A brief overview- how nature functions

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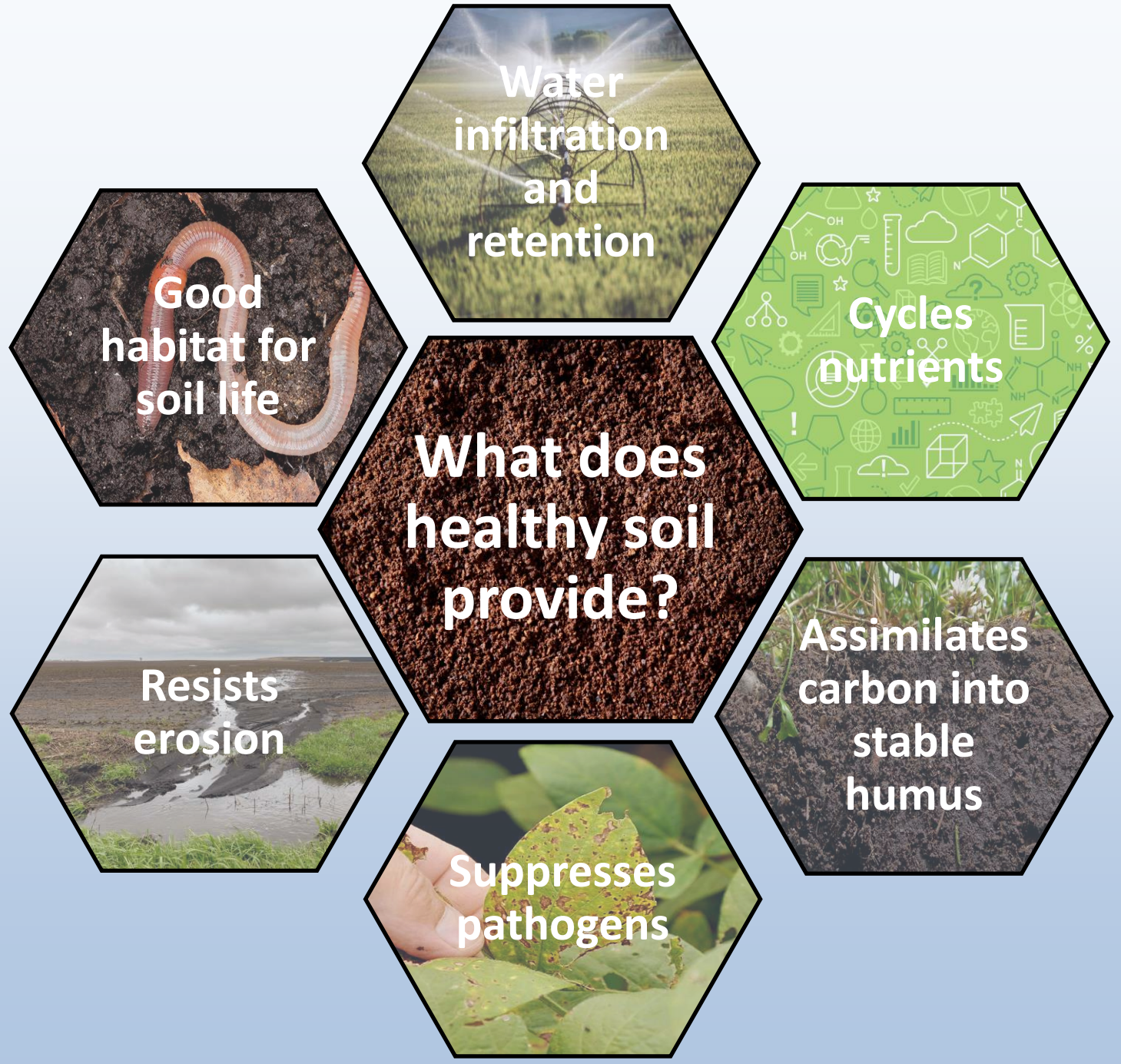
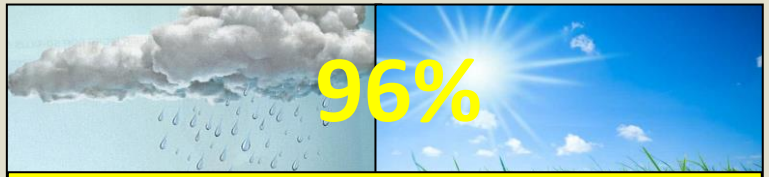
WARD Laboratories, Inc.


