

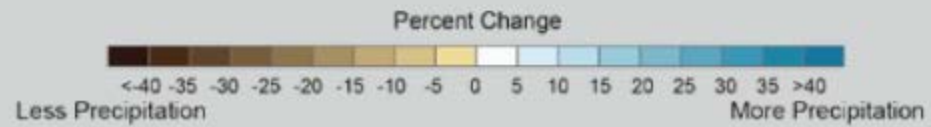
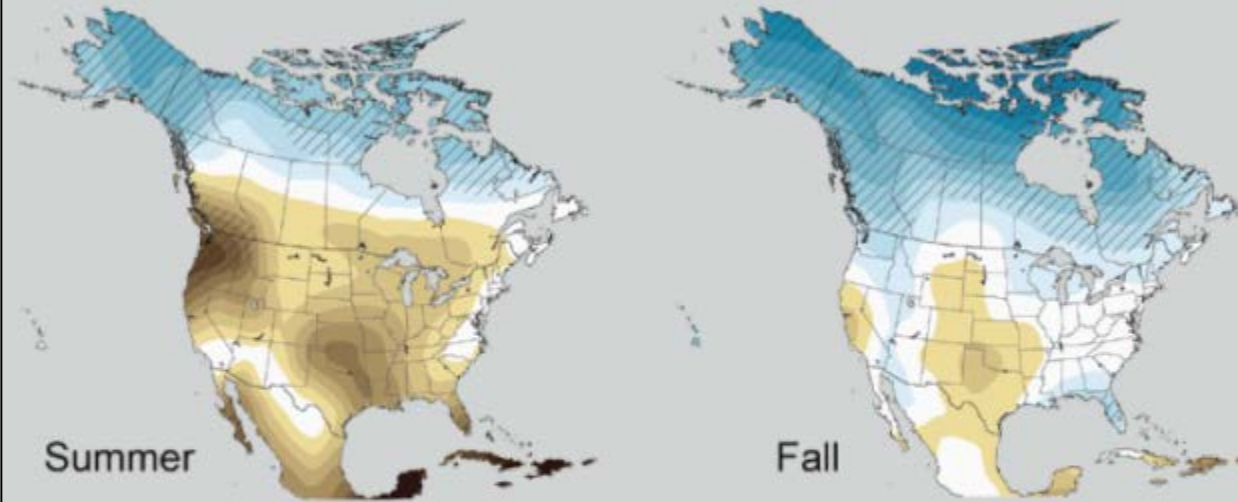
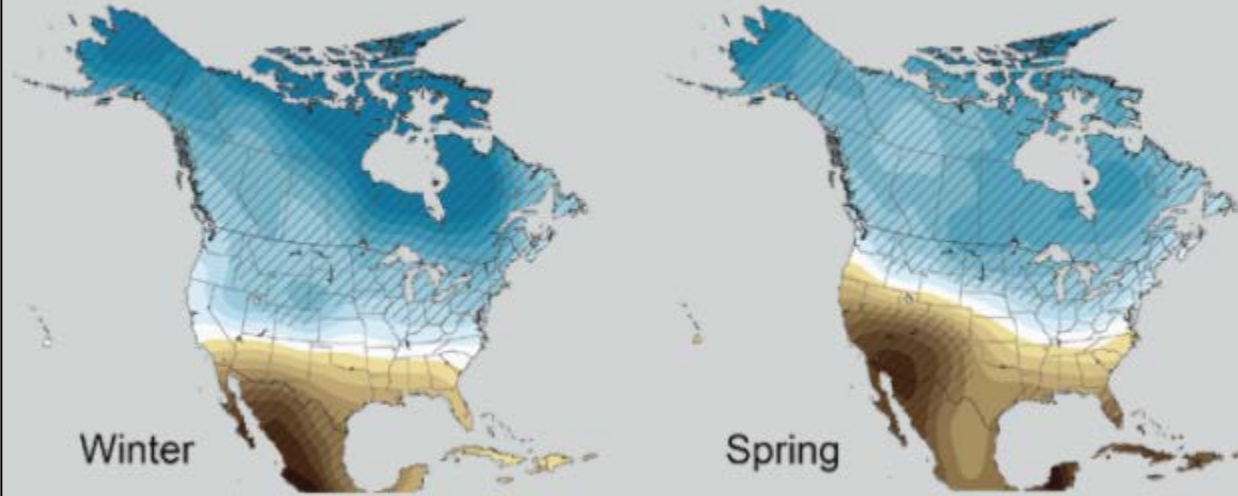


