Effects of Perennial Grasses on Soil Quality Indicators in Peanut and Cotton Rotations in Virginia

J. Michael Weeks, Jr.
Dr. Joel C. Faircloth
Dr. Pat M. Phipps
Dr. Mark M. Alley
Dr. Chris Teutsch



Virginia Polytechnic Institute and State University

Why initiate this study in VA?

- Positive results demonstrated by including bahiagrass in rotations in Florida, Georgia, and Alabama.
- Influences soil quality indicators through soil stabilization mitigating soil loss, increased organic matter deposition, greater water infiltration, aggregate stabilization and root penetration.
- Possible benefits from disease suppression.

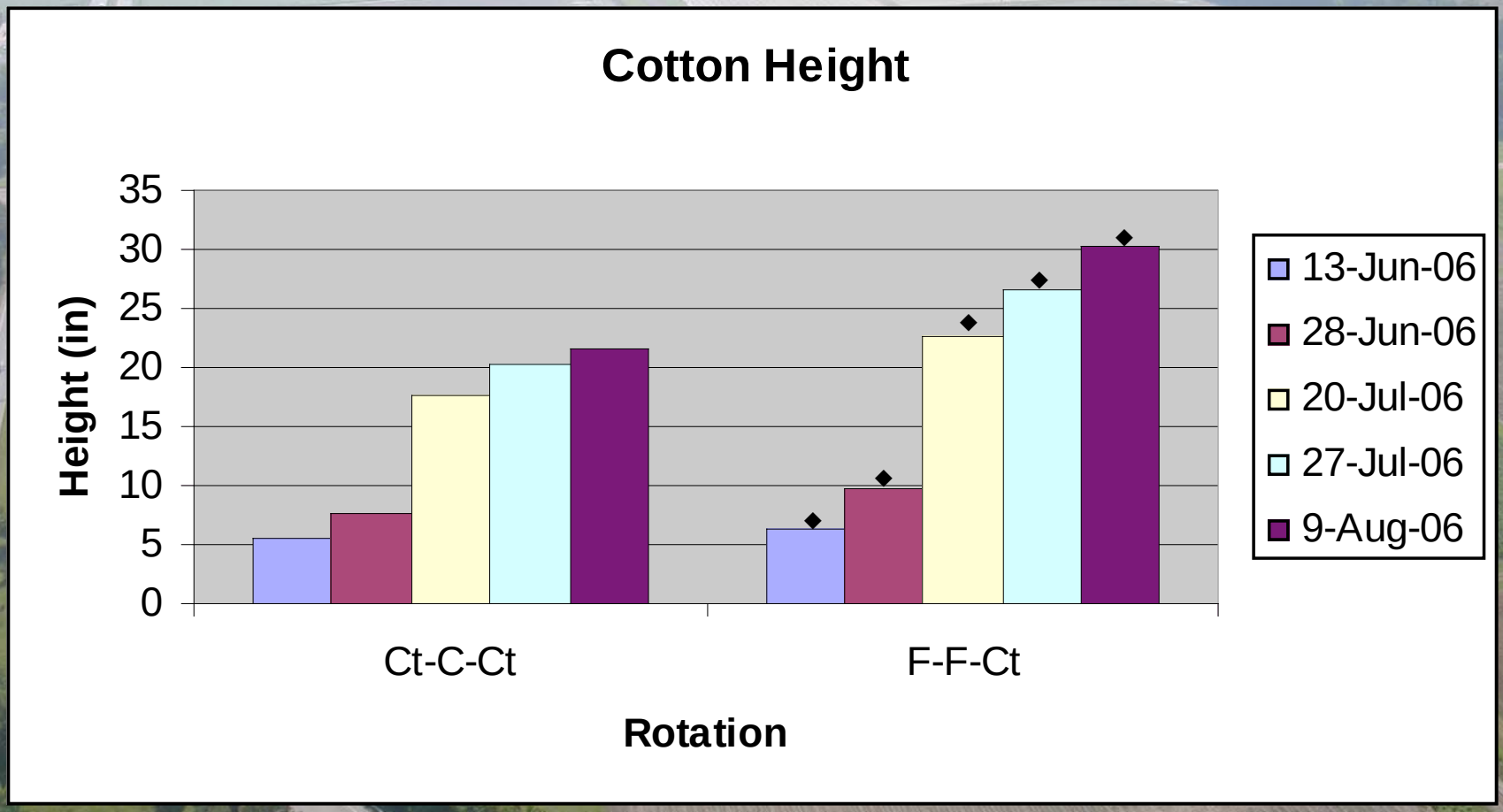
Objectives of Rotation Study

1. Examine shifts in soil quality parameters attributed to the various rotations.
2. Examine changes in disease pressure associated with treatments.
3. Examine cotton growth, development and yield response influenced by rotation and latter soil quality parameters.