Nature functioning in all its glory without interference


Water infiltration and retention
Good habitat for soil life
Cycles nutrients
What does healthy soil provide?
Resists erosion
Assimilates carbon into stable humus
Suppresses pathogens

Sources from nature's non-living building blocks

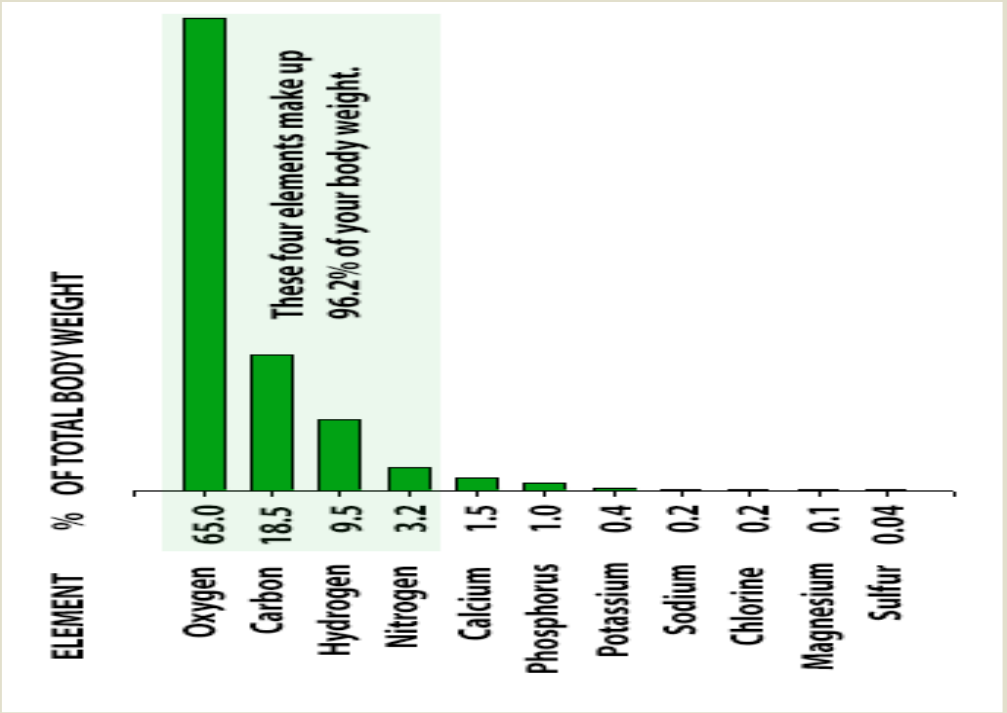
C H O N



Sun & Atmospheric Inputs

S P K Ca Mg Fe Mn Zn Cu B Mo Na Cl Si Cr

Soil minerals

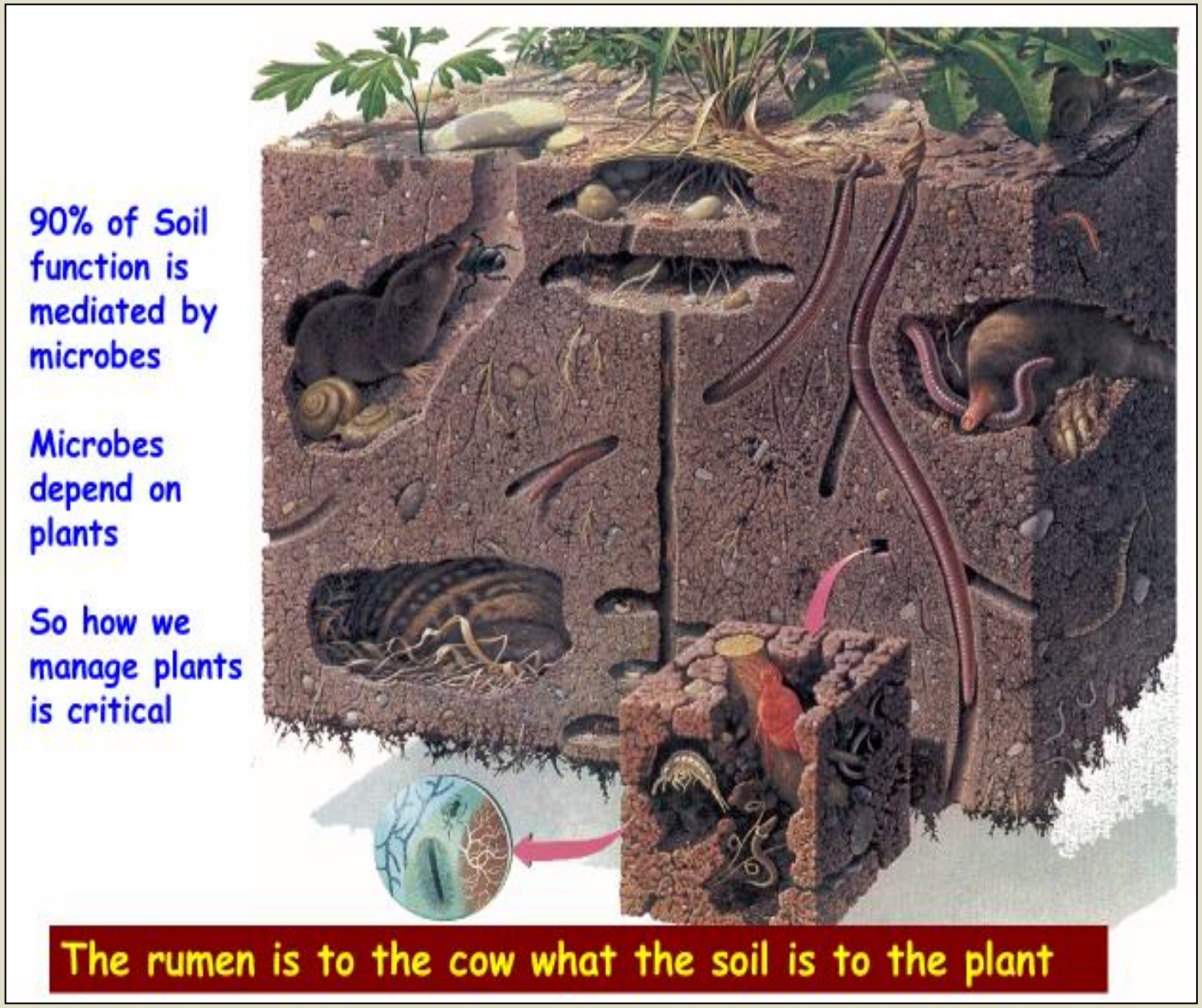


Manganese, Iron, Copper, Zinc, Boron, Molybdenum, Selenium, Chromium, Cobalt, Vanadium, Tin, Nickel, Rubidium, Strontium and more.

