Chapter 1
Understanding Soil

Lecture 5 – What went wrong, the History of Agriculture

When did we start degrading our soils?

Plato 400 BC

“the land was the best in the world,” and “in comparison of what was then was, there are remaining only bones of the wasted body.”

There are parallels to be drawn with the first European settlers in the Americas who were astounded by the fertility of the soils they found in the new world.

What went wrong?

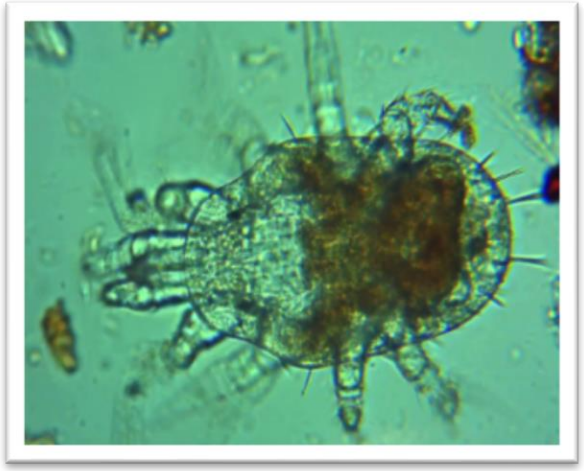
- Something changed
- No chemicals were used by the ancient Greeks
- So what ***did*** they do that reduced soil fertility?
- We know they used the plough….
- What gets ***disturbed*** when you plough a field with a bull?
- What gets ***annihilated*** when you plough a field with a 400hp tractor?

*What **was** in the soil that was no longer there????*

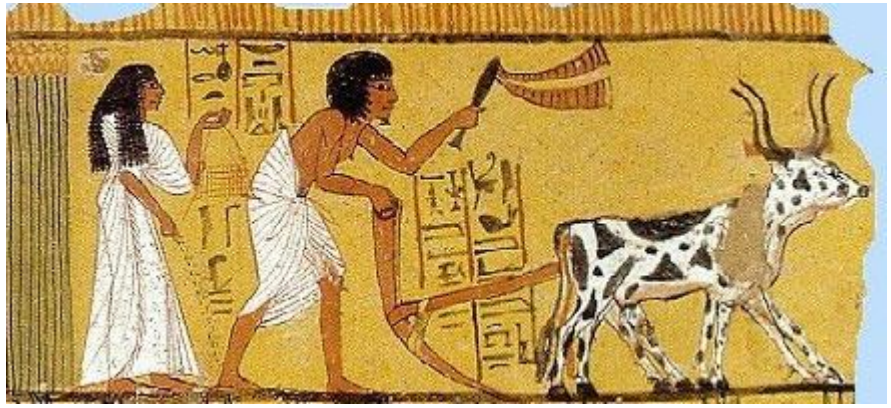
What dies when you plow a field?

- Fungi
- Nematodes
- Microarthropods
- Earth Worms

  and more….



1000 BC



How many times a year do you till the soil if you have to push the plow into the ground, keep the animals pulling the plow, and keep them going in a straight line? Once a year!

How many acres can you plow a day by hand? Less than an acre?

But still they, eventually, destroyed their soils.

One tillage a year to make the seed bed……

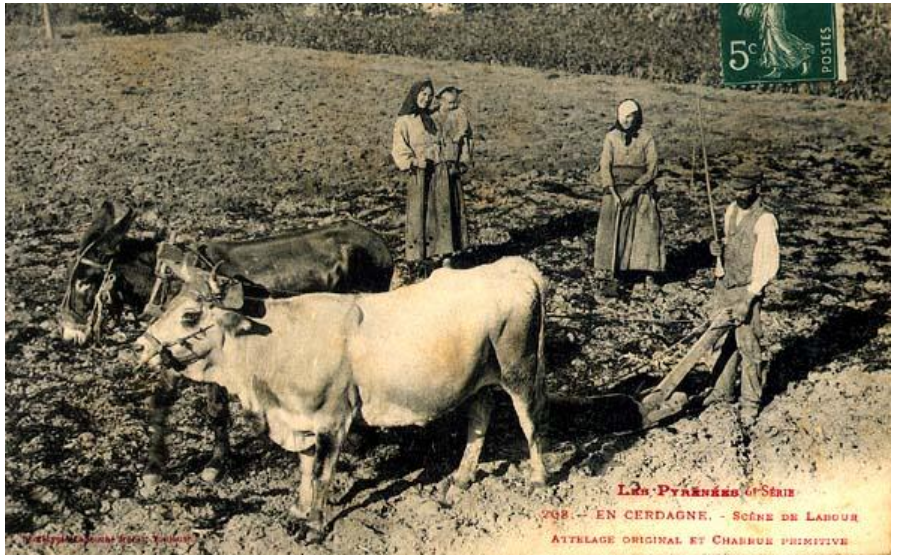
Damage to the life in the soil is minimal with only one tillage a year. Recovery of the organisms killed by slicing and dicing happened.