Developing Resilient and Sustainable Fruit and Vegetable Production Systems

Tom Buller
Kansas State Research and Extension
Douglas County



Projected Change in North American Precipitation by 2080-2099



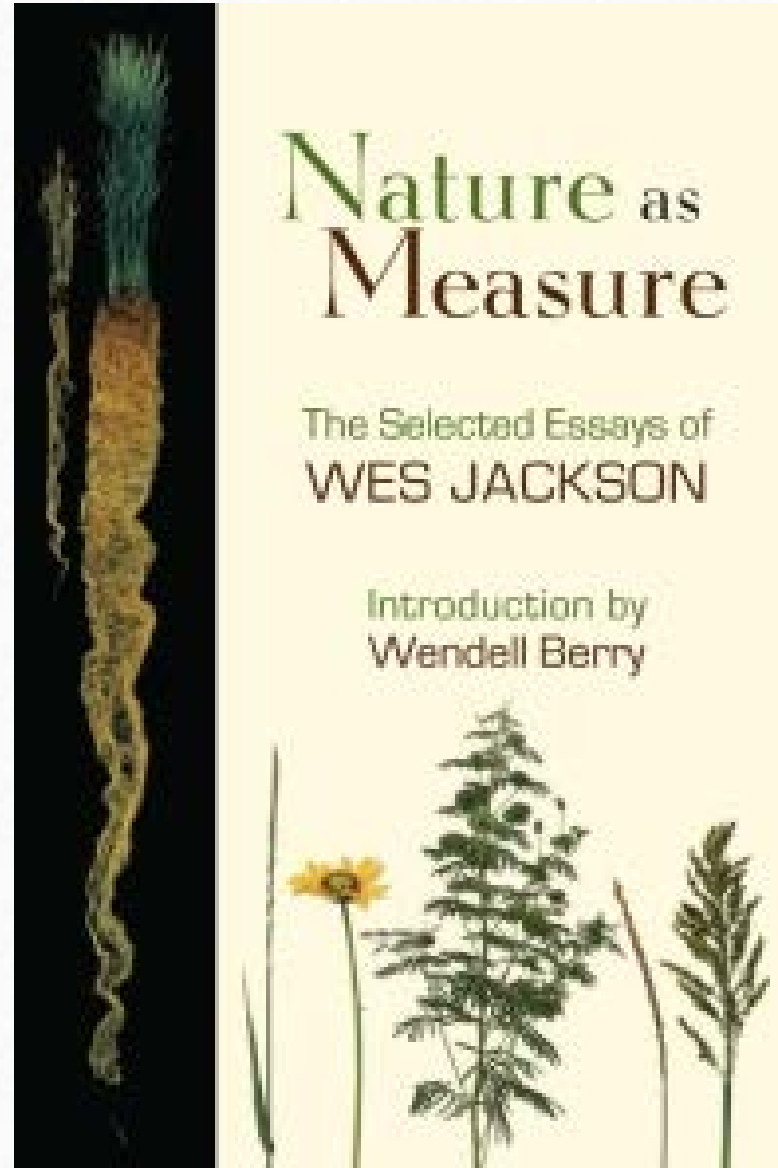
Climate Change: Basic models for KS

- Temperature
 - Warmer
- Precipitation
 - Shift to more in winter/spring, less in summer/fall in E Kansas but roughly similar
 - Western KS similar shift, but less overall
- Increasing Atmospheric Carbon
- More extreme events

How to create resilient systems?



Modeling other resilient, healthy systems



Starting with Soil Health

The capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.

Physical

- Aggregation and Structure
- Surface Sealing
- Compaction
- Porosity
- Water Movement and Availability

