Conservation Production Systems – A Basic Review

2013 Conservation Tillage Production Systems Training Conference

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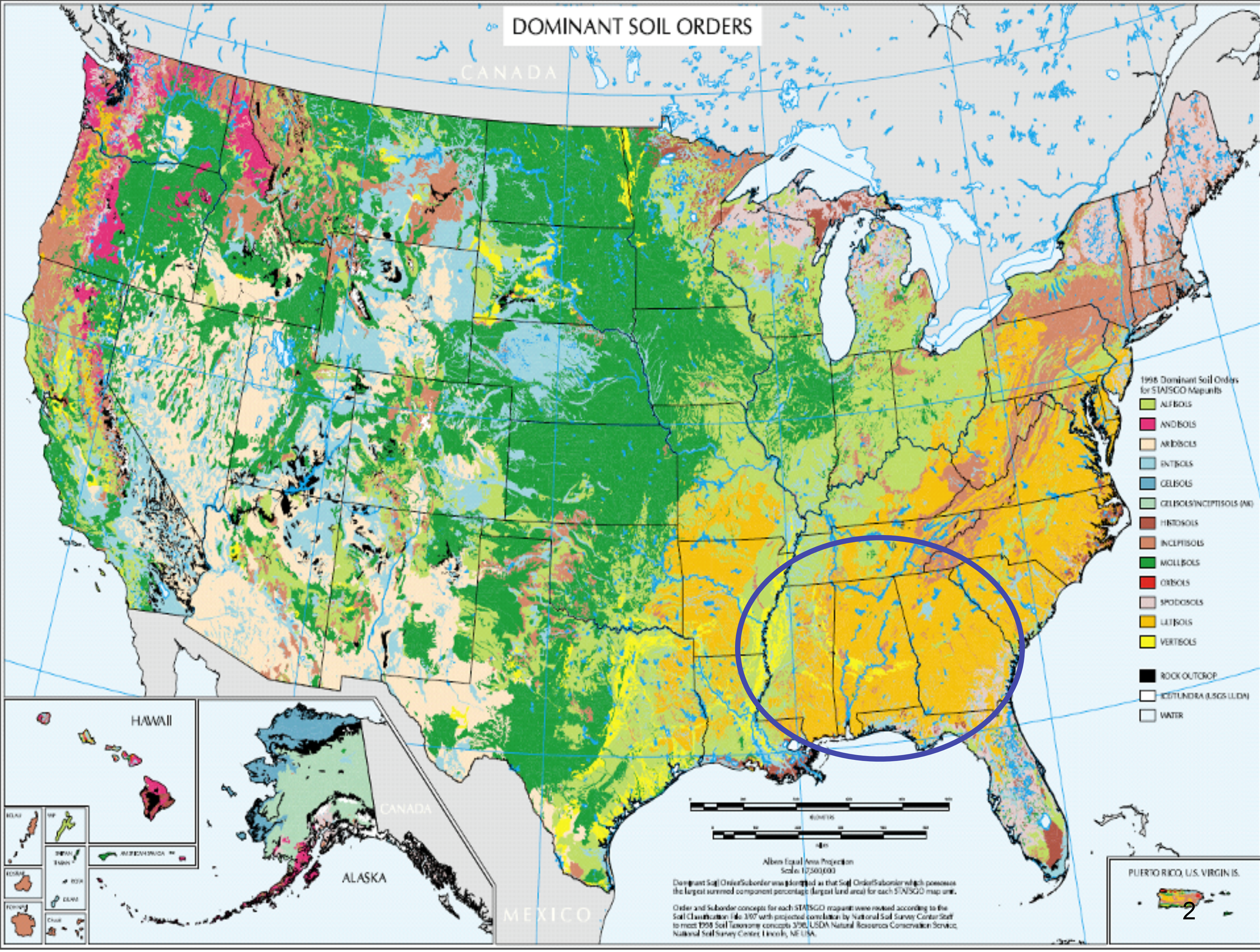
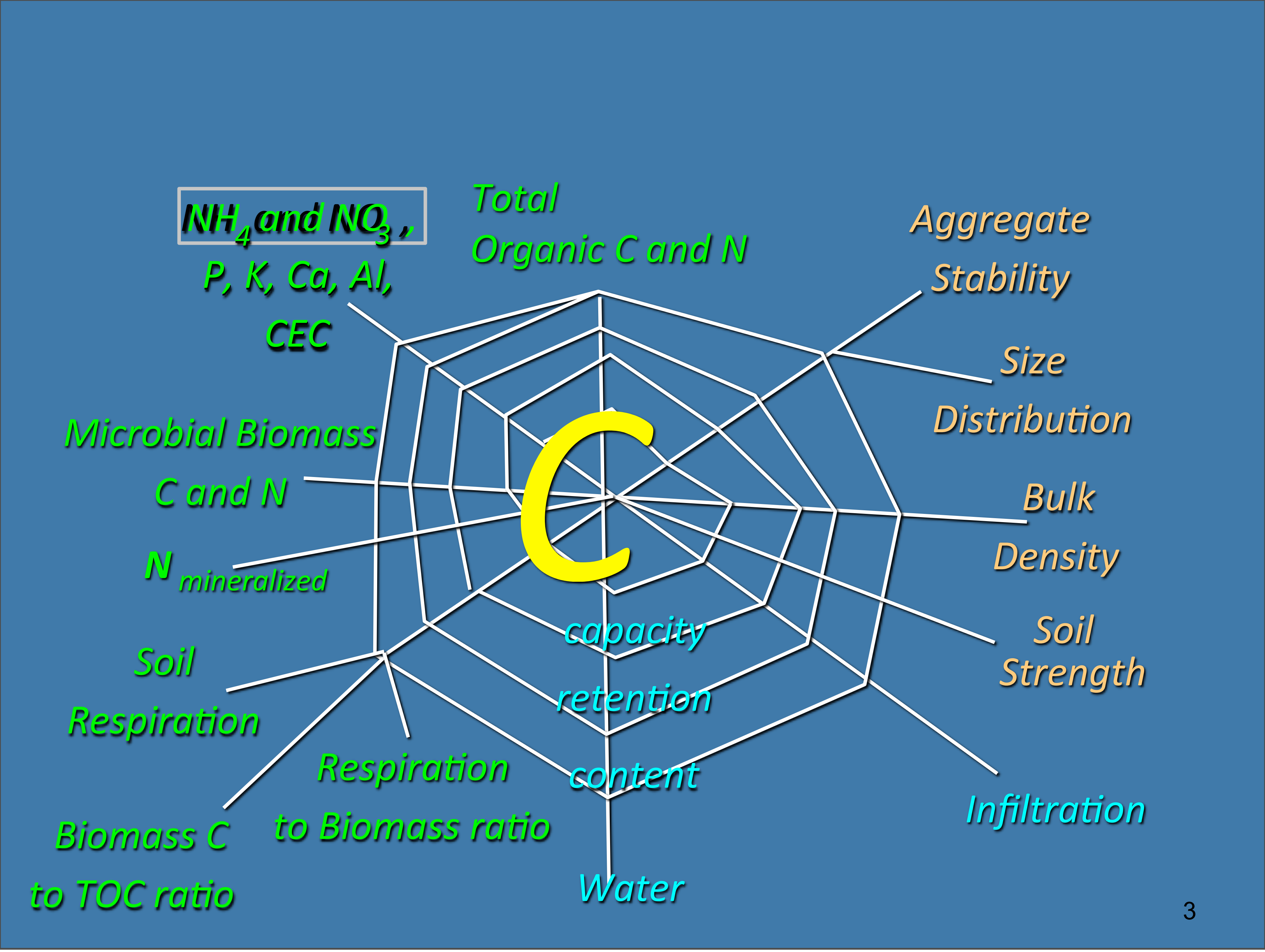
Conservation Systems Research

Auburn, AL



In case you are not familiar, I want to show you a map of the U.S. and give you and idea of where I am from. The research and application of this research that I plan to discuss applies to the Southeastern region of the U.S. The soils is this region are predominately Ultisols that are characterized by coarse soil textures, poor structure, and organic matter contents below 1%. These soils could certainly use some improvements through the use of conservation tillage.

The blue star is also for reference and indicates where the National Soil Dynamics Lab is located in Auburn, AL.



Soil C is the basis of soil quality and productivity. It affects many physical and chemical soil properties as indicated by this illustration. By increasing soil C, the positive effects associated with these soil properties are also enhanced.

How to increase soil C and improve soil quality?

