

Chapter 4

Soil Food Web Microorganisms

Lecture 19 - Mycorrhizal Fungi

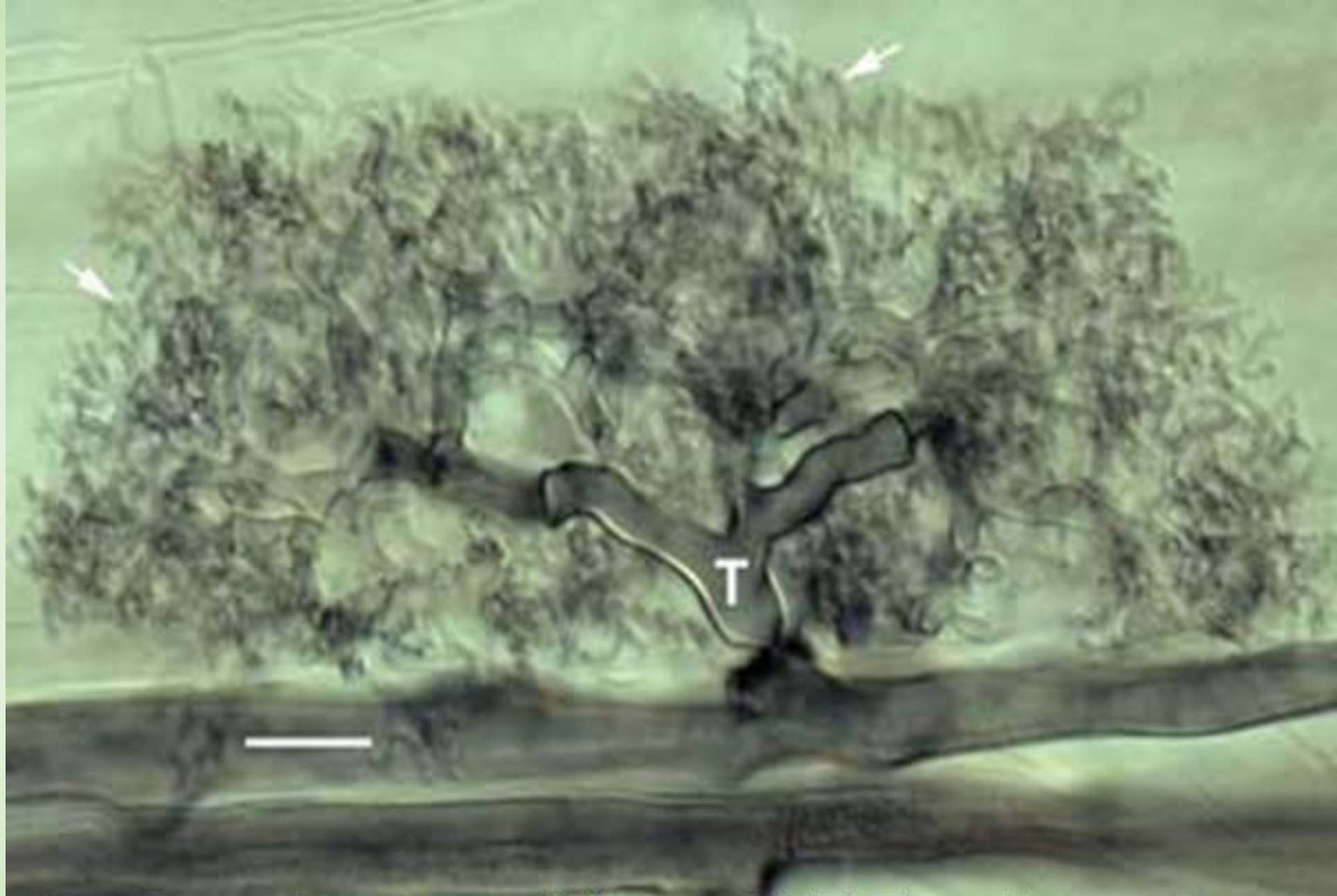
Four types of Mycorrhizal Fungi

Endomycorrhizal – hyphae grow into the space between the cell wall and cell membrane.

1. **VAM (AM)** – arbuscles, maybe vesicles form
2. **Ericoid** – coiled hyphae (no arbuscles)
3. **Orchid** - no arbuscles or vesicles form (just hyphae)

anbg.gov.au/fungi/mycorrhiza.html

4. **Ectomycorrhizal** – hyphae surround the first one or two layers of cells of the root, where nutrient exchange occurs (Hartig Net)

