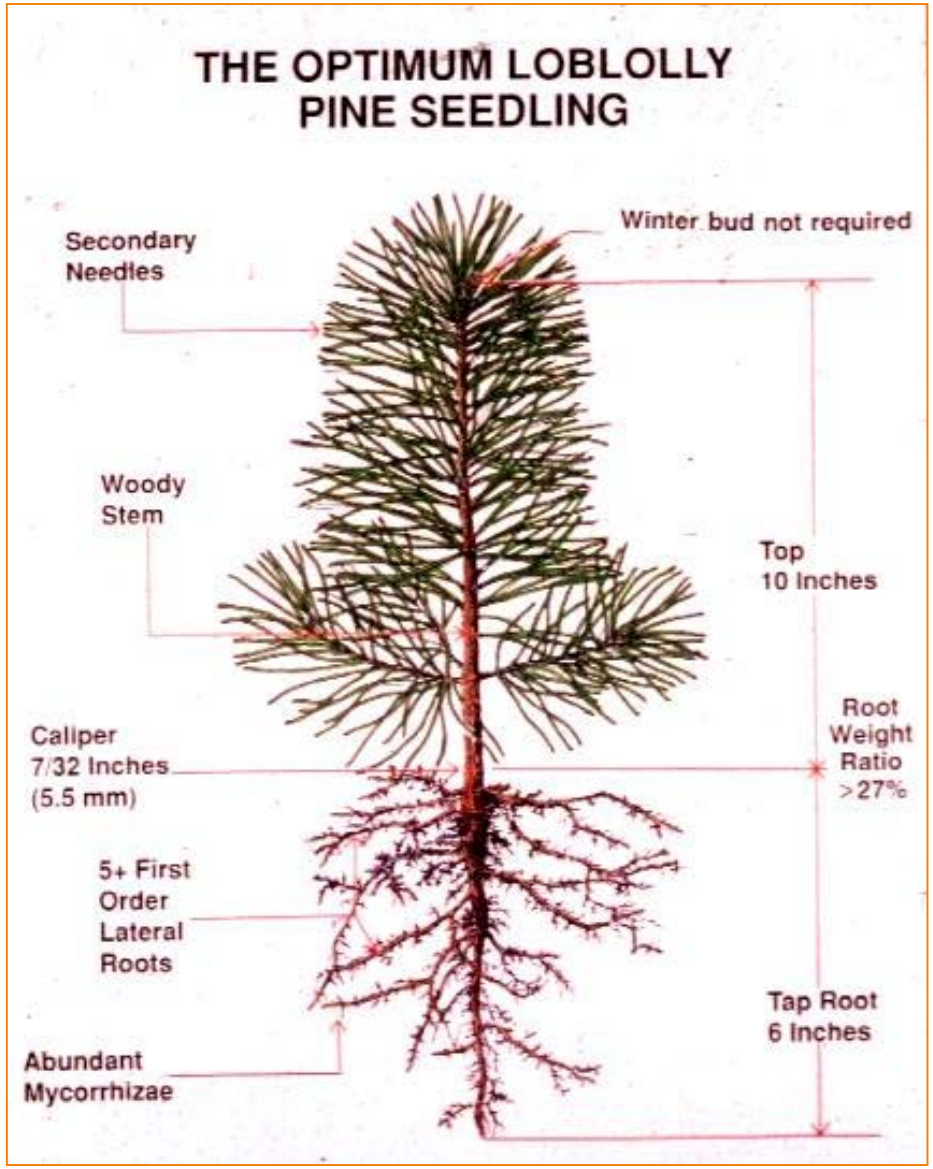
Seedling Quality, Slow Release Fertilizer and Tip Burn Study