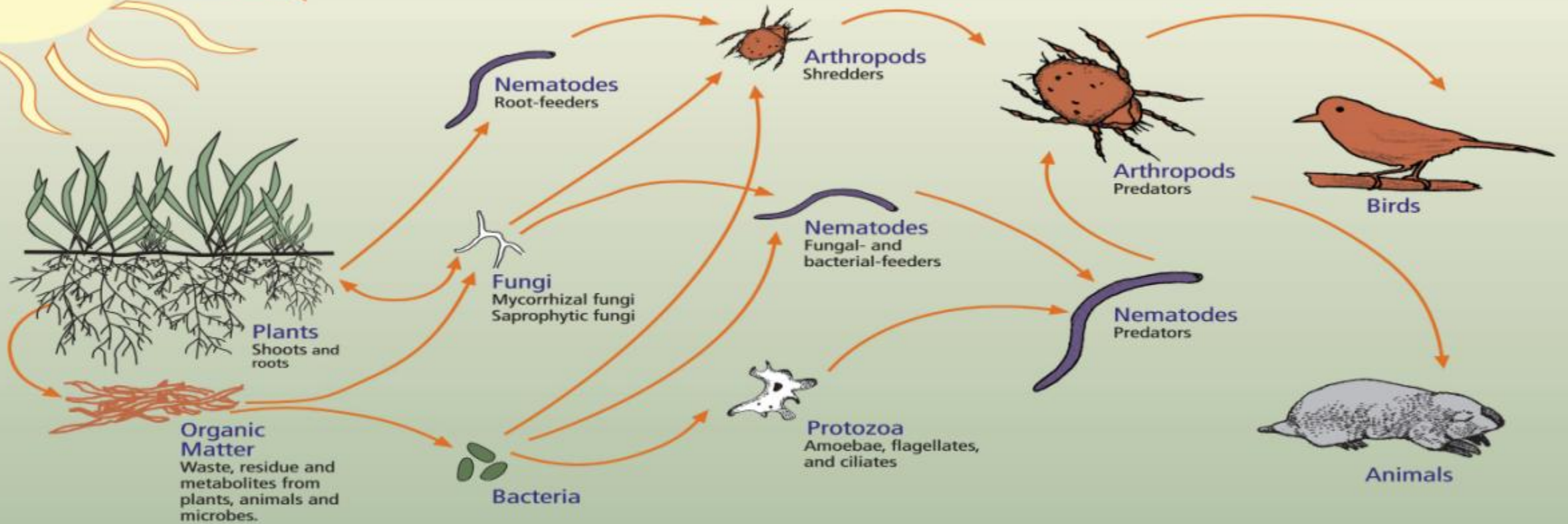
Chemical

- pH
- Soluble Salts
- Sodium
- Nutrient Holding Capacity
- Nutrient Availability

Biological

- Macrofauna
- Microfauna
- Microorganisms
- Roots
- Biological Activity
- Organic Matter

The Soil Food Web



First trophic level:
Photosynthesizers

Second trophic level:
Decomposers
Mutualists
Pathogens, Parasites
Root-feeders

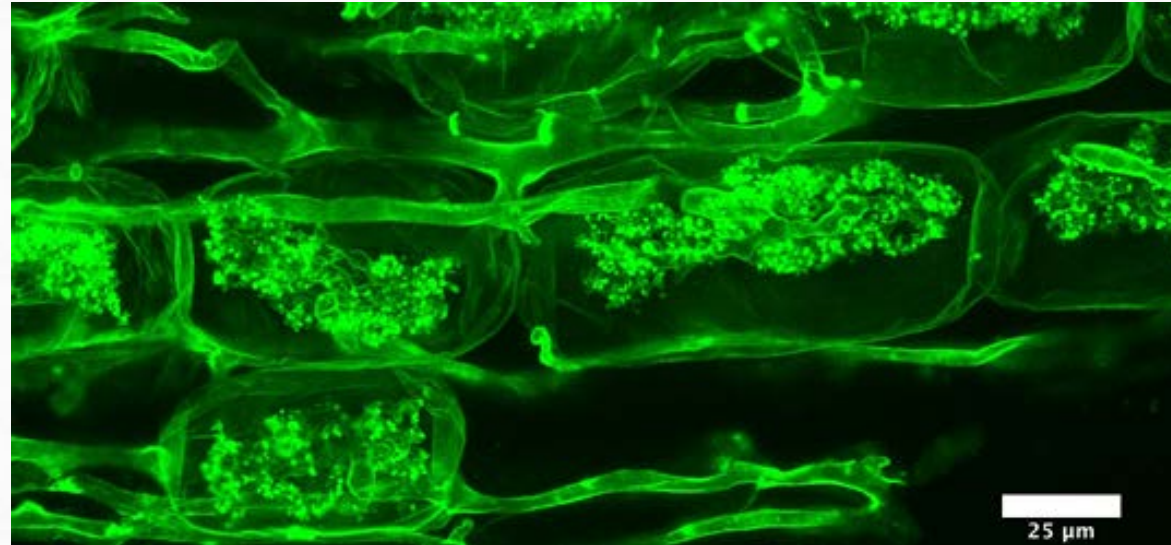
Third trophic level:
Shredders
Predators
Grazers

Fourth trophic level:
Higher level predators

Fifth and higher trophic levels:
Higher level predators



Arbuscular Mycorrhizal Fungi- Plant symbiosis



Shrub-like arbuscules in root cells, stained with a fluorescent dye.
Scale bar = 25 μm. Credit: Priya Pimprikar
Read more at: <https://phys.org/news/2016-03-symbiosis-mycorrhizal-fungi-access-scarce.html#jCp>

