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Soil & Water SCIENCES

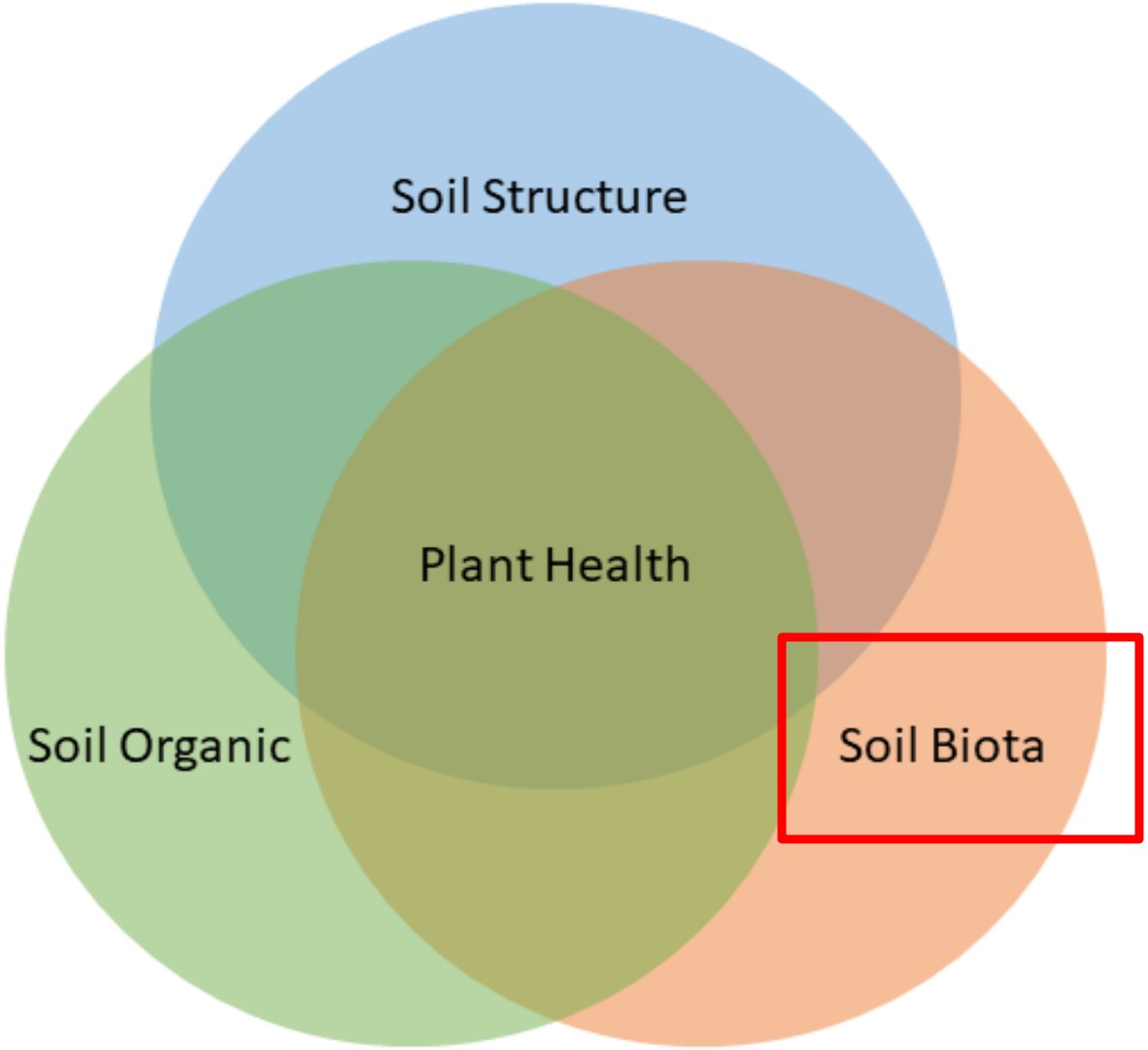
SOUTHERN SARE Sustainable Agriculture Research & Education