Ryan Nadel

Seedling quality

Seedling quality

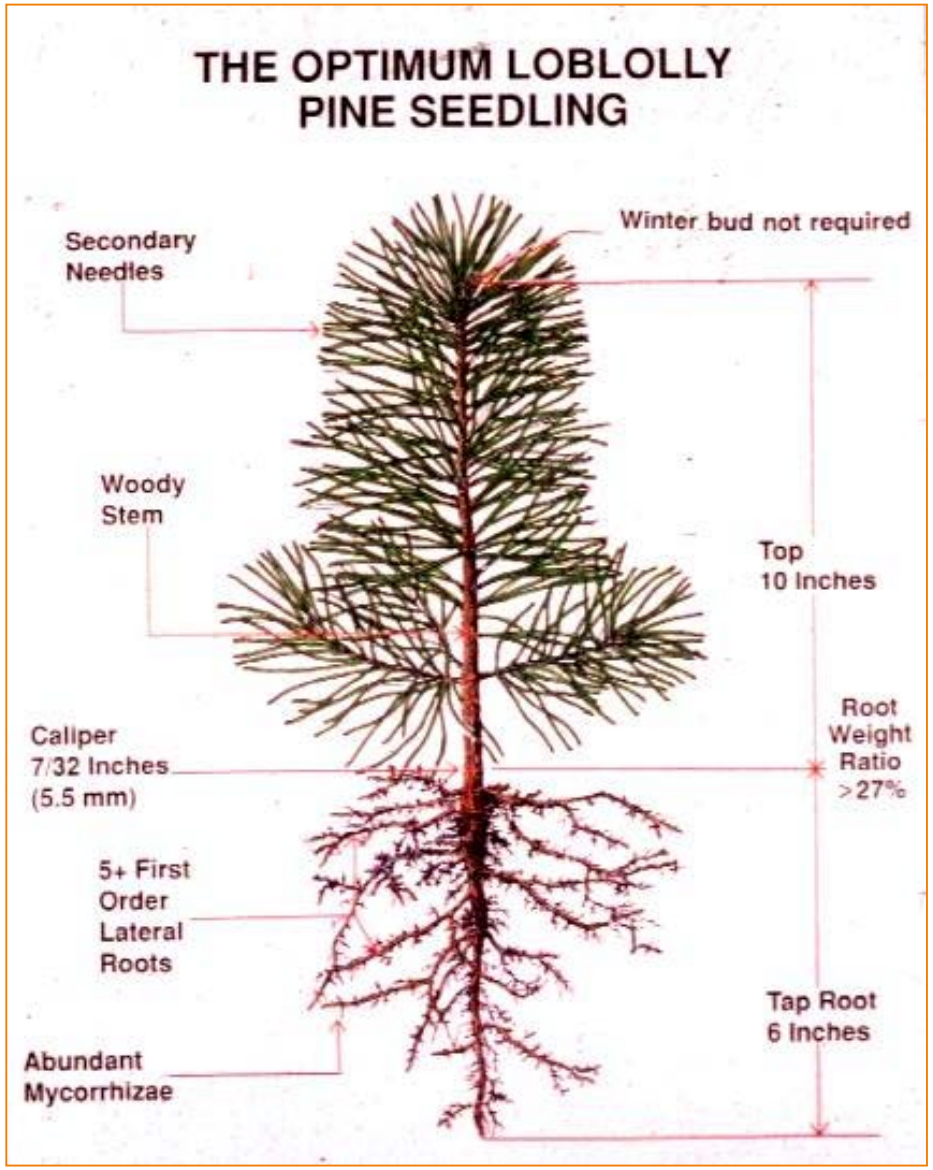
- A high quality seedling is one that can survive prolonged environmental stress and produce vigorous growth following out planting



Nursery Coop

- SFNMC will once again provide bareroot and container seedling quality analysis service to our members throughout the southern United States.
- Each report provides numerous statistics as to measures of central tendency and variability in addition to informative seedling parameter ratios. Histograms of root collar diameter, height and the height: diameter ratio frequency are also provided.

  - **Height: diameter** is a sturdiness ratio. A high ratio indicates a relatively spindly seedling while a lower ratio indicates a stouter seedling It is calculated by dividing the seedling height by the stem diameter with height and diameter in the same units



Possible comparisons and uses

- Compare the same seedlot grown at different company nurseries
- Compare the same seedlot grown in different media or containers types
- Compare the same seedlot year to year
- Compare the same seedlot grown in different nursery units or at different densities
- Compare the same seedlot sown early versus late
- Comparing the variability (Coefficient of Variation) between seedlot or among the same seedlot in different locations
- Comparing the root weight ratio of different seedlots
- Comparing the variability of root collar diameters using the range, confidence intervals and the RCD histogram
- Comparing root weight ratios (or root biomass) for the same seedlot hand lifted to machine lifted
- Provide selected customers with all or part of analysis for the seedlots they purchased
- Indicate to customers how you are trying to improve seedling quality by reducing variation in a particular parameter.
- Use RCD histogram to explain to customers why an average RCD of 5 mm does not imply all seedlings will have the same RCD

Evaluations

- We have been evaluating **container seedlings from October 2016.**
  - For container seedling analysis, in addition to the seedling samples, a sample of 10 plugs (placed in a single Ziploc bag) taken within the same container type that does not contain a seedling will be needed. We request that these plugs are taken randomly from the same trays that seedlings are sampled from. These plugs do not have to be intact.

- We can **begin bareroot evaluations in January 2017**.

  - **Very important – please contact me before sending seedlings so as to ensure seedlings can be evaluated between our normal Nursery Cooperative trial processing.**

Sample report

Auburn University
Southern Forest Nursery
Seedling Evaluation Report

PAGE 1

9/10/2016

A sample

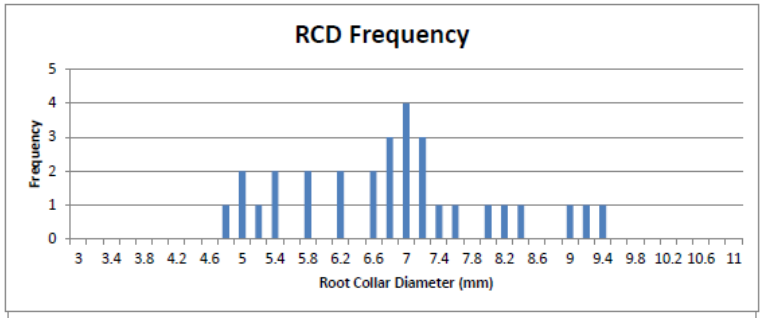
Company:	A Company	
Contact:	A Name	0
Nursery/State:	A nursery	
Species:	Lob	
Stock:	Bareroot	aname@auburn.edu
Source:	Coastal	
Genotype:	2nd	
Hand or Machine Lifted:	Hand	