How does nature put this growth model together?

WITH LIFE !

- Bacteria
- fungi
- protozoa
- nematodes
- arthropods earthworms
- and more!

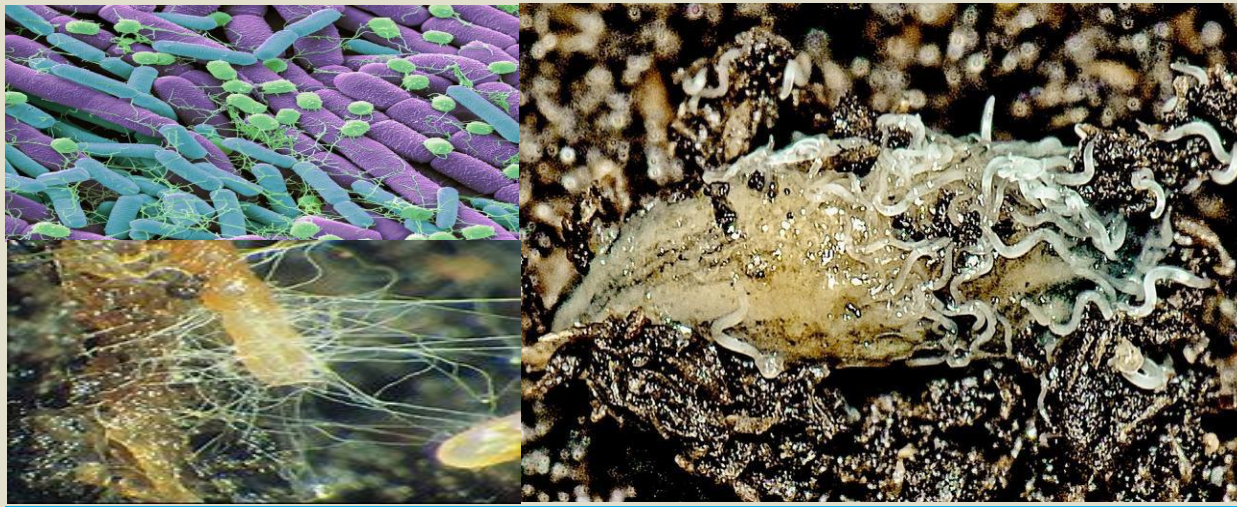


Soil provides infrastructure linking building blocks and resources

Soil as provider of mineral building block resources

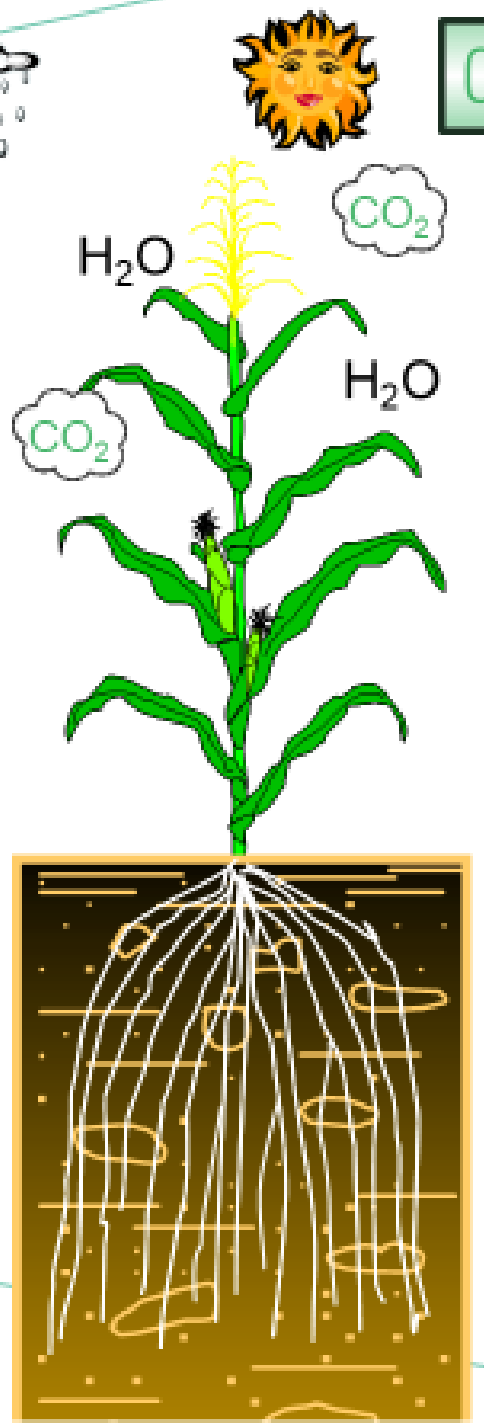
Facilitates nitrogen infiltration from the atmosphere