But, other disturbances harm the organisms. Organic matter starts to be depleted (Cole et al, 1984) through tillage and inadequate return of organic matter to the soil.

As the food to feed the organisms is lost, soil life slowly decreases

Salts build up….

Manure and other debris was applied to fields to reduce the loss of organic matter.



Salts build up from use of manure and poorly composted materials. Crop production decreased and often failed. Soil was horribly compacted and weeds were out-of-control.

Dr. David Montgomery documented this downward spiral in every failed civilization.

Mechanical Tillage

Mechanical tractors allow more acres to be tilled more often.

Eight or more tillage events became common to remove weeds, till-in residues and to keep fields level.

Believing they were controlling weeds, they set the stage for worse weeds.

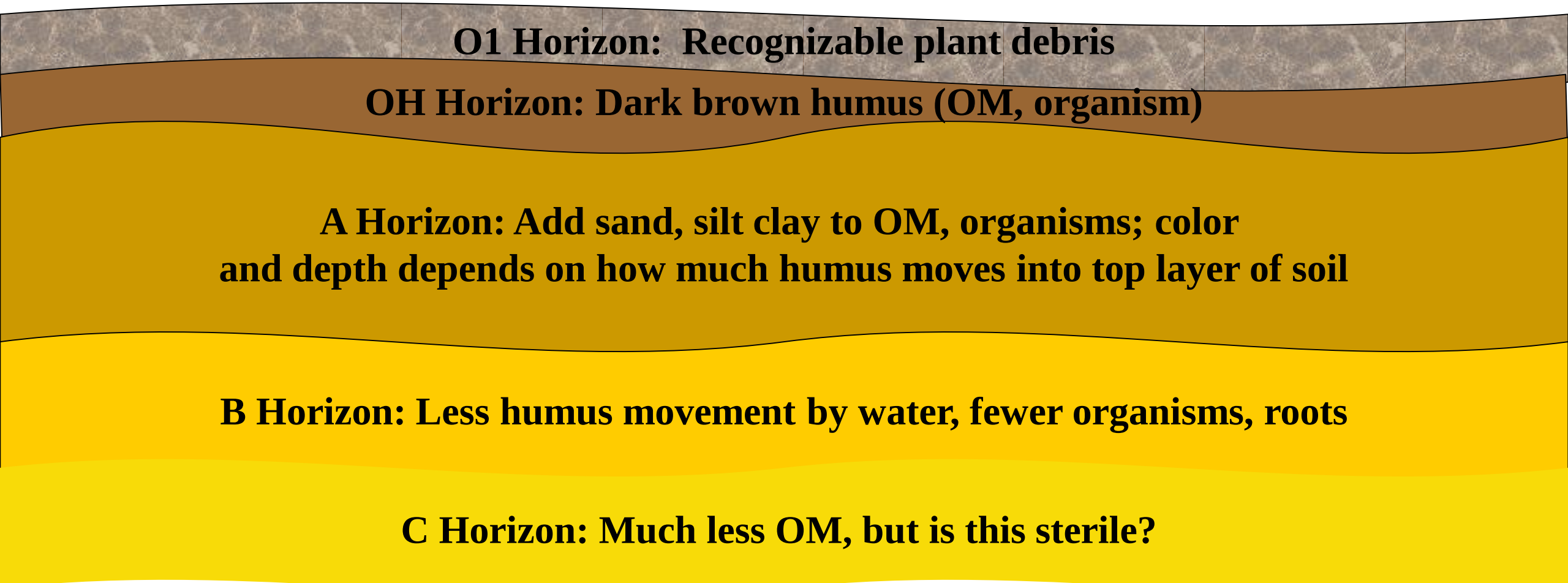
Destroying soil life meant no plant available nutrients produced and inorganic fertilizers became necessary.