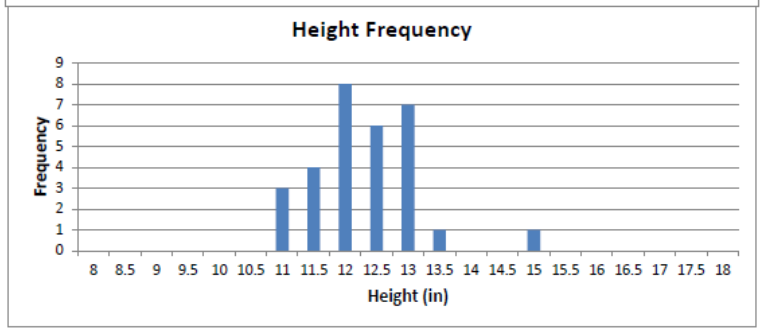
Measure of Central Tendency	
Average Height (in)	12.09
Average RCD (mm)	6.76
Median Height (in)	12.00
Median RCD (mm)	6.76

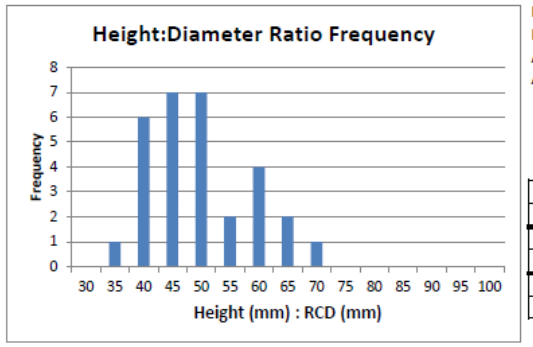
Measure of Spread (Dispersion)			
95% Confidence Interaval for RCD (mm)	6.76	±	0.44
98% Confidence Internval for RCD (mm)	6.76	±	0.53
Standard Deviation of Height (in)		0.83	
Standard Deviation of RCD (mm)		1.24	
Coefficient of Variation of Height (in)		7%	
Coefficient of Variation of RCD (mm)		18%	
Range (maximum - minimum) of Height (in)		4.40	
Range (maximum - minimum) of RCD (mm)		4.55	

Ratio	
Root Weight Ratio	22.5%
Height:Diameter Ratio (mm/mm)	47
Top Dry Weight (g) (indiv)	5.281
Root Dry Weight (g) (indiv)	1.532

Sample # **A sample** 9/10/2016 PAGE 2







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

Loblolly pine tip burn trial

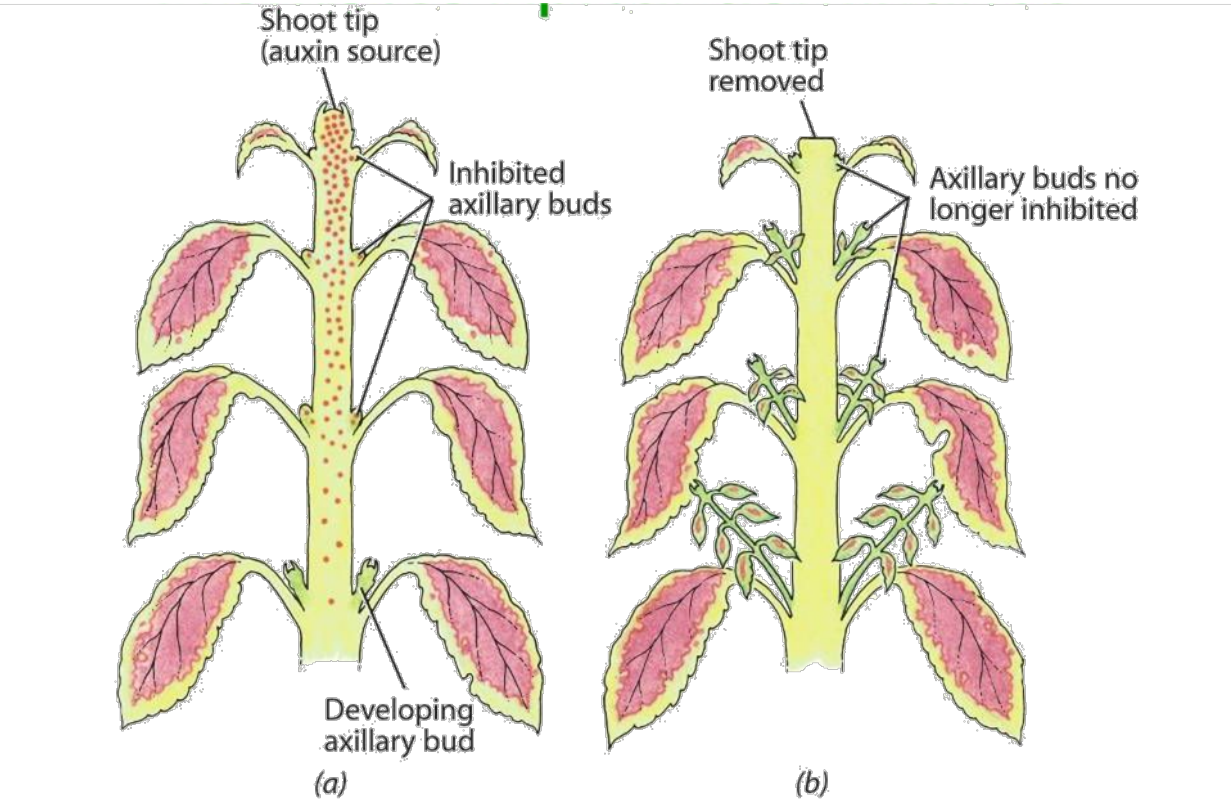
Scott Enebak, Tom Starkey and Ryan Nadel

