# Soil Biology Masterclass 2021

# **Soil biology - links to soil structure**

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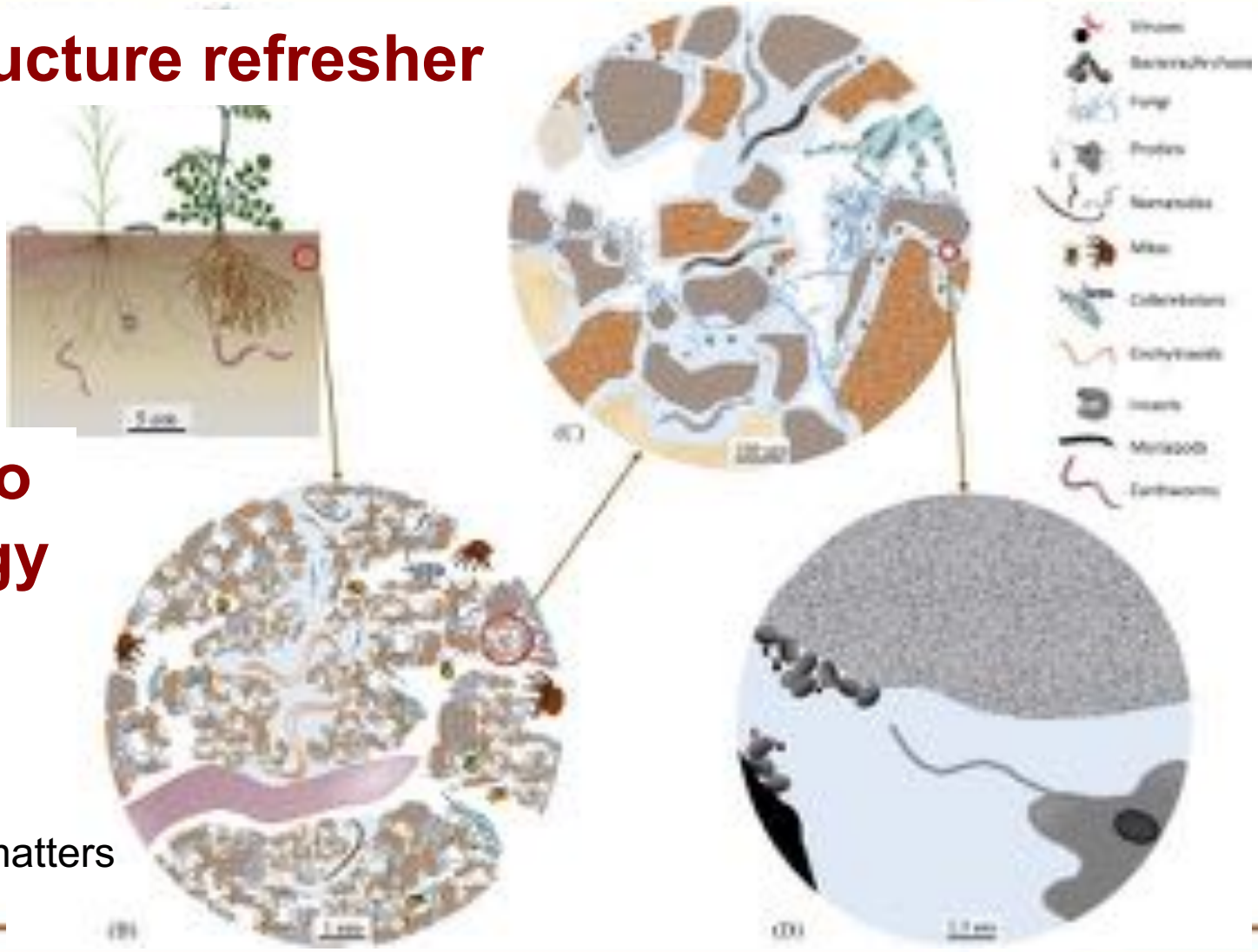
# What I will cover

