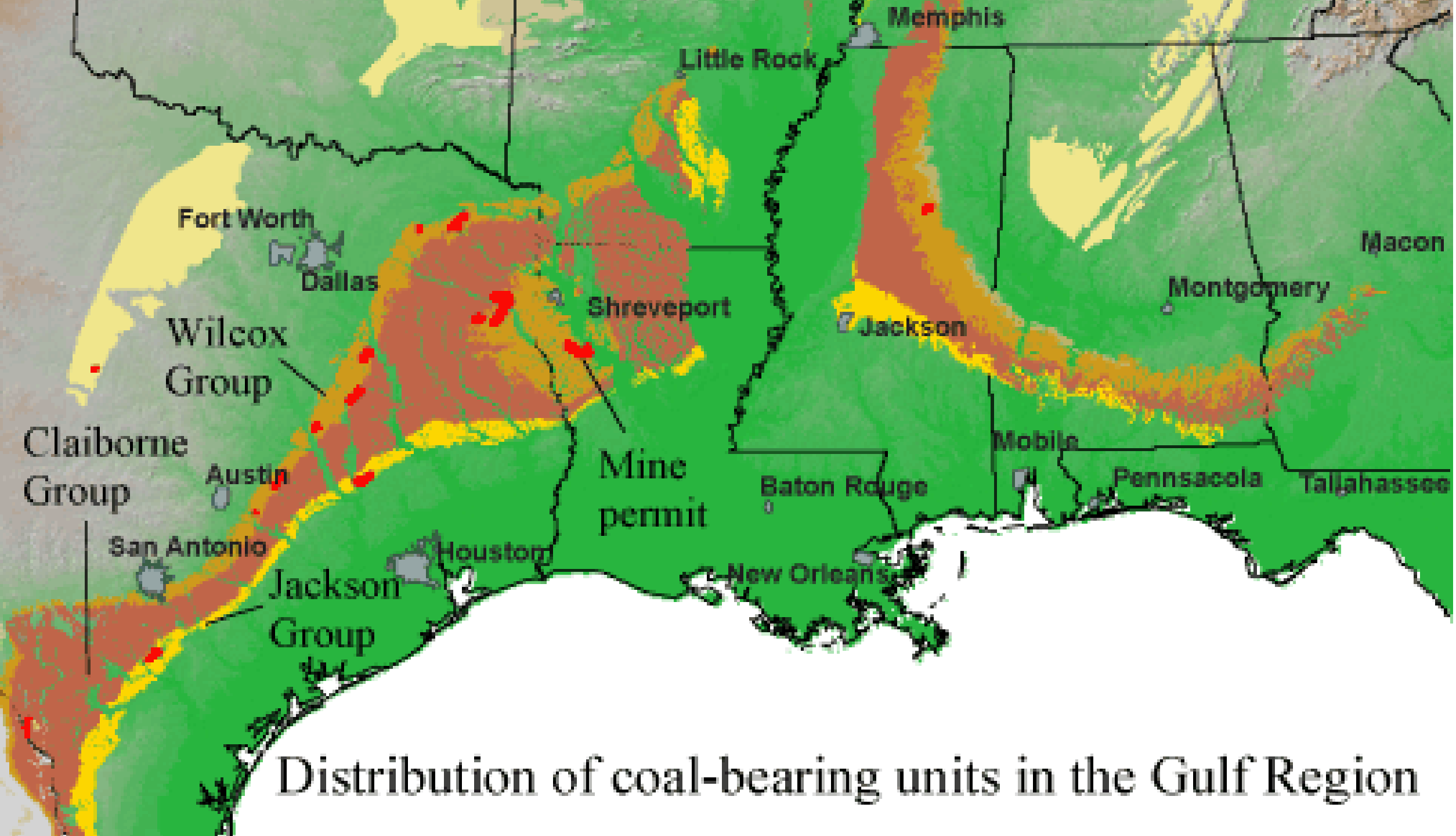


FORAGE NUTRITIVE VALUE AND PRODUCTIVITY OF GRASS ON RECLAIMED AND UNDISTURBED LIGNITE LAND

**David J. Lang¹, Brandon Shankle,
Jeremy Duckworth, Robert Elmore and
Vitalis Temu²**

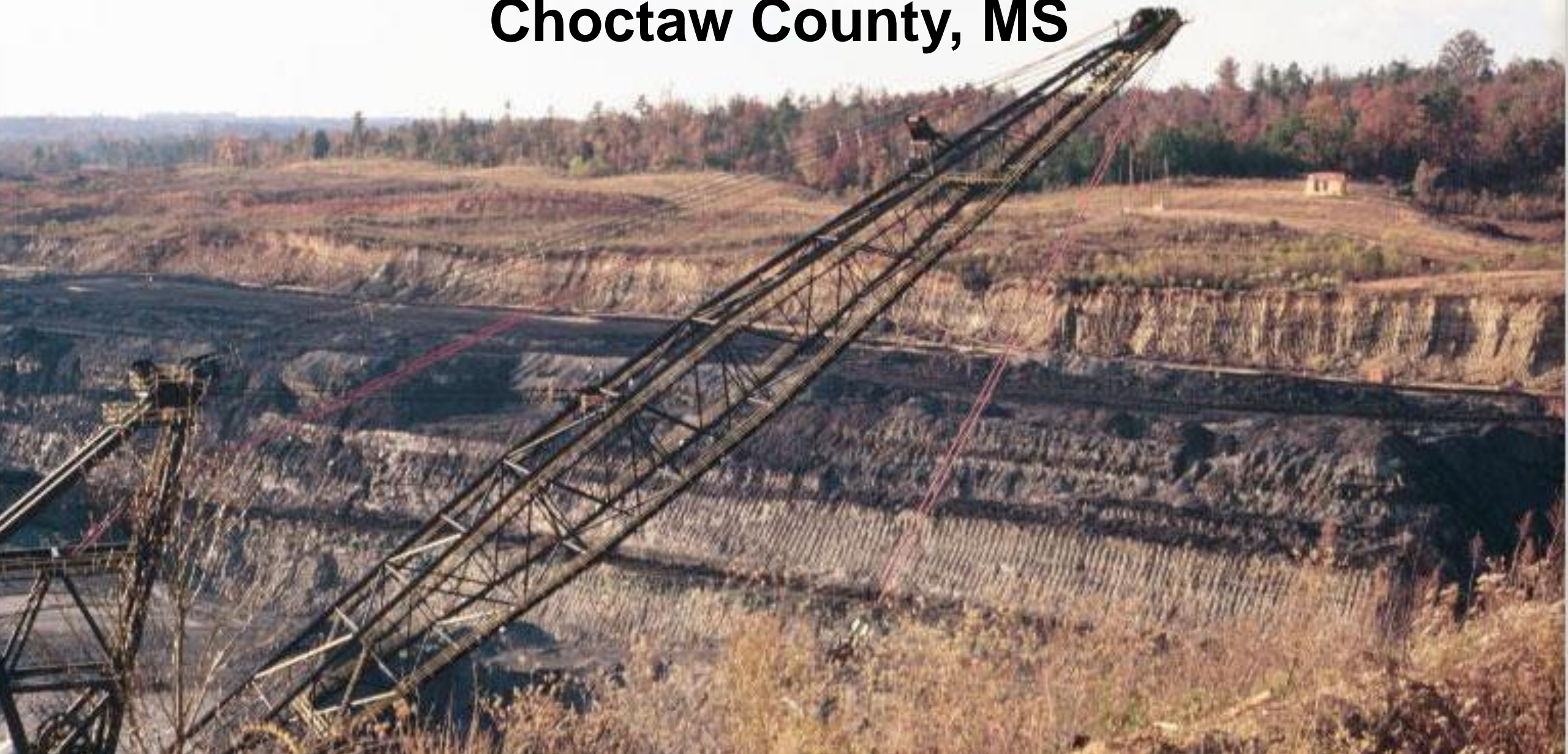
¹Mississippi State University, Plant & Soil Sciences, Mississippi State, MS 39762

²Virginia State University, Petersburg, VA 23806



Distribution of coal-bearing units in the Gulf Region

Red Hills Lignite Coal Mine - North American Coal Choctaw County, MS



Reclamation Sequence

- Red Oxidized Soil Substitute
- Incorporate
 - Fertilizer: 750 lbs 17-17-17 / Acre
 - Lime: 10 tons / Acre until 2004
- Plant Browntop Millet and Bermudagrass
- Plant Loblolly Pine



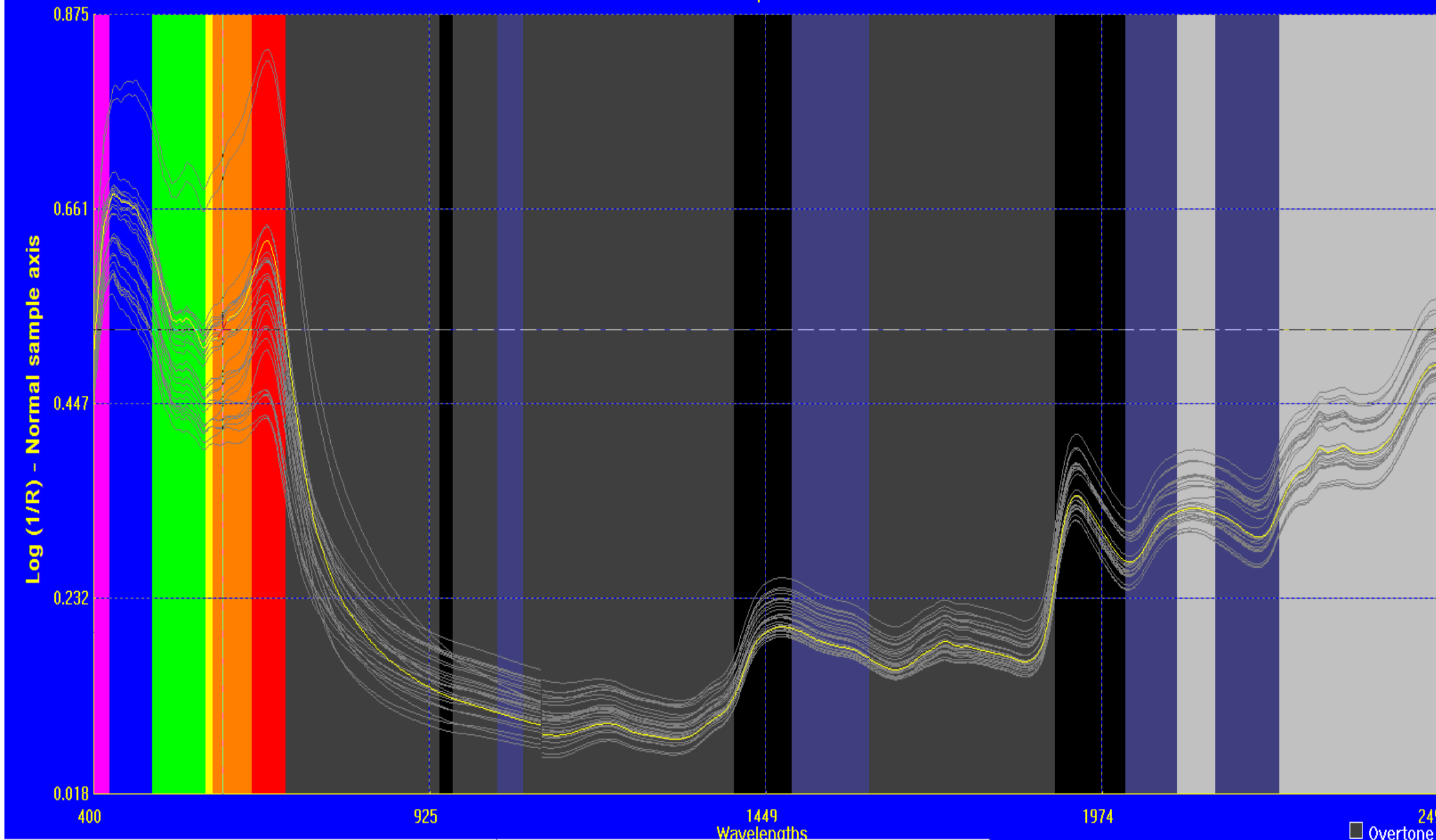
Unoxidized Overburden and Oxidized Soil Substitute Respread





ASMR 2015 – Prime Farmland Soil (PFL)

- **Productivity of Undisturbed Prime Farmlands – Bermudagrass**
- **Productivity of Reclaimed PFL and Potential Substitute for PFL**
- **Forage Nutritive Value by Near Infrared Spectroscopy (NIRS)**
 - **Fiber (ADF and NDF), Digestibility, and Lignin**
 - **Protein, Minerals (Ca, P, Mg, K) and Ash**



X = 602 Y = 0.52808619

Visible region

▲ Position 19 Sample number L2448

▼ Position 20 Sample number L2449

■ Overtone

■ O-H

■ N-H

Yield Potential of Native Soils in Choctaw County, MS

Soil	Wheat	Bermudagrass	Pine
	Bu/A	Lbs/A	Site Index
Oaklimiter	35	9000	90
Chenneby	30	7000	90
Upland – Non Prime Farmland (Red Oxidized)			
Smithdale Sweatman	30	4000	80

NRCS Planting Guidelines – Bermudagrass:

- **Fertility requirements:** “Use soil test recommendations for optimum production. In lieu of a soil test apply 400 lbs/acre of 13-13-13 at time of planting. For maintenance, apply 70 lbs N, 40 lbs P₂O₅ and 40 lbs K₂O.”