UF IFAS UNIVERSITY of FLORIDA

Sustainable Farming: Agroecosystems

Growing plants

Plant health & Soil health



Microbial association with plants

PHYLLOSPHERE

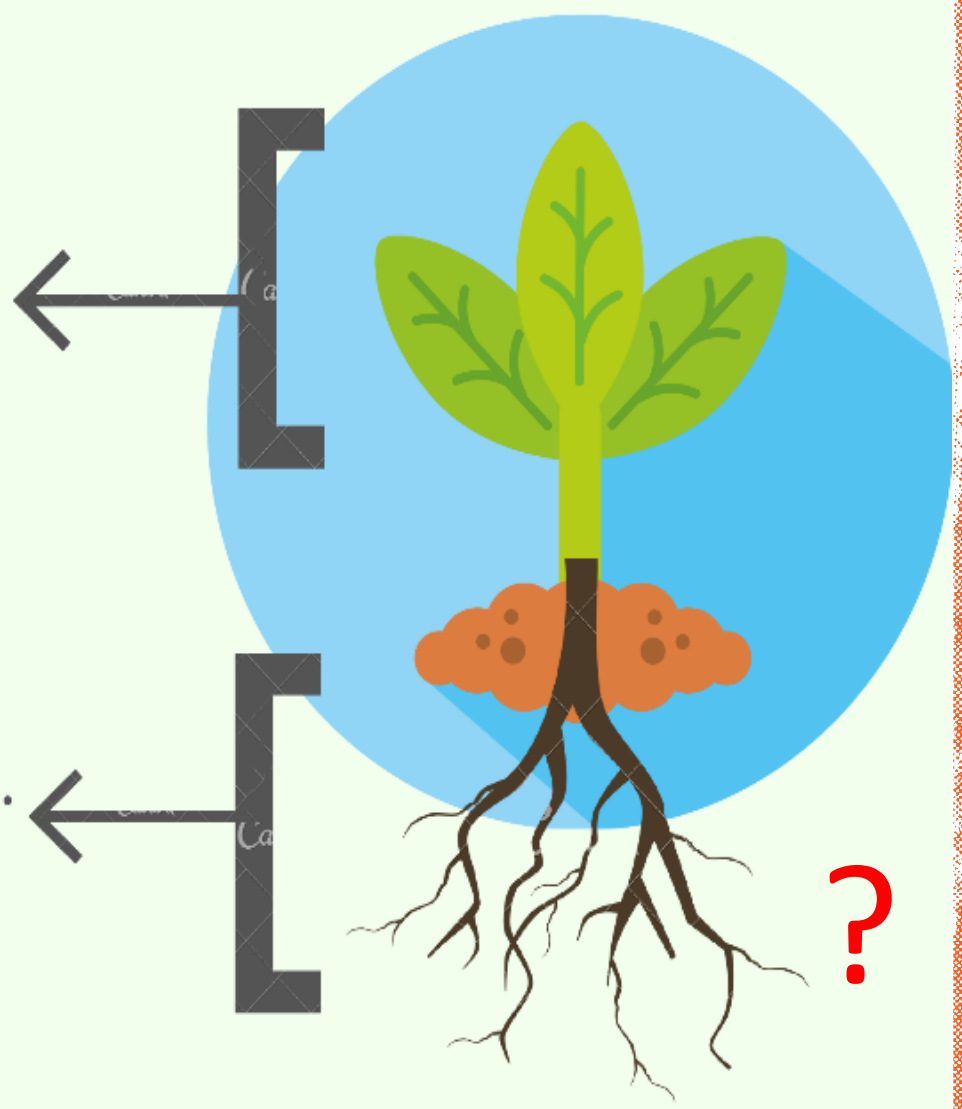
~10 million microbes

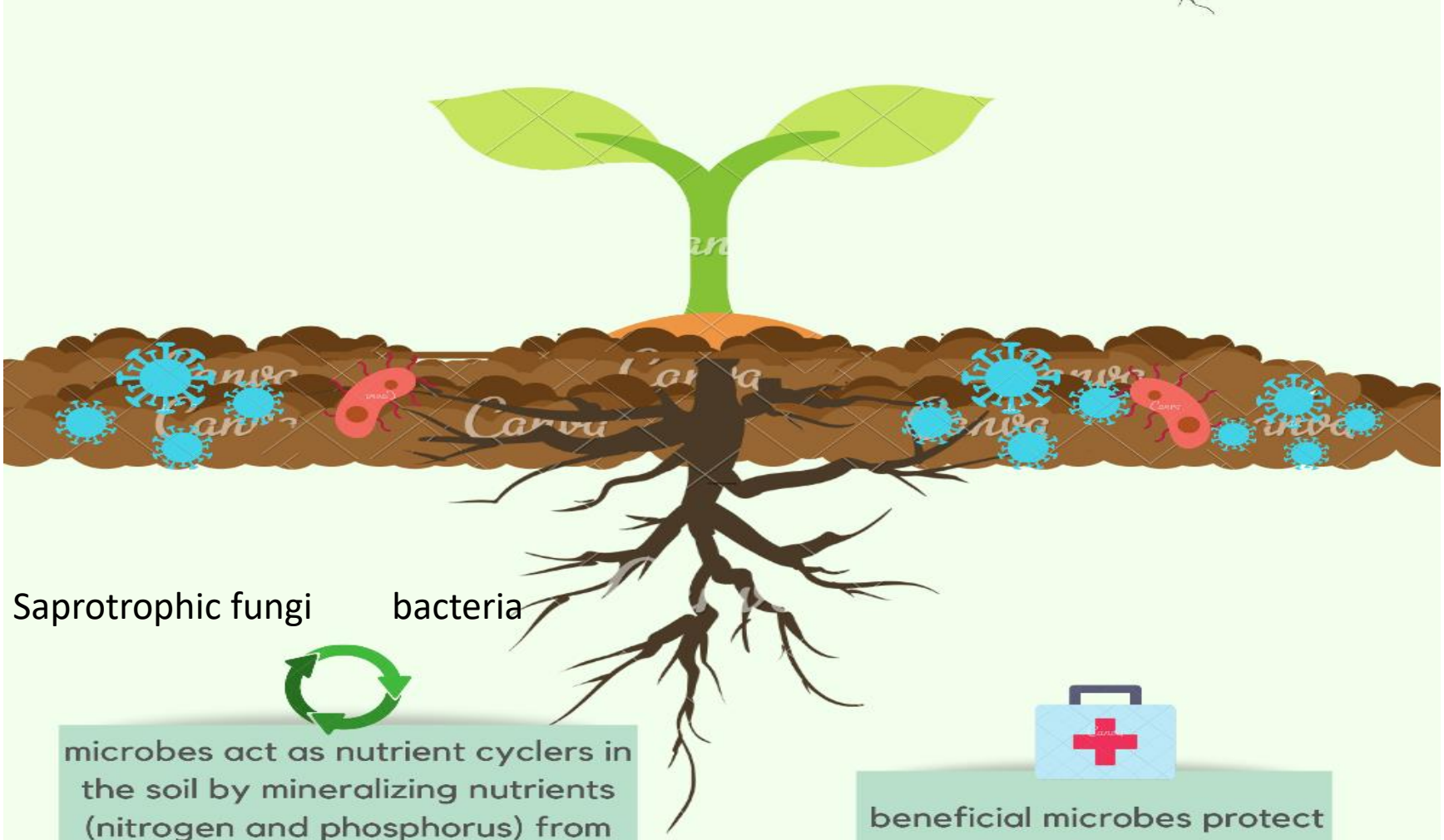
per square centimeter

RHIZOSPHERE

~1 billion microbes per gram.

