APPALACHIAN REGIONAL REFORESTATION INITIATIVE

2008 ARRI Conference

"Mined Land Reforestation"

August 5-7 - Chief Logan State Park, Logan, WV

Co-organizers
Scott Eggerud and Brad Edwards
2008 6 10

FRA Step #1

"CREATE A SUITABLE ROOTING MEDIUM"

Jeff Skousen, WVU

THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI)

FOREST RECLAMATION ADVISORY

Forest Reclamation Advisory No. 2 December 2005

THE FORESTRY RECLAMATION APPROACH

Jim Burger[1], Don Graves[2], Patrick Angel[3], Vic Davis[4], Carl Zipper[5]

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.

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 FRA's Five Steps

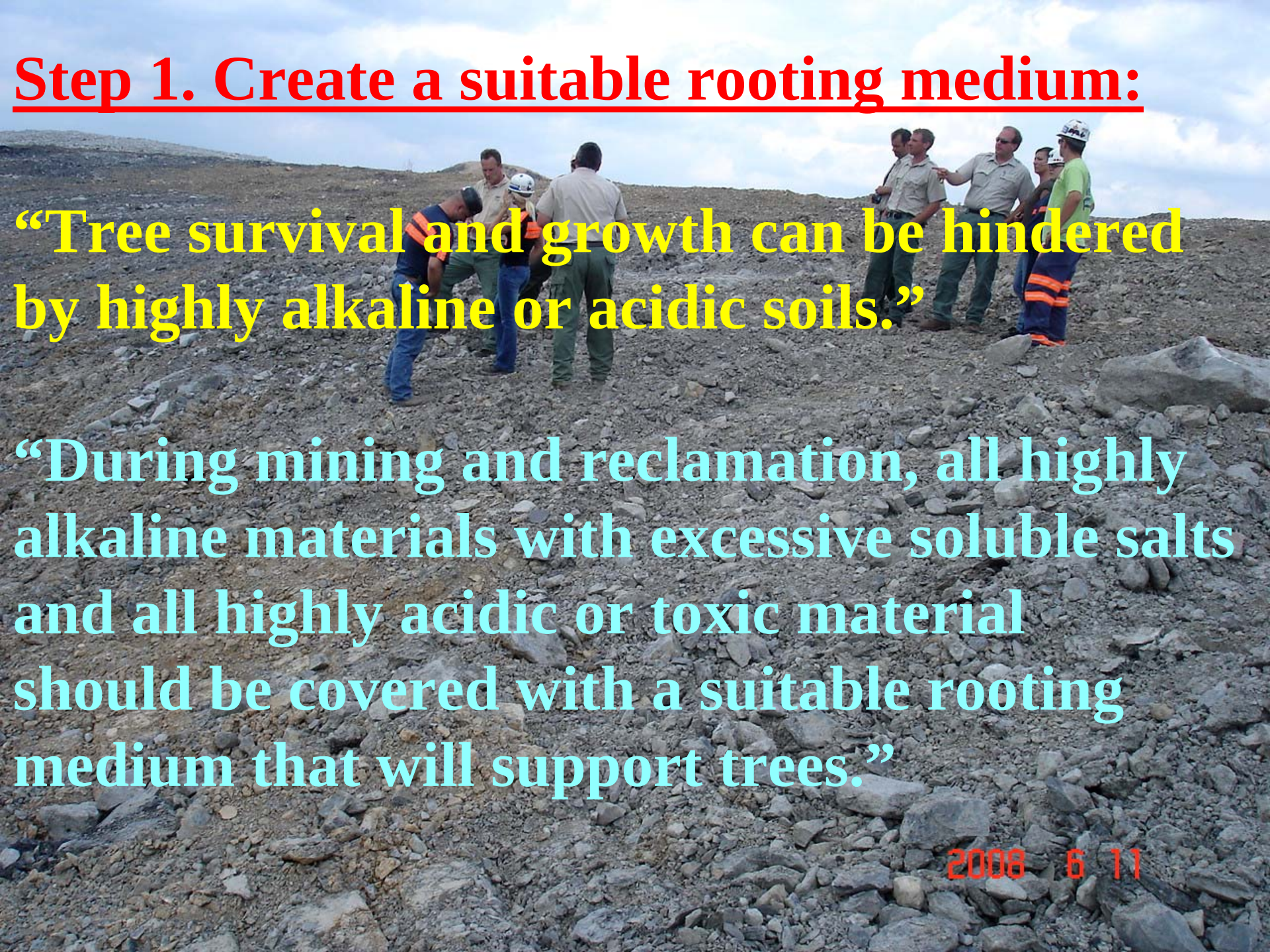
The FRA can be summarized in five steps:

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

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.

Step 1. Create a suitable rooting medium:



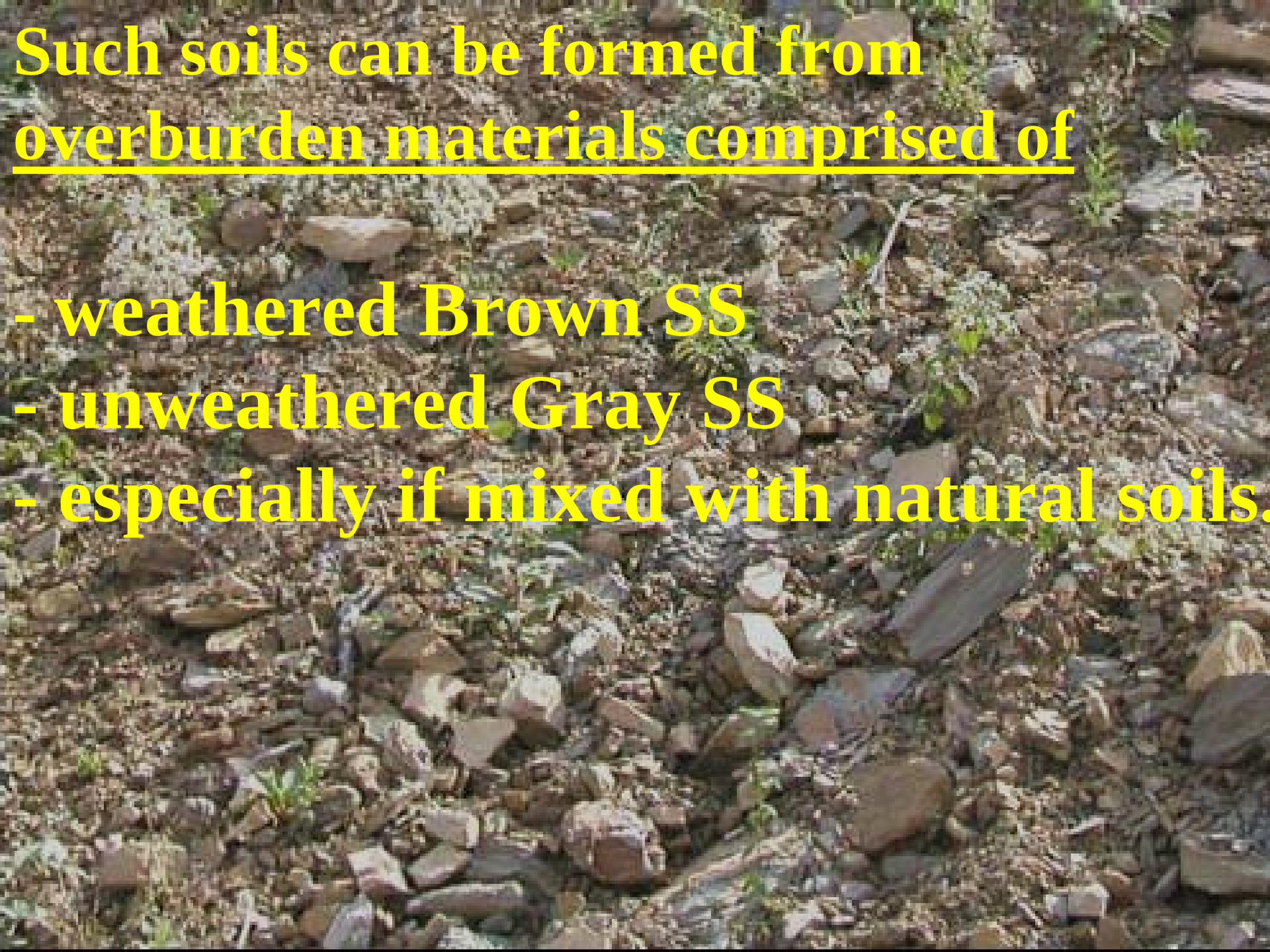
"Tree survival and growth can be hindered by highly alkaline or acidic soils."

"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."

Growth media:

-Low levels of soluble salts,

- pH of 5.0 to 7.0,
- Low pyritic S content,
- Loamy textures.



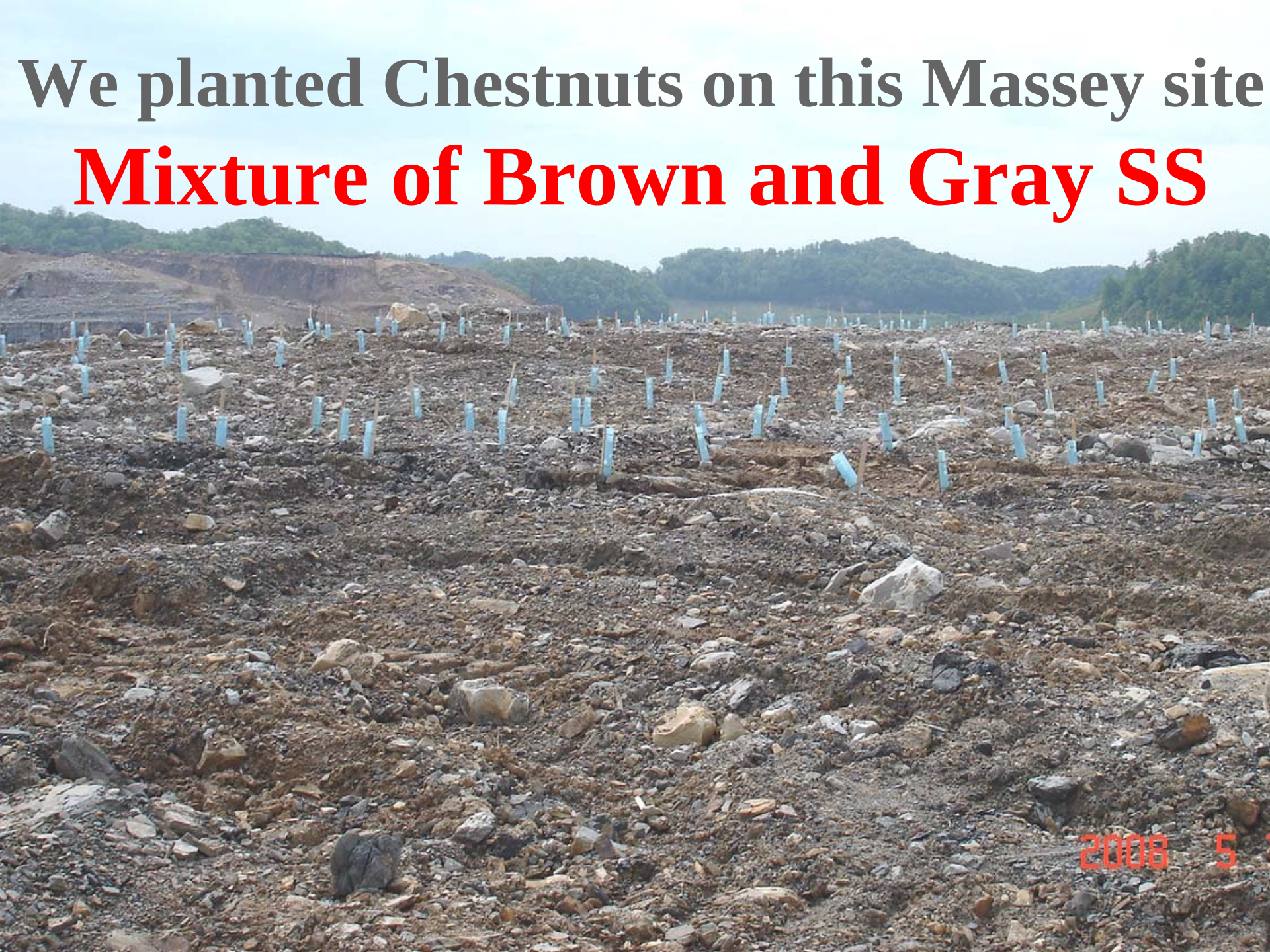
Such soils can be formed from <u>overburden materials comprised of</u>

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

Mixture of Brown and Gray SS

We planted Chestnuts on this Massey site

Mixture of Brown and Gray SS



What about this?