Why did we think the Green Revolution worked?

Because we had already killed
all the beneficial organisms in the soil by using

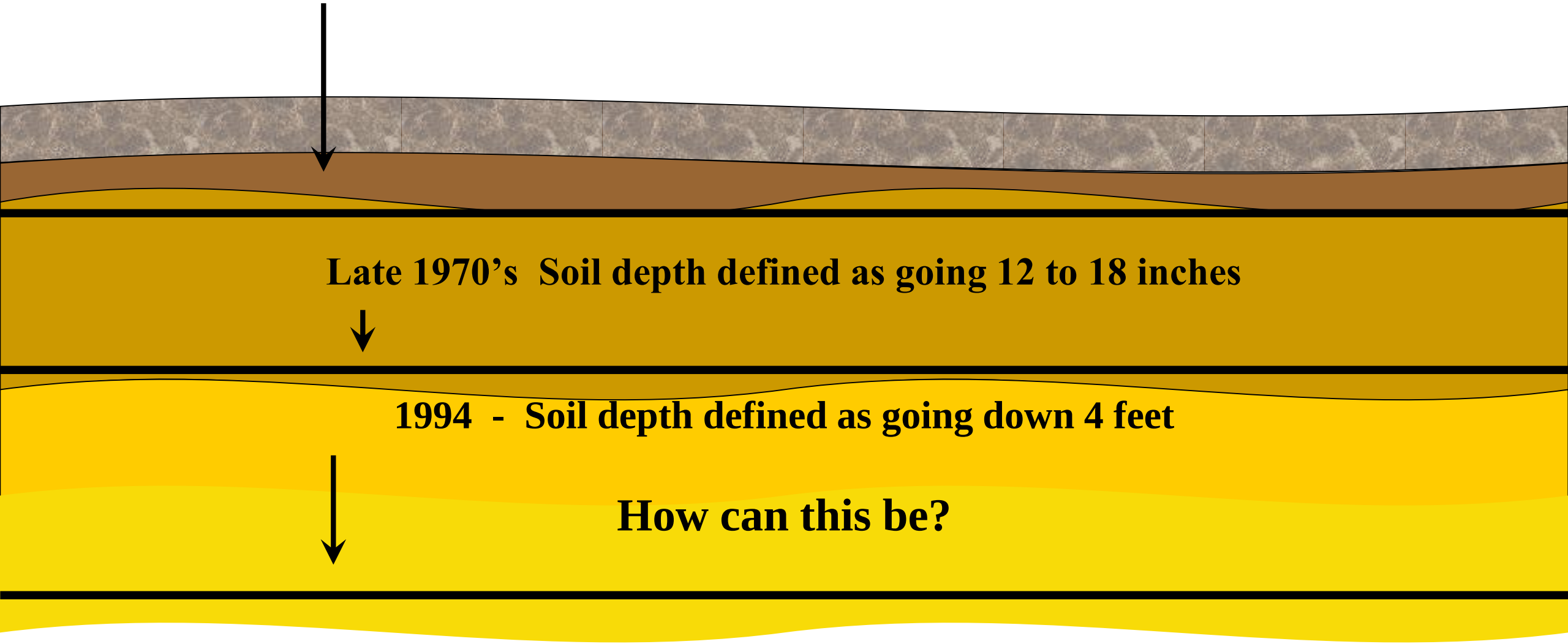
- Tillage
- Toxic Chemicals
- Inorganic Fertilizers

