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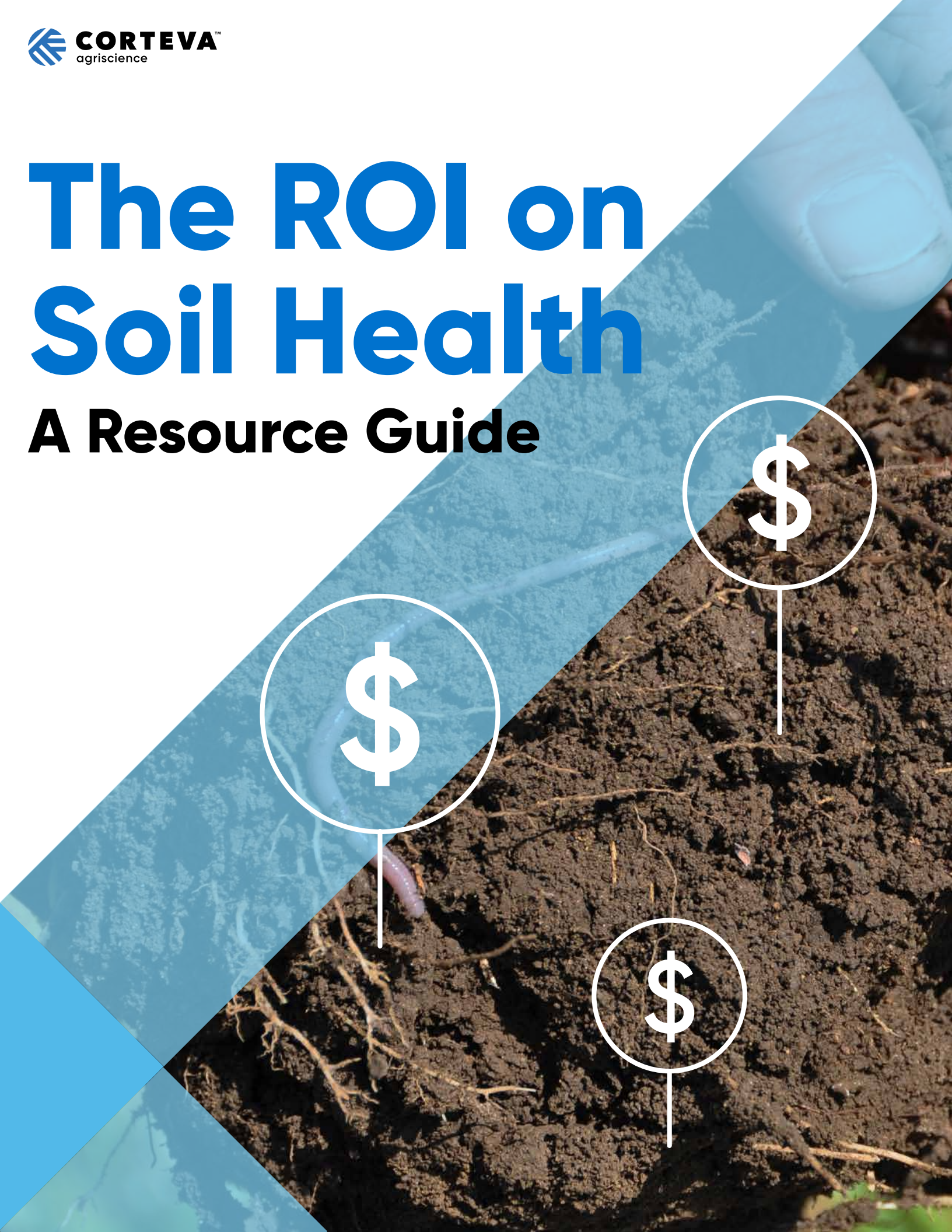
The ROI on Soil Health

A Resource Guide



Breaking Down Soil Health ROI

It's getting harder to farm. Extraordinary factors like drought and superweeds compound existing challenges like erosion, nutrient runoff, and rising input costs. Many farmers are now finding their go-to practice playbook isn't working, and they need new solutions to help mitigate risk and protect their bottom line.

