



Soil Health

Senate Committee Agriculture and Forestry
Syngenta, OSCIA, OSN

April 26, 2023



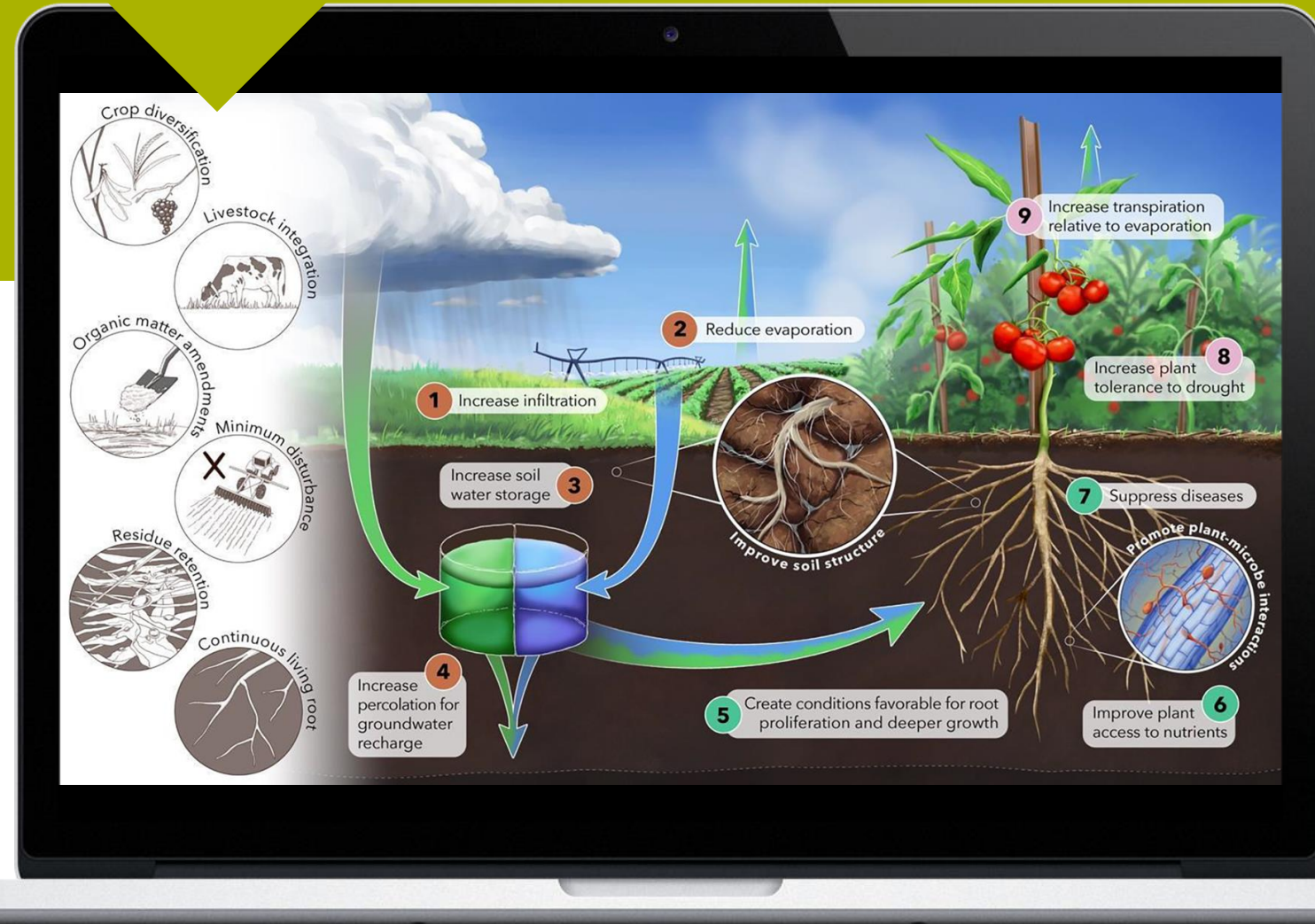
Functions of Healthy Soil

Definition

Soil health

is the capacity of a soil to function as a **vital** living **ecosystem** that sustains plants, animals, & humans