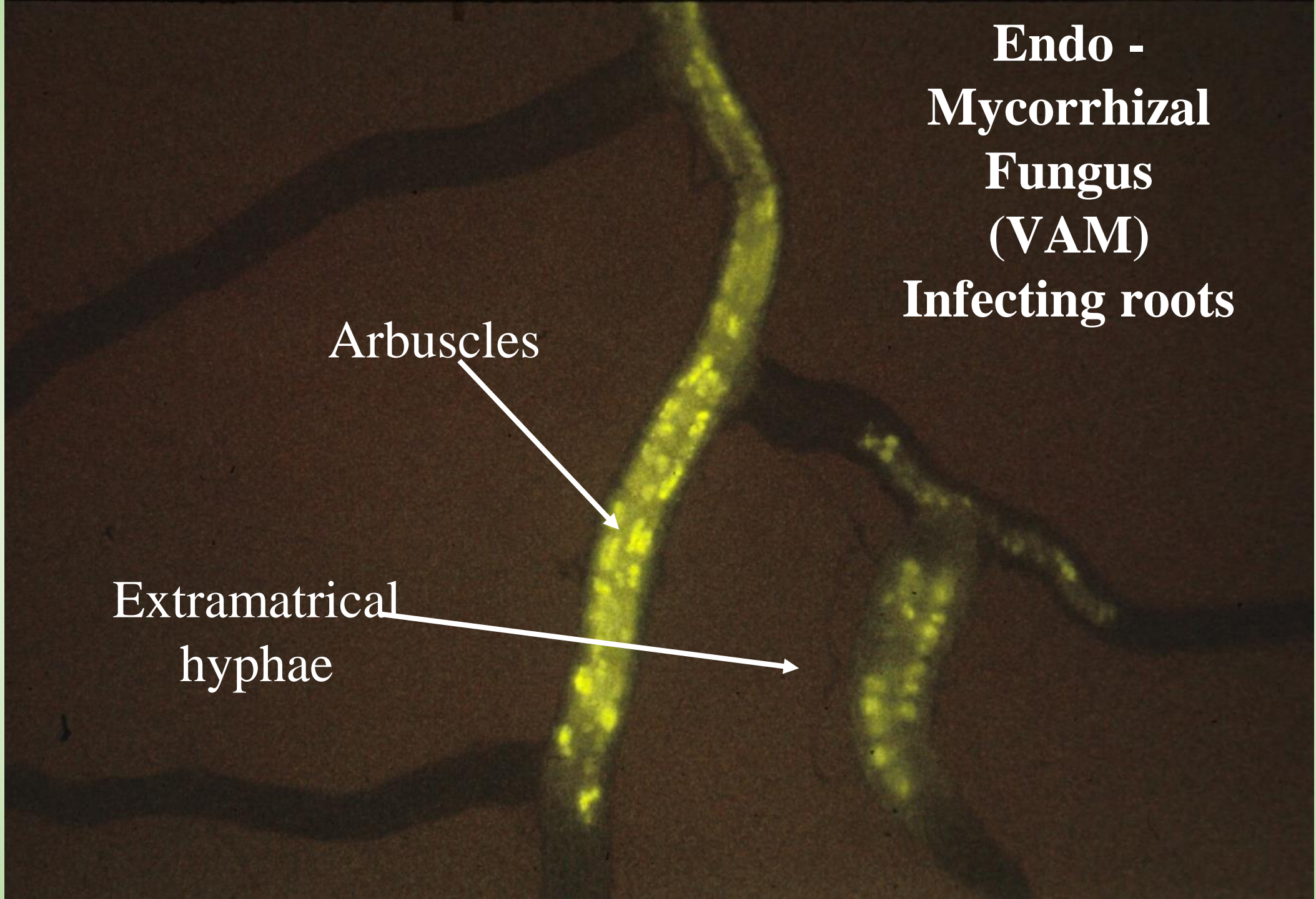


A classic tree-like VAM arbuscule

**Endo -
Mycorrhizal
Fungus
(VAM)
Infecting roots**

Arbuscles

Extramatrical
hyphae

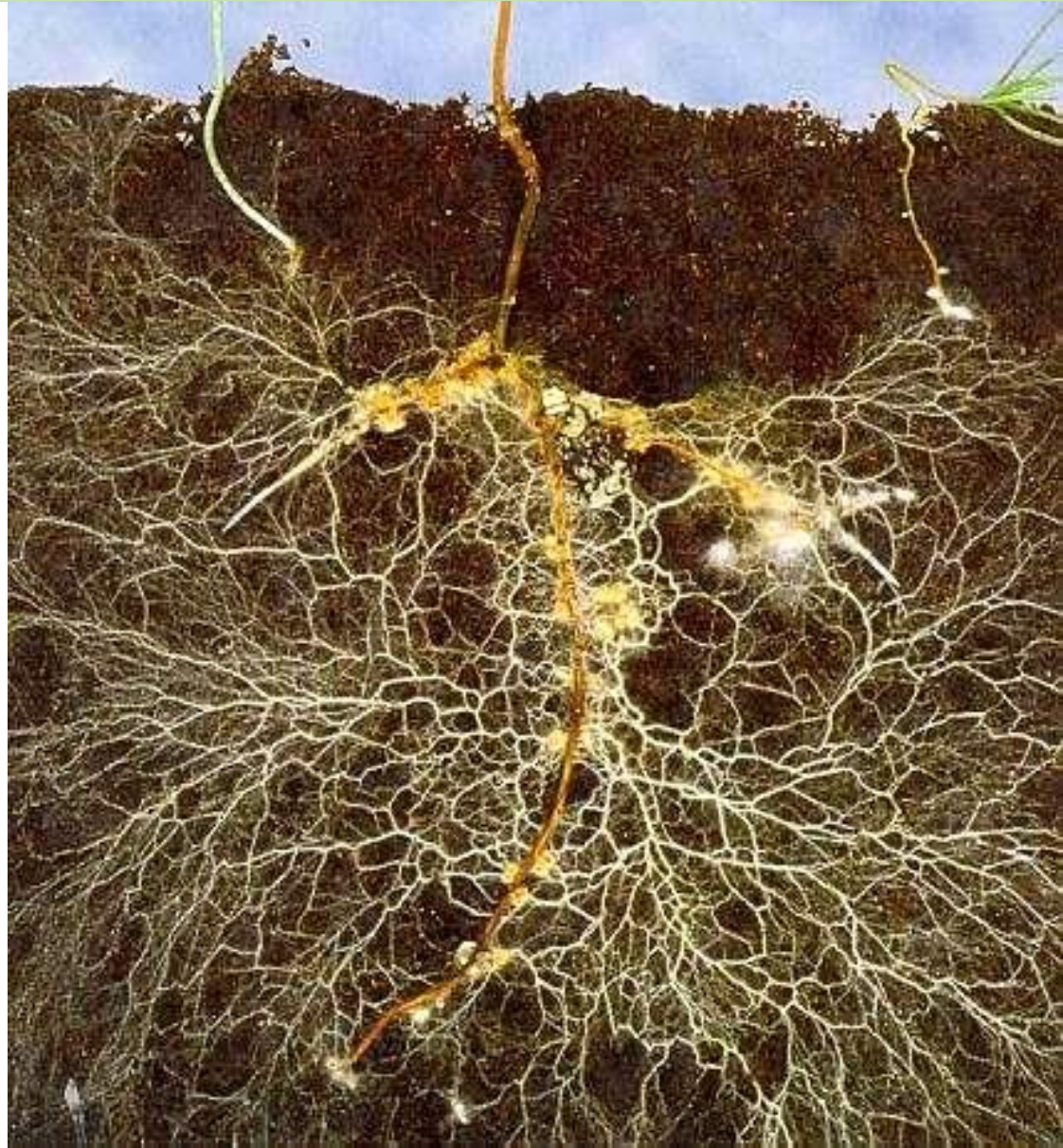


Ecto-Mycorrhizae

David Reid

**Ecto-
Mycorrhizal** fungi
on pine seedling

How much more of
the soil can the plant
get nutrients from?



What does your plant need?

Non-mycorrhizal (rare exceptions)

Bare Parent Material
100% Bacterial

Cyanobacteria, True
Bacteria, Protozoa, Fungi,
Nematodes, Microarthropods
F:B = 0.01