~30,000 different species





Saprotrophic fungi bacteria

microbes act as nutrient cyclers in the soil by mineralizing nutrients (nitrogen and phosphorus) from organic matters

beneficial microbes protect plants from pests

Mycorrhiza fungi

microbes improve crop fertilities by providing nutrients and water to plants

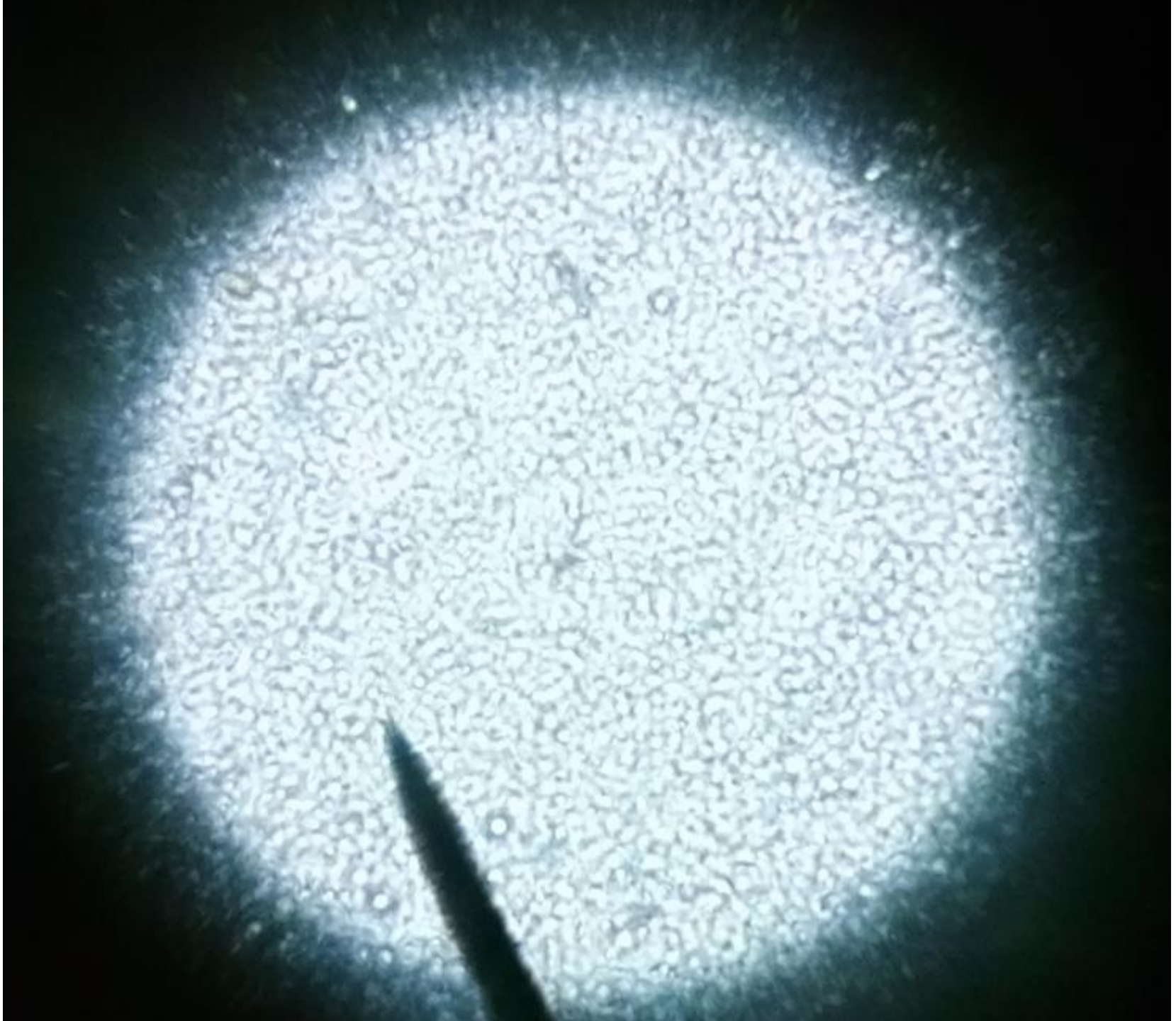
microbes store carbon and water in soils