Misinterpreted as only 70-40-40

and that is not enough for hay production cut 3 to 4 times per summer

- **Mississippi State University Extension:**

Crop	Yield Range	Maintenance	
		Grazing	Hay
Common Bermuda Grass	1-2 tons/acre	90-20-60	120-40-80
	2-4 tons/acre	180-40-80	240-80-200
	With Legume	2-4 tons/acre	90-40-80

- Split 3-4 times after each cutting

Prime Farmlands

- **SMRCA requires prime farmland topsoil and subsoil layers to be replaced**
- **Substitute Materials can be used if they are demonstrated to:**
 - **Have a greater productive capacity**
 - **Productivity that is equal to or greater than pre-mining prime farmland productivity**
 - **Are the best available materials located at the mine site**

Prime Farmland Reconstruction

- **Current Plan at RHM is to Recover and Replace the Top 12 Inches**
 - **Leached and Worn Out (Particularly on Upland Sites)**
 - **Operationally Difficult**
- **Better Long-Term Productivity may be Achieved if a Portion of the Subsoil Layers are Mixed with the Topsoil**

Oaklimiter Soil Landscape



A wide, flat expanse of light brown, sandy soil, likely a field or clearing. The soil is mostly bare with some sparse, small green plants and scattered twigs. In the background, there is a dense line of trees, including several tall, thin pines and a thick stand of deciduous trees. The sky is clear and blue. The text "Oaklimiter Soil in Choctaw County Mississippi" is overlaid in yellow in the center of the image.

Oaklimiter Soil in Choctaw County Mississippi

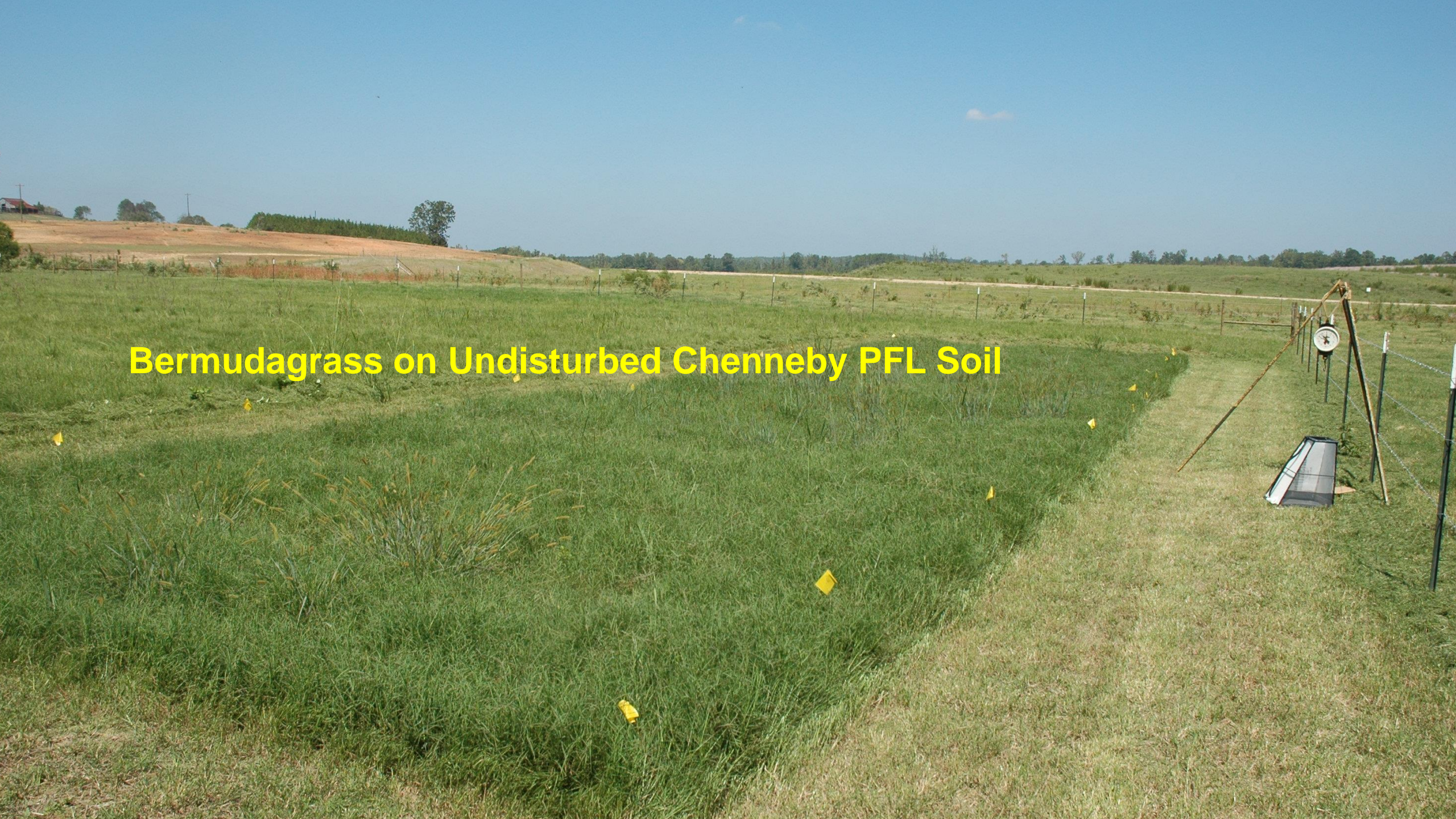


Chenneby Prime Farmland Soil
Similar to Oaklimiter Soil, BUT much Wetter!

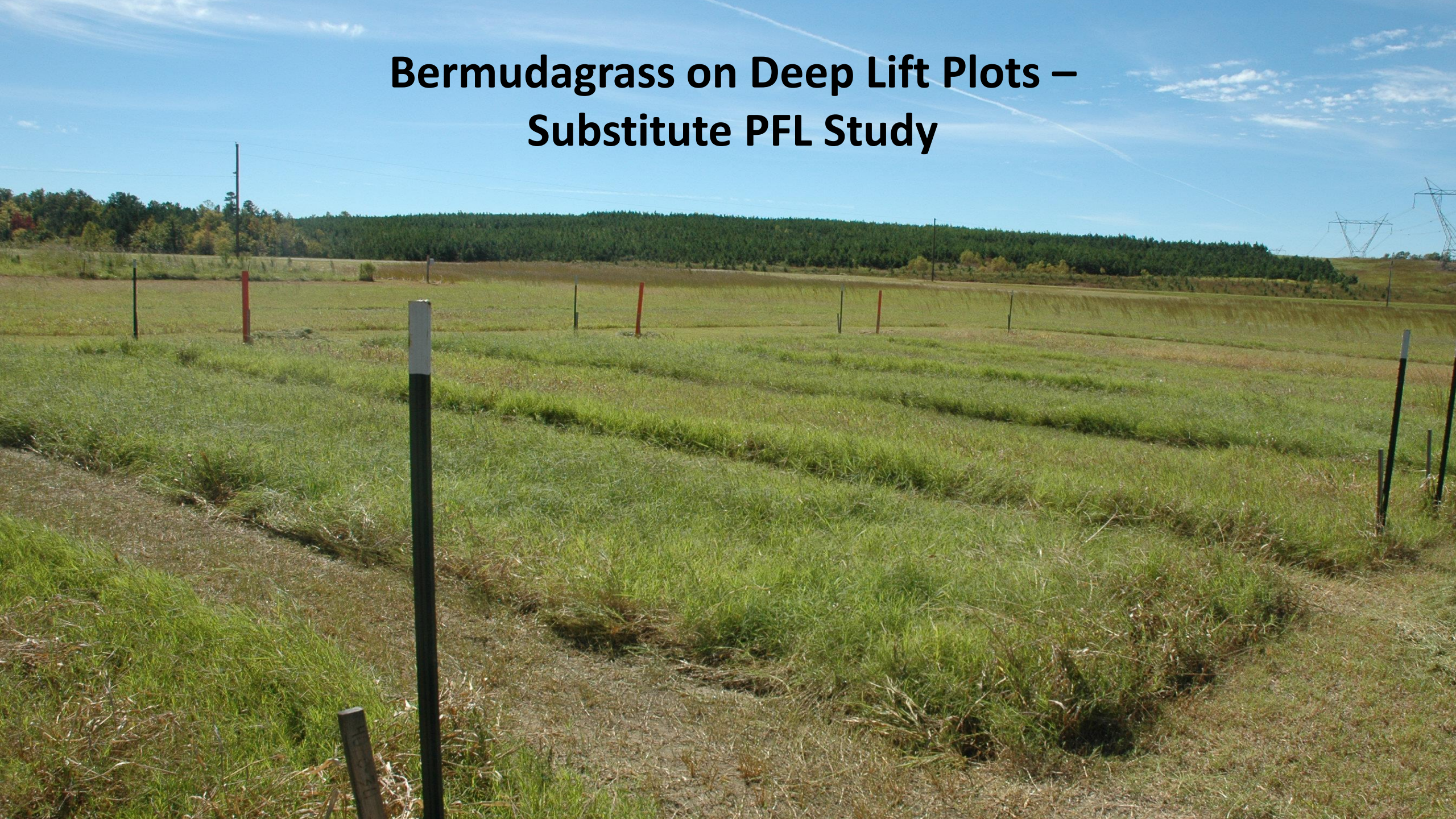


Chenneby Soil in Choctaw County Mississippi

Bermudagrass on Undisturbed Chenneby PFL Soil



Bermudagrass on Deep Lift Plots – Substitute PFL Study



A wide-angle photograph of a grassy field under a clear sky. The field is filled with green grass, with some patches of brown soil visible. Numerous small blue and white markers are scattered across the field. In the background, there is a dense line of tall green trees. The text '50 N', '0 N', and '100 N' is overlaid in yellow on the grass. Below these, the text 'August 2010' and 'Bermudagrass on Reconstructed Prime Farmland Soil' is also overlaid in yellow.

50 N

0 N

100 N

August 2010

Bermudagrass on Reconstructed Prime Farmland Soil



Bermudagrass on Chenneby Soil with 50 lbs N Ac⁻¹

as 15-5-10

Established in 2006 – Uniform N Rates 2006 to 2008

N Rate Plots as 0, 50 and 100 lbs A⁻¹ as 15-5-10 in 2009



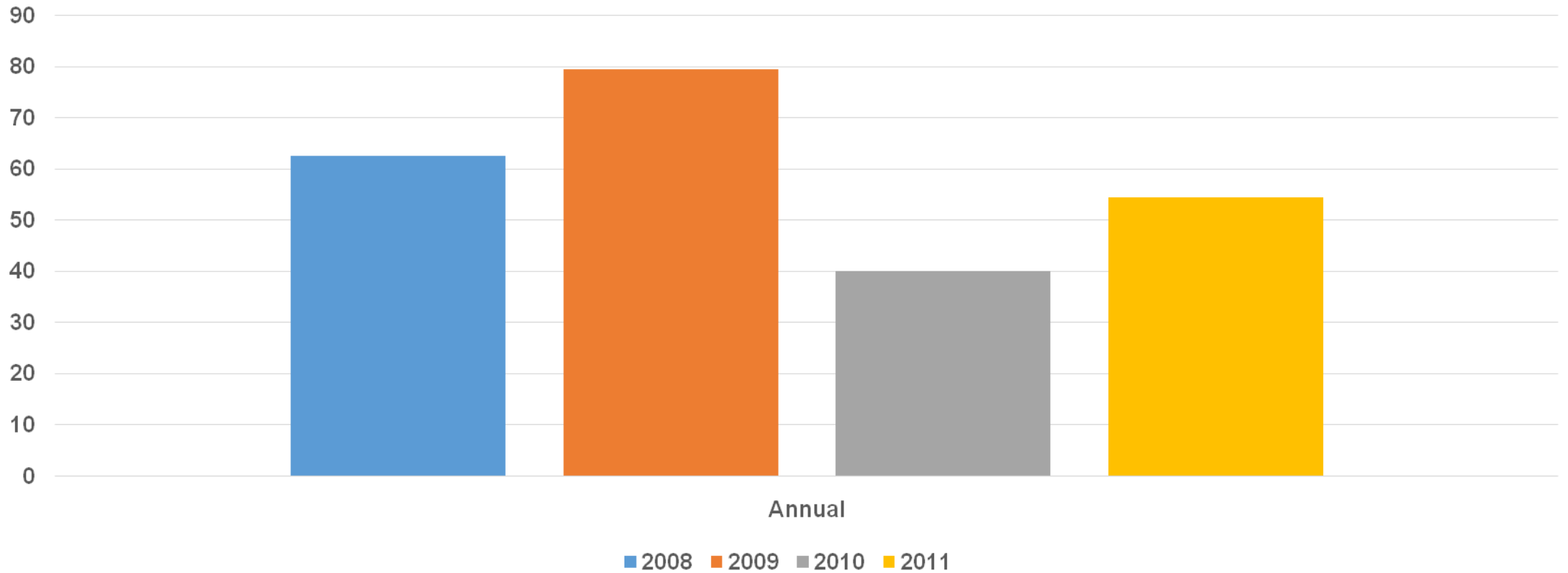
Bermudagrass on Undisturbed Oaklimiter PLF Soil

