

Chapter 4

Soil food Web Microorganisms

Lecture 18 - Fungi

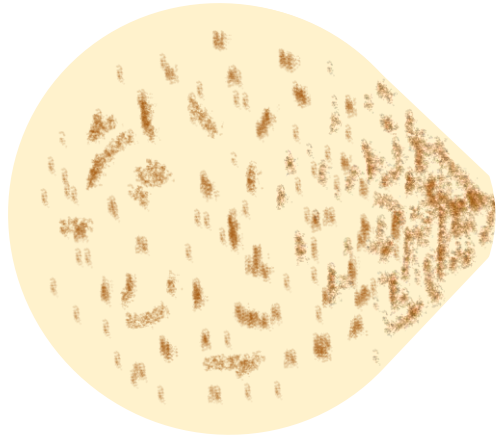


Manual

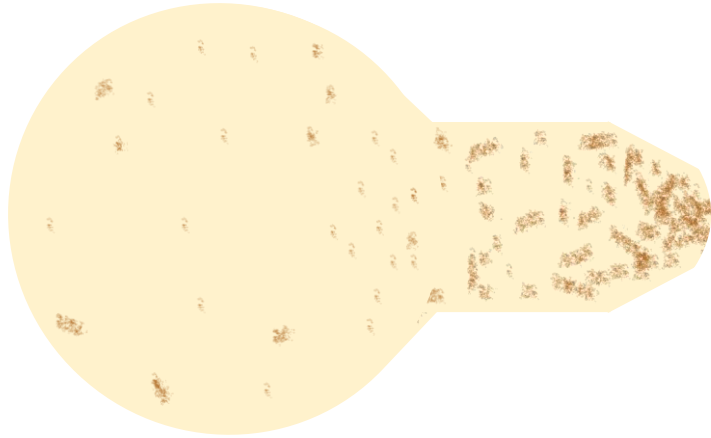
**Bacteria, fungi, humus, aggregates:
400X total magnification**

Characteristics of Fungi

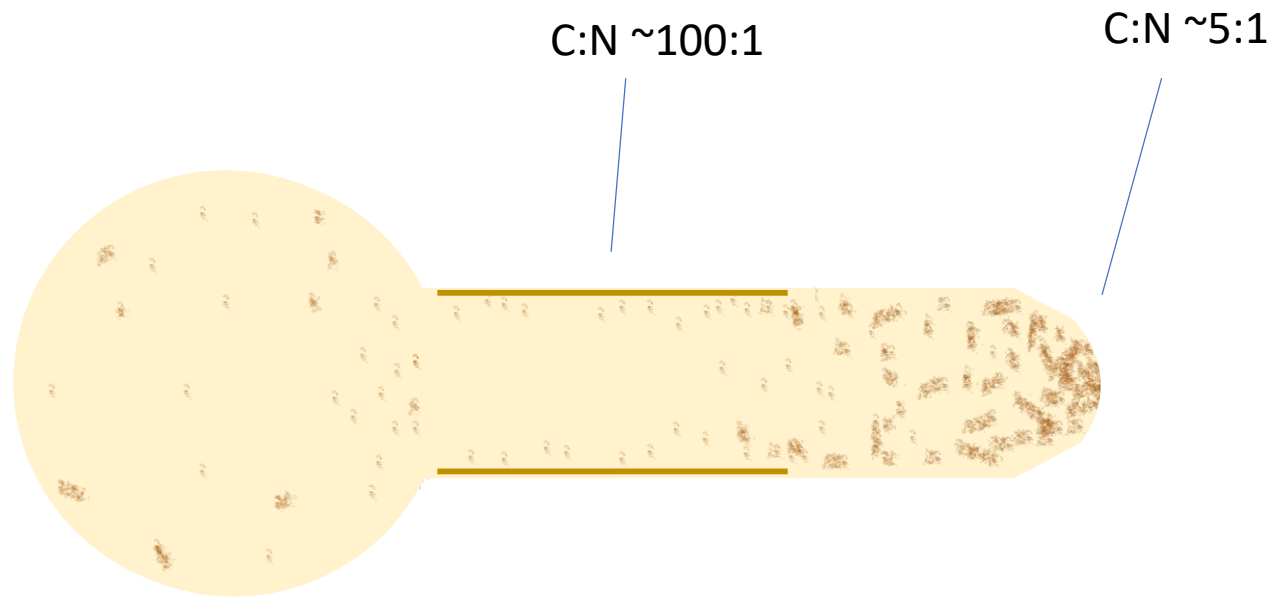
Beneficial Saprophytic Fungi	Mycorrhizal Fungi	Disease-causing Fungi (Oomycetes)
Uniform diameter hyphae	Uniform diameter hyphae	Usually lumpy, cytoplasm appears frothy
Diameter generally $>3.0 \mu\text{m}$	Diameter typically $>3.0 \mu\text{m}$	Diameter $1.5 - 2.5 \mu\text{m}$; rare species wider diameter
Colored hyphae more likely to be beneficial	Many colors , most commonly dark brown	Clear, colorless
Uniform distance septa (cross-walls), clamp connections in Basidiomycetes	May or may not have septa, but if present, uniform distance septa. Colonize roots: Arbuscles exchange nutrients for sugars	Septa, if present, not uniform distances
Dormant Stages: Asexual spores-Sexual Asci with Ascospores or Basidiospores	Dormant stages: Vesicles, Extramatrical Spores	Dormant spores