The Nitrogen Cycle

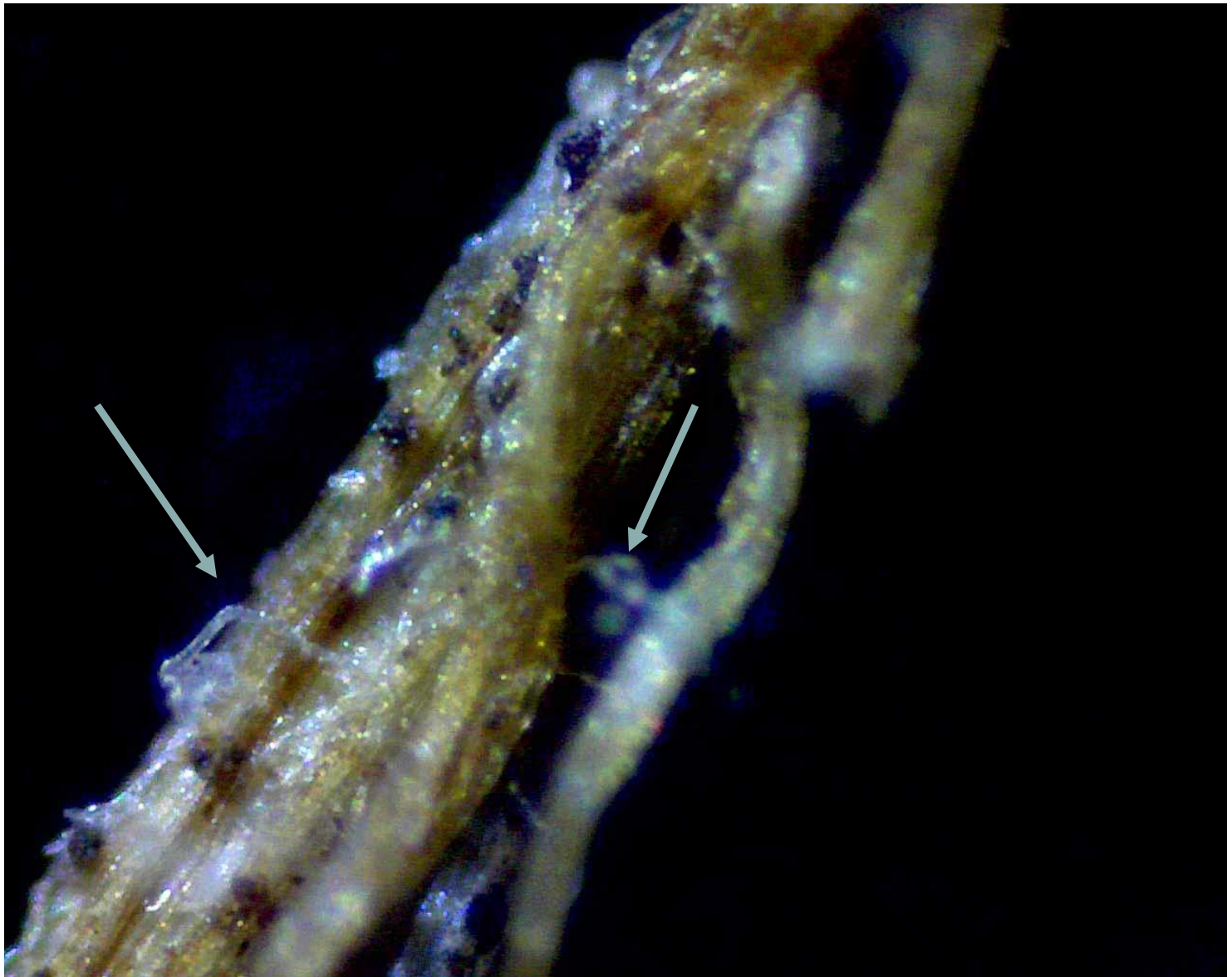
Symbiotic bacteria (Rhizobia)