Similar N Rate Plots established in 2009

Annual Rainfall – 2008 to 2011

Inches

RHM – Choctaw County MS



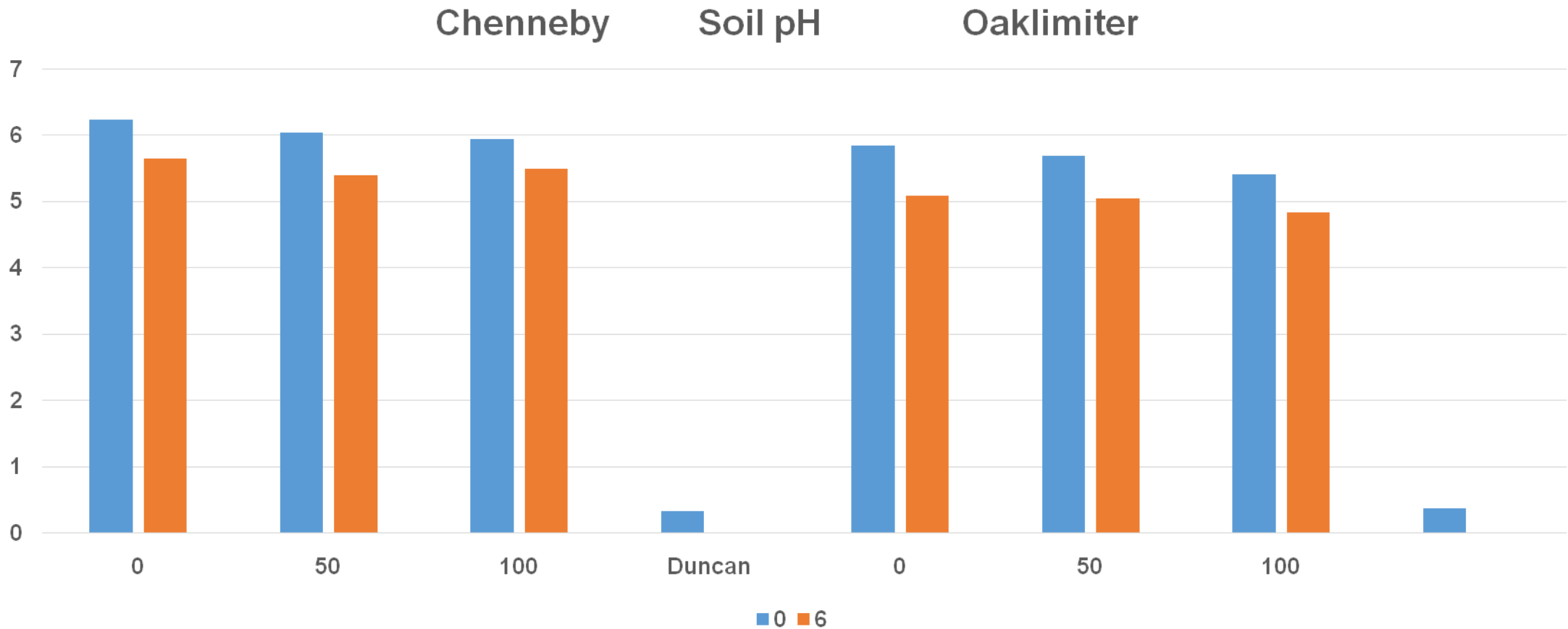
Prime Farmland Soil Fertility Oaklimiter and Chenneby Soils

**Soil Sampled 0 to 15 and 15 to 30 cm on April 21 2010
(0-6 and 6 to 12 Inches)**

**Mississippi Soil Test Laboratory – Includes Extractable SO₄-S
Lancaster Extraction**

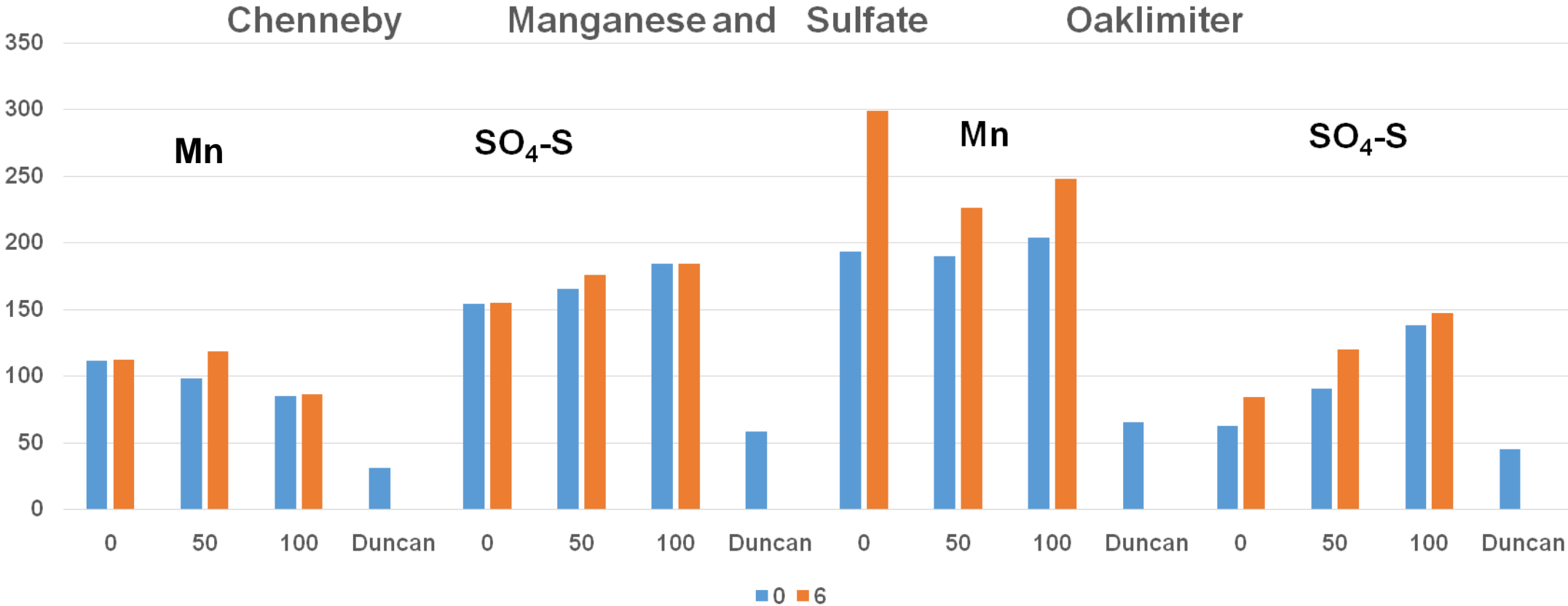
**Units are Extractable lb Ac⁻¹ based on a Six Inch Sample Depth
Divide by 2 = mg kg⁻¹ or PPM
Except as Noted**

Soil pH to 0-6" and 6-12" After two Years of Fertilizer Applications to PFL Soil



Applied 15-5-10 Fertilizer at 0 50 and 100 lbs of N Acre⁻¹ after each harvest in 2009

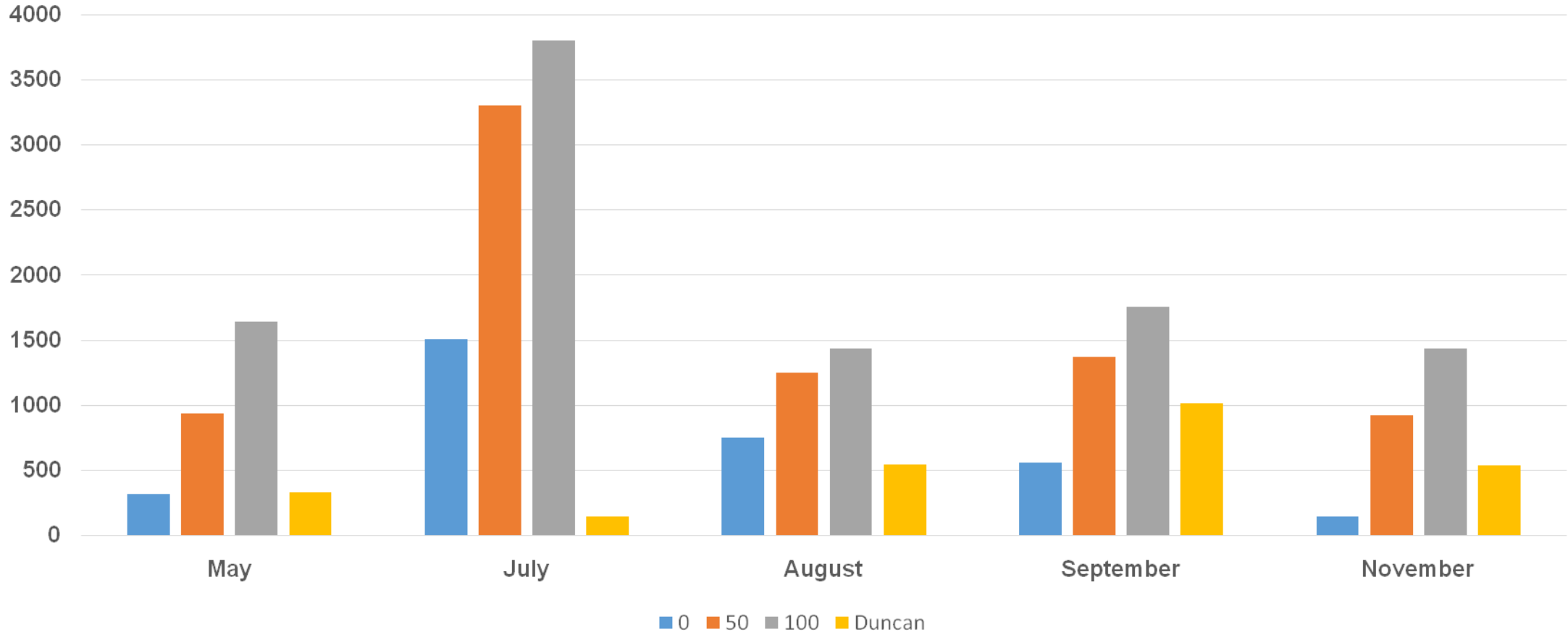
Soil Fertility at 0-6" and 6-12" After Two Years of Fertilizer Applications to PFL Soil



These Represent Values in "Normal" Agricultural Soil
 Elevated Amounts of Sulfate *May* be Indicative of Pyritic Sulfur in Reclaimed Overburden Materials
 > 500 on the MS Soil Test

Bermudagrass Yield of Undisturbed Chenneby Prime Farmland Soil in Choctaw County, MS 2010

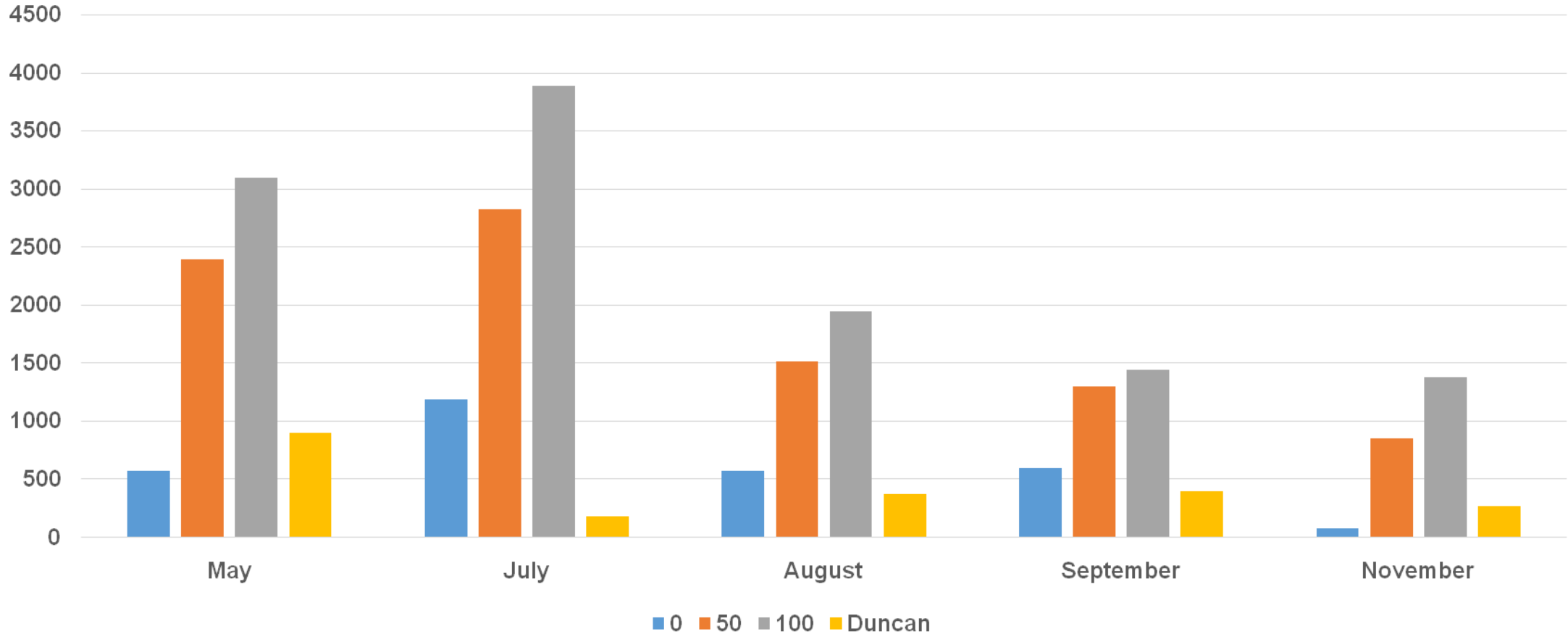
Ibs per Acre



N Rate applied as 15-5-10 Fertilizer in April and after each Harvest through September

