

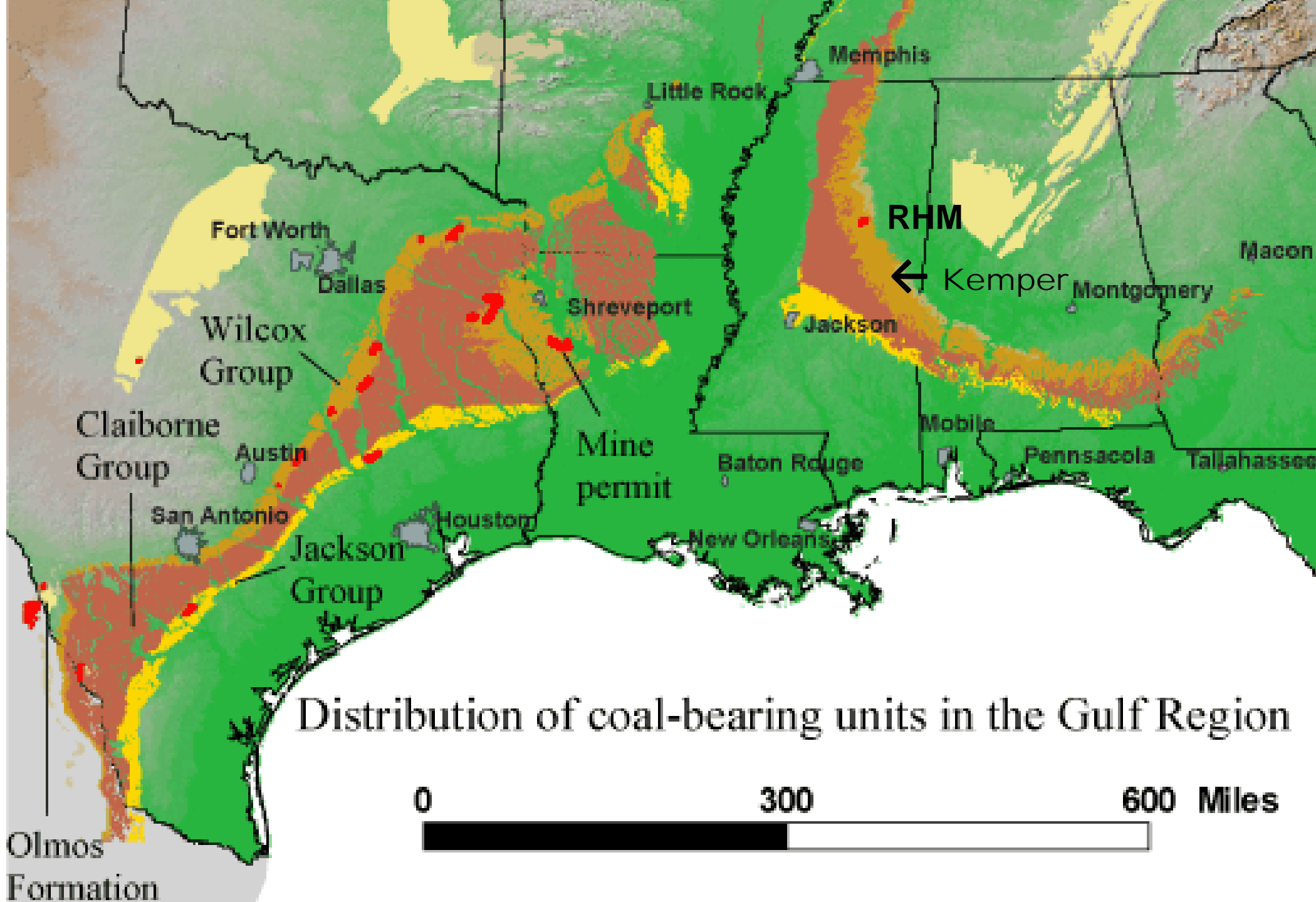
# SWITCHGRASS BIOENERGY AS SILVOPASTURE ON RECLAIMED MINE SOIL

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# Lignite Coal Mine, Choctaw County, MS





Distribution of coal-bearing units in the Gulf Region



# Switchgrass

## *Panicum virgatum* L.

- Native to North America
- Tall Growing (> 2 meters)
- Productive (10 to 22 Mg ha<sup>-1</sup>) with Low Inputs (50 kg N ha<sup>-1</sup> Yr<sup>-1</sup>)
- Nutritious April to June/July in MS
- Suitable for Beef Animals
- Good Seed Production Potential



# Introduction – Switchgrass for Reclamation

- Establishment of Switchgrass can be Slow
  - Takes Two Years to Reach Full Growth Potential
- May Not Provide Adequate Ground Cover
  - Initially for up to 1 Year
  - Soil Erosion Potential
- Known to be an Excellent Soil Stabilizer for Soil Carbon Sequestration and Soil Health
  - Once established

# Lignite Coal in Choctaw County, MS

	As Received @ 60% DM	
Lignite		11,000 kJ kg <sup>-1</sup>
RHM Mines 40-50 hectares per Year	3.3 M tonnes	66,000 t ha <sup>-1</sup>
Switchgrass	6 to 10 t ha <sup>-1</sup>	@ 15% Moisture: 15,000 kJ kg <sup>-1</sup>
110,000+ ha to Replace Lignite Mine	@ 8 t ha <sup>-1</sup>	300 ha day <sup>-1</sup>