✓Conservation Tillage with Cover Crops

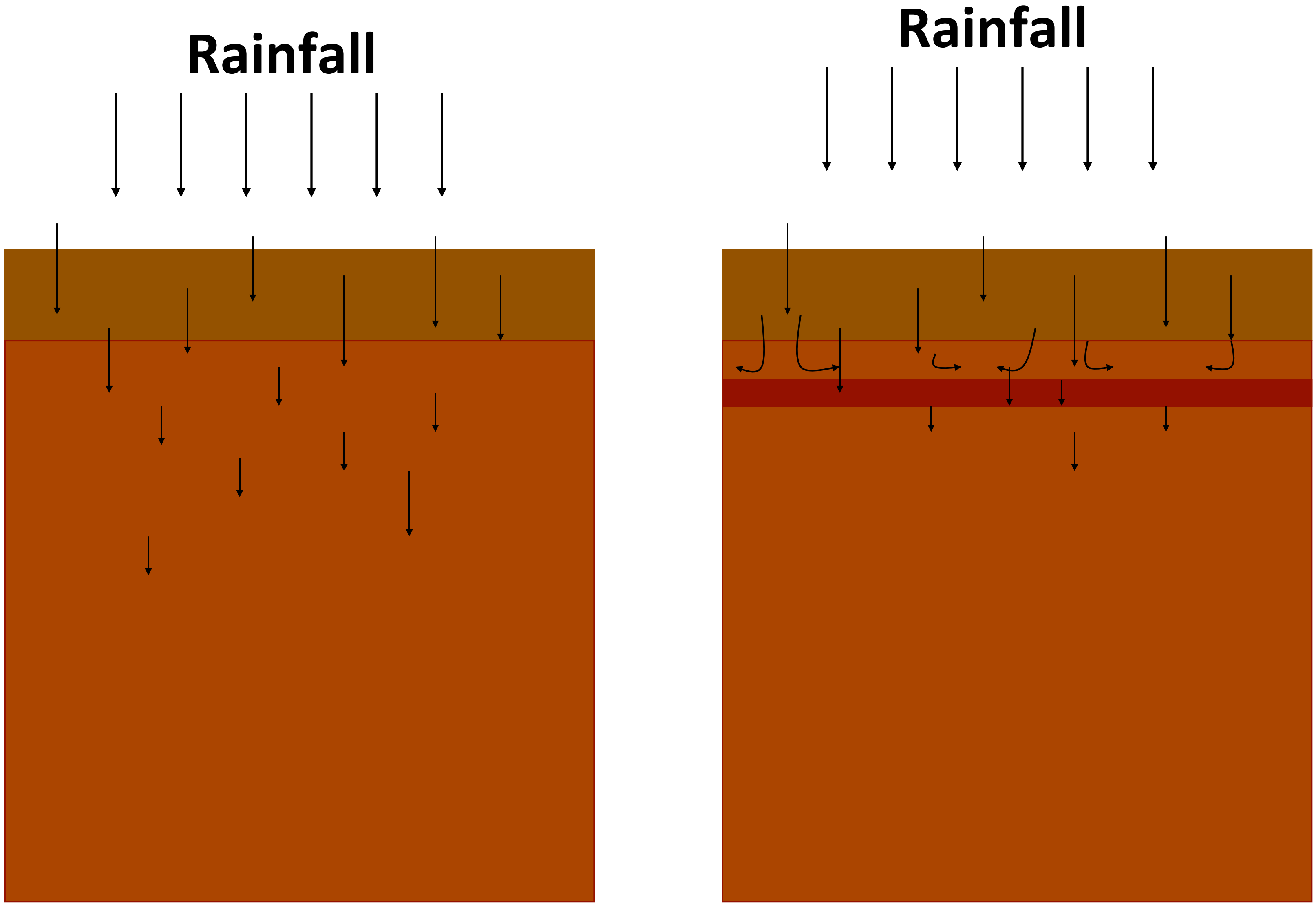

In our part of the world, we use a two pronged system to increase soil C. This involves a tillage component and a cover crop component. We try to use non-inversion tillage to maintain surface residues and maximize below ground disruption. With the cover crops, we want to utilize a high residue cover crop.

Conventional Tillage Promotes SOM Oxidation

Manage compaction . . .

Our Coastal Plain soils are particularly susceptible to hard-pan formation. We are not able to utilize no-tillage because our soils have the potential to form hard pans. Obviously, the hard pans limit the rooting depth and hinder nutrient and water uptake. The picture on the right shows the hardpan belowground and the grooves are where implements have scratched across the top of the hardpan, but they have not fractured the hard pan.

Soil Compaction



Non-inversion Tillage

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Residues/Soil C

Surface soil effects are most critical

We have discussed the benefits of increasing soil C. These effects are most pronounced in the surface soil. By minimizing surface soil disturbance and keeping the soil covered, we can increase surface soil C contents. It is difficult to change soil C levels very far below the soil surface, but increasing soil C near the soil surface can be very beneficial.

High Residue Cover Crop

I mentioned the second component of conservation systems for us is using a high residue cover crop. Based on the gentleman standing in the back, you can see we try to promote a lot of growth. Rye is a very popular choice for us due to its adaptability to many soil types, biomass potential, and resistance to decomposition. In addition to the aboveground portion, the root system helps to minimize hard pan formation and help break up existing hard pans.

What is a Cover Crop?

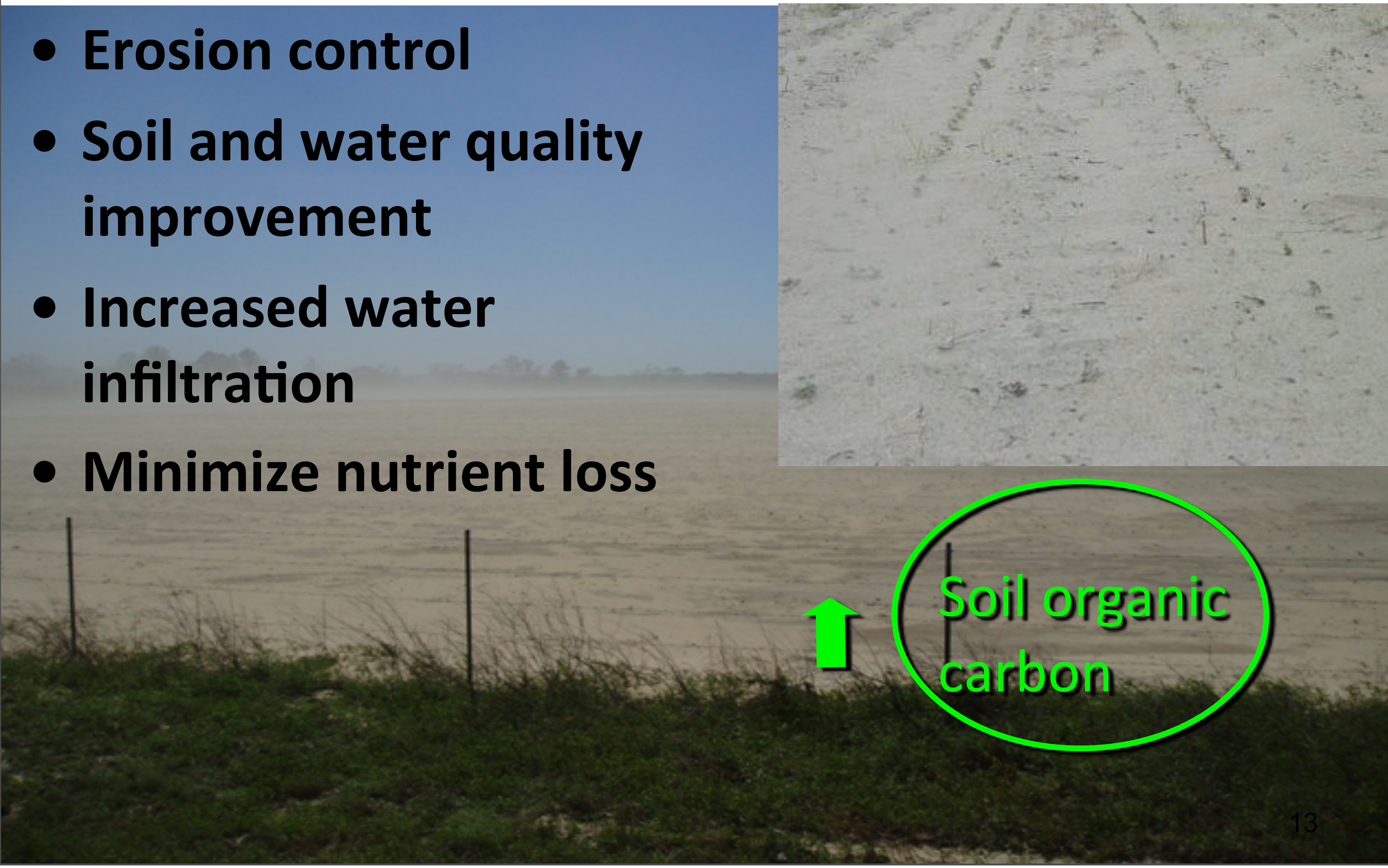
- A crop whose main purpose is to benefit the soil and/or a subsequent crop in one or more ways, **but is not intended to be harvested for feed or sale.**

Courtesy: Harry Schomberg, USDA-ARS

A cover crop is a crop whose main purpose is to benefit the soil or other crops in one or more ways, but is not intended to be harvested for feed or sale.

Why use Cover Crops?

- Erosion control
- Soil and water quality improvement
- Increased water infiltration
- Minimize nutrient loss



Cover crops can provide several benefits both for the farmer and for society. These include erosion control and improved soil organic matter, the capacity to provide nitrogen (from legumes), to recycle nutrients from deeper in the soil profile, and to take up and retain nutrients against loss through leaching or erosion. Well-managed cover crops can also decrease weed management costs while conserving water and decreasing the need for irrigation. Cover crops can provide habitat for wildlife including deer, ground nesting birds, and rodents. Finally, cover crops can increase profitability of conservation tillage systems . Improvements in soil productivity and profitability are usually seen after the second or third year, when the on-going addition of residues has resulted in soil quality improvements.