## 1- Soil structure refresher

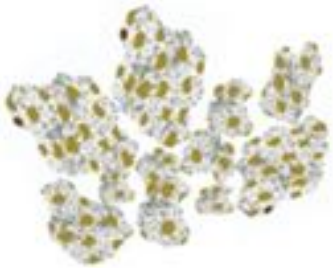
## 2 - Links to soil biology



Organic matter matters

# Broad categories of soil structure

Granular (high permeability)



Aggregated (high permeability)

This is what we want:

Aggregates that are stable to wetting

Blocky (moderate permeability)

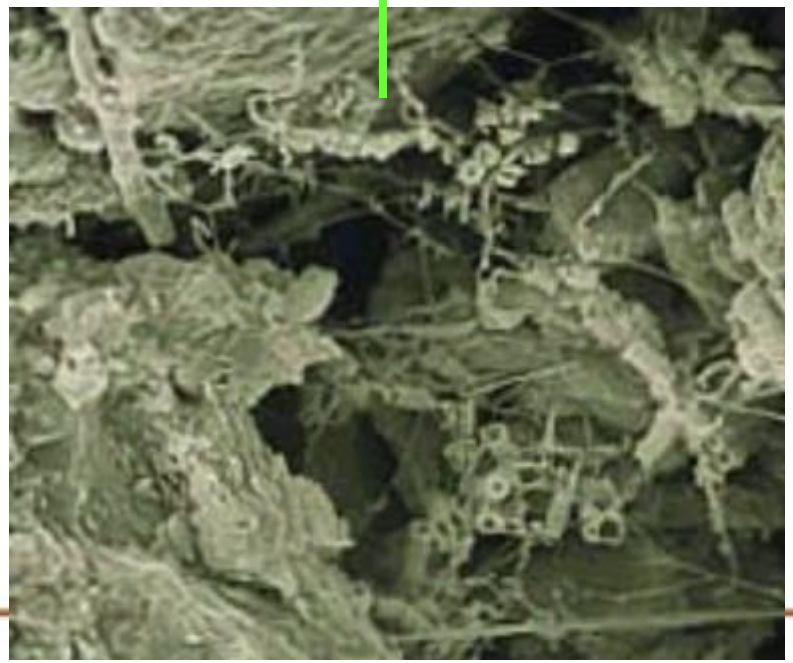
Columnar/prismatic (moderate permeability)

Platey (low permeability)

Massive (low permeability)