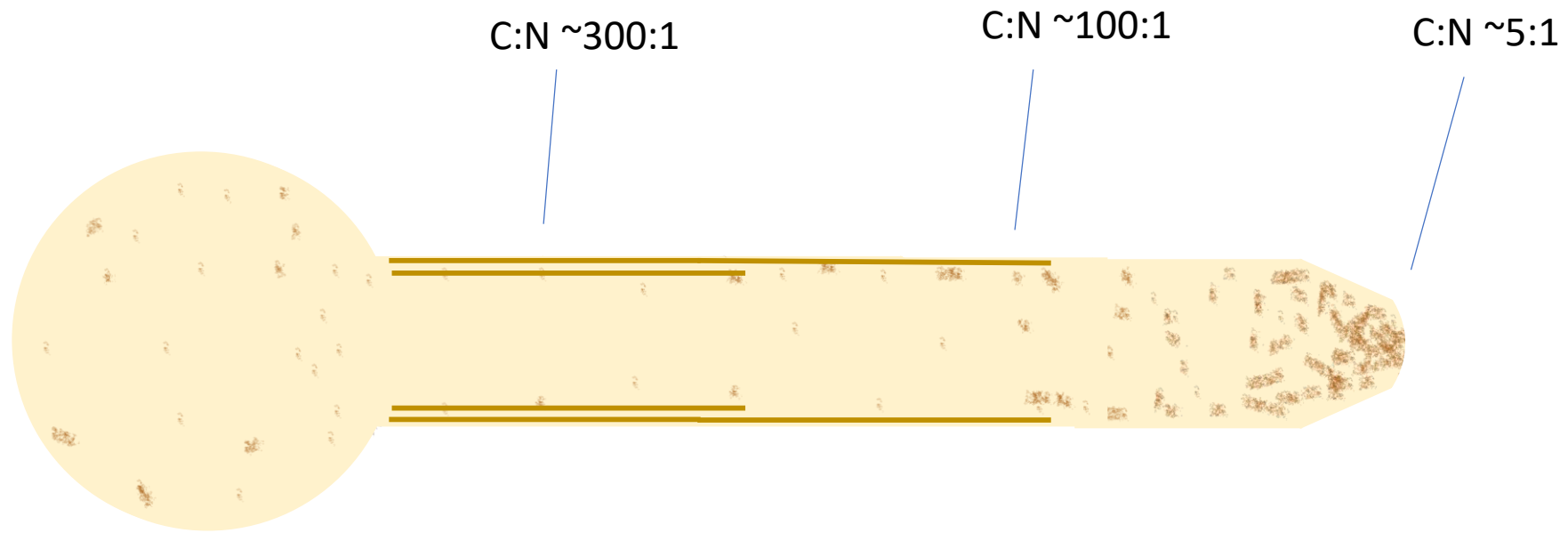
The Hypha begins to emerge from the Fungal Spore