2007 3 13

2007 3 13

Last stop on
ARRI Field Trip
VA 2007
MIXTURE?
2007 8 9

Reclamation materials
can come from
any interval

1. Composition of Material

Brown vs Gray Sandstone

The real deal is getting a suitable mixture

Morgantown
Charleston
Samples Mine
Beckley

760-acre experimental practice

Three, 7-acre demonstration plots

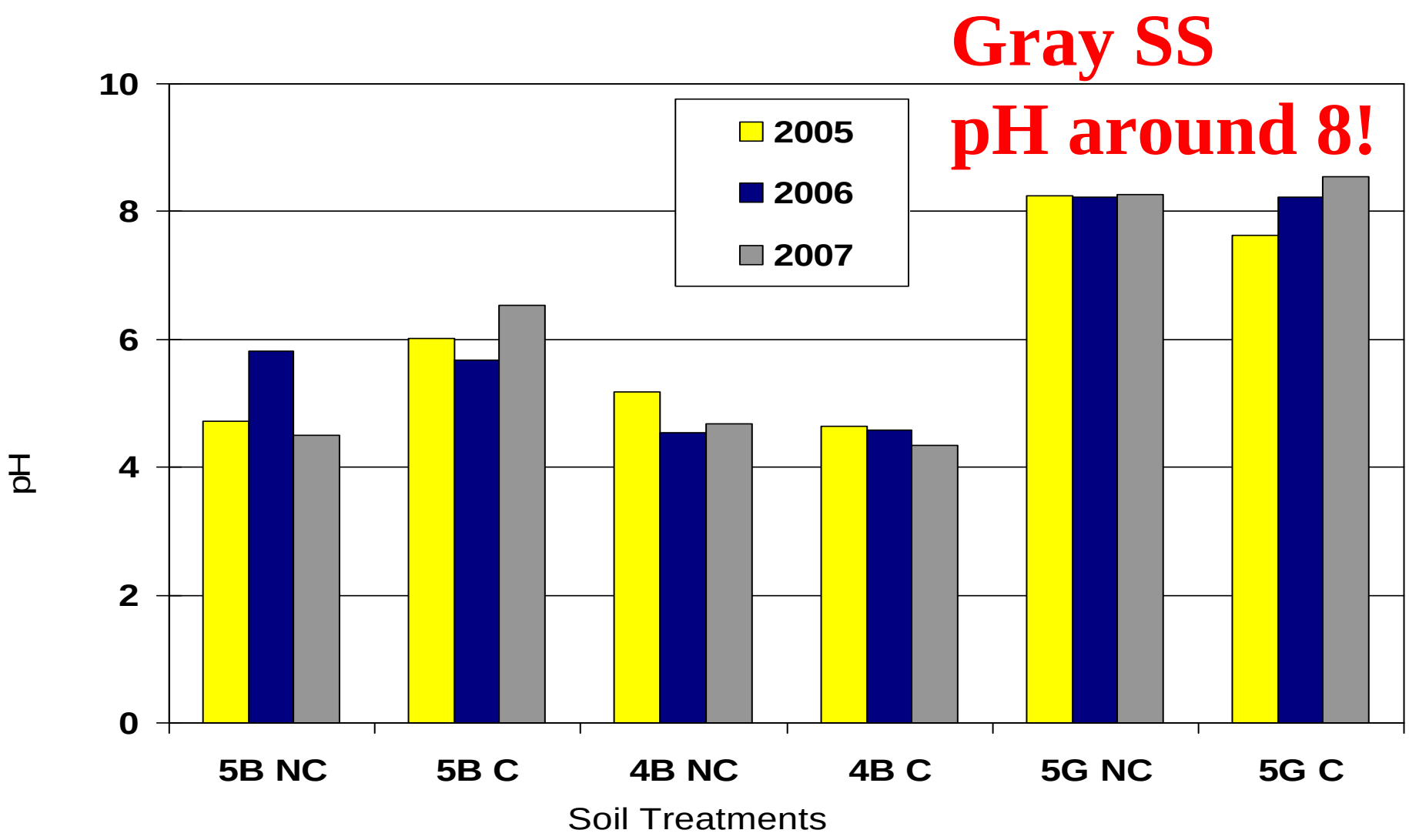
Gray vs. Brown sandstone

Experimental Plots

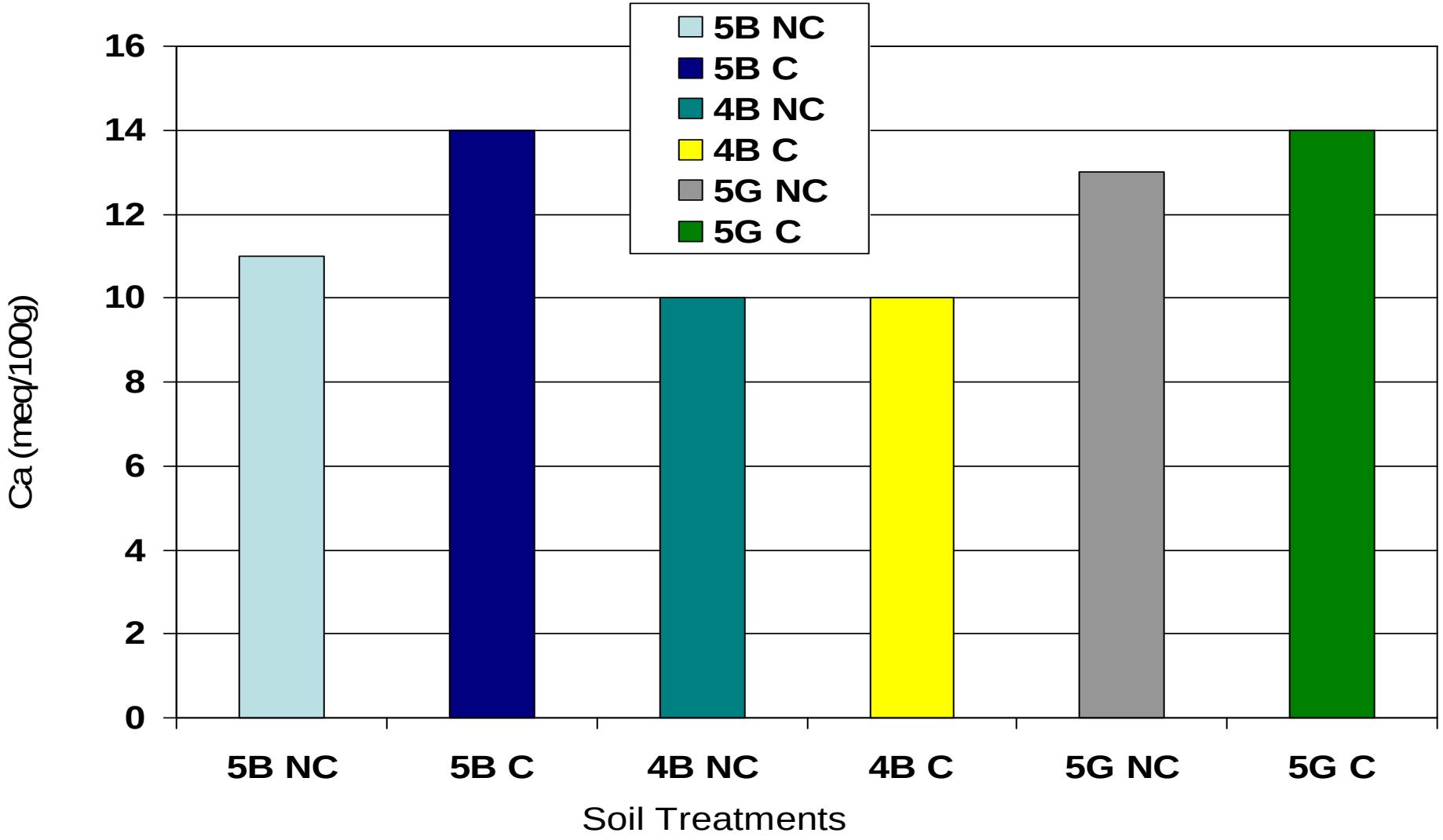
Brown Sandstone

Gray Sandstone

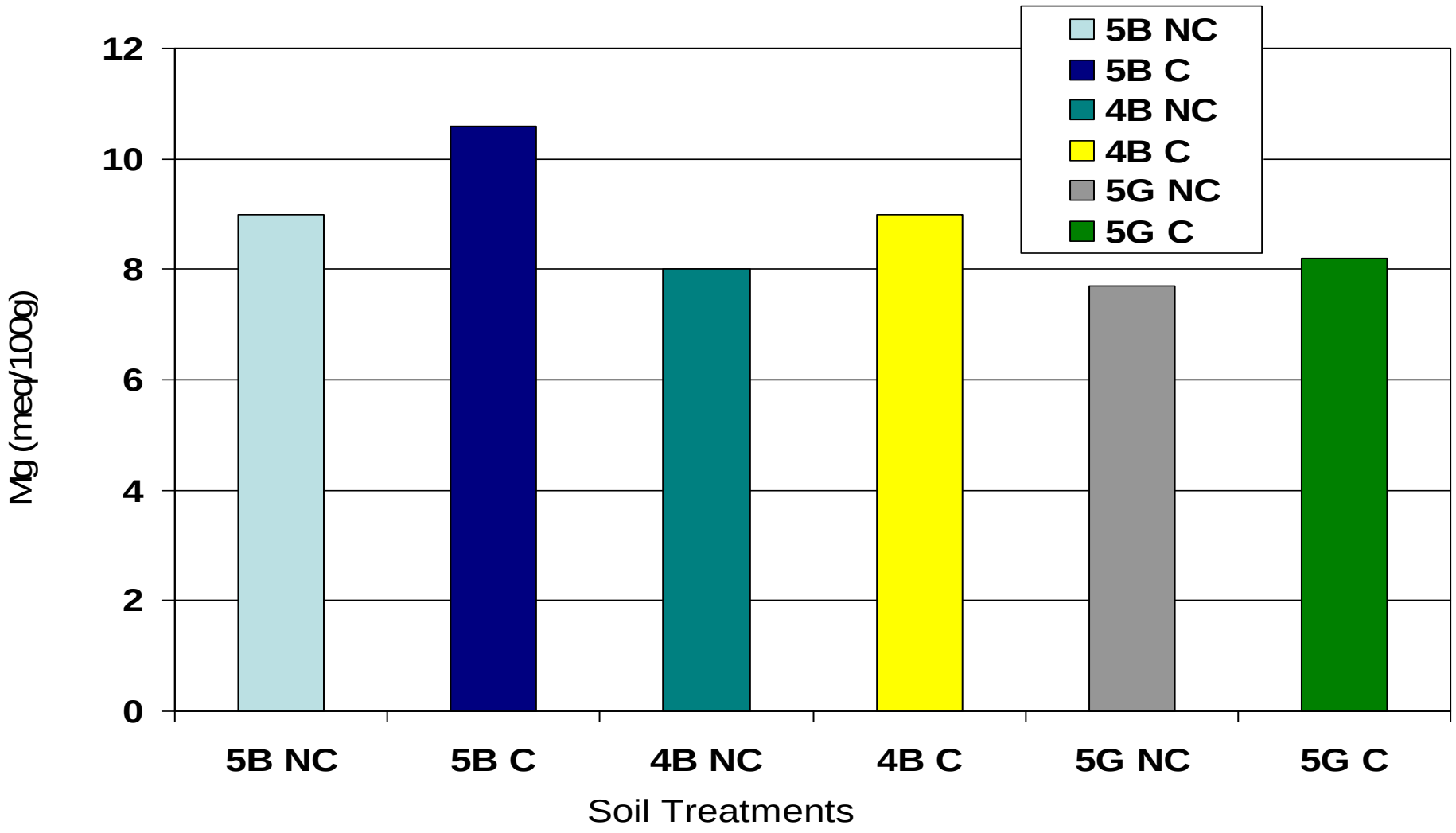
Results-pH


Gray SS
pH around 8!
2005
2006
2007
10
8
6
4
2
0
pH
5B NC
5B C
4B NC
4B C
5G NC
5G C
Soil Treatments

