Fungus Among Us: Soil Health Through Fungal Partnerships

Enhancing Plant Resilience with Mycorrhizal Fungi

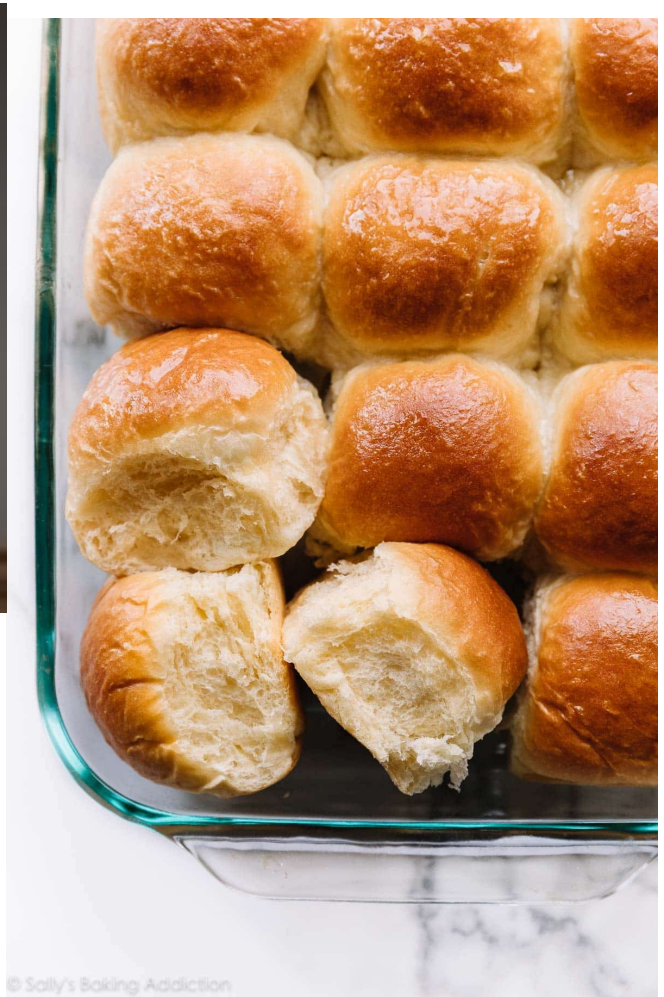
Scott County Cooperative Extension

FUNGI

They're Everywhere!
They're Everywhere!

YOUR Body, Your Plants, Your Home

YOUR Favorite Foods and Beverages



Fungus Among Us in Healthy Soil

Why They Matter

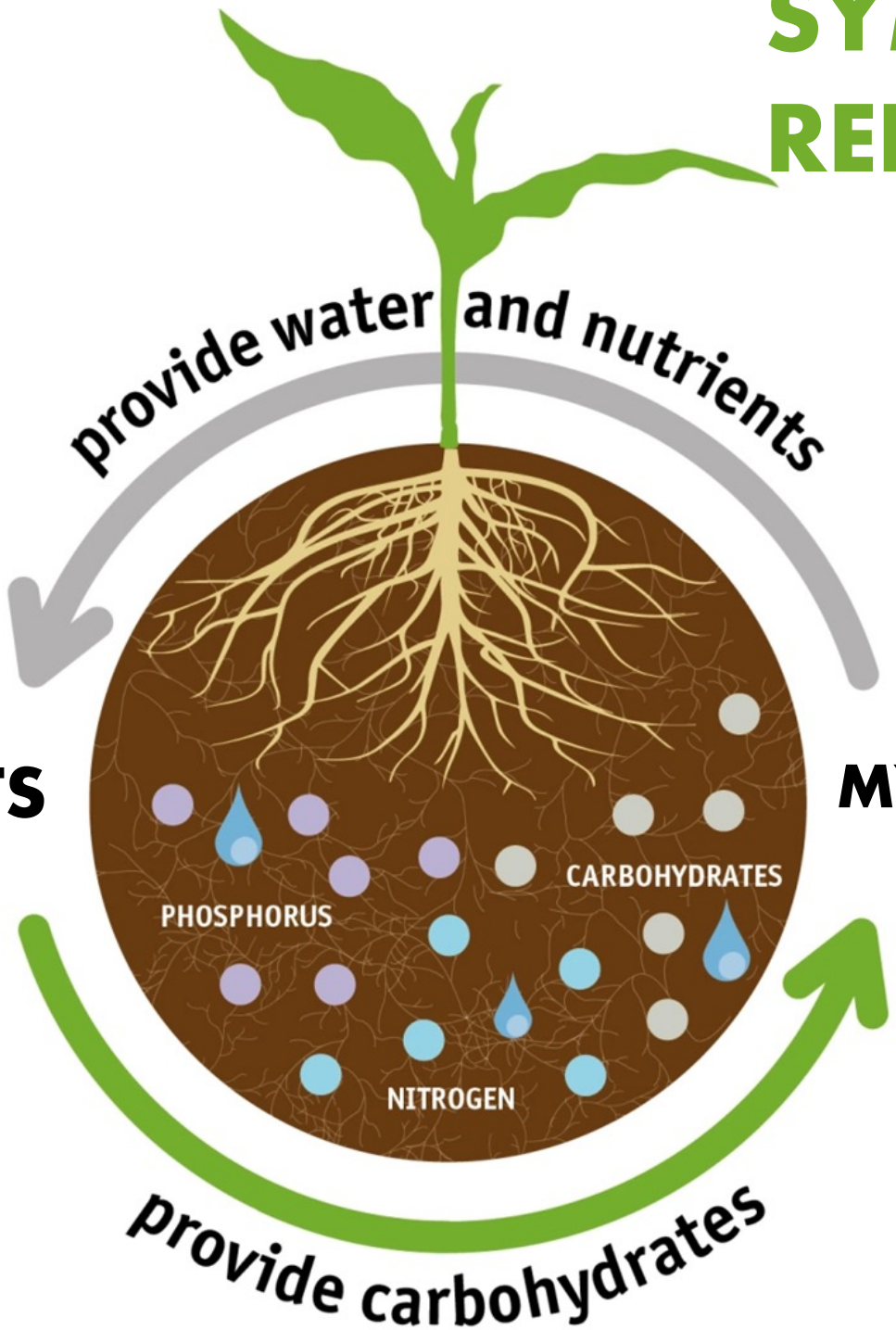
- Crucial partners in natural ecosystems and sustainable gardening
- Found in ~80–90% of all plant species
- Fungi form a symbiotic relationship as they grow in and around plant roots