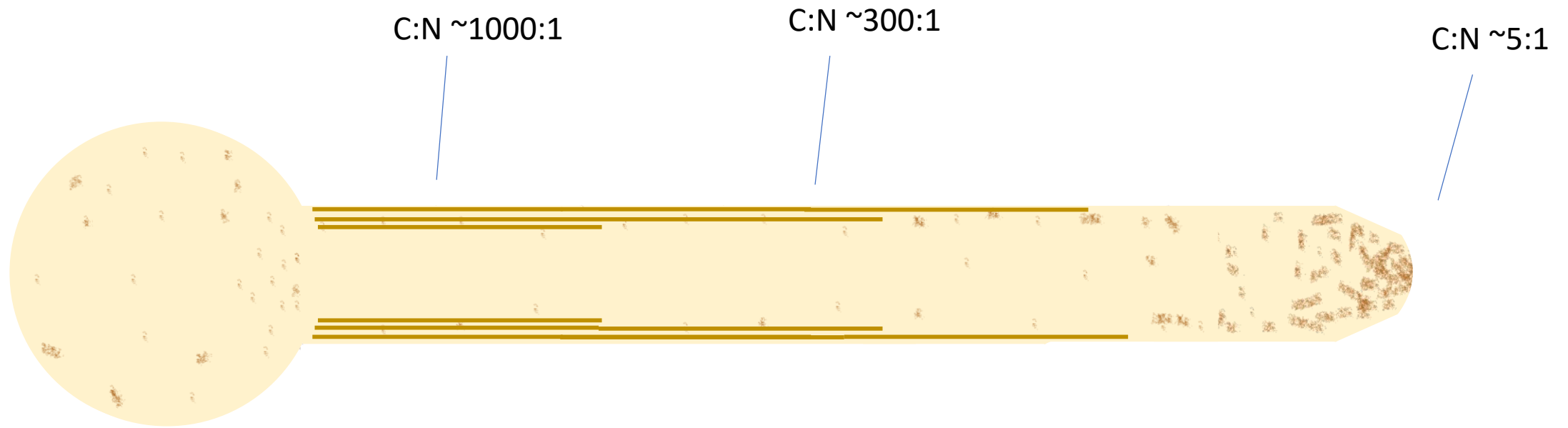
Cytoplasm concentrated in the tip-cell continues to build new cell walls, elongating the hypha



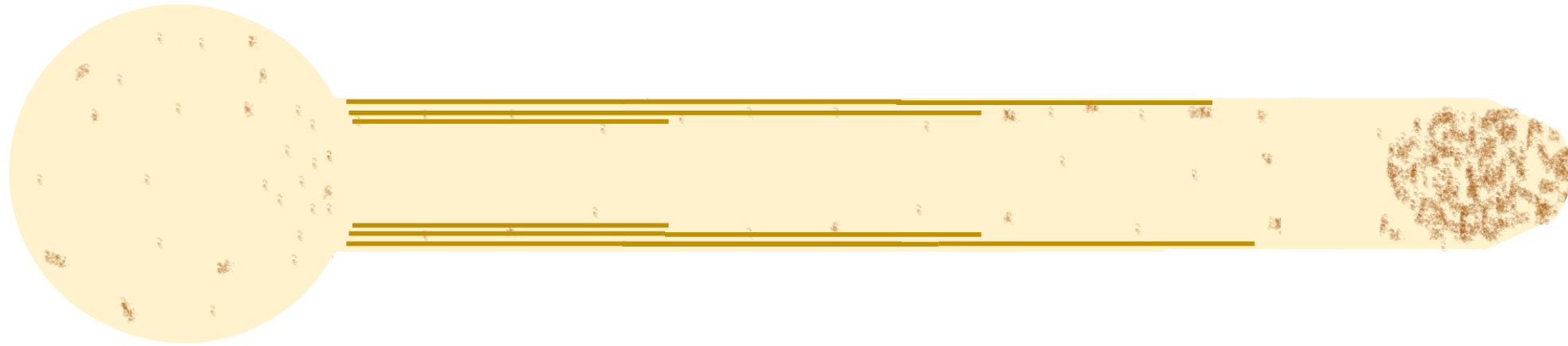
Waste products, rich in carbon, are left behind (mannans and chitin) forming layers of Carbon that increase the thickness of the cell wall.