Soils have individual structure limitations based on soil type and texture

GOOD

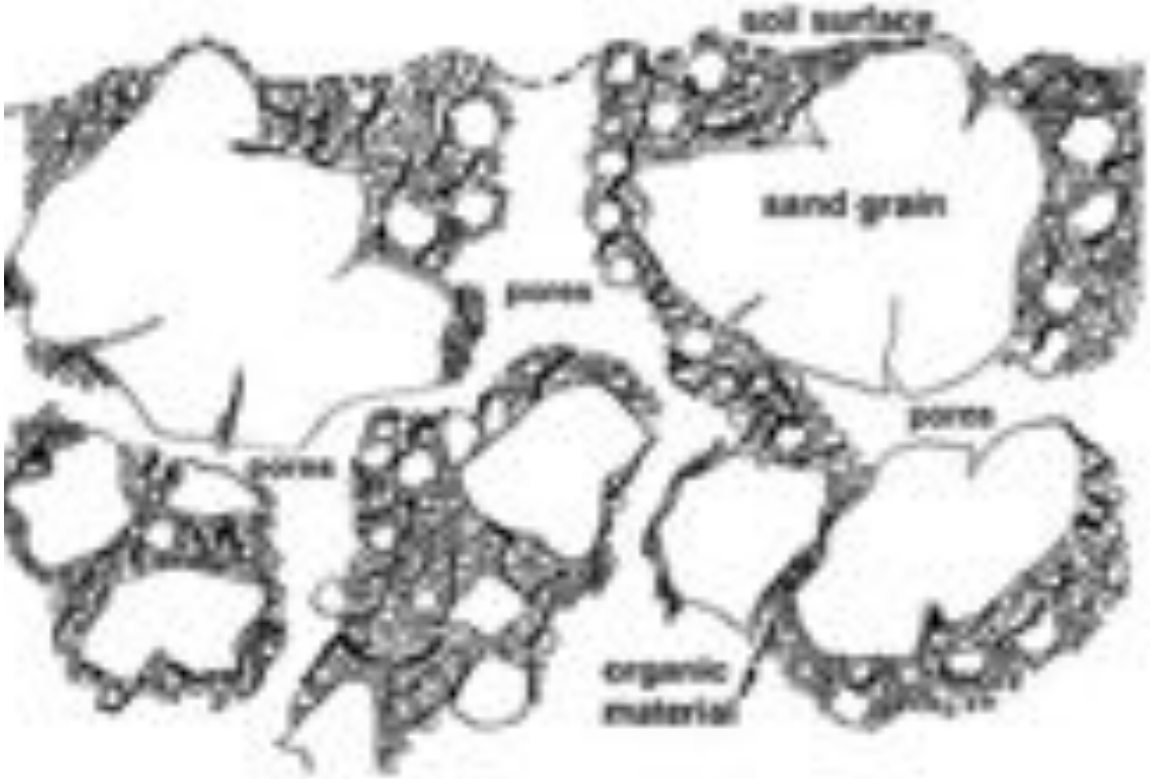


STRUCTURE

POOR

# Action happens in pores

Soil life creates and stabilises pores = aggregation

# Soil aggregation overview

A. Aggregate

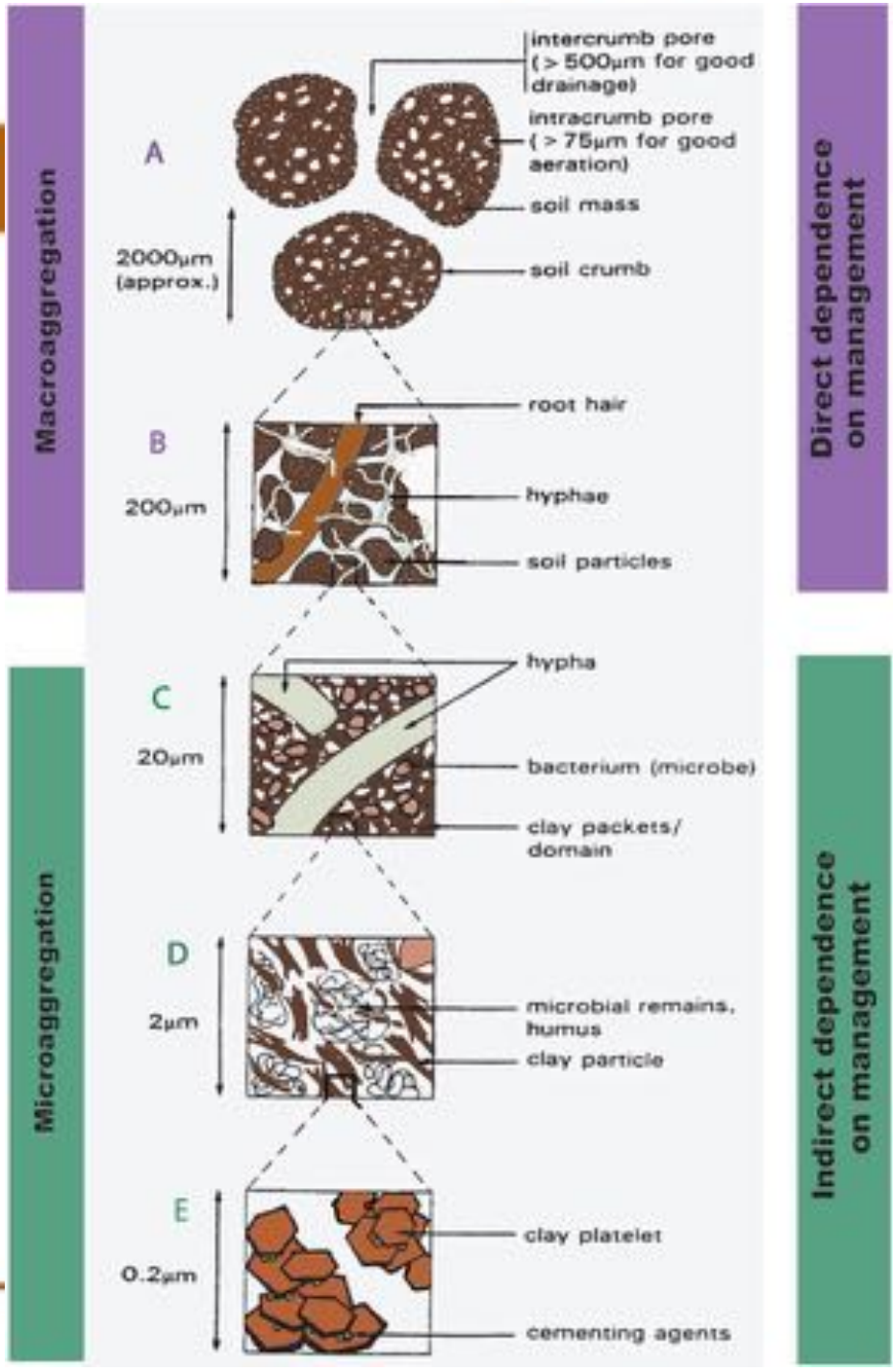
B. Plant roots, fungal hyphae; with short- to medium- term persistence