Nitrogen Fixation

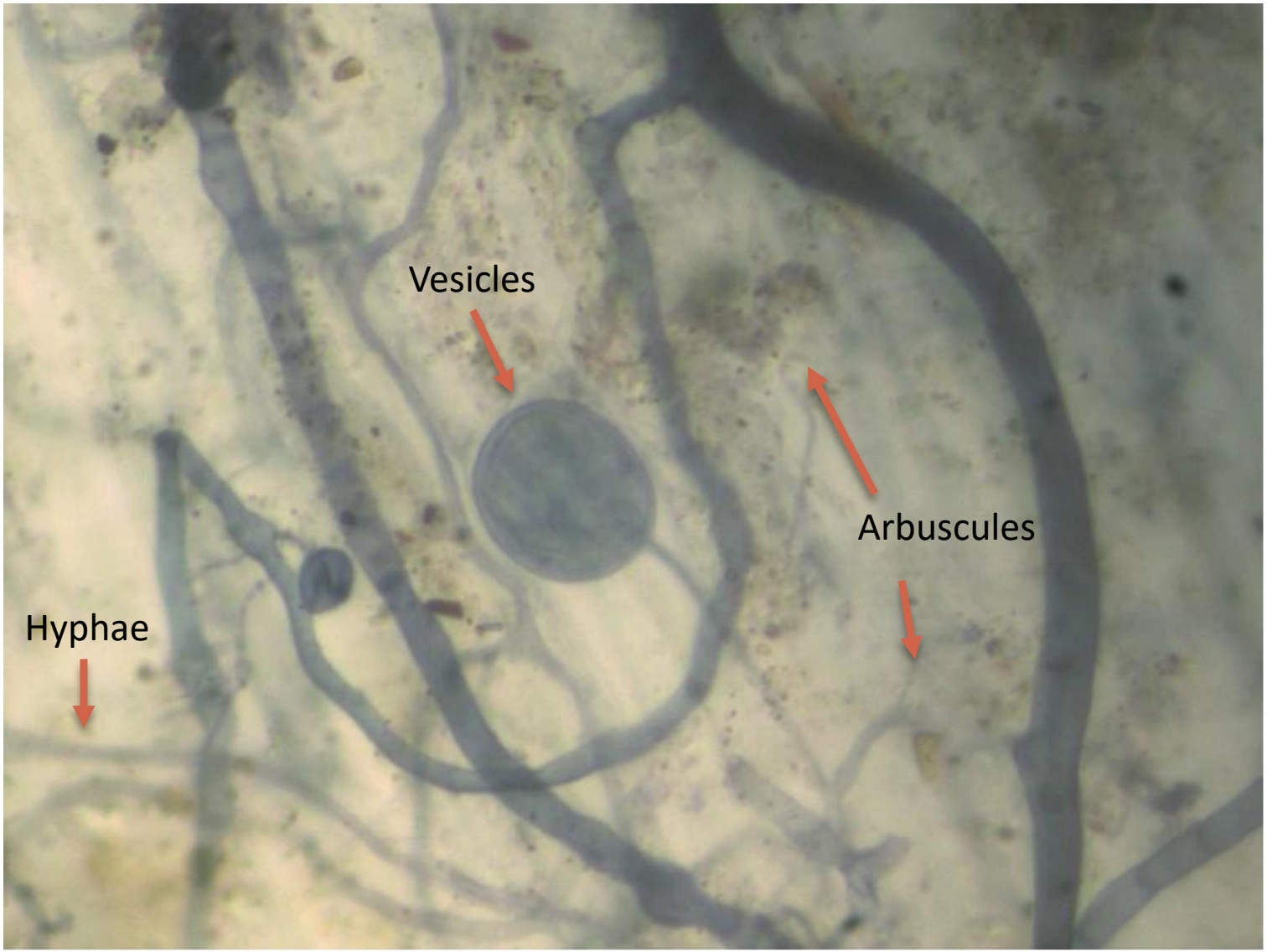
Nitrogen enters soil from the atmosphere in a form that the plants are not able to use. This is where beneficial soil microbes come in and convert the nitrogen into a usable form for the plants



Symbiotic fungi (mycorrhiza)



Arbuscular mycorrhiza fungi (colonize root)