USDA-NRCS

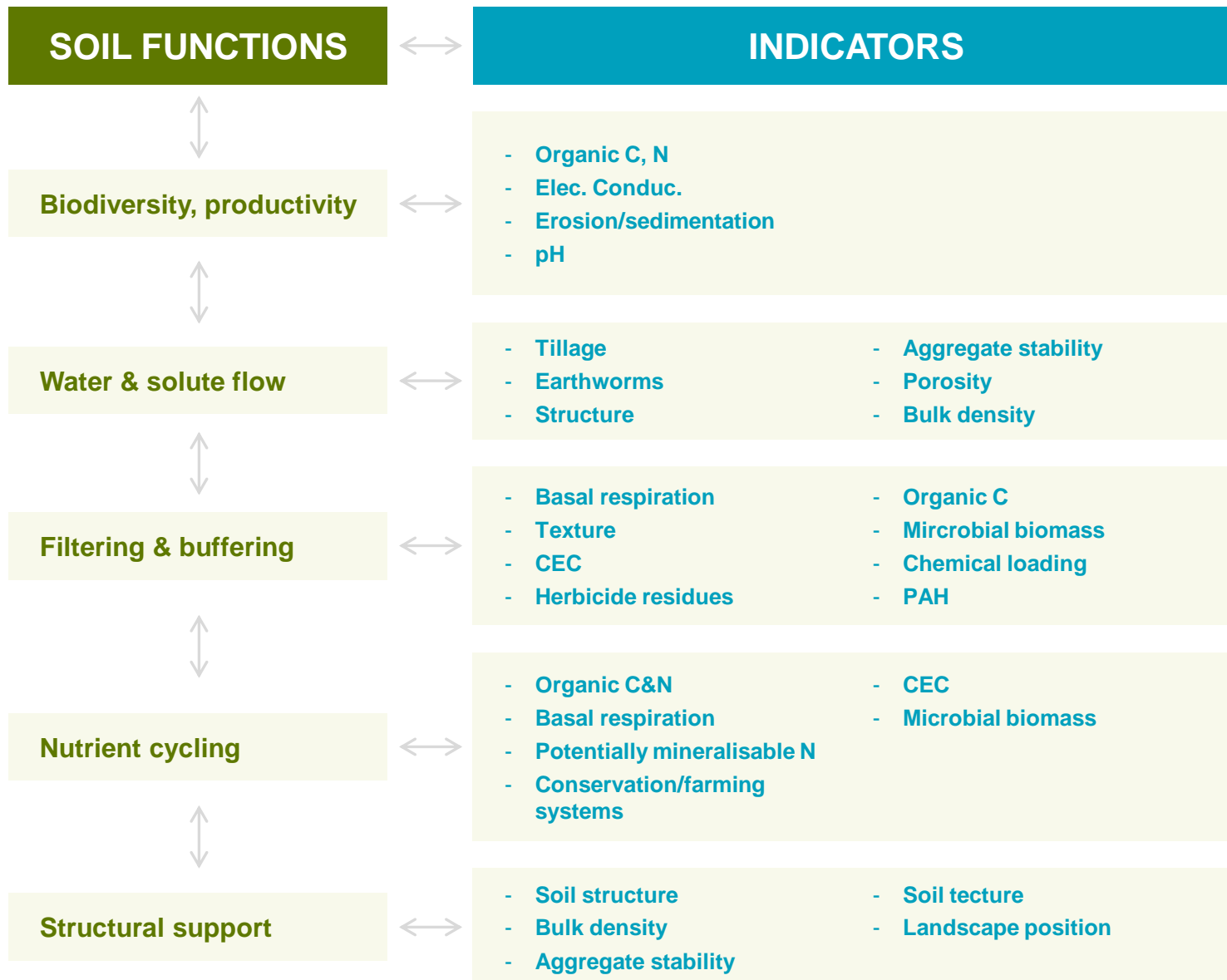


Each soil has different inherent properties

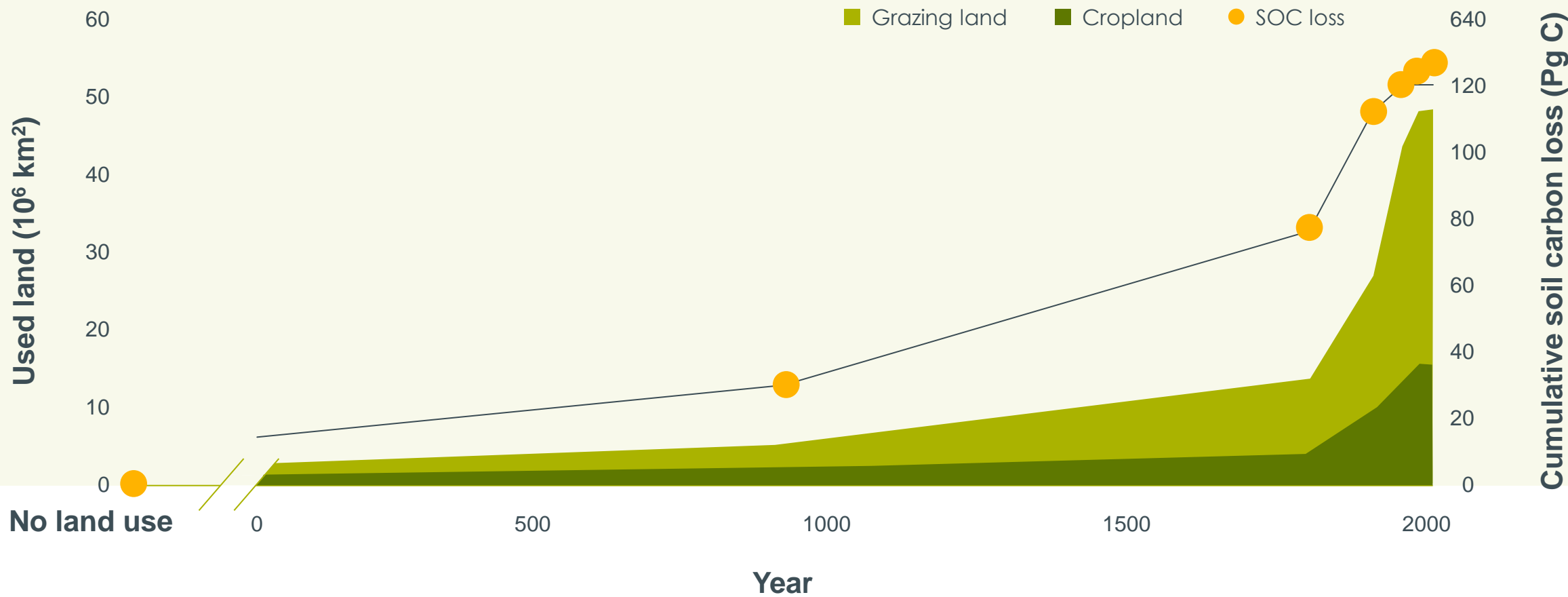
Our job is to help each soil achieve its

