

# FRA Step #1

**“CREATE A SUITABLE  
ROOTING MEDIUM”**

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THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI)

# FOREST RECLAMATION ADVISORY

Forest Reclamation Advisory No. 2

December 2005

## THE FORESTRY RECLAMATION APPROACH

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The Forestry Reclamation Approach (FRA) is a method for reclaiming coal-mined land to forest under the Surface Mining Control and Reclamation Act (SMCRA). The FRA is based on knowledge gained from both scientific research and experience (Photo 1). The FRA can achieve cost-effective regulatory compliance for coal operators while creating productive forests that generate value for their owners and provide watershed protection, wildlife habitat, and other environmental services.

The purpose of this Advisory is to describe the FRA, which is considered by state mining agencies and US Office of Surface Mining to be an appropriate and desirable method for reclaiming coal-mined land to support forested land uses under SMCRA (Angel and others, 2005). The FRA is also supported by members of the ARRI's academic team, which is drawn from Universities in nine states, and by other groups and agencies.

### The FRA's Five Steps

The FRA can be summarized in five steps:

1. Create a suitable rooting medium for good tree growth that is no less than 4 feet deep and

**Photo 1.** A white oak stand that grew on a pre-SMCRA surface mine in southern Illinois. Observations by reclamation scientists and practitioners of soil and site conditions on reclaimed mines such as this, where reforestation was successful, have contributed to development of the Forestry Reclamation Approach.



# The 5 Steps of FRA

1. Create a suitable rooting medium...
2. Loosely grade the rooting medium...
3. Use compatible ground covers...
4. Plant two types of trees...
5. Use proper tree planting techniques.

*Are they all equally important?*

# Step 1.

Create a suitable rooting medium:

Tree survival and growth  
can be hindered by  
highly alkaline or acidic soils.

2008 6 11

## Step 1. Create a suitable rooting medium:

During mining and reclamation, all highly alkaline materials with excessive soluble salts and all highly acidic or toxic material should be covered with a suitable rooting medium that will support trees.

2008 6 11

# Growth media:

- Low levels of soluble salts,

- pH of 5.0 to 7.0,

- Low pyritic S content,

- Loamy textures

What about Rocks? How much?

2007 7 31

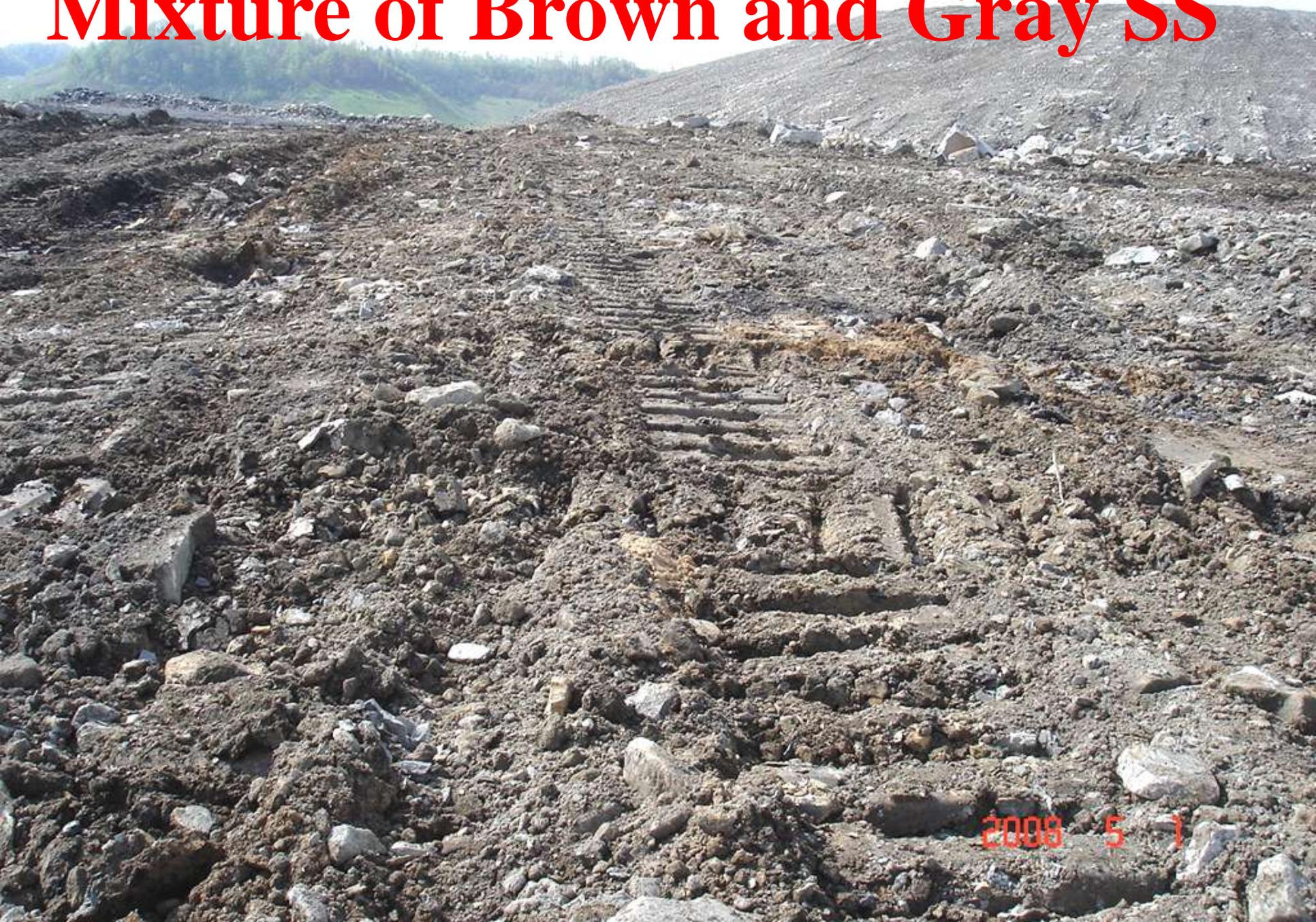


**Such soils can be formed from overburden materials comprised of**

- weathered Brown SS**
- unweathered Gray SS**
- especially if mixed with natural soils.**