Soil Health Benefits

- Reduced erosion
 - Increased plant health and bioavailable nutrients
 - Increased **water infiltration**
 - Increased **water and nutrient storage capacity**
 - Increased productivity
-
- Increasingly important under stress

Soil Health Principles



How to
Build Soil
Health

Across
Scales



Minimize Disturbance

- Vertical Tillage
- Shallow Tillage
- Zone Tillage
- “No-Till”- heavy mulch and rolled cover, lasagna gardening
- Occultation
- Perennials









Maximize Cover

- Cover Cropping
- Mulching
- Planting Density
- Buffers/ Farmscape







Maximize Diversity

- Cover Cropping
- Crop Rotation- diversity through time
- Companion planting
- Farmscapes/buffer strips
- Animals?





Maintain Continuous Living Roots

- Cover Cropping
- Intensifying Rotations
- Perennials

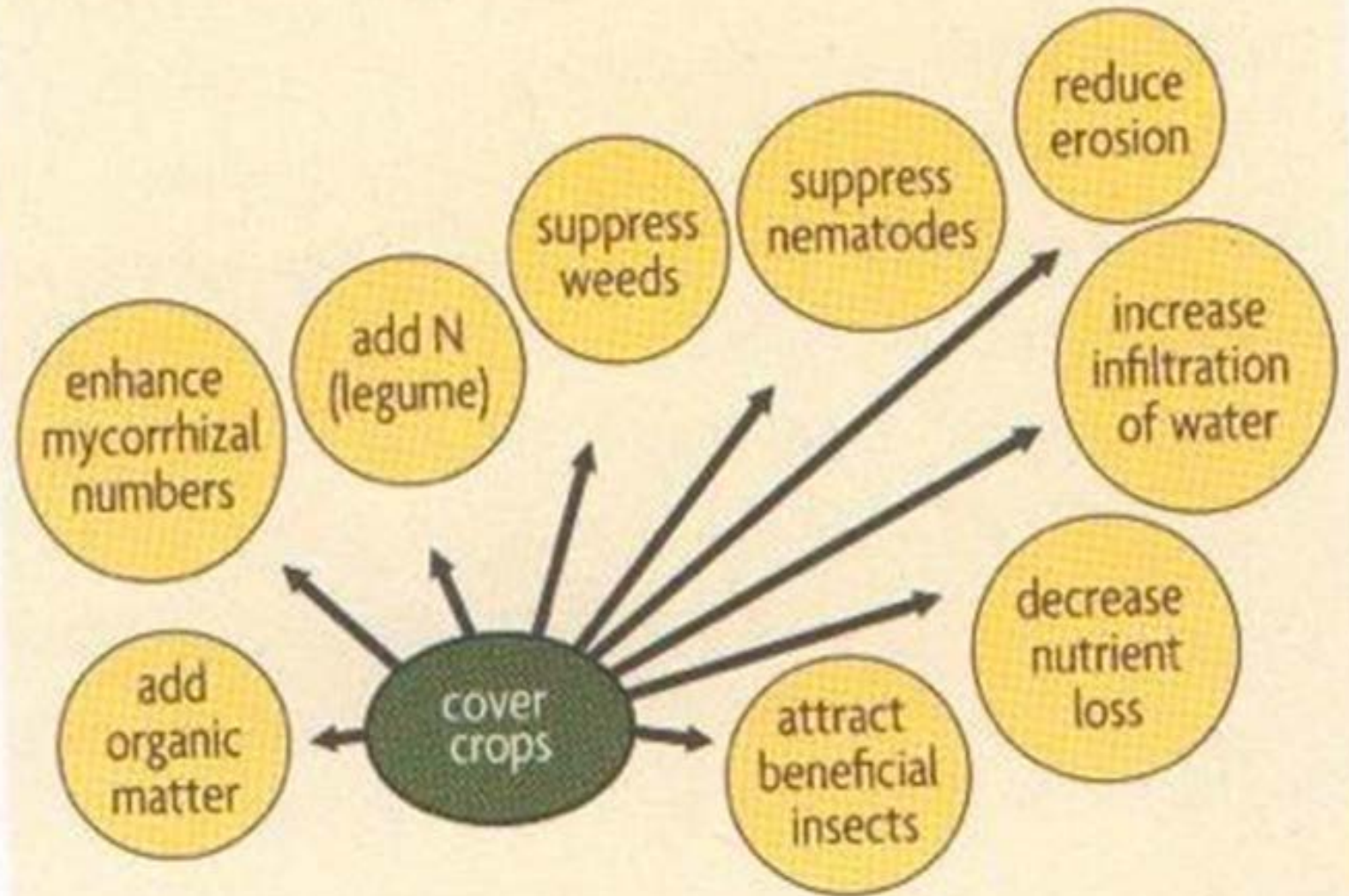




Green String Farm, Sonoma, CA

Cover Crops

Many Purposes





Cool Season Covers

Winter Kill- Summer Annuals

- Oats
- Tillage Radish- Reduce Compaction, nematocide
- Buckwheat- quick to grow, and break down, bee forage