Soil Health Indicators

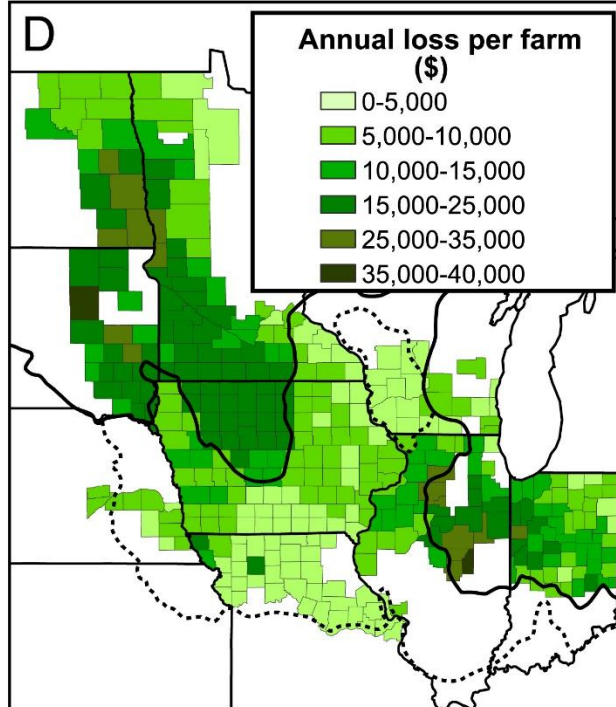
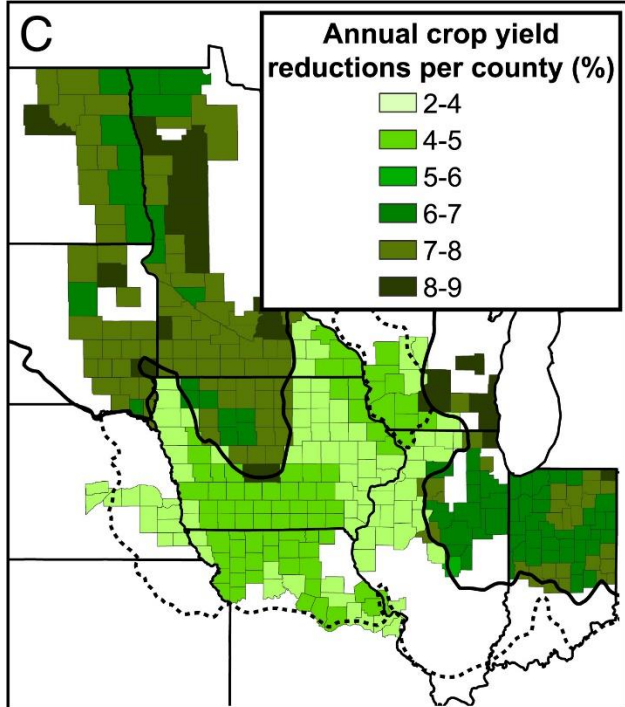
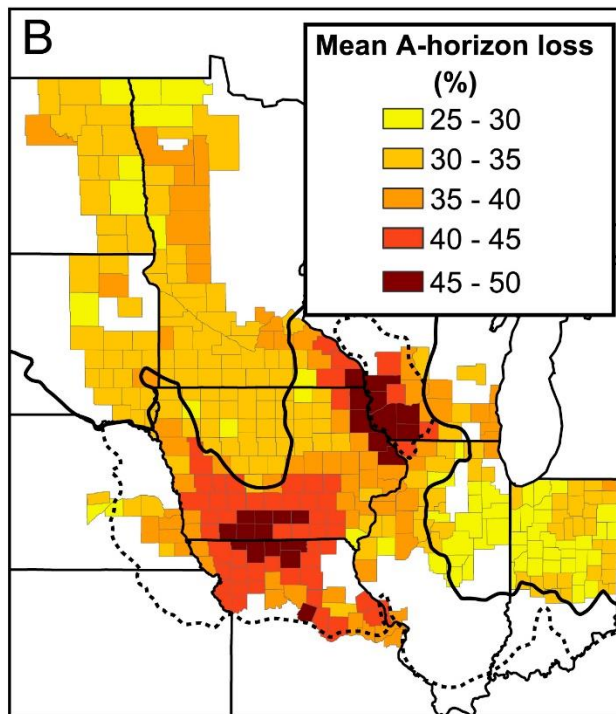
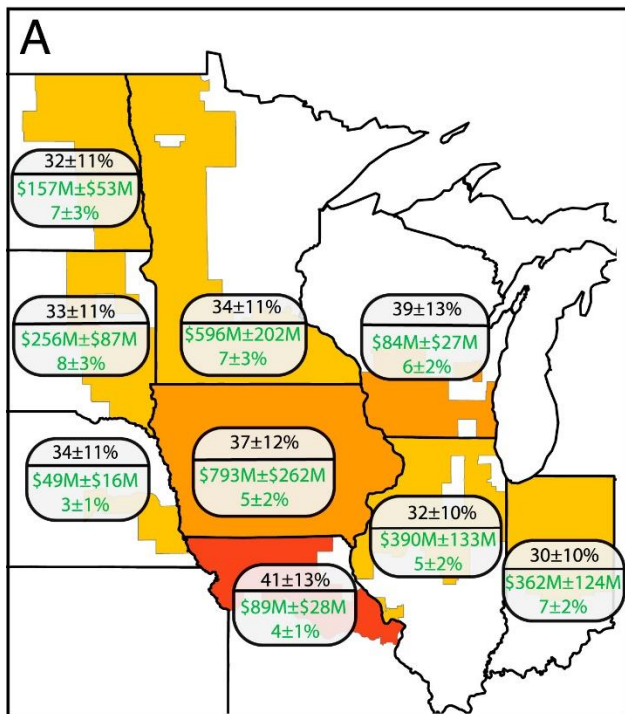
Chemical, Physical & Biological



