How do we evaluate Seedling Quality and why it is important

Tom Starkey

September 2015

What is your first impression?

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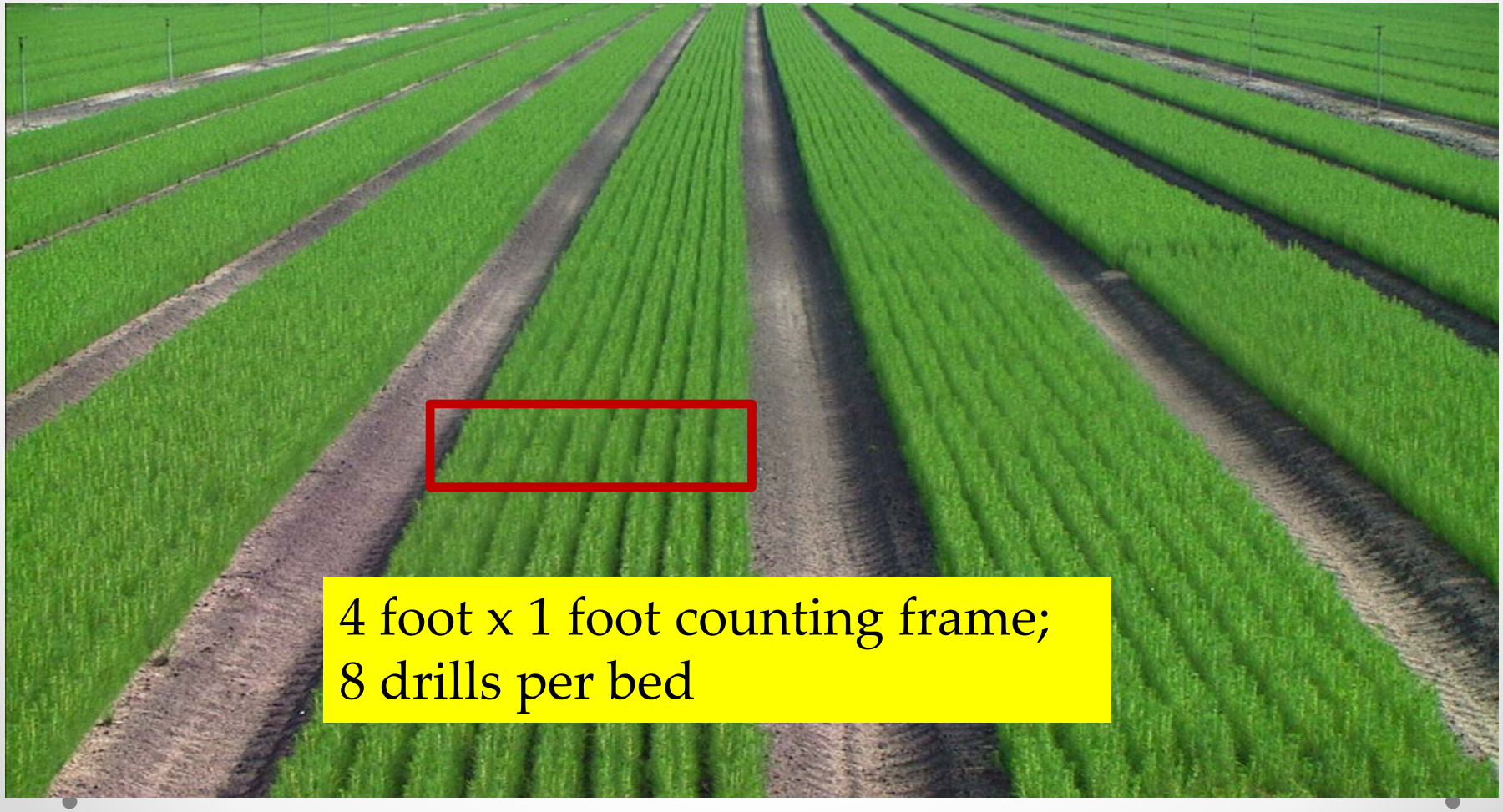
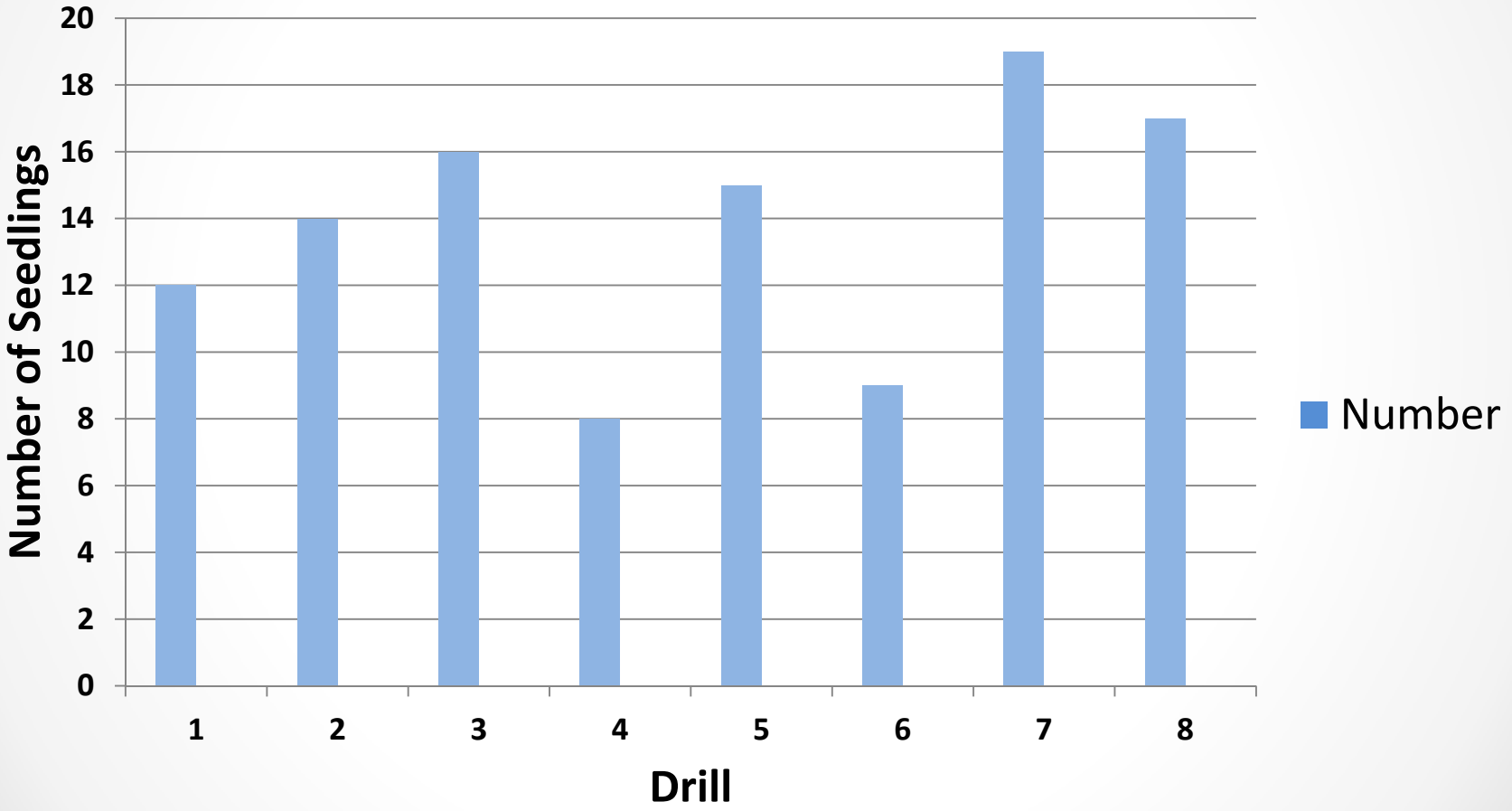
1. Color – green
2. Uniform appearance

How Uniform?