**Why natural soil material?**

# Mixture of Brown and Gray SS



2008 5 1

**We planted Chestnuts on this Massey site**  
**Mixture of Brown and Gray SS**



2008 5 14

**After two growing seasons...  
No seeding!**



**What about this?**



# Suitable Mixture?



2007 3 13



2007 3 13

# Suitable Mixture?



2007 7 31



# One stop on ARRI Field Trip VA 2007



2007 8 9

# One stop on ARRI Field Trip WV 2008



2008 8 5

**One stop on  
ARRI Field Trip  
KY 2009**





**Reclamation materials  
can come from  
any geologic interval!**

**Convenience and Cost versus Best**

# 5 Cs of Reforestation

1. **Composition of Material**
2. **Compaction**
3. **Competition – Ground Cover**
4. **Consumption – Animals**
5. **Commerical Trees and Planting**

A large yellow mining truck is driving on a dirt road in a quarry. The background features a massive, layered rock face with various shades of brown, tan, and gray. The foreground is filled with loose rocks and debris. The text "1. Composition of Material Brown vs Gray Sandstone" is overlaid in yellow. In the bottom right corner, there is a red stamp that reads "PMT 10 2008".

# 1. Composition of Material Brown vs Gray Sandstone

PMT 10 2008

**The real deal is getting a suitable mixture**





**Morgantown**

**Charleston**

**Samples Mine**

**Beckley**

# Experimental Plots

**Brown Sandstone**

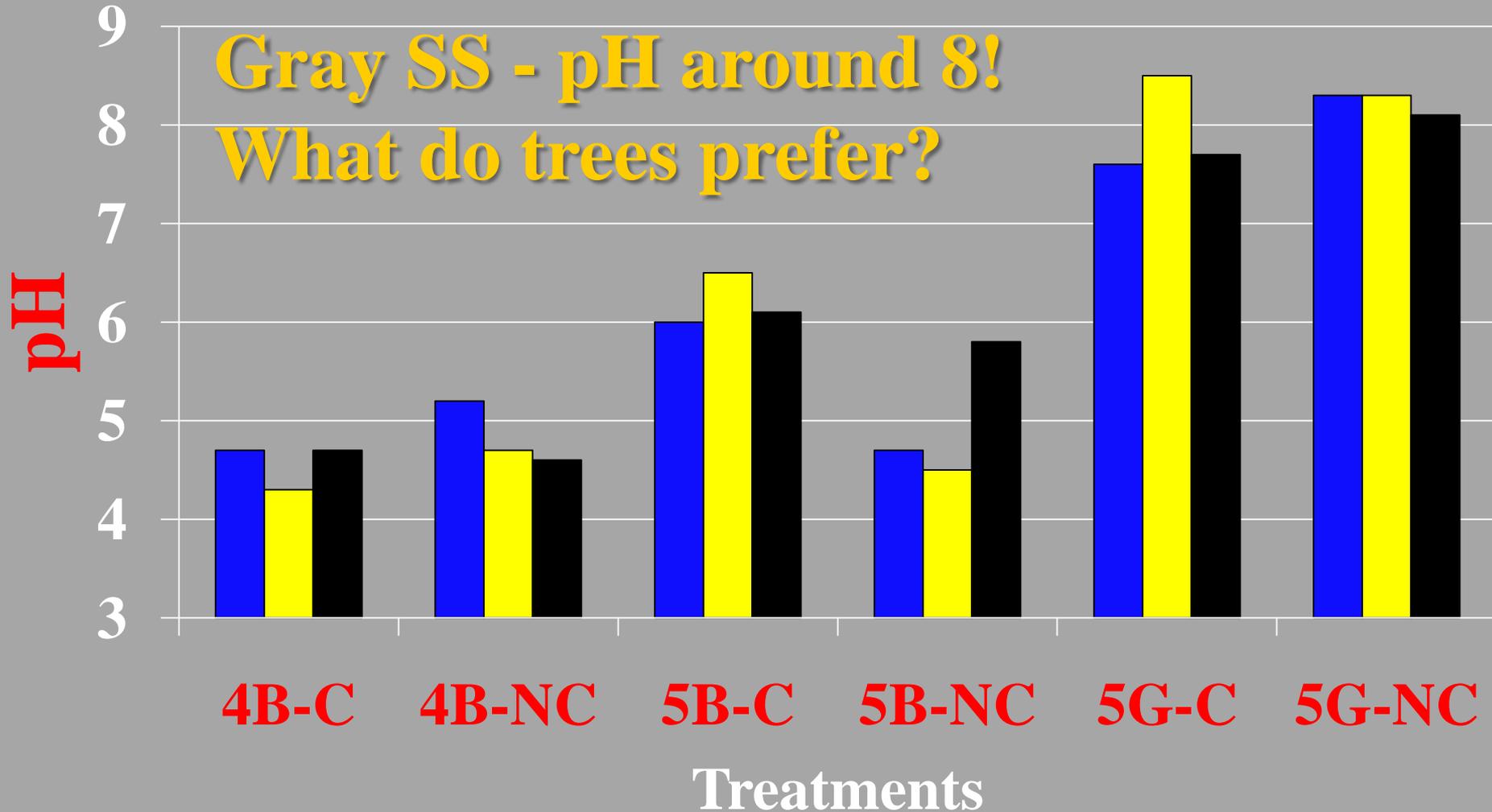


**Gray Sandstone**



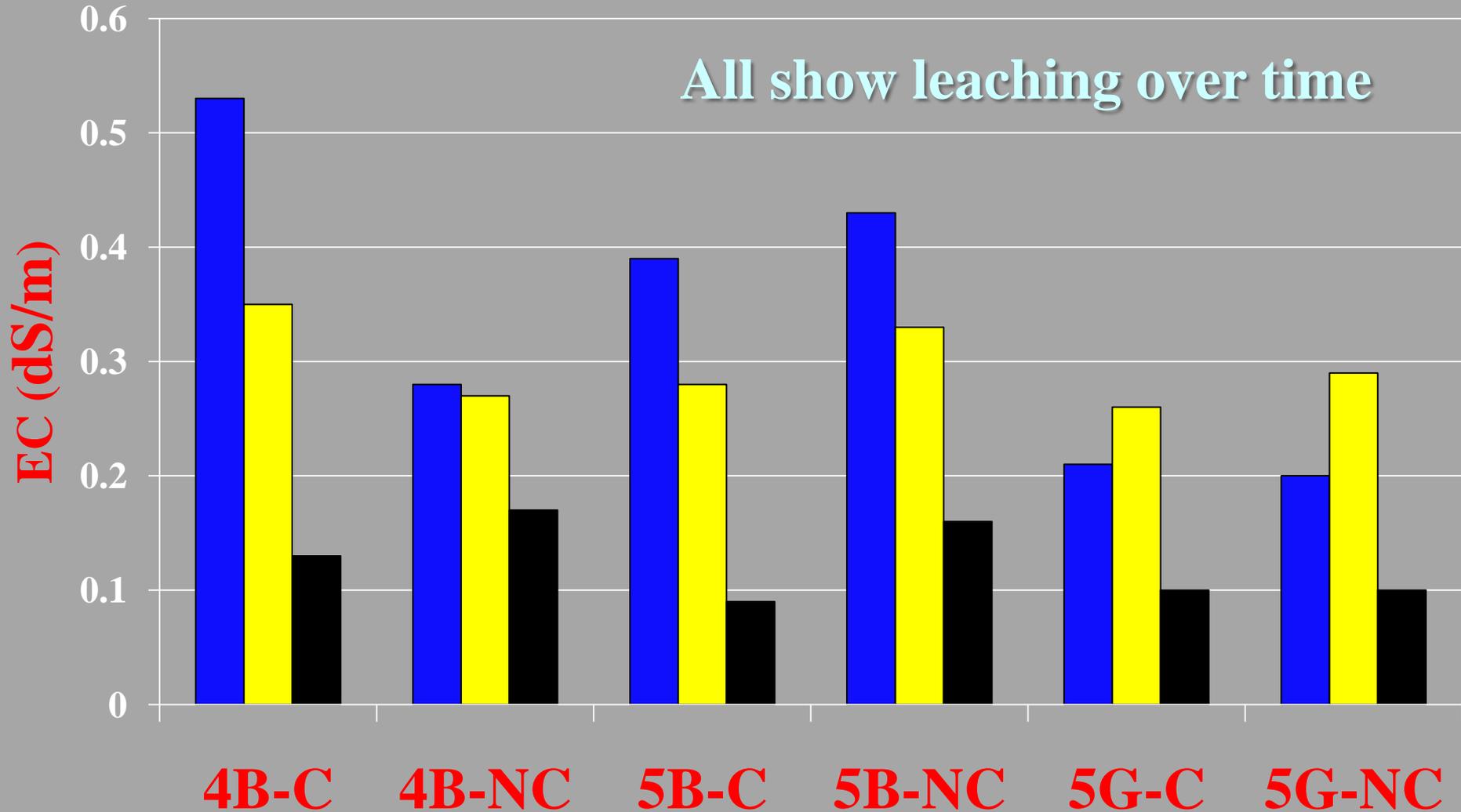
# Results - pH

■ 2005 ■ 2007 ■ 2009

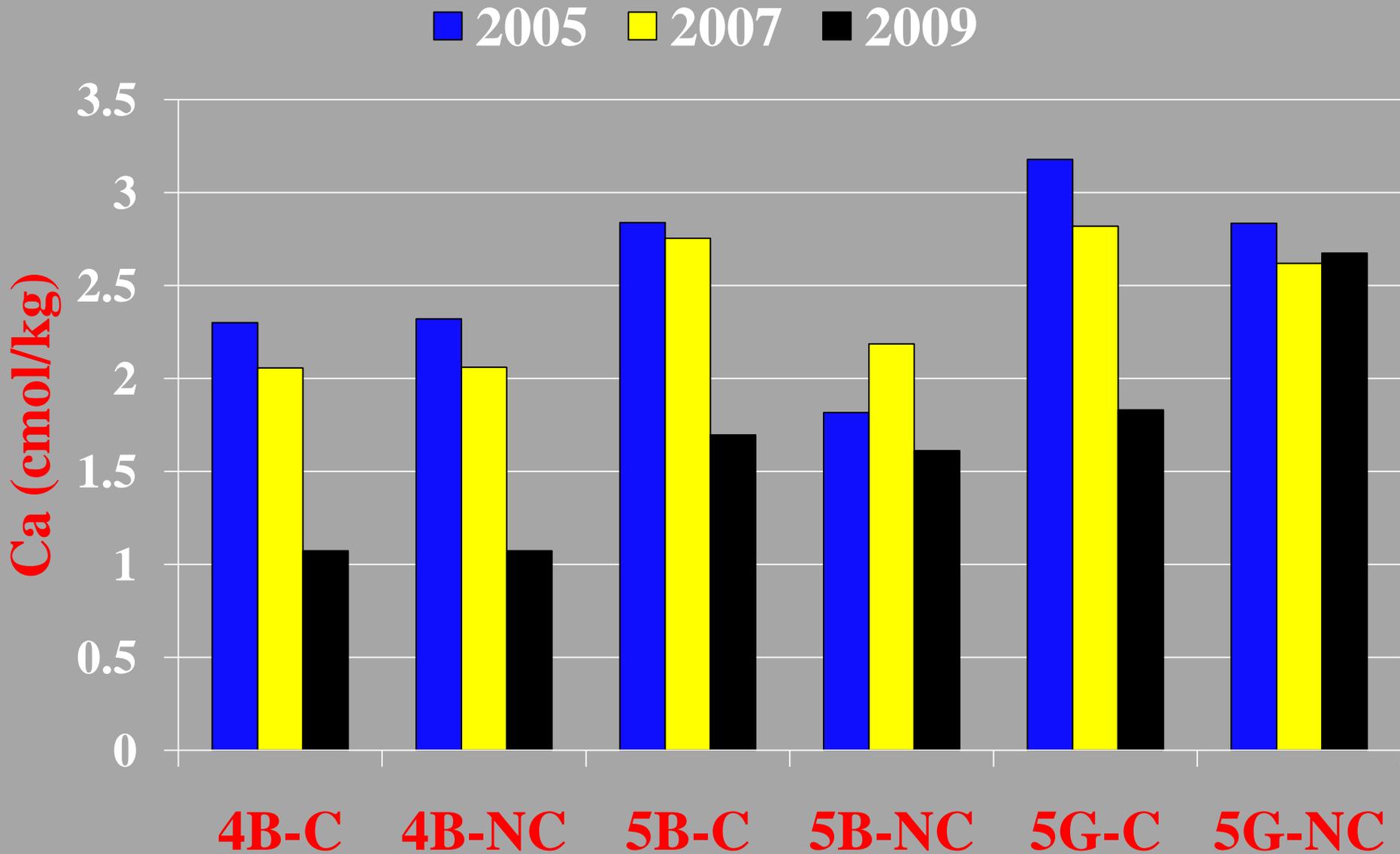