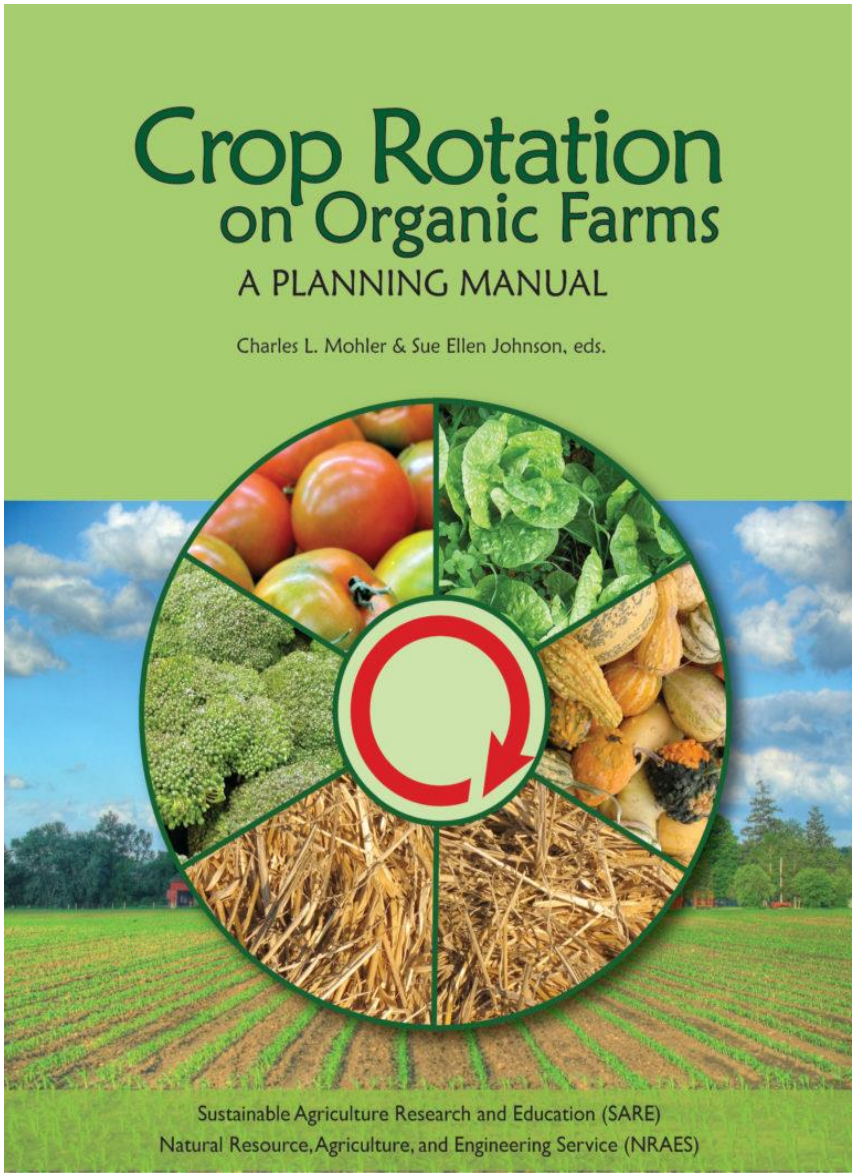


Sustainable agricultural practices

Cover cropping

- Add organic matter
- Add nitrogen (legume)
- Prevent from evaporation and erosion
- Prevent nutrient leaching
- Maintain soil microbial populations

Crop rotation



- More yield compared to continuous monoculture
- Decreases disease pressure
- Do not deplete necessary resources for plants
- Maintain soil fertility and health
- Increases microbial biomass and diversity

No till or low till

- Minimize disturbance
- Maintain soil structure
- Maintain soil organic carbon
- Maintain soil moisture
- Prevent soil erosion
- Maintain soil microbial communities

Wright et al 2006. SS-AGR-11

Organic soil amendment

Crop residues, manure, compost, biosolids

- Increases organic matter in soils
- Nutrients released slowly via microbial activities
- Increases water holding capacity and retention
- Increases microbial biomass and activities

Bhadha et al 2017. SL447

Integrated Pest Management (IPM)

"Integrated pest management emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms."

Barzman et al 2015

Integrated Pest Management (IPM)

- IPM has 4 steps:
  1. Set an **Action Threshold** ("when is the pest a serious concern?")
  2. **Monitor** and ID pests ("are these pests harmful?")
  3. **Prevent** pests (create an area unfavorable for pests)
  4. **Control** pests (if pests are a genuine concern, begin the process of eradication with targeted tactics)
     - Broad-use pesticides are a **last resort**!