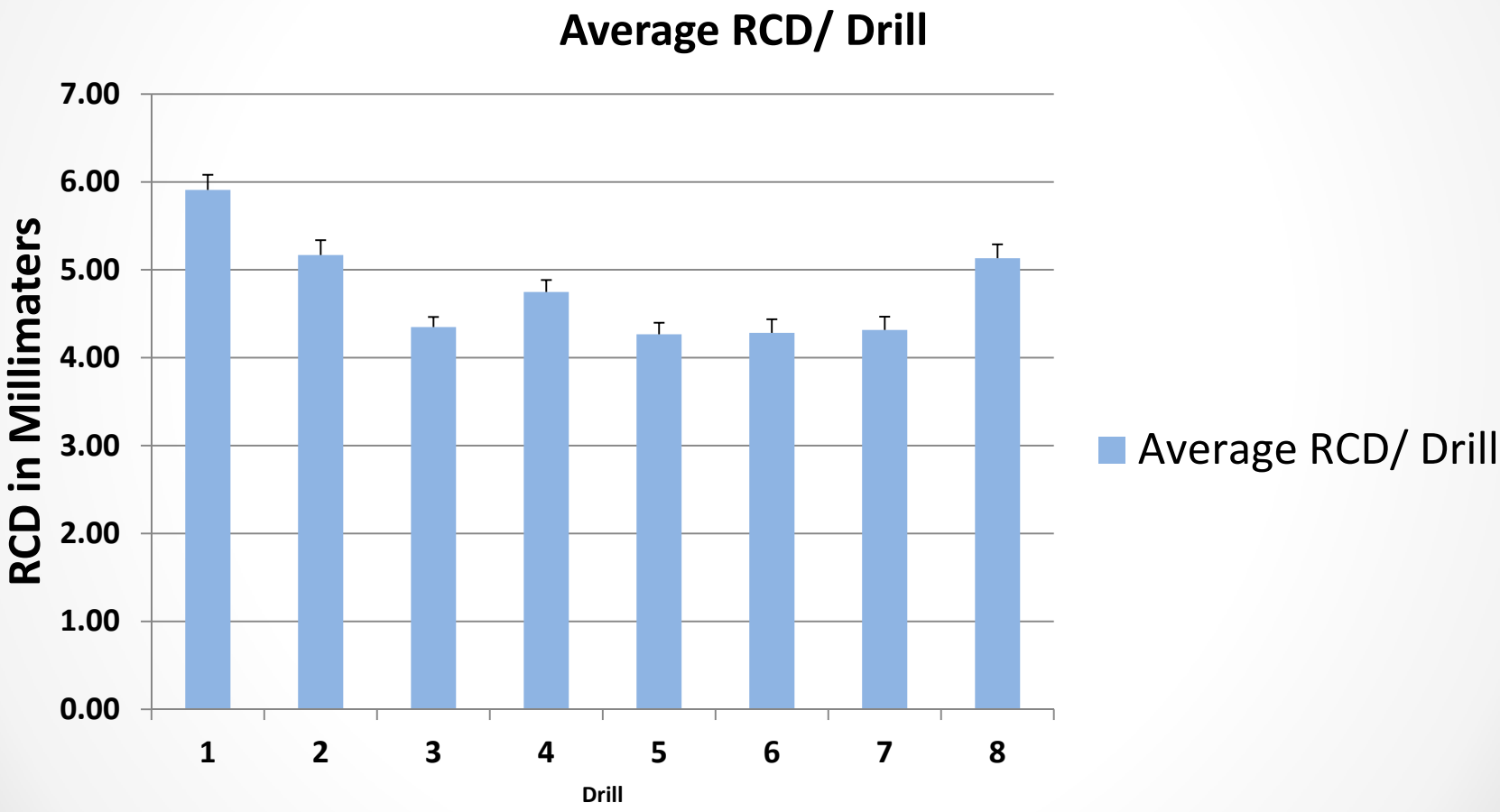
Number of Seedlings per Drill



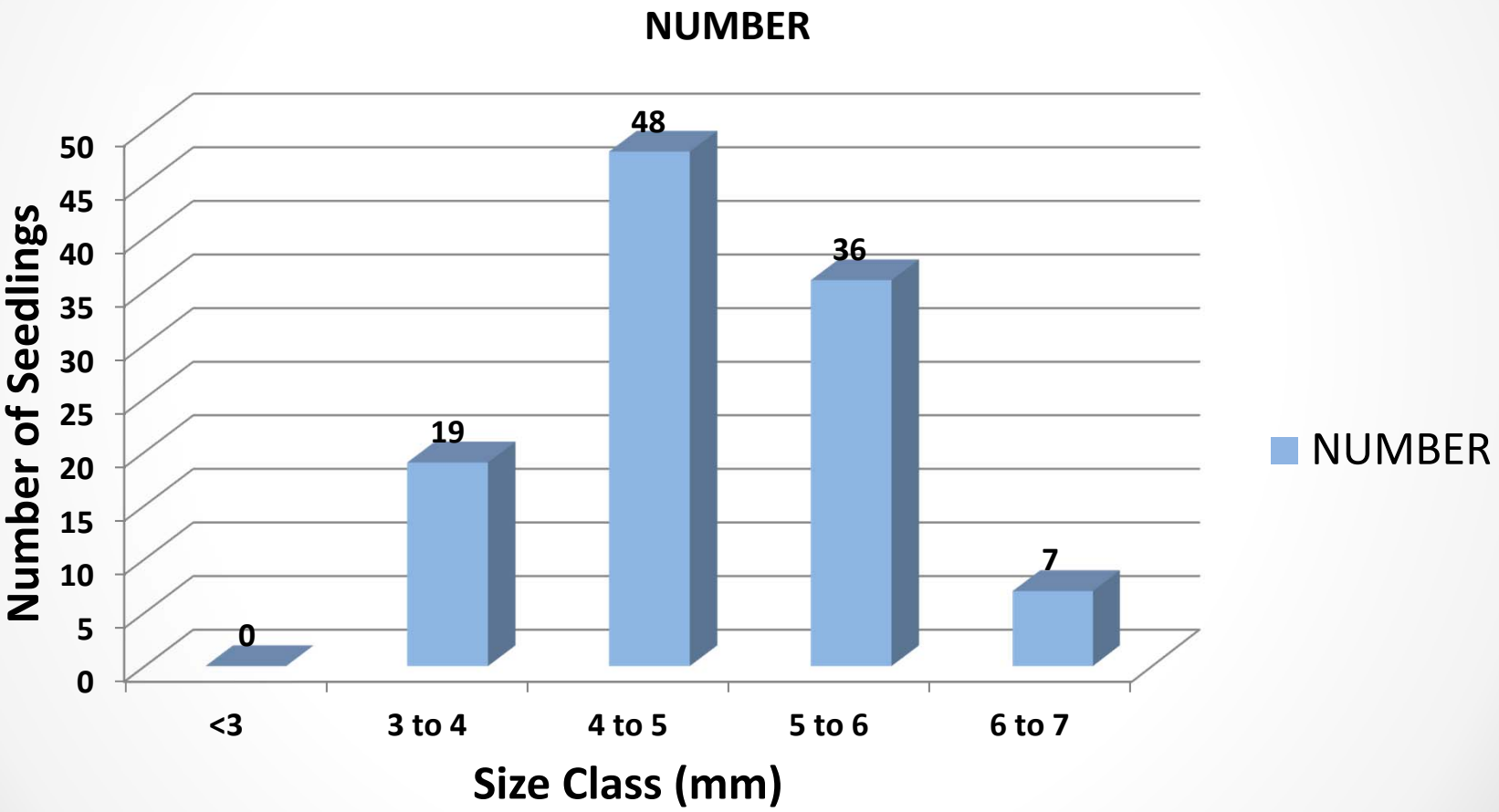
4 ft x 1 ft counting frame

seedling total = 110

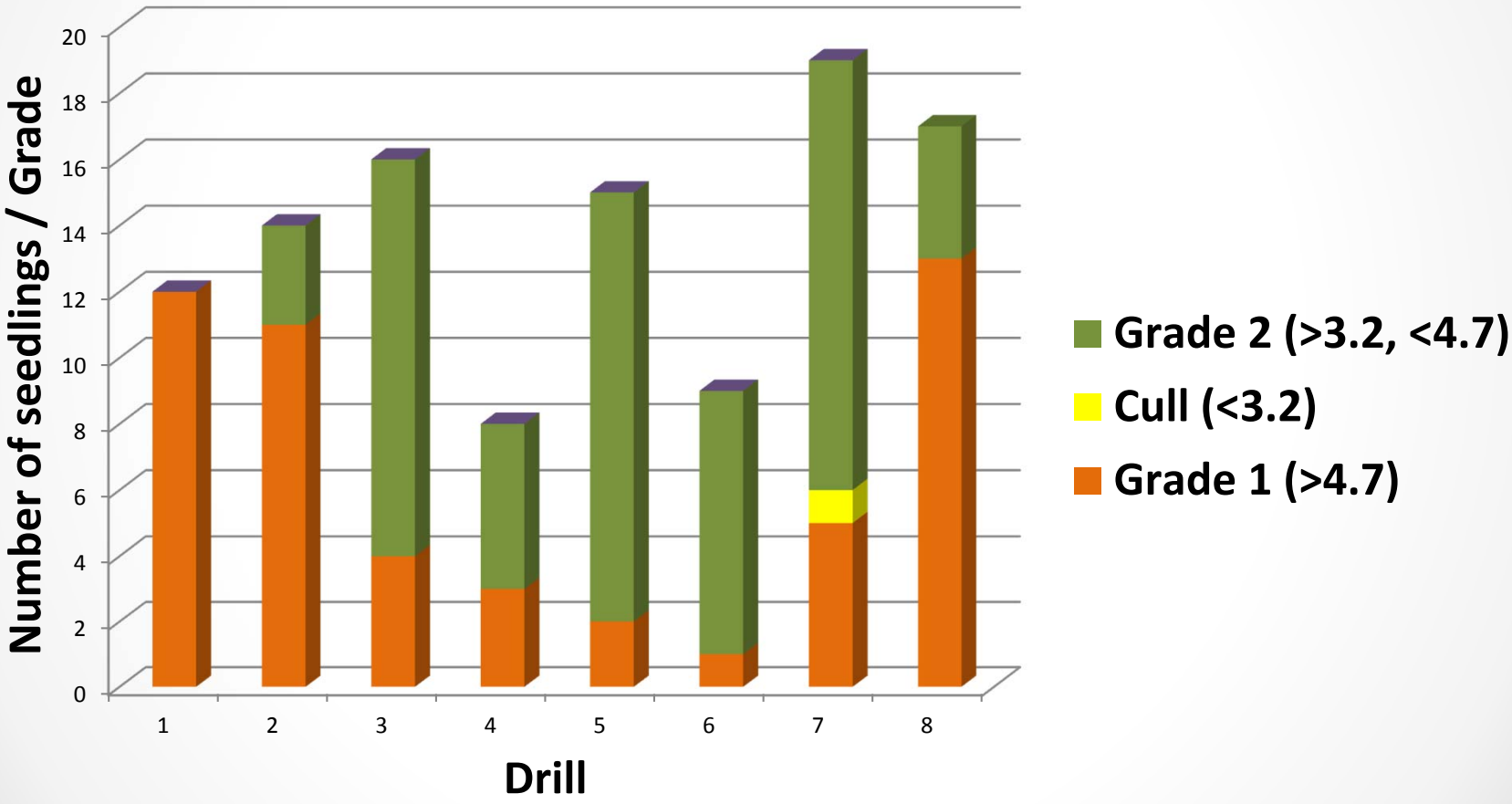
Average RCD per Drill

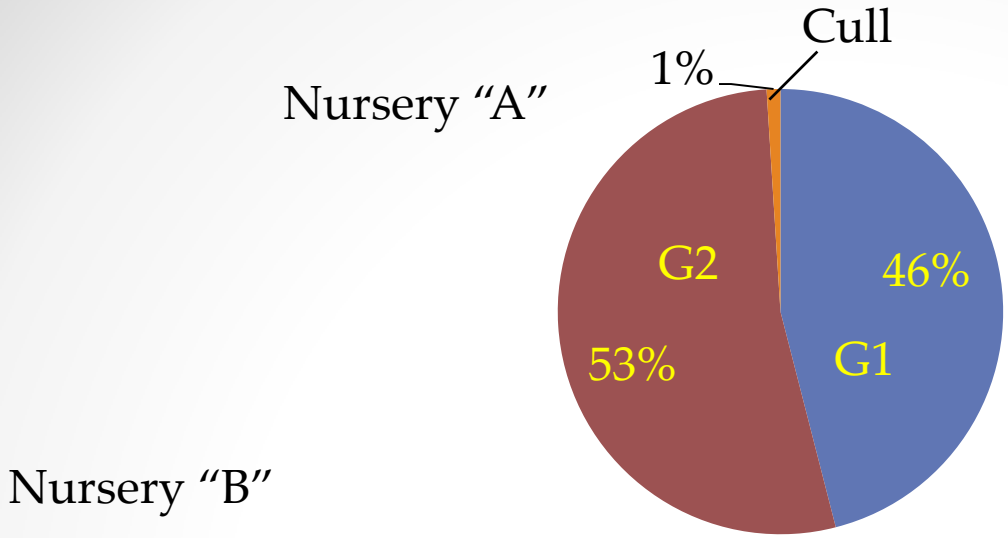


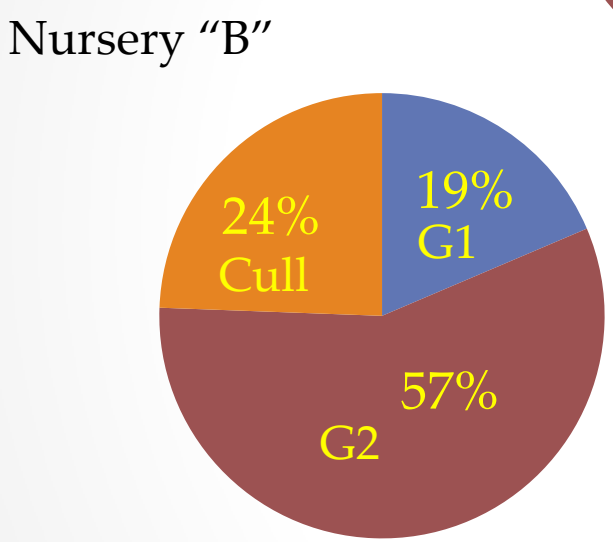
Number of Seedlings Per Size Class

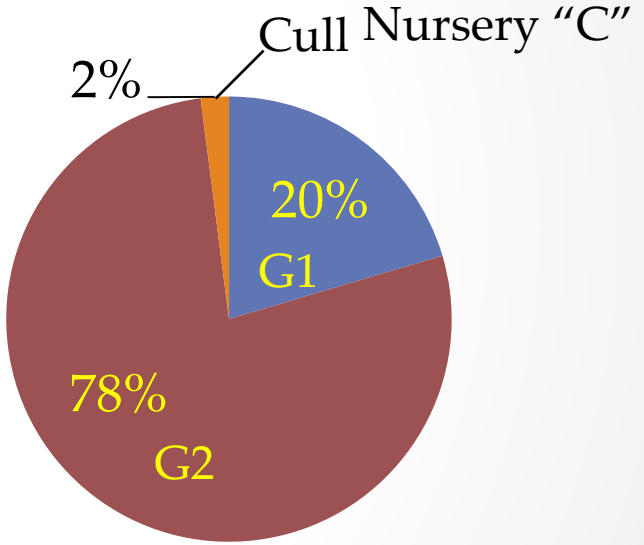


Number of Seedlings per Grade by Drill









G1 – Grade 1 (>4.7 mm)

G2 – Grade 2 (3.2 – 4.7 mm)

Cull – (<3.2 mm)

Seedling Quality

- Definition:
  - A high quality seedling is one that can survive prolonged environmental stress and produce vigorous growth following out planting.

Seedling Density

- Definiton – the number of seedlings grown per unit of nursery bed
  - Expressed either as:
    1. Square feet
    2. Linear bed foot (of a 4' foot bed)

25 seedlings/sq ft = 100 seedlings per linear foot

“The quality of planting stock is the degree to which the stock realizes the objectives of management (to the end of the rotation or achievement of specified sought benefits) at minimum cost.

Quality is fitness for purpose.”

Willen and Sutton (1980)

10 characteristics of a quality seedling :

1. Free of disease
2. Lignified, single stem
3. Large RCD
4. Symmetrical crown
5. Root system free of deformities