Treatments

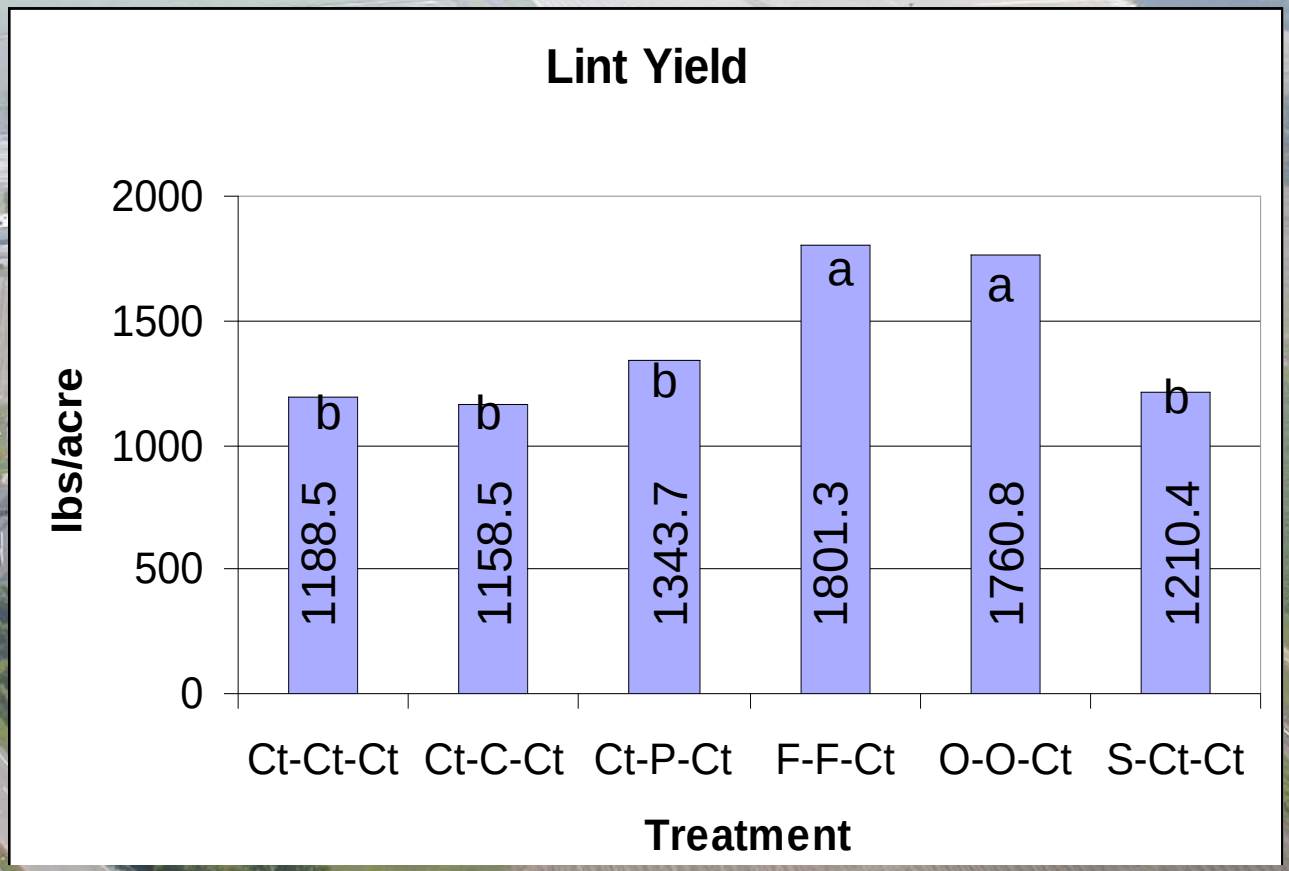
Rotation	2003	2004	2005	2006	2007
1	Peanut	Cotton	Cotton	Cotton	Cotton
2	Peanut	Cotton	Corn	Cotton	Peanut
3	Peanut	Cotton	Peanut	Cotton	Peanut
4	Peanut	Tall fescue	Tall fescue	Cotton	Peanut
5	Peanut	Orchardgrass	Orchardgrass	Cotton	Peanut
6	Peanut	Tall fescue	Tall fescue	Tall fescue	Peanut
7	Peanut	Orchardgrass	Orchardgrass	Orchardgrass	Peanut
8	Peanut	Soybean	Cotton	Cotton	Peanut