Left showing the effects and cooperation of mycorrhizal growth, right without it

Symbiotic Relationship

Benefits to both

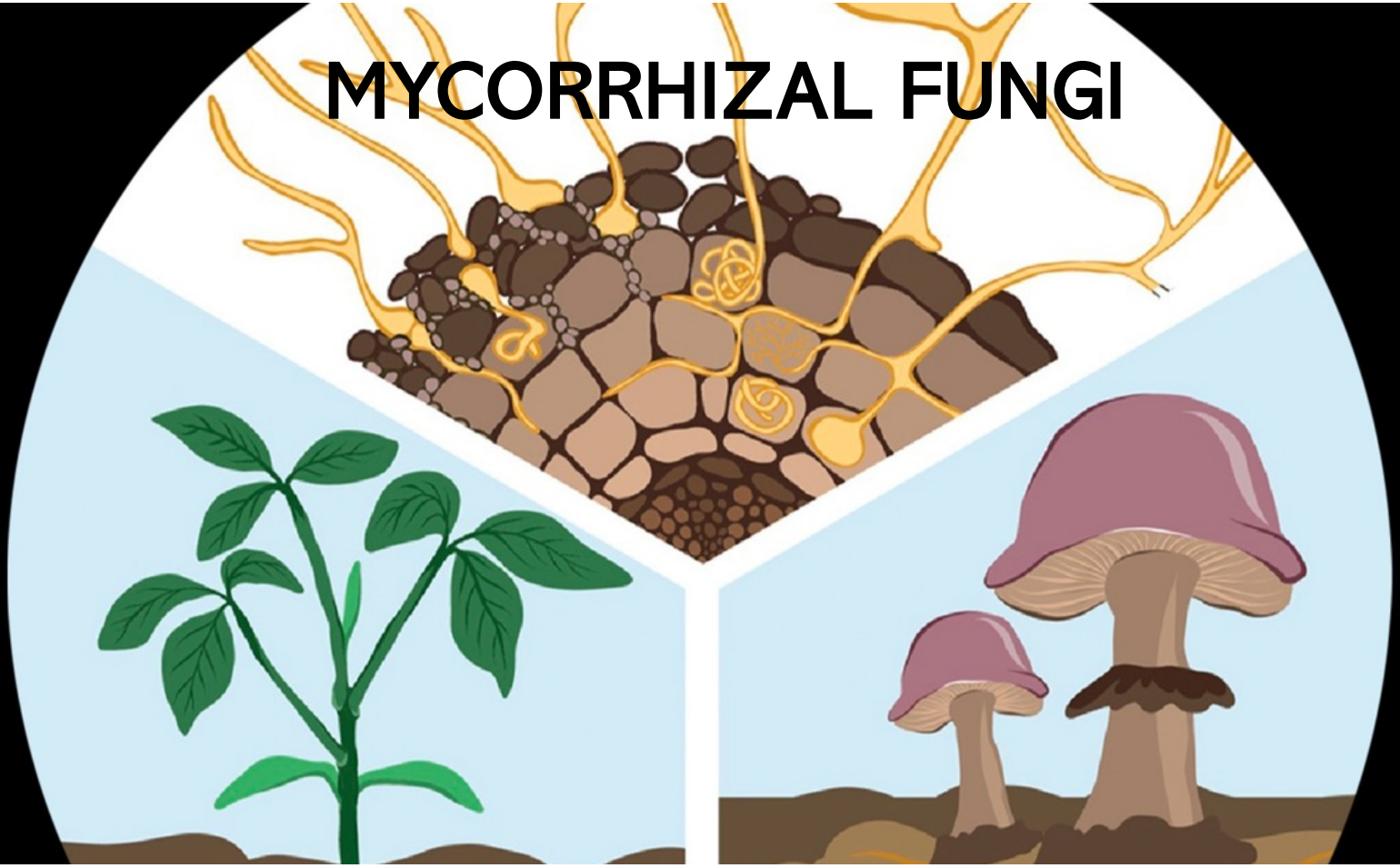
SYMBIOTIC RELATIONSHIP



PLANTS

MYCORRHIZAE

MYCORRHIZAL FUNGI



What Are They?

- important parts of a soil ecosystem
- diverse group of beneficial organisms