6. Fibrous root system with white root tips
7. Balanced seedling
8. Winter color
9. Survive short drought
10. Full sunlight

Quality versus quantity

- Which is more important?

- Why a poor quality tree is poor

Early seedling grade Longleaf 1935 (Wakeley)

Grade	Usual needle lengths	Stems
1	12 to 18 inches	3/16 to ½ “ 4.76 – 12.7mm
2	Intermediate	Intermediate
3	6 to 8 inches	Very slender

Early seedling grade Loblolly 1935 (Wakeley)

Grade	Usual heights	Stems
1	8 to 14 inches	Stout woody
2	Mostly less than Grade 1	Spindling to moderately stout
3	All less than Grade 2	Spindling succulent

Early seedling grade Slash 1935

Grade	Usual heights	Stems
1	10 to 16 inches	Stout woody
2	Mostly less than Grade 1	Spindling to moderately stout
3	All less than Grade 2	Spindling succulent

Updated seedling grade Longleaf 1984 (May)

Grade	Usual needle lengths	Stems
1	6 to 8 inches clipped	11/16 inch 17.5 mm
2	6 to 8 inches clipped	½ inch 12.7 mm
3-cull		< ½ inch

Loblolly and Slash 1984 (May)

Grade	Usual heights	Stems
1	9 to 12 inches	3/16 – 5/16 4.8 – 7.9 mm
2	6 - 10 inches	1/8 – 3/16 3.2 - 4.8 mm
3	3 – 12 inches	< 1/8 inch <3.2 mm

Seedling Densities

1920 – 1930's

- Longleaf: 25 – 35/ sq. ft.
- Loblolly: 40 – 50/ sq. ft.
- Slash: 35 – 45/ sq. ft.
- Shortleaf: 55 – 75/ sq. ft.