C. Decayed roots and fungal hyphae; with longer-term persistence

D. Microbial remains and humus; with longer-term persistence.

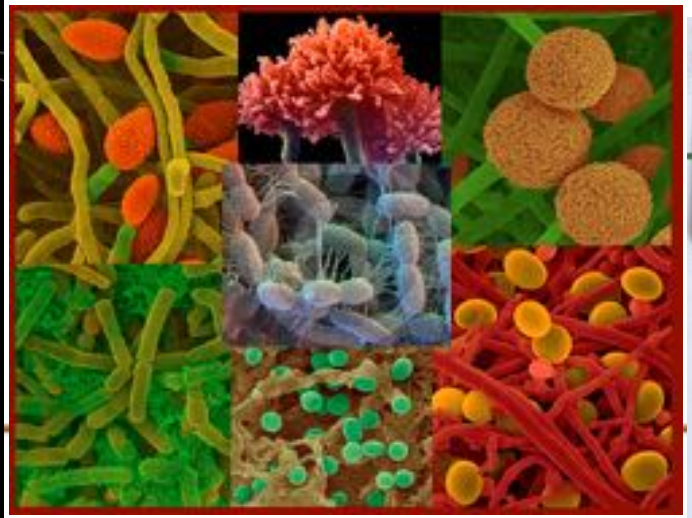
E. Adsorbed humic substances, hydrous oxides; with very long-term persistence

Soruce: Tisdall and Oades (1982).