# Results - EC

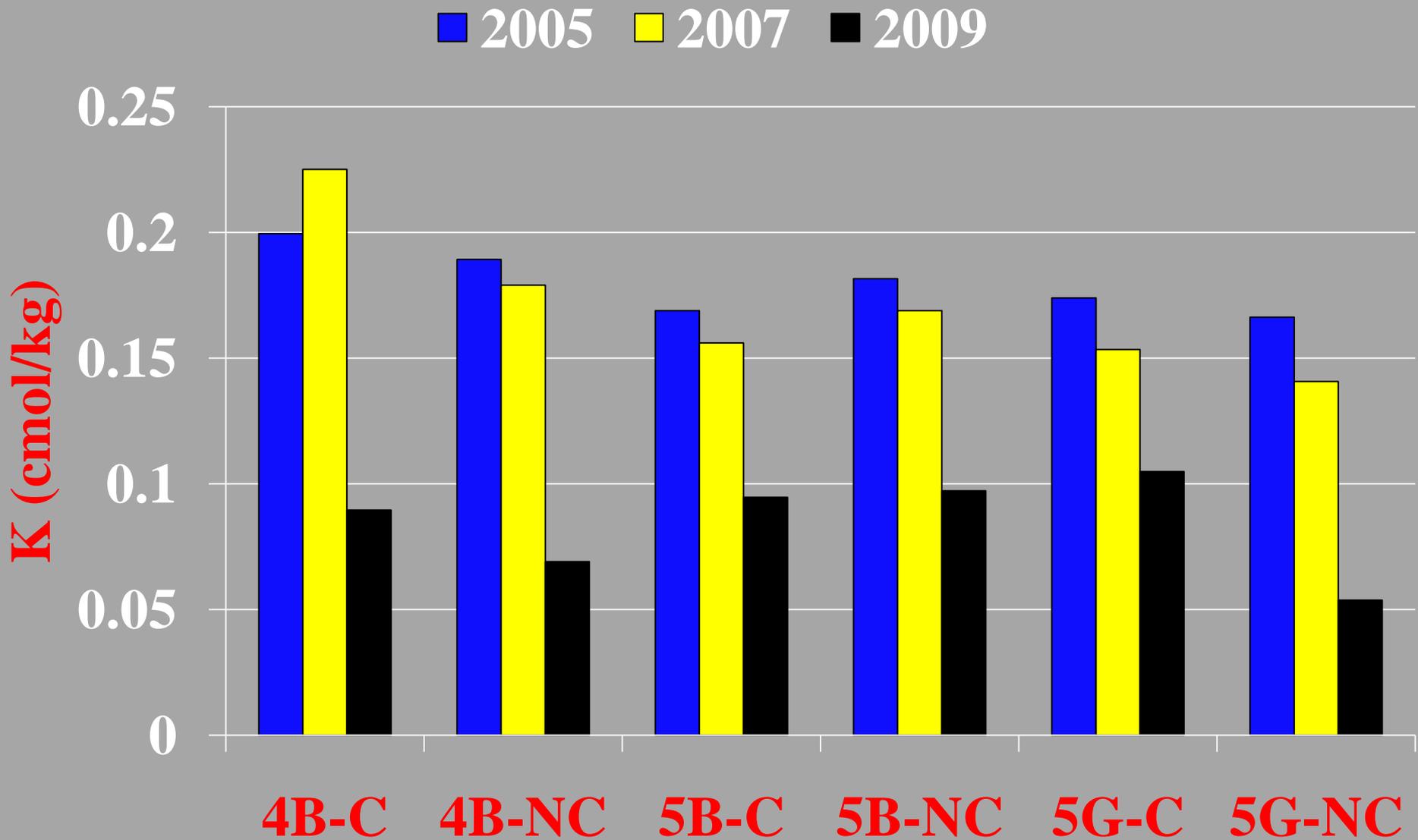
■ 2005 ■ 2007 ■ 2009



# Results - Ca

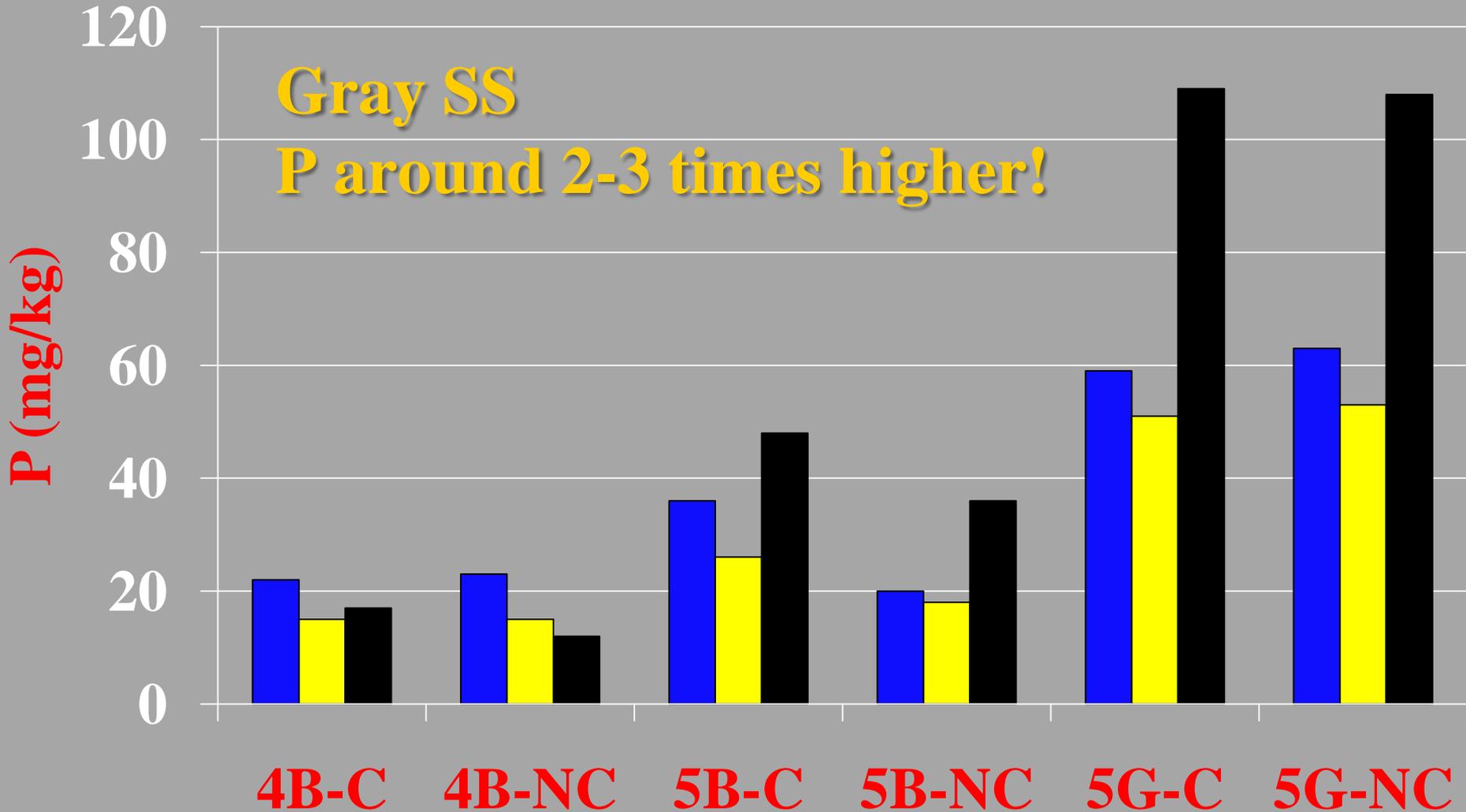


# Results - K



# Results - P

■ 2005 ■ 2007 ■ 2009



# Results - % Fines

## Treatments

<u>Size</u>	<u>4B C</u>	<u>4B NC</u>	<u>5B C</u>	<u>5B NC</u>	<u>5G C</u>	<u>5G NC</u>
2005	49 a	48 a	50 a	53 a	40 a	36 a
2007	59 a	61 a	64 a	60 a	34 b	34 b
2009	56 a	55 a	60 a	47 a	37 b	37 b

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Is there a difference in breakdown?