Wakeley - 1935

Today

- Longleaf: 10 – 15/sq. ft.
- Loblolly: 20 – 28/sq. ft.
- Slash: 20 – 26/sq. ft.
- Shortleaf: 25 – 35/sq. ft.
- Morphologically Improved (Low Density)– < 20 seedlings/sq. ft.& > 5.5 mm RCD

Terminology

- **Grade 1 Seedling** – Seedling with RCD greater than 4.7 mm
- **Grade 2 Seedling** – Seedling with RCD ranging from 3.2 – 4.7 mm
- **Cull Seedling** – seedling not meeting size standards or has RCD <3.2 mm
- **Morphologically Improved (low density)** – Seedlings grown at lower densities and have an average RCD above 5.5 mm

Root Collar Diameter

2.5

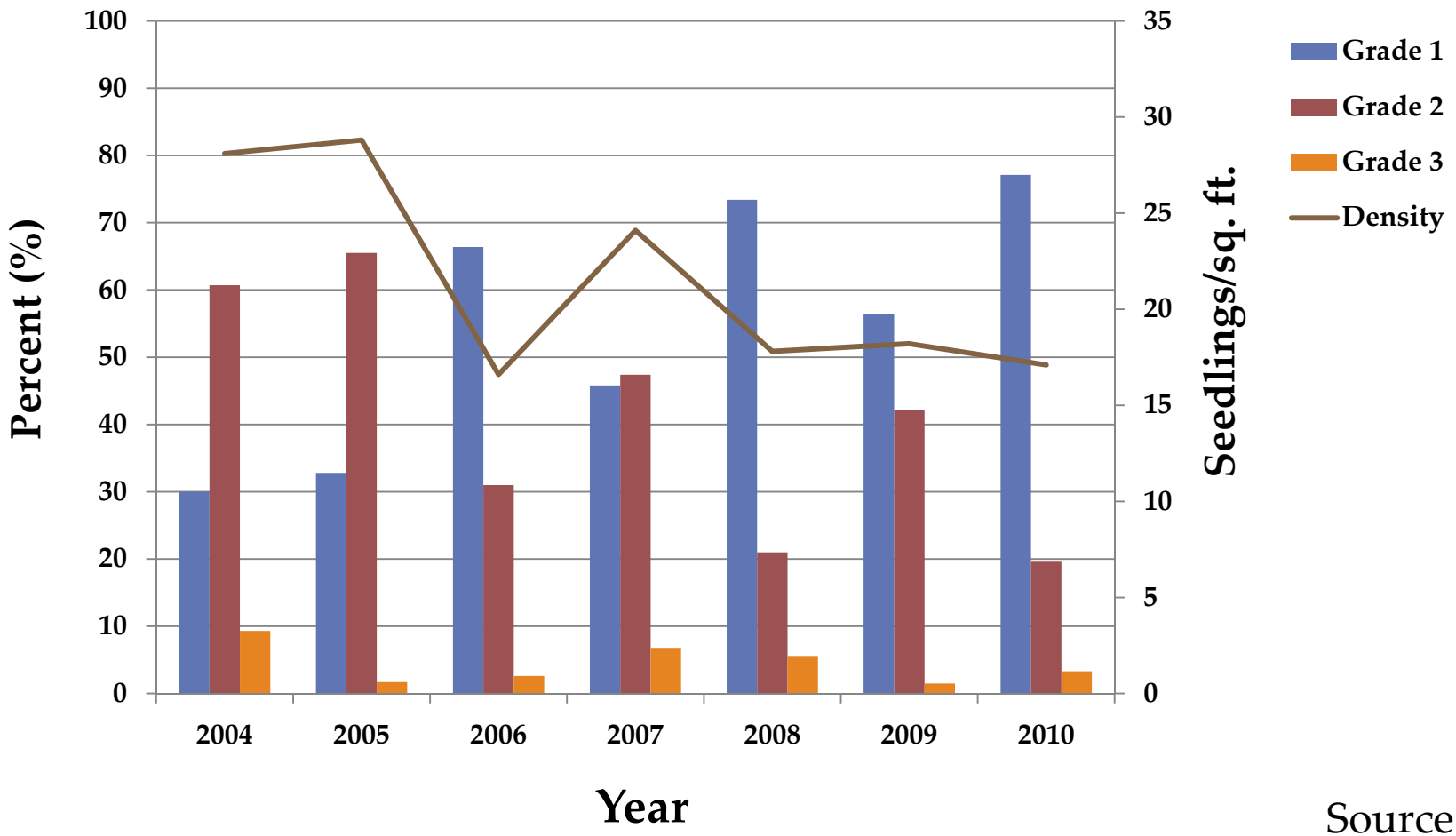
4.5

6.5

8.5

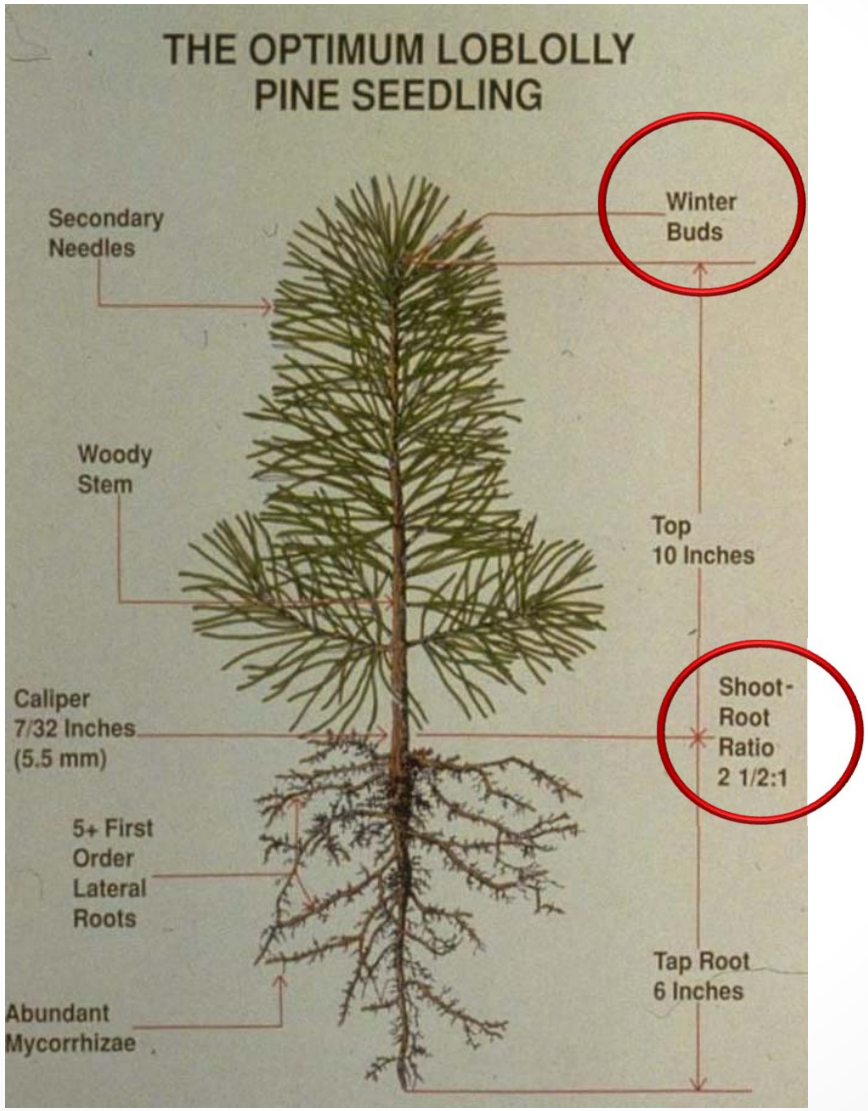
10.5

Seedling Density's Effect on Seedling Grade