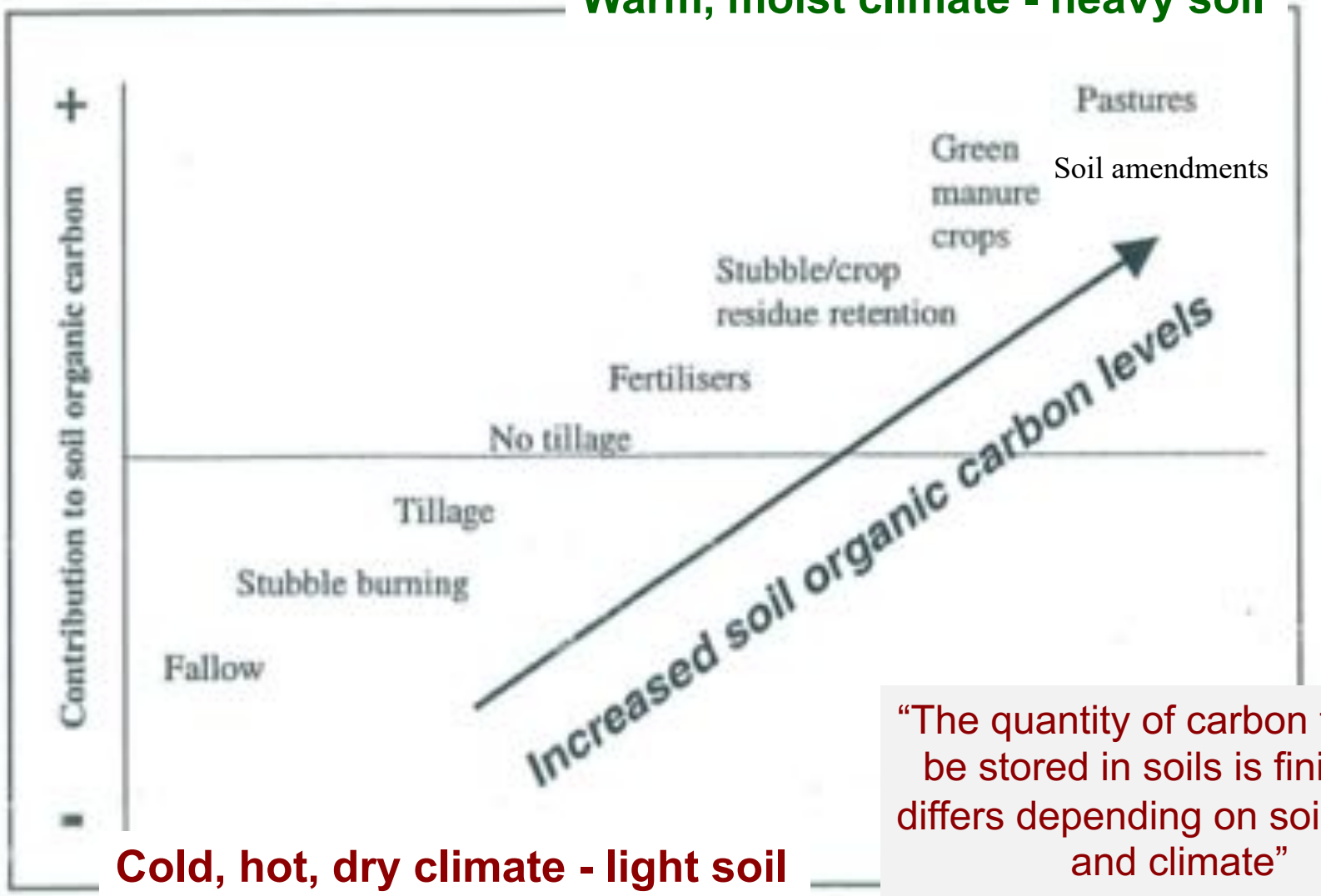
# Organic Matter drives soil biology

- **Biological** - OM is a food source for soil biology, nutrient cycling & holding, **binds soil particles**
- **Physical –** OM and soil biology build and maintain soil structure (less compaction and erosion), better water infiltration & holding capacity, drainage & aeration, soil temperature, root penetration
- **Chemical –** OM has high cation exchange capacity (CEC), supports nutrient cycling, and pH buffering, OM provides binding sites for pesticides & heavy metals.