We've treated our soils like dirt



Sanderman et al., 2017. PNAS. Soil carbon debt of 12,000 years of human land use.



Both in the US and Canada loss in yield due to erosion account for +/- \$3B.

- The extent of soil loss across the US Corn Belt
- Dr. Lobb, University of Manitoba

<https://doi.org/10.1073/pnas.1922375118>

Regenerative farming practices



1

Minimize soil disturbance

ADOPT NO-TILL OR REDUCED-TILL TECHNIQUES



2

Plants in the ground year-round

PLANT COVER CROPS BETWEEN CASH CROPS TO PREVENT SOIL EROSION AND INCREASE CARBON INPUTS



3

Diversify crops in time and space

EXPAND CROPS IN ROTATION AND ADOPT INTERCROPPING



4

Precision application of biological and chemical inputs

DATA-ENABLED PRECISION PLACEMENT OF SEEDS, CROP PROTECTION AND CROP NUTRITION



5

Integrate livestock when possible

CROP RESIDUES AND COVER CROP GRAZING, MANURE AND COMPOST INPUTS

Minimized soil disturbance

Classification: PUBLIC

Low or no-till:

Nutrient cycling

Decreased soil erosion

Soil retention of
organic matter





Practices such as cover crops:

- Build soil health and quality
- Retain soil from impact of extreme weather
- Suppress weed growth
- Reduce agricultural inputs
- Improve biodiversity