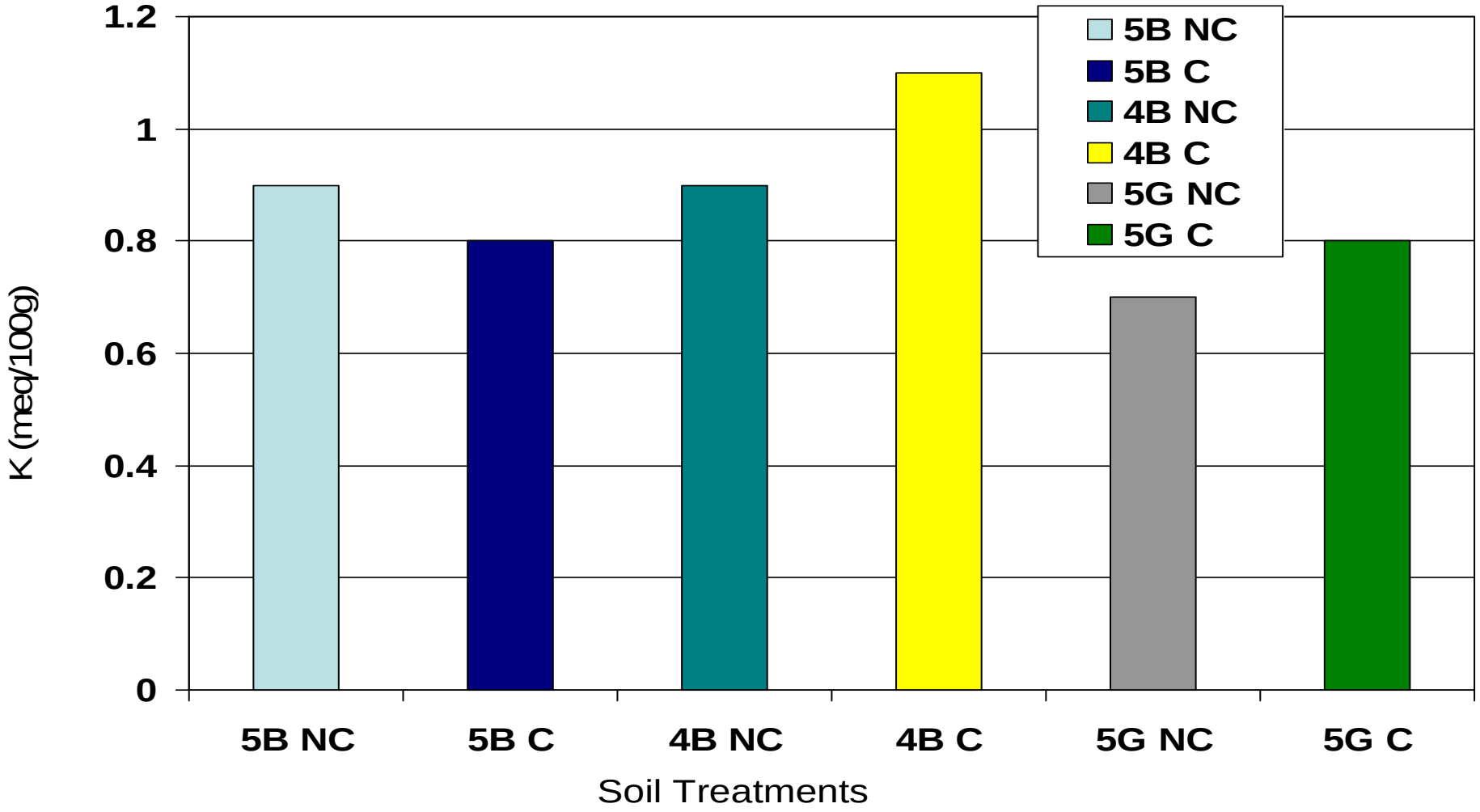
Calcium


5B NC
5B C
4B NC
4B C
5G NC
5G C
16
14
12
10
8
6
4
2
0
Ca (meq/100g)
5B NC
5B C
4B NC
4B C
5G NC
5G C
Soil Treatments

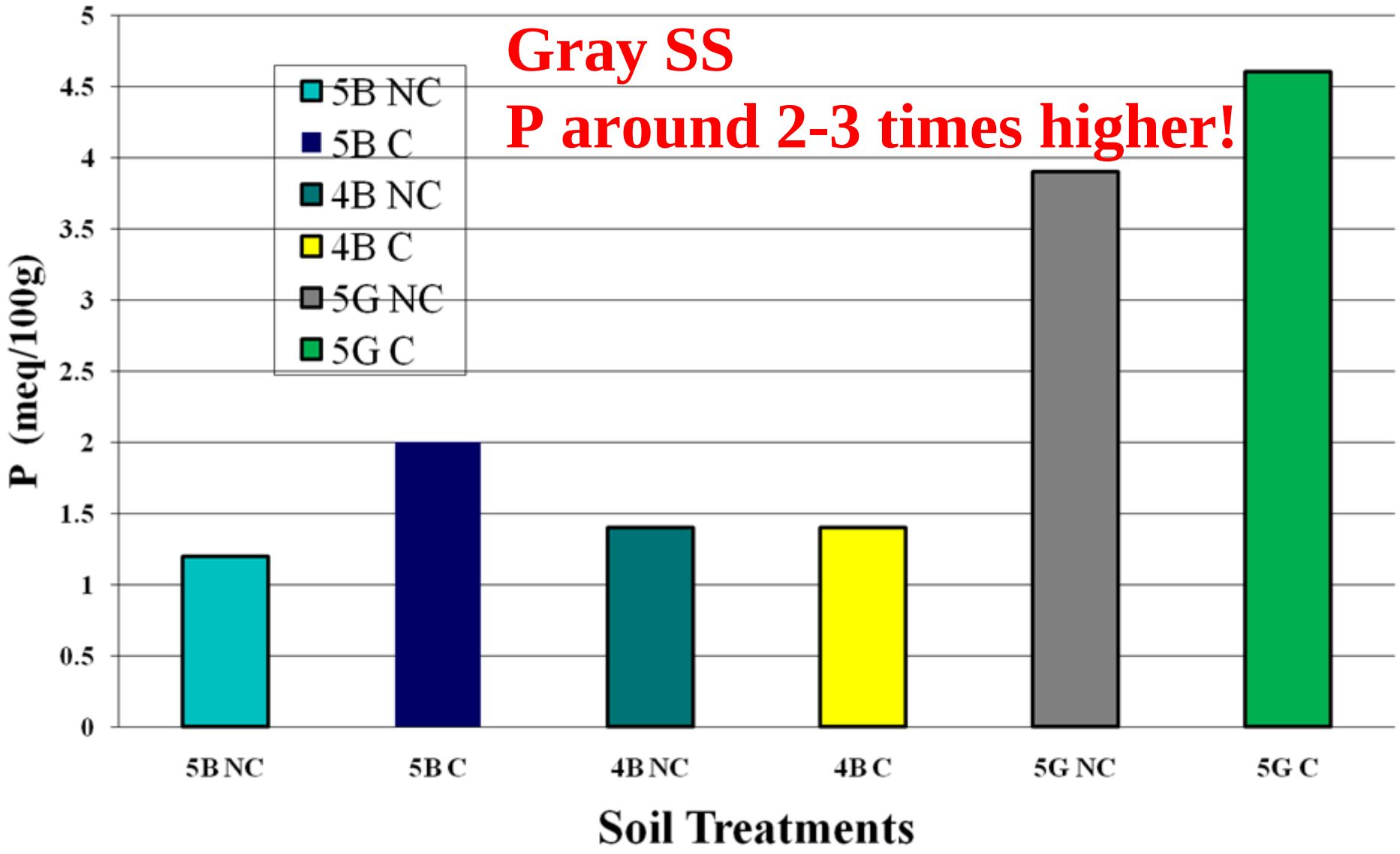
Magnesium


5B NC
5B C
4B NC
4B C
5G NC
5G C
12
10
8
6
4
2
0
Mg (meq/100g)
5B NC
5B C
4B NC
4B C
5G NC
5G C
Soil Treatments