# Objectives

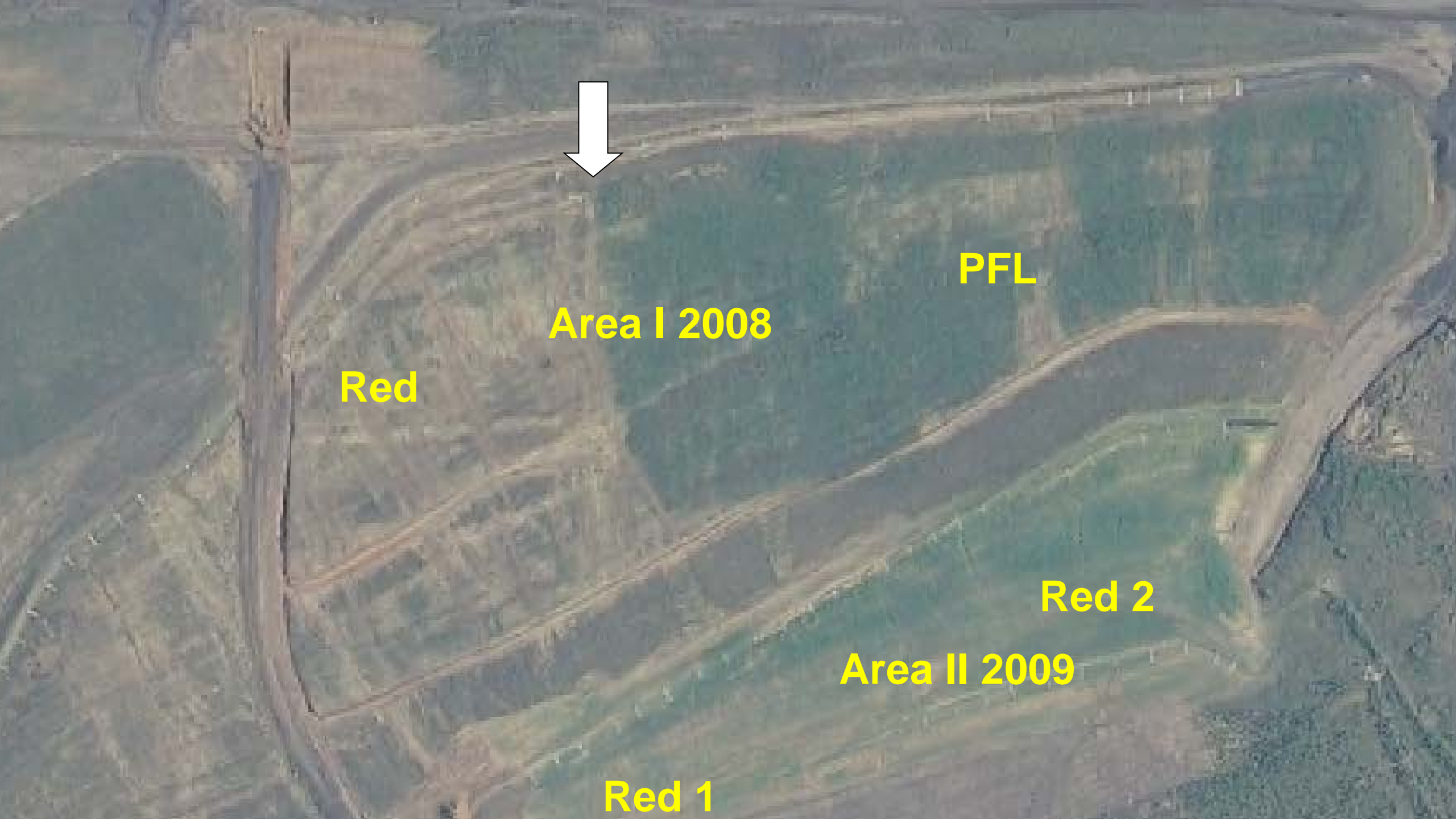
- Establishment of Switchgrass into Reclaimed Mine Soils:
  - Red Oxidized and Prime Farmland Topsoil
- Yield and Utilization of Switchgrass as Bioenergy
- Evaluate Prediction of Energy by Near Infrared Spectroscopy (NIRS) - Vogel et al 2011 Equation
- Long Term Soil Development and Organic Matter Accumulation in a Loblolly Pine Silvopasture System with Switchgrass



# Methods

## Six Transects South to North Down Slope





**Area I 2008**

**PFL**

**Red**

**Red 2**

**Area II 2009**

**Red 1**

# LoblollyTree Strips and Switchgrass Strips

5 May 2010



May 2016



# Soil with Switchgrass on Reclaimed Land

Planted 2008 and Sampled 2011

Two Types of Respread: PFL Topsoil and Red Oxidized Soil Substitute

Depth of 0 to 15 cm and

15 to 30 cm (Represents Original as Planted Levels)

MSU Soil Testing Lancaster Extraction

Also included Extractable Mn and  $\text{SO}_4\text{-S}$

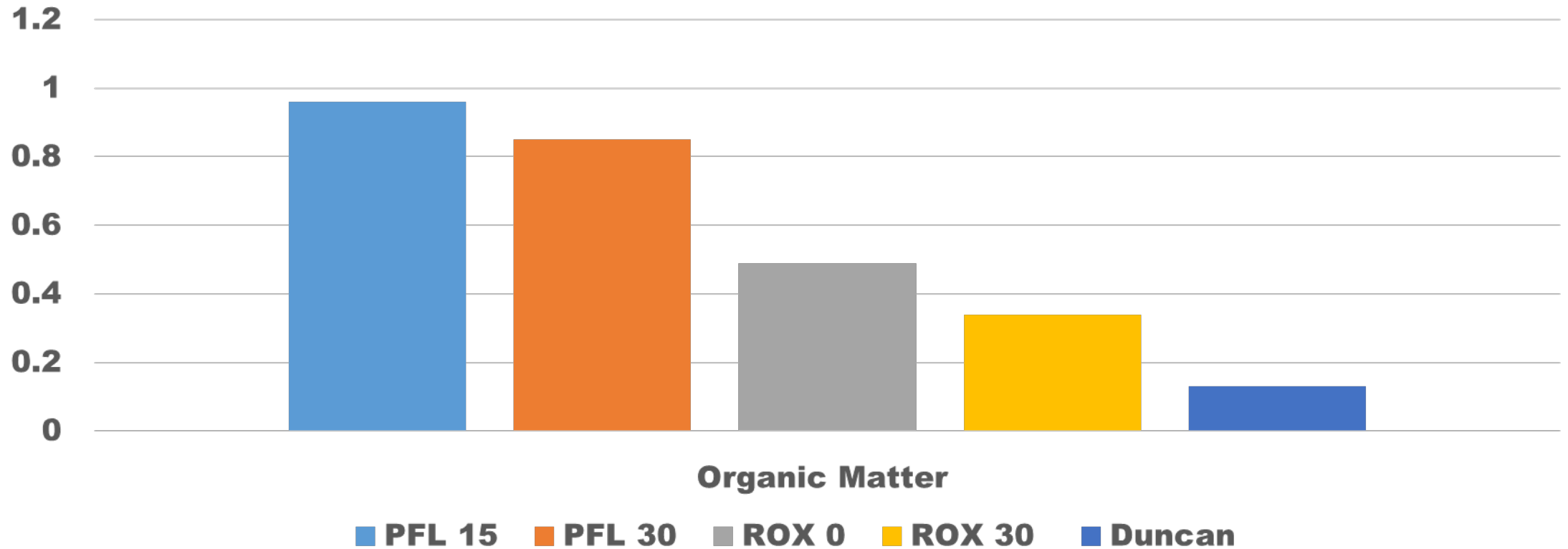
# Initial Respread Soil for Planting of Switchgrass

Soil	pH	OM	P	K	Ca	Mg	CEC
	s.u.	----- mg kg <sup>-1</sup> -----					cmoles <sup>+</sup> kg <sup>-1</sup>
ROX	5.4	3000 0.30%	20	69	1723	915	20
PFL	5.4	8800 (0.88%)	17	86	1183	505	16

**Sampled to 0-30 cm**

# Changes in Organic Matter of PFL and Red Oxidized Respread Planted to Switchgrass

2011



A wide-angle photograph of a field of switchgrass in November 2009. The grass is tall and dense, with a mix of green and golden-brown hues. In the background, a line of farm buildings, including a large white silo and several smaller structures, is visible against a clear blue sky. The text "Switchgrass November, 2009" is overlaid in the center of the image in a bright yellow font.