- form symbiotic relationships with plant roots

How Do They Work?

- Exchange nutrients for plant sugars
- Create soil-wide fungal networks
- Increase root surface area
- Improve soil structure
- Boost plant resilience

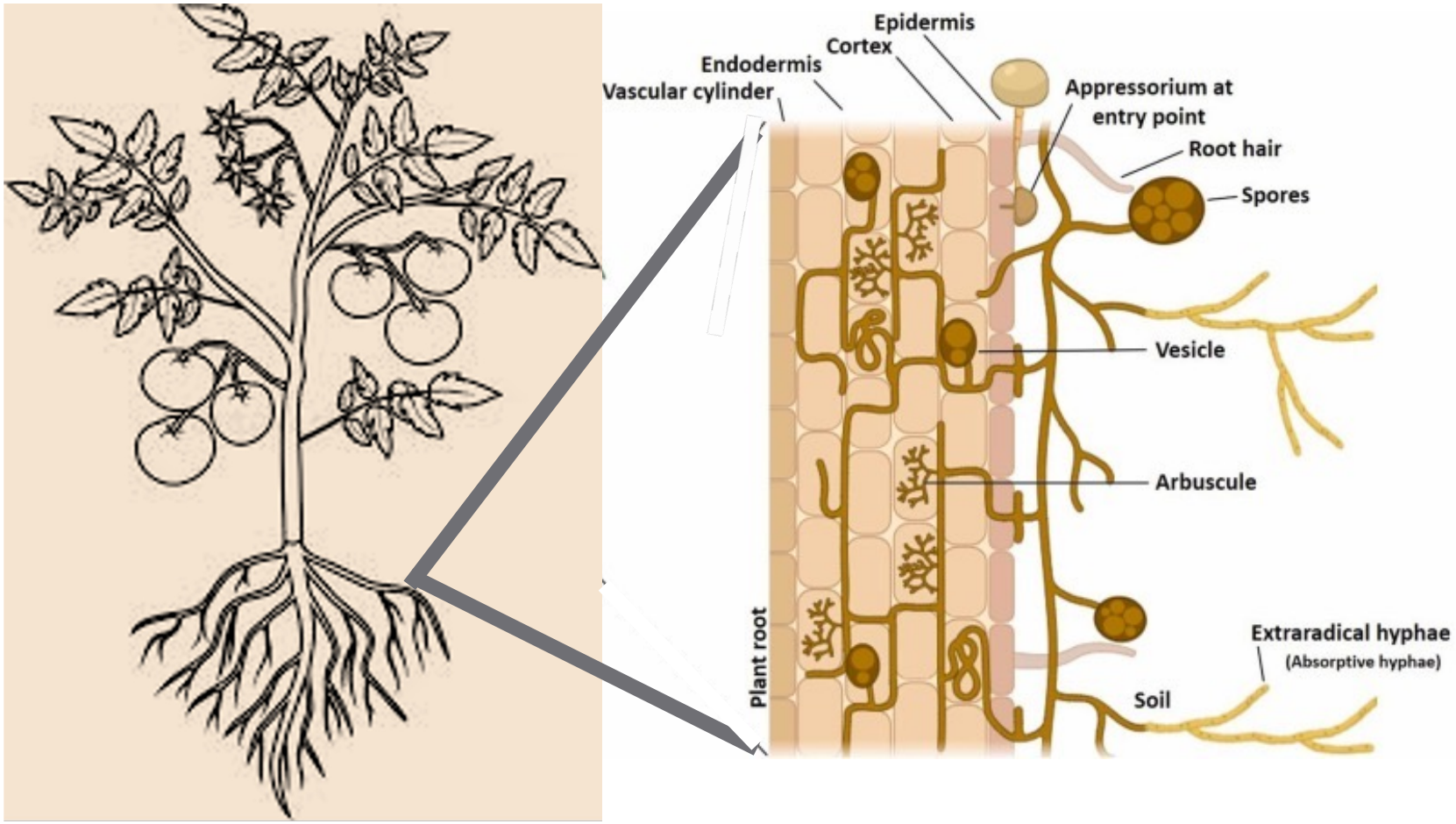
From Where Do the Mycorrhizae Come?