Cover Crop Fertilization

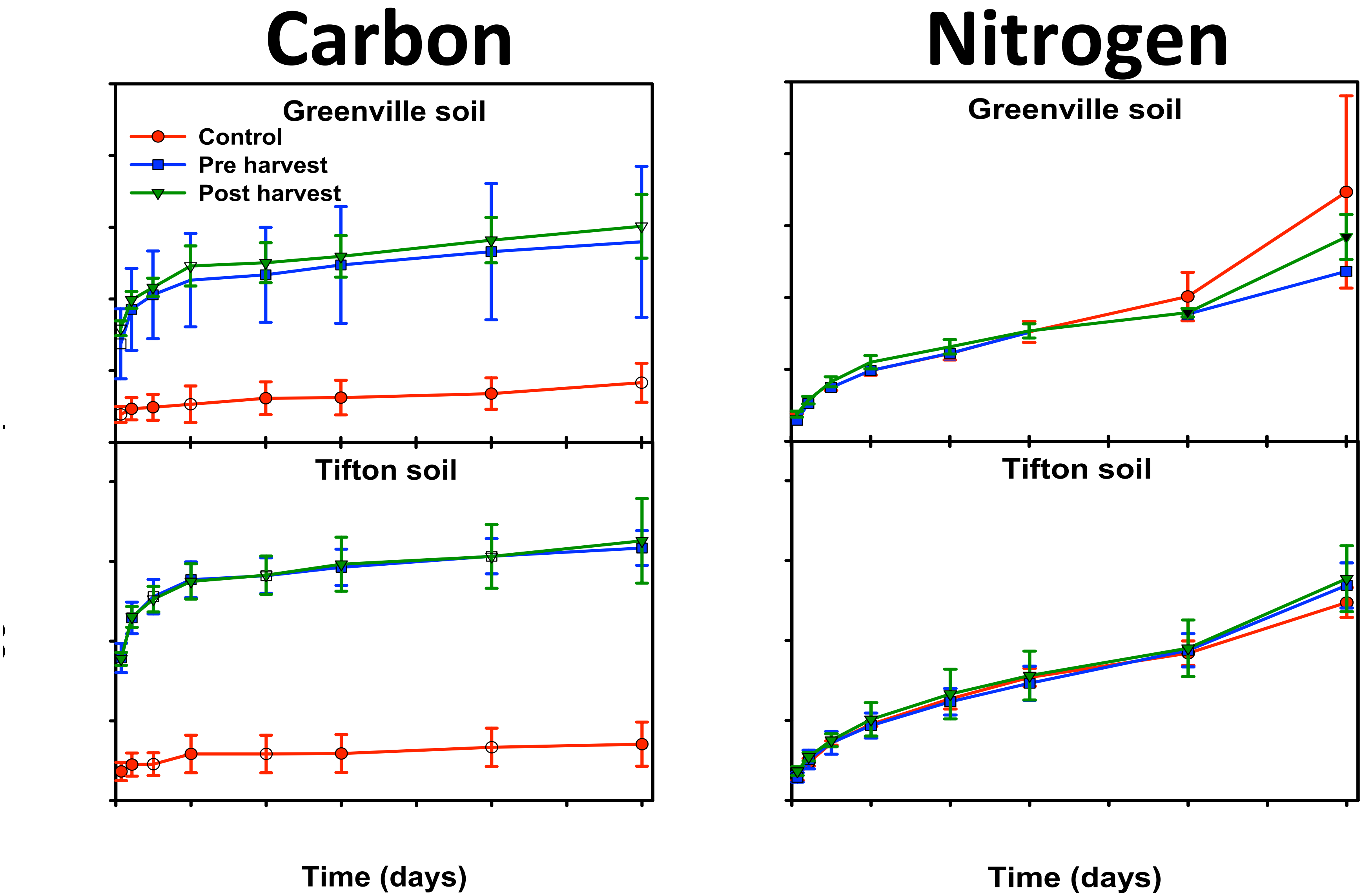
N Contribution of Peanut Residue

- **Estimate N contributed by peanut residues to a succeeding rye cover crop in a conservation tillage system.**

- **Utilized laboratory and field studies.**

Peanut residue did not contribute significant amounts of N based on 3-year biomass yields.

Peanut Residue Mineralization

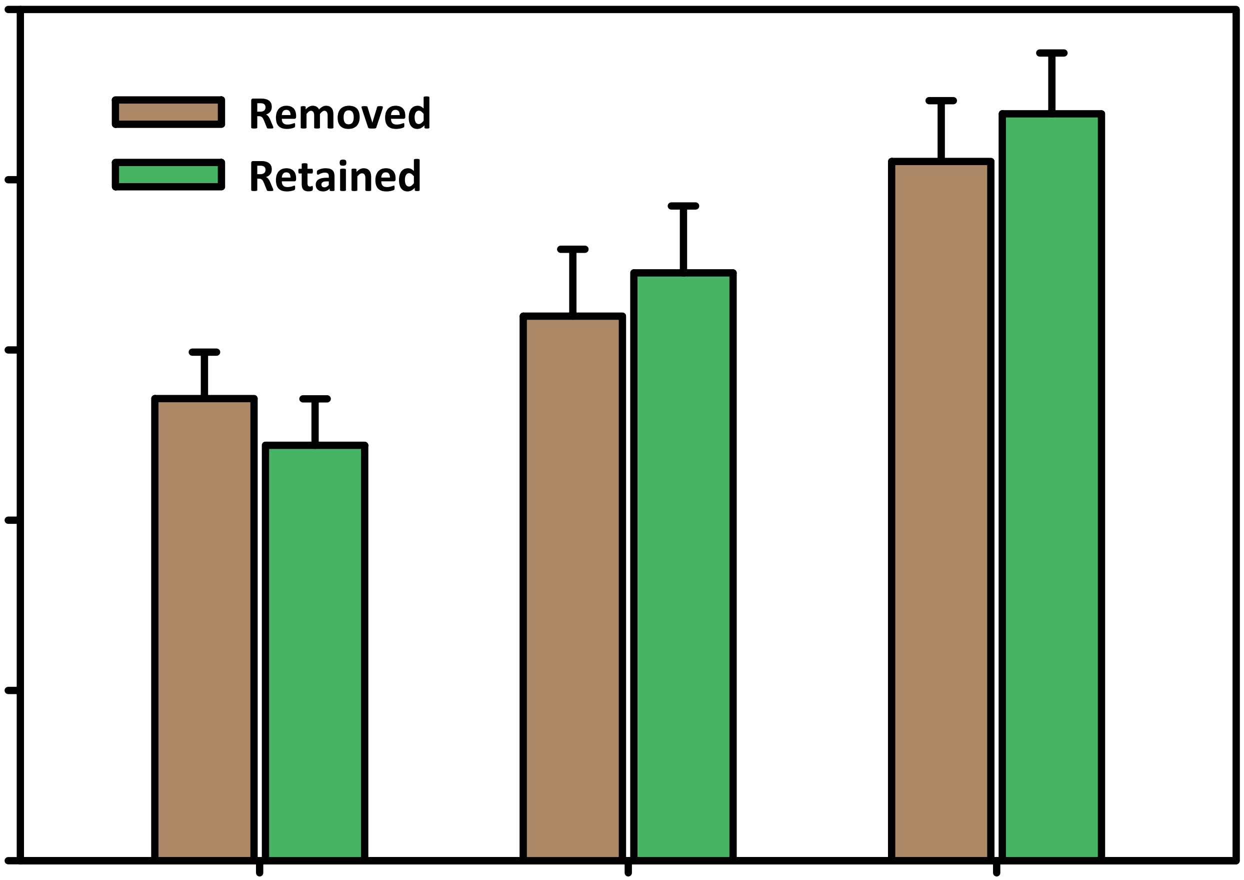


Balkcom et al., 2004

Peanut Residue

Peanut crop year	Peanut biomass	C	N	C/N ratio	P	K	Ca
	lb ac^{-1}	-----%-----			---------%---------		
2002	2820	42.2	1.7	25.3	0.10	1.2	0.83
2003	2880	44.0	1.1	39.6	0.16	1.3	1.2
2004	3000	36.2	1.4	26.6	0.18	0.35	0.97