Soil Horizons



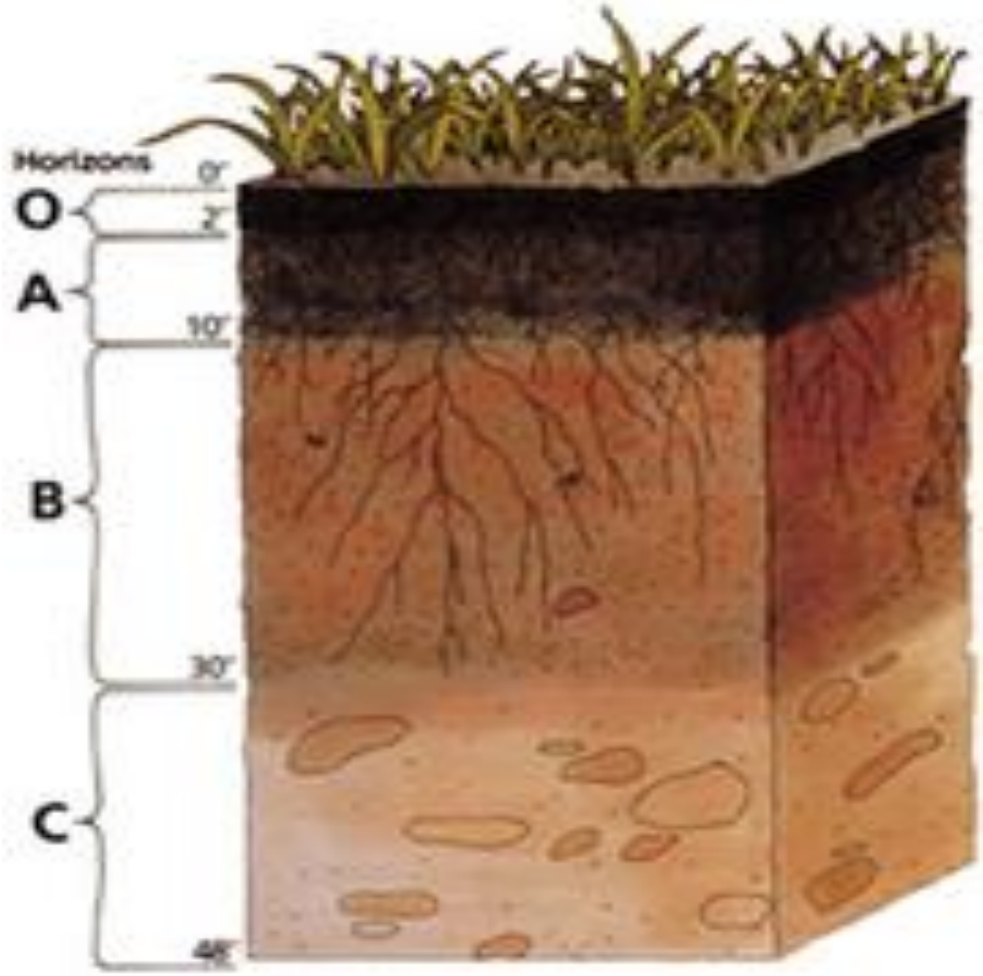
The USDA wrongly discovered that tilling deeper was beneficial

