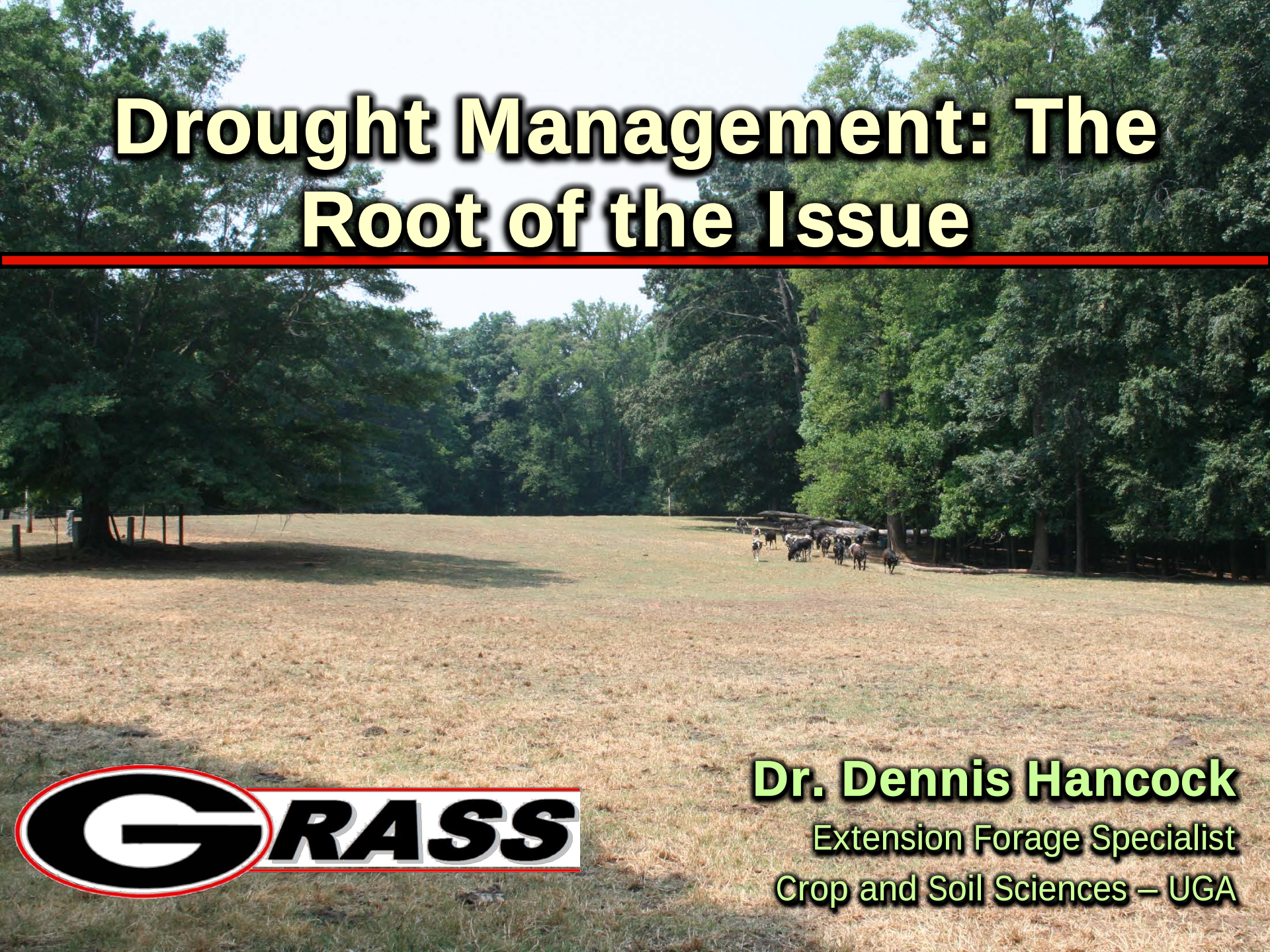
Drought Management: The Root of the Issue



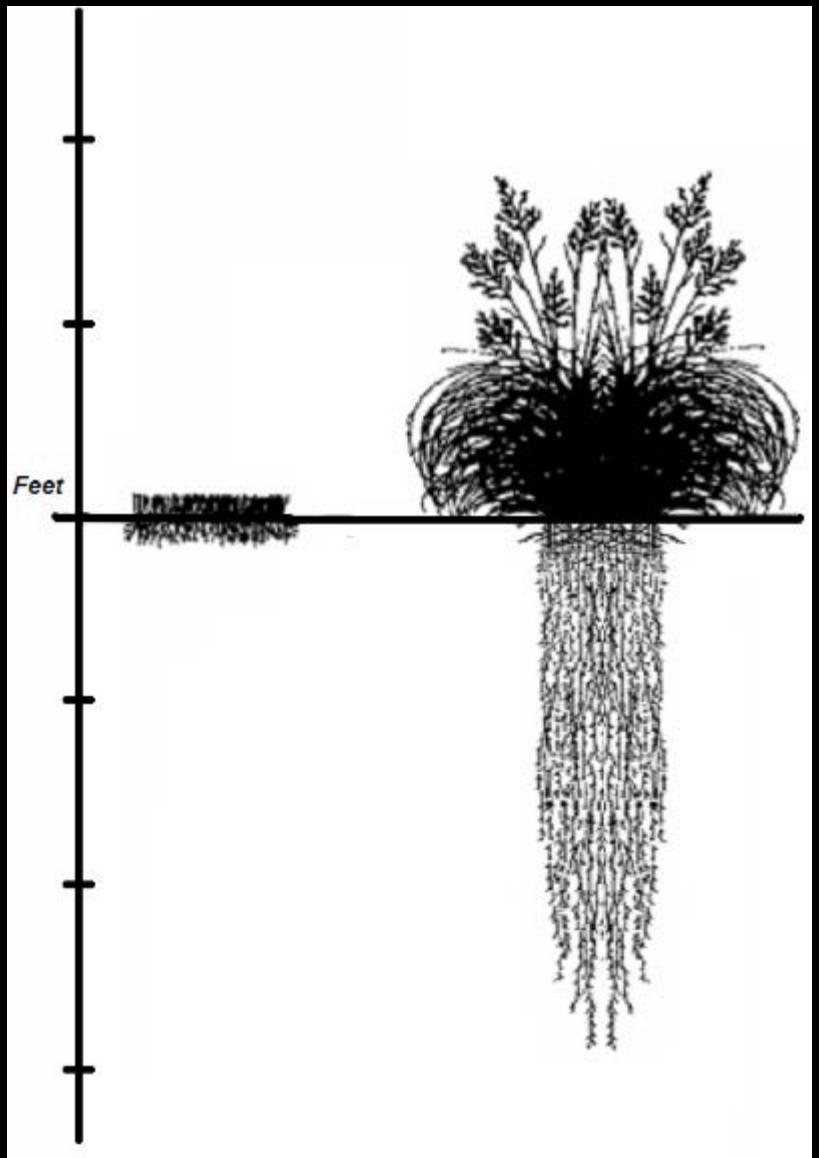
GRASS

Dr. Dennis Hancock
Extension Forage Specialist
Crop and Soil Sciences – UGA

The Most Popular Question in a Drought Year:

"Why are my hayfields green and my pastures brown?"

Get to the root of the problem.



Overview…

Strategies to Promote Roots to Reduce Drought Risks

- Components needed for root development
- Promoting roots with fertility
- Building soil organic matter (OM)