Plants in the
ground year-round

Regenerative agriculture increases soil organic carbon

Rotation Diversity

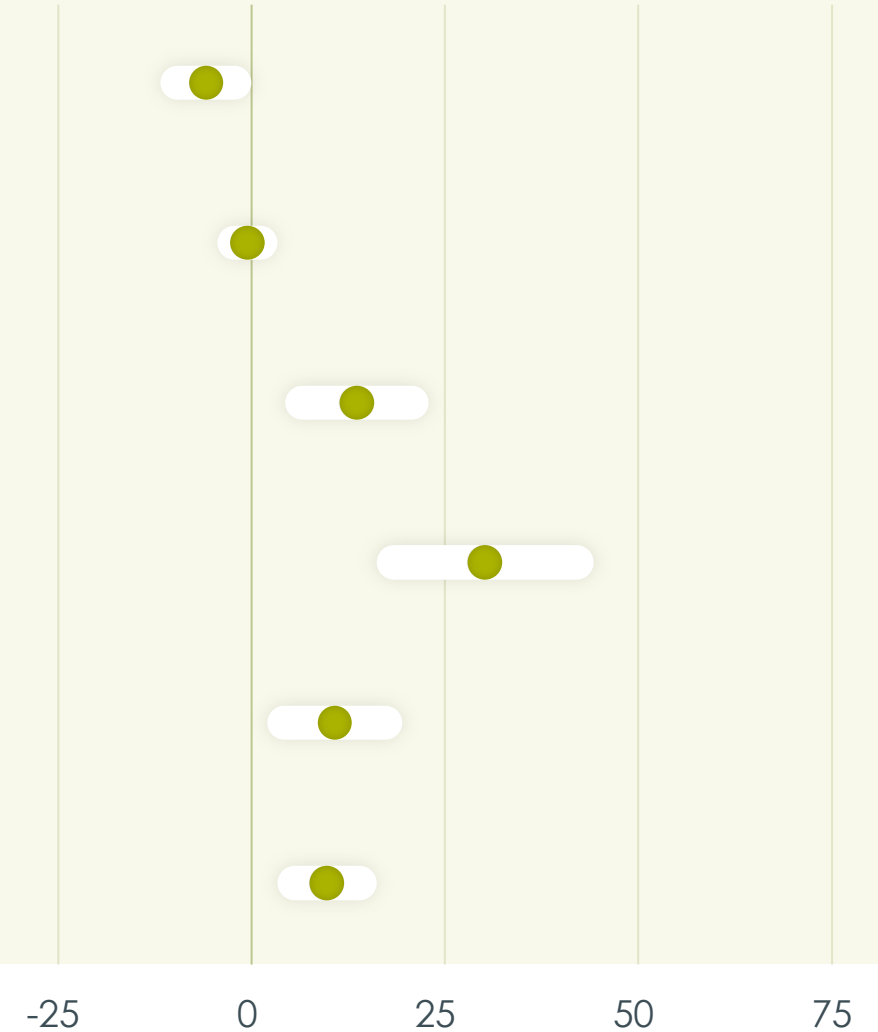
Crop Count

Residue Retention

Organic Nutrients

Cover Crops

Decreased Tillage



% Gain in Soil Organic C

Liptzin et al 2022.

Value Propositions of Soil Health

Farmer-facing

- 01 Increased yield, yield stability
- 02 Disease suppression
(lower input costs)
- 03 Improved nutrient & water use efficiency
(lower input costs)
- 04 Increased land value
- 05 Reduced runoff & erosion

Societal Benefits

- 01 Carbon sequestration
- 02 Biodiversity
(the next carbon?)
- 03 Reduced GHG emissions
- 04 Enhanced crop nutrient density
- 05 Improved water quality

Syngenta Contribution to Sustainable Agriculture



Syngenta is striving to transform agriculture through solutions that support and enable farmers across the world to adopt regenerative agricultural practices, for the benefit of farmers, society and our planet.