2006 Crop Response to Rotation

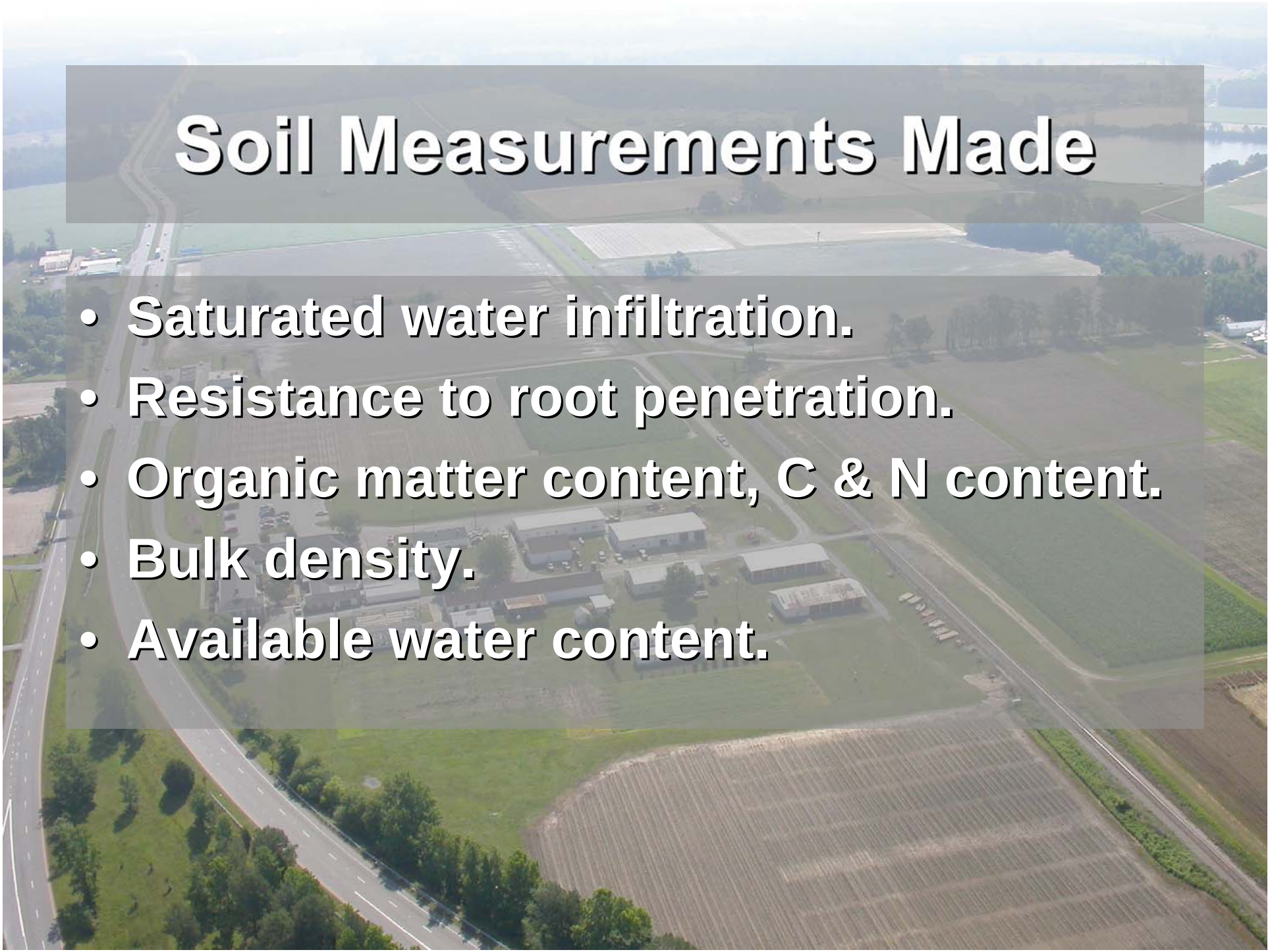


◆ = significant at P = 0.05

2006 Crop Response to Rotation



Fisher's Protected LSD, $P \leq 0.05$ Level



Soil Measurements Made

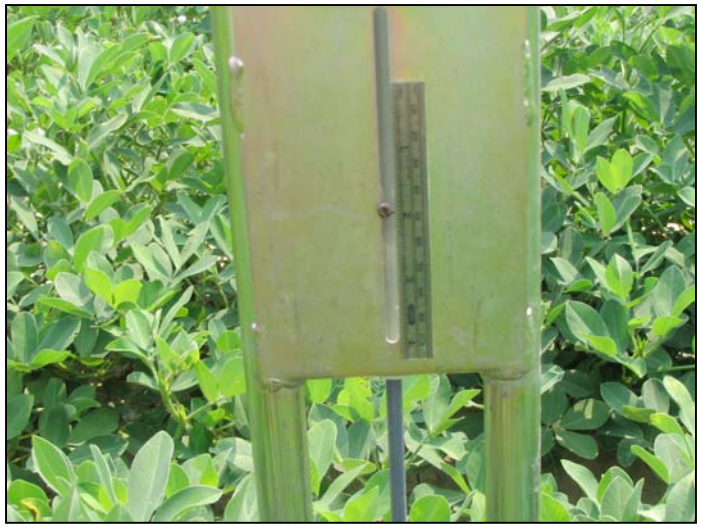
- Saturated water infiltration.
- Resistance to root penetration.
- Organic matter content, C & N content.
- Bulk density.
- Available water content.

Potential for Greater Water Infiltration