# Organic Carbon - does and don’ts

**Warm, moist climate - heavy soil**




**Cold, hot, dry climate - light soil**

“The quantity of carbon that can be stored in soils is finite and differs depending on soil texture and climate”

# Soil biology building Soil Structure

Ecosystem engineers – invertebrates (e.g. ants and earthworms, termites )

They break down OM and alter the physical structure of soil, they:

- initiate fragmentation of organic residues and
- take OM deeper into soil profiles
- create pores that allow water and plant roots (as well as other soil biota) access to deeper parts of the profile.

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# Soil biology building Soil Structure

Litter transformers – small invertebrates (e.g. mites, springtails)

- further fragment plant residues and other organic substances
- make this material more available to microbes by increasing residue surface area for further chemical degradation and nutrient cycling.

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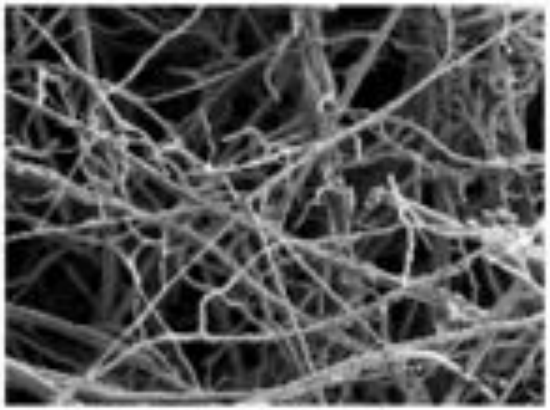
# Soil biology building Soil Structure

## Micro-food web processors - Soil microbes

- They work at all levels in micro-food webs:
  - transferring energy from one organism to another
  - Cycling nutrients through the soil e.g. bacteria, and fungi decompose plant litter and are in turn eaten by predatory protozoa, nematodes and small invertebrates, nutrients become available to roots
  - Bacteria and fungi produce a variety of ‘glues’, using easily available carbon substrates from fresh residues and roots, helping the formation of aggregates. Fungal hyphae stabilise aggregates.

Bacterial colony



Fungal hyphal network

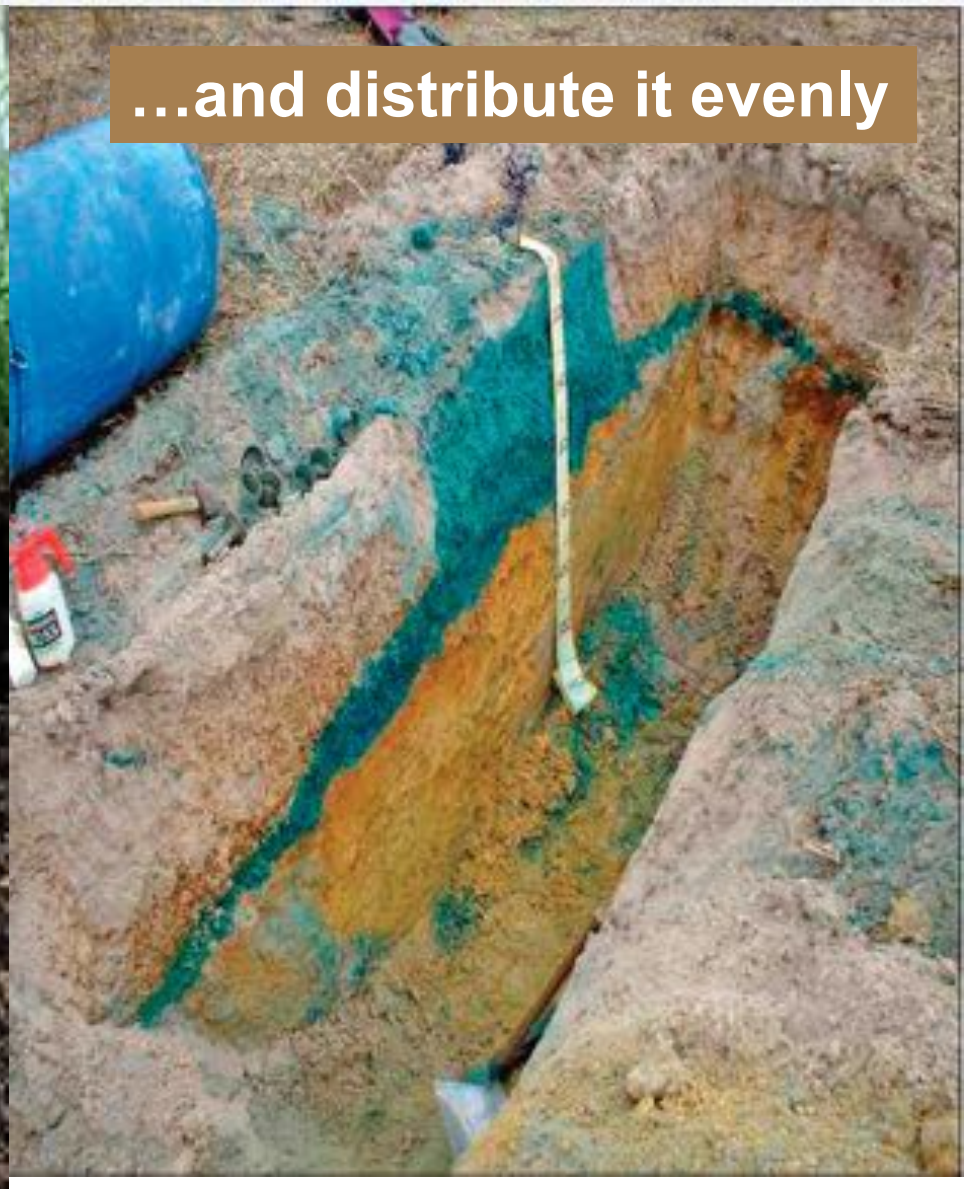
Fungal spores forming at the terminus of hyphae