Switchgrass November, 2009



A wide-angle photograph of a lush green field of tall switchgrass. The grass is dense and reaches a height of several feet. In the background, a line of dark green trees stretches across the horizon. To the left, a blue industrial structure, possibly a conveyor system or a small building, is visible against the sky. The sky is a clear, pale blue. The text "Switchgrass May 2016" is overlaid in the center of the image in a bright yellow font.

Switchgrass May 2016

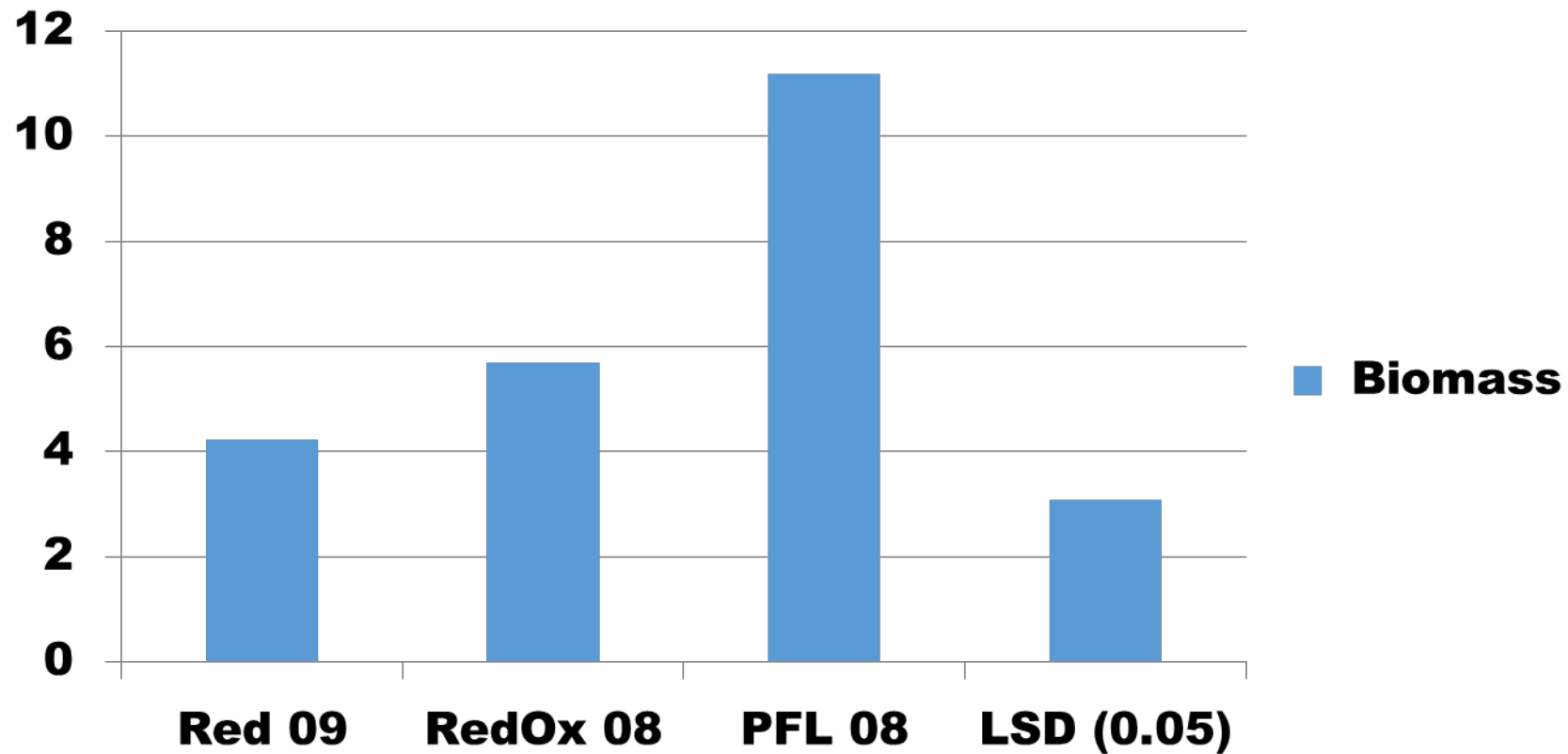
# Biomass Harvest 2010





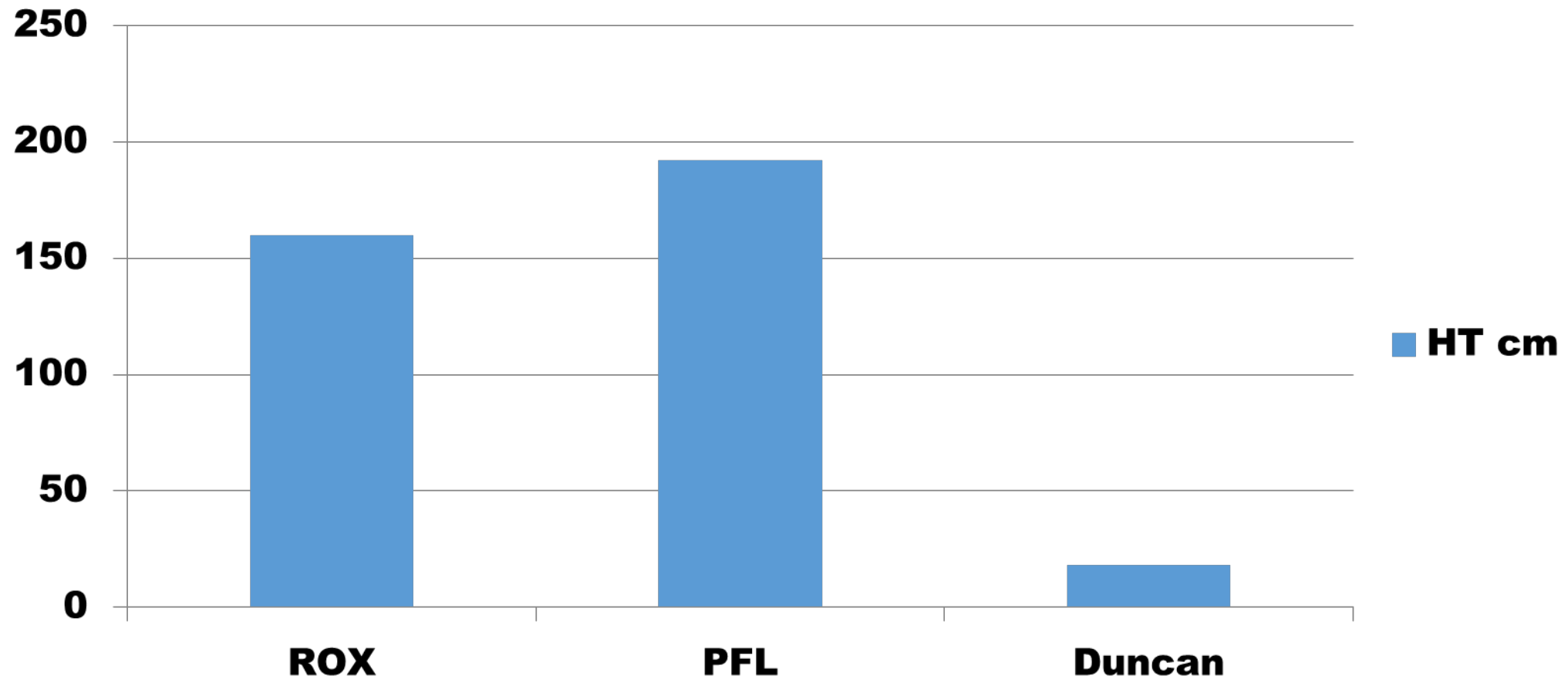
# Switchgrass Yield in in 2010 Planted in 2008 and 2009