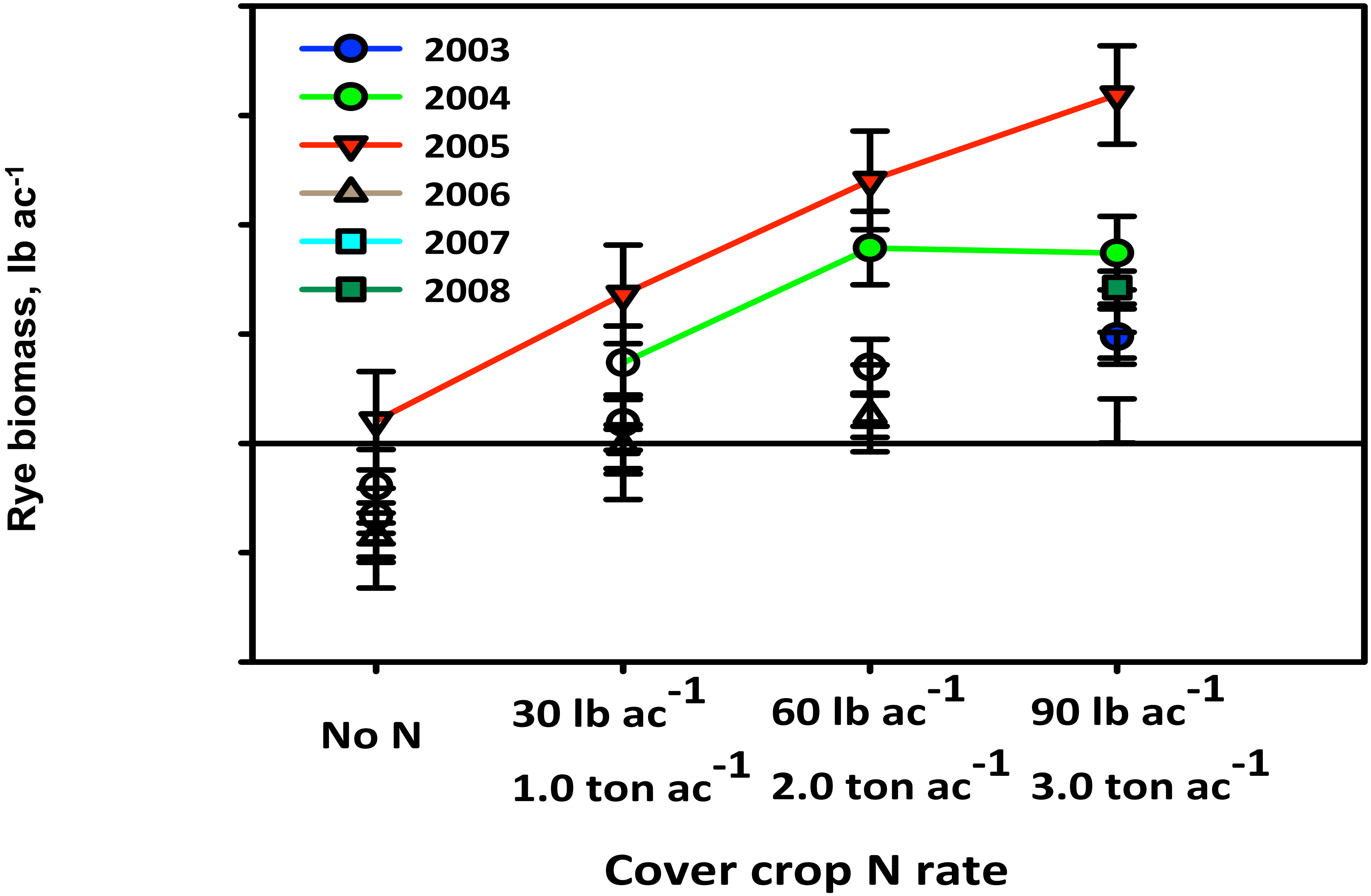
Peanut Residue



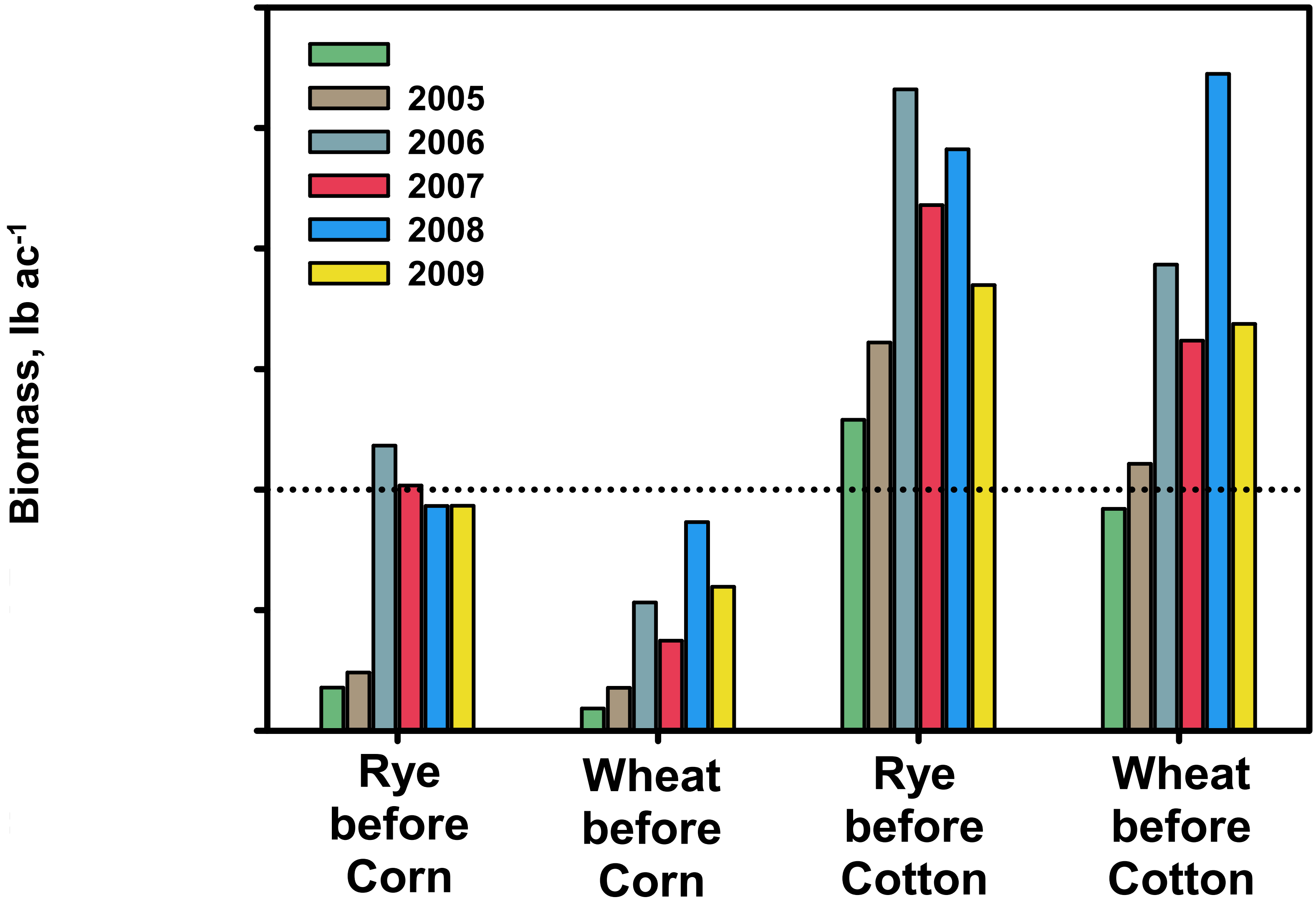
WGS Headland, AL

Alternative N Sources

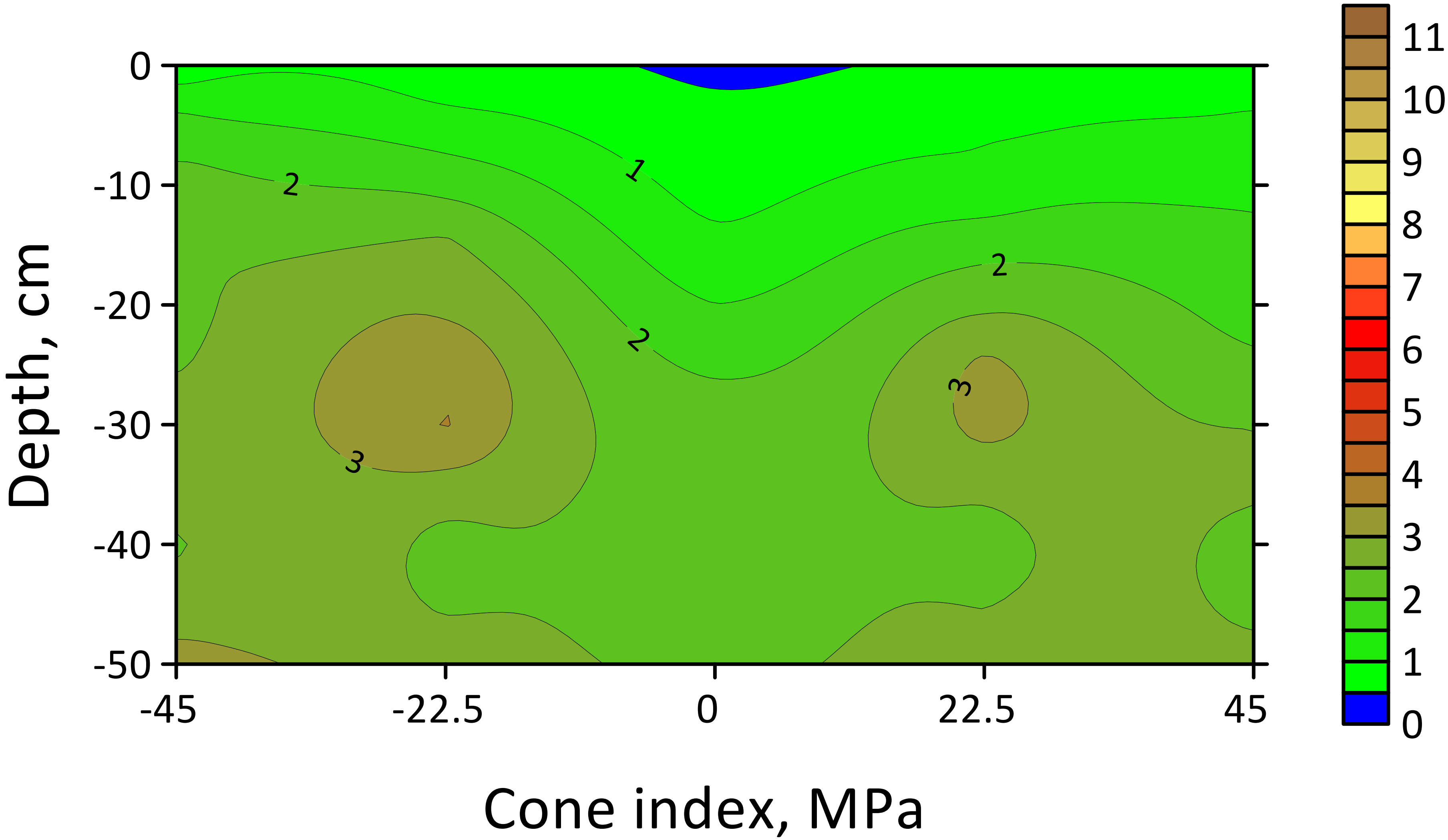
- **Compare N sources, rates, and time of application for a rye cover crop to maximize biomass production.**