Compacted soil

Friable soil

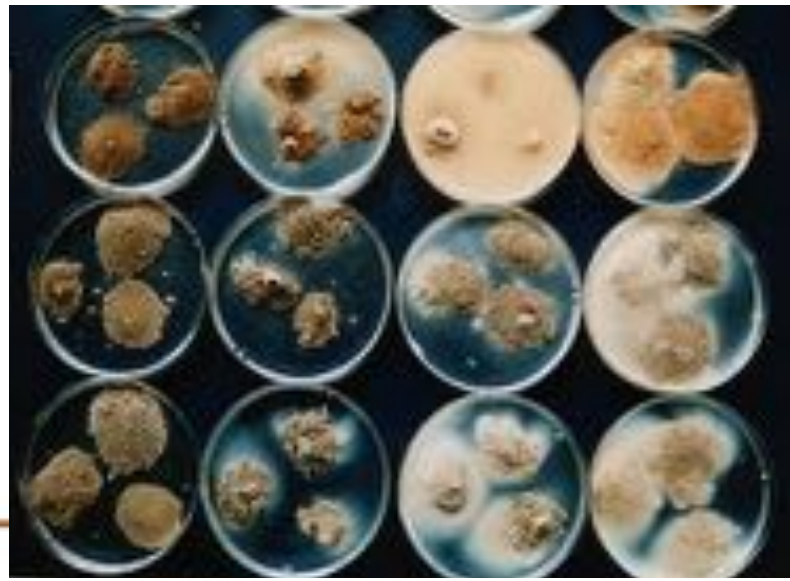
# Well structured soils hold more water..



…and distribute it evenly

# Soil structure indicators

1. Penetration resistance - Resistance to root growth
2. Aggregate sizes - Water & air holding capacity
3. Aggregate stability - Resilience under pressure
4. Dispersion - Sodicity (Ca need)
5. Bulk density - Compaction
6. Slaking - Organic matter need
7. Infiltration Rate – Drainage
8. Soil Texture - Nutrient holding



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# Thank You