1940 – 1950 Soil depth defined as going to 4 to 6 inch depth



Undisturbed Soil

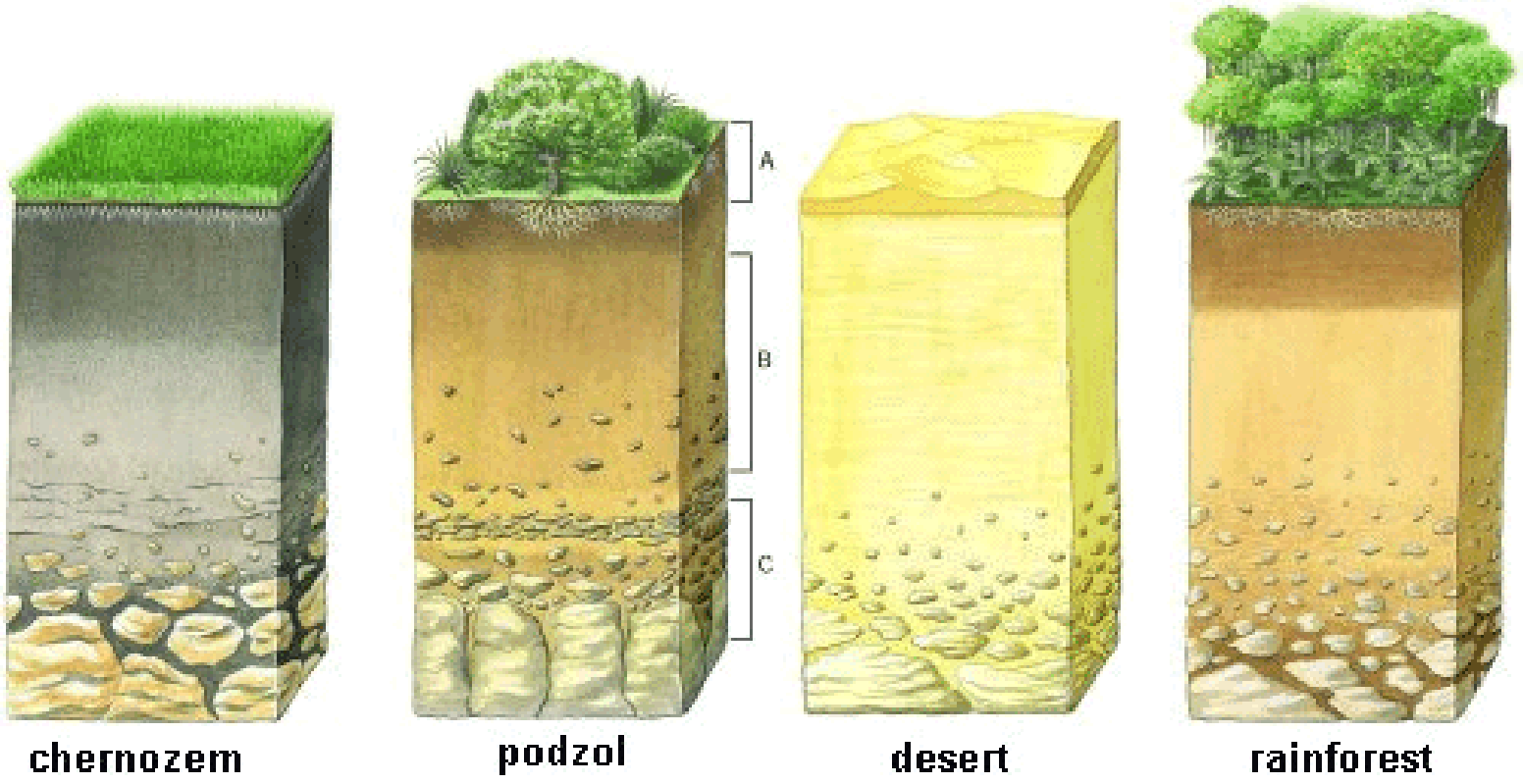
Undisturbed
Soil Horizons



Soil Profiles