Mg ha<sup>-1</sup>



# Switchgrass Height on Red Oxidized and PFL Respread

**September**



# Switchgrass Biomass to be Used as Mulch at RHM

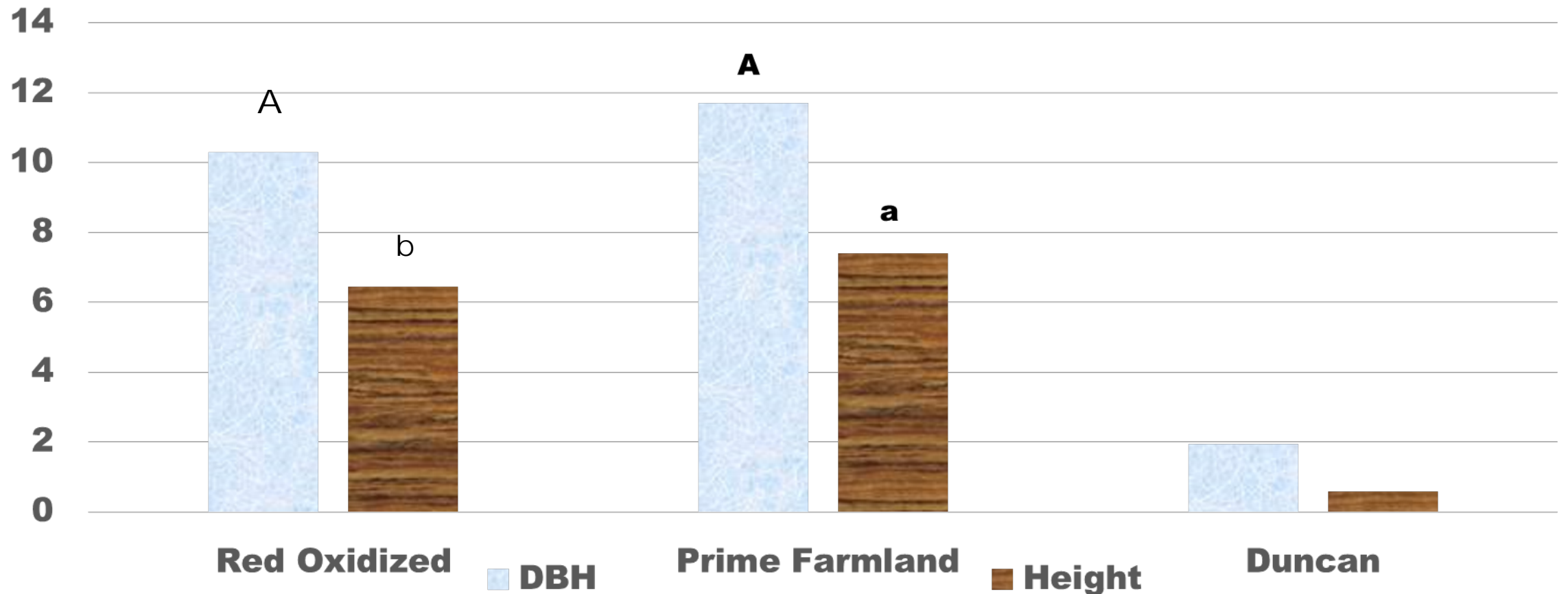


# Switchgrass Bales from 2015 – Cut Twice as Forage Hay for the Palmer Children's Home Ranch



# Growth of Loblolly Pines at the Red Hills Lignite