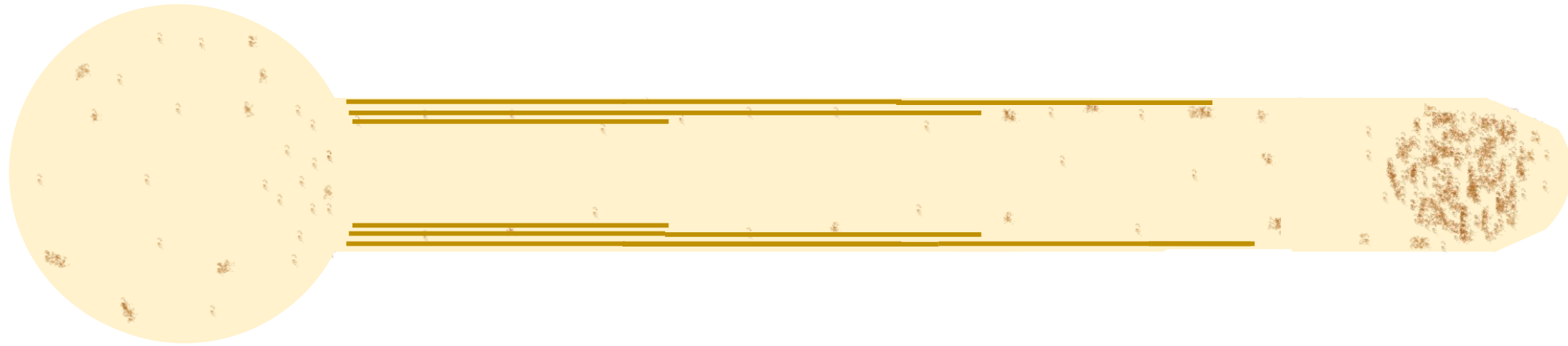
Growth continues and the carbon layers build-up
increasing the C:N and storing carbon potentially for
100s of years



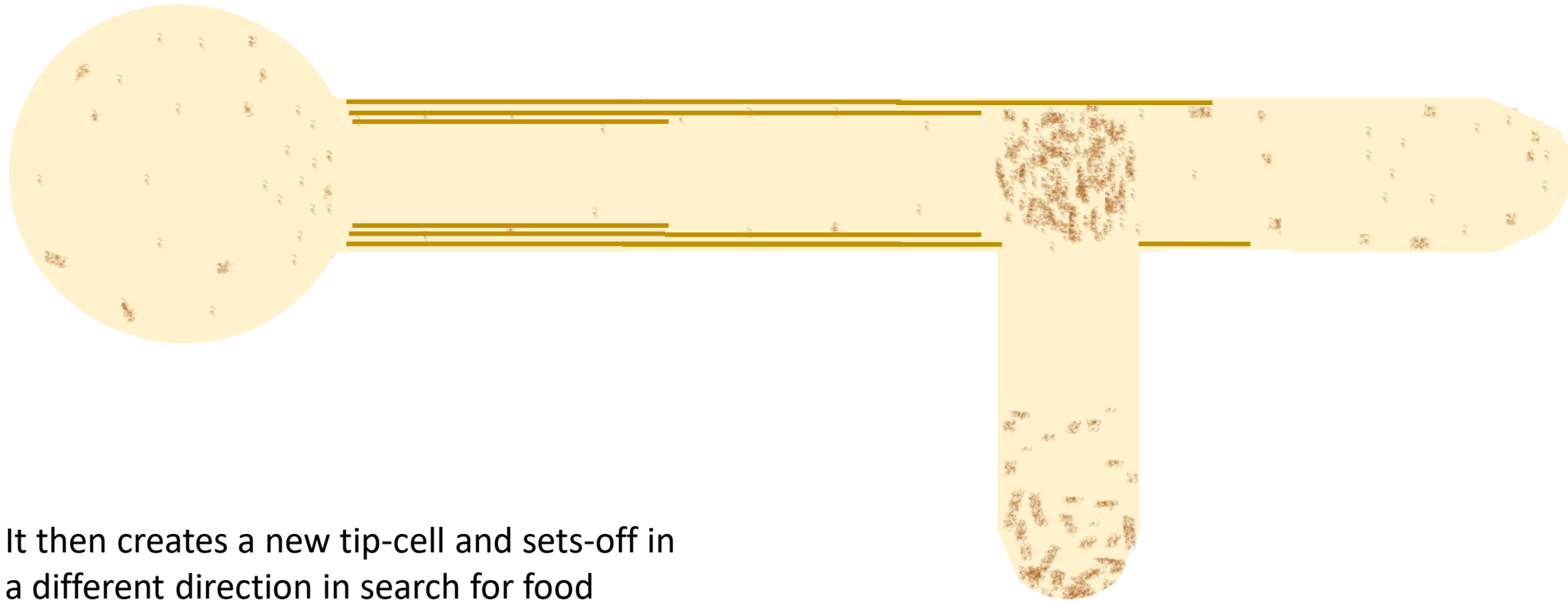
The C:N may reach 1000:1 in the oldest parts of the hypha. Whilst at the tip-cell it is still ~5:1



If food becomes scarce in one place, then the cytoplasm moves back along the hypha...



If food becomes scarce in one place, then the cytoplasm moves back along the hypha...