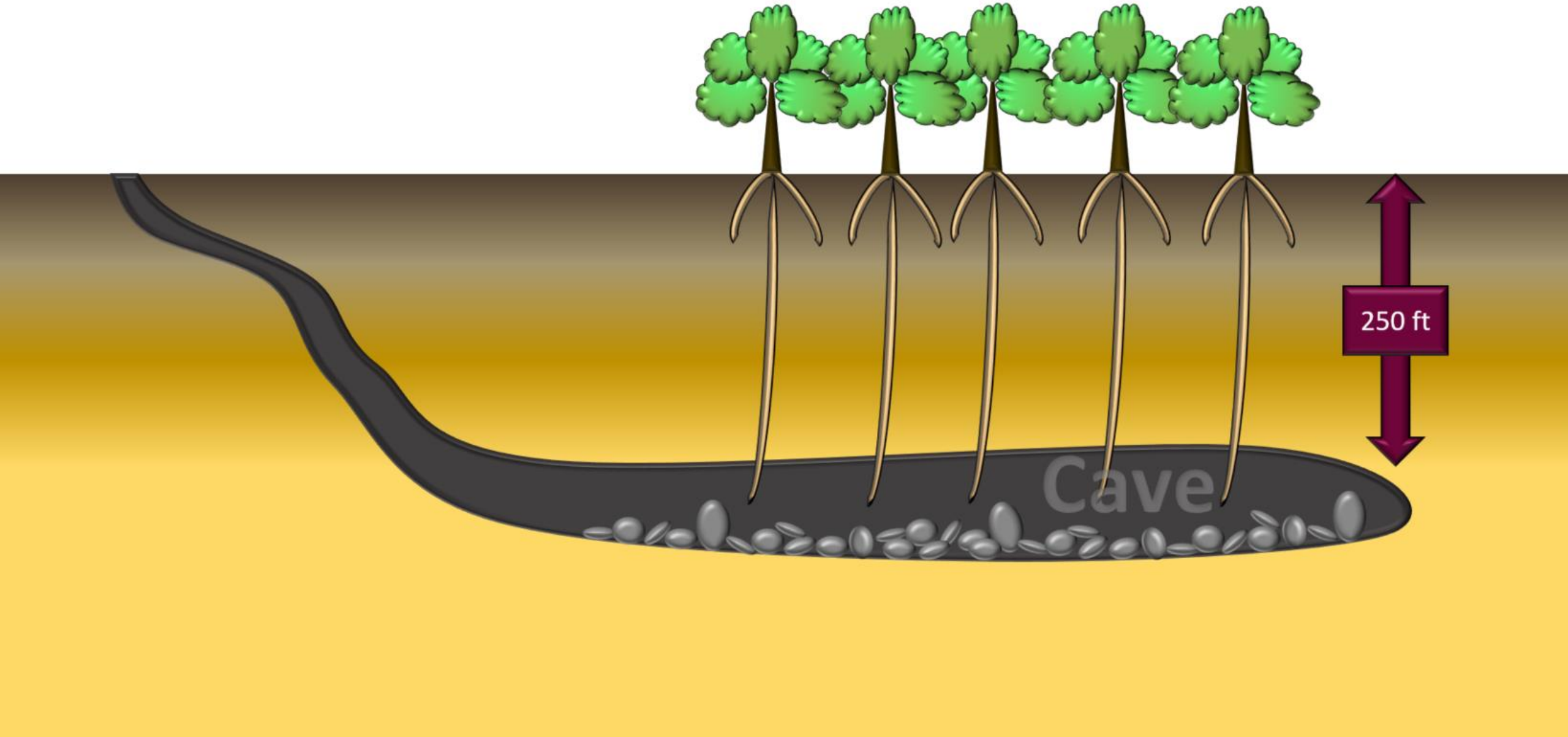
Soil profiles, or horizons (O, A, B, C) are slightly different in different climates, but all require soil life to develop.