Soil as habitat for soil life



Soil as a provider for water infiltration and storage

Carbon energy flow path



Sun

$CO_2 + H_2O$

$C_6H_{12}O_6$

Plant stem

Plant roots

Root exudates

microbes

Soil fauna

Nutrient cycling

Carbon cycling

Plant nutrition

Ecosystem services

Food nutrition

CO_2

Food

Feed

Fiber

Fuel

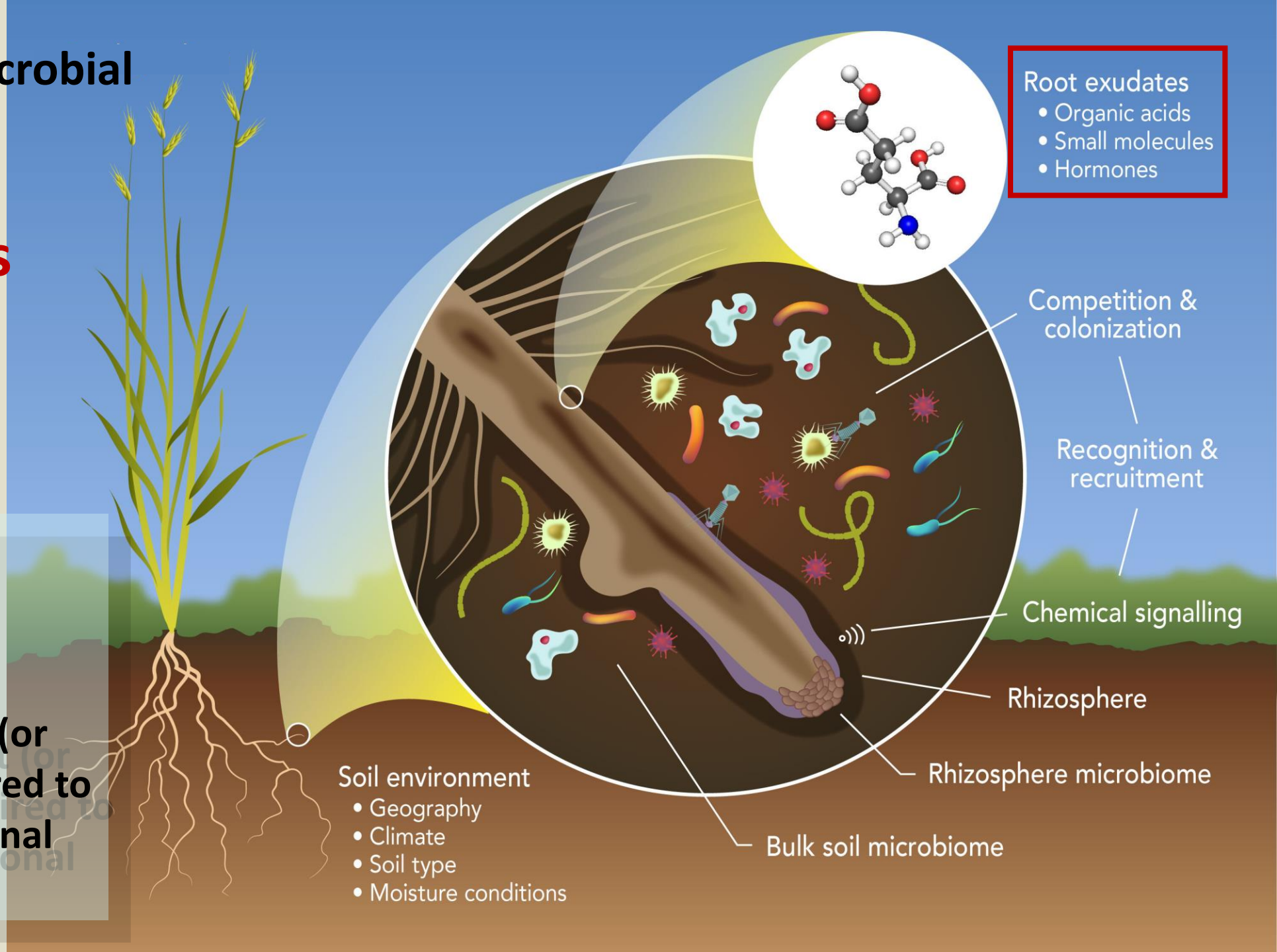
Slide with acknowledgement of Dr Jerry Hadfield.