- Looser, more porous soil from perennial grass root growth.
- Greater cover protecting soil from rain drop impact and sealing.

Greater Residual Ground Cover

Double Ring Infiltrometer



Results from Infiltration

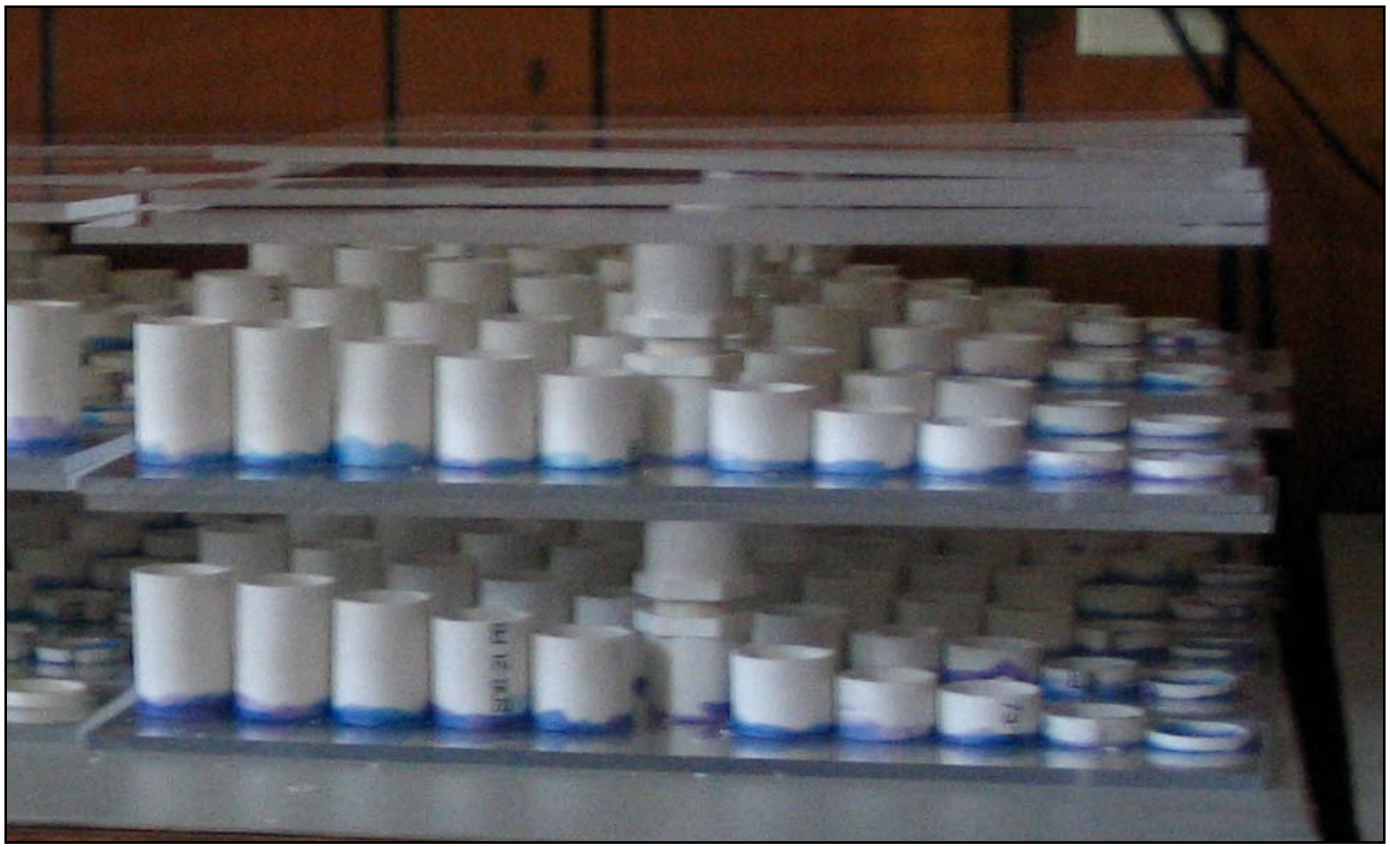
- No measured differences found between treatments for saturated infiltration.
- Measurements may not reflect what actually happens during a heavy rain.