Note incorrect root depths in all pictures.



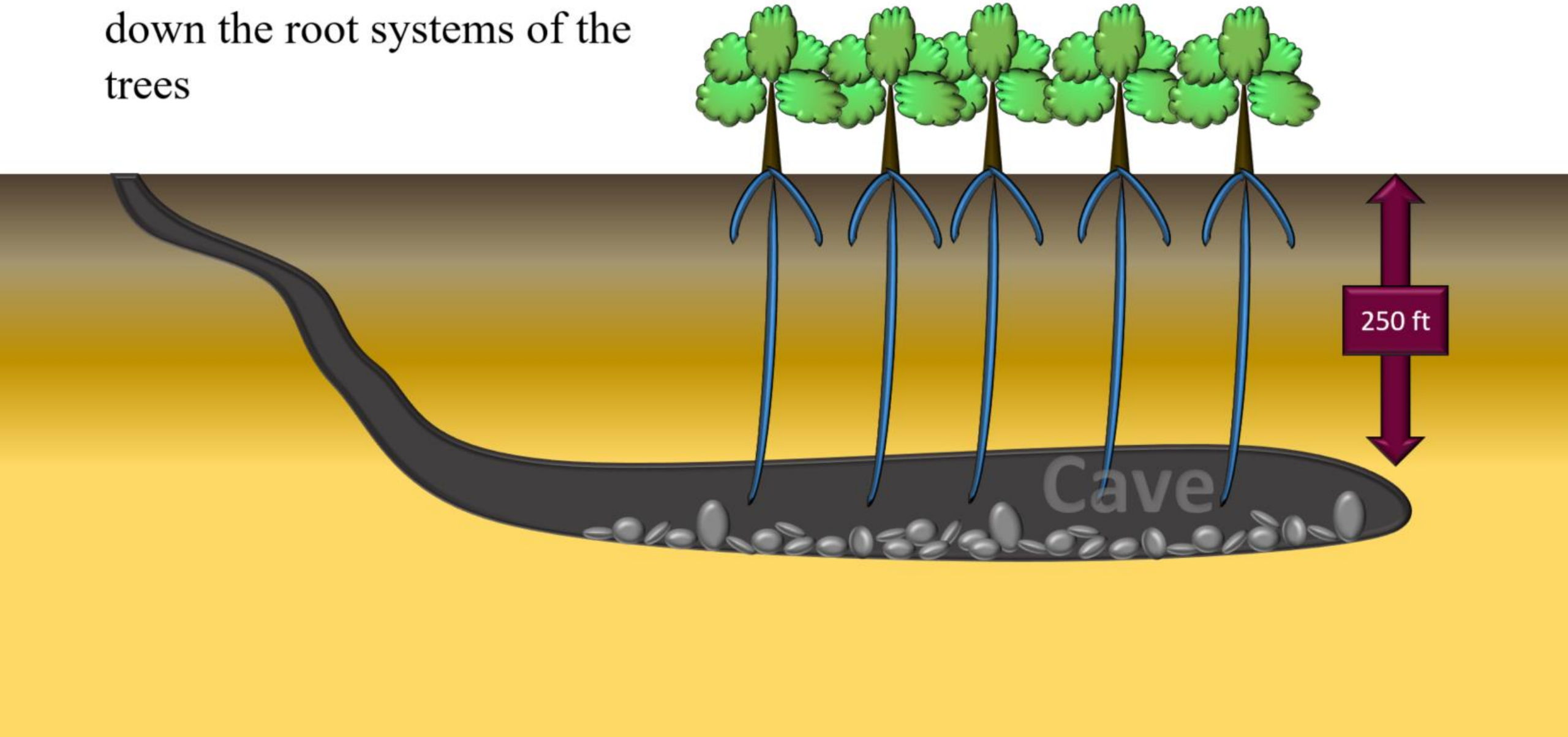
Proof that roots can travel deep

Blue dye is injected into the trees at ground level

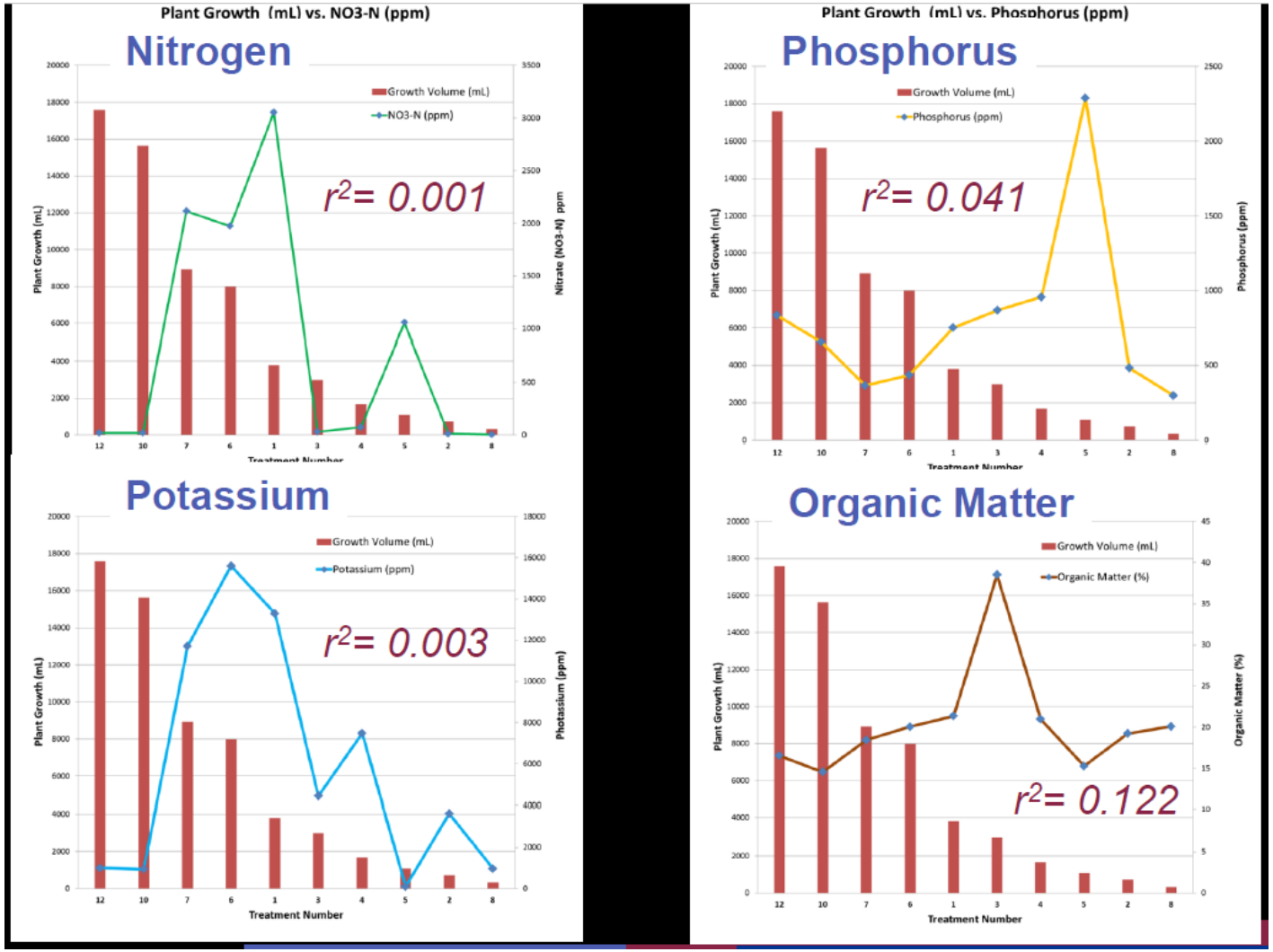


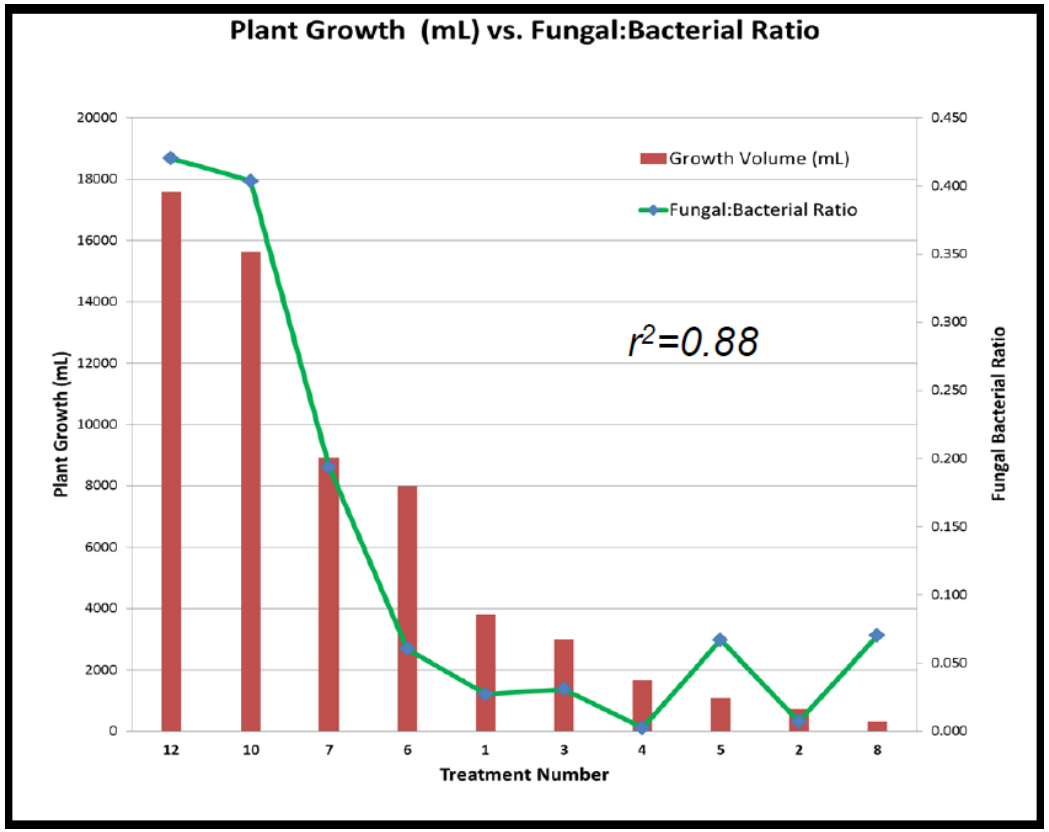
Proof that roots can travel deep

It takes the blue dye only 3 minutes to travel 250 ft down the root systems of the trees



Does the SFW really work???





Work done by Dr David Johnson NMSU

MVOA Ukraine Barley 2009

Metric	Control	Extract
Weeds/m^2	40-44	12-15
Tillers/Plant	1.6	2.8
Seeds/Seed Head	30	36
Plant Height	1m	1.25m
Compaction Depth (150psi)	4.5cm	15-24cm
Root Length at Heading	3cm	6-10cm