“Weeds”
- high NO₃
- lack of oxygen
F:B = 0.1

Early Grasses
Brassicas, Mustards
F:B = 0.3

Ecto-mycorrhizal

Conifer, old-growth
forests
F:B = 100:1 to 1000:1

Soil Foodweb Structure
Through Succession,
Increasing Productivity

Mid-grasses,
vegetables
F:B = 0.75

Deciduous Trees
F:B = 5:1 to 100:1

Shrubs, vines,
bushes
F:B = 2:1 to 5:1

Late successional
grasses, row crops
F:B = 0.75 to 1:1

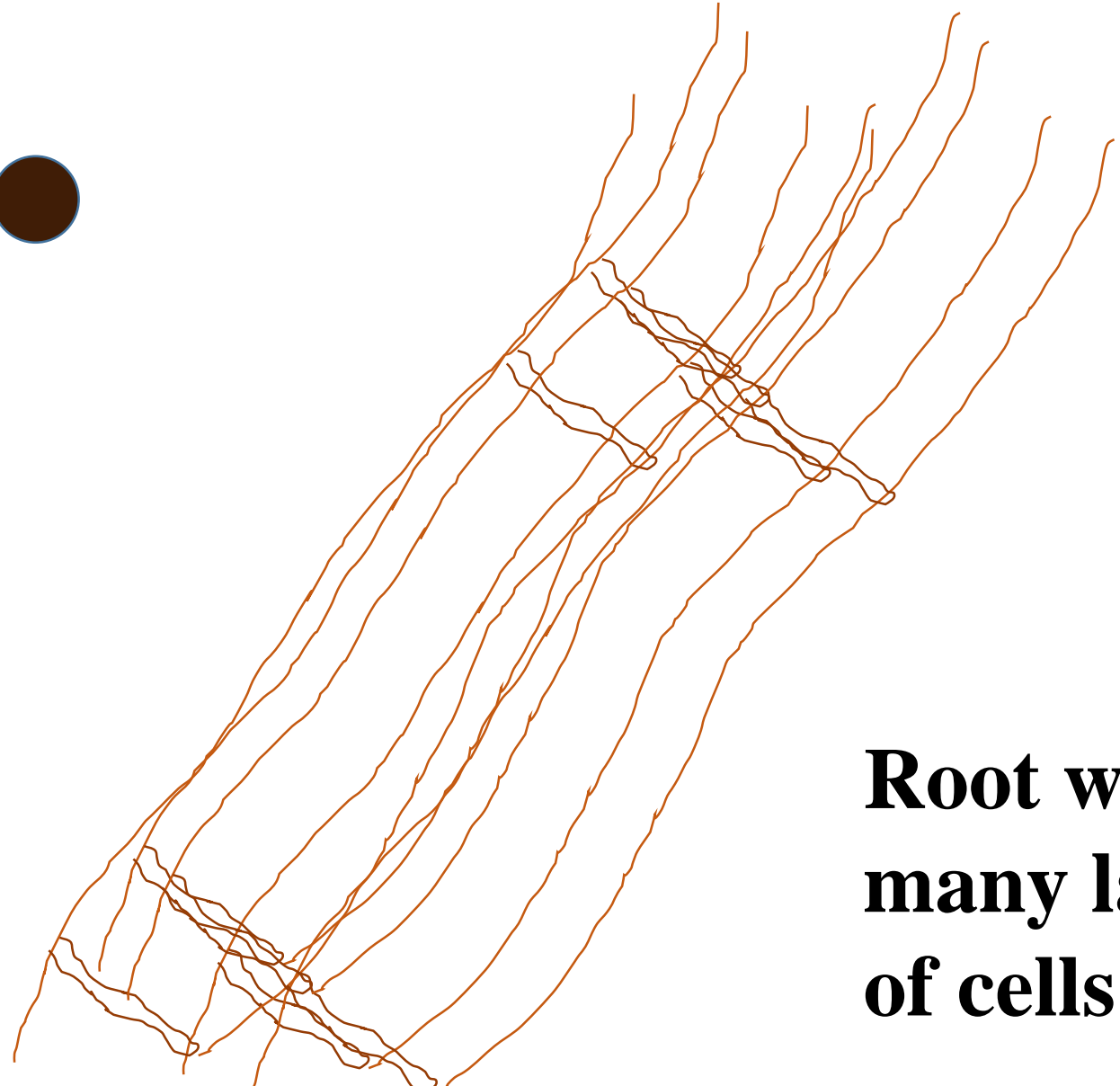
VAM colonized

Arbuscular Mycorrhizal Colonization

Step 1

Spore ●

Loads of bacteria, other fungi, protozoa, nematodes out here running around between and within the aggregates