Sustainable disease prevention and control

Biological fumigation (Biofumigation)

- Brown Mustard (Brassica juncea)
- Grow as cover crop or apply seed meal
- Glucosinolates (GSLs) – Isothiocyanates
- fungicidal and nematicidal

https://extension.wsu.edu/wam/
Volume 5 Issue 4

Resources:

Brown, P.D. and M.J. Morra. 1997. Control of soil-borne plant pests using glucosinolate-containing plants. Adv. Agron. 61:167-231

Sustainable disease prevention and control

Anaerobic Soil disinfection

Gopi et al. 2016. Adv Plants Agric Res. 4:270–271.

https://ohioline.osu.edu/factsheet/hyg-3315

- Create anaerobic conditions in soil
- Add labile carbon (rice bran or wheat bran)
- Irrigate
- Cap the soil with plastic mulch

Resources

Shennan et al 2018. Plant Pathology. 67: 51–66
Priyashantha et al 2021. Pathogens 10: 133.

Farm waste utilization

Composting

- Microbes degrade organic waste aerobically
- Farm wastes become sustainable resources
- Composts with microbes suppress plant diseases
- Increase organic matter in soil

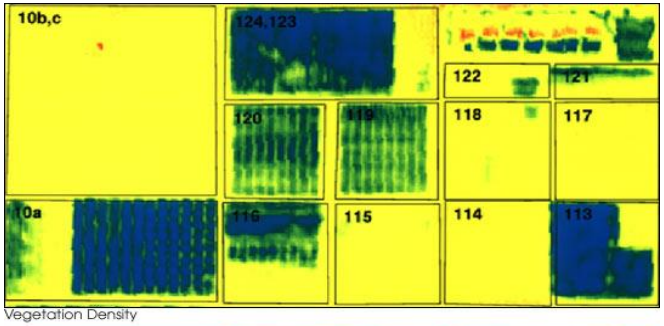
Farm waste utilization

Anaerobic digestions

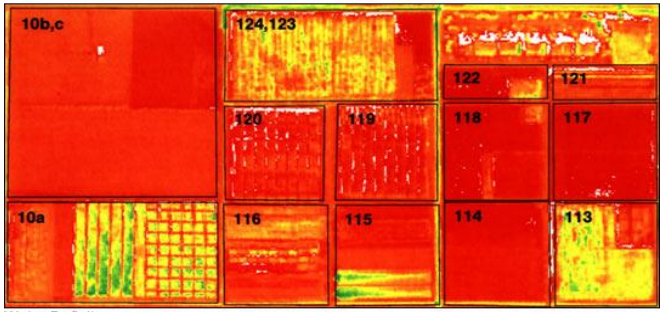
UF Dairy Research Unit in Hague

- Microbes degrade organic waste anaerobically
- Slower process than composting
- Digestate with high N and P
- Conversion to bioenergy (methane gas)
- Co-digestion

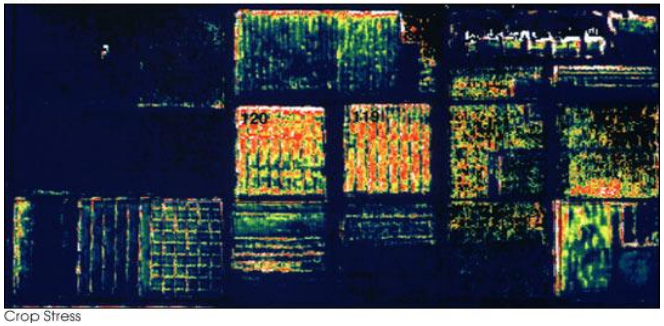
Precision Agriculture



Vegetation Density



Water Deficit



Crop Stress

https://earthobservatory.nasa.gov/images/1139/precision-farming

- To increase produces while reducing amount of resources
- Precisely measure and identify needs
- Obtain real time information
- Sensors
- GPS equipped machines

Resources

Gebbers, Robin, and Viacheslav I. Adamchuk. "Precision agriculture and food security." *Science* 327.5967 (2010): 828-831.

Sustainable Farming

Questions?

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