- **What Produces Mycorrhizae?**
  - Fungal spores in the soil germinate
  - They grow into hyphae (tiny filaments)
  - Hyphae connect with plant roots
  - This partnership forms the mycorrhizae

What They Look Like

Hyphae

- **microscopic thread-like strands**
- **white, cream, or translucent**
- **In clumps can look like fine spiderwebs**



Root Colonization

Photo: Texas A & M Extension – Travis County

Mycorrhizal fungi are already present in many soils

- They thrive in undisturbed areas such as gardens, fields, and forests
- Lawns, gardens enriched with compost, and forested areas typically support healthy fungal populations

Benefits to Plants

- Enhanced nutrient uptake
- Greater drought tolerance
- Reduced transplant shock
- Improved disease resistance

Benefits to Soil Health

- Improved structure & aeration
- Stable soil aggregates
- Supports beneficial microbes
- Reduces nutrient runoff

Plants That Host Mycorrhizae

FRUITS AND VEGETABLES

- **Tomatoes, peppers, eggplant**
- **Corn, beans, peas**
- **Cucumbers, melons, squash, pumpkins**
- **Strawberries, blueberries, grapes**

PERENNIALS AND ORNAMENTALS

- **Sunflowers, marigolds, zinnias**
- **Coneflowers, black-eyed Susans, asters**
- **Hosta, daylily, lavender**

TREES AND SHRUBS

- **Hardwoods:** oak, maple, hickory, walnut
- **Conifers:** pine, spruce, fir, cedar
- **Fruit trees:** apple, peach, cherry, citrus
- **Shrubs:** azalea, rhododendron, viburnum, rose

Mycorrhizae & Native Plants

- Many natives rely heavily on fungal partners

- Key to successful pollinator habitat restoration

Lady Bird Johnson Wildflower center
The University of Texas at Austin

Native Indian Grass, *Sorghastrum nutans*

Plants That Do NOT Benefit from Mycorrhizae

80–90% of plants form mycorrhizal partnerships

Exceptions include brassicas and beets/spinach

- **Brassicaceae:** broccoli, cabbage, kale, cauliflower, radish, turnip, canola
- **Chenopodiaceae: spinach, beets, chard**

Why Brassicas Don't Form Mycorrhizae

- Lack key symbiosis genes
- Produce defensive compounds that also deter fungi
- Rely on large root systems to gather nutrients on their own
- Release root exudates (organic acids) that unlock minerals without fungi
- Rare colonization, but usually no functional exchange

Why Chenopodiaceae Don't Form Mycorrhizae

•Lack symbiosis genes needed to build fungal exchange structures

•Rely on specialized root hairs and extensive root systems for nutrient uptake

•Produce root exudates (salts, organic acids) that can interfere with fungal colonization

•Evolved to thrive in saline or nutrient-poor soils without fungal help

Aren't they in every soil?

Can be low or missing in soils where there has been heavy disturbance

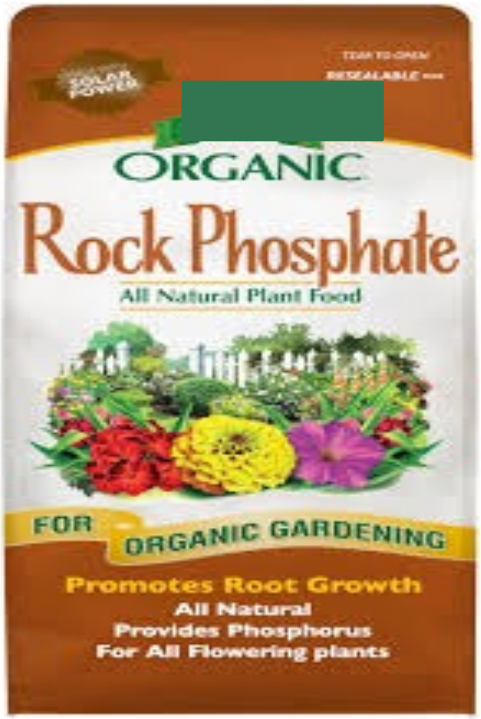
- Common causes include:
  - Construction and soil disruption
  - Frequent tillage
  - Soil sterilization or fumigation
  - Extended bare soil or monocultures of non-mycorrhizal crops
  - Excessive use of high-phosphorus synthetic fertilizers