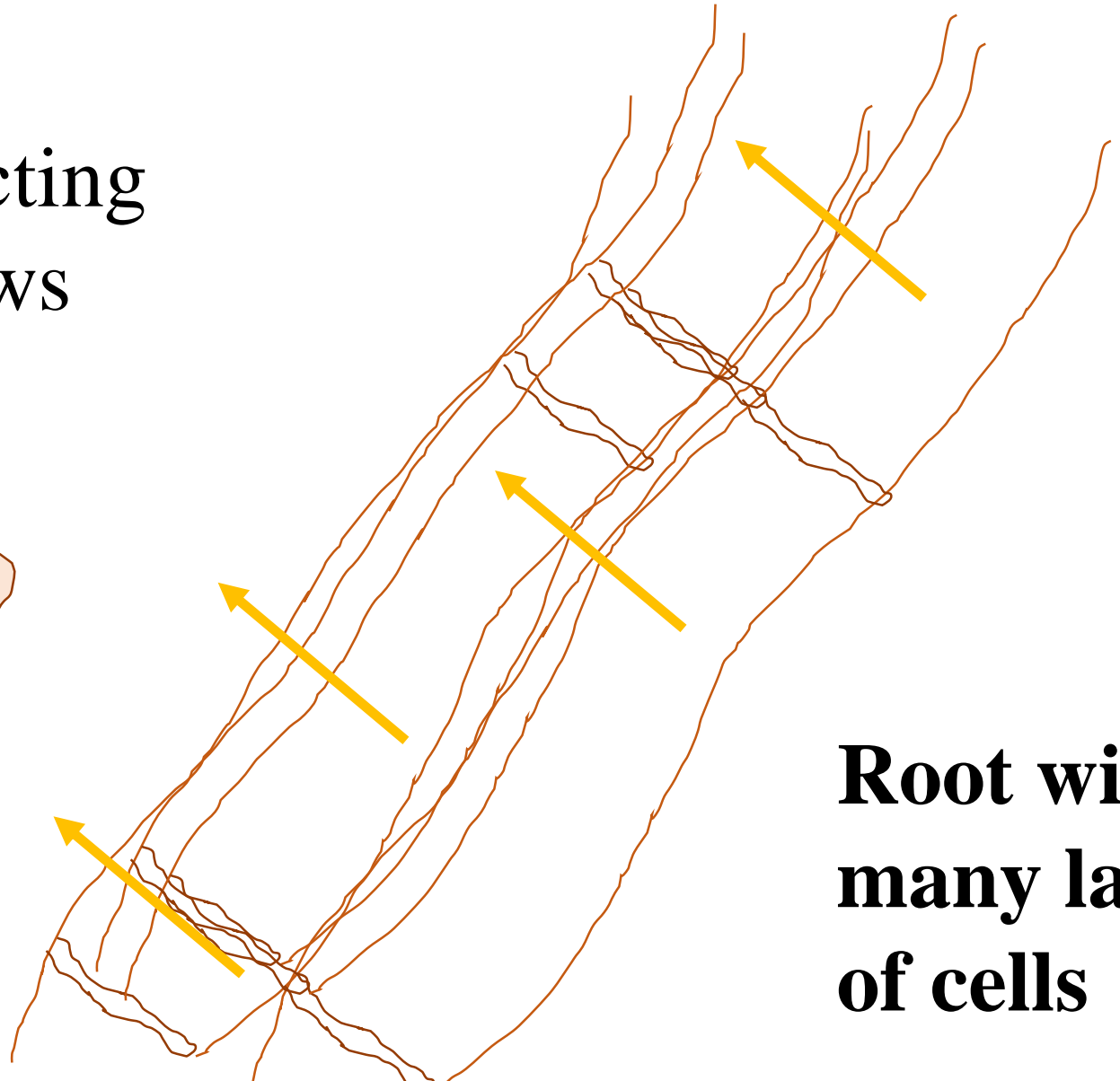
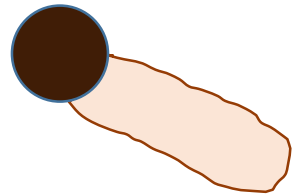
Root with many layers of cells

Key for Arbuscular Mycorrhizal Colonization

Step 2

Spore germinates and, detecting exudates from the root, grows towards the root system.