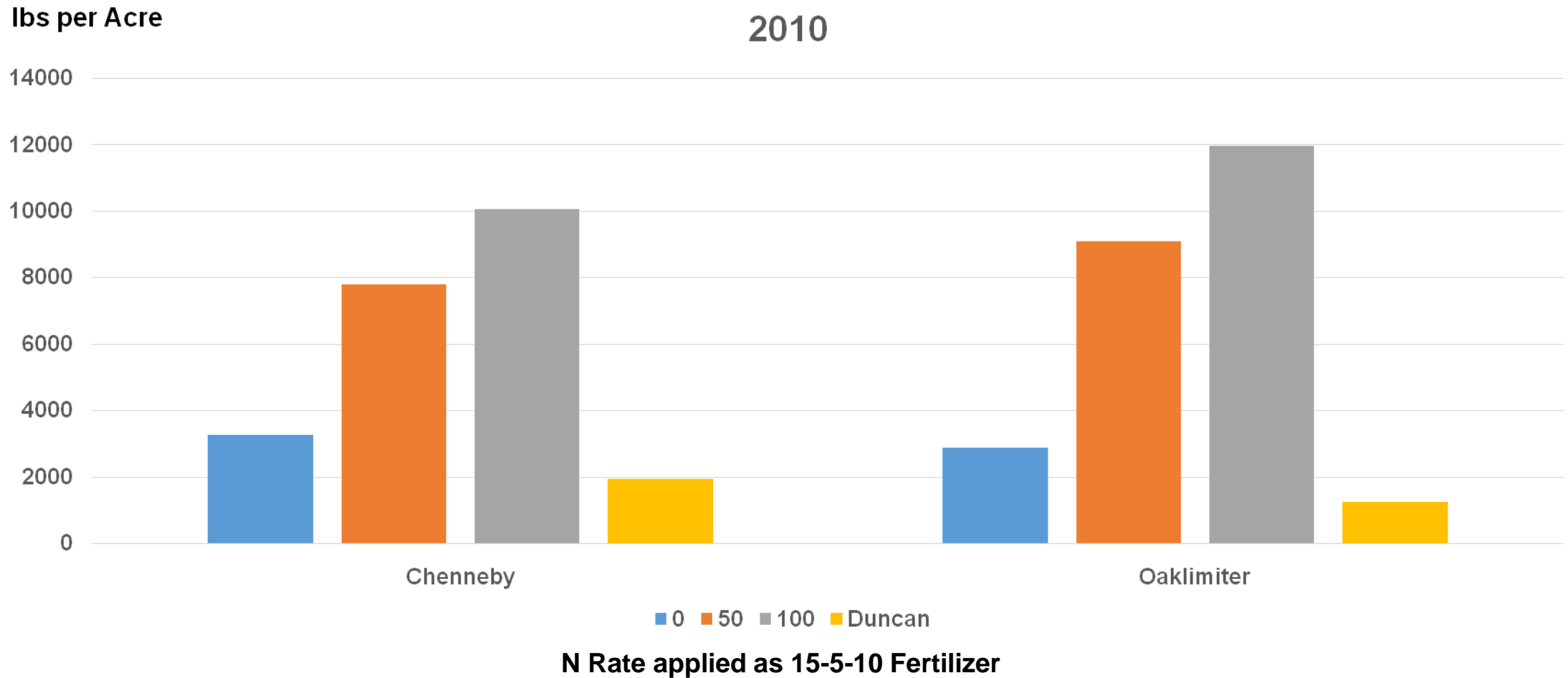
Bermudagrass Yield of Undisturbed Oaklimiter Prime Farmland Soil in Choctaw County, MS 2010

Ibs per Acre



N Rate applied as 15-5-10 Fertilizer in April and after each Harvest through September