Mine in Strips Between Switchgrass May 2016

**DBH (cm) and Height Meters**







# Bioenergy and Forage Nutritive Characteristics of Full Season Switchgrass Harvested as Biomass

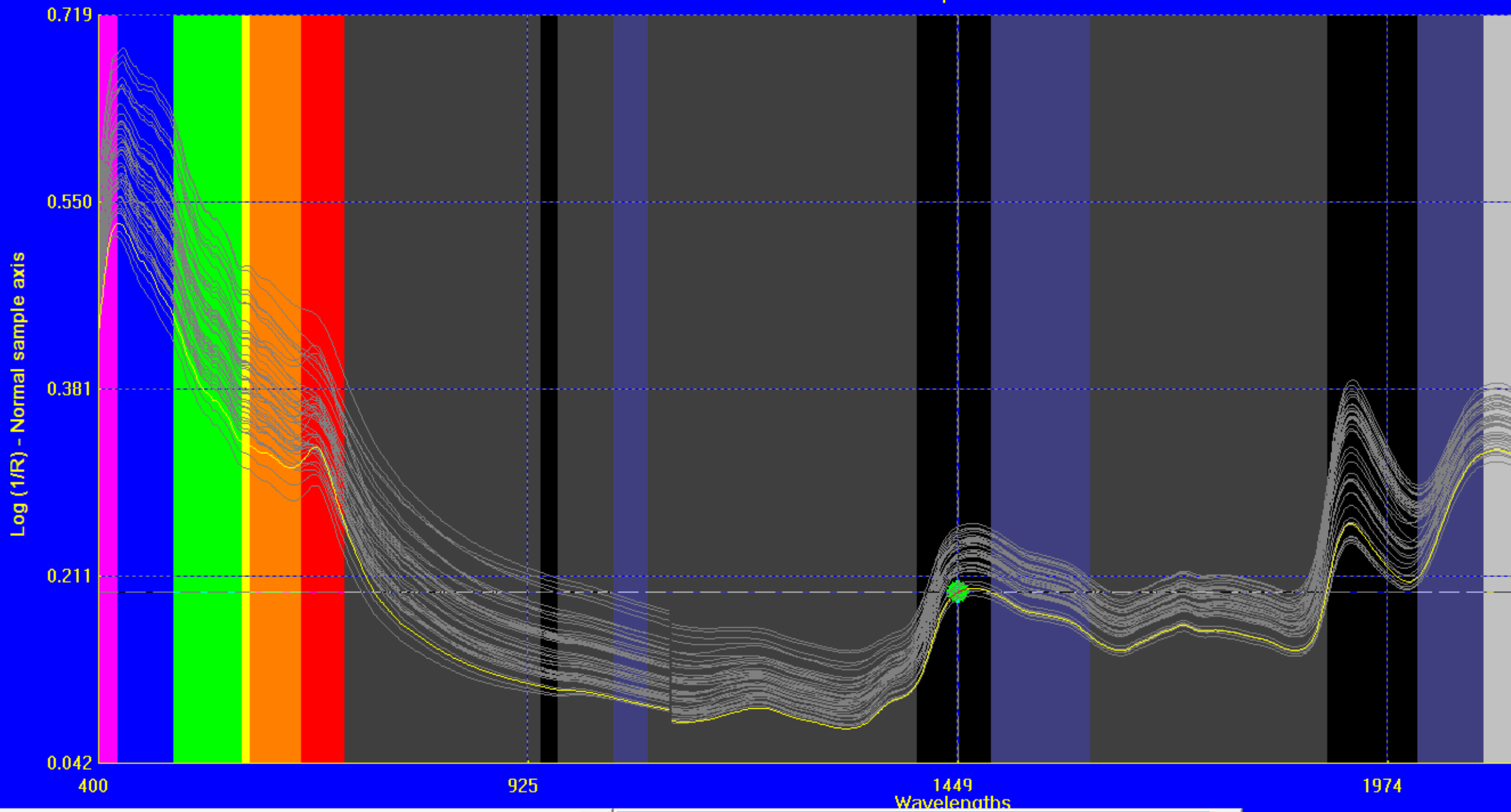
RHM 'Alamo' Switchgrass

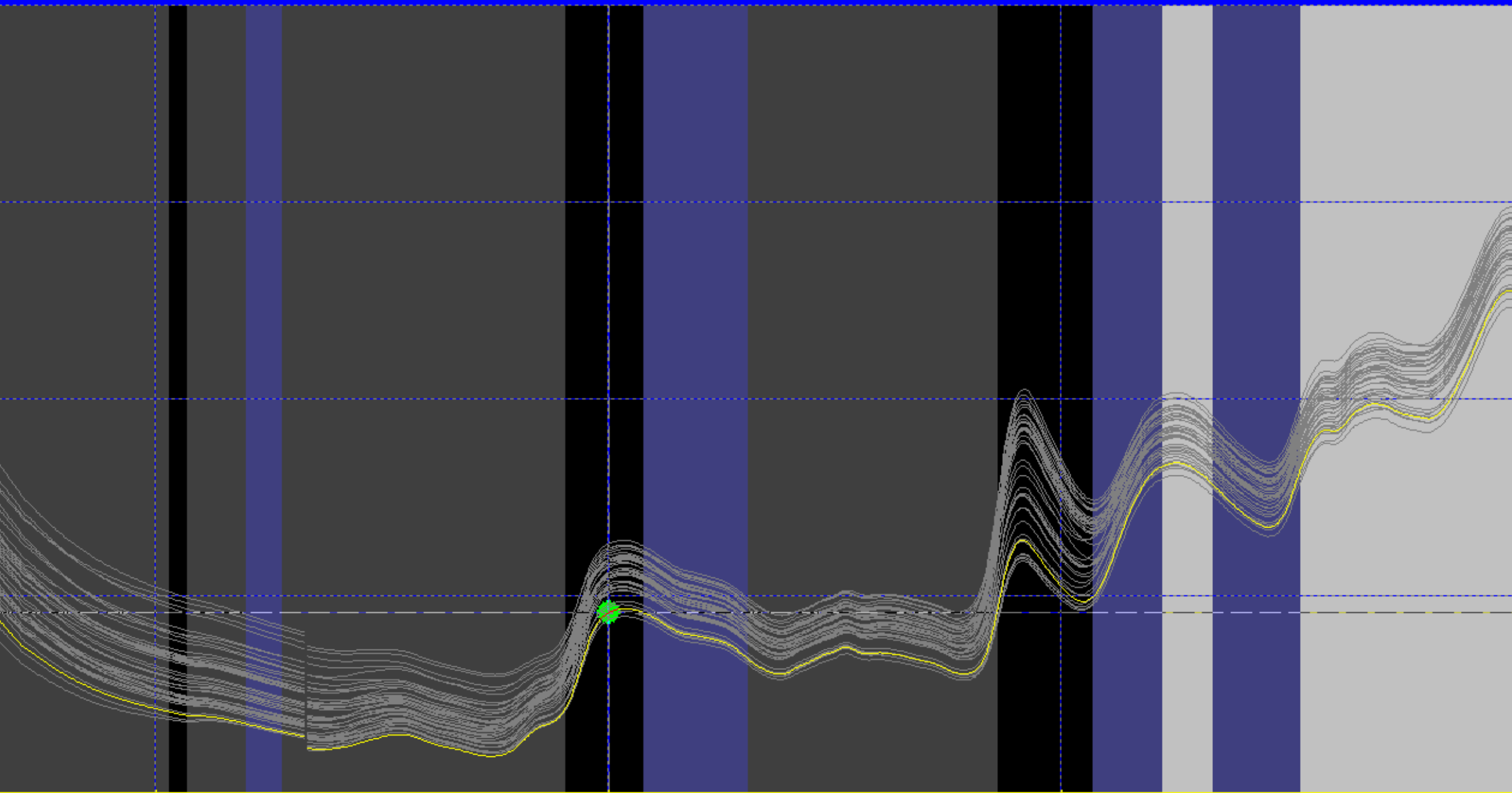
Hand Clipped Quadrat samples from Transects