Exudates produced by the plant specific to wake up the AM fungi it needs

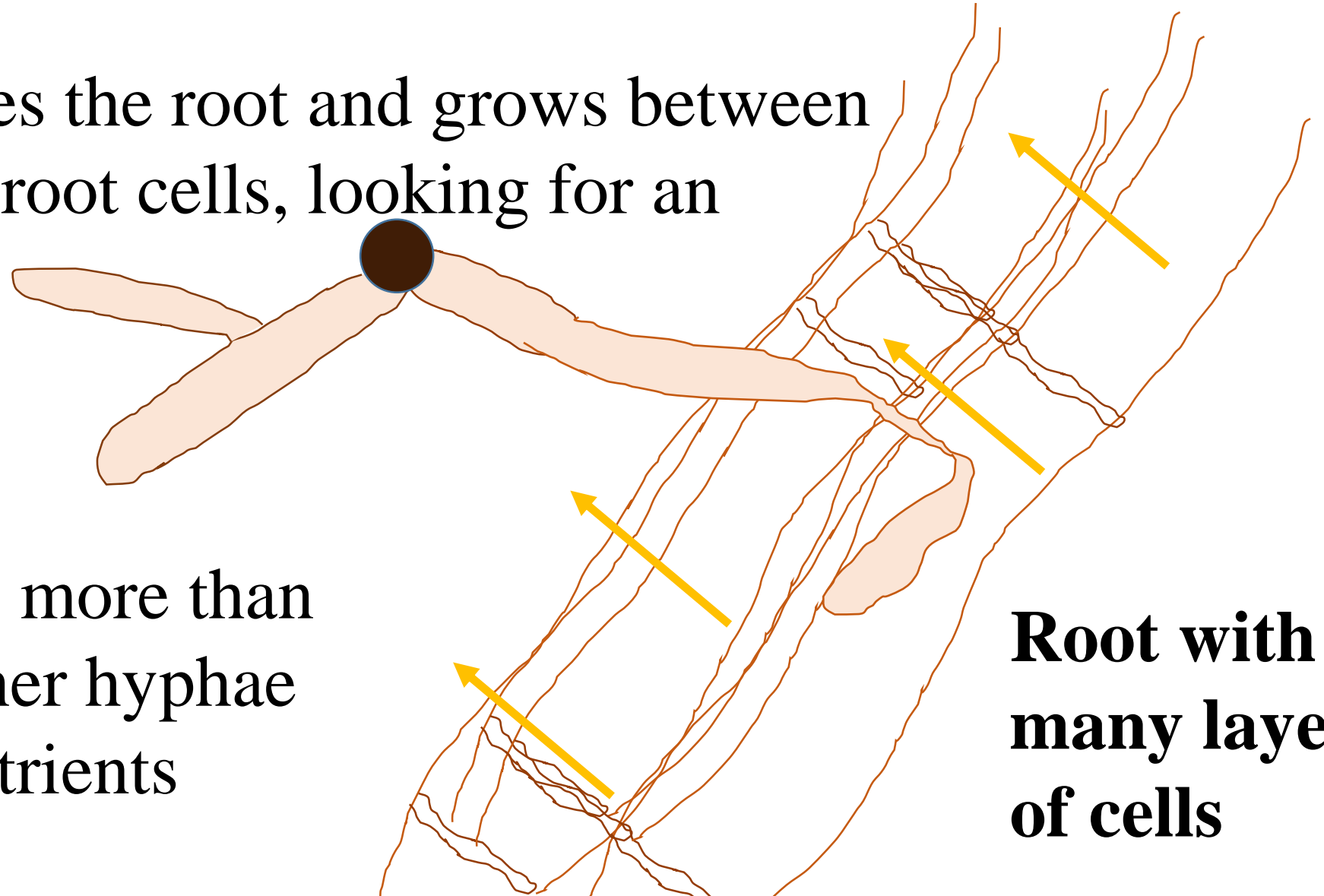


Root with many layers of cells

Key for Arbuscular Mycorrhizal Colonization

Step 3

The hypha reaches the root and grows between the spaces of the root cells, looking for an “infection” site.



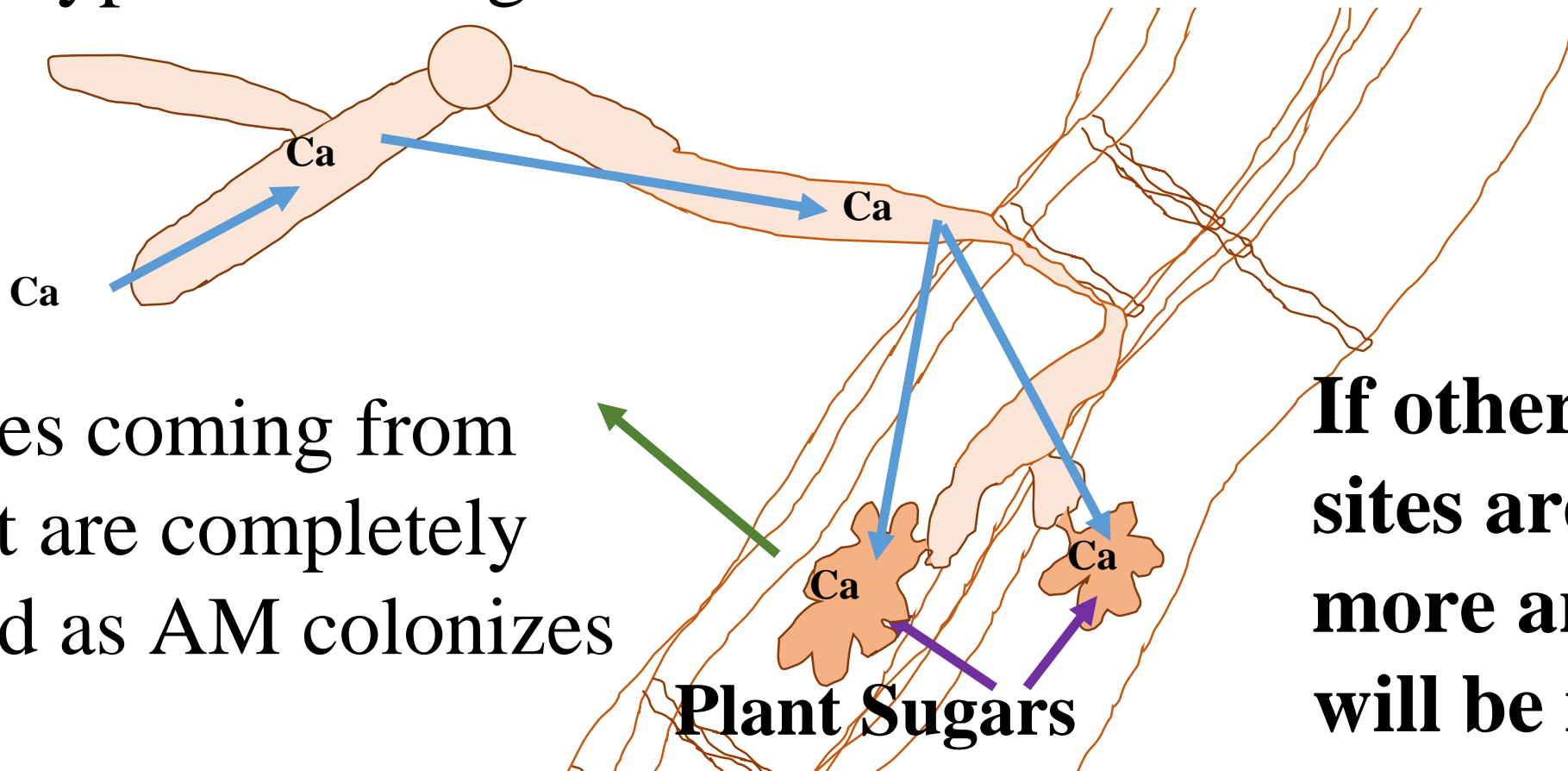
The fungus needs more than just sugars, so other hyphae go looking for nutrients