Legumes

- Chickling Vetch- Quick N fix

Overwintering- Winter Annuals

- Cereal Rye- biomass, allelopathy
- Winter wheat
- Triticale

Legumes

- Austrian Winter Peas- pea shoots???
- Hairy Vetch
- Crimson Clover





Warm Season Covers

- Sorghum Sudangrass- Organic Matter, Smother
- Millets- Pearl and Japanese- Organic Matter, Smother
- Buckwheat- quick to grow, and break down, bee forage

Legumes- N Fixation

- Cowpeas
- Forage Soybeans
- Sunn Hemp- Expensive Seed- biomass, N

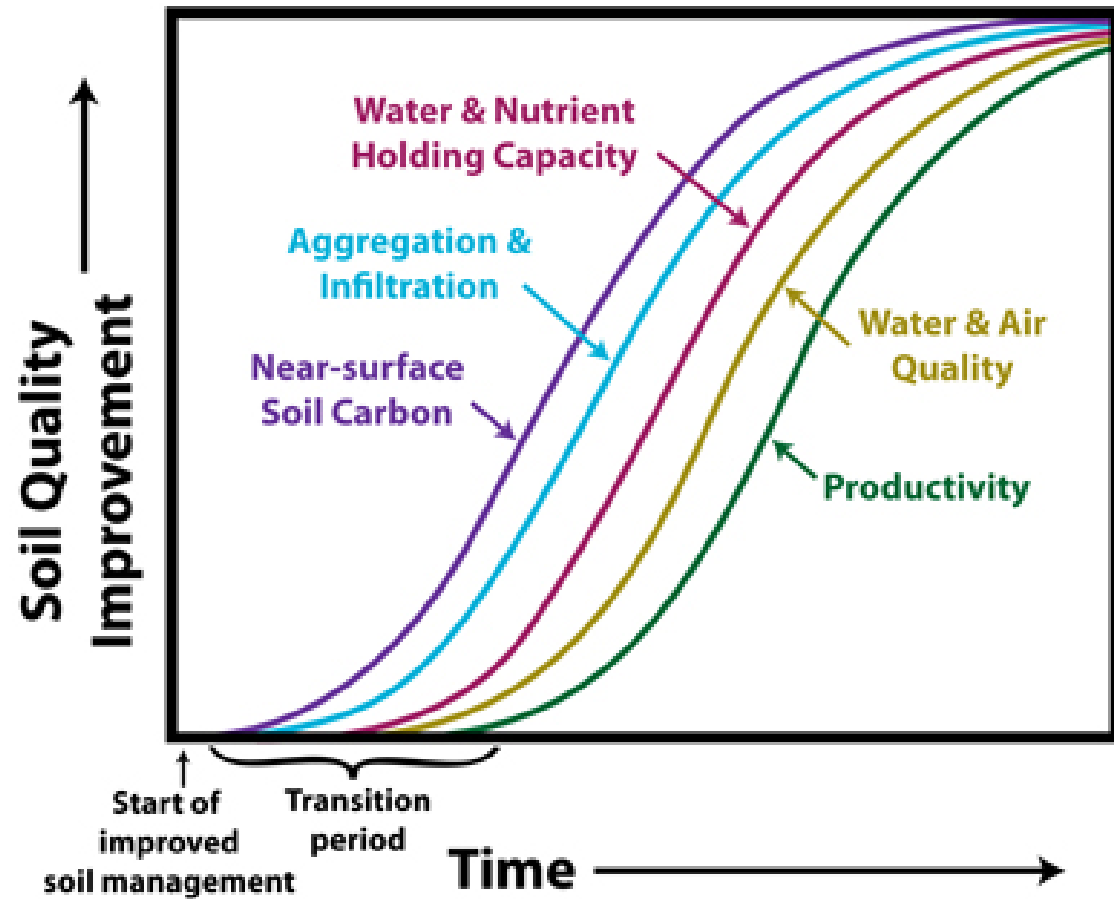




Challenges

- Moving away from the gardening styles we know
- Learning to understand advanced ecological dynamics
- Lag time for soil health
- Gearing up for new management strategies
- We need more research on these topics!

Lag Time





Questions??

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