## Brown Sandstone

Lower pH ~ 6.0

Greater % Fines



## Gray Sandstone

High pH ~ 8.0

Greater Phosphorus



**Trees grow in both!**  
**But...how well?**



# Gray SS 2007



2007 7 30

# Brown SS

## 2007



2007 7 30

# Gray SS

# 2008



2008 6 10

# Brown SS 2008



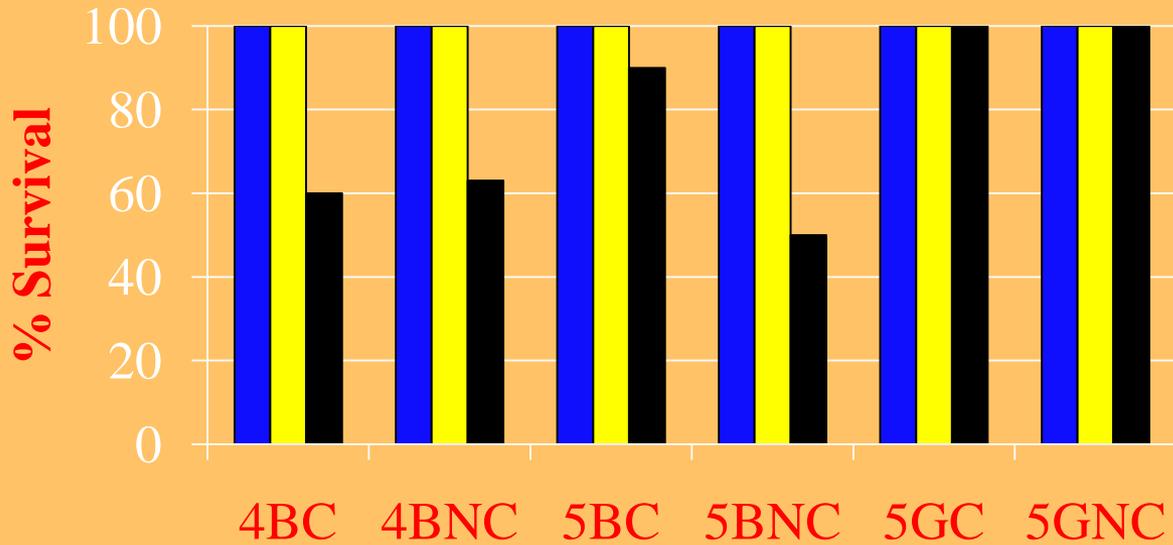
# Gray SS 2009



# Brown SS 2009

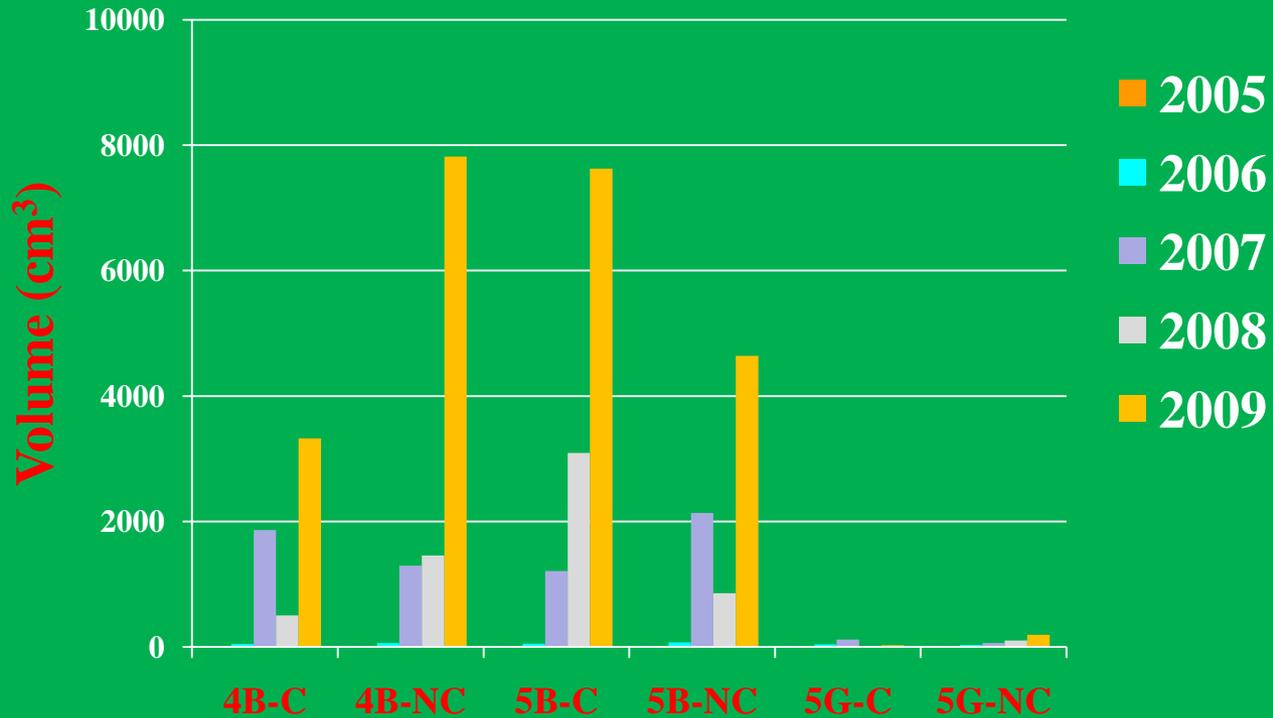


2006 2007 2009



# Black Locust

Scale!





