutrient management over the 300-acre study area, as reported by Bob Waring.

- Rounding of per acre values may result in minor discrepancies in totals.
- All values are in 2021 dollars.
- 2021 standard prices: Corn Grain $5.45/bu, Soybeans $13/bu (USDA NASS, Crop values: 2021 Summary); Nitrogen: $0.72/lb, Phosphate: $0.62/lb, Potash: $0.56/lb (ISU, 2022, Ag Decision Maker.)
- Machinery costs include the cost of custom hire, labor, depreciation, interest, insurance, housing, repairs, and fuel (Univ. of IL at UC, 2021, Farm Business Management Machinery Cost Estimates: Field Operations.)
- For information about (1) study methodology, see farmland.org/soilhealthcasestudies; (2) USDA's NTT, see ntt.tiaer.tarleton.edu; and (3) USDA's COMET-Planner Tool, see comet-planner.com.

For more information about this study or to discuss soil health practices, please contact:
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To read more case studies, visit farmland.org/soilhealthcasestudies