The plant-soil-microbial association is facilitated by

root exudates

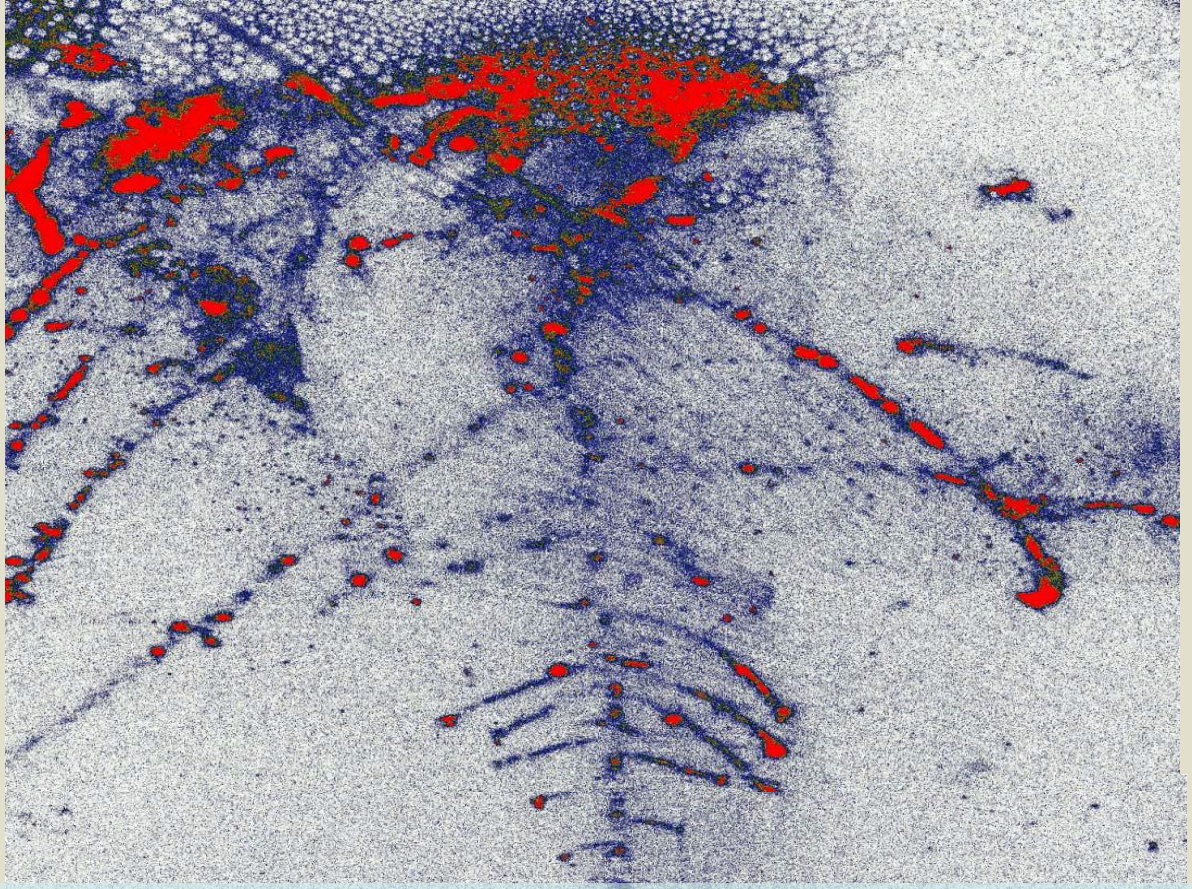
Soil health relevance?

Microbial and plant (or root) diversity is required to maintain soil functional services



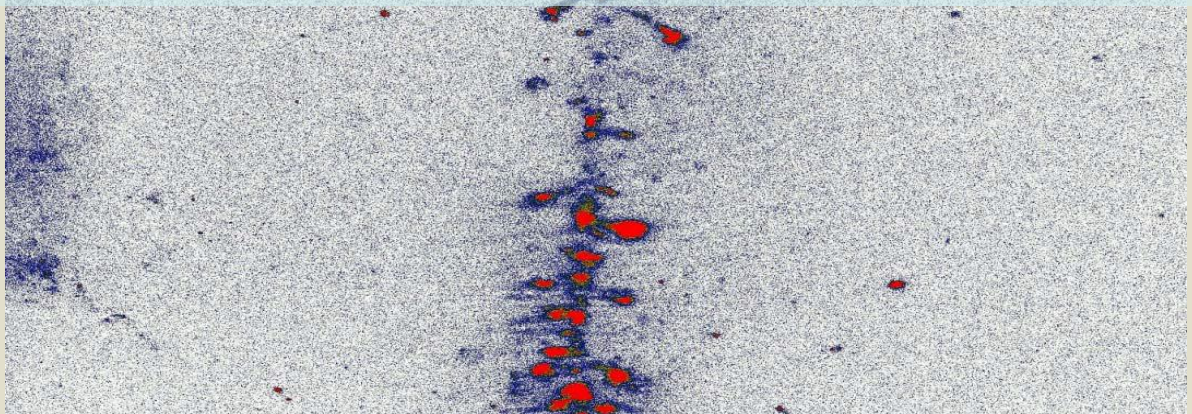
Localisation of root exudates by ^{14}C imaging