2003
2004
2005
2006
2007
2008
Rye biomass, lb ac-1
No N
30 lb ac-1
1.0 ton ac-1
60 lb ac-1
2.0 ton ac-1
90 lb ac-1
3.0 ton ac-1
Cover crop N rate

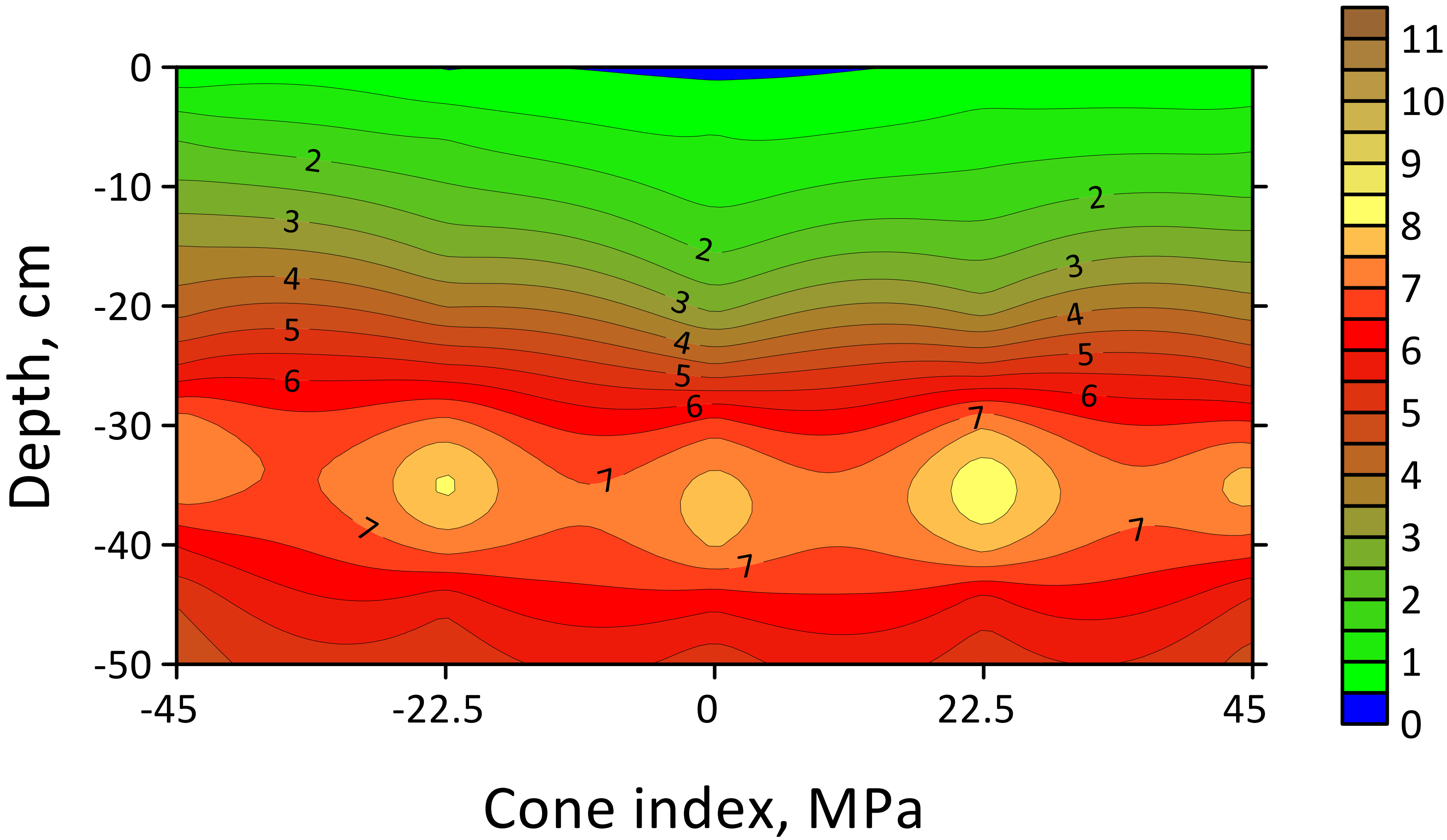
Biomass Production
Time of Termination



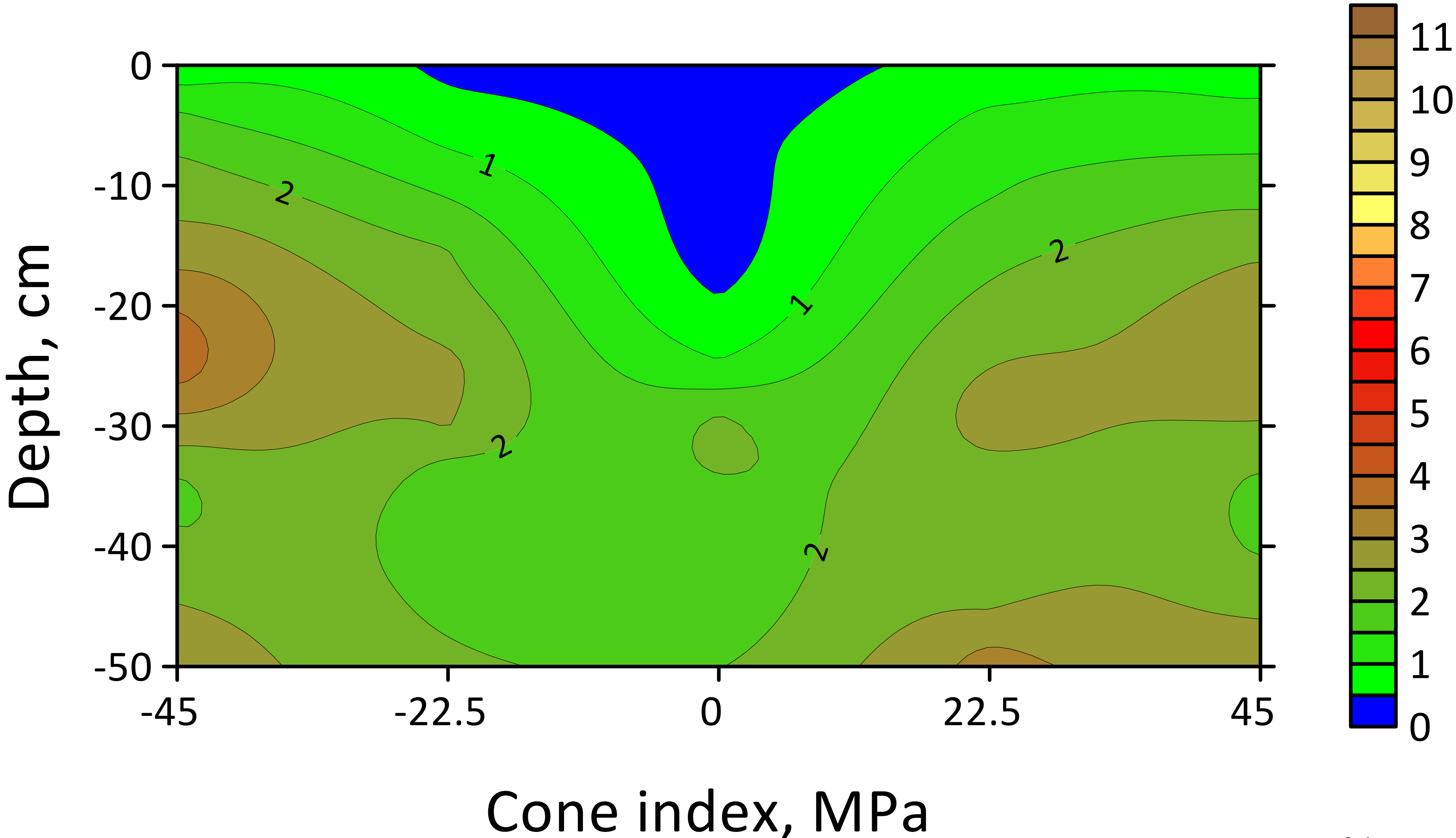
Headland – Initial Plots; No Cover Crop



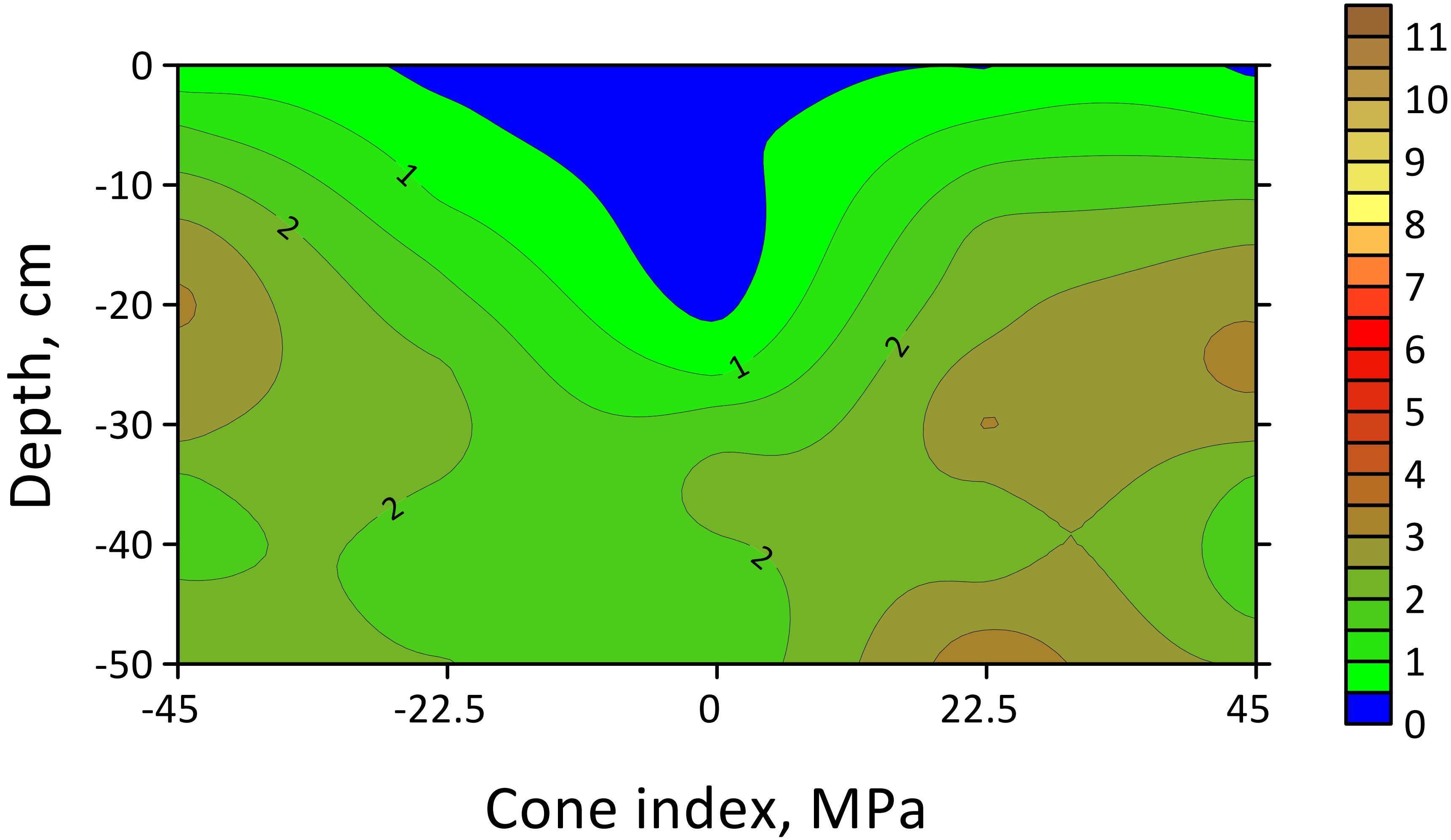
Headland – Initial Plots; Cover Crop



Headland – At Planting; No Cover Crop