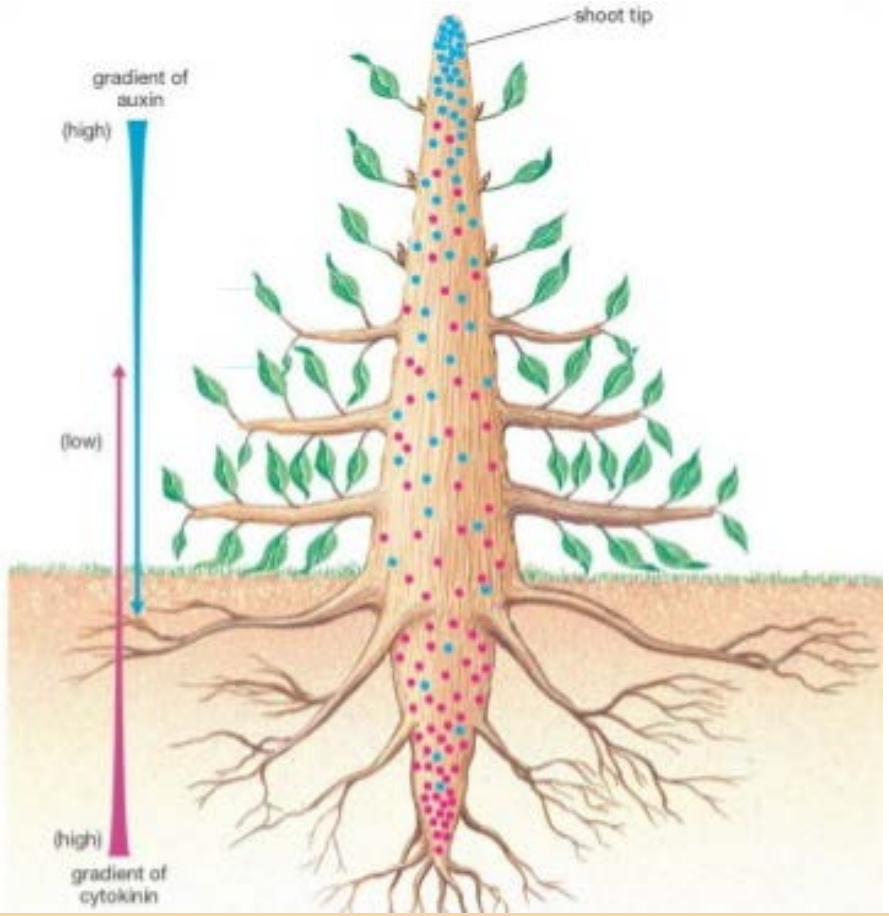
Introduction

- Establishment problem was reported
- Seedlings that had a shoot tip were growing, however, those that had a "burned" shoot tip had little root growth 4 months after planting
- Freeze injury had killed the shoot tip, resulting in a "burned" appearance

Auxin information

- Auxin – Indoleacetic Acid (IAA) released from shoot tip stimulate cell elongation in the stem and promotes apical dominance by suppressing lateral buds (concentration related).
- Cytokinins, produced in the roots, can stimulate lateral buds if the shoot tip is removed