Bermudagrass Yield of Undisturbed Prime Farmland Soil in Choctaw County, MS 2010

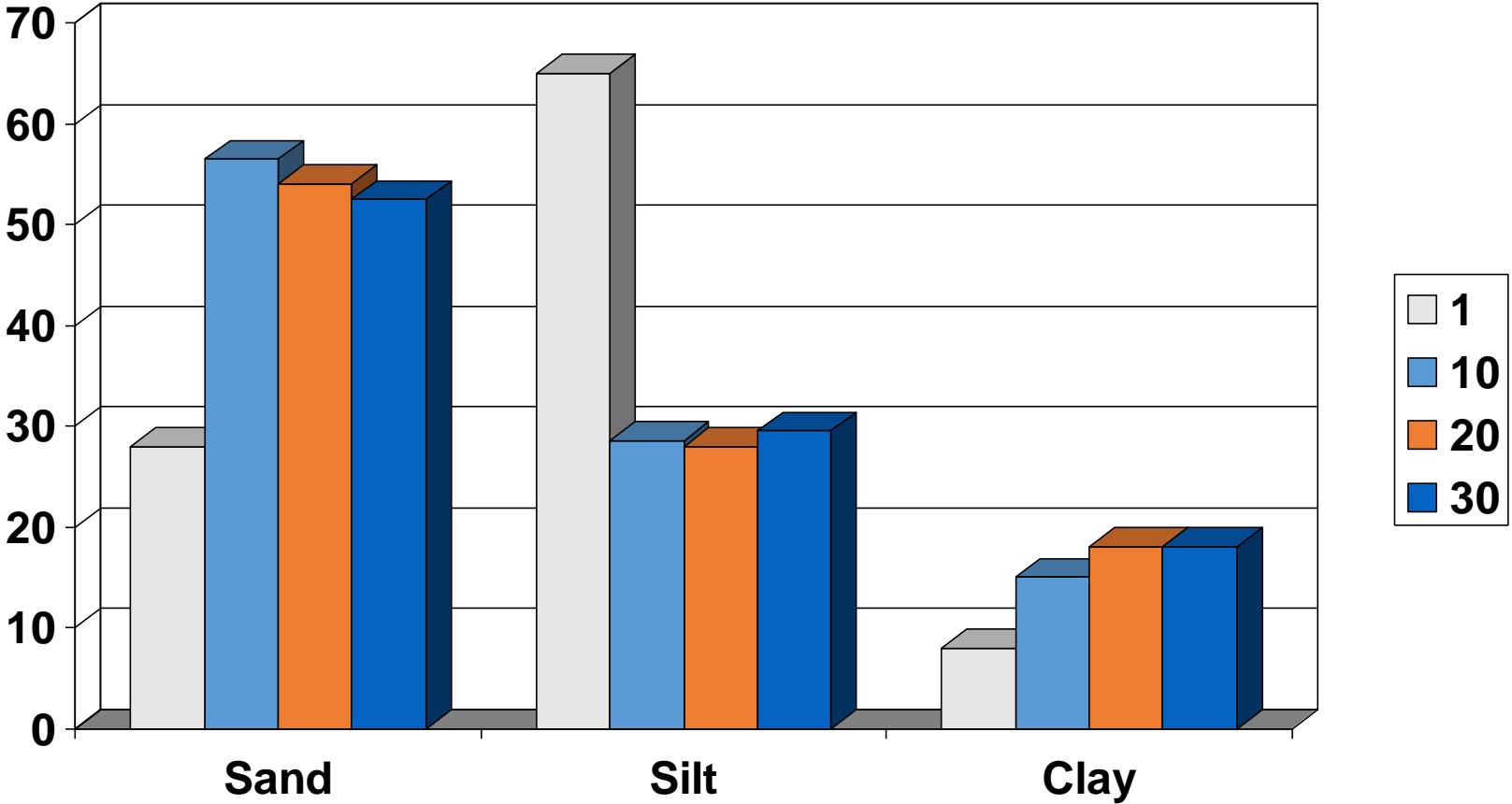


Deep Profile of Oaklimiter Prime Farmland Soil



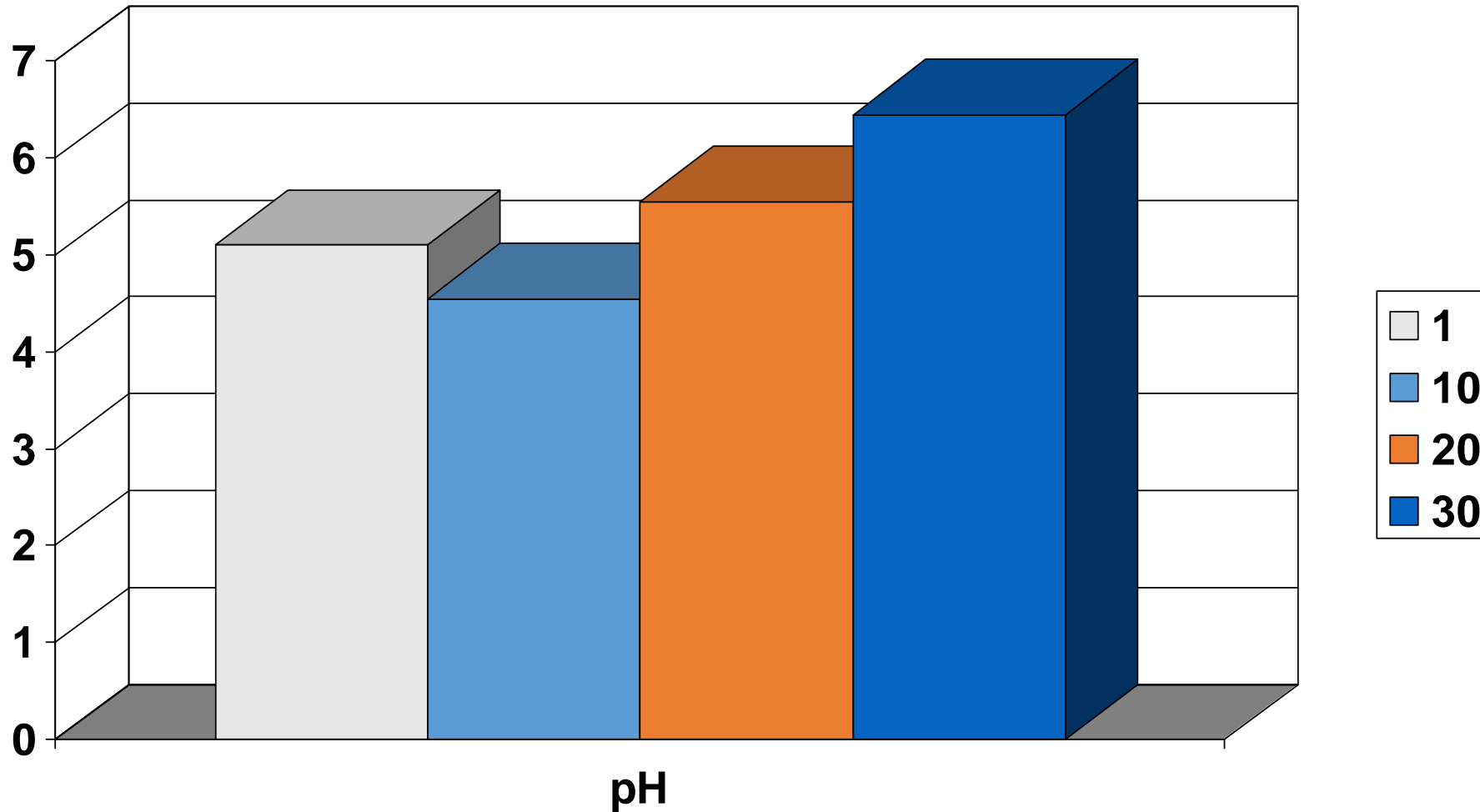


Soil Texture of Deep Lift Mixtures



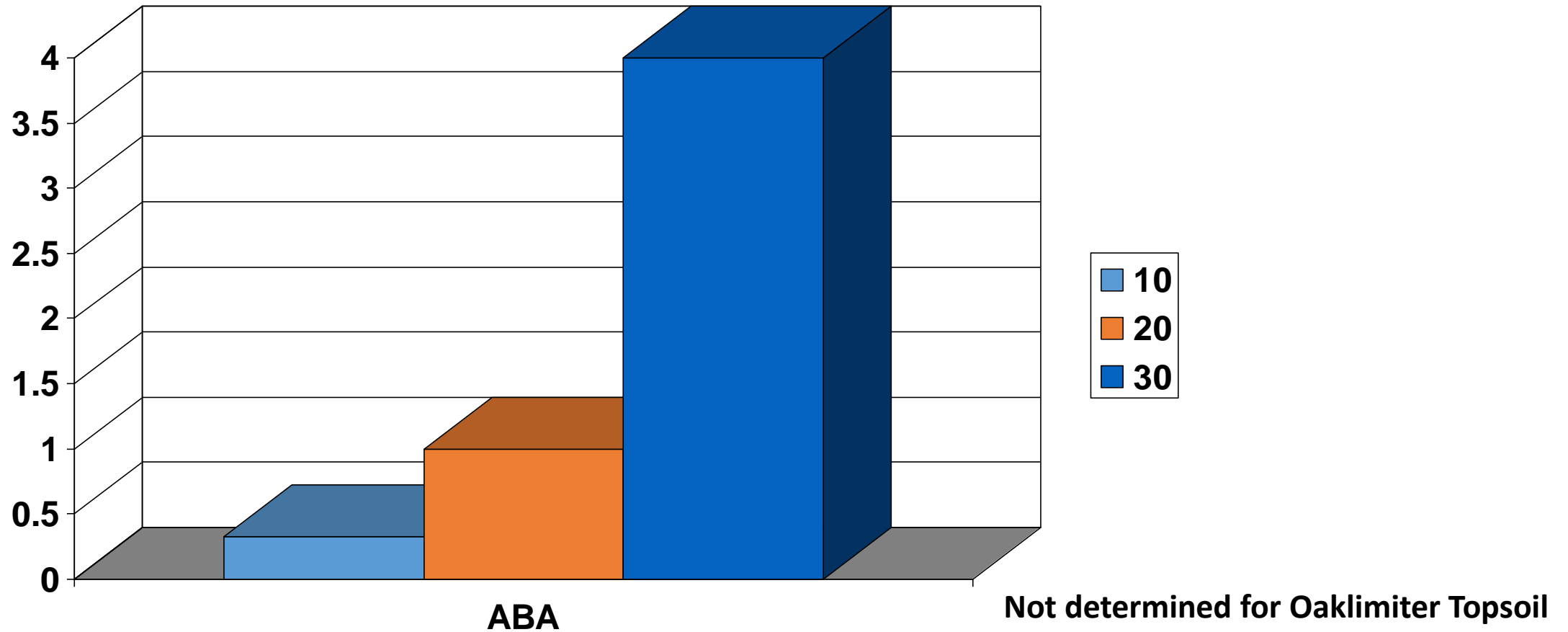
1 Foot is an Oaklimiter topsoil

Initial pH of Deep Lift Mixtures

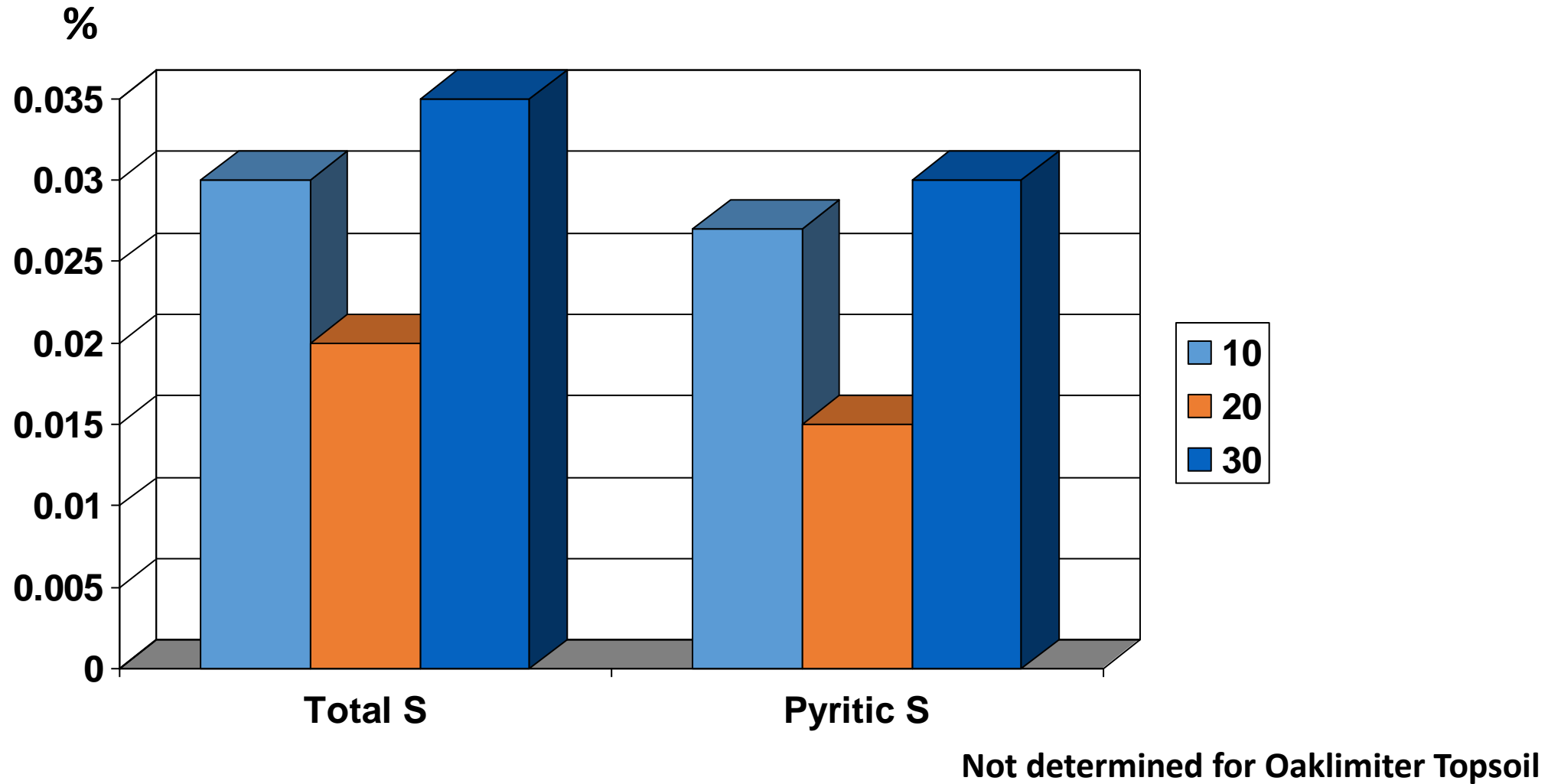


Acid Base Accounting of Deep Lift Mixtures

tonne CaCO₃/ktonne overburden

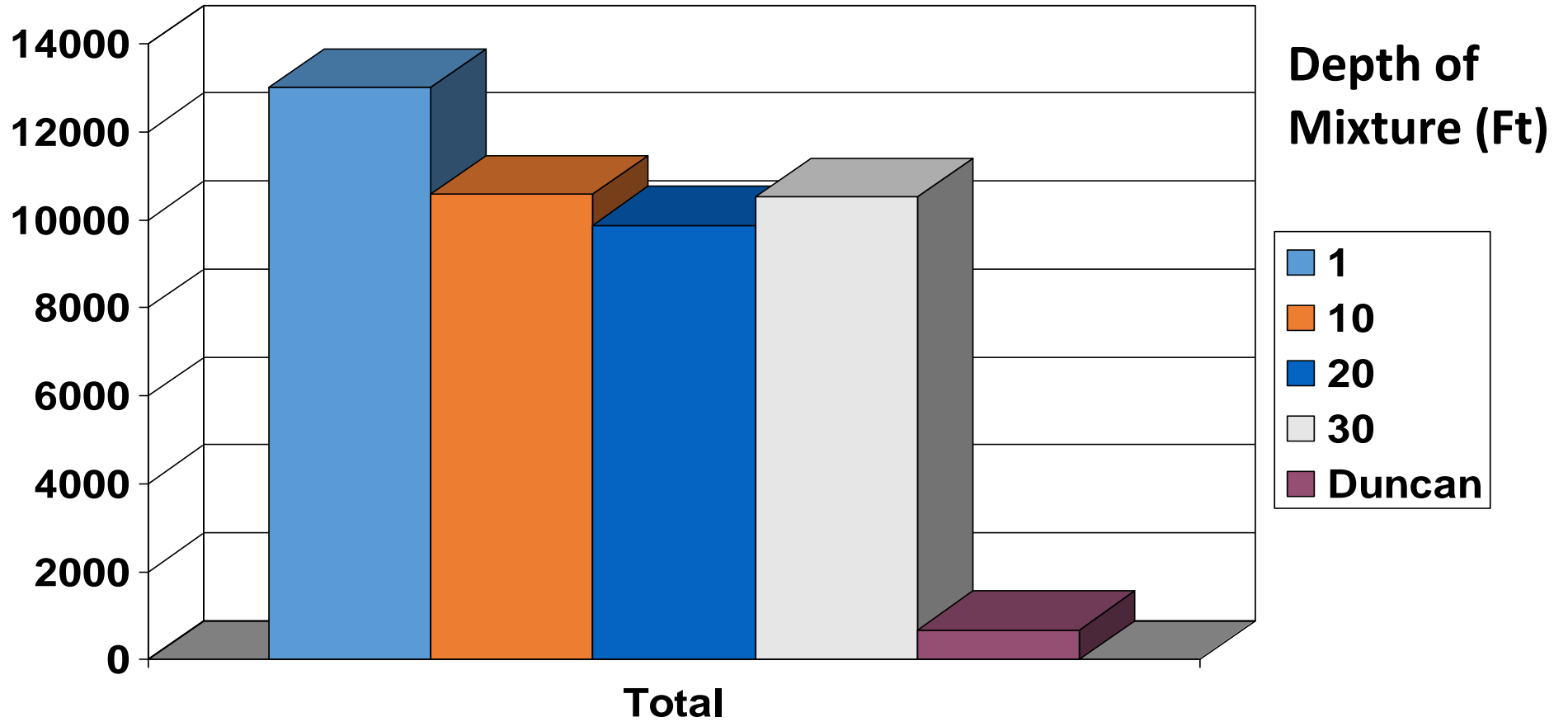


Total S and Pyritic S of Deep Lift Mixtures



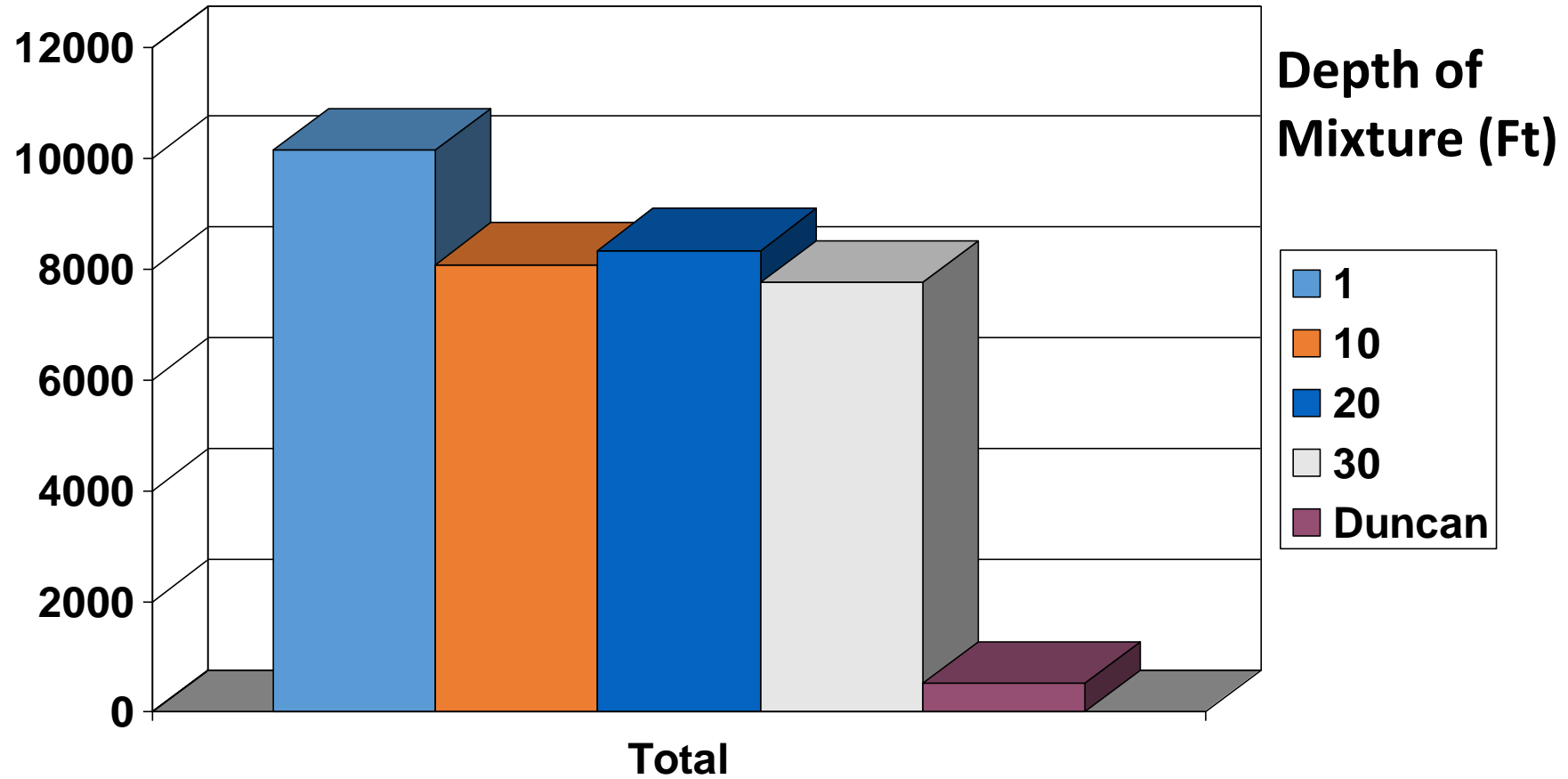
Bermudagrass Yield 2008

lb Ac⁻¹