← Gray SS

**Black Locust**

**Brown SS** ↓

**2007**





← Gray SS

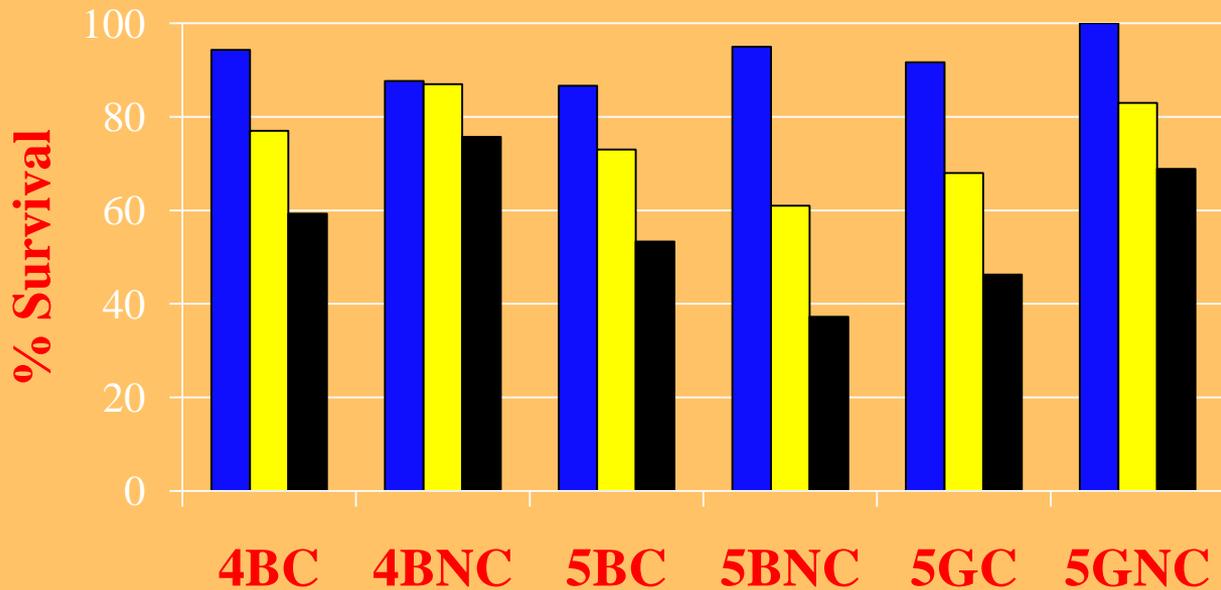
**Black Locust**

**Brown SS ↓**

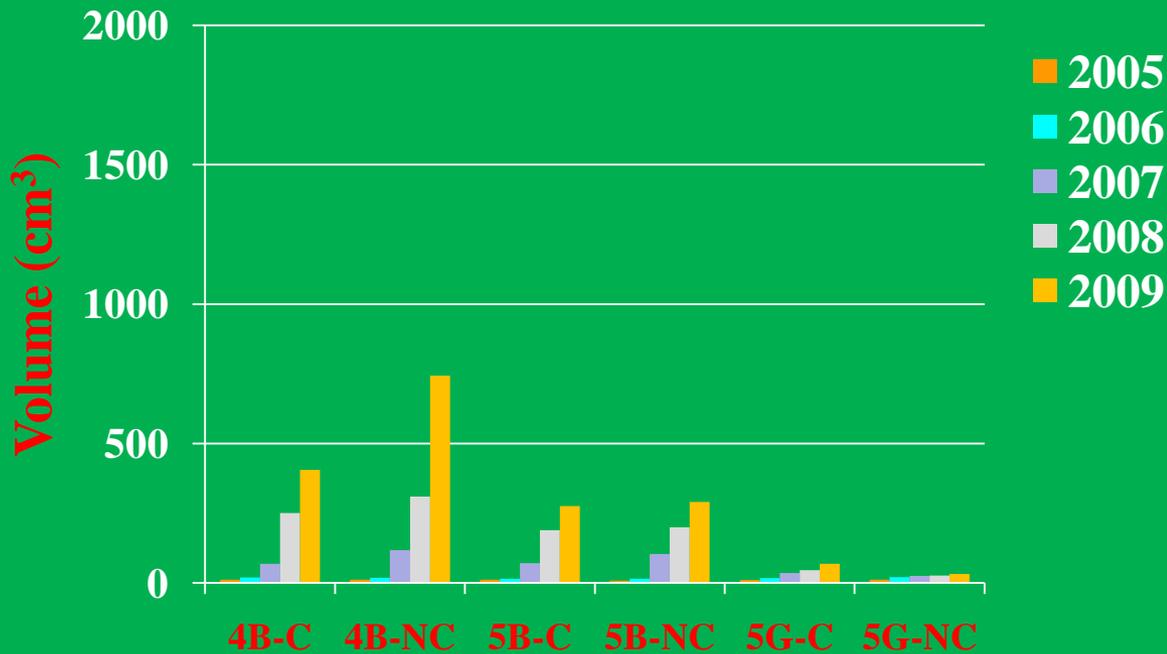
**2009**



2006 2007 2009



# Red oak





← Gray SS  
**Red Oak**  
Brown SS ↓

**2008**





← Gray SS

**Red Oak**

**Brown SS** ↓

**2009**





← Gray SS

**Tulip Poplar**

**Brown SS ↓**

**2007**





← Gray SS

**Tulip Poplar**

**Brown SS ↓**

**2009**





← Gray SS

**Black Cherry**

**Brown SS** ↓

**2009**





← Gray SS

**White Oak**

**Brown SS ↓**

**2009**





← Gray SS

White Ash

Brown SS ↓

2009



# Growth and Survival by substrate, treatment, and depth

	Survival ( % )	Growth (cm <sup>3</sup> )
<u>Substrate</u>		
Gray	71 a	73 b
<b>Brown</b>	<b>67 a</b>	<b>600 a</b>