Science and research to quantify environmental, agronomic, and economic outcomes



Technologies that enhance crop and soil health



Technical advice and training to growers



Access to digital tools to unlock the potential of precision agriculture



Elite crop varieties with sustainability traits for climate resilience



Support the transition to regenerative agricultural practices

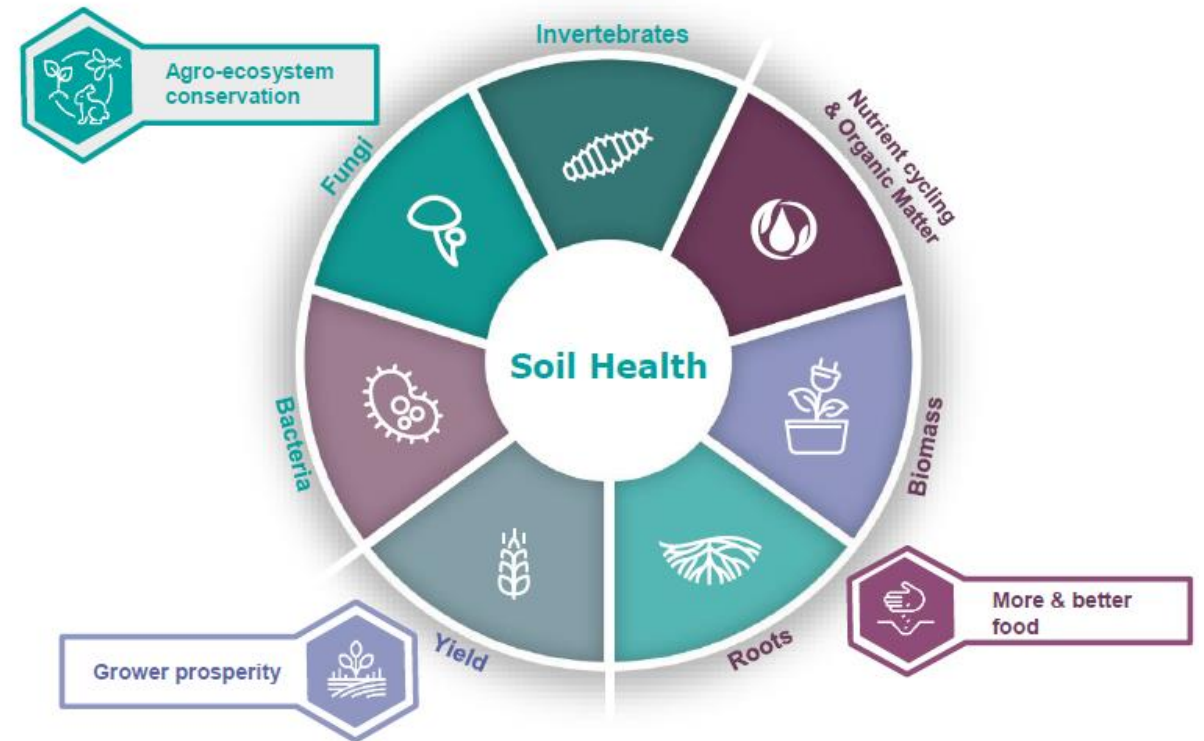


New value chain partnerships



Soil Health and Biodiversity

“Healthy soils maintain a **diverse community of soil organisms** that help to control plant diseases, insect and weed pests, **form beneficial symbiotic associations with plant roots**, **recycle essential plant nutrients**; improve soil structure with positive repercussions for soil water and nutrient holding capacity, **and ultimately improve crop production**”



FAO, 2008

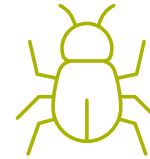
Soil Health and Agronomic Practices



Soil health gets improved with reduced- or no-tillage

Grower's adoption of **reduced- or no-tillage practices and residue management** for soil and water conservation, and organic matter retention is an area of action for OMAFRA.

These practices **improve soil diversity and health of soil organisms** that decompose plant material, aid in nutrient cycling and **improve soil structure**.



Reduced/no tillage comes at the cost of soil insect/disease pressure

Many plant pathogens/pests survive better under previous year's crop residue, **making diseases/insects more problematic** under reduced-tillage conditions.

The **cooler and moist environment** created by reduced tillage is **ideal for pathogens/pests to cause diseases/damage on roots**.

Seed Treatments- a tool in the toolbox to help improve soil health



Seed treatments target soil diseases/insects

Seed treatment provides “targeted protection” to the seeds and seedlings from the increased diseases and pests associated with reduced-no till farming.



Sustains biodiversity of soil microbial community

Control of soil diseases/pests offers less competition for resources to the beneficial organisms, including mycorrhizal fungi and their ability to assist in nutrient uptake by the plant.



Improves plant biomass and organic matter

By controlling diseases/pests, seed treatments improve root health which leads to optimum uptake of water and nutrients for overall plant growth, and ultimately an increase in the organic matter in the soil and the soil structure.

Biological Categories



Biocontrol

addresses **biotic stress** – stress that occurs as a result of damage done to a plant by a pest, pathogen or other organism.



Insect



Disease



Weeds



Biostimulant

addresses **abiotic stress**. Can include any substance applied to plants, seeds or the root environment with the intention to stimulate natural plant processes. Benefits can include nutrient use efficiency, tolerance to abiotic stress or crop quality.



Heat



Cold



Flooding/hail



Biofertility

addresses **nutrient need**. These products colonize the rhizosphere and/or inside the plant to promote growth by synthesis of growth promoting nutrients