Bermudagrass Yield 2009

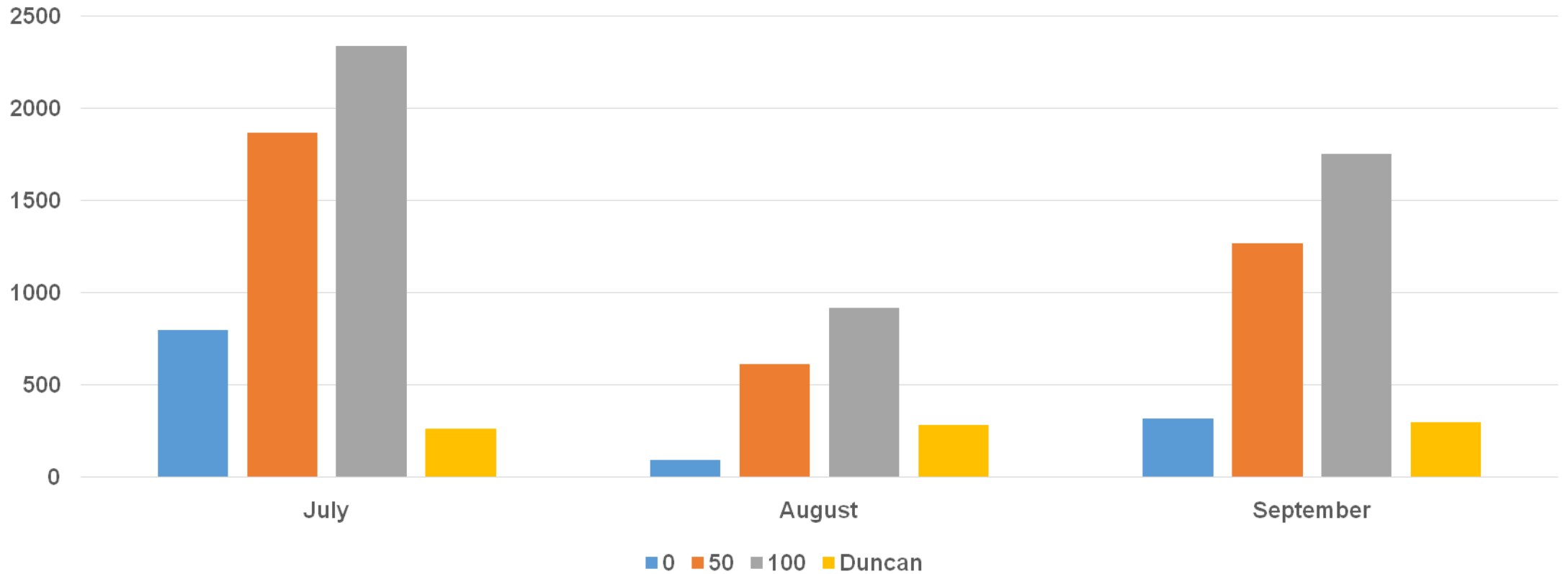
lb Ac⁻¹

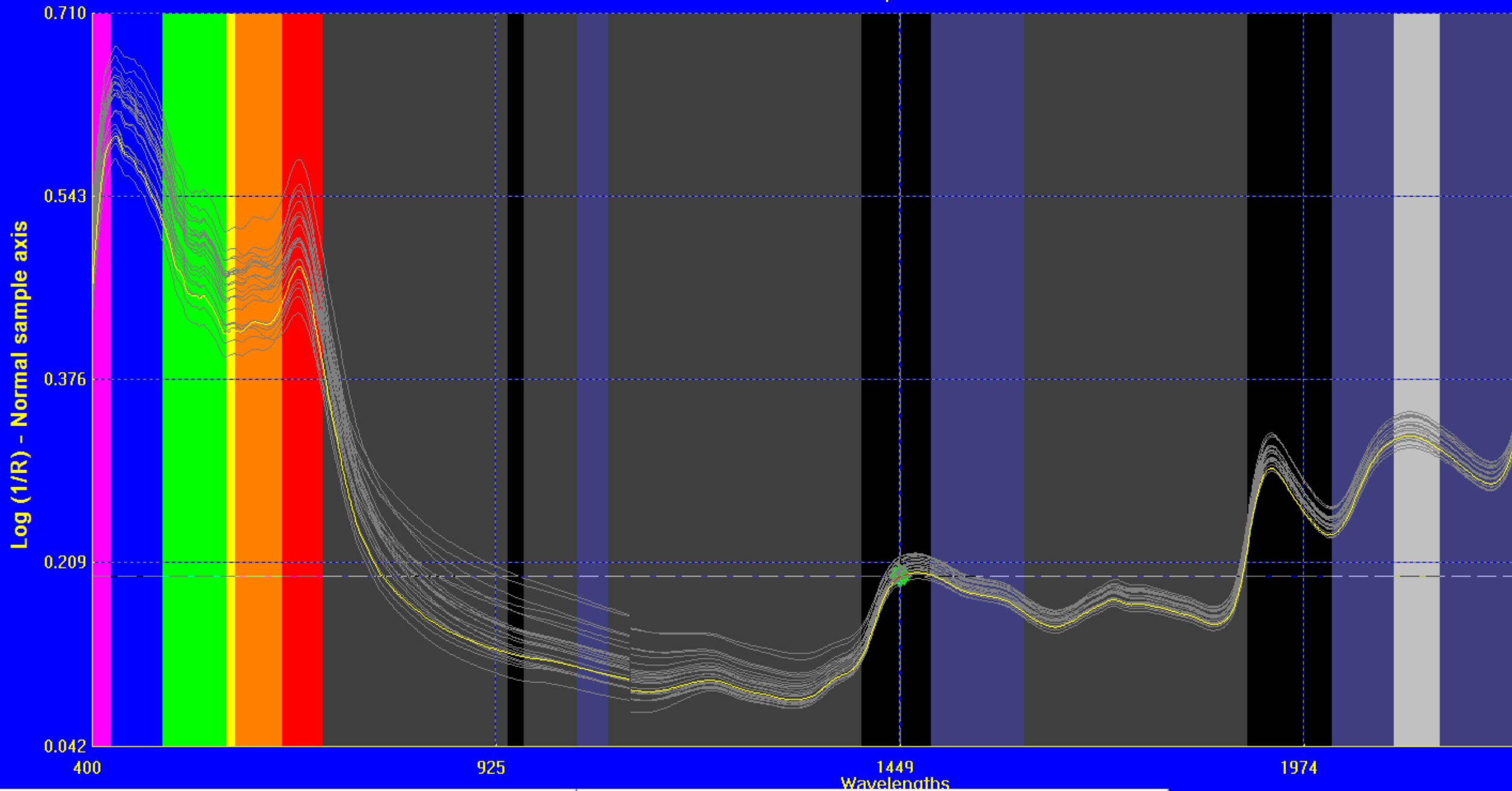


Bermudagrass Response of Reclaimed PFL Topsoil to Fertilizer

lb Acre⁻¹

2010





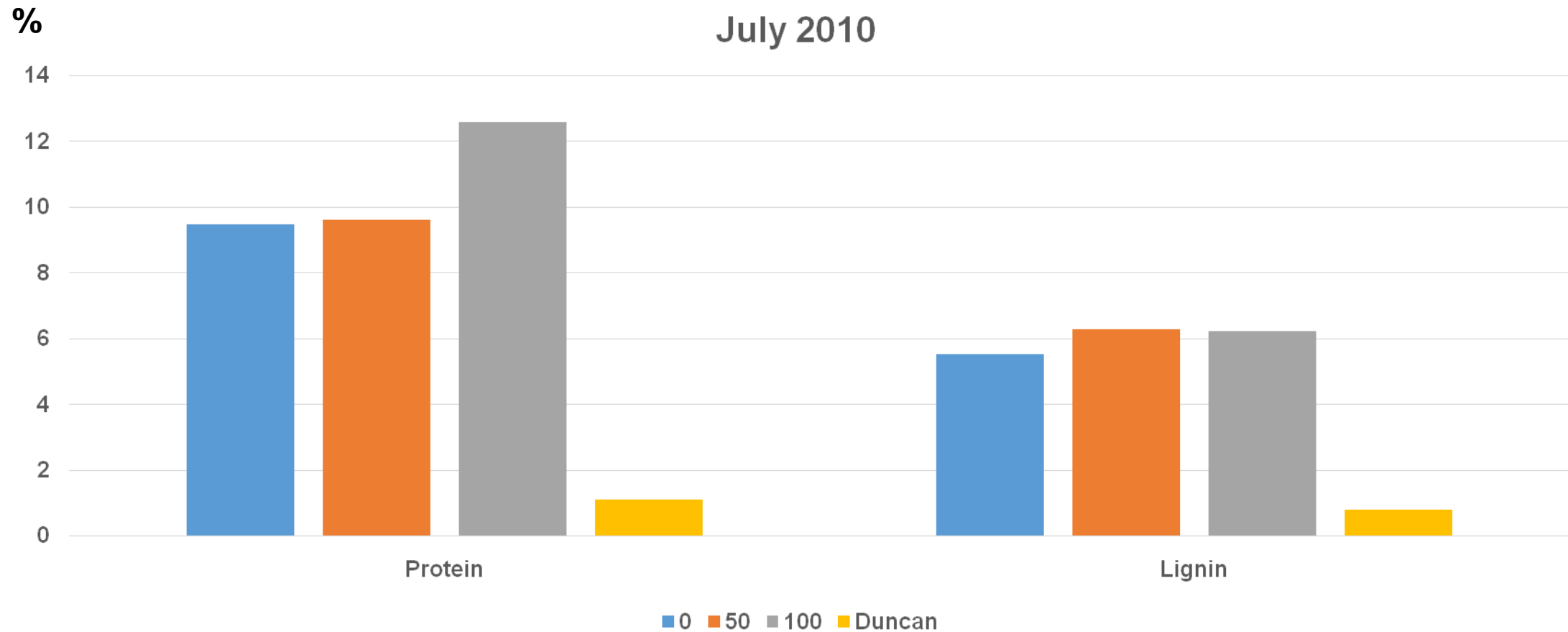
X = 1450 Y = 0.19605222

NIR region

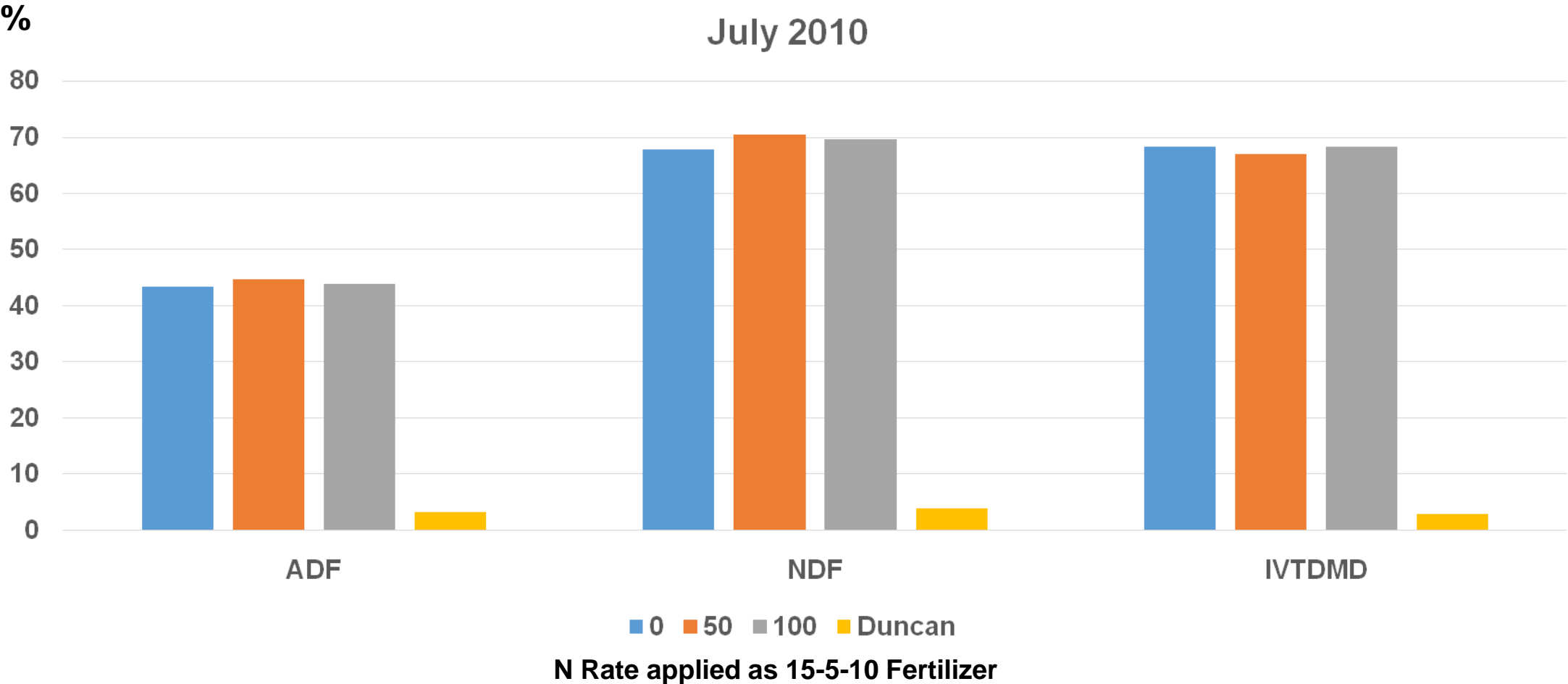
Position 1 Sample number L3022

Position 2 Sample number L3023

Forage Nutritive Quality (Protein and Lignin) of Bermudagrass on Prime Farmland Soil in Choctaw County, MS

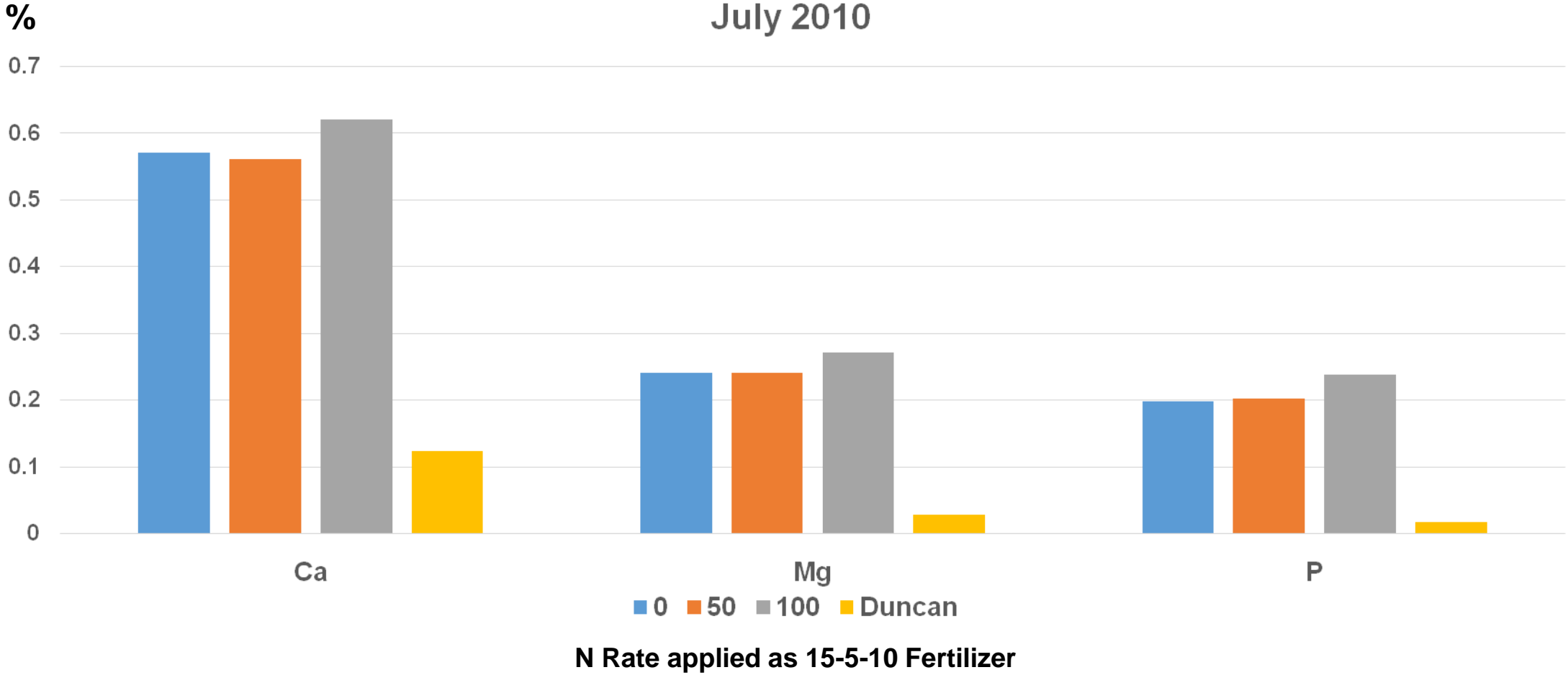


Forage Nutritive Quality (Fiber and Digestibility) of Bermudagrass on Undisturbed Prime Farmland Soil in Choctaw County, MS