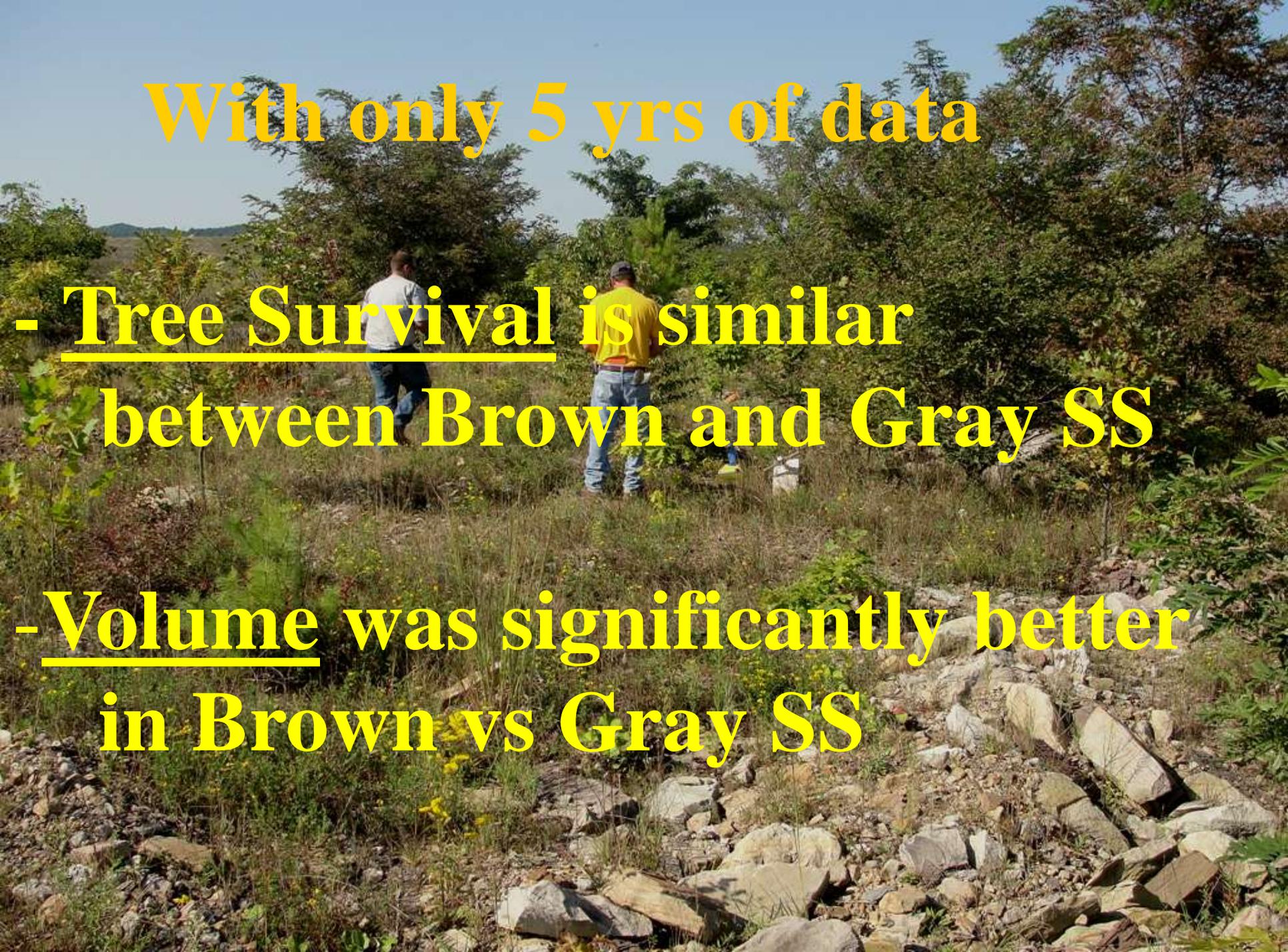
A yellow bulldozer is shown in the background, working on a large pile of gray soil or debris. The bulldozer has "D11R" and "CA" visible on its side. The foreground is filled with a large pile of gray, rocky soil.

# Soil Properties

- % Fines greater in Brown vs Gray

- Soil pH is 8 with Gray, 6 with Brown

- Phosphorus is greater in Gray vs Brown



With only 5 yrs of data

- Tree Survival is similar between Brown and Gray SS
- Volume was significantly better in Brown vs Gray SS

# **ARRI Advisory #2:**

**Such soils can be formed from overburden materials comprised of**

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- unweathered Gray SS**
- especially if mixed with natural soils.**

# A mixture of Brown and Gray?



**2 Brown : 1 Gray**  
**1 Brown : 1 Gray**  
**1 Brown : 2 Gray**

# Experiments to test Mixtures



# Experiments to test Mixtures



**You  
Got  
Any  
Questions?**



# Gray SS 2009



**Brown SS**  
**2009**