Root exudates in red

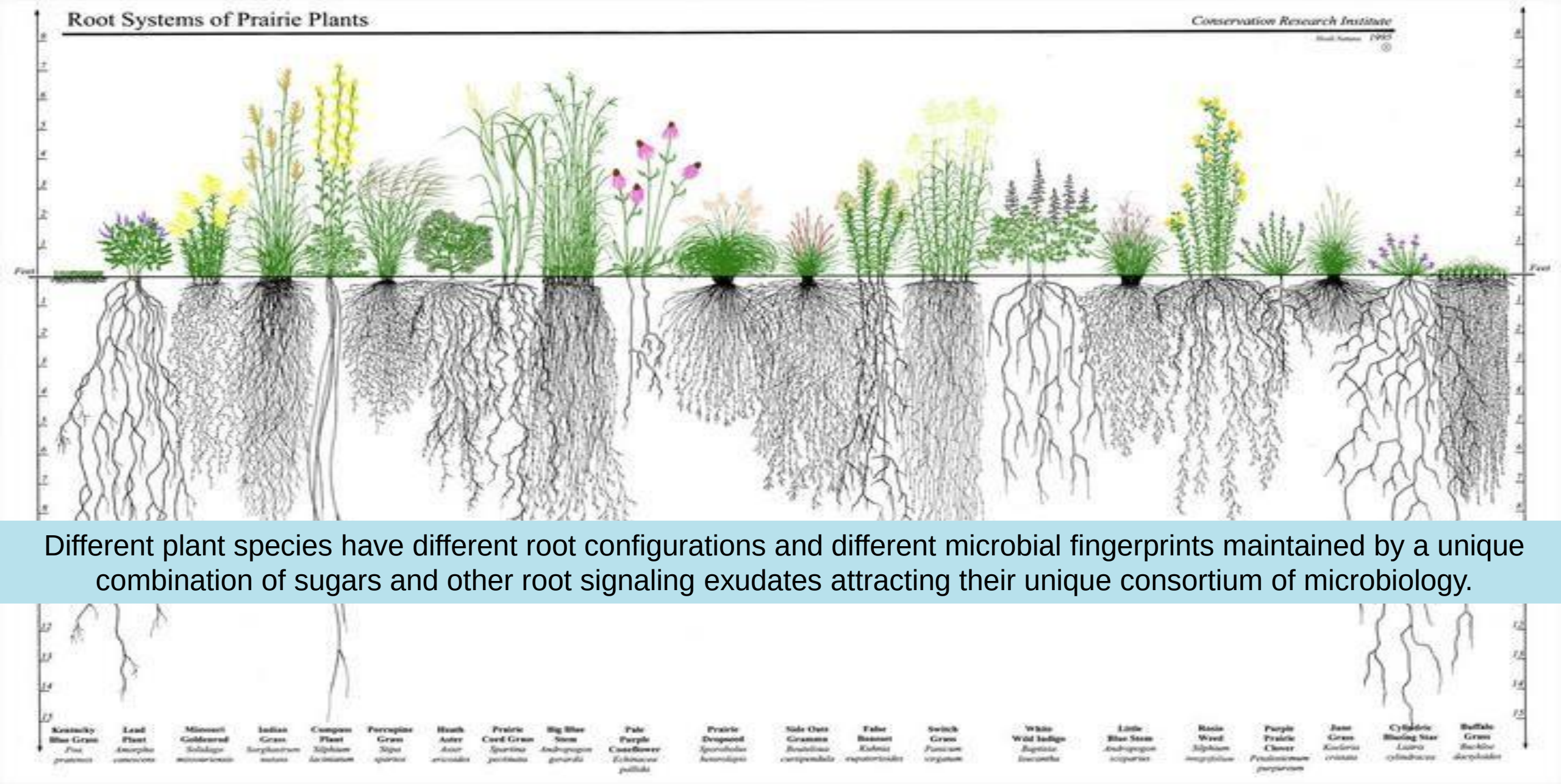


Corn plant grown in CO_2 enriched environment

Illustrating root exudates that feed the microbes

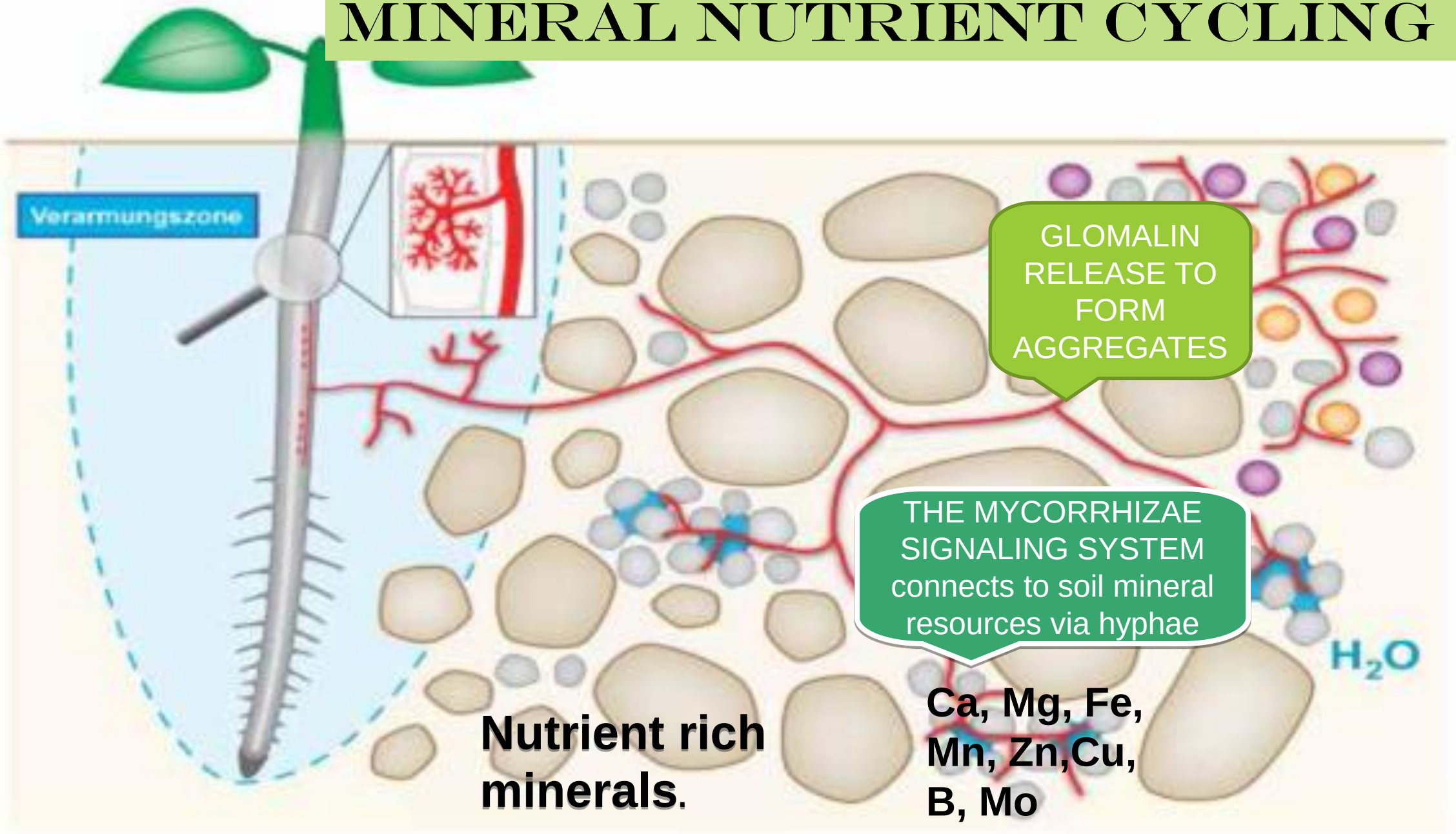


Establishing a diversity of soil ***microbial teams*** of Saprophytic and Mycorrhizal fungi and helper bacteria.