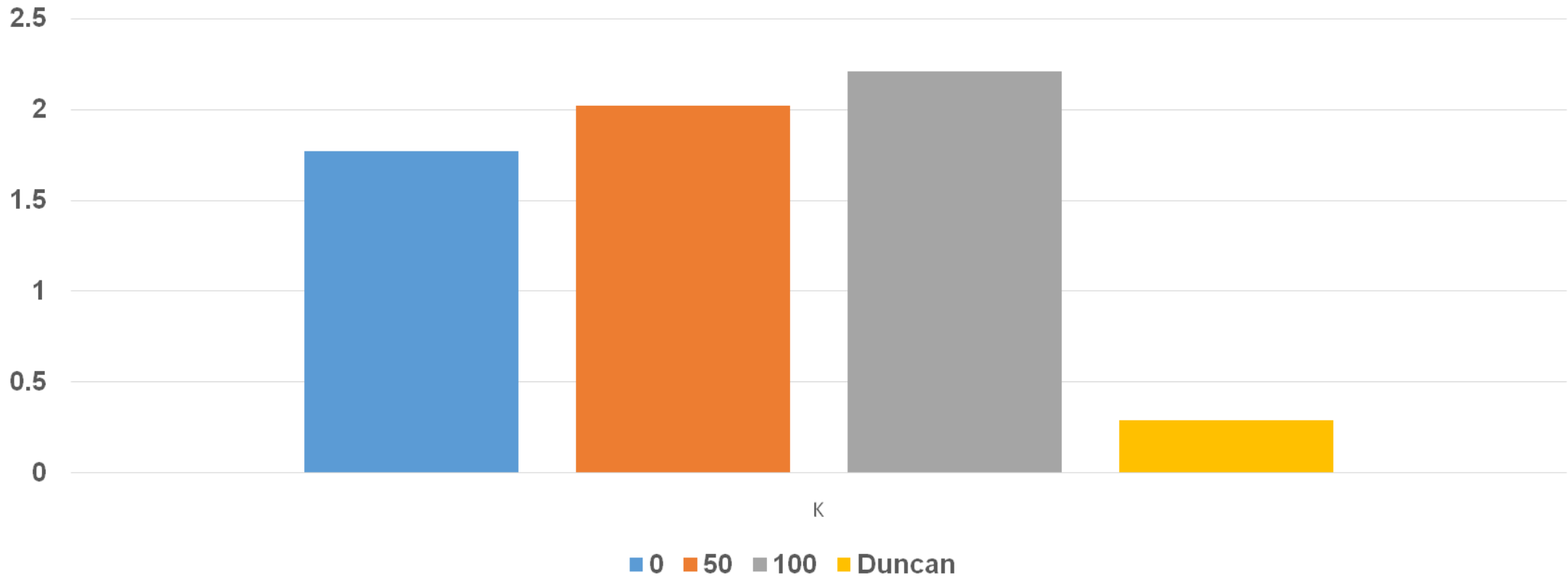
Forage Minerals (Ca, Mg and P) of Bermudagrass on Undisturbed Prime Farmland Soil in Choctaw County, MS

July 2010



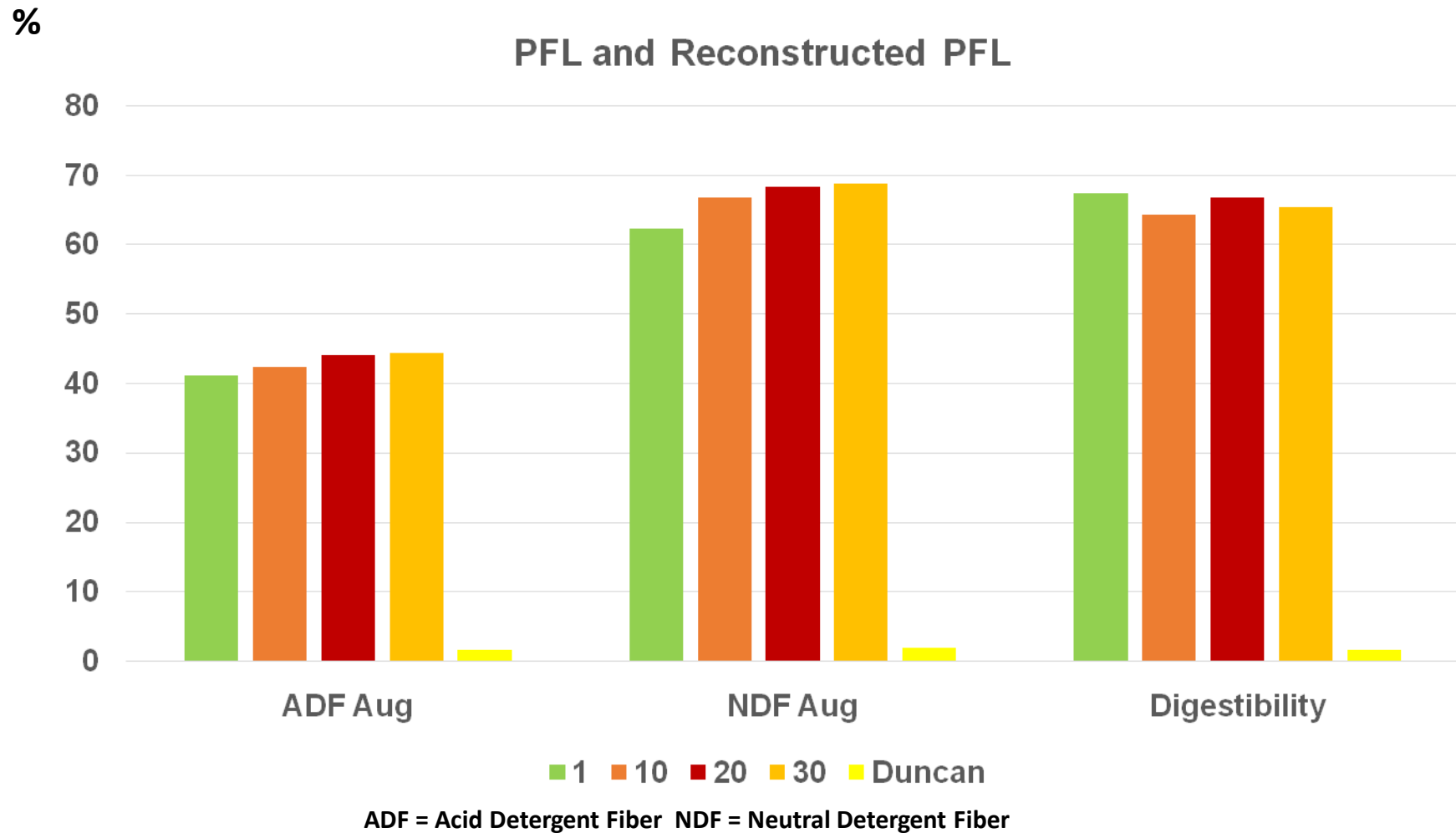
Forage Minerals (K) of Bermudagrass on Undisturbed Prime Farmland Soil in Choctaw County, MS

July 2010

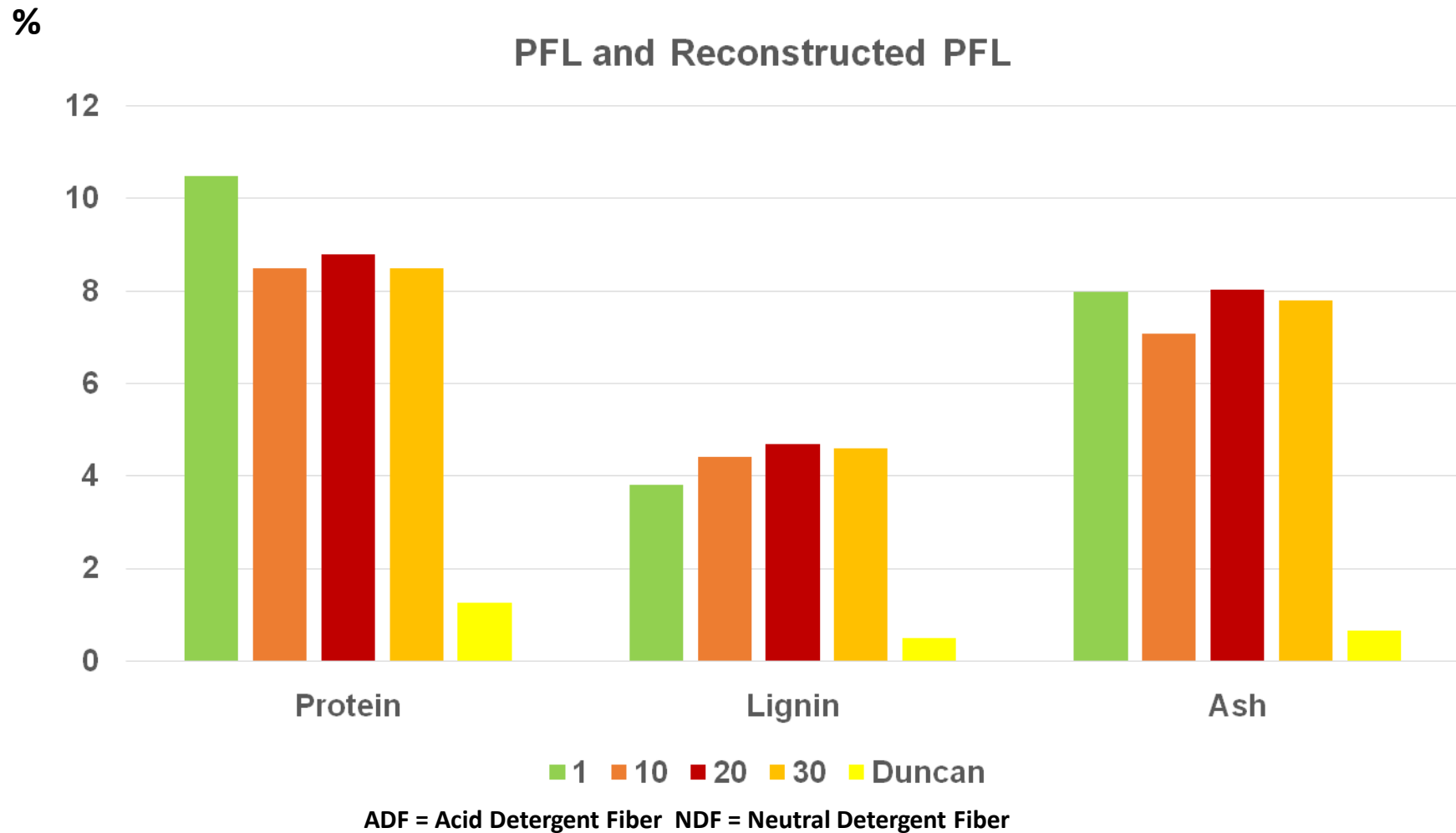


N Rate applied as 15-5-10 Fertilizer

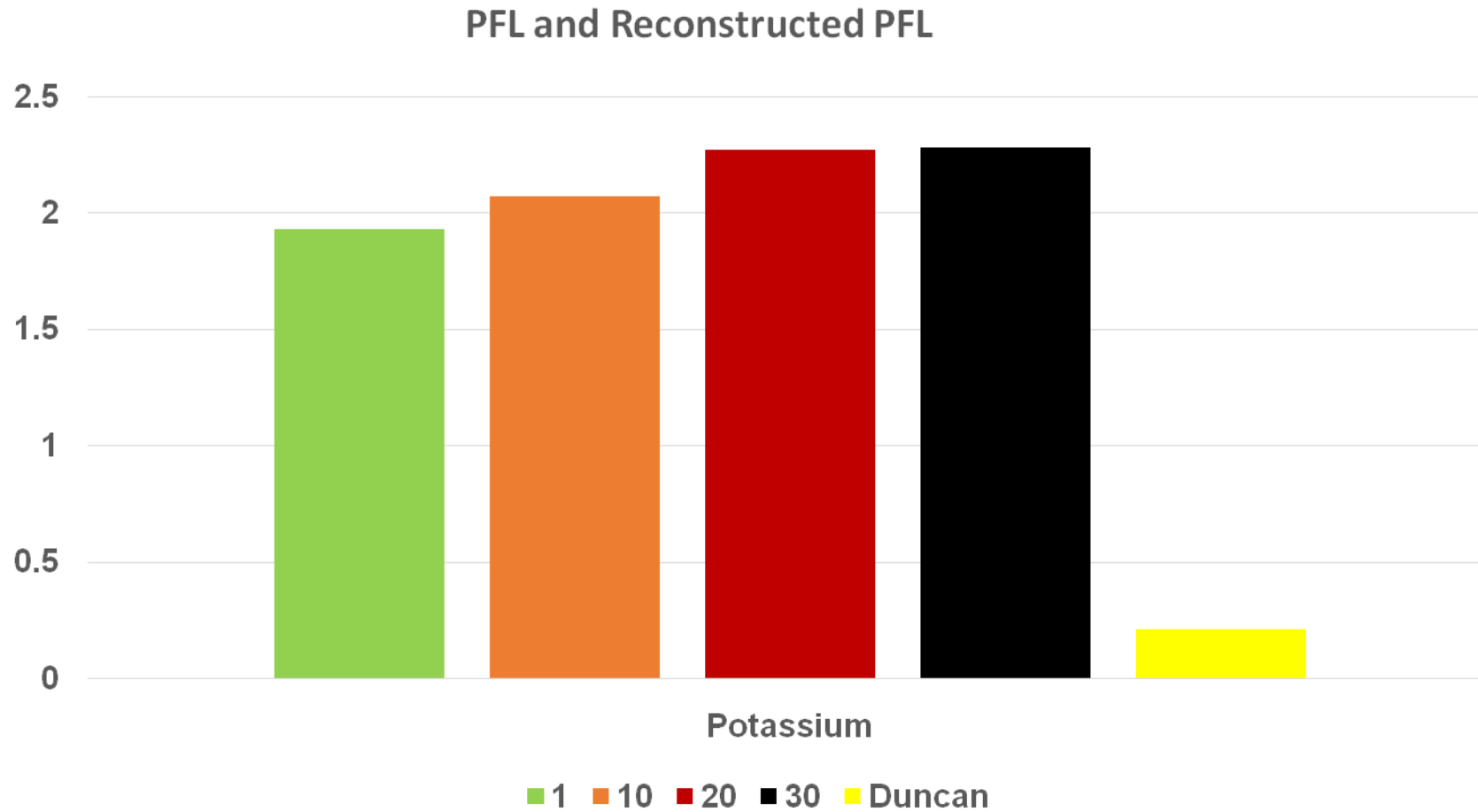
Fiber and Digestibility of Bermudagrass August 2009