Common questions about soil compaction

Roots Run Deep

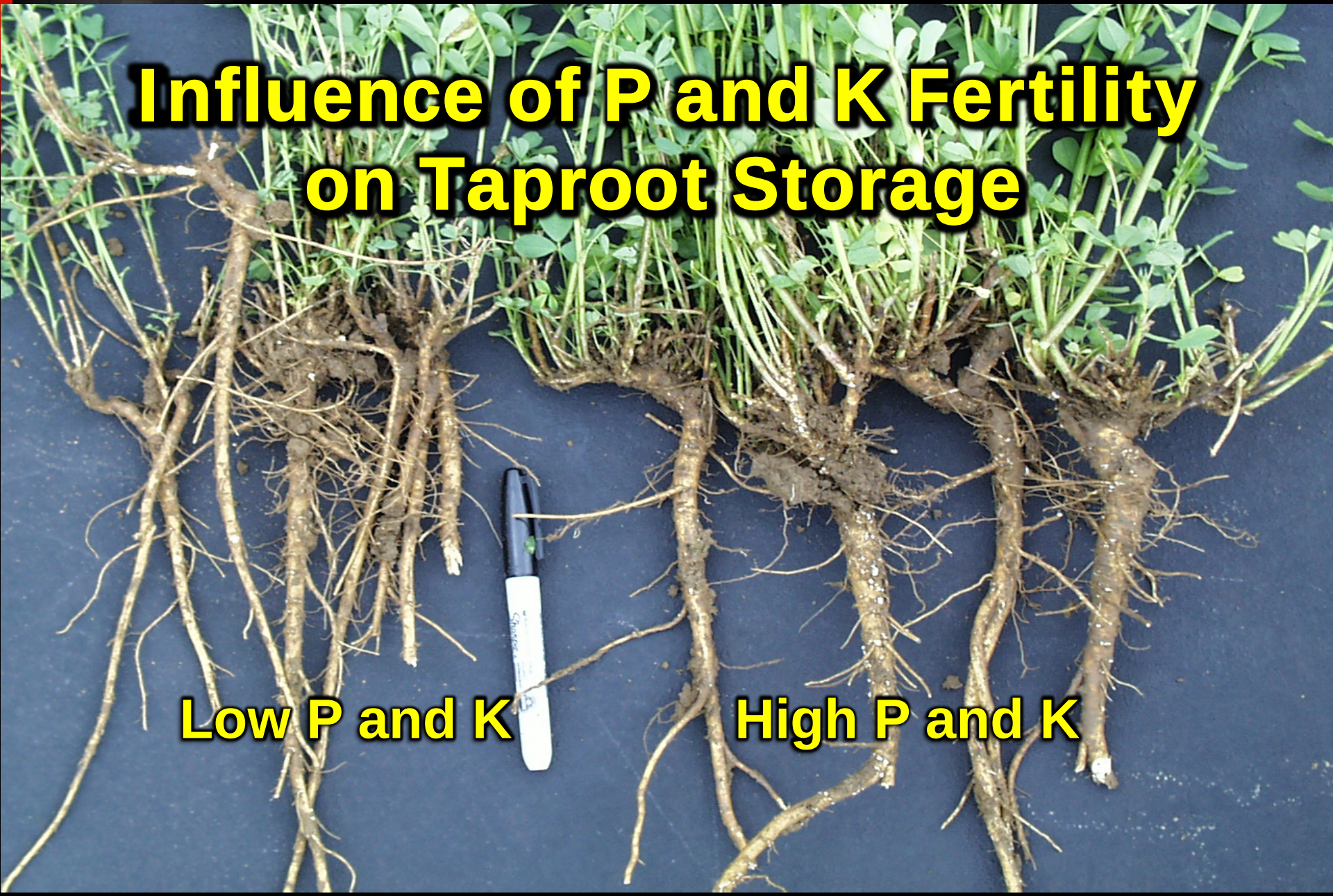
Drought Tolerance

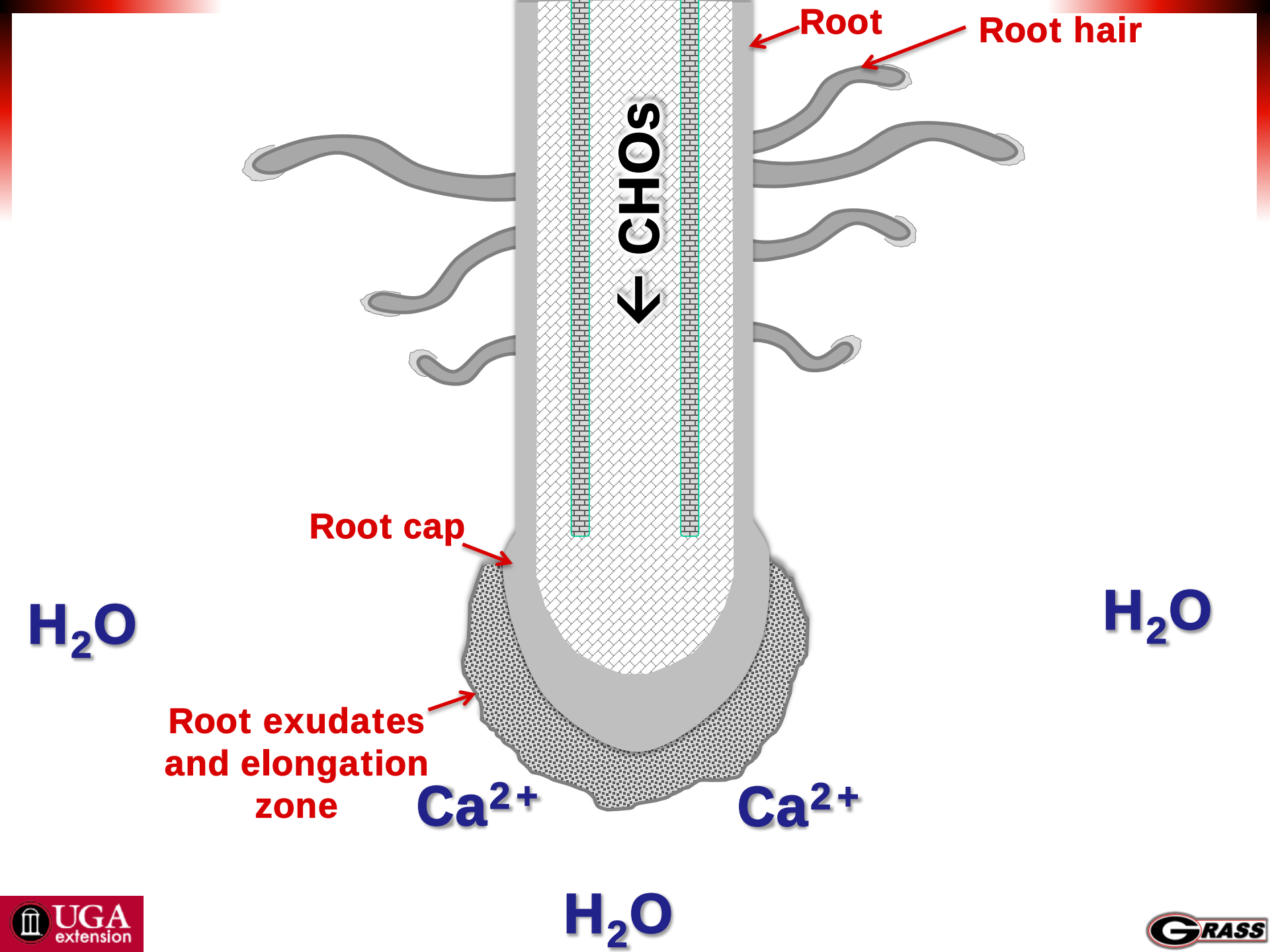
Species	Water Use Efficiency	Max. Root Depth
	DM lbs/inch	inches
Coastal Bermudagrass	1646	78
Pensacola Bahiagrass	1194	79
Tall Fescue	1064	48
Ladino Clover	480	38
Red Clover	436	45

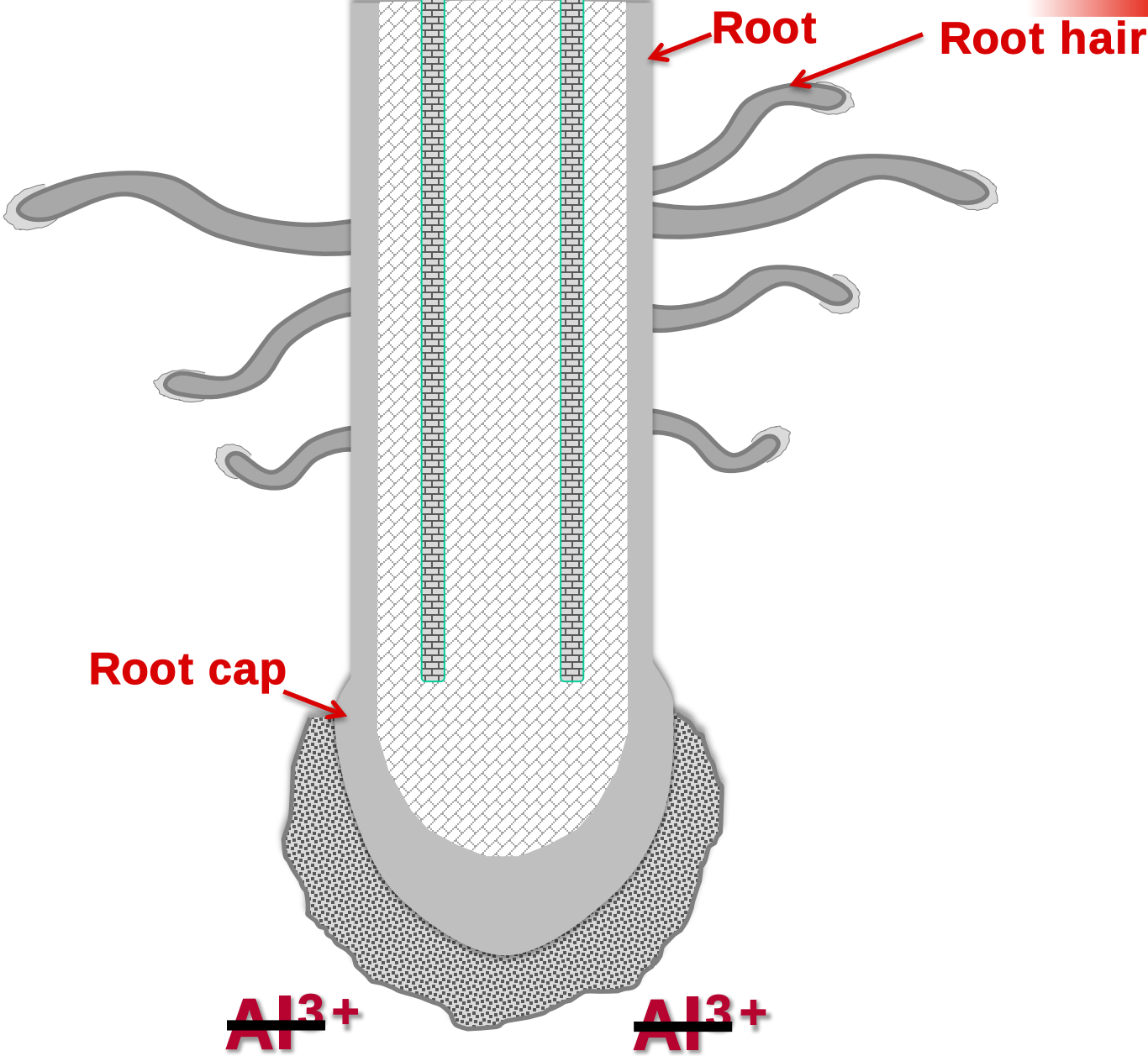
From: Southern Forages, as adapted from Doss et al. (1960; 1962; 1963)