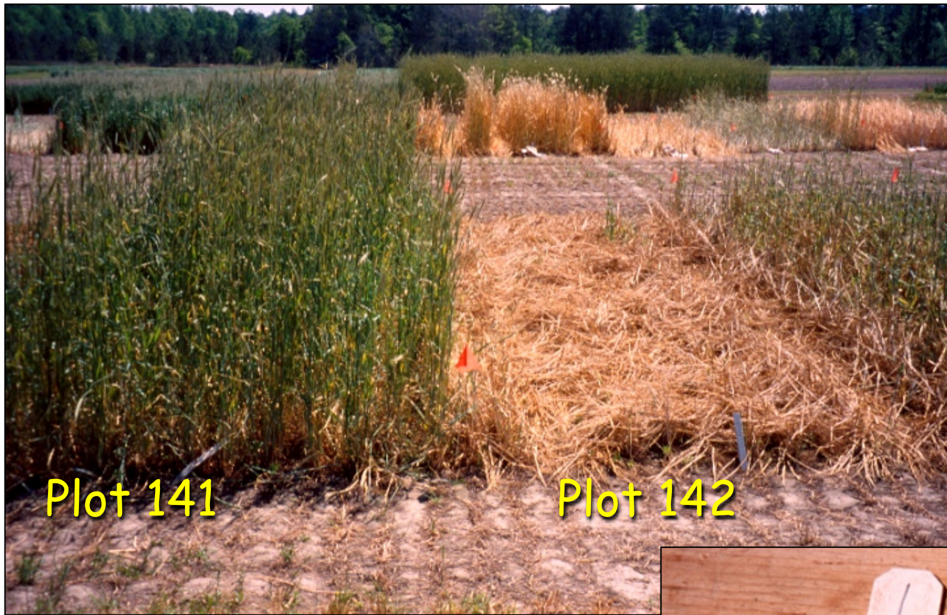
Headland – At Planting; Cover Crop



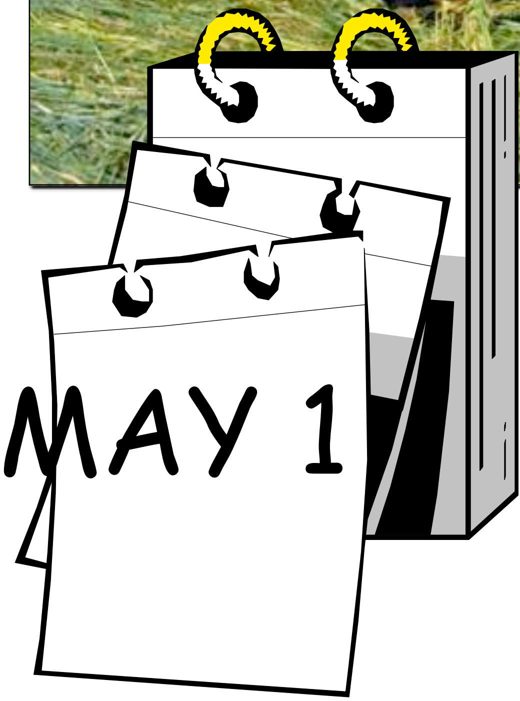
Headland – Soil Moisture; 2 Depths

	Initial		At Planting		Harvest	
Cover	Depth (cm)		Depth (cm)		Depth (cm)	
Crop	0-15	15-30	0-15	15-30	0-15	15-30
	-----------------------Soil Moisture, %---------------------------					
No	8.38	9.65	8.38	10.32	6.75	6.51
Yes	7.81	7.46	9.54	10.36	7.45	7.29