The answer is right under our feet. Soil is a farmer's greatest asset and, as it turns out, building soil health pays off—agronomically and financially.

This resource guide looks at some of the toughest challenges farmers are facing today and demonstrates how soil health practices such as reduced tillage and cover crop adoption can help.

It's Never Been Easier to Get Started

Carbon program payments can help offset the cost of investing in soil health. Check out our Carbon Payment Calculator to see in seconds the dollars you may be leaving on the table.

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Added Nitrogen

Nothing hits a farmer's bottom line quite like fertilizer—and prices in 2022 will hit harder than hail in May—from $746/ton for anhydrous ammonia to $800/ton for NH3.

As fertilizer becomes more expensive, cover crops and reduced tillage may be the answer given their ability to restore and build nutrient rich soil.

What's the ROI?*

40 lbs/acre
fixated N from a legume cover crop[1]

X

$0.63 /lb
cost of N[2*]

=

$25.20 /acre/year
saved

**How much additional nitrogen and when it's available depends on multiple factors[3]. Direct savings from fixated nitrogen varies based on species and practices, as outlined here[4].*

Where's the Proof?

- Every 1 % of soil organic matter releases **10-20 lbs of plant-available nitrogen, 1-2 lbs of phosphorus, and up to 0.8 lbs of sulfur** per acre/per year (NRCS) [5]
- **Rye biomass scavenged between 5 to over 100 lbs N/acre in its biomass**, significantly reducing nitrate leaching and restoring it to the soil after termination, as found in a 5-year, two-site research study (Iowa State) [6]
- Many state universities **reduce recommended added fertilizer rates on no-till fields**. NDSU, for example, deducts 40-50 lbs N/acre for long-term no-till soils versus conventional till
- **Conventional tillage reduced soil organic matter levels by almost 70%**, leaving only 30-40% of soil organic compound stocks with a correlated drop in nitrogen efficiency to 30-40% (Ohio State) [7]

Case Studies On the Farm

Ford County, IL	
Farm	Thorndyke Farms[8]
Crops	Corn and soybeans
Soils	Silty clay loam soils on flat to slightly rolling hills
Acreage	1,400 acres
Soil Health Practices	Cover crops and no-till
Nutrient Benefits	• Nutrient savings from reduced applications = $66/acre • Reduced machinery costs from less tillage and one less fertilizer pass = $20/acre

Delaware, OH	
Farm	Homewood Farm[9]
Crops	Corn and soybeans
Soils	Silt and clay loam soils on flat to slightly rolling fields
Acreage	915 acres
Soil Health Practices	Cover crops and strip till
Nutrient Benefits	Use of strip-till, cover crops and fertilizing banding reduced N losses by 35%, P losses by 84% and sediment losses by 99%

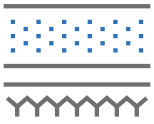
What's Happening in the Soil?

Cover crops "scavenge" and "fix" nitrogen

- Legume cover crops produce (aka "fix") their own nitrogen by converting atmospheric nitrogen gas into soil nitrogen, for a natural nitrogen boost for your next crop
- Cover crops "scavenge" residual nitrate by uptaking it to grow and releasing it back into the soil through decomposition

Reduced tillage and cover crops boost soil health

- Crop residue creates soil organic matter that feeds the biological organisms in soil
- Soil organic carbon stock is directly related to nitrogen use efficiency



Crop residue builds strong soil structure

- Soil with good structure has better water infiltration. More soil moisture equals better microbial activity, enhancing nutrient cycling

Weed Suppression

The standard playbook on weed management is becoming more expensive. With glyphosate priced at over $80/gallon and "superweeds" like Palmer amaranth and waterhemp becoming more prevalent, each additional pass cuts into the bottom-line.