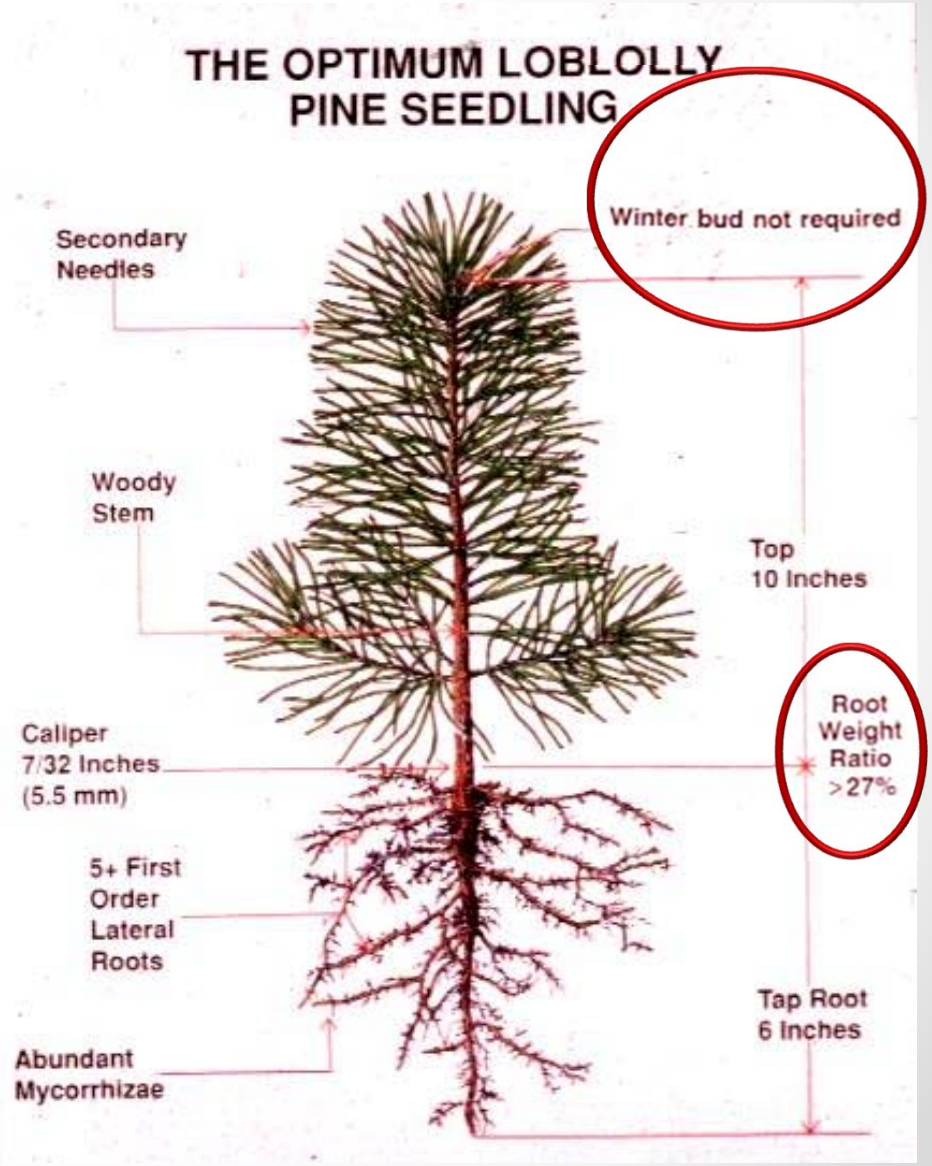
Source:
Chris Rosier

Target, Ideal or Optimum Seedling



Target, Ideal or Optimum Seedling

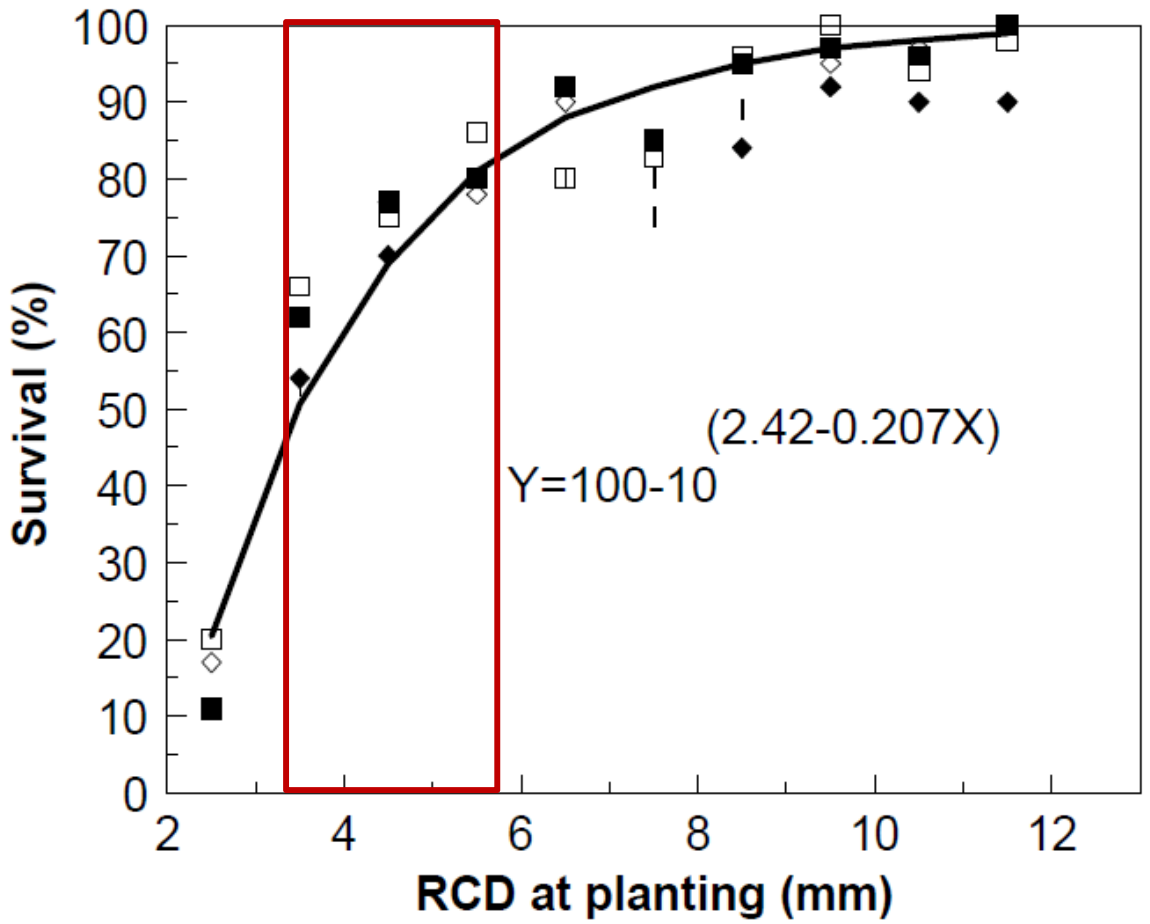
- **modified by Nursery Coop:**



Measuring Seedling Quality

- ☹ Shoot Height
- ☺ Root Collar Diameter (RCD)
- Ratios:
  - ☹ oShoot- Root Ratio
  - ☺ oRoot Weight Ratio

SEEDLING SURVIVAL



South. 2000. Increasing pine survival and early growth by planting "morphologically improved "seedlings to increase survival and growth

Ratios

Shoot:Root Ratio

- Volume of Shoot: Volume of Roots
  OR
- Weight of Shoot: Weight of Roots
- not
- Shoot length: Root Length

- Shoot:Root ratio was never intended to be expressed by dividing taproot length by shoot length.