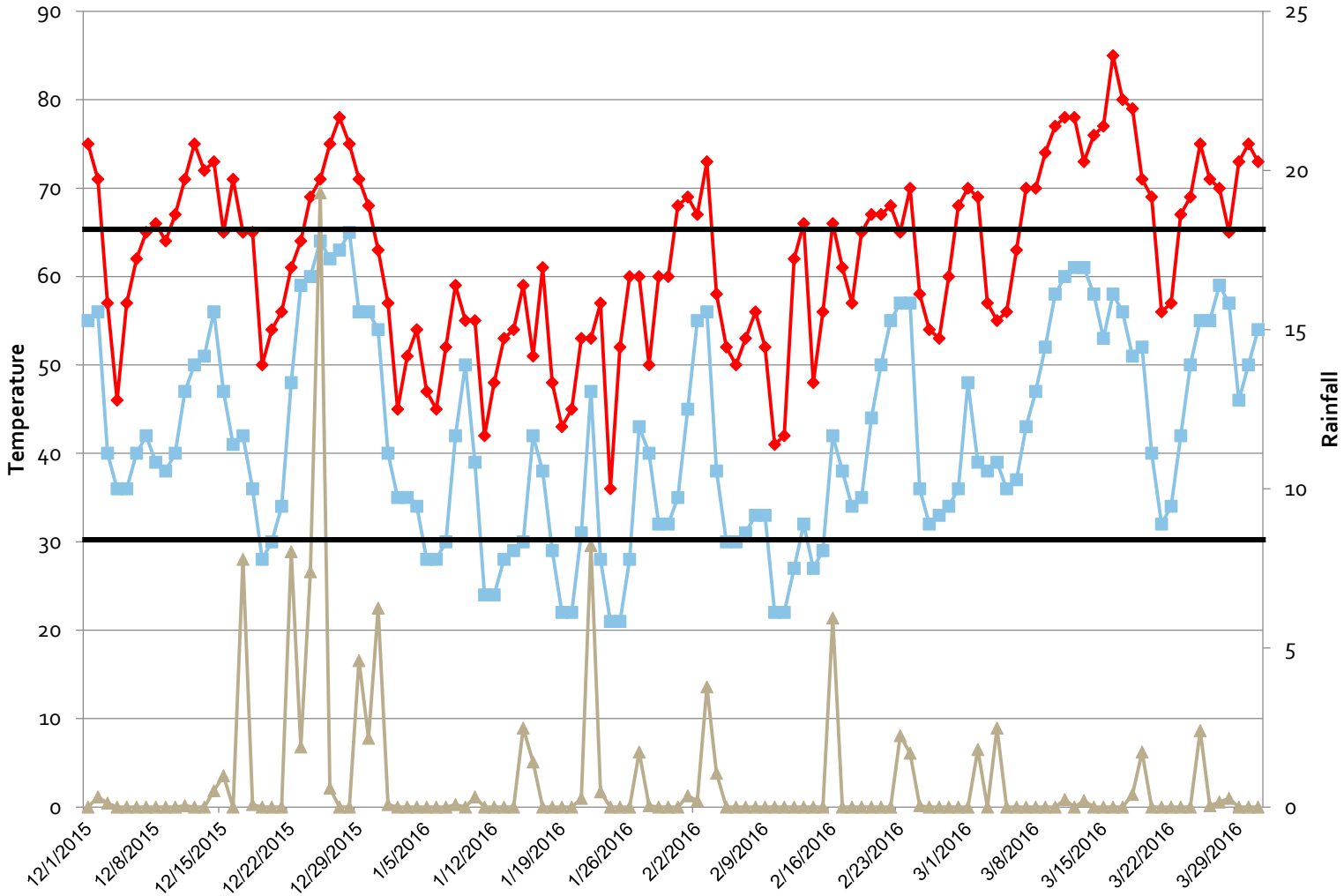
Methodology

- To determine the long term impact on out planted seedling survival as a result of the "burned" shoot tip when exposed to various levels of environmental stress
- Three levels of planting stress
  - Low stress – Greenhouse (exposed to moderate temperatures and were watered)
  - Moderate stress - Stress box (amount of water was regulated but seedlings were exposed to ambient temperatures)
  - Stressed - Trophatron (received no supplemental water and exposed to ambient temperatures)
- For the study every second seedling had its growing tip burned
- Planted 16 December 2015
- Data recorded in April 2016