Cover crops and reduced tillage can eliminate one or two herbicide passes, as research demonstrates their ability to inhibit weed germination and growth.

What's the ROI?

1 pass reduced[11] x **$22** /acre cost of herbicide + application[12] = **$22** /acre saved

Where's the Proof?

- Over 90% of farmers surveyed in the USDA's National Cover Crop Survey reported a **25% - 91% improvement in weed control** when planting a cereal rye cover crop (SARE) [13]
- Incorporating **small grain cover crops resulted in 95%, 75% and 57% fewer weeds** over one, two and four months following burndown herbicide applications on field trials (Oklahoma State) [14]
- Across four studies, **fast-growing cover crops suppressed weed growth by 80-100%** (Clemson) [15]
- **Cover crop biomass was found to be inversely related to weed biomass and density**—if cover crop biomass went up 100%, weed biomass and density went down 67% (Kansas State meta-analysis) [16]
- **Conventional soybean growers relied on glyphosate alone 2x as much as no-till growers**, increasing the risk for resistance, as found in a 6-state (including IA, IN and NE) , 5-year benchmark study (Benchmark study) [17]

- Conservation tillage kept 90% of seeds within the top 2 inches of soil, **leaving seeds more susceptible to weathering and pathogens**, as found by a multi-study analysis [18]

- **Soil disturbance from late season tillage can foster waterhemp germination and increase emergence by 10%** when compared to no-till fields. While tillage took down emerged waterhemp plants and Palmer amaranth, field trials showed that roots remained, and tillage triggered a six-fold spike in emergence (Southern Illinois) [19]

Case Studies On the Farm

Livingston, IL	
Farm	Ifft Family Farm[20]
Crops	Corn and soybeans
Soils	Silt loam and silty clay loam soils on flat to slightly rolling fields
Acreage	825 acres
Soil Health Practices	Cover crops
Herbicide Savings	Reduced herbicide applications resulting from cover crop weed control = $14.80/acre

Marion & Delaware Counties, OH	
Farm	MadMax Farms[21]
Crops	Corn and soybeans
Soils	Silt loam and clay loam soils, flat to slightly rolling terrain with slopes from 0 to 10%
Acreage	1,250 acres
Soil Health Practices	Cover crops, no-till and nutrient management
Herbicide Savings	• Pesticide savings from cover crop = $18.75/acre • Reduced fungicide soybean seed treatment = $6/acre

What's Happening in the Soil?

Cover crops compete with and inhibit weed growth

- Cover crops suppress weed germination by competing for space, light, moisture and nutrients
- Certain cover crops release allelopathic chemicals that inhibit weed germination and growth

Crop residue suppresses weed growth

- Crop residue acts like mulch, blocking sunlight and hindering weed germination
- Limiting soil disturbance keeps weed seeds and mold spores buried and out of the germination zone

Drought & Flood Resilience

In 2021, almost every state west of the Mississippi River experienced water shortages due to drought. These recent shortages stand in sharp contrast to the historic rainfall of 2019 which flooded the Corn Belt, resulting in record unplanted acres and economic losses estimated at $2.9 billion.

As extreme and erratic weather becomes more common, water availability becomes less predictable. Utilizing cover crops and reducing tillage are two methods that can be used to maintain the soil structure that is critical to conserving water in dry periods and cycling water when there's too much.

What's the ROI?

3.5 inches/acre
irrigated water saved per year[24]

x

$2.40 /inch
cost of irrigated water[25]

=

$8.40 /acre/year
saved

Where's the Proof?