Potassium


1.2
1
0.8
0.6
0.4
0.2
0
K (meq/100g)
5B NC
5B C
4B NC
4B C
5G NC
5G C
Soil Treatments

Phosphorus


Gray SS
P around 2-3 times higher!
5B NC
5B C
4B NC
4B C
5G NC
5G C
P (meq/100g)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
5B NC
5B C
4B NC
4B C
5G NC
5G C
Soil Treatments

Results- Soil Nutrients

	Treatments (meq/100g)					
Element	5B NC	5B C	4B NC	4B C	5G NC	5G C
Ca	11 a	14 a	10 a	10 a	13 a	14 a
K	.85 ab	.78 b	.90 ab	1.13 a	.71 b	.77 b
Mg	9.0 a	10.6 a	8.0 a	9.0 a	7.7 a	8.2 a
P	1.2 b	2.0 b	1.4 b	1.4 b	3.9 a	4.6 a

Results- Soil Fractions

Treatments

Size	5B NC	5B C	4B NC	4B C	5G NC	5G C
% Fines						
2005	53 a	50 a	48 a	49 a	36 a	40 a
2007	60 a	64 a	61 a	59 a	34 b	34 b
% Sandstone						
2005	44 a	47 a	50 a	48 a	61 a	57 a
2007	40 a	36 b	40 b	41 b	66 b	66 b

Results- EC (Salts) & Metals

	Treatments (dS / m)					
Size	5B NC	5B C	4B NC	4B C	5G NC	5G C
EC	.43 a	.39 a	.28 a	.53 a	.20 a	.21 a
Al	118	90	125	141	40	60
Fe	71	64	174	86	210	123
Mn	82	75	29	123	23	51
Zn	2	2	4	3	5	4

Brown Sandstone

Greater % Fines

Gray Sandstone

High pH ~ 8.0

Greater Phosphorus

Trees grow in both!
But…how well?