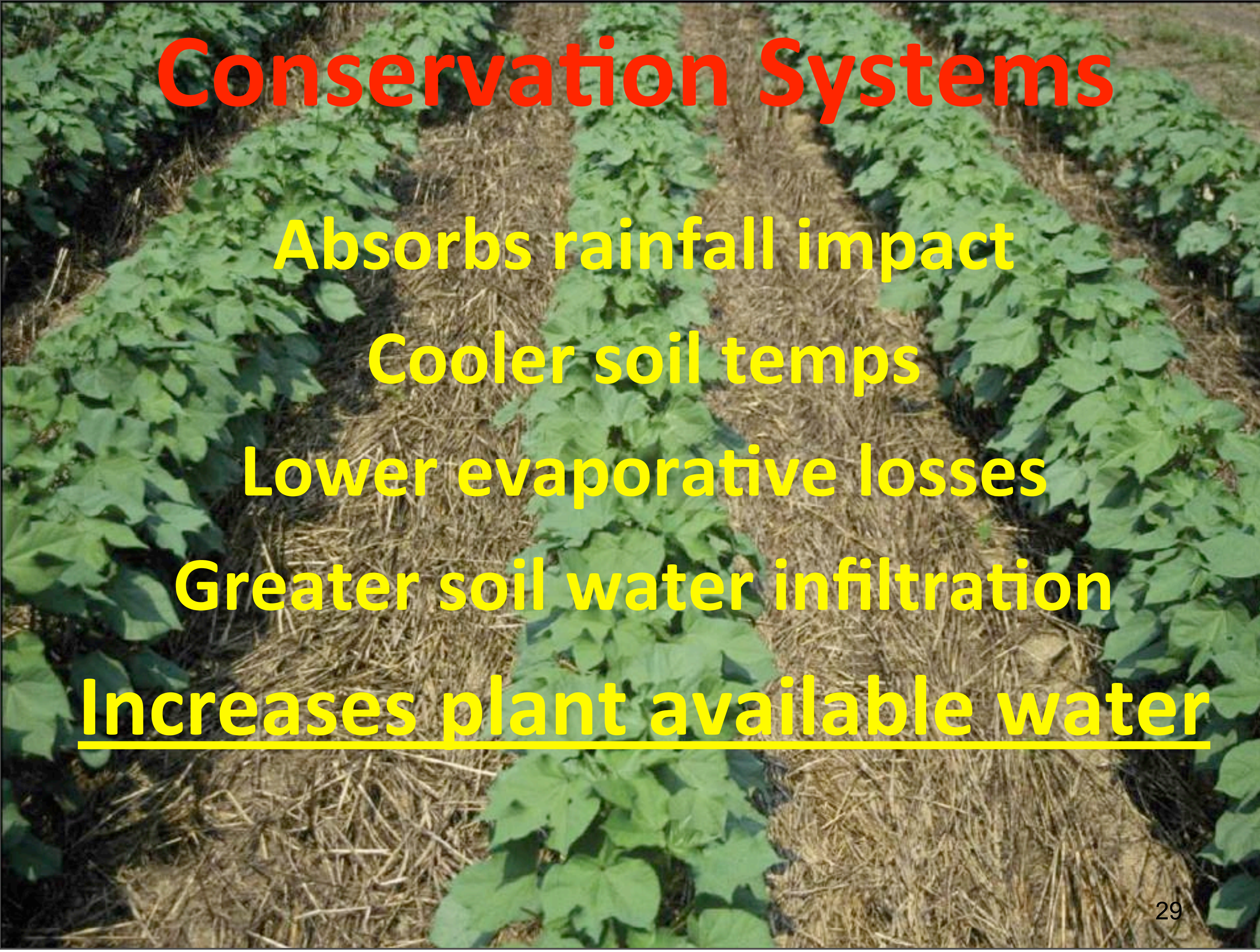
Soil Water Conservation



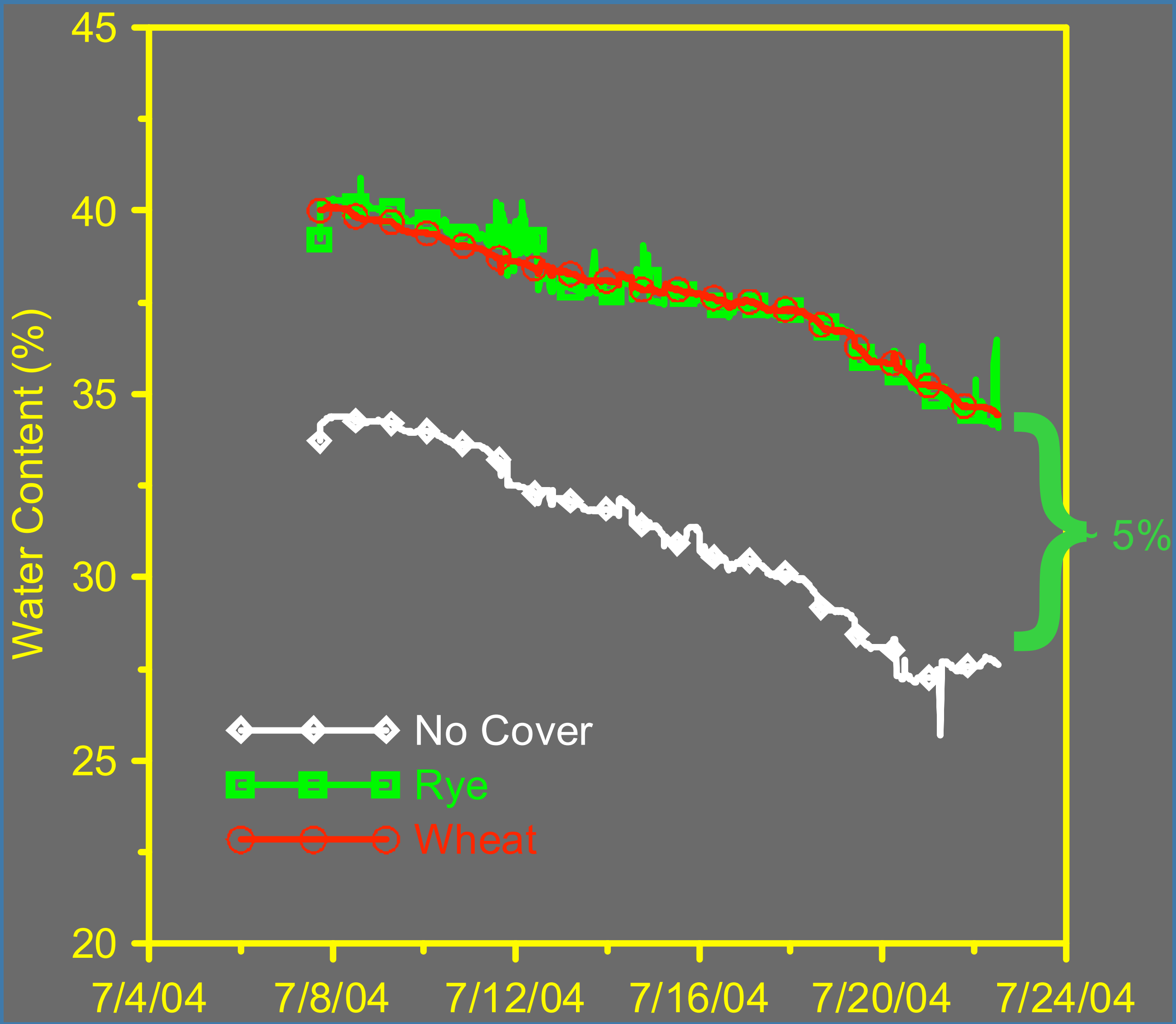
Timing Termination



2-4 weeks

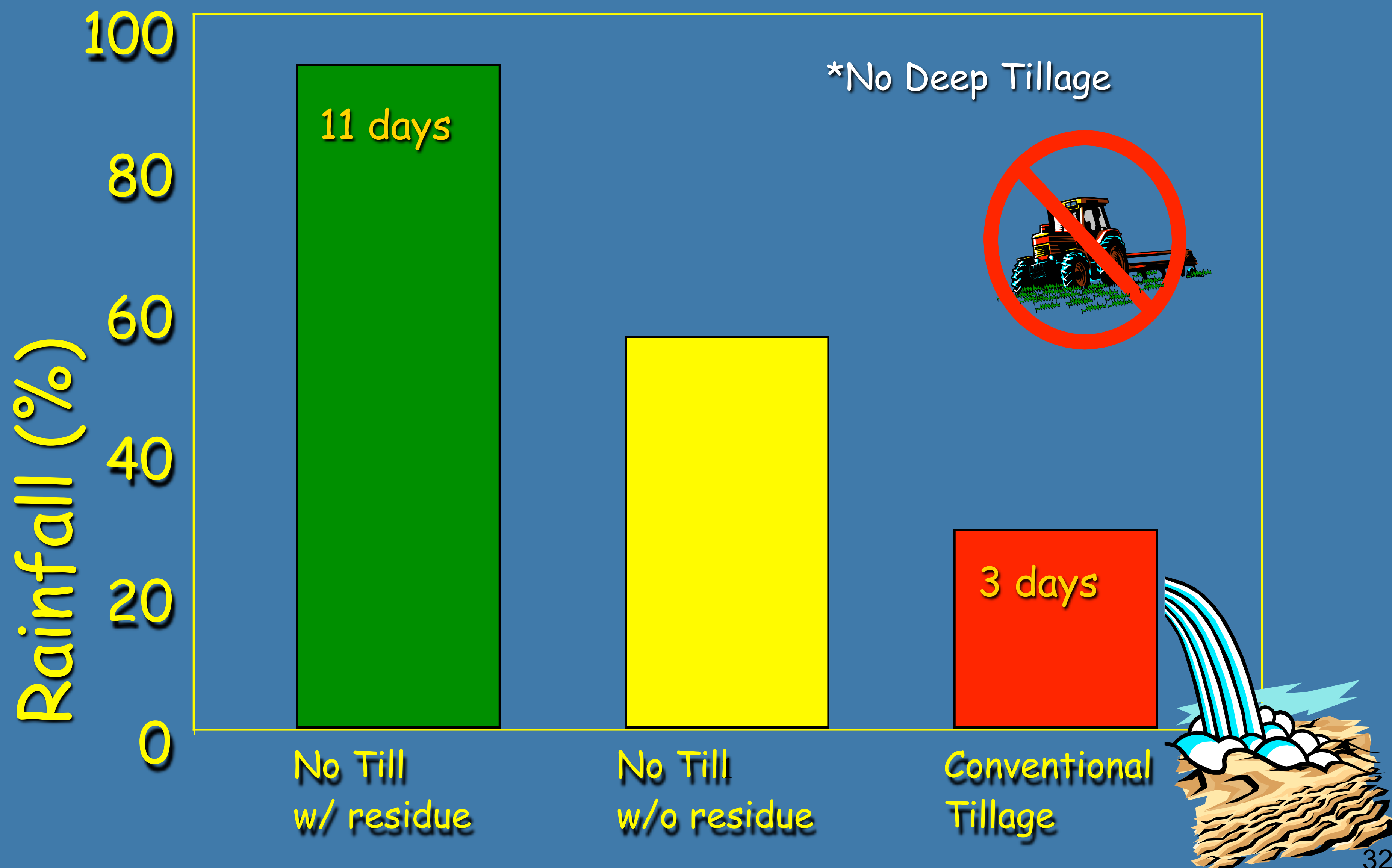

Conservation Systems
Absorbs rainfall impact
Cooler soil temps
Lower evaporative losses
Greater soil water infiltration
Increases plant available water
29

Water Content-Cover Crop



Rainfall Simulations

Tillage and residue effects on infiltration of a Coastal Plain Soil (2-inch rain event)