Ct-P-Ct


F-F-Ct


S-Ct-Ct


O-O-Ct



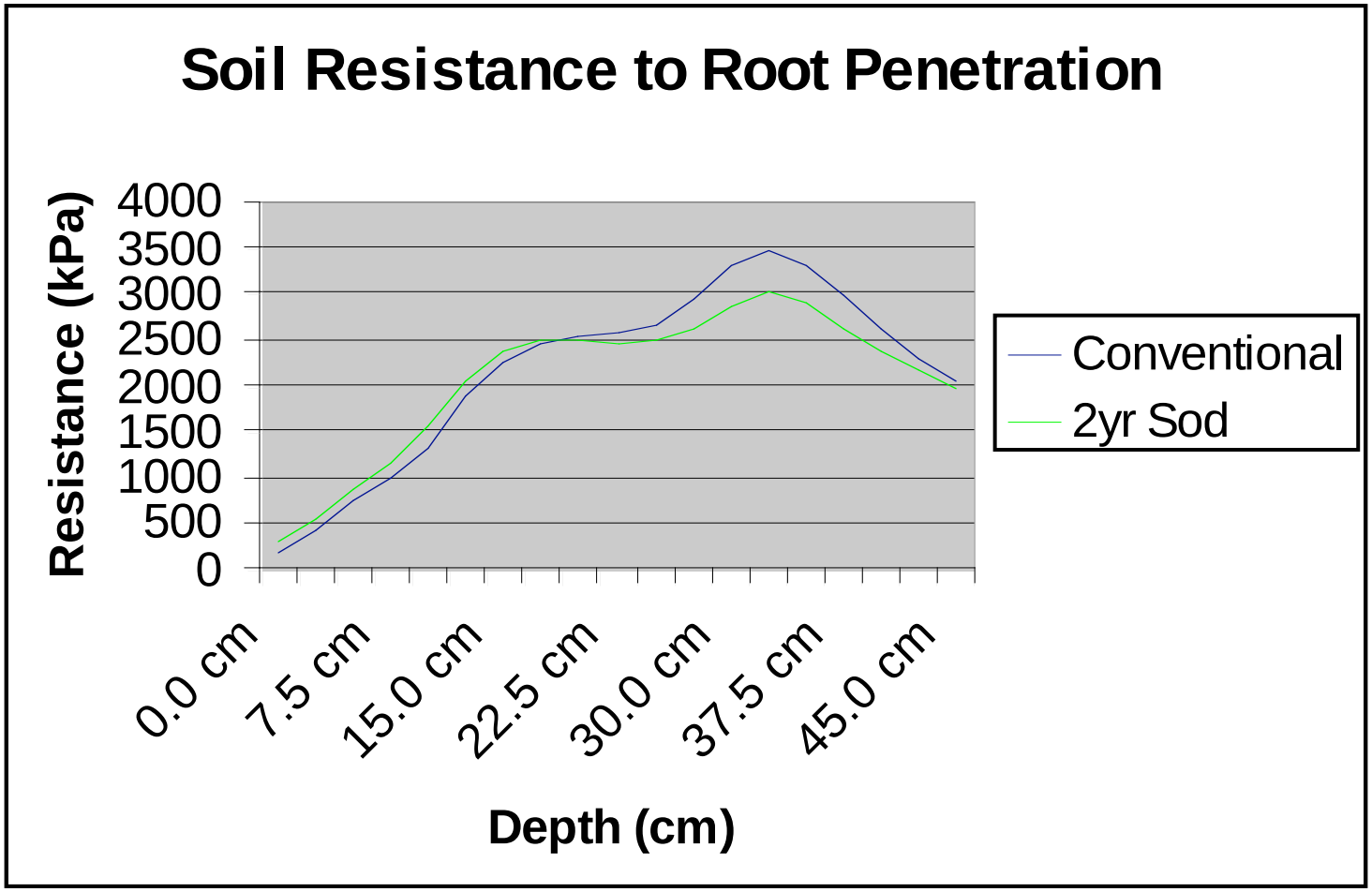
Series of pipes fixed water tight to base graduated from 0.5 cm to 5 cm with a roof to prevent rainfall from falling directly in.