Soil Test and Follow Fertility Recommendations

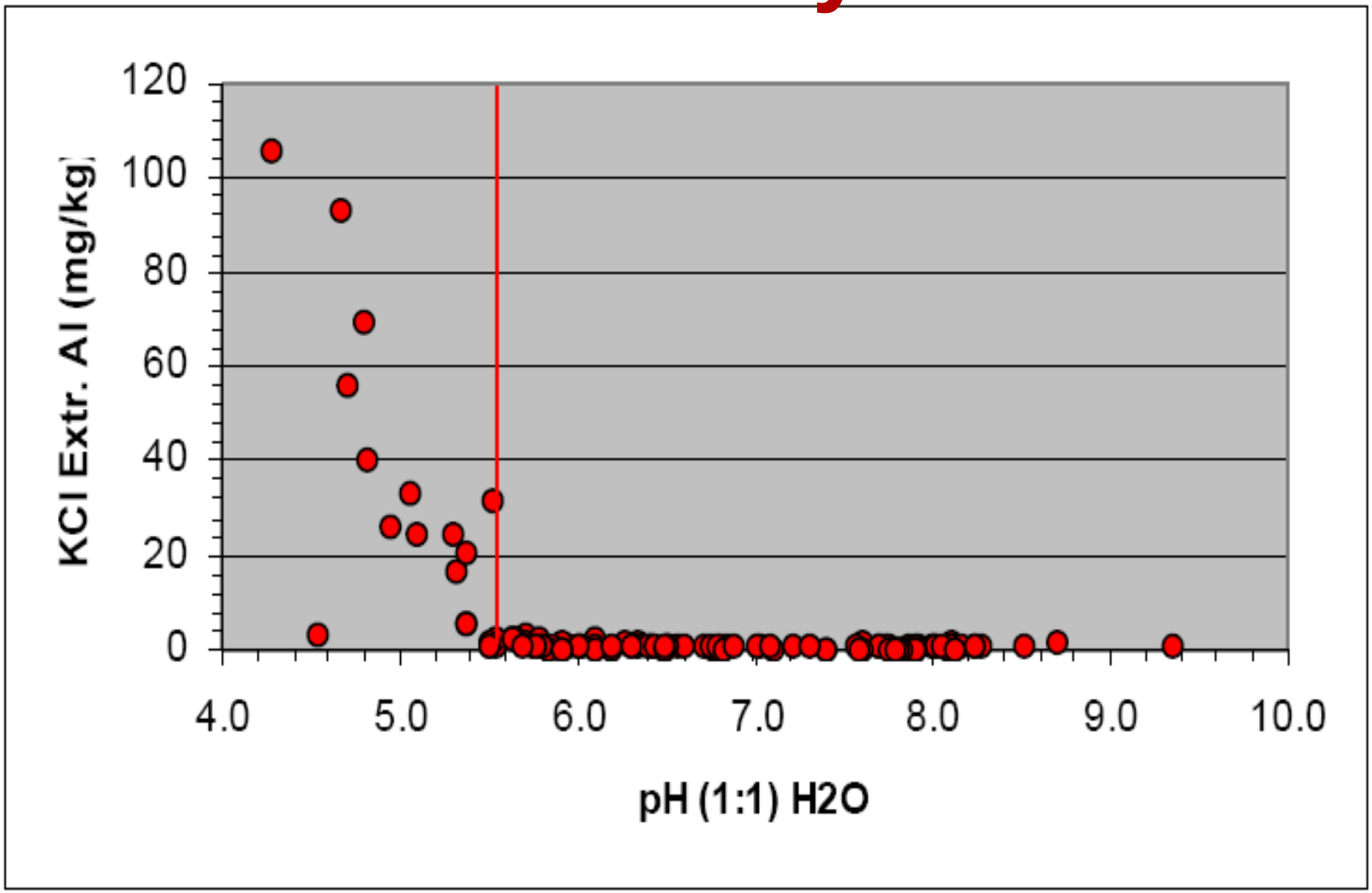
Sample hayfields every year and 1/3 of your pastures each year.


Influence of P and K Fertility
on Taproot Storage
Low P and K
High P and K

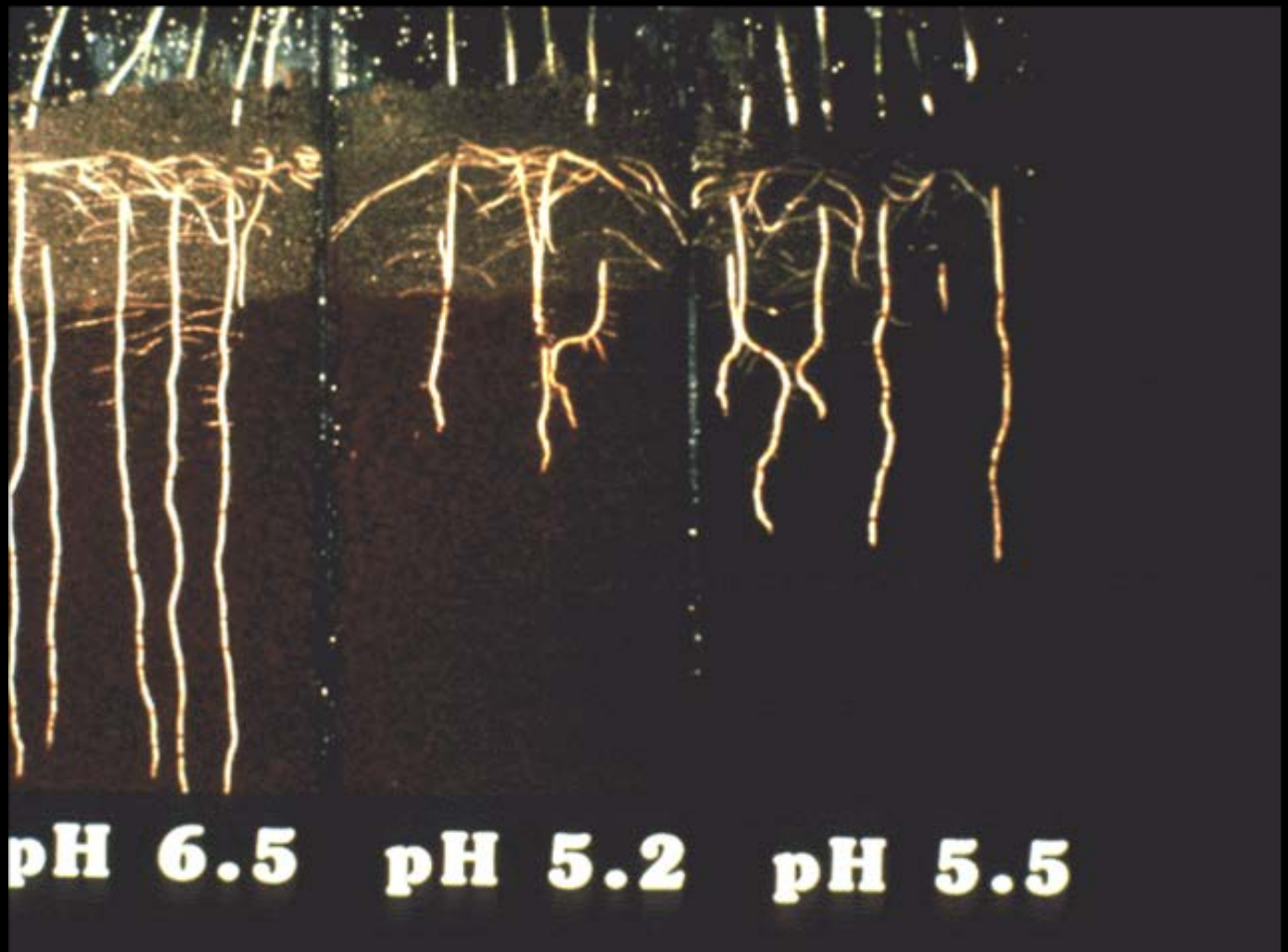

Root
Root hair
CHOs
Root cap
H_2O
H_2O
Root exudates and elongation zone
Ca^{2+}
Ca^{2+}
H_2O


Root
Root hair
Root cap
Al3+
Al3+

Low Soil pH = Aluminum Toxicity



Get at the Root of a Problem: Soil pH Problems

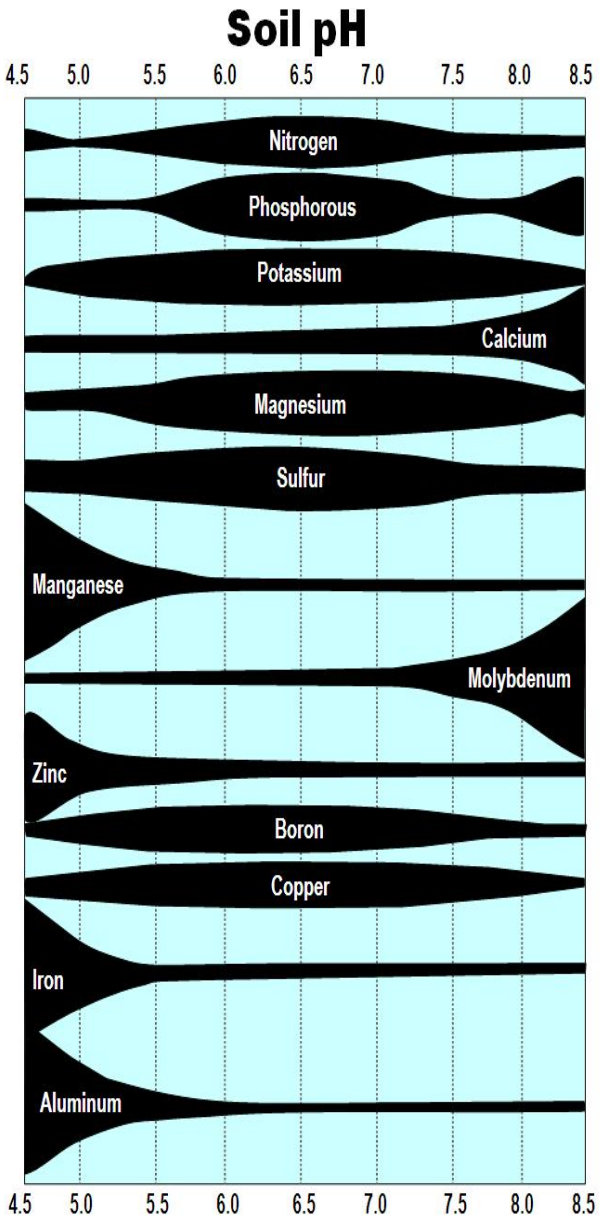


DO NOT cut back on lime!

Get your priorities right!