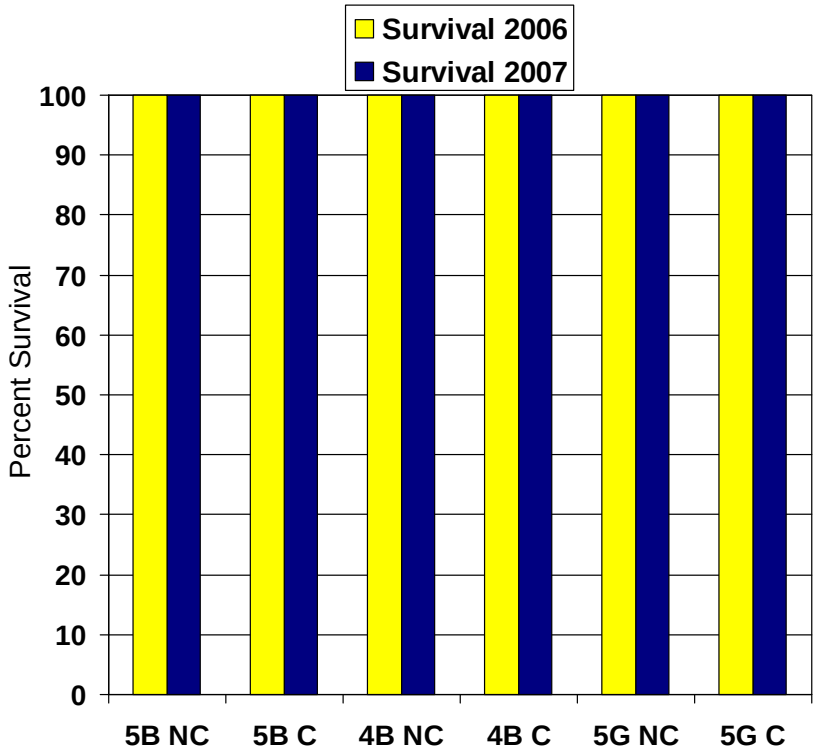
Brown SS
2007 7 30

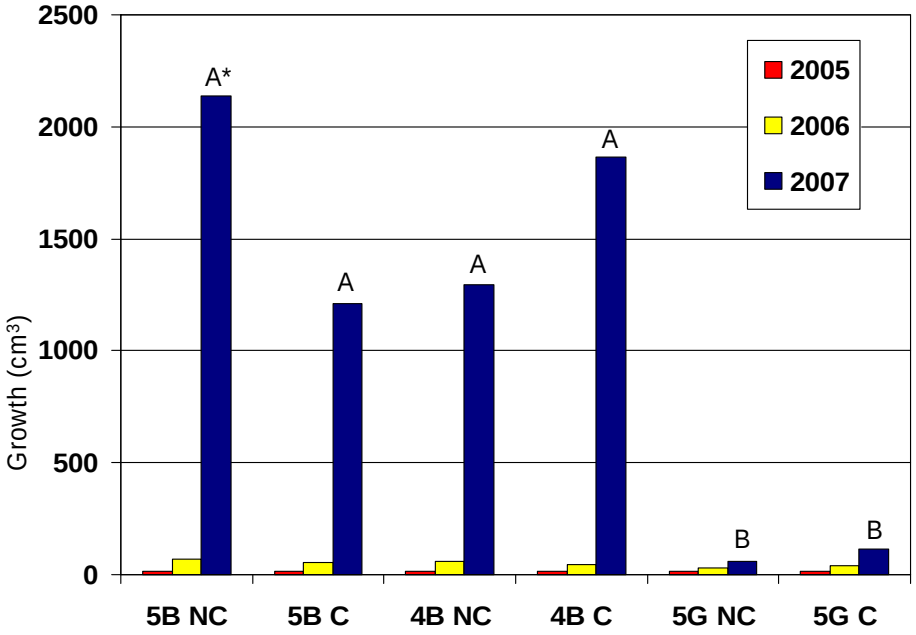
Gray SS
2007 7 30

Brown SS

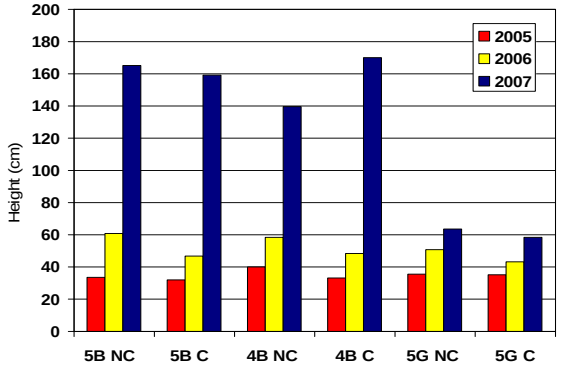
Gray SS

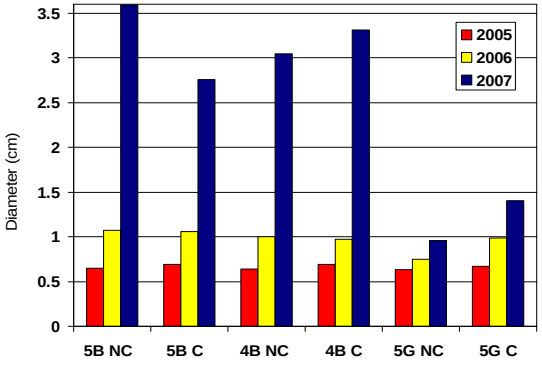
Black locust





*Columns with different letters are significantly different at the alpha=.05 level. Columns with the same letters or no letters are not significantly different.