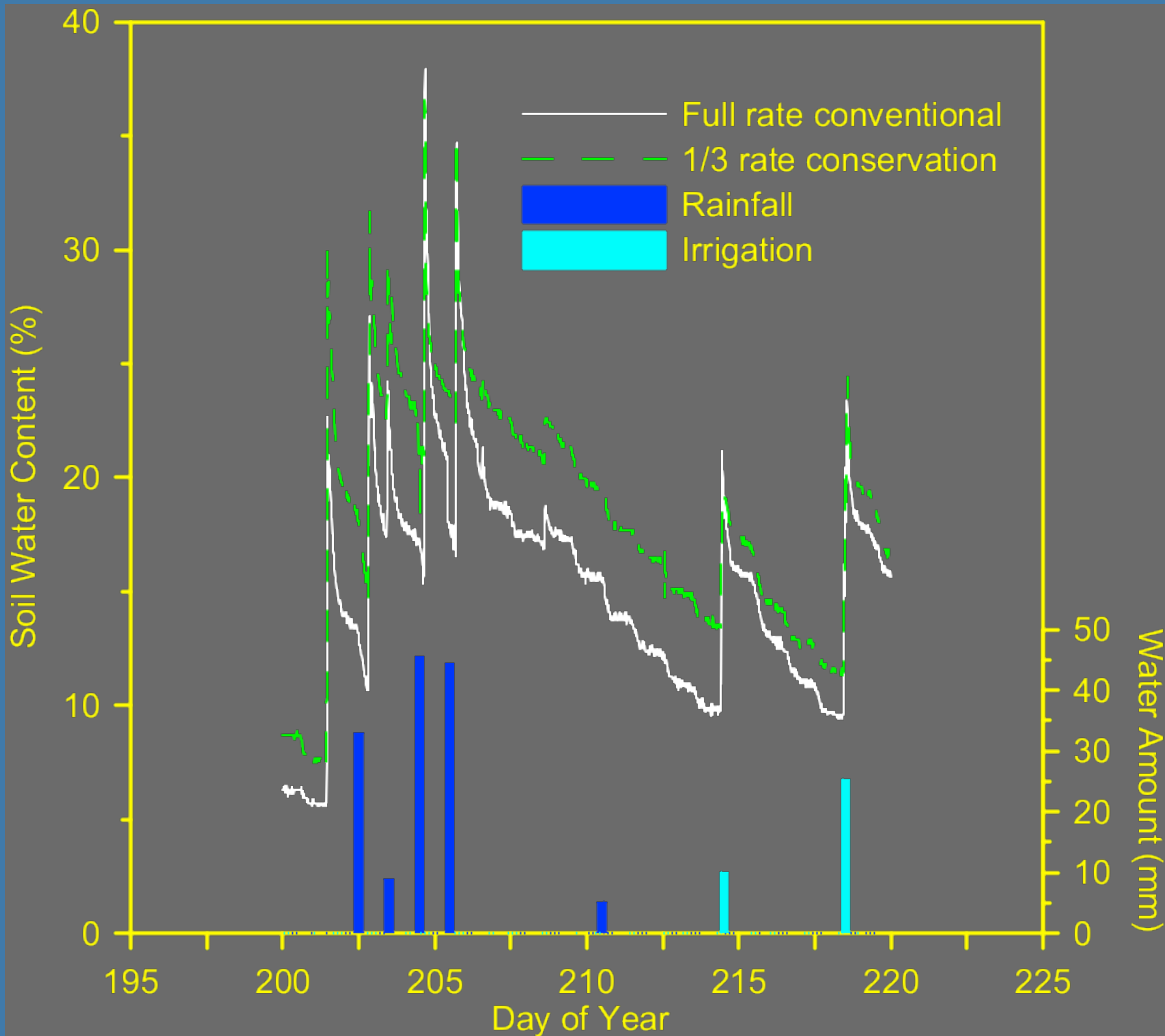


Rainfall Simulations

			Infiltration		Runoff			
Soil	Tillage	Time in tillage regime (years)	mm/h	% rainfall	mm/h	% rainfall	ET assigned (mm/d)	PAWest (days)
Tifton	CT	6	26.0	51	25.0	49	7	3.7
	ST	6	44.0	80	11.0	20	7	6.3
Cecil	CT	15	25.0	44	31.0	56	6	4.2
	ST	15	51.0	90	6.0	10	6	8.5

Sullivan et al. (2007)

Soil Water Content and Irrigation



(unpublished data)

Increased Plant Available Water

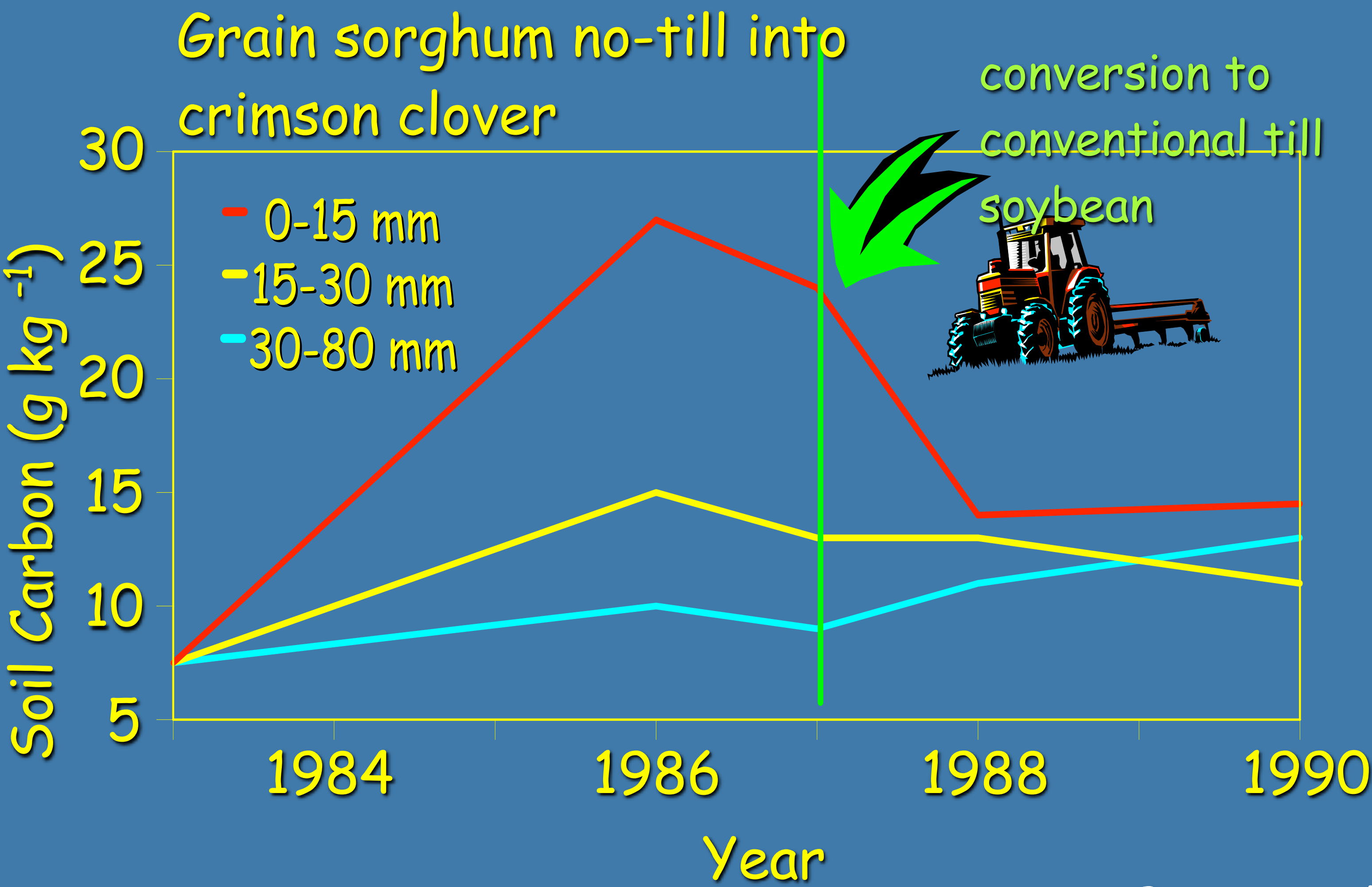
- **Increases efficiency of a rain or irrigation event.**
- **Potential lower water requirements.**
- **Preserve water resources and lower production costs.**

Peanut Yield (2002)

	Irrigation Level %			
Tillage	0	33	66	100
	-------------lb/ac-------------			
Conv	3265	4267	4770	4681
Strip	3349	4506	4818	4958

1994-2001 state avg. 2787 lb/ac
(Georgia Agricultural Statistics Service)

Effect of cropping/tillage system on soil C from an eroded Ultisol in Georgia.



Bruce et al., 1995

This slide illustrates how a specific rotation affects soil C levels in an Ultisol in Georgia over a period of time. You can see the most dramatic increase was in the most shallow depth. The graph also illustrates what happens when conventional tillage is introduced back into the system. The organic C levels drop very rapidly and fall back to levels equal to the lower depths.

Benefits of Conservation Systems

- Soil erosion control - increased soil quality
- Increased water infiltration and storage – potentially increase yields and profits
- Preserve water supplies (e.g. streams and lakes)

Conservation Systems Research

Managing Cover Crops Profitably, 3rd ed. Sustainable Agriculture Network. www.sare.org/publications/covercrops/covercrops.pdf

Schomberg, H.H., and K.S. Balkcom. Cover crops [Online]. Available at: www.soilquality.org/practices/cover crops.html

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