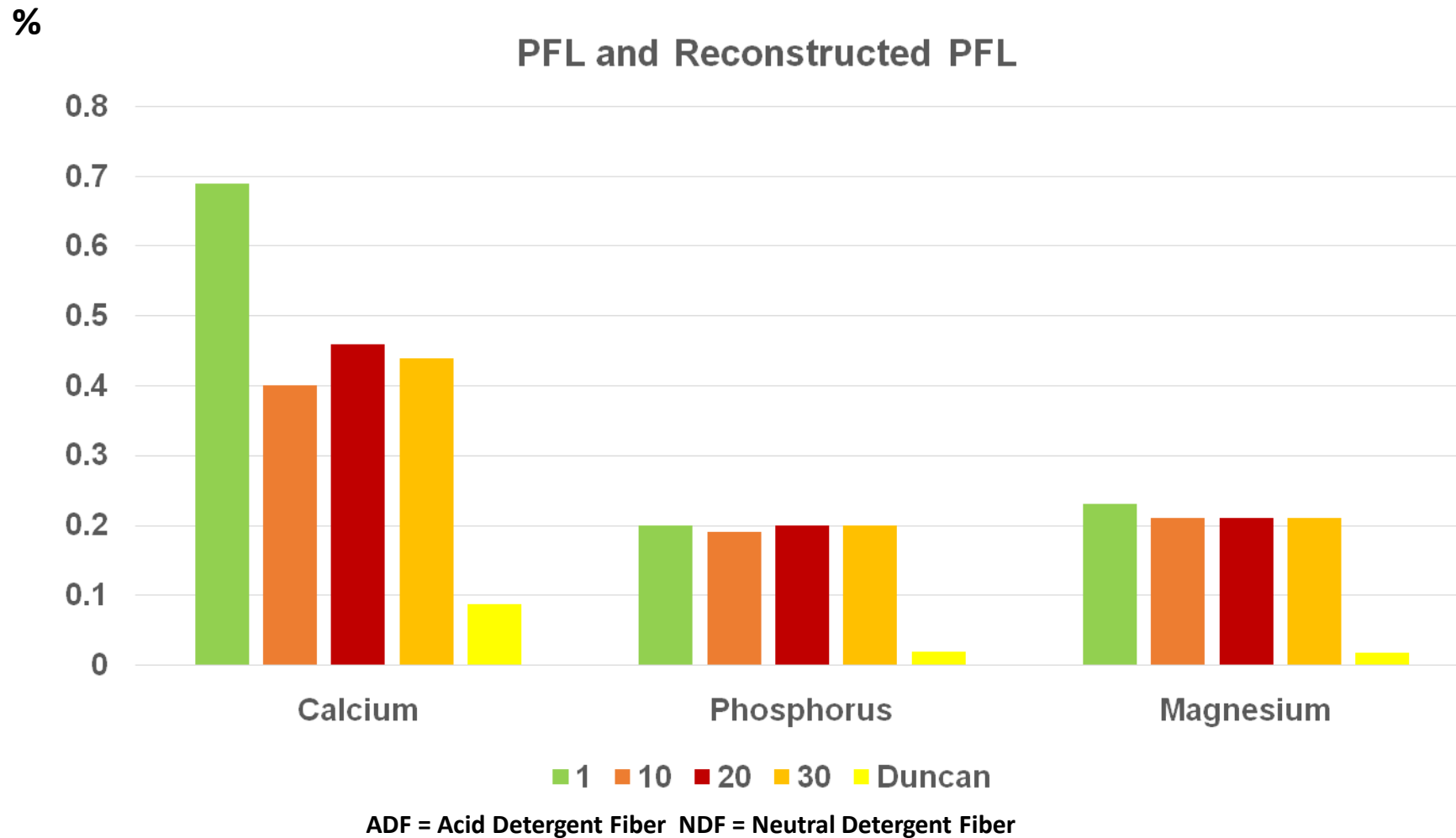
Protein Lignin and Ash Bermudagrass August 2009



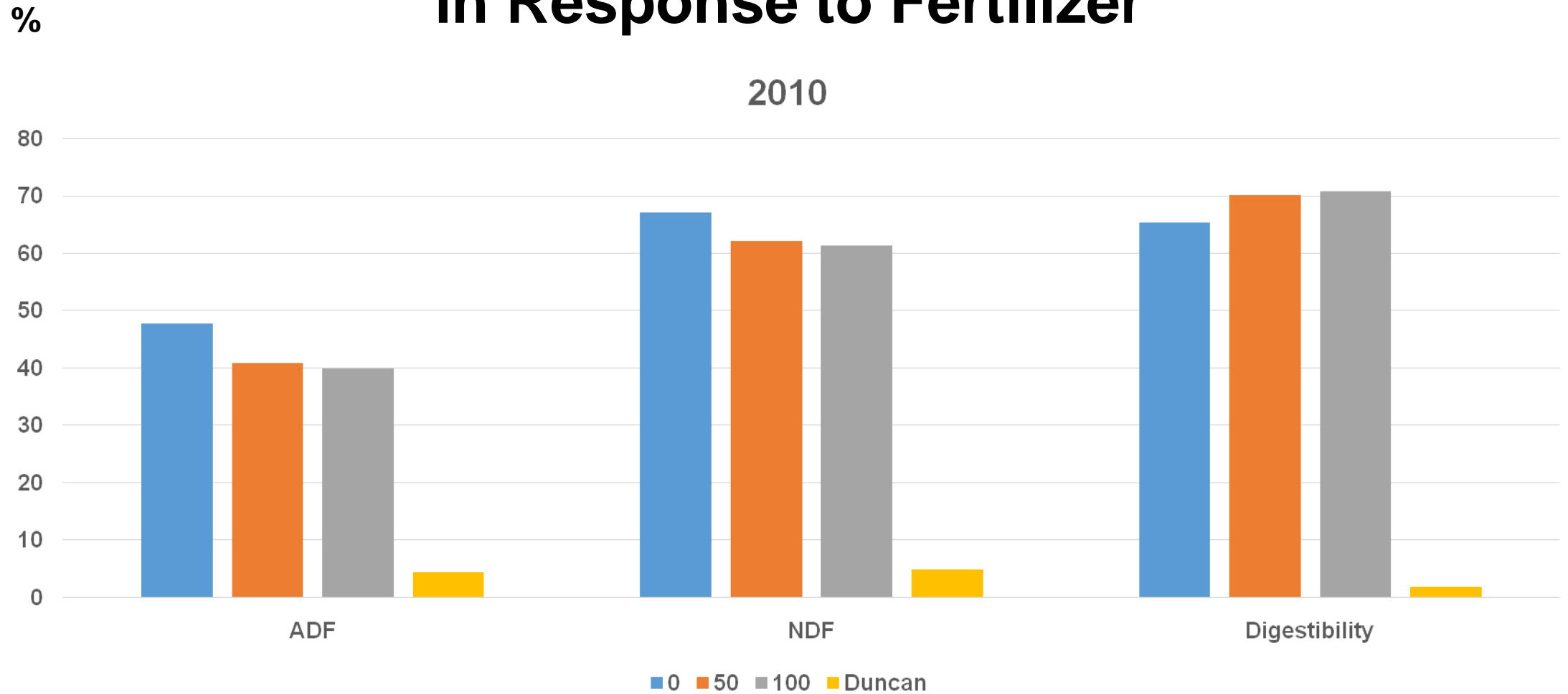
Potassium Levels in Bermudagrass August 2009



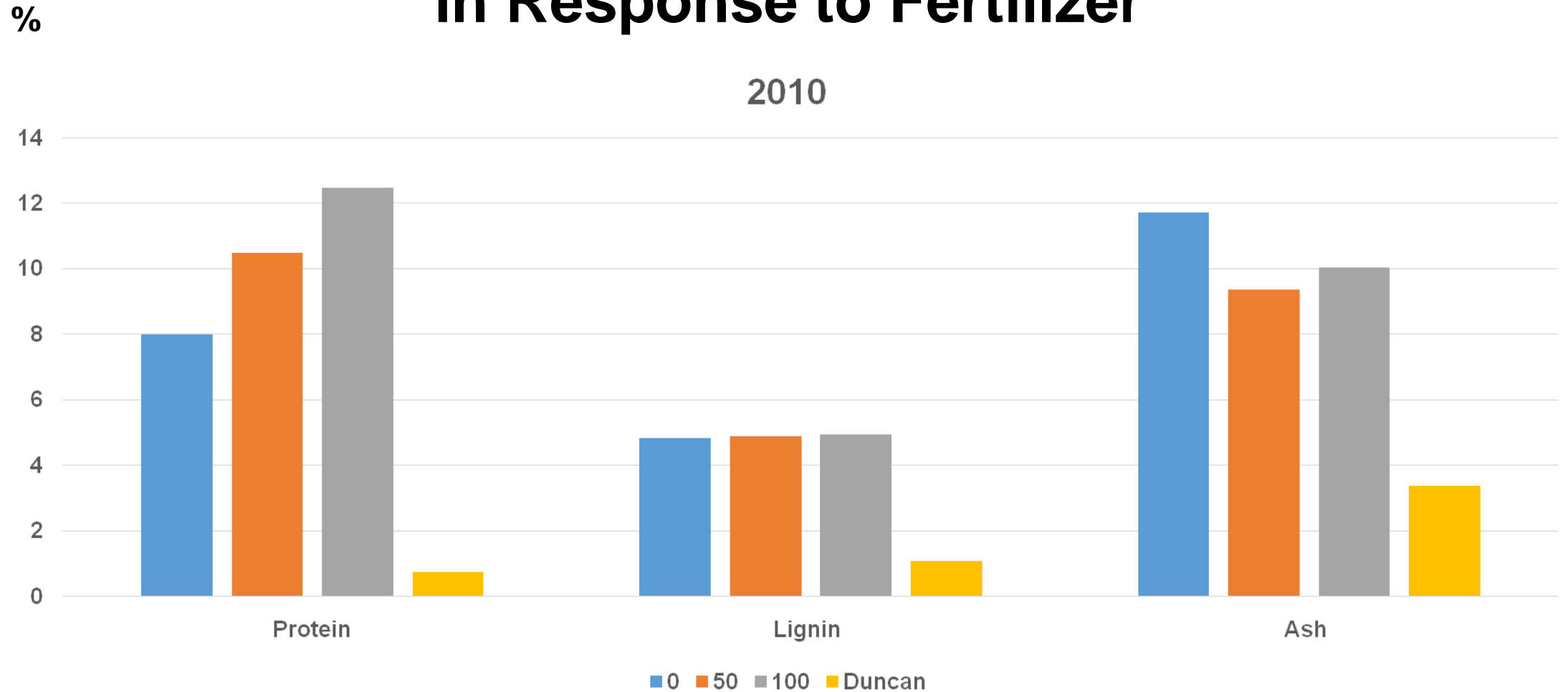
Calcium Phosphorus and Magnesium Levels in Bermudagrass August 2009



Bermudagrass Forage Nutritive Fiber and Digestibility on Reclaimed PFL Topsoil in Response to Fertilizer



Bermudagrass Forage Nutritive Protein, Lignin and Ash on Reclaimed PFL Topsoil in Response to Fertilizer



Summary and Conclusions

- **Bermudagrass yield ranged from 3,000 to 10,500 lbs/acre on the undisturbed Oa site and from 3,000 to 8600 lbs/acre on the Ch sites**
 - **Oa > Ch as indicated by the NRCS Yield Potential**
- **Yield was 8000 to 9000 lbs/acre on reclaimed PFL land – Slightly less than on undisturbed Oa PFL, but it would be similar to Ch PFL**

Summary and Conclusions

- **Protein levels of bermudagrass were 9.9 to 11.5% growing in reclaimed soil were similar to protein levels of bermudagrass growing on undisturbed PFL at 9.4 to 11.7%.**
- **Nutrient uptake of P, K, Ca and Mg were similar between sites**
- **Digestibility was greater than 60% at each site indicating that productive land was reclaimed for livestock production.**

Thanks!