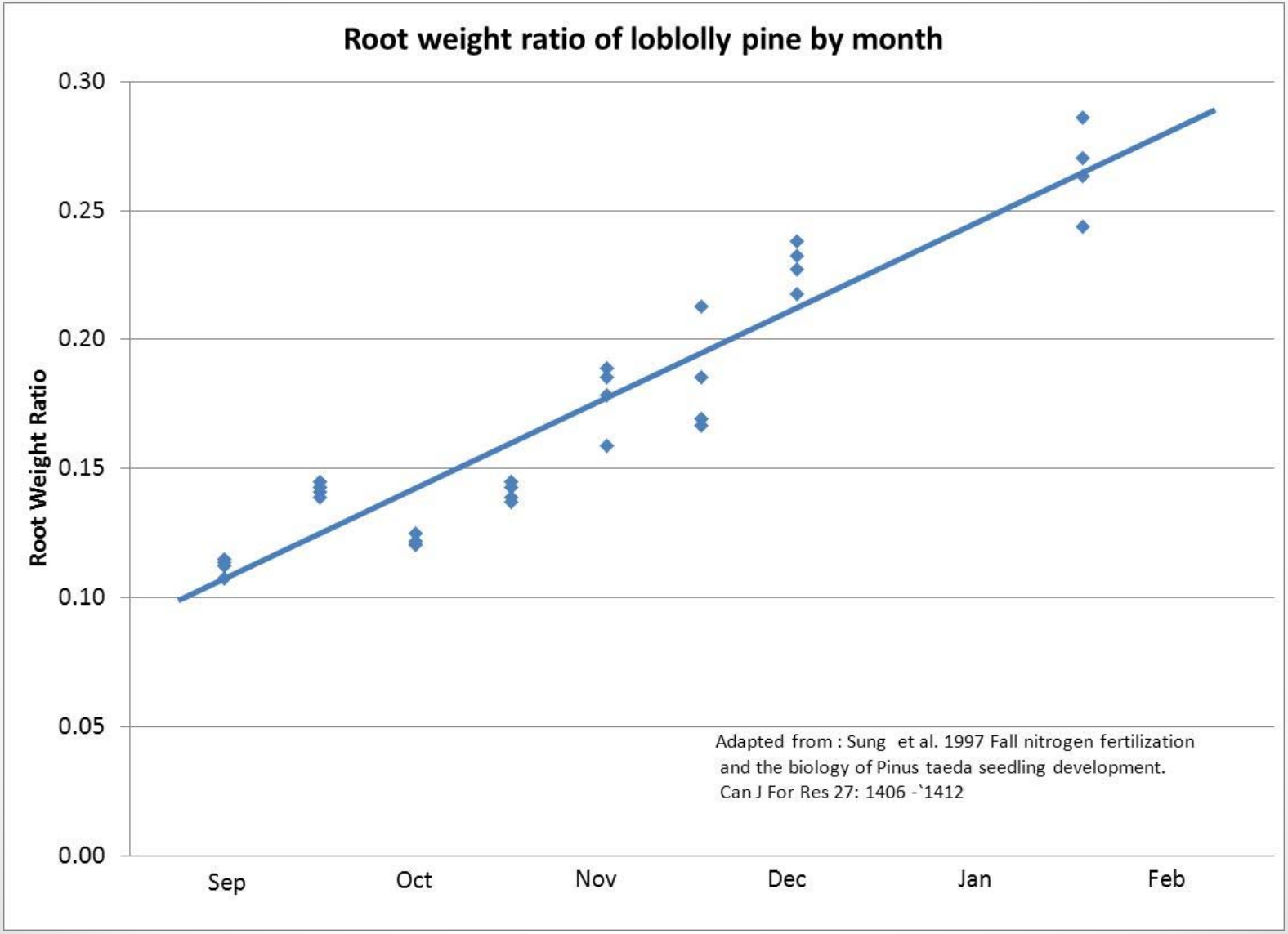
Ratios

Root Weight Ratio

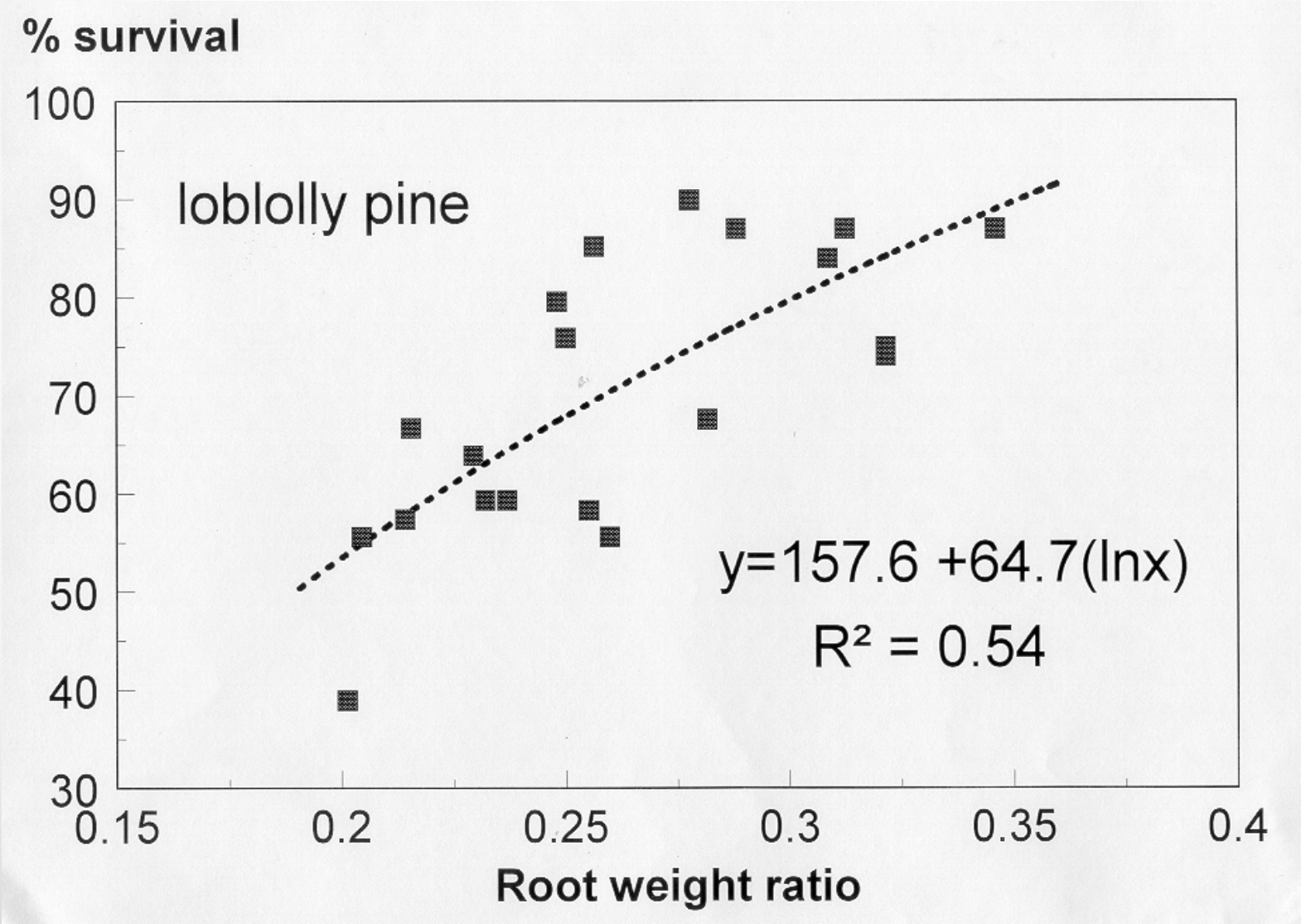
- $$\frac{\boldsymbol{Dry\ Root\ Weight}}{(\boldsymbol{Dry\ Root\ Weight + Dry\ Top\ Weight})} \times \mathbf{100} = \_\_\%$$

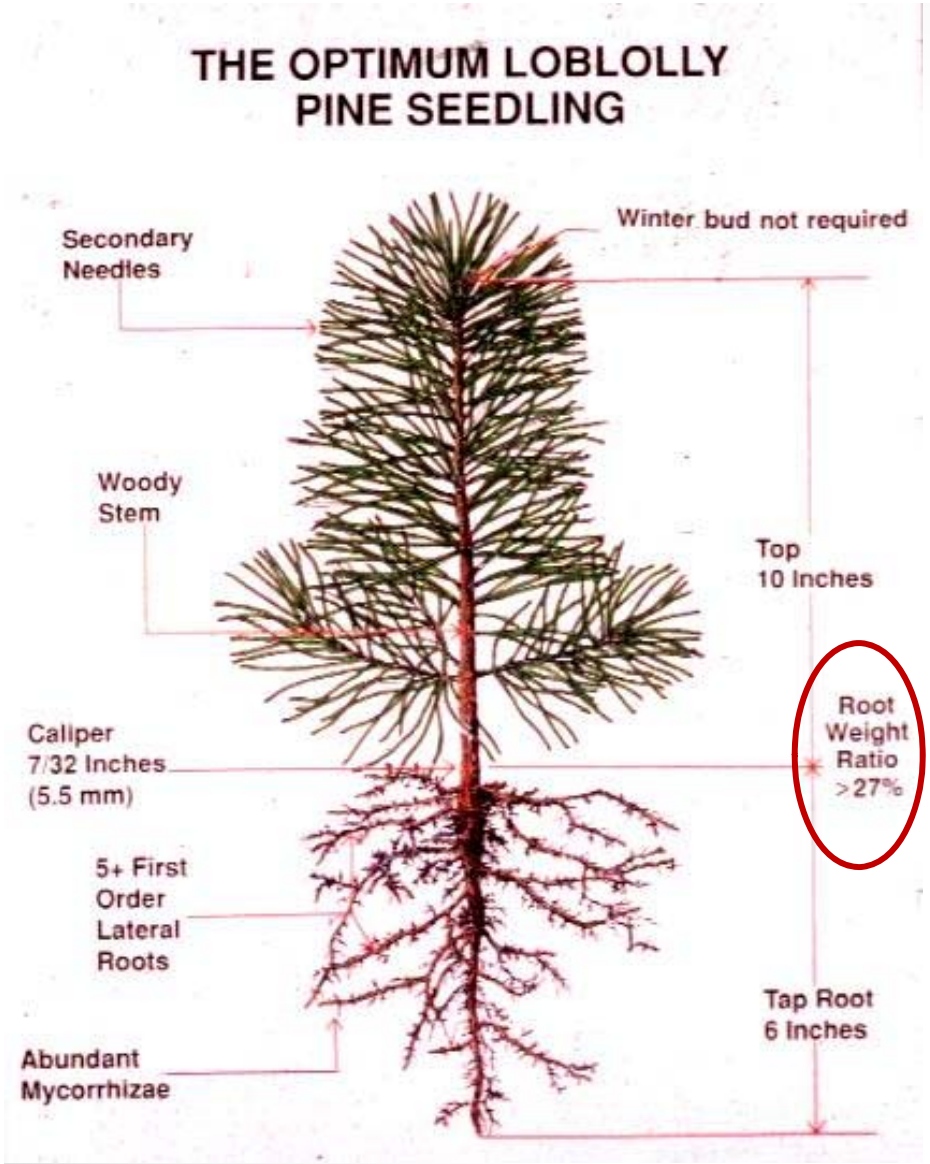
- Example: Root wt = 1 gm and Shoot (top) wt = 3 gm
- RWR = ?????