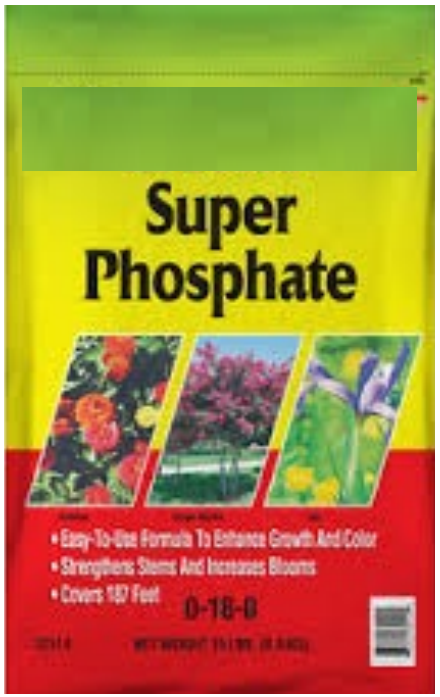
Impact of Long Periods Without Host Plants

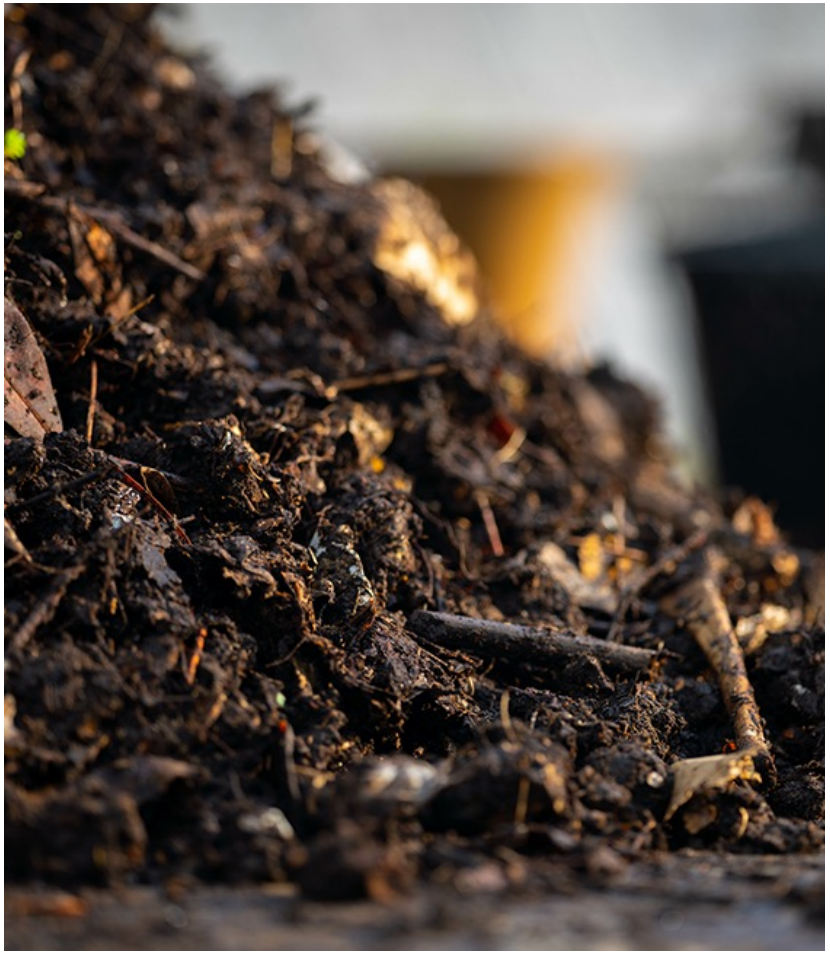
- Fungi lose their plant partners (no sugars to survive)
- Hyphal networks collapse
- Soil health and structure decline
- Nutrient cycling slows

How Phosphorus (P) Affects Mycorrhizae

- **Low to moderate P** → encourages mycorrhizal growth and partnerships
- **High P (from synthetic fertilizers)** → reduces or suppresses mycorrhizal colonization, because plants no longer "need" the fungi for nutrient uptake







Reintroduction

Is it possible?