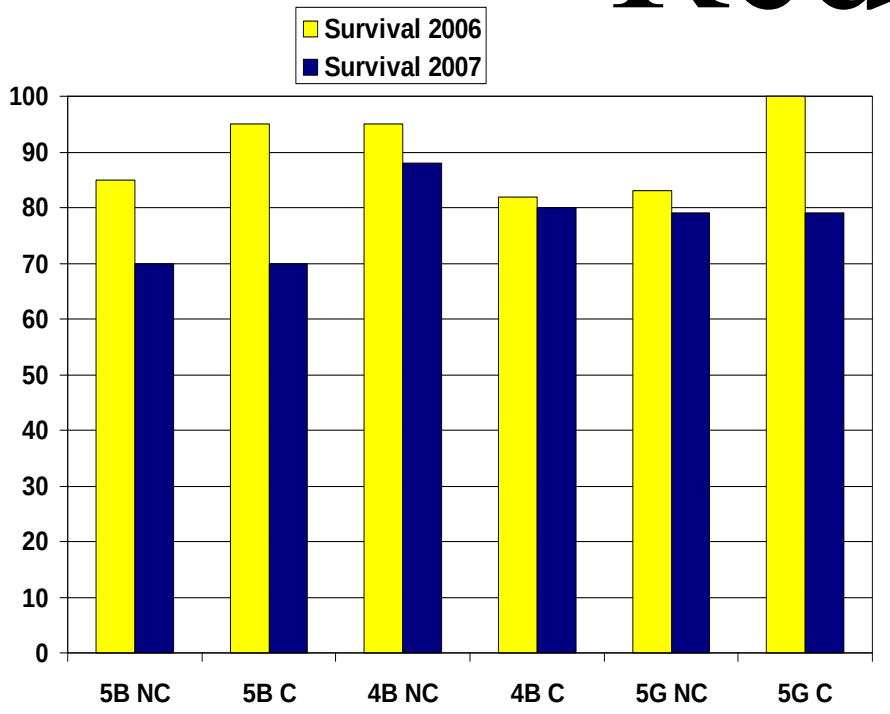


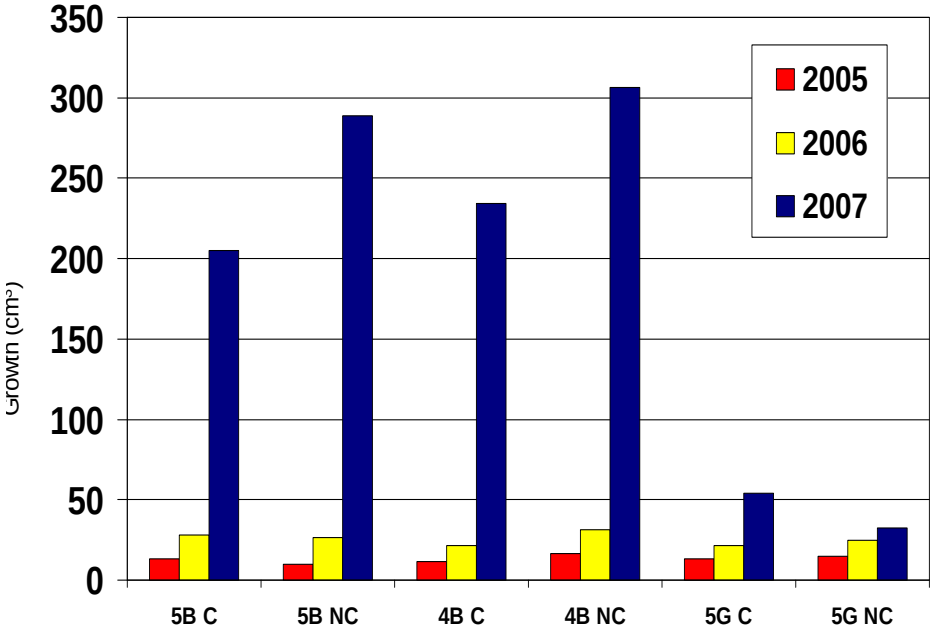
← Gray SS

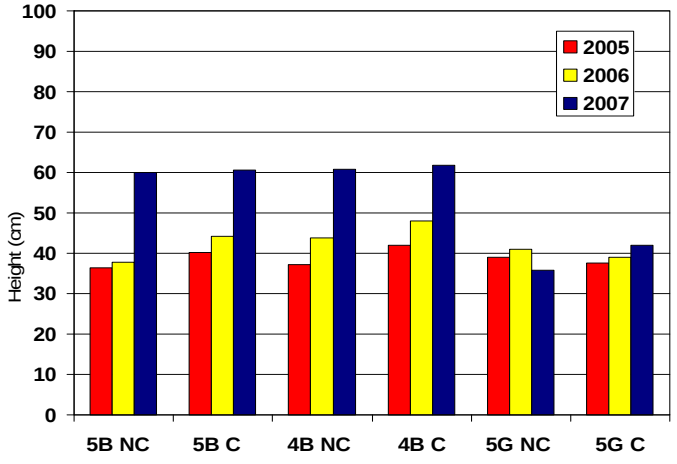
Black Locust

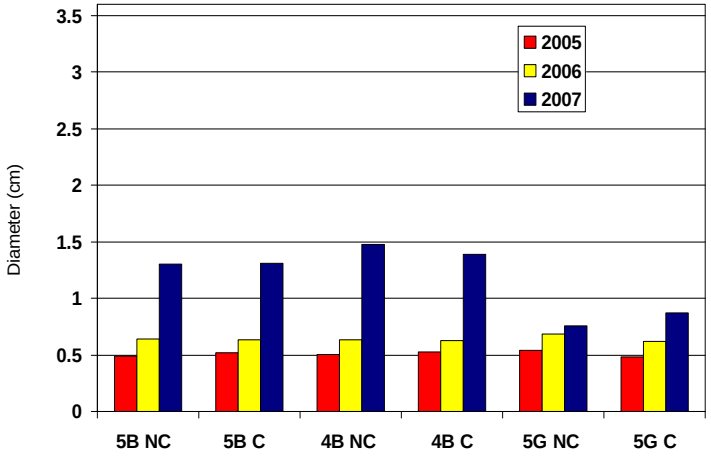
Brown SS ↓

Red oak


Survival 2006
Survival 2007
100
90
80
70
60
50
40
30
20
10
0
5B NC
5B C
4B NC
4B C
5G NC
5G C


2005
2006
2007
350
300
250
200
150
100
50
0
5B C
5B NC
4B C
4B NC
5G C
5G NC


Height (cm)
2005
2006
2007
100
90
80
70
60
50
40
30
20
10
0
5B NC
5B C
4B NC
4B C
5G NC
5G C


Diameter (cm)
2005
2006
2007
3.5
3
2.5
2
1.5
1
0.5
0
5B NC
5B C
4B NC
4B C
5G NC
5G C

← Gray SS

Red Oak

Brown SS ↓

← Gray SS

Tulip Poplar

Brown SS ↓

Growth and Survival by substrate, treatment, and depth

	Survival (%)	Growth (cm^3)
Substrate		
Gray	**86 a**	**44 b**
Brown	**74 b**	**218 a**

Interactions of variables

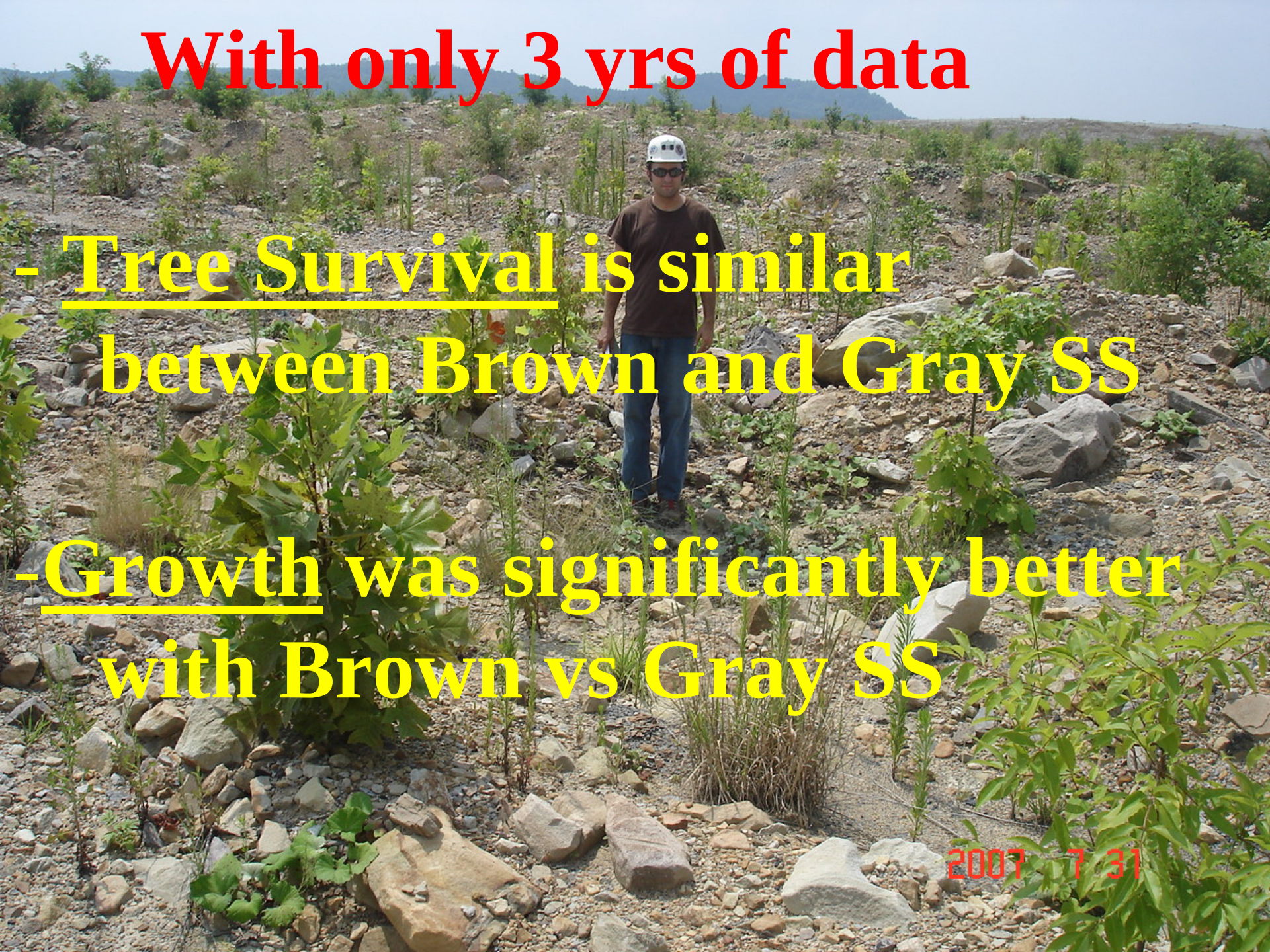
	Survival (%)	Growth (cm^3)
Interactions		
5ft Brown NC	**59 b**	117 ab
5ft Brown C	75 a	212 a
4ft Brown NC	88 a	308 a
4ft Brown C	76 a	236 a
5ft Gray NC	86 a	**34 c**
5ft Gray C	87 a	**55 bc**

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 3 yrs of data

- Tree Survival is similar between Brown and Gray SS

-Growth was significantly better with Brown vs Gray SS

ARRI Advisory #2:

Such soils can be formed from <u>overburden materials comprised of</u>

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

CATERPILLAR
A mixture of
Brown and Gray
2 Brown : 1 Gray
1 Brown : 1 Gray
1 Brown : 2 Gray

You
Got
Any
Questions?