Relationship of RWR and time of lifting



Relationship of RWR to survival



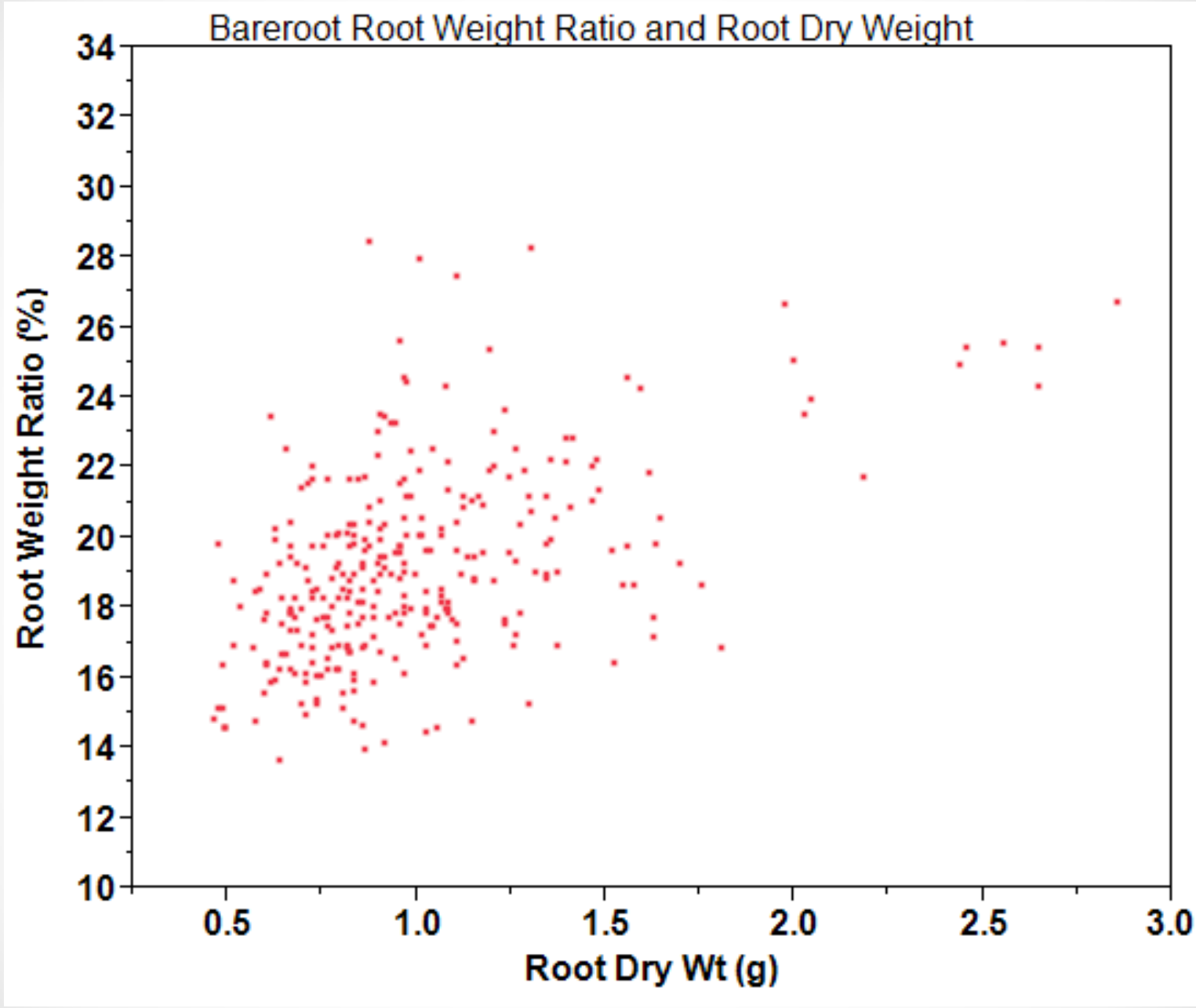


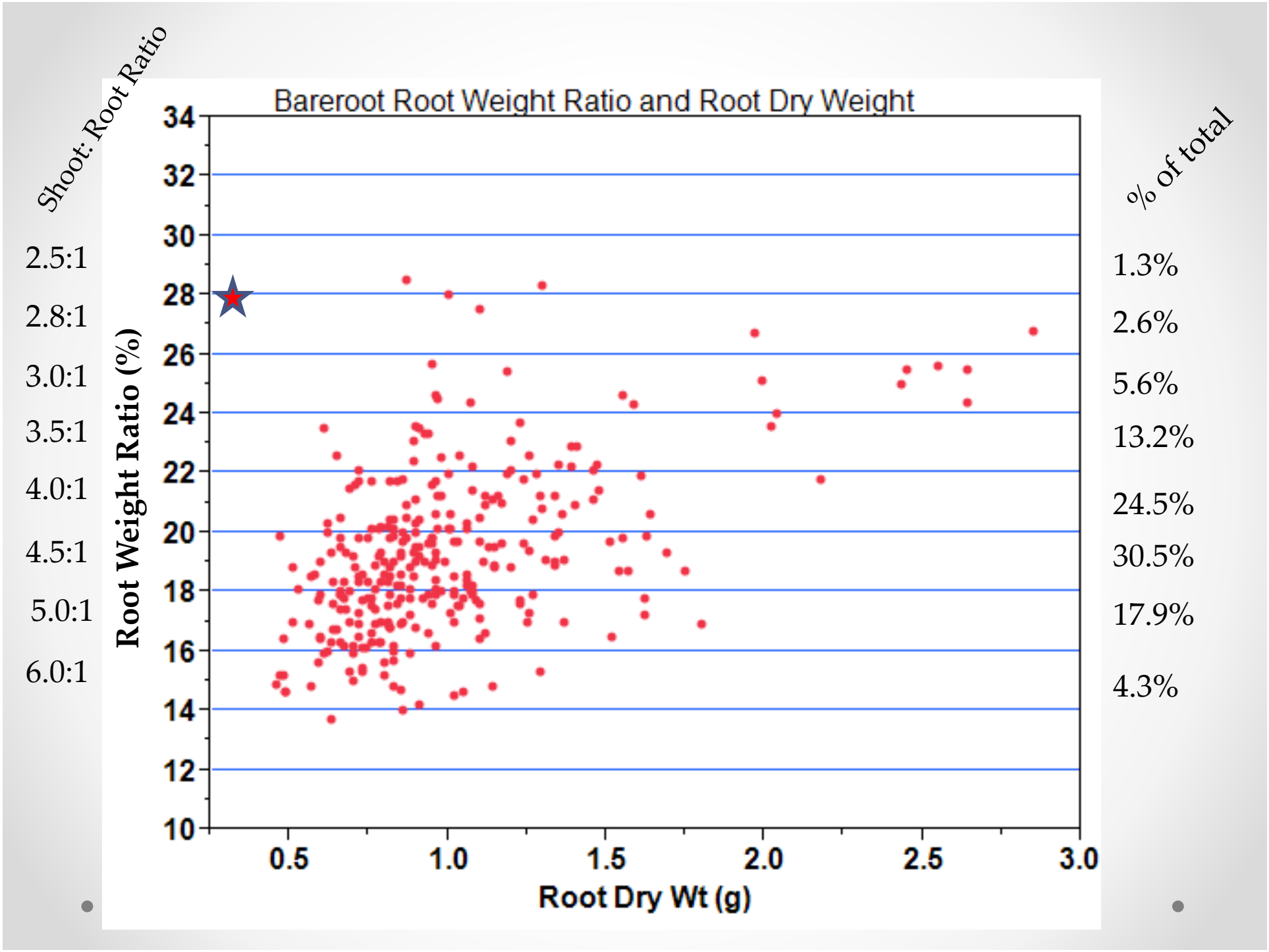
How close do bareroot nurseries come to a Root Weight Ratio of >27%?