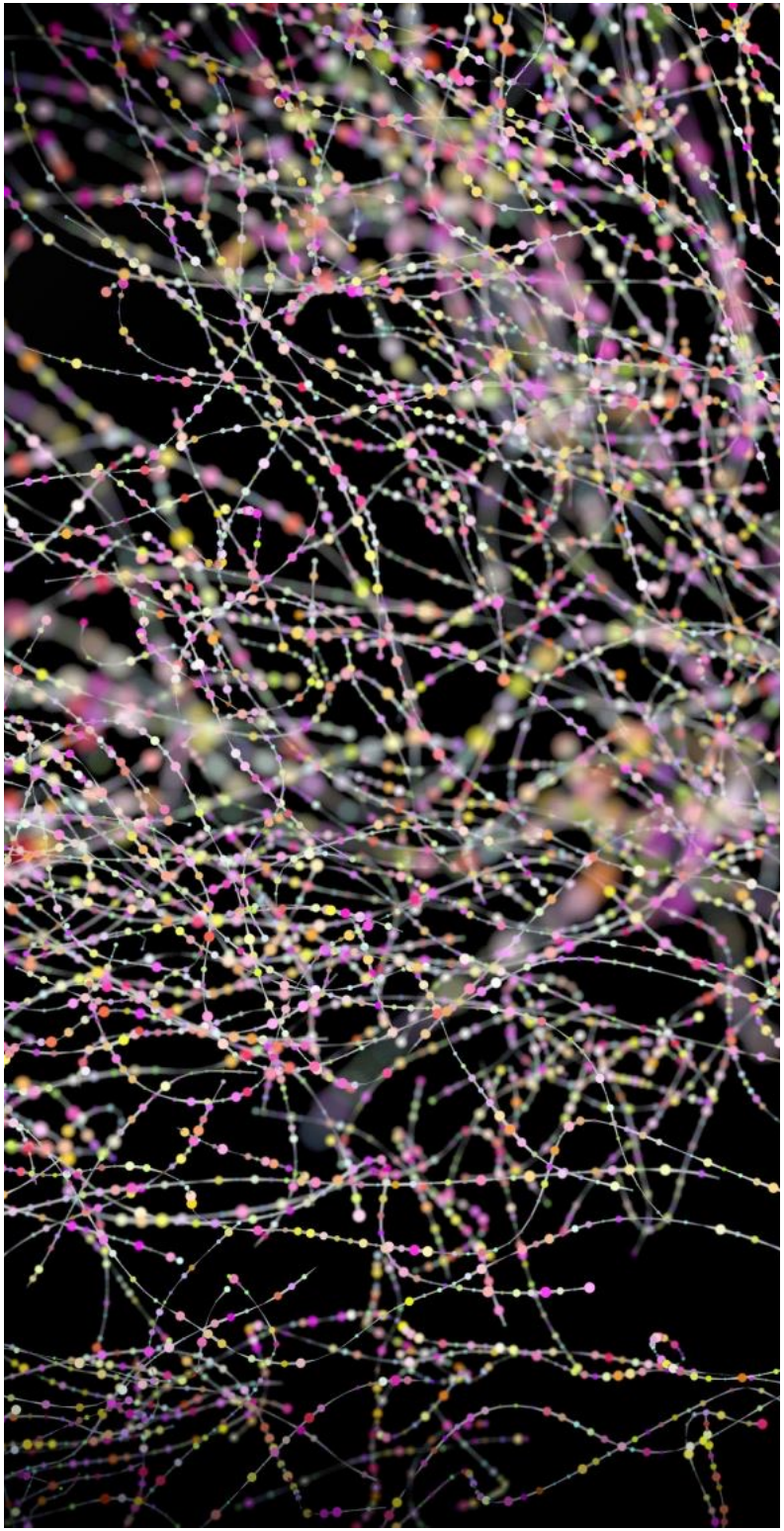
How to Reintroduce Mycorrhizae Naturally

- Add organic matter: Use compost, mulch, or cover crops to feed fungi
- Grow host plants: Choose plants that partner well with fungi (legumes, perennials, native grasses)
- Disturb soil less: Reduce tillage to protect fungal networks
- Fertilize carefully: Too much phosphorus can harm fungi
- Inoculate if needed: Add mycorrhizal products when soils are depleted
- Borrow from nature: Mix in soil, roots, or leaf litter from healthy areas

•**They spread on their own:** Once reintroduced, mycorrhizae grow with plant roots and keep multiplying.

How Mycorrhizae Enter Soil:

- From nearby plants – Hyphae spread outward through soil and reach new roots
- From spores – Tiny fungal “seeds” carried by wind, rain, animals, or people
- From organic matter – Decaying roots or compost with living fungi/spores
- Through soil movement – Tillage, planting, or soil transfer moves fungi to new areas



What Are Soil Inoculants?

- Commercial products with beneficial microbes (bacteria, fungi, or mycorrhizae)
- Applied to soil or seeds

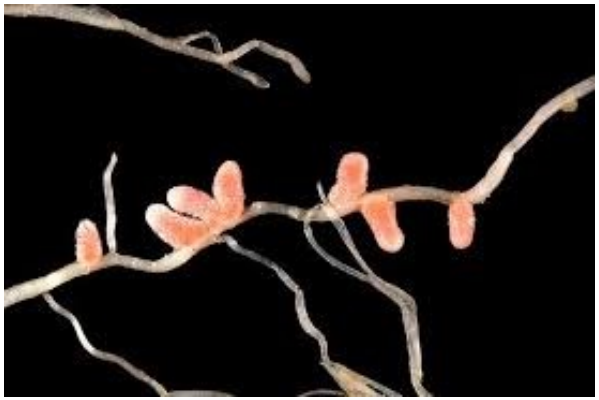
Inoculants can help in depleted soils, but they're not a substitute for building soil health through organic matter, crop diversity, and reduced