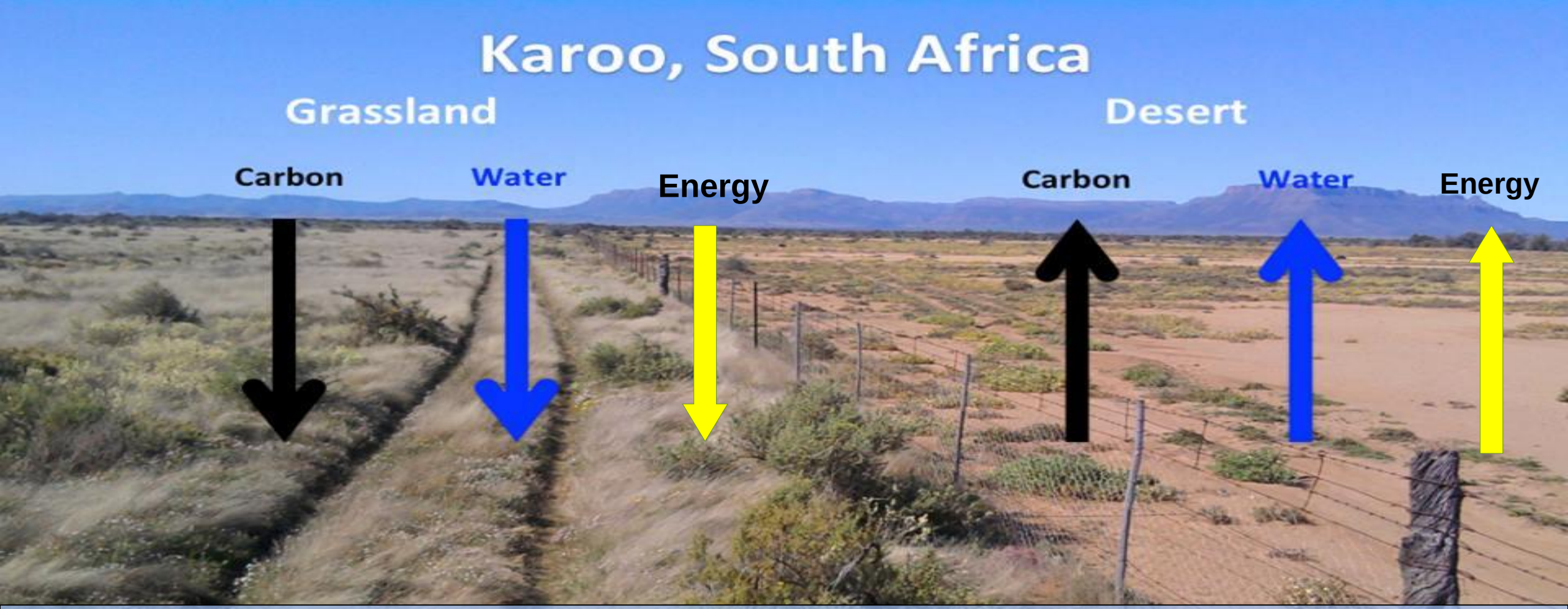
Different plant species have different root configurations and different microbial fingerprints maintained by a unique combination of sugars and other root signaling exudates attracting their unique consortium of microbiology.