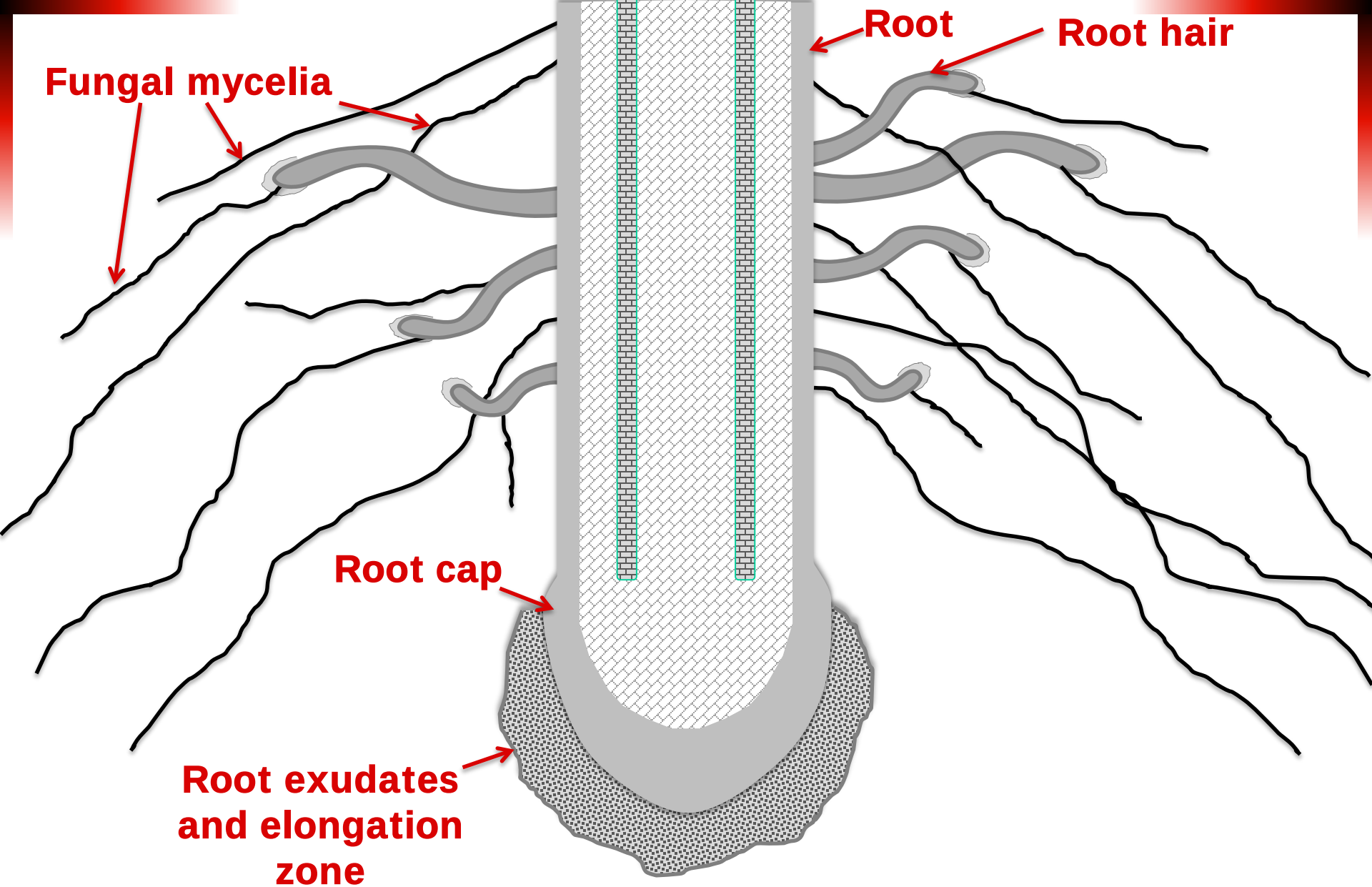
1. Lime is still job #1.
   - Aluminum toxicity
   - Nutrient availability
   - Soil structure
   - Soil biological activity

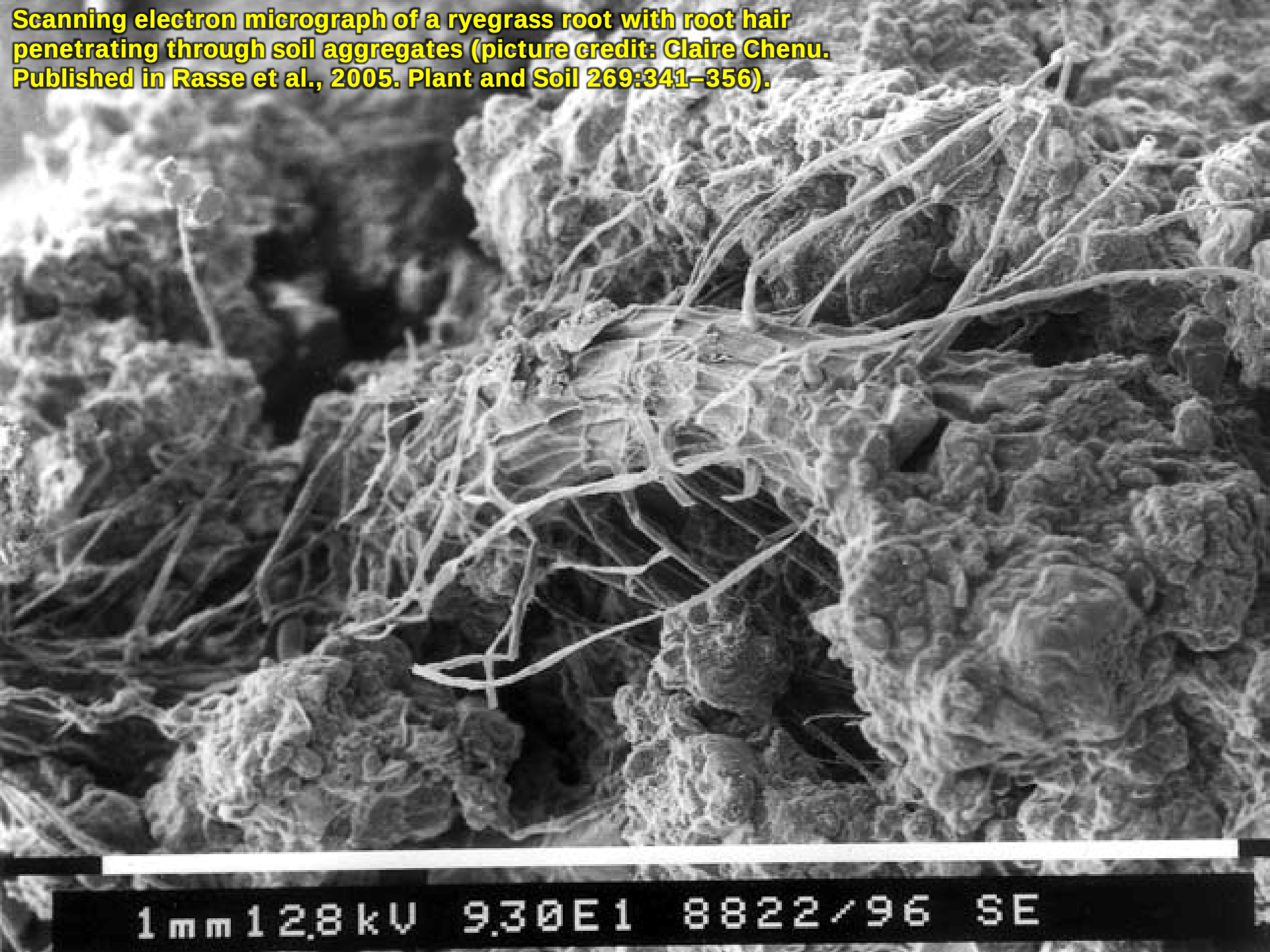
How Soil pH Affects Availability of Plant Nutrients



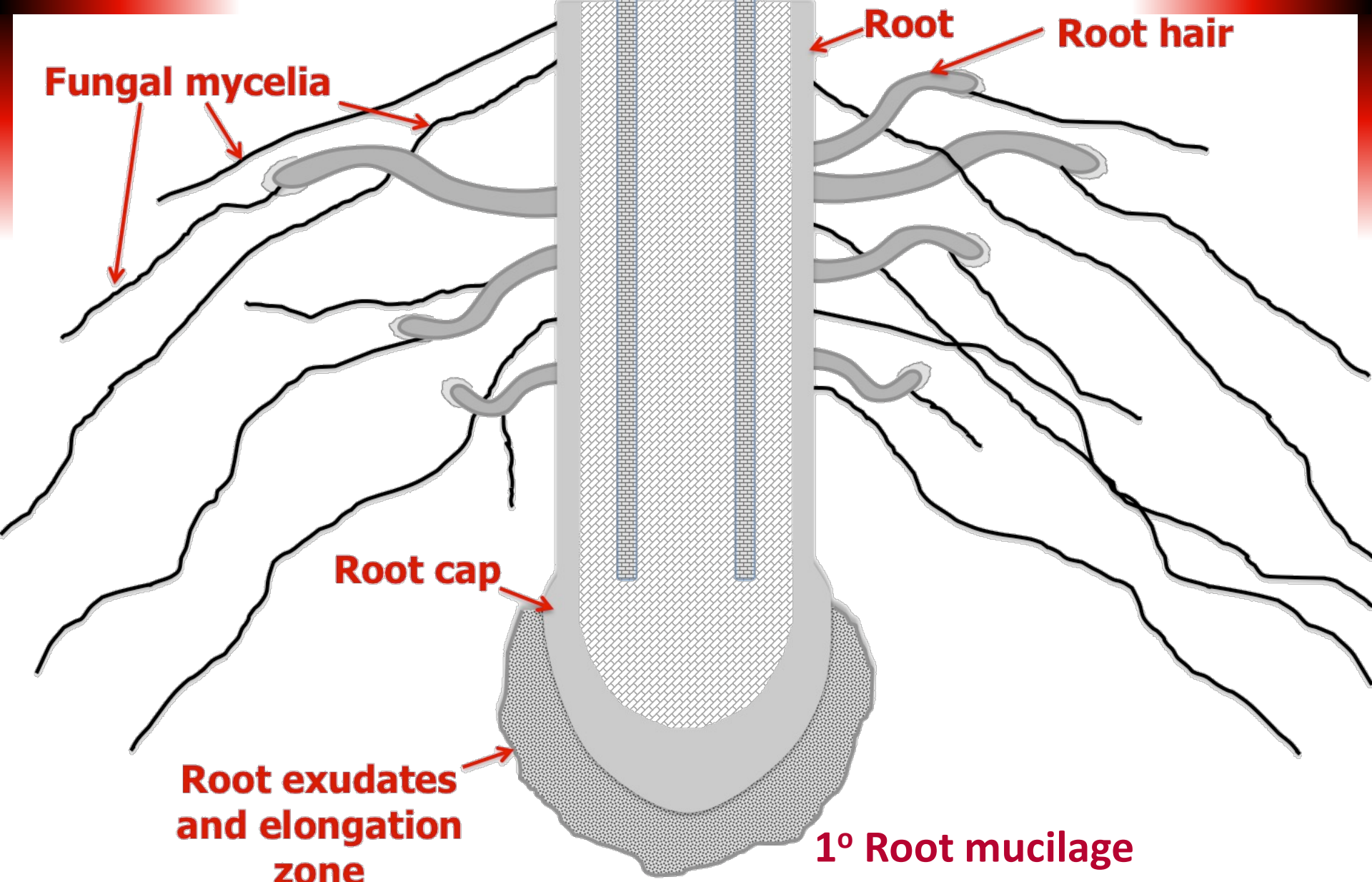
The difference of a soil pH of 5.6 vs. 6.2:

Nutrient	Amt. Used Annually	Unit Price	Dec. in Efficiency	Value of Decrease
	(Lbs/acre)	*($/lb)*		*($/acre)*


Root
Root hair
Fungal mycelia
Root cap
Root exudates and elongation zone

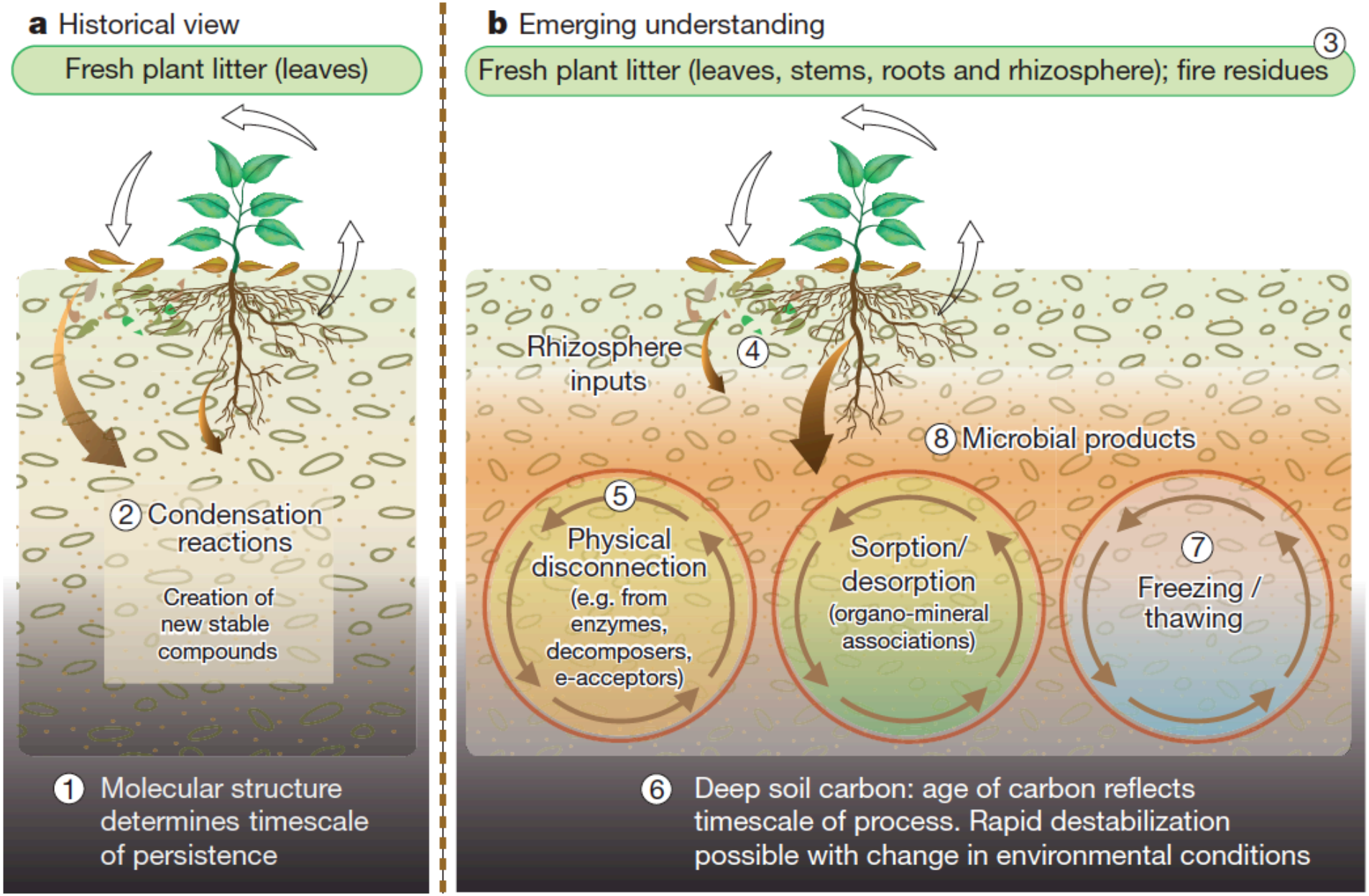


Scanning electron micrograph of a ryegrass root with root hair penetrating through soil aggregates (picture credit: Claire Chenu. Published in Rasse et al., 2005. Plant and Soil 269:341–356).

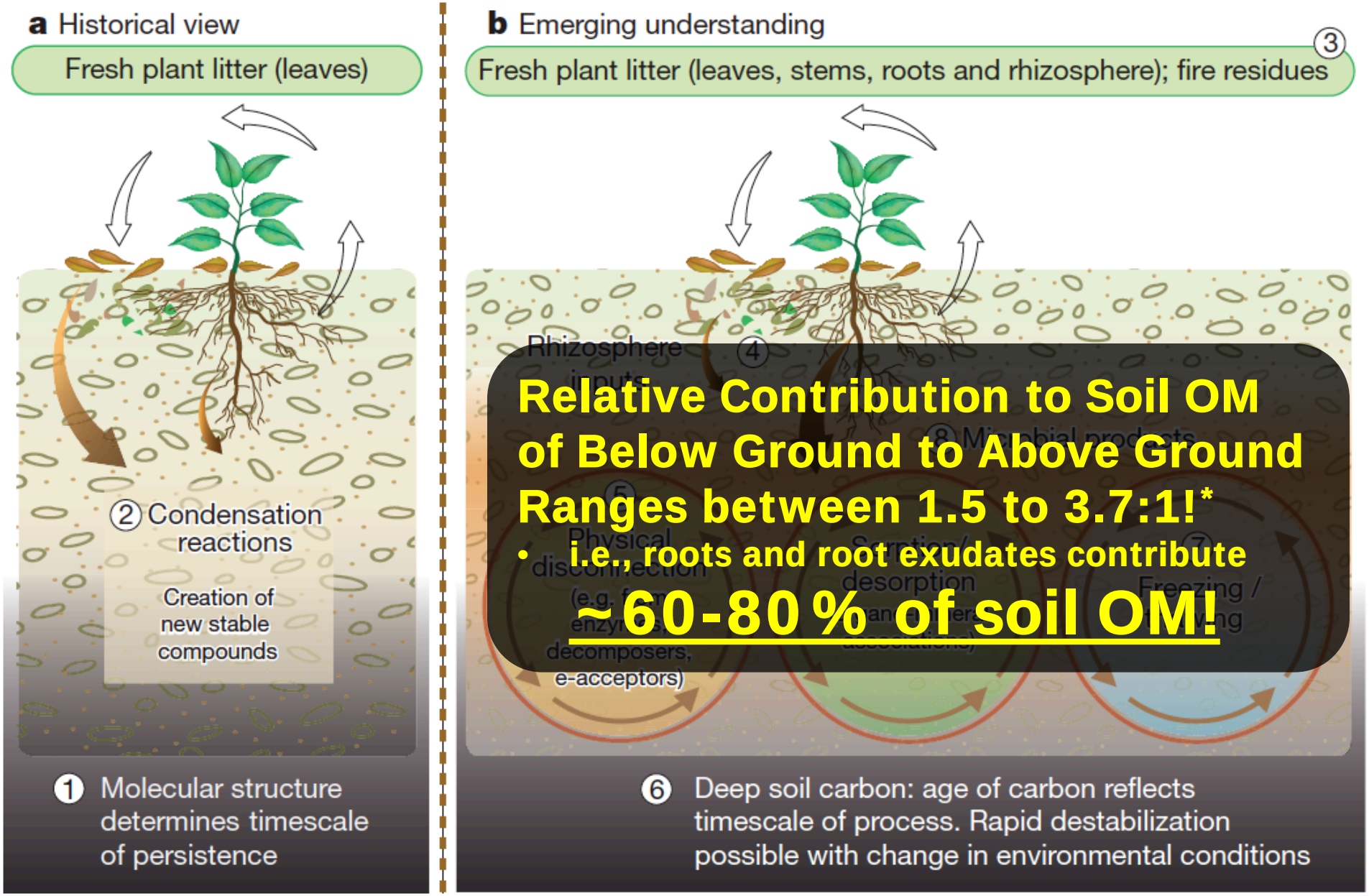


1º Root mucilage

- Sugars from ruptured cells



Schmidt et al. 2011. Persistence of soil organic matter as an ecosystem property. Nature. 478:49-56