It then creates a new tip-cell and sets-off in a different direction in search for food

A Beneficial Fungus



400X Total
Magnification

A Beneficial Fungus



Probable Pathogen: Wilt, Blight or Mildew



Borderline Hyphae



400X Total
Magnification

Hypha being attacked by anaerobic bacteria

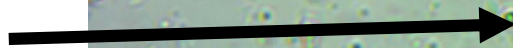


400X Total
Magnification

Basidiomycete

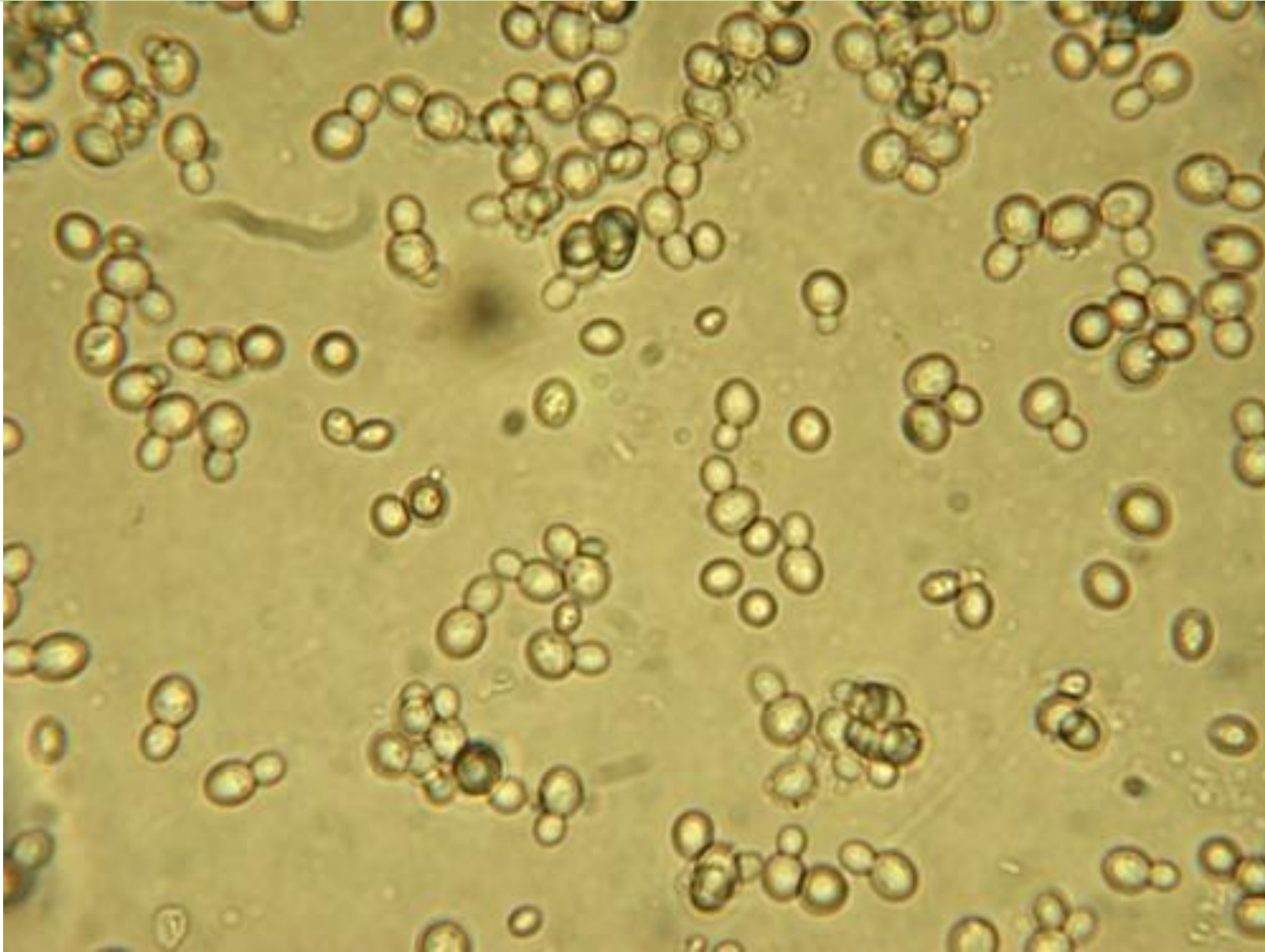


Clamp
Connection




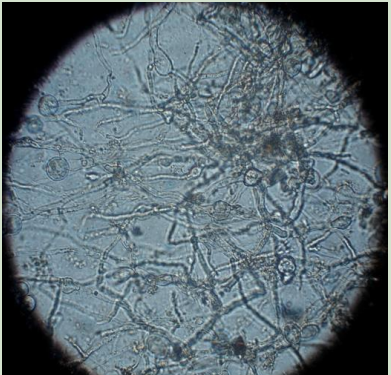


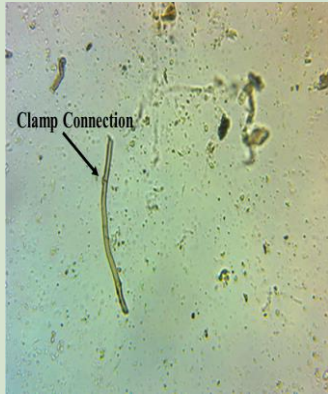
400X Total
Magnification

Brewer's Yeasts



Baker's Yeasts



Filamentous Microorganisms	Actino	Bad Fungi	Ok Fungi	Good Fungi	Great Fungi
Family	Bacteria	Oomycetes (Mildews, Blights & Wilts)	Deuteromycetes	Ascomycetes	Basidiomycetes
Diameter	1 – 1.5 μm	1.5 - 2.5 μm	2.0 - 3.5 μm	2.0 - 3.5 μm +	3.0 - 5.0 μm +
Uniformity (of Diameter)	Uniform	Non-uniform	Uniform	Uniform	Uniform
Characteristics	Flexible, filamentous strands. Looks like a hair. IS NOT MOBILE!	Hyphae typically have random bulges or are swollen.	Flexible, filamentous strands.	Flexible, filamentous strands.	Flexible, filamentous strands.
Growth Pattern	Sometimes form messy/knotty looking clumps	Often forms messy/knotty clumps.	Forms orderly structures, not messy clumps.	Forms orderly structures, not messy clumps.	Forms orderly structures, not messy clumps.
Coloration	Clear, Colorless	Clear, Colorless	Typically colorless	Can be colorless or colored.	Usually colored
Septation	None	Adventitious, non-uniform	Adventitious, non-uniform	Only in best examples (will be uniform)	Yes, in most cases (will be uniform)
Oxalates	None	None	Very Rarely	Possible	On the best examples
Picture					

Filamentous Fungi - Mycelium



Beneficial Fungi - Mycelium



Fungal Function	Explanation
<p>Reproduction</p>	<p>Fungi grow at the tip, elongating the hypha as the fungus takes up and accumulates nutrients and energy. With adequate food resources, each hypha will branch, and branch again, doubling the growing tips, doubling the growth rate each time a new branch is formed.</p>