Detecting Infiltration Differences During Rainfall Events

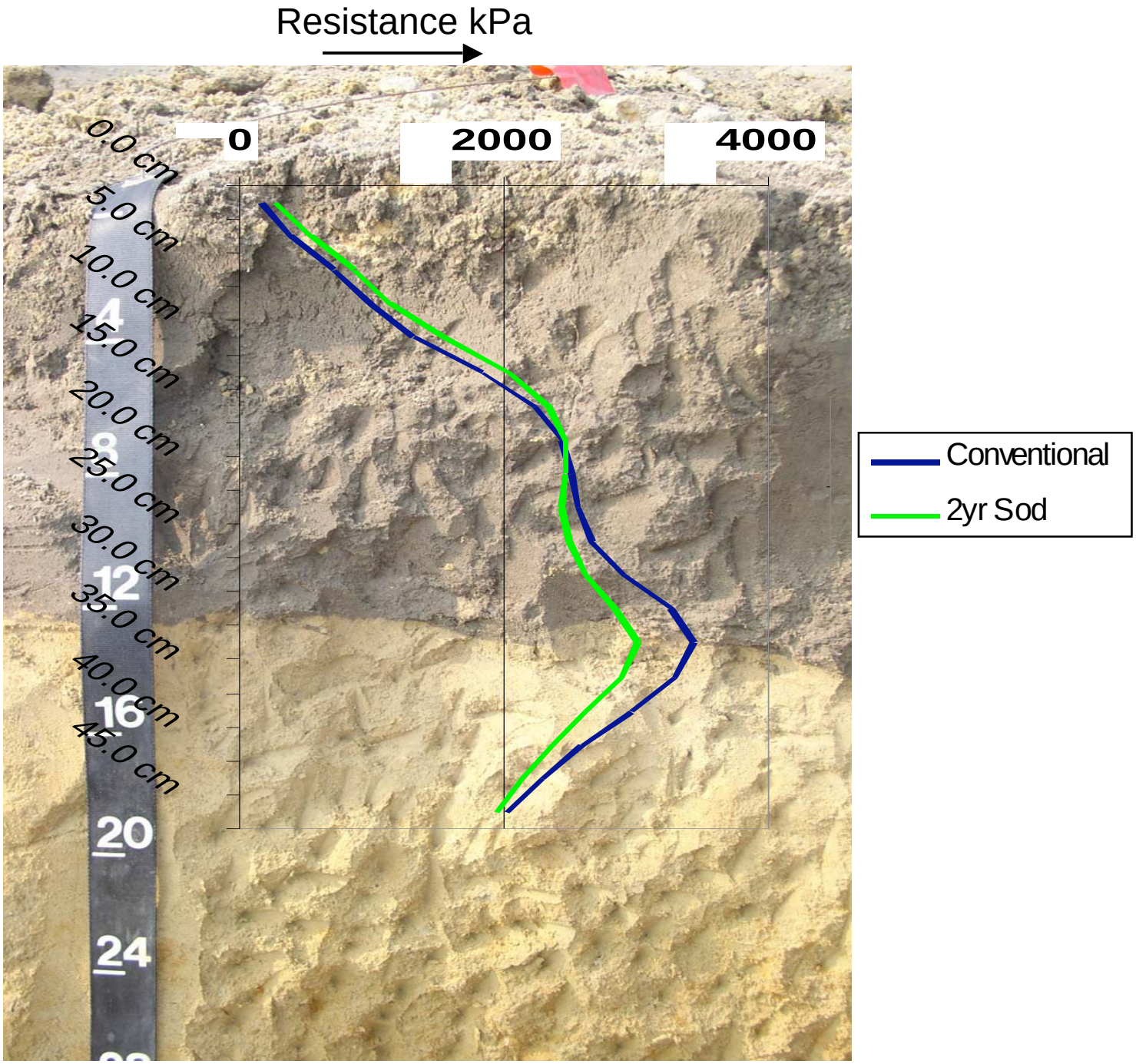
Root Penetration

- Soils are often compacted at depths beyond the reach of typical tillage.
- Multiple years of grass may provide opportunities for roots to penetrate restrictive layers.
- Subsequent annual crops could explore residual root channels left behind allowing for greater access to water and nutrients.

Data Logging Penetrometer


Soil Resistance to Root Penetration
Resistance (kPa)
4000
3500
3000
2500
2000
1500
1000
500
0
0.0 cm
7.5 cm
15.0 cm
22.5 cm
30.0 cm
37.5 cm
45.0 cm
Depth (cm)
Conventional
2yr Sod

Soil resistance to penetration



Other Differences in Soil Parameters?