October and November

Two Types of Respread:

Prime Farmland (PFL) and Red Oxidized (ROX)





925

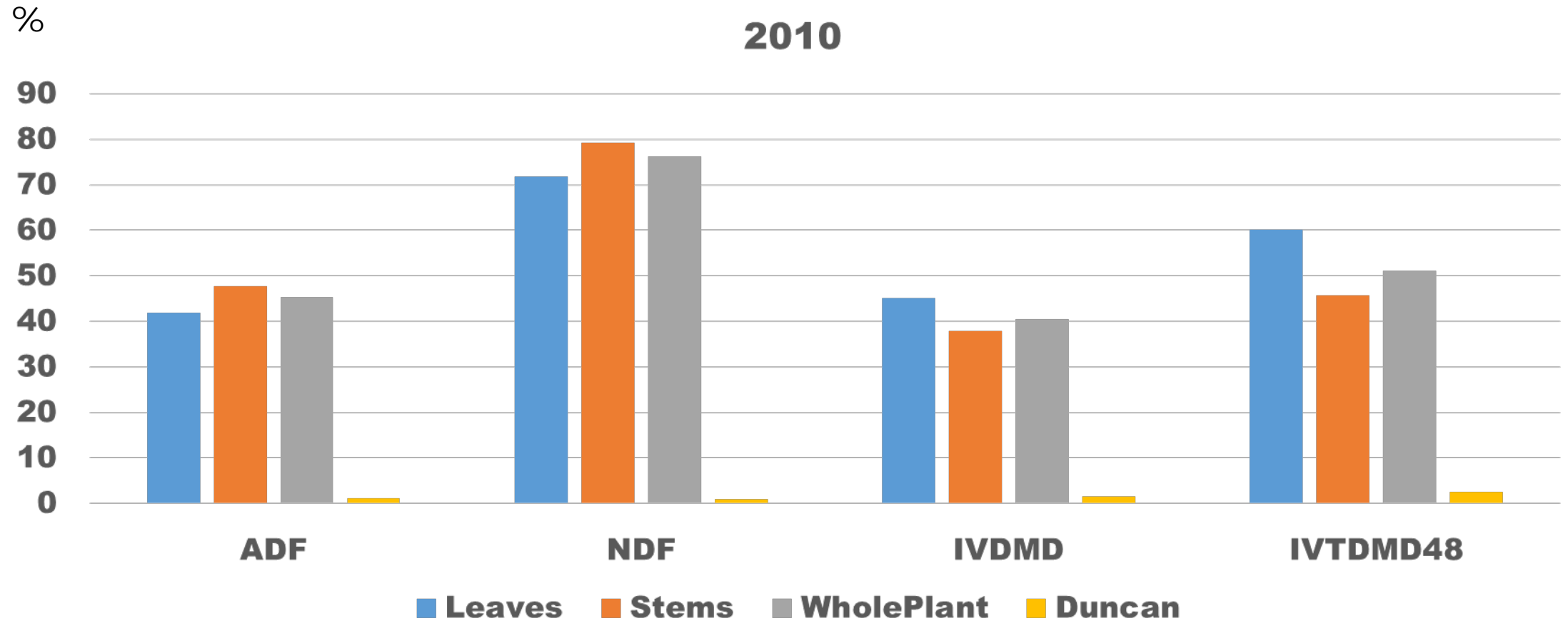
1449  
Wavelengths

1974

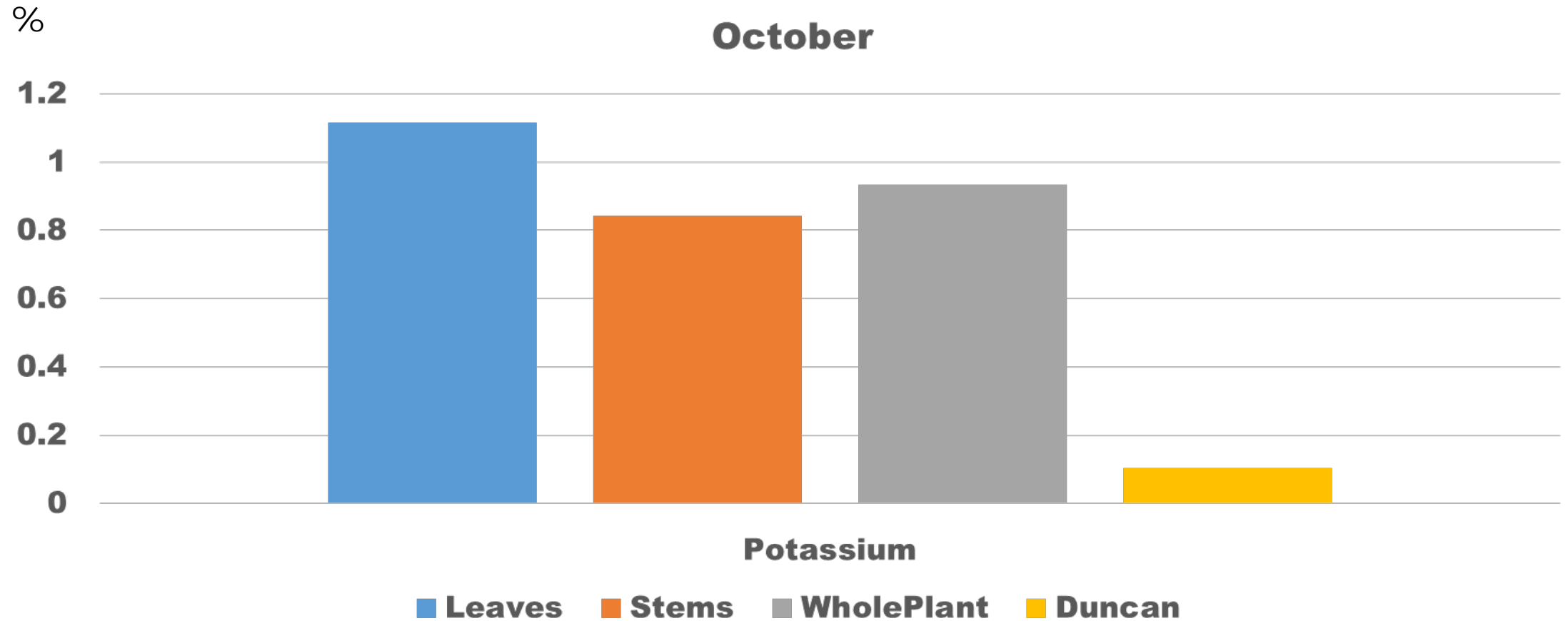
2498

Overtone  
Q-H