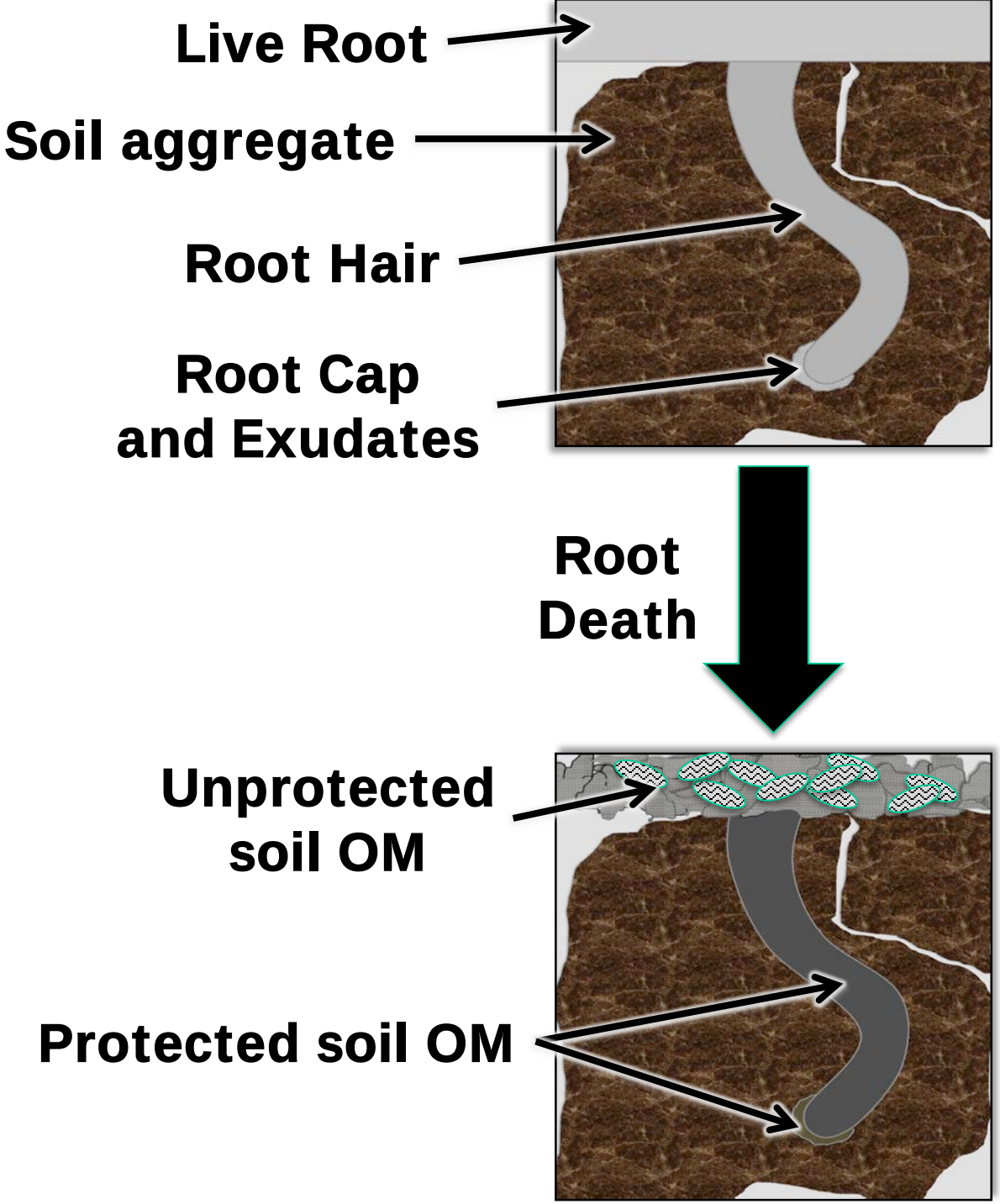
Relative Contribution to Soil OM of Below Ground to Above Ground Ranges between 1.5 to 3.7:1!*

- **i.e., roots and root exudates contribute**

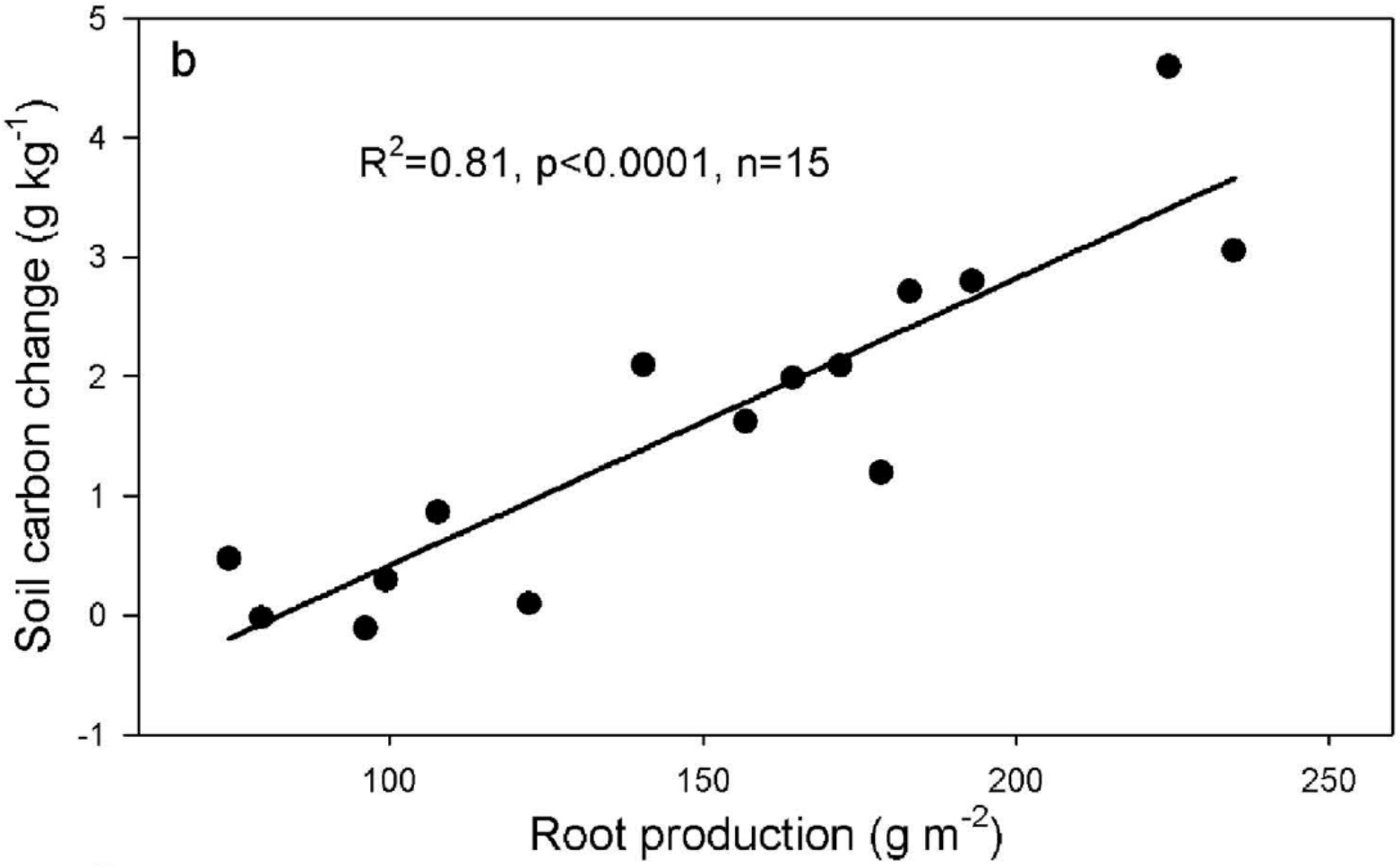
~60-80 % of soil OM!

Schmidt et al. 2011. Persistence of soil organic matter as an ecosystem property. Nature. 478:49-56

* Rasse et al., 2005. Plant and Soil 269:341–356.

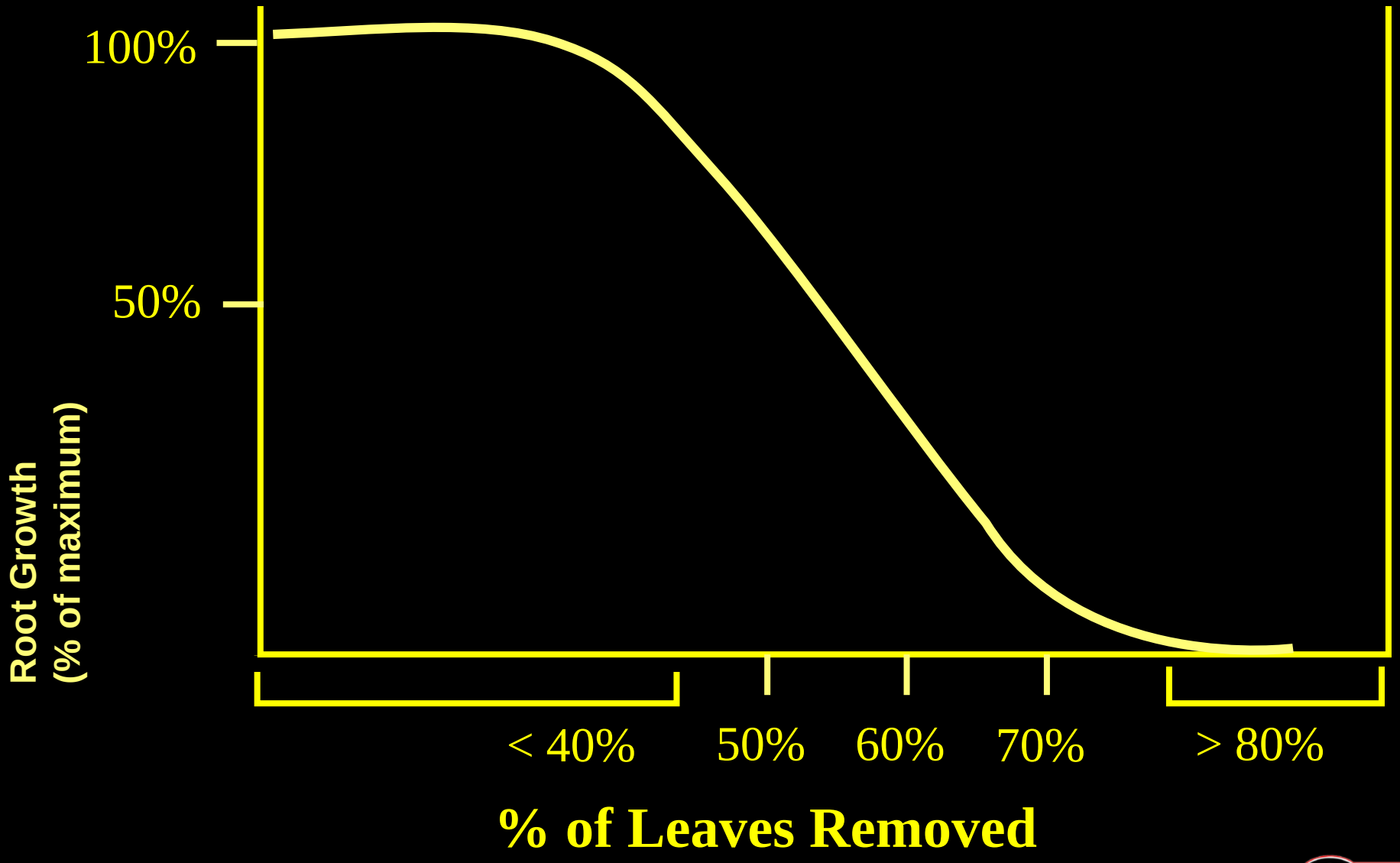

Live Root
Soil aggregate
Root Hair
Root Cap
and Exudates
Root
Death
Unprotected
soil OM
Protected soil OM