3 growing seasons

2012, 2013, 2014

300 seedling samples


Bareroot Root Weight Ratio and Root Dry Weight
Root Weight Ratio (%)
34
32
30
28
26
24
22
20
18
16
14
12
10
0.5
1.0
1.5
2.0
2.5
3.0
Root Dry Wt (g)


Shoot: Root Ratio
Bareroot Root Weight Ratio and Root Dry Weight
% of total
2.5:1
2.8:1
3.0:1
3.5:1
4.0:1
4.5:1
5.0:1
6.0:1
1.3%
2.6%
5.6%
13.2%
24.5%
30.5%
17.9%
4.3%
Root Weight Ratio (%)
34
32
30
28
26
24
22
20
18
16
14
12
10
0.5
1.0
1.5
2.0
2.5
3.0
Root Dry Wt (g)

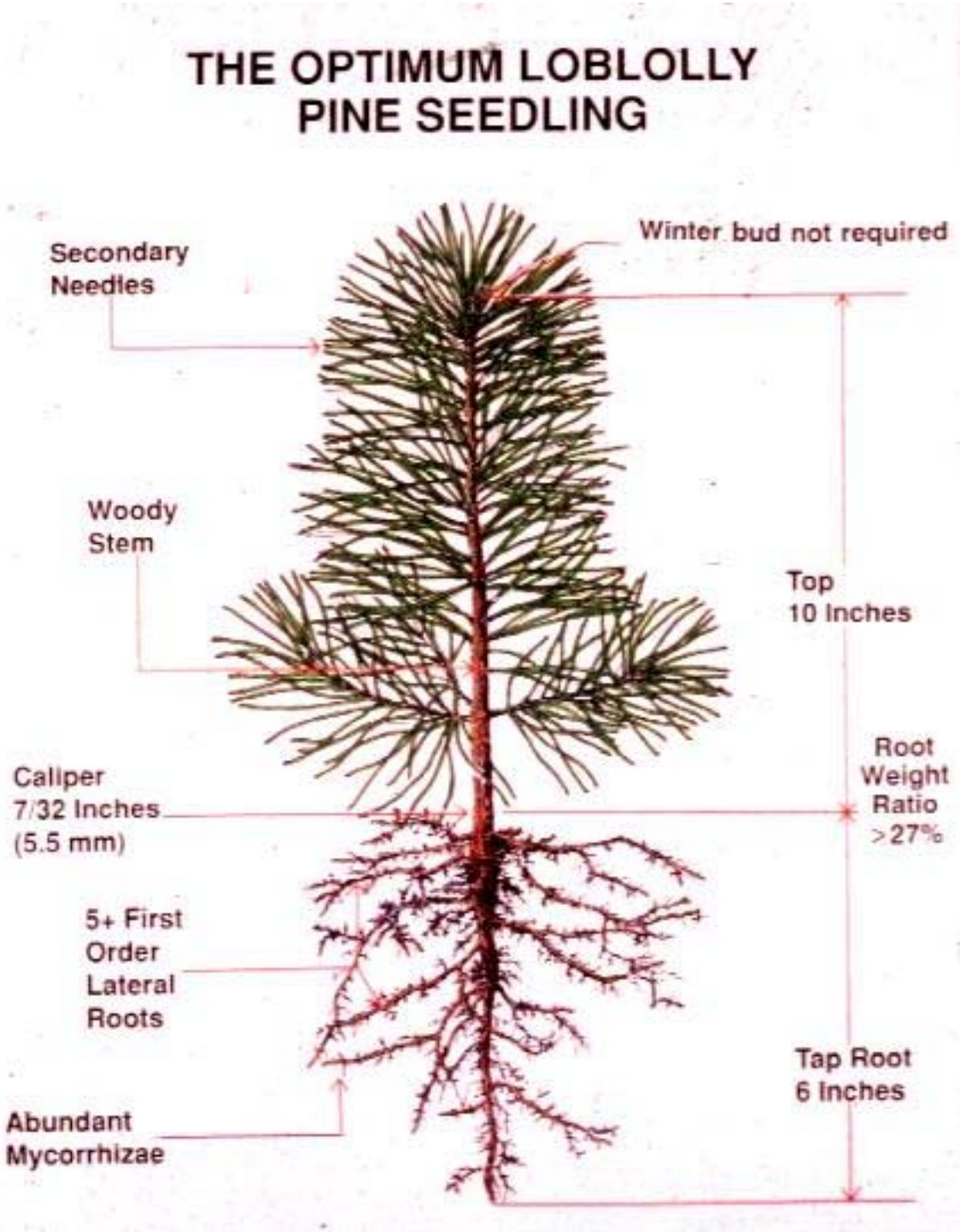
7 Factors That Effect Root Growth?

1. Time of lifting
2. Growing density
3. Irrigation
4. Fertilization
5. Genetics
6. Root and top culture
7. Time of sowing

How to negate good seedling quality

- **Nursery:**
  - Improper lifting/handling of your seedlings
- **Out Planting:**
  - Improper transportation/storage of your seedlings
  - Root pruning your seedlings
  - Root stripping your seedlings
  - Improper planting of your seedlings

THE OPTIMUM LOBLOLLY PINE SEEDLING



How the Nursery Coop can help you evaluate seedling quality

- Beginning in late fall for container seedlings and January for bareroot seedling we will evaluate samples of seedlots for you.
- One sample = 30 seedlings (same seedlot/family)
- Cost – Bareroot $35/sample
  Container $40/sample
- What you will receive: 2 page report

Auburn University
Southern Forest Nursery Management Cooperative
Seedling Evaluation Report

1/13/2015

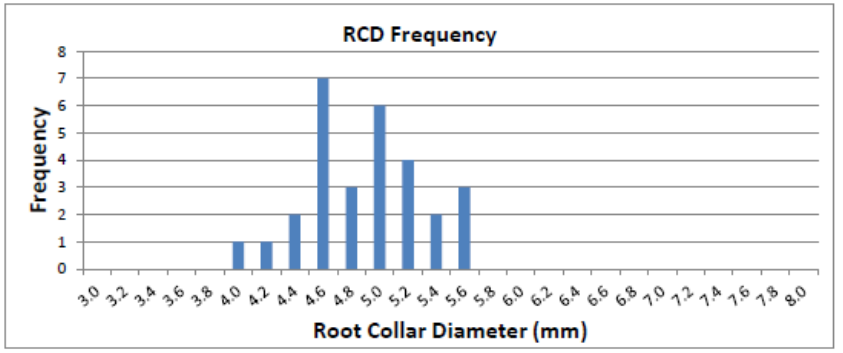
GXN54A

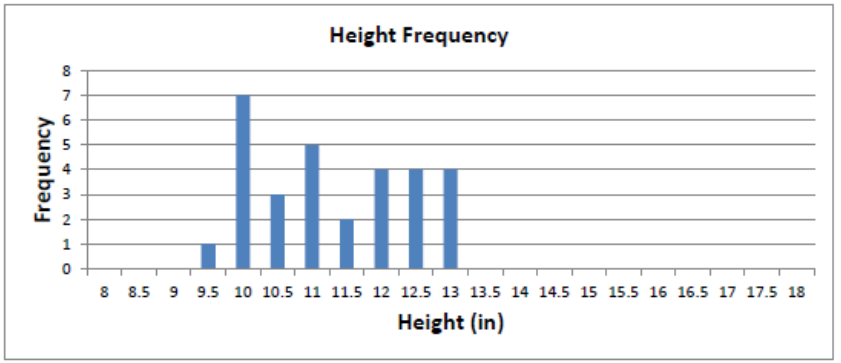
Company:	BT Nursery	
Contact:	Tom Starkey	Scott Enebak
Nursery/State:	Auburn Nursery	
Species:	Loblolly	
Stock:	Bareroot	Tom.starkey@auburn.edu
Source:	Coastal	
Genotype:	2nd	
Hand or Machine Lifted:	hand	

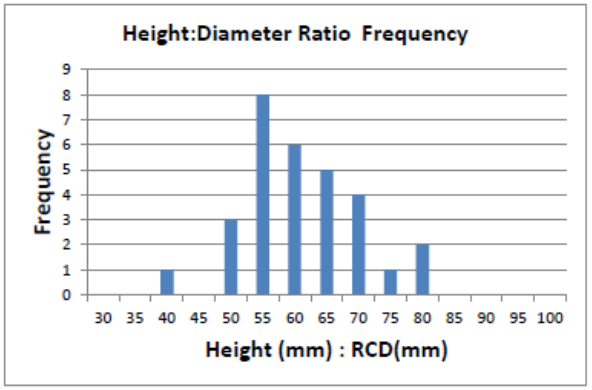
Measure of Central Tendency	
Average Height (in)	11.05
Average RCD (mm)	4.91
Median Height (in)	11.00
Median RCD (mm)	4.82

Measure of Spread (Dispersion)			
95% Confidence Interaval for RCD (mm)	4.91	±	0.26
98% Confidence Internval for RCD (mm)	4.91	±	0.31
Standard Deviation of Height (in)		1.08	
Standard Deviation of RCD (mm)		0.74	
Coefficient of Variation of Height (in)		10%	
Coefficient of Variation of RCD (mm)		15%	
Range (maximum - minimum) of Height (in)		3.20	
Range (maximum - minimum) of RCD (mm)		4.20	

Ratio	
Root Weight Ratio	20.0%
Height:Diameter Ratio (mm/mm)	58
Top Dry Weight (g) (indiv)	3.443
Root Dry Weight (g) (indiv)	0.861







H:D is a ratio of sturdiness
Height (mm):RCD (mm)
A high ratio = "spindly"
A low ratio = "stouter"

Example

RCD (mm)	Ht (in)	H:D Ratio
4.5	10	56
5	10	51
4.5	12	68
5	12	61
4.5	14	79
5	14	71

Summary

- No single characteristic
- Height alone is not a good indicator
- ***A good nursery practice is to judge seedling quality by several traits***