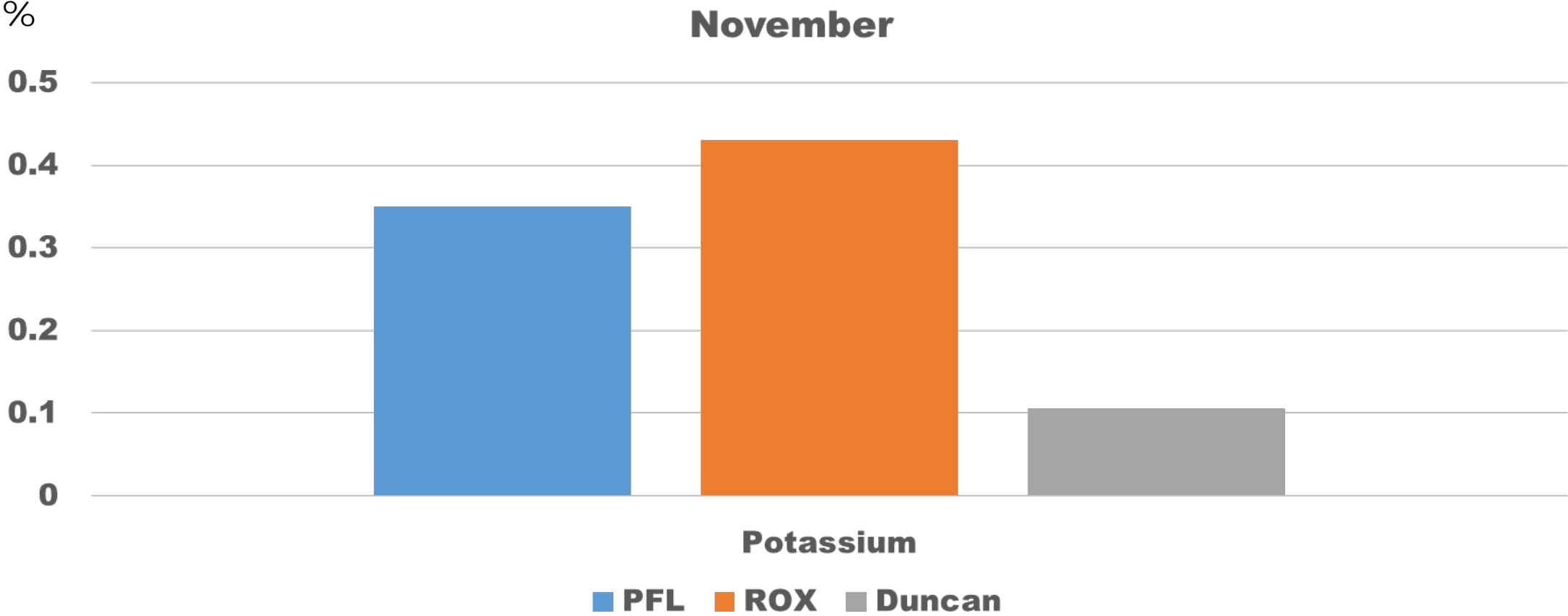
# Fiber and Digestibility of Switchgrass at RHM



# Minerals (K) in Leaves and Stems of Switchgrass at RHM



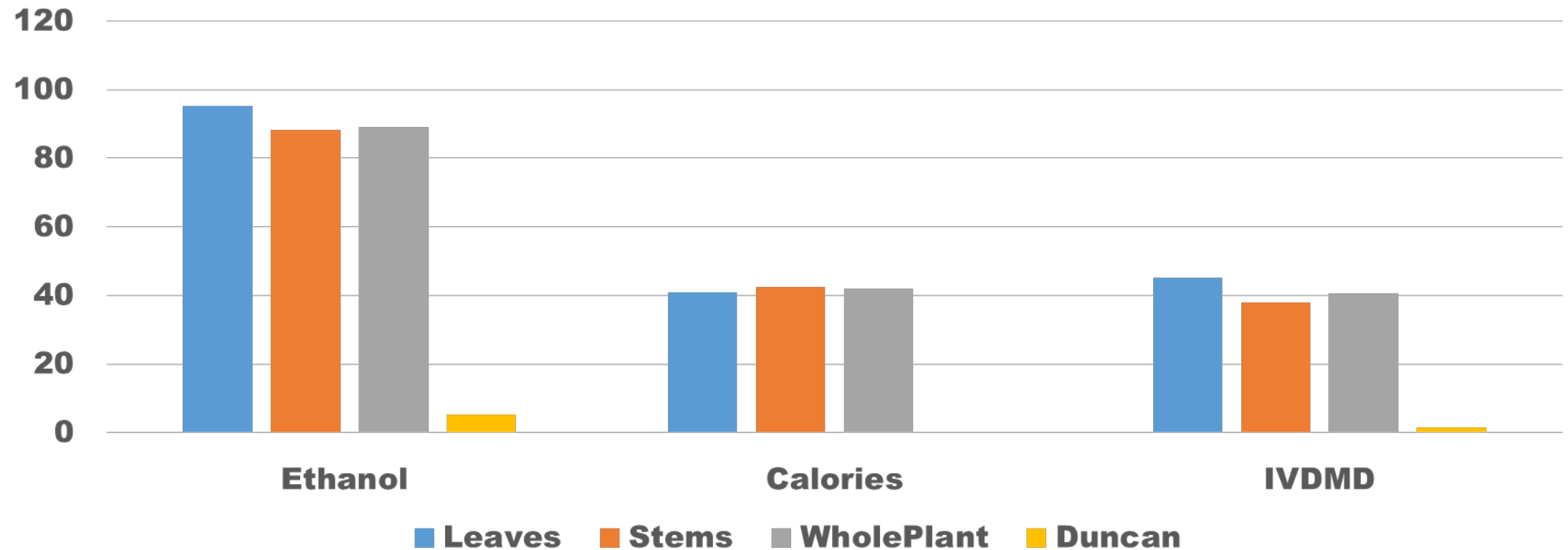
# Minerals (K) in Whole Plants of Switchgrass