Inoculants

Endophytes

Higher impact on Soil Health

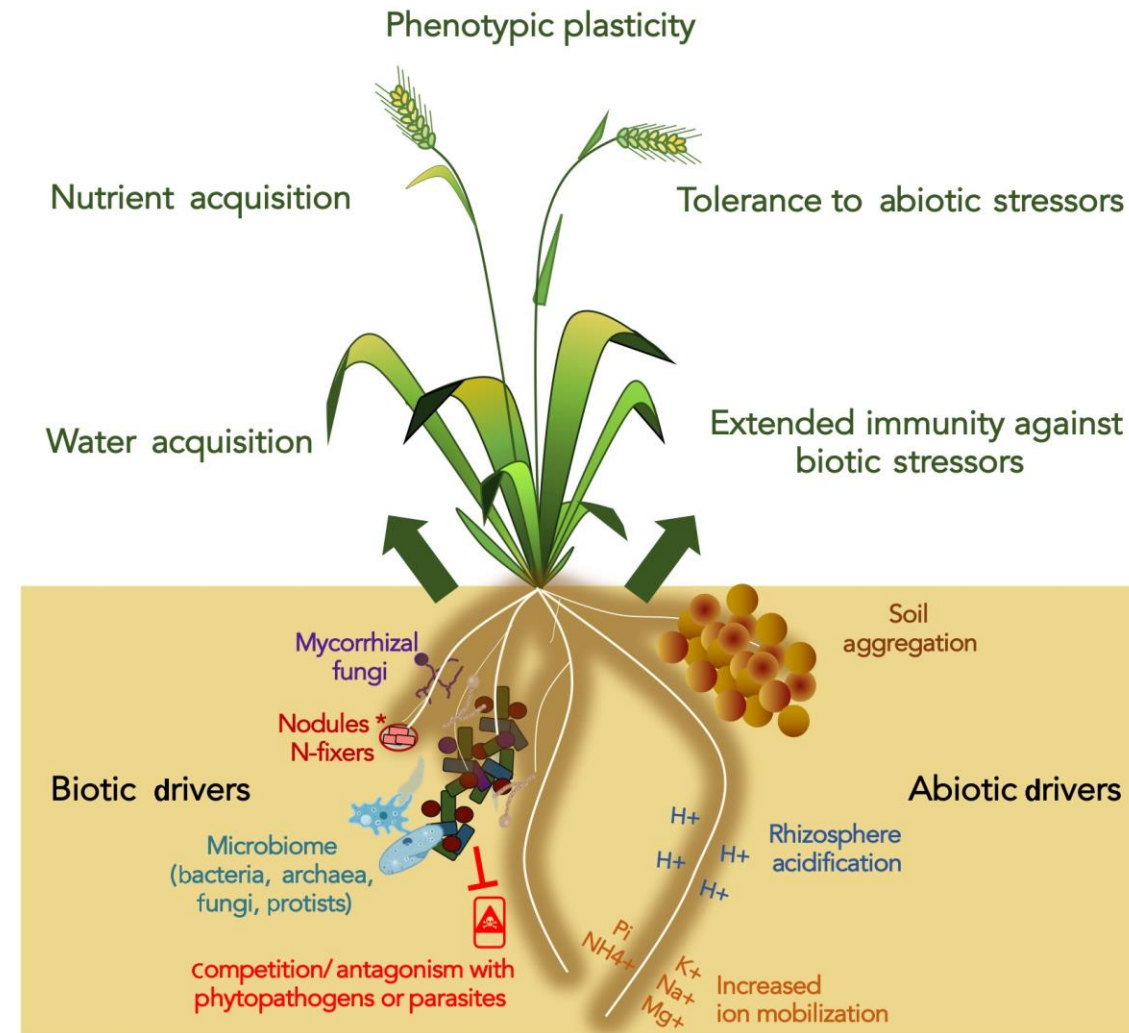
Pest Management Regulatory Agency

Canadian Food Inspection Agency

Soil microorganisms and their interactions with plants

- Plants themselves are an ecosystem and have complex associations with both helpful and harmful soil organisms.
- Plants secrete nutrients through their roots to attract and work with beneficial microorganisms.
- These beneficial microorganisms contribute to overall plant health by alleviating weather/conditions and disease/insect stresses.