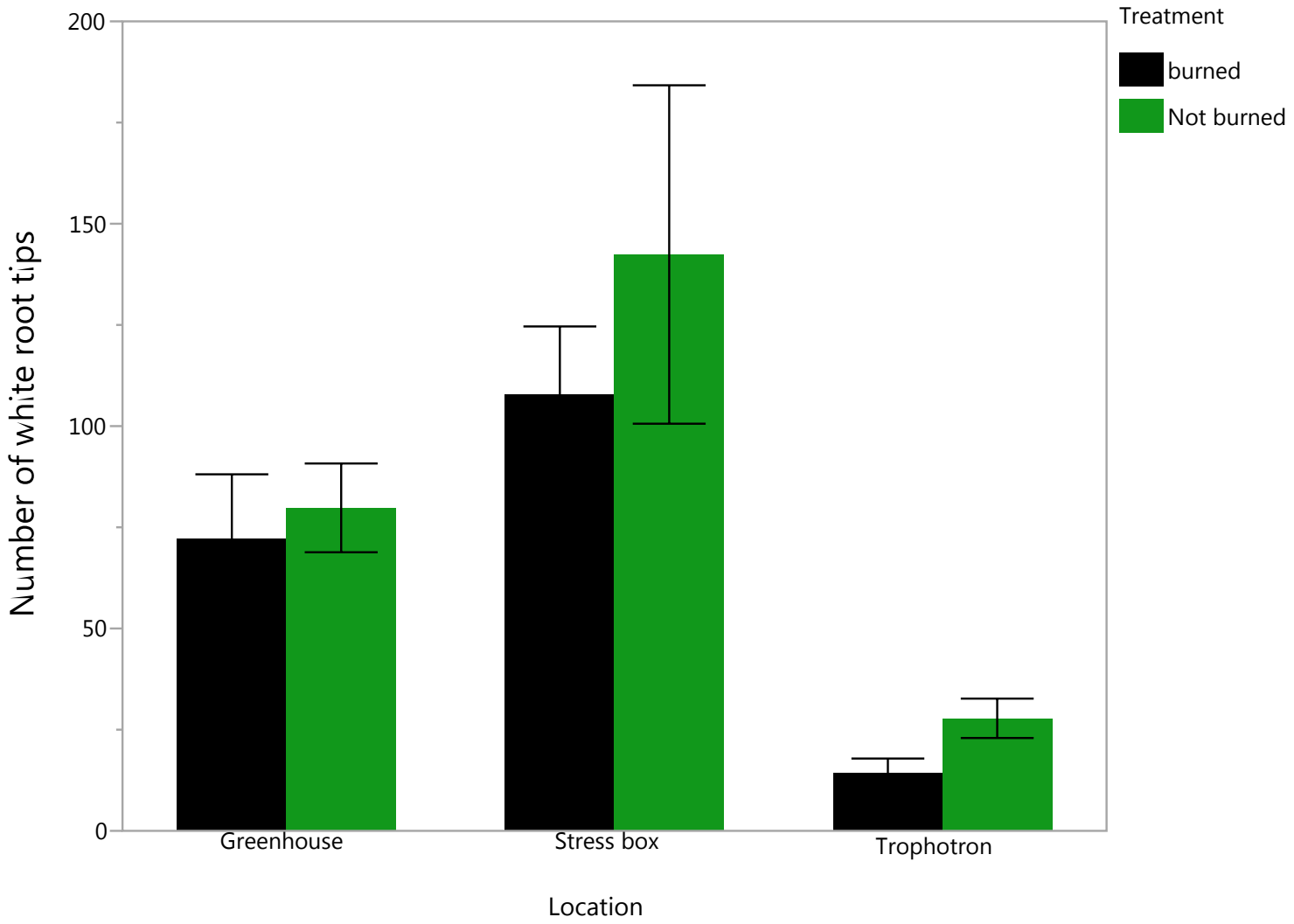
Methodology

Results

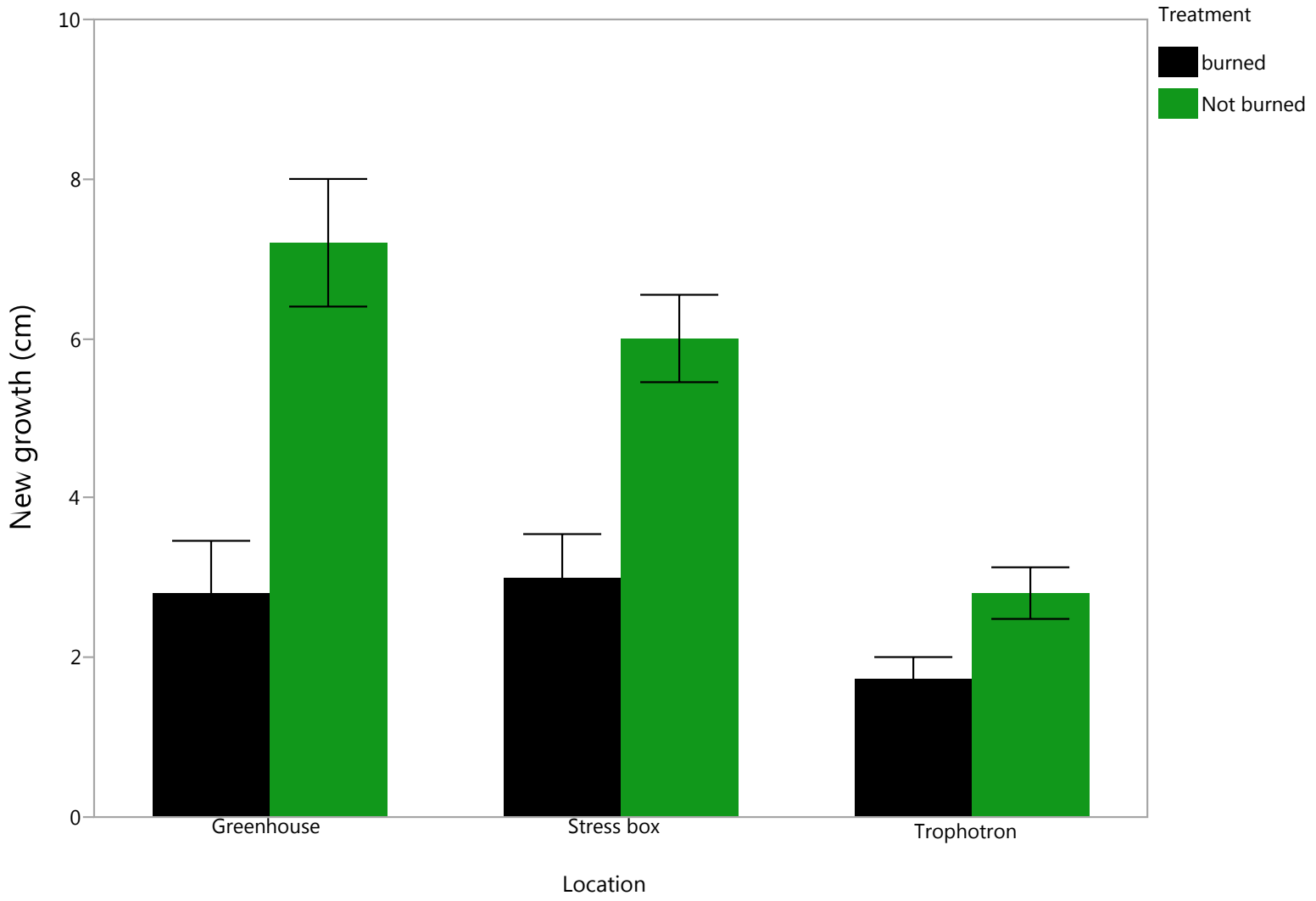
Temperature and Rainfall



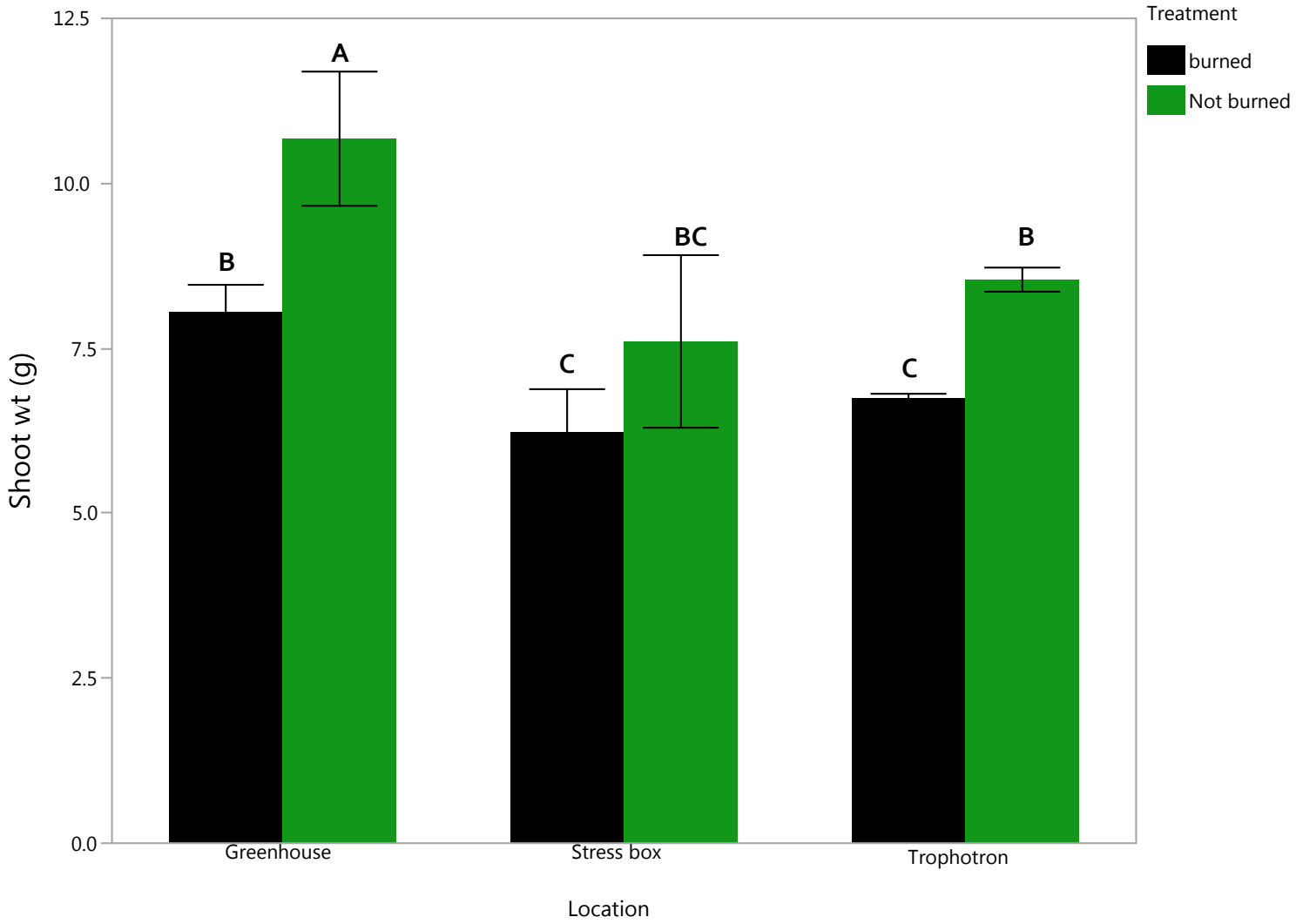
Results of RGP



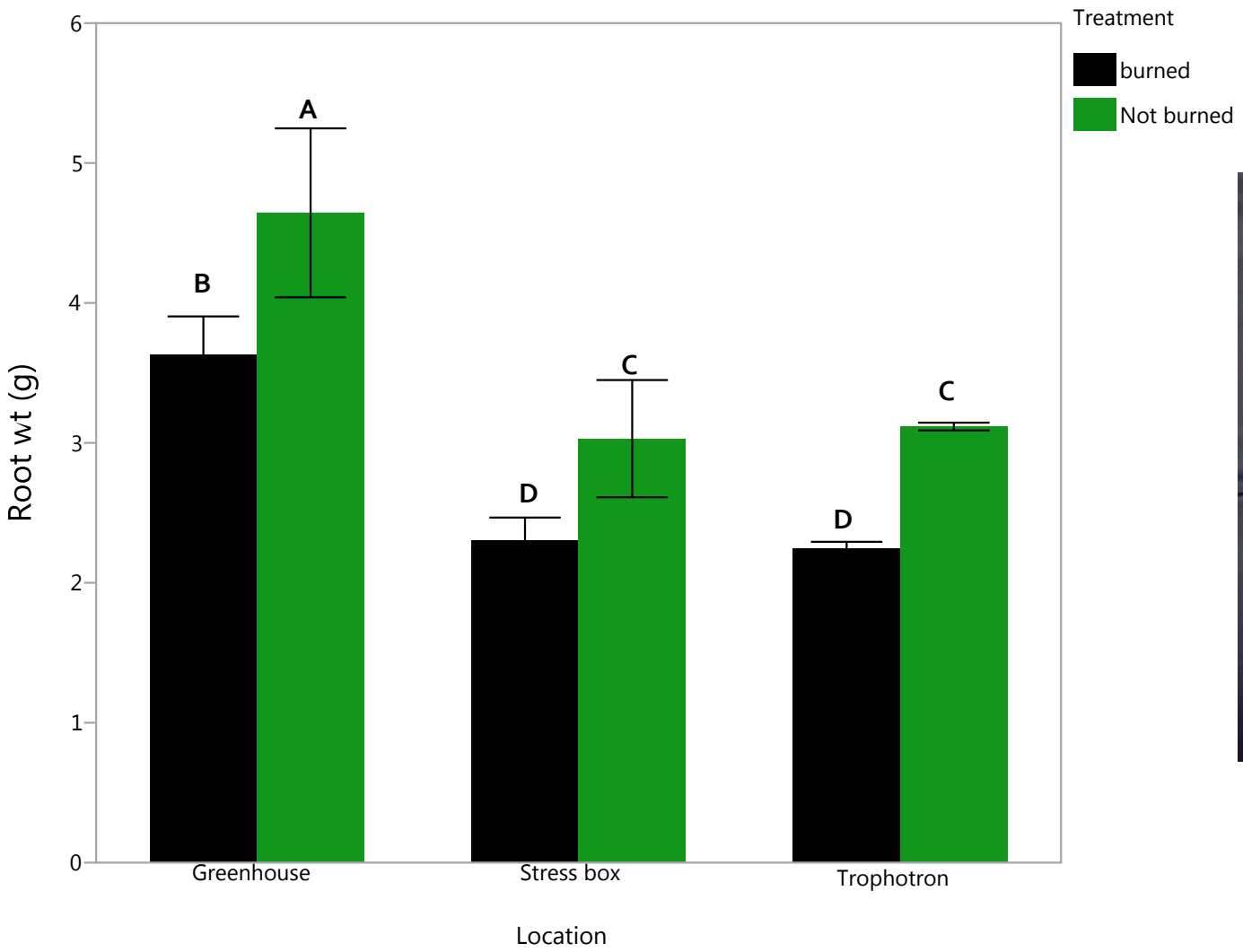
Results of new growth



Results for shoot weight



Results for root weight



Conclusions

- Water and temperature stress had an effect on root and shoot development