<p>Decomposition</p>	<p>Fungal enzymes are best at decomposing complex foods (C:N ratios > 60:1). “Sugar fungi” will try to compete with bacteria for simple substrates, but bacterial enzymes are much more efficient on simple sugars, and the bacteria win. However, fungi win in competition with bacteria for the more complex foods. Early in succession, there are few complex foods present, so bacteria predominate. Later in succession, complex foods abound, and thus fungi predominate.</p>
<p>C:N</p>	<p>The C:N of fungi vary between 5:1 in the tip cell to 100 to 1000:1 in older hyphae. As fungi grow in conditions where competition with bacteria force use of wide C:N organic matter, the “excess” carbon is stored in the fungal hyphae and NOT released as CO₂. Fungi behave quite differently when they are grown on rich media in the lab, so soil decomposition models that rely on lab data have badly mislead officials and the public about how much carbon can be stored in soil.</p>

Fungal Function	Explanation
Predation	<p>Fungi are consumed mainly by fungal-feeding nematodes, micro and macroarthropods, and earthworms. These predators focus on tip cells of fungi high in nutrients. Predators do not need the high concentration of nutrients as is present in fungal biomass, so predators release the excess nutrients in a soluble, plant available form (the “poop loop”). These predators lack enzymes to decompose the high carbon fungal cell walls, and leave that material for fungi to decompose. Fungi will further condense these complex organic materials into even more complex organic forms, such as olmic, fulvic and humic acids.</p>
Dormancy	<p>Different fungal groups produce different types of spores, from structurally simple asexual spores, to more complex spores produced by sexual reproduction. All of these spores can resist severe environmental disturbance, depending on intensity and duration of the disturbance. Fungi generally require more time than bacteria to respond to extreme conditions, produce fruiting structures, and form spores. Spores can survive for several hundred years, although extreme fluctuations in conditions result in poorer survival rates.</p>