Root with many layers of cells

Key for Arbuscular Mycorrhizal Colonization

Step 4

The plant indicates to the fungus what the plant wants, the fungus tells the hyphae looking for nutrients to send that to the arbuscule.



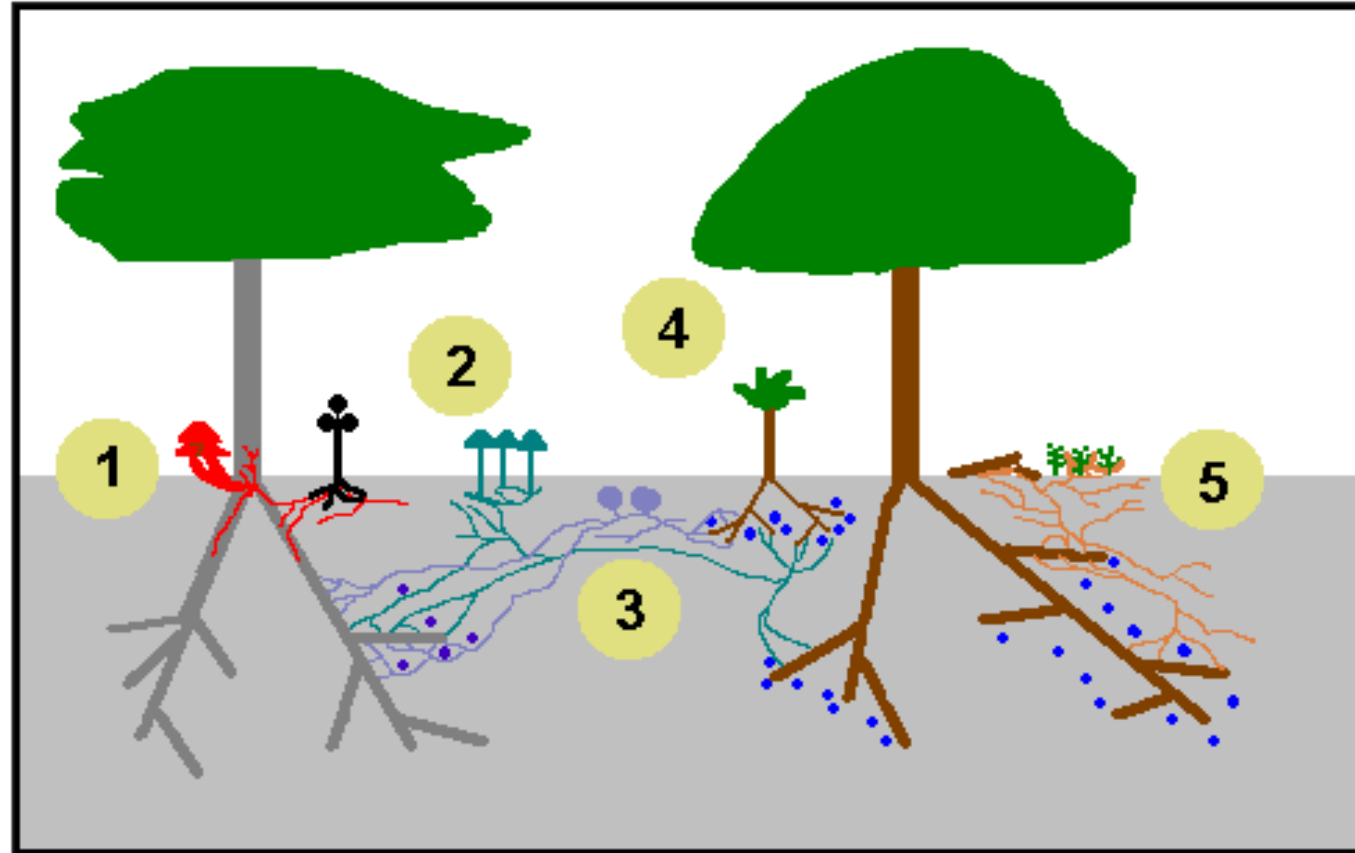
Exudates coming from the root are completely changed as AM colonizes