Current Challenges

1. **Uncertain Effectiveness**
2. **Short-Term Survival**
3. **Cost vs. Return**
4. **Compatibility Challenges**
5. **Marketing Claims**
6. **Soil Ecology Imbalance**
7. **Quality and Regulation Issue**

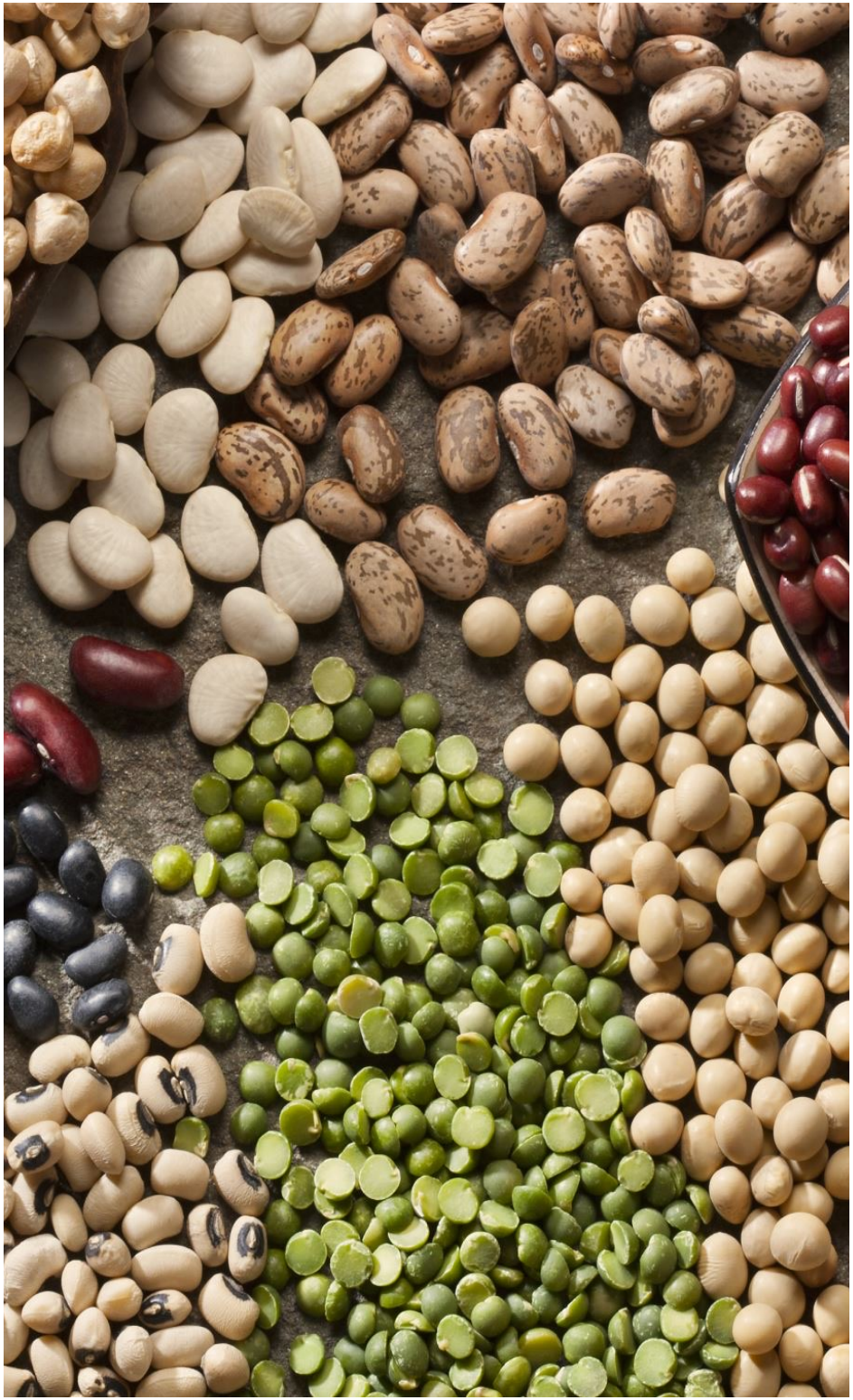
LEGUME VS. MYCORRHIZAL

- Clover/Legume Inoculants
  - Contain rhizobia bacteria
  - Rhizobia live in nodules on legume roots (clover, peas, beans, alfalfa)
  - They fix nitrogen from the air into a form plants can use



VS.