Importance of Roots to Building Soil Organic Matter

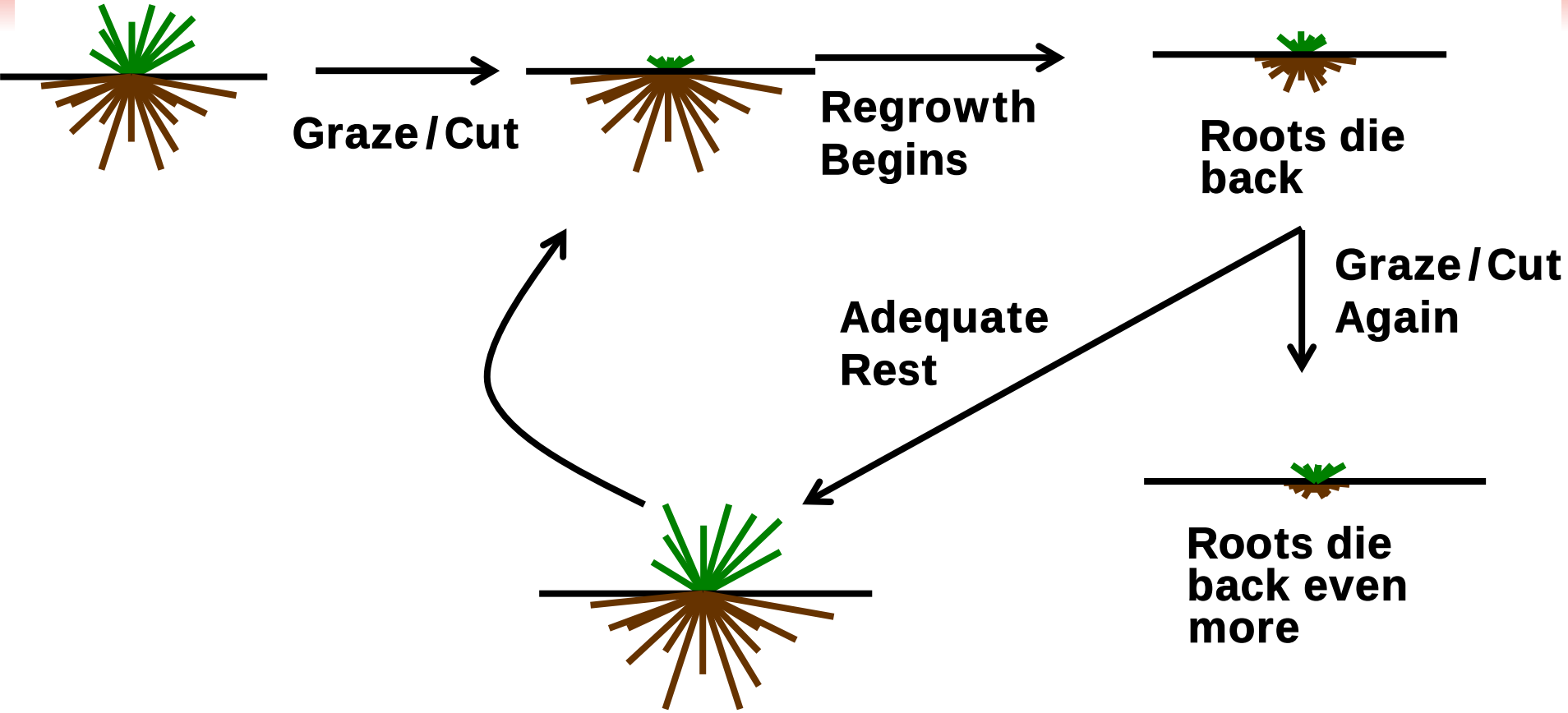


Chen, W. et al. 2015. Improved grazing management may increase soil carbon sequestration in temperate steppe. Nature's Sci. Rep. 5, 10892; doi: 10.1038/srep10892.

Impact of Defoliation on Root Growth



What you don't see....



Soil Cone Penetrometer

Soil should be
<300 psi (2.0 Mpa)
when wet (field capacity)

Renovation with an Aerator

Renovation with an Aerator

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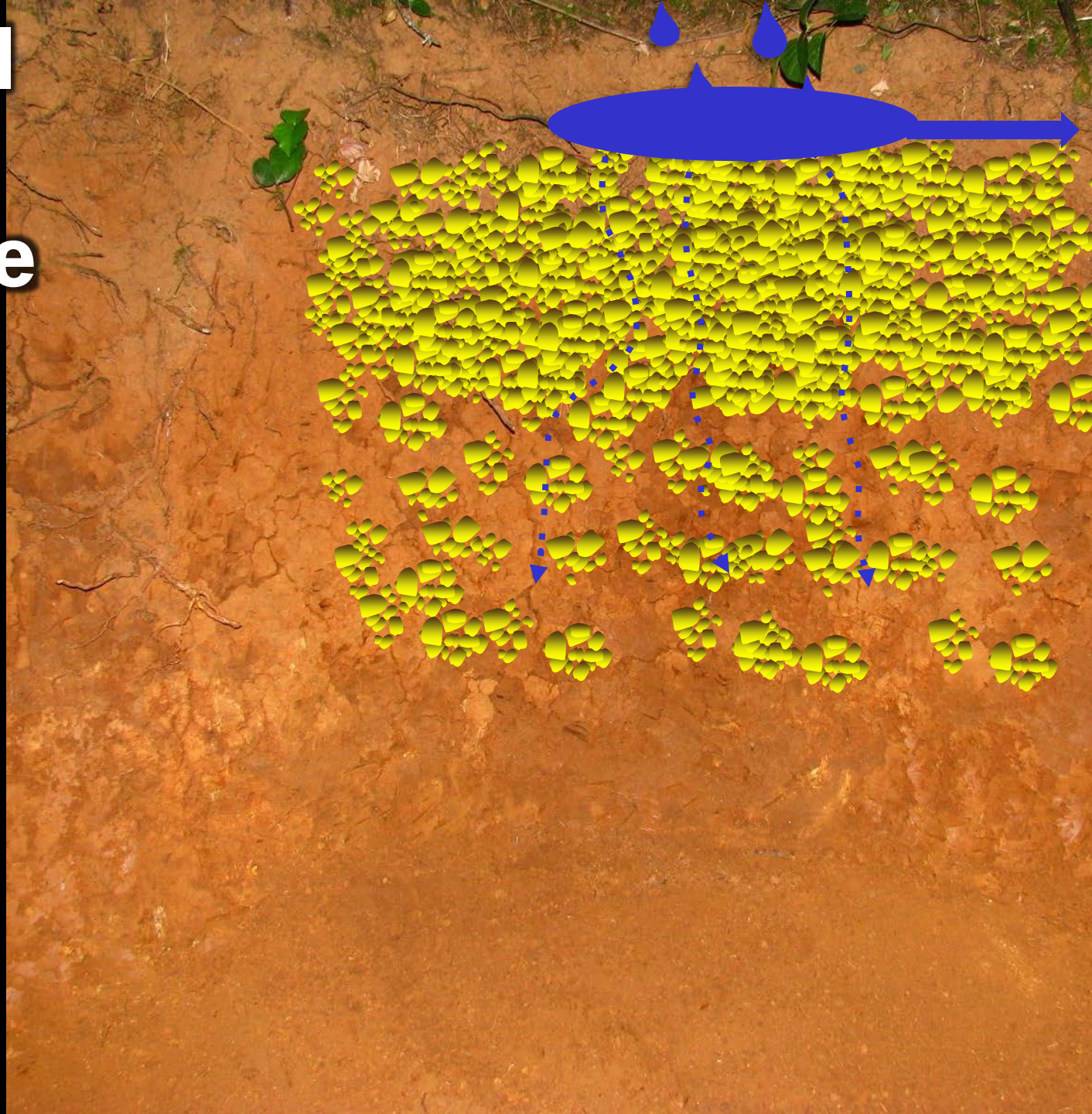
Poor Soil Physical Structure