MINERAL NUTRIENT CYCLING



Comparisons of Total Soil Nutrients stored to 1 foot depth: World survey (left) versus 45 farms in ND and Canada (right) to 1 ft depth.

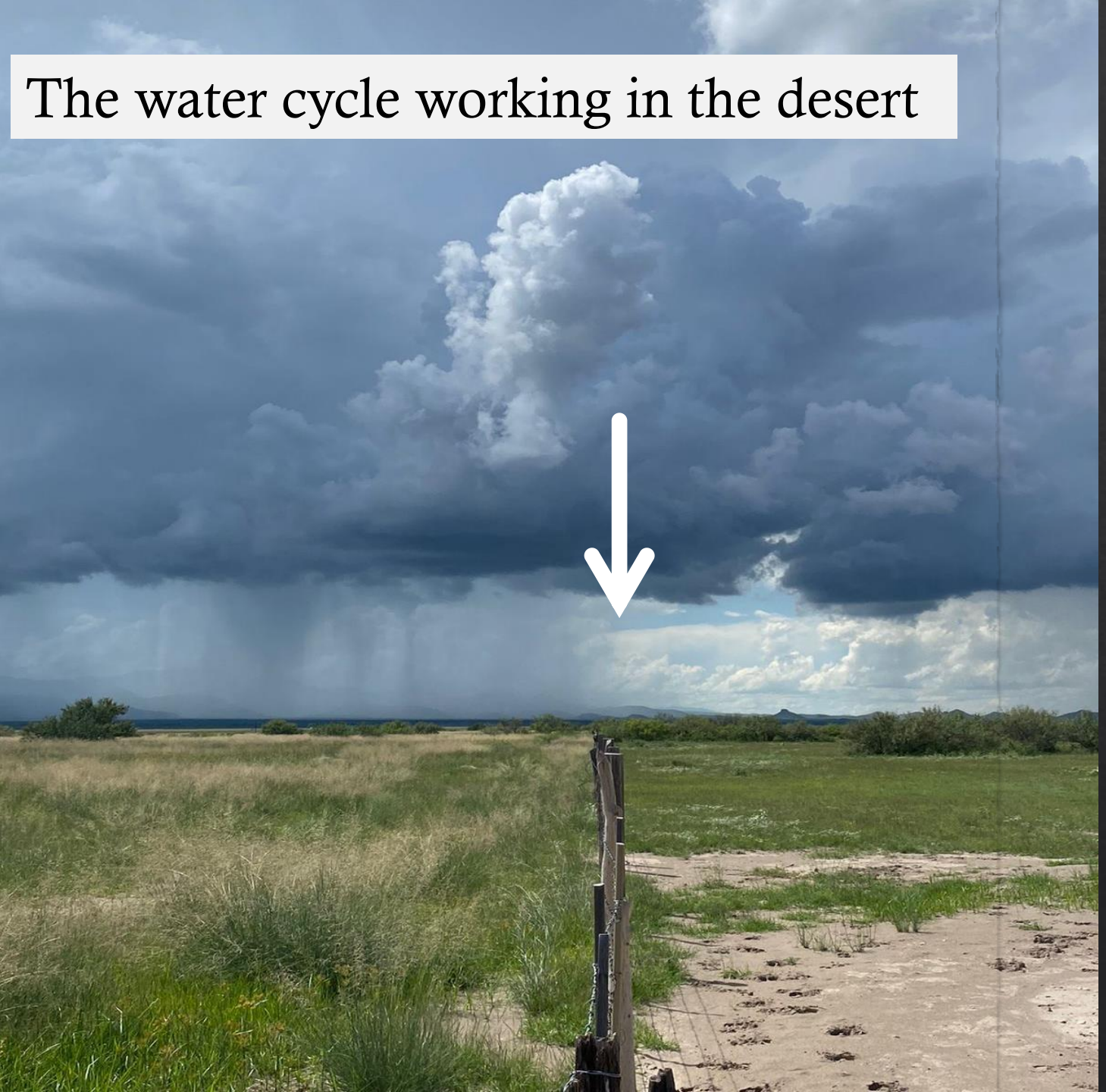
Mineral	World Survey (Sparks, 2003) lbs /acre	45 ND & Canada farms (Gabe Brown) lbs/acre
N	4000	9000
P	1600	2300
K	28000	11000
Ca	30000	40000
S	1400	2000
Mg	10000	20000
Zn	180	240
Fe	80000	60000
Mn	2000	2400
Cu	60	40
B	Not done	40
Mo	2.4	3



Carbon not stored in ***living biomass*** or ***stable soil carbon*** will return to the atmosphere.

The Result:

Stable farming system with ***minimal inputs*** and ***functioning carbon, water, nitrogen*** *and* ***mineral nutrient cycles.***



Fence Line Comparison

- Palmitas Ranch, Chihuahua, Mexico on the left side of the photo. *Courtesy: Jose Fernandez*
  - Use Adaptive Grazing Practices
- Neighbor's ranch on the right side of the photo
  - Conventional grazing practices

Slide with thanks from Dr Allen Williams