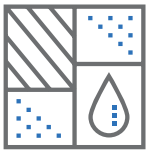
- For every 1% increase in soil organic matter, a multi-study review found that the available **water capacity increased by 3,400 gallons per acre** (University of Minnesota) [26]
- **Crop residue can save 3-4 inches of irrigation water** compared with bare soil to achieve the same yield across field trials (University of Nebraska-Lincoln) [27]
- Overall soil water storage increased, with the amount of **plant available water increasing 20%**, in a 6-year site study analyzing continuous in-field soil water with a winter rye cover crop (Iowa State University) [28]
- Crop residue limited evaporation from the soil, **maintaining 80-90% humidity levels in undisturbed soils**, as found in a 5-year study in the Red RIver Valley (NDSU, UM Extension) [29]

Case Studies On the Farm

Waco, NE	
Farm	Gonnerman Farm[30]
Crops	Corn and soybeans
Acreage	825 acres
Soil Health Practices	Cover crops and no-till
Benefits	• Adding cover crops to no-till fields increased soil organic matter from 2.2% to 3% • On a field with 6-7% slope, water infiltration went from 0.75 inches in an hour to 2 inches in 7 minutes

Ford County, IL	
Farm	"Junior" Upton[31]
Crops	Corn and soybeans
Acreage	1,250 acres
Soil Health Practices	Cover crops and no-till
Benefits	• Root depth from cover crop mix of cereal rye, ryegrass and hairy vetch reached 48 inches deep, despite above-ground biomass of less than 5 inches, breaking up the soil fragipan • New practices alleviated drought impact by improving soil water-holding capacity; root depth of cash crop increased from 5 inches to four feet

What's Happening in the Soil?



Increase water infiltration

- Cover crop biomass protects the ground and prevents the soil from sealing out water, while the root structure boosts soil aggregate stability, soil porosity and water storage capacity

Conserve soil moisture

- Cover crop biomass and crop residue form a protective barrier above the soil surface to reduce evaporation
- Both cover crops and reduced tillage build soil organic matter, forming aggregates that are critical to holding water

Soil Erosion

Losing soil means losing money. A 2021 study[33] estimates 35% of the Corn Belt is without topsoil. With every ton of eroded soil, NRCS estimates[34] that farmers lose over 2 pounds of nitrogen and 1 pound of phosphorus. That equates to a $2/ton loss in fertilizer based on current pricing.

Reduced tillage and cover crops support soil structure—building and maintaining the organic matter crucial to water infiltration. Without healthy soil structure, wind and runoff remove precious soil and nutrients, limiting potential profitability.

What's the ROI?

2.5 tons/acre soil saved per year[35] x **3.3** lbs/ton N + P in soil[36] x **$0.63** /lb cost of N + P[37] = **$5.20** /acre/year saved

Where's the Proof?

- Cover crops were found to **reduce runoff loss by up to 80% and sediment loss from 40-96%**, based on a review of current research (University of Nebraska-Lincoln)[38]
- Conventional till fields saw a yearly average loss of 3 tons of topsoil versus **0.5 tons for the no-till field** on three crop production fields in southeast Kansas (Kansas State)[39]
- **Strip-till and no-till lost 1.73 and 1.14 tons/acre/year in total sediment** versus conventional till at 12.15 tons/acre/year, in an Iowa State simulated 30-year field study (Iowa State)[40]
- **The water infiltration rate for no-till fields at a research farm in Lincoln was measured at over 4 inches/hour** versus 0.4 inches/hour for long-term conventional tilled fields, with similar results at a second research location (University of Nebraska-Lincoln)[41]
- **Infiltration rates on two different soils are 2 to 4 times greater on no-till fields** versus fields with minimum tillage or conventional moldboard plowing with secondary tillage, as shown in a long-term Ohio study (Ohio State)[42]

Case Studies On the Farm

Marion & Shelby Counties, MO	
Farm	TJT Gottman, Inc.[42]
Crops	Corn-soybean-wheat rotation
Soil Health Practices	Cover crops
Erosion Benefits	• A fallow field lost 28 tons/acre over more than 3 years, versus almost zero loss on the cover cropped field • Soil aggregate stability on the cover crop field increased significantly (about 9%)

Northeast MO	
Farm	Case Study Operation[43]
Crops	Corn and soybeans
Acreage	1,800 acres
Soil Health Practices	Cover crops and no-till
Erosion Benefits	• Erosion reduction savings totaled $5.60/acre • Cover crops controlled erosion and eliminated the need for building terraces, saving $53/acre

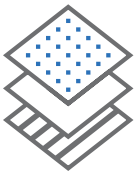
What's Happening in the Soil?