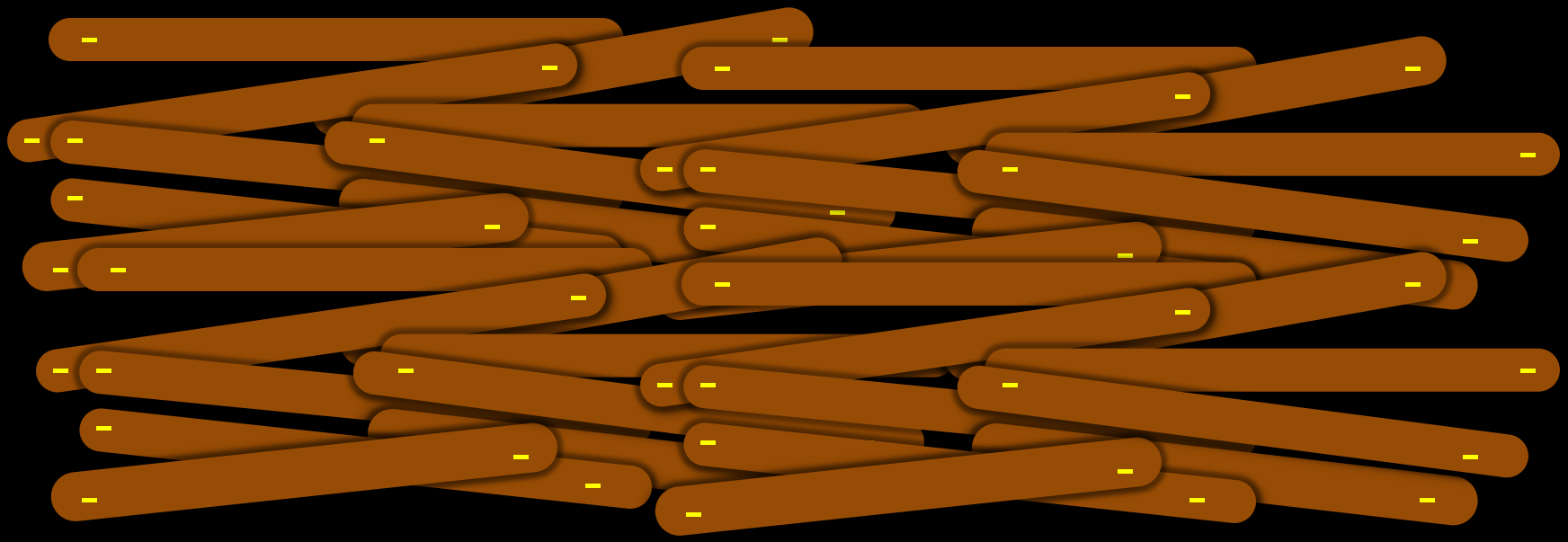
Pasture Aeration Treatment –
Mississippi State Univ. 1993; Bahiagrass

	Bahiagrass Yields	Penetrometer Strain (July)
	lbs of DM/ac	*lb/in²*
Rolling Spike		
Shank Renovator		
Disk		
Deep Chisel (10")		
Control		
LSD(0.05)	866	28

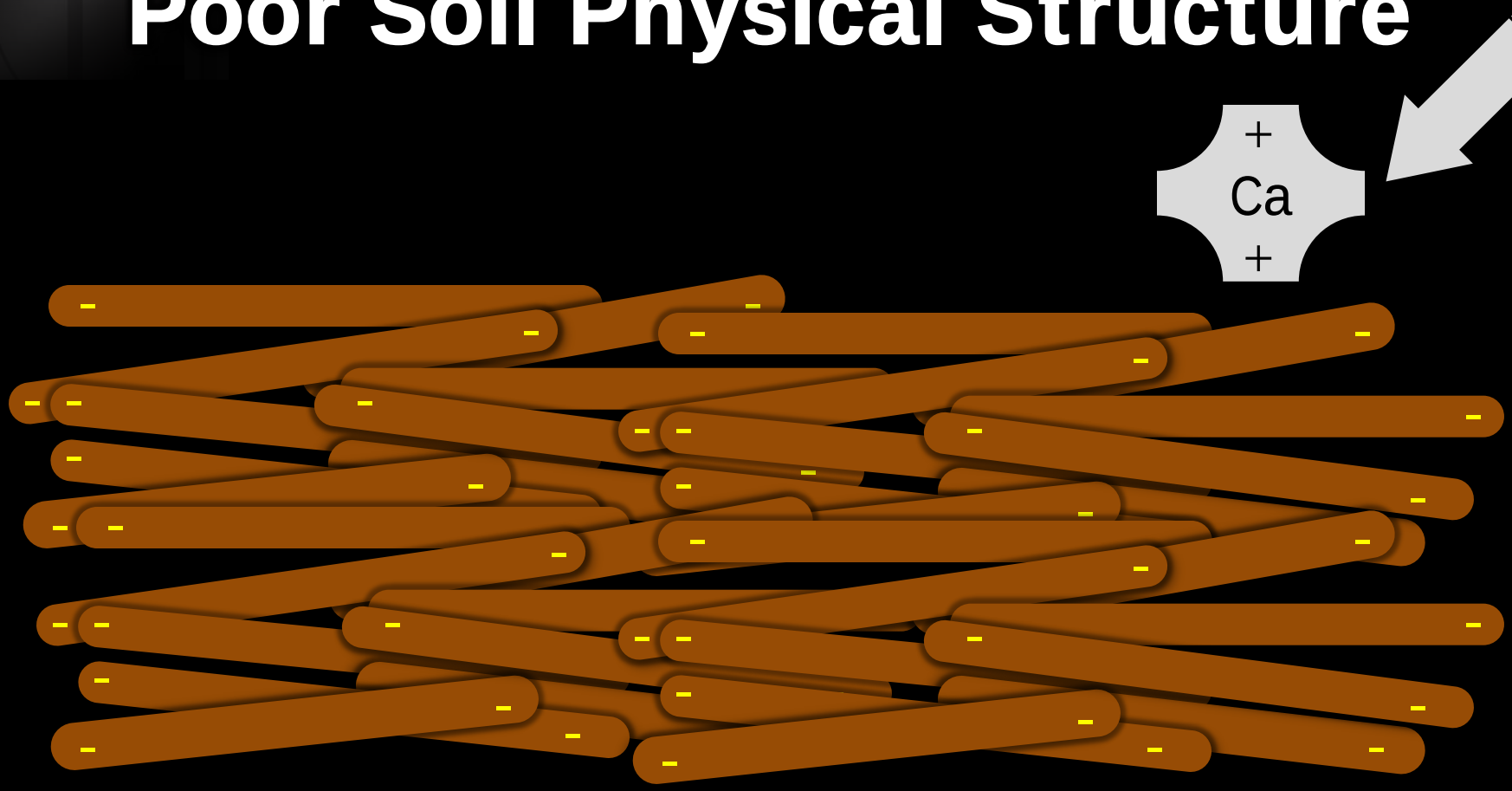
Hayfield Aeration
MSU 1994-95; Bermudagrass

	Coastal, Brown Loam Branch		Tifton 78, Coastal Plain		Alicia, White Sands	
	1994	1995	1994	1995	1994	1995
	lbs DM/acre					
Control						
Spring						
Summer						
Spring + Summer						
$LSD_{(0.05)}$						

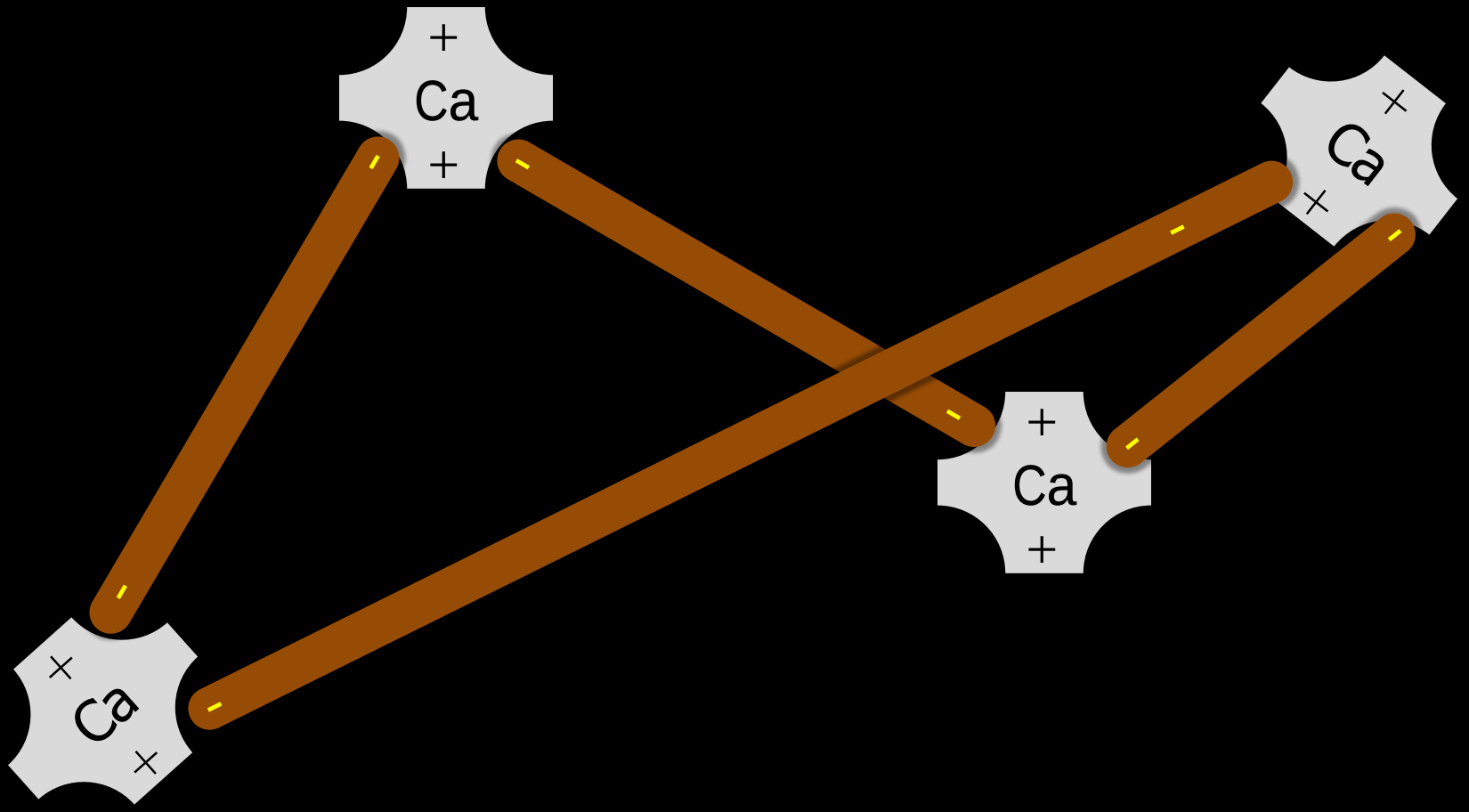
Poor Soil Physical Structure



Poor Soil Physical Structure



Soil Particles Flocculate and Improve Physical Structure



Calcium and Magnesium Are Good Flocculating Cations

Ion		Relative Flocculating Power
Sodium	Na^{+}	1.0
Potassium	K^{+}	1.7
Magnesium	Mg^{2+}	27.0
Calcium	Ca^{2+}	43.0

Dr. Malcolm Sumner, UGA Professor Emeritus

Rainfall Simulator

Rainfall Simulator

QUESTIONS?

www.georgiaforages.com