Benefits provided by the extended root phenotype



<https://onlinelibrary.wiley.com/doi/full/10.1111/tpj.14781>

Nitrogen Cycle



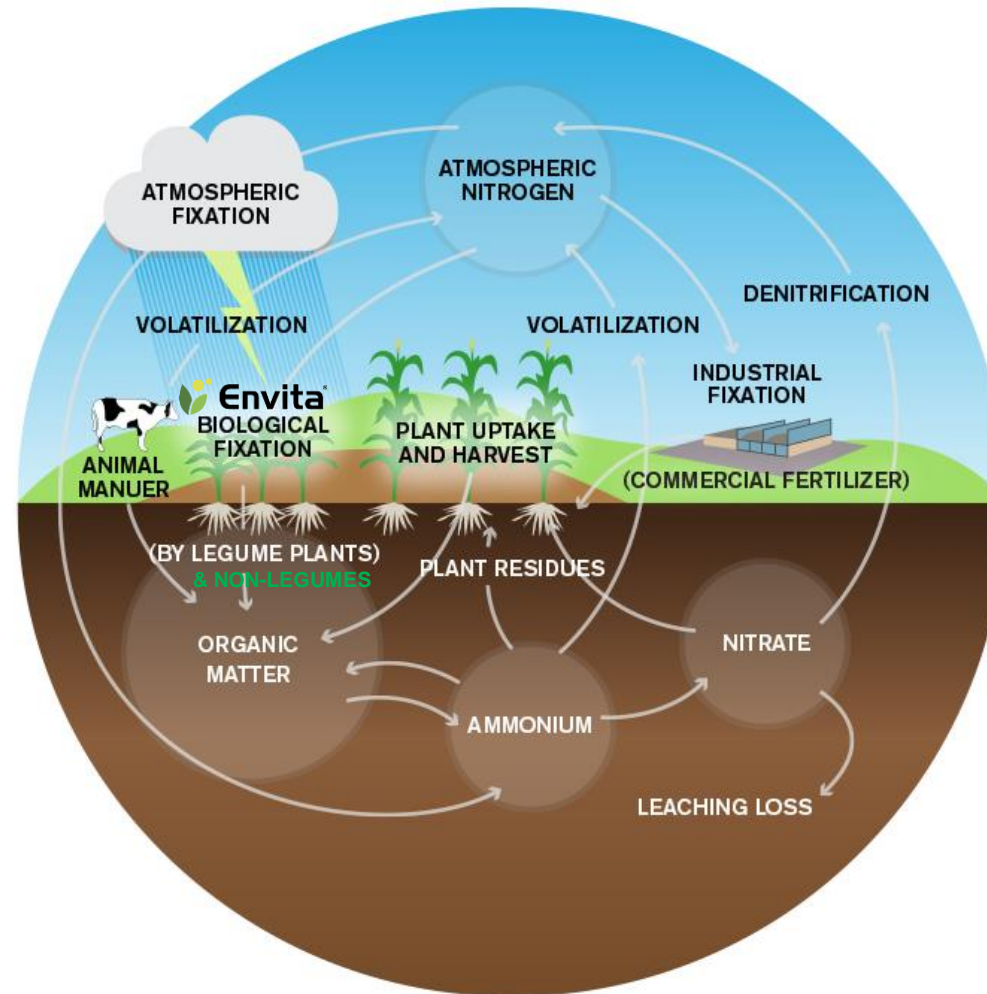
Nitrogen Forms and Conversions

Nitrate and Ammonium

- Plant available – the key!
- Susceptible to losses

Organic Matter

- Mineralization
- Immobilization



Nitrogen Crop Uptake

Corn 🌽

1.5 lbs of N per bushel

200 bu/ac corn = 300 lbs of N

Canola 🌻

3 lbs of N per bushel

50 bu/ac canola = 150 lbs of N

Cropwise™ Sustainability & the Sustainable Outcomes in Agriculture Standard



The SOA achieved **GOLD** Equivalency with the Internationally recognized Sustainable Ag Initiative Platform Farm Sustainability Assessment v3.0



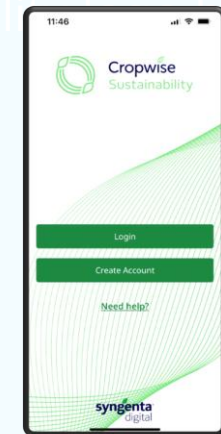
- Sustainable Outcomes in Agriculture (SOA) is a **Standard** developed by Syngenta and publicly available
- The **Standard** aligns to value chain commitments with **Soil Health** being one of the sustainable outcomes
- This Standard helps growers to measure and deliver **continuous improvement outcomes** on the farm



Cropwise®
Sustainability

- The Cropwise™ Sustainability app was **designed for farmers** to help tell their story

Making Sustainability bigger.

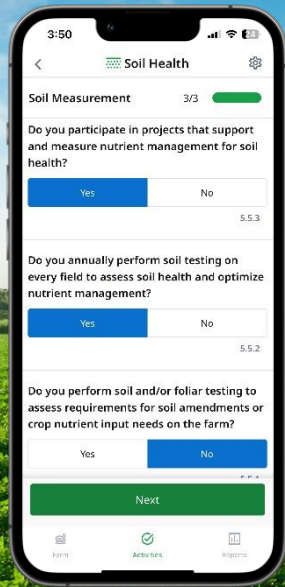


Sustainable Outcomes in Ag Standard is aligned to industry commitments

| Industry Commitments | Associated Sustainable Outcomes In Agriculture | Definition |
|------------------------------------|--|--|
| Soil Health | Soil Health | Enhanced resilience and health of soils over time to sequester carbon, support crop growth , and reduce impacts from extreme climatic conditions, pest outbreaks and nutrient imbalances. Management of crop production inputs aligned to soil conditions and crop needs to minimize greenhouse gas emissions . Soil conservation and management of non-crop and conservation areas to protect the quality of surface water and ground water . |
| Water Use | Water Impact | Improvements in the efficiency of irrigation water use and reductions in risks associated with the scarcity of water sources used for crop irrigation. Management of water holding, delivery and drainage systems to enhance productivity and soil conditions as well as protect the quality of surface water and ground water . |
| Biodiversity | Biodiversity & Habitat | Non-target species (e.g., pollinators, beneficials, wildlife) and their habitat are protected and managed to safeguard and enhance habitat quality and biodiversity . Enhanced diversity of cropping systems and conservation of non-crop areas. |
| Farmer Livelihoods | Community Leadership | Support the viability of the local community and its understanding of agriculture. Leadership, outreach and youth development within communities of farming professionals. Community access to conservation areas. |
| | Human & Animal Health | Safe-guard the well-being of agricultural workers , adjacent neighbors and livestock. Safe-guard both human and animal consumers of consumer products with crop ingredients. |
| Regenerative Ag & Carbon Emissions | Optimal Production Management Practices | Crops are efficiently produced in the quantities, qualities and timeliness necessary for financial viability and consistent with minimizing waste and reducing greenhouse gas emissions . Efficient and economically optimum crop health and production outputs. |
| | Management Practices | Regenerative agriculture practices impacting crop-level carbon emissions/sequestration and other environmental indicators are recorded. |

Outcome: Soil Health

Enhanced soil health to **sequester carbon**, **support crops**, and reduce impacts from extreme weather, pest outbreaks and nutrient imbalances. Management of inputs aligned to soil conditions and crop needs to **minimize emissions**. Soil conservation and management of non-crop and conservation areas to **protect the quality of water**.



Grower Experience
Cropwise® Sustainability App



Aggregate Reporting
PowerBI Pro

Drivers:

- **Soil measurement** – soil measurement for nutrient management
- **Soil function** – soil disturbance, tillage, compaction
- **Production for conservation** – crop rotations for conservation benefits
- **Runoff erosion management**
- **Wind erosion management**