Protect the Soil Surface

- Cover crop roots hold soil in place, while the plants cover the soil and deflect rain impact. Soil particles hold firm, preventing runoff and soil sealing
- Crop residue creates a wind barrier, cushions rainfall, and dams water in the field, reducing soil erosion

Increase Water Infiltration

- Cover crop roots push through compacted soil, creating macropores that allow water to better permeate the soil
- Crop residue slows the speed and amount of waterflow, allowing more time for soil to absorb water



Build Strong Soil Structure

- Both cover crops and reduced tillage build soil organic matter, which reduces bulk density and increases soil porosity

Carbon Payments

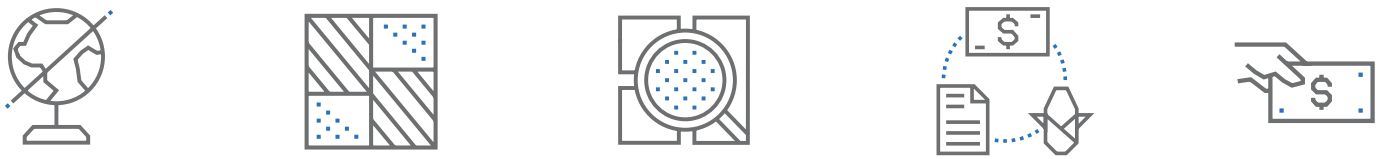
Making the shift to cover crops and reduced till has its own costs. On average, total cover crop costs can range from $20-$100/acre[44], while converting to no-till can involve significant new equipment costs[45]. A carbon program can ease the transition to soil health by offsetting necessary initial investments in new practices.

What's the ROI?

0.1-1.0 ton/year carbon sequestered[46] x Up to **$30** /ton payment[47] = **$3-$30** /credit/year earned

Calculate your payment potential in seconds with our **Carbon Payment Calculator**.

What's a Carbon Program?

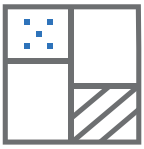


1. Demand for cutting greehouse gases (CO_2) is growing
2. Soil Health practices can store carbon in soil
3. Net-new carbon in the soil is quantified into credits
4. Companies buy credits to reduce their carbon footprint
5. Corteva pays farmers for their impact

Where's the Proof?

- A 12-year study showed that **cover crops consistently sequestered soil organic carbon in the topsoil, subsoil and root zone.** Fields with cover crops and no-till saw the largest increase (SOC up 46% in the subsoil zone) (University of Illinois-Urbana) [48]
- **Cereal rye and a cover crop mix boosted total particulate organic matter (POM) by 14%** versus the control without cover crops, as demonstrated at two of three sites in a 4-year field trial study (UNL) [49]
- Soil tilled with **a moldboard plow released almost 14x the amount of carbon** following tillage as no-till (USDA/MN) [50]

What's Happening in the Soil?



Build Soil Organic Carbon

- Cover crop plants pull CO_2 from the atmosphere through photosynthesis and crop root exudates add organic carbon in the soil
- Organic matter from crop residues boosts soil microbes and aggregate retention of soil organic carbon (SOC)

Prevent Carbon from Leaving the Soil

- Tillage and plowing break down soil structure and expose soil organic carbon to the sun and air—allowing it to respirate into the atmosphere
- No-till reduces soil disturbance, which preserves soil structure and prevents soil organic carbon from re-emitting into the atmosphere

Offer farmers a new revenue stream

- Over 20% of the world's largest public companies (representing nearly $14 trillion in sales) have committed to net zero targets[51]
- Skyrocketing demand for carbon credits is driving price (carbon credits are projected to reach $60 by 2030)

Appendix

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