# Potential Ethanol, Calories and Digestibility of Switchgrass at RHM

EtOH mg g<sup>-1</sup>  
Calories x 100  
% for IVDMD

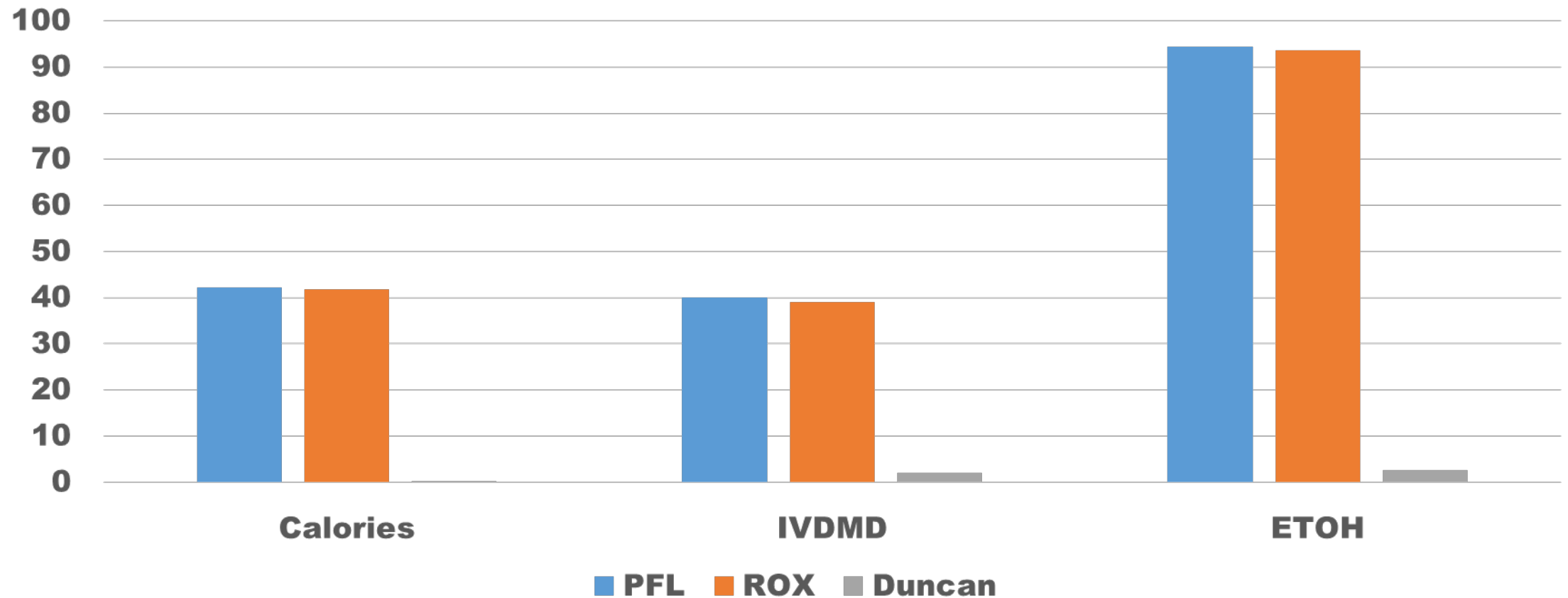
**October**





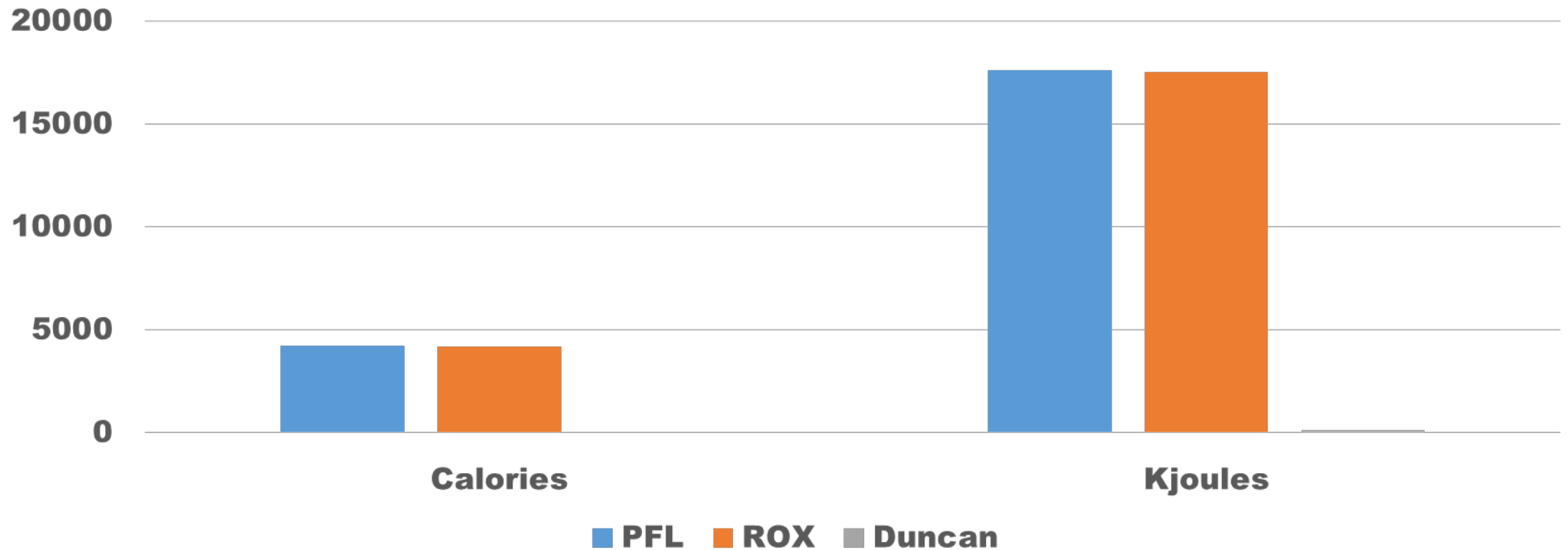
# Energy Content of Whole Plants of Switchgrass - Full Season in November

**Units: Calories x 100; IVDMD = % and ETOH = mg g<sup>-1</sup>**



# Energy Content of Whole Plants of Switchgrass - Full Season in November

**17000 kjoules kg-1 = 7300 BTU per lb**



# Conclusions

- Switchgrass Did a Poor Job of Initial Soil Stabilization
- Switchgrass Established with a No-Till Drill was Successful
- Yield was greater on PFL Respread than Red Oxidized Substitute – of both Switchgrass and Loblolly Pines
- Switchgrass Stands were Very Successful in 2016 after 8 Years!
- 
- Energy Content was Similar to Lignite as Verified by NIRS, but Hectares would require 2000 fold to replace the Mining Operation
- Soil Carbon is building under both Switchgrass and Loblolly Pines

THANK YOU!!



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