- Mycorrhizal Inoculants
  - Contain fungal spores or hyphae
  - Fungi attach to or grow inside roots
  - They help plants take up phosphorus, water, and micronutrients



INOCULANT COMPARISONS

Legume Inoculants:

- **Proven Success:**
- **Rhizobia inoculants have been used for over 100 years**
- **They reliably improve nitrogen fixation in legumes such as clover, alfalfa, beans, and peas.**
- **Especially effective in soils where the right rhizobia strains are absent or low**
- **Farmers see higher yields and reduced need for nitrogen fertilizer.**

Mycorrhizal inoculants (fungi): less consistent

- **because native fungi are often already present**
- **Fungal growth results depend heavily on soil conditions**

Why Legume Inoculants Work Better Than Many Fungal Inoculants

- ***Legume partnerships are very specific and easy to "match"***
- ***Had many years to "get it right"***

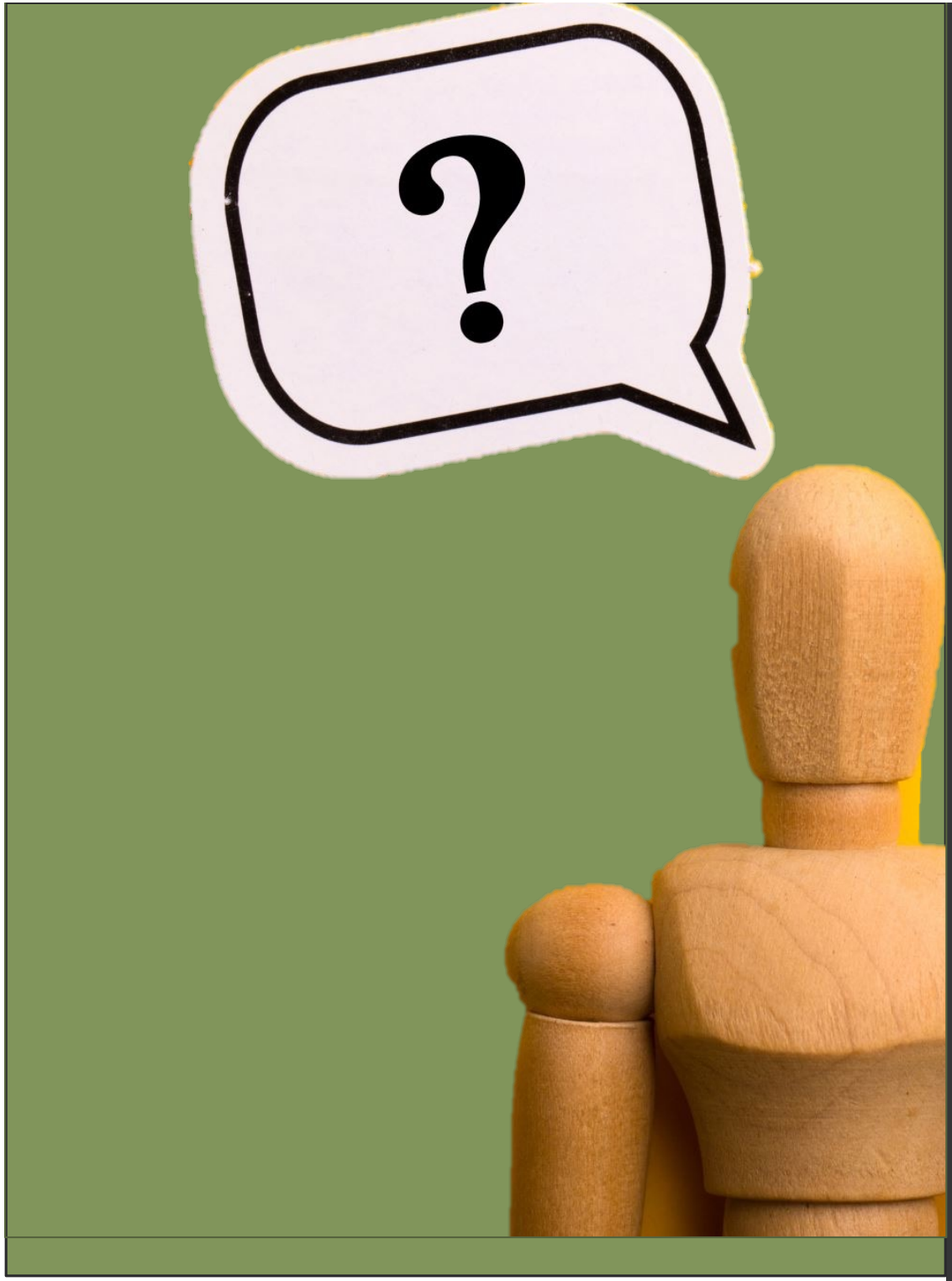
Bottom line:

Soil inoculants are not a substitute for sound soil management.

They may offer benefits in certain situations, but often provide limited or inconsistent results

In short, new research indicates that mycorrhizal fungi play a vital role in plant growth, the maintenance of healthy ecosystems, and the adoption of sustainable practices. Studying these partnerships in more detail is crucial to addressing global environmental challenges.

Q&A and Discussion



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