- No difference found in
  - Soil organic matter
  - Carbon and nitrogen content
  - Bulk density
  - Available water content
  - Measured infiltration
- Only measured difference in soils between treatments is penetration resistance.

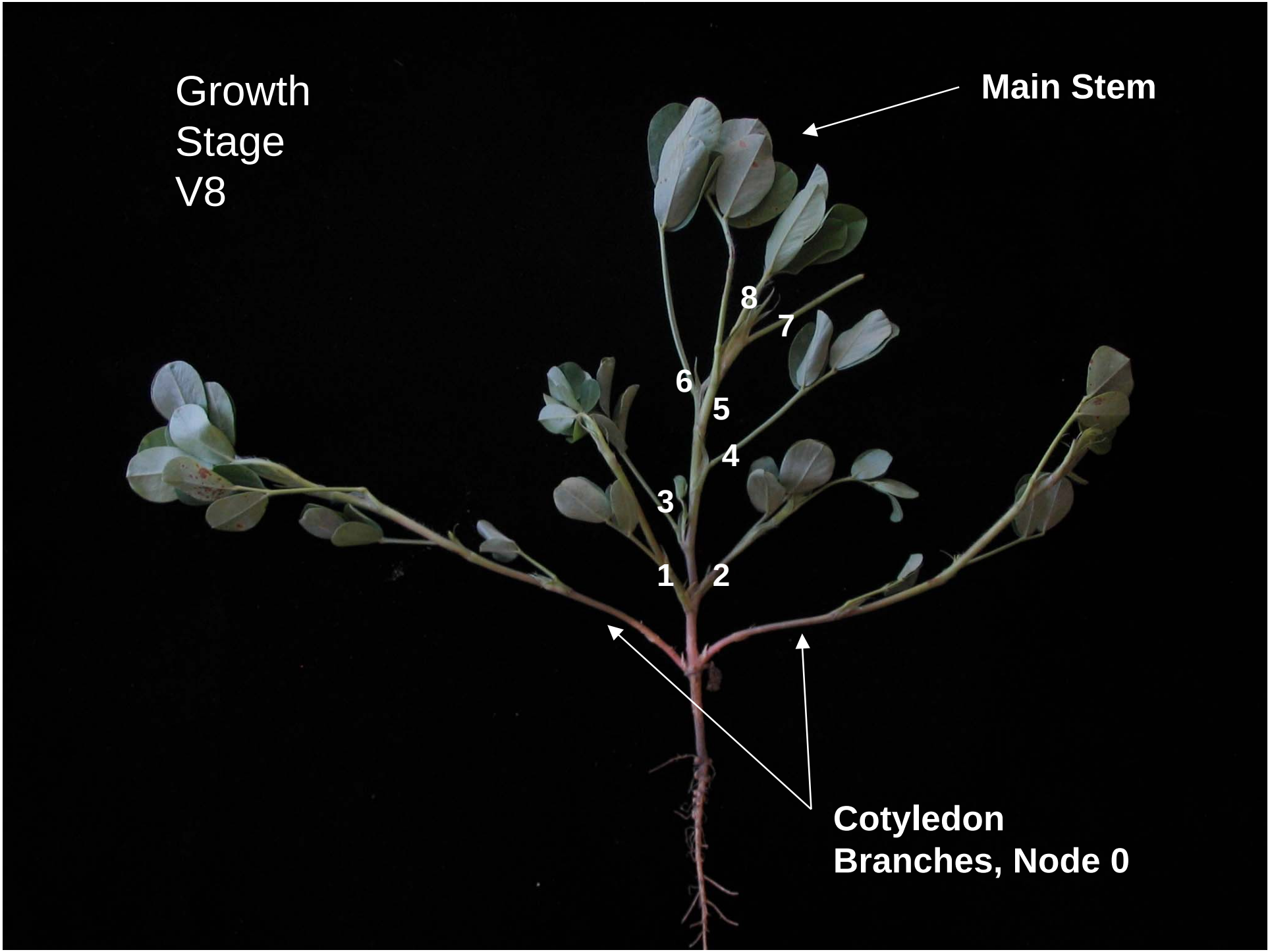
Conclusions

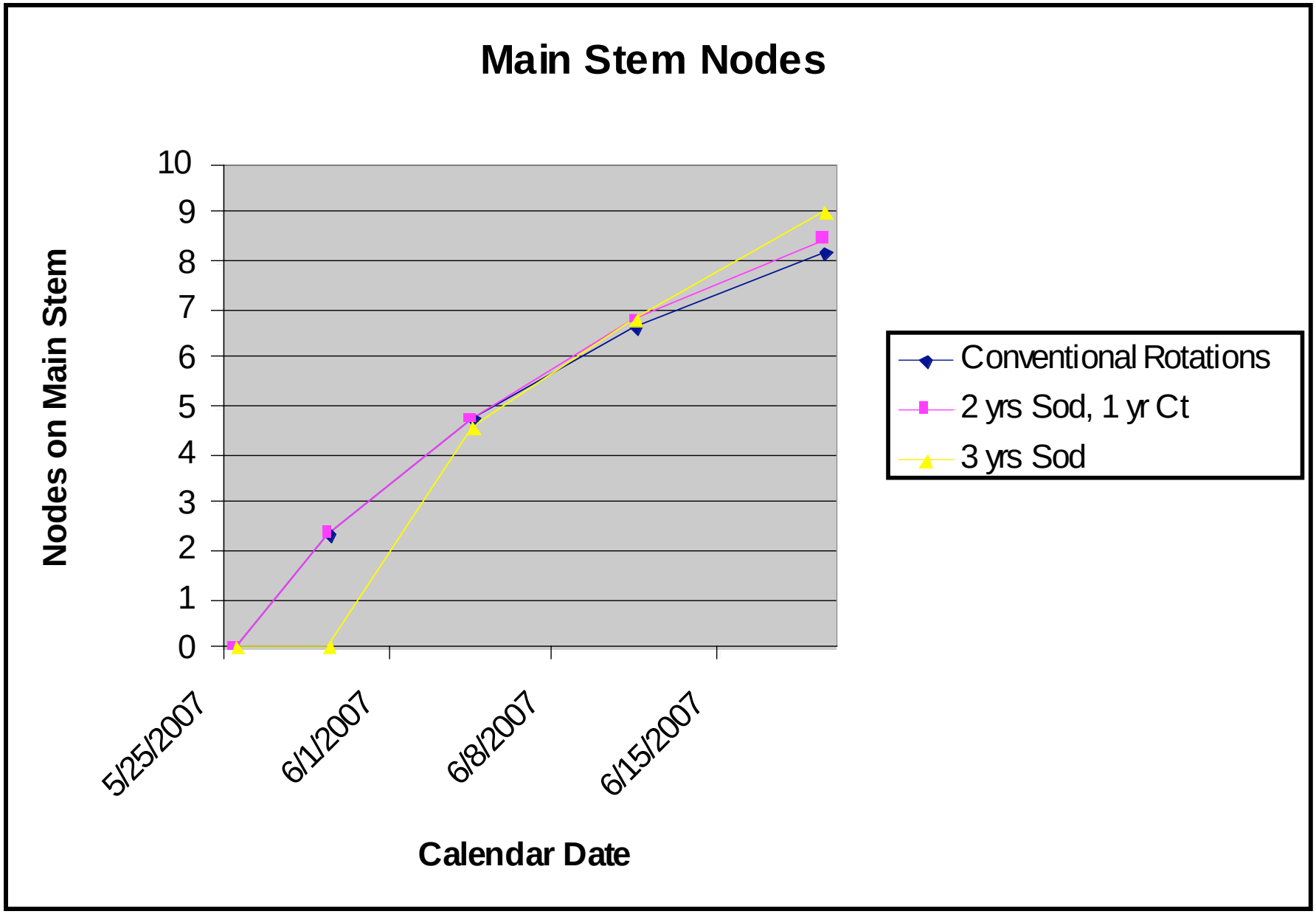
- Resistance to root penetration.
  - Major difference in soil quality parameters.
- Lower resistance following 2 yrs grass at increasing depths.
  - Greater soil volume utilized by plant?
  - Yield response seen this year.
- Inclusion of grasses enhanced yield in 2006.
  - Yield enhancement may be magnified by lack of rainfall.
- Perennial grasses may be useful for moving into conservation tillage management plans.

Future Research Goals

- Continuous measurement of soil moisture content following planting using moisture probes.
- Stratify measurements of organic matter to see if greater changes are seen at shallow depths.
- Determine response of peanut to rotation.
  - Peanut will be planted in all plots except continuous cotton.
  - Disease suppression from rotation of greater importance in peanut than cotton.

Peanut strip tilled into 3 yrs of orchardgrass vs. soybean-cotton-cotton.


Growth
Stage
V8
Main Stem
8
7
6
5
4
3
1
2
Cotyledon
Branches, Node 0


Main Stem Nodes
Nodes on Main Stem
10
9
8
7
6
5
4
3
2
1
0
5/25/2007
6/1/2007
6/8/2007
6/15/2007
Calendar Date
Conventional Rotations
2 yrs Sod, 1 yr Ct
3 yrs Sod

Questions???