Plant Sugars

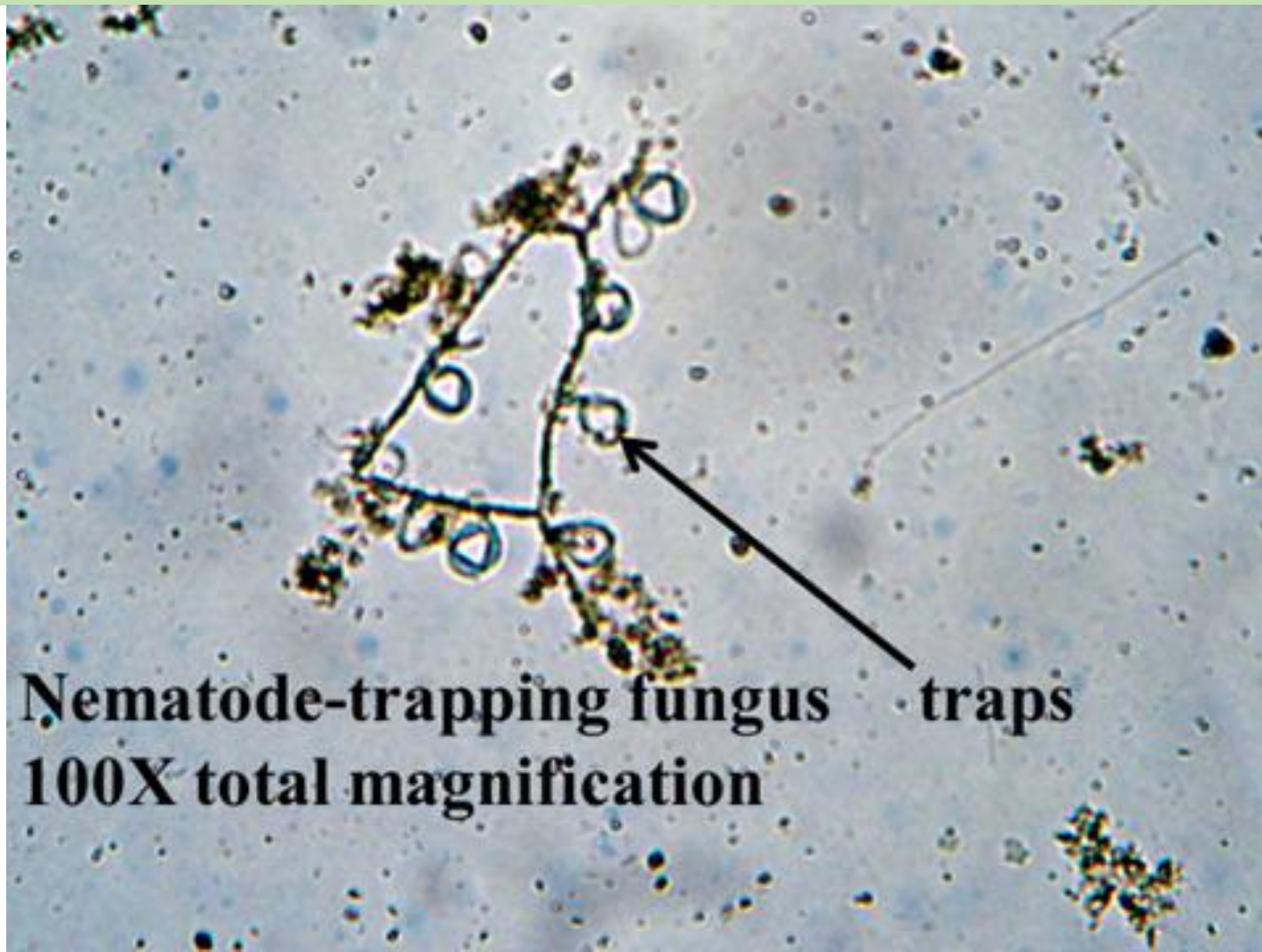
If other infection sites are found, more arbuscles will be made

Ecological Connections

- 1. Black = AM fungus** moving photosynthate from the tree to non-photosynthetic plant (Lady Slipper, orchids) as well as to fruiting structures of the fungus (red)
- 2. Fruiting bodies (mushrooms)** of AM fungus transferring nutrients between “momma tree” and “baby tree” and most likely to tree #2 as well. Blue dots are helper bacteria.
- 3. An Ecto fungus** with truffle fruiting bodies connecting momma tree and baby tree
- 4. The baby tree** can't get enough sunlight to survive on its own, so it needs the photosynthate brought to it by the mycorrhizal fungi
- 5. Another AM fungus** retrieving nutrients from the decomposing log for the plant in exchange for photosynthate.



Nematode Trapping Fungus



Nematode-trapping fungus traps
100X total magnification