- Burning the tip resulted in significantly less root weight, shoot weight, new root growth and fewer new white root tips when compared to the unburned control
- Tip dieback due to freeze injury / drought, significantly affects root growth infield and could also affect survival

Controlled Release Fertilizer Study

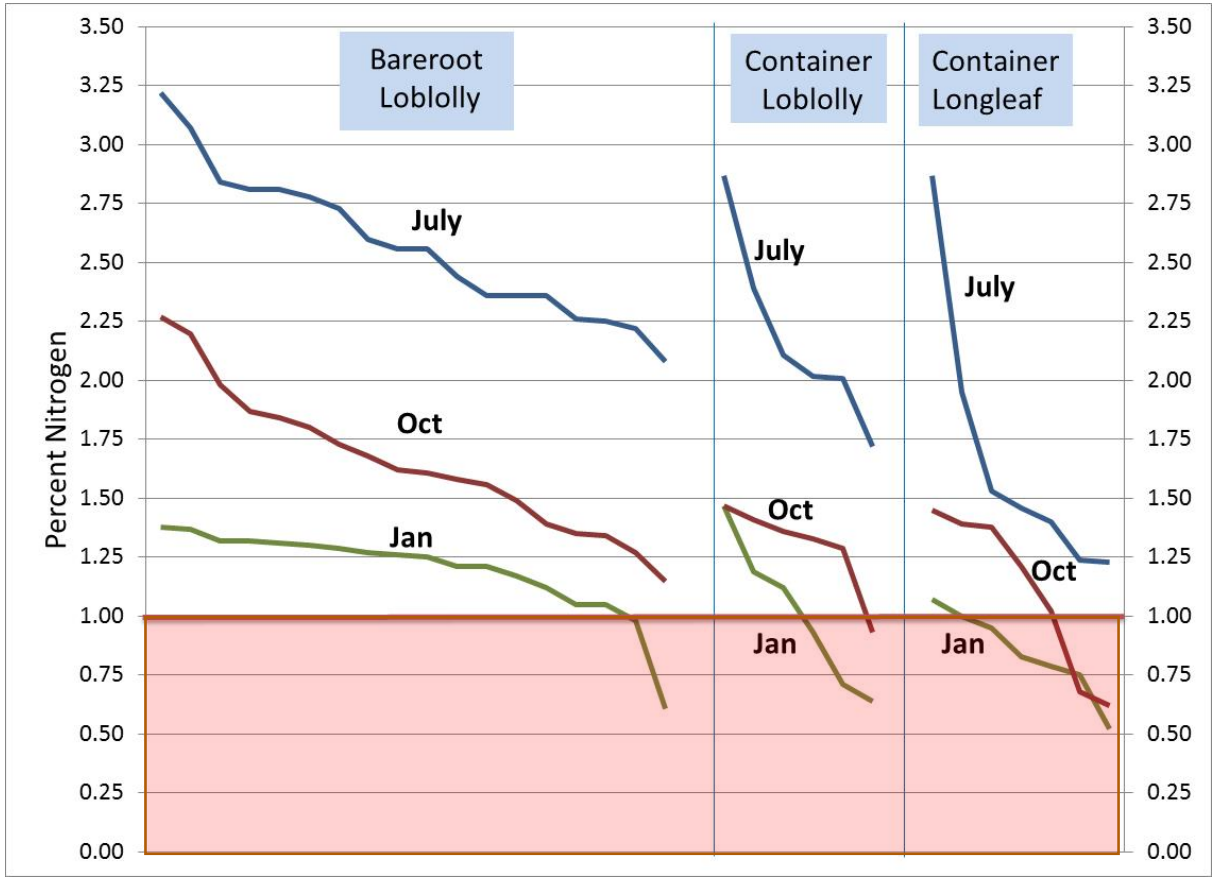
Tom Starkey and Ryan Nadel

Why Fall Fertilization?

- Good seedling nutrition at time of outplanting is strongly tied to successful stand establishment.
- Important to have an adequate level of nutrients in the foliage at time of outplanting.
- Root growth in the spring for outplanted seedlings is correlated with the amount of current stored photosynthate.
- Historically 2% nitrogen has been a good target that will allow seedlings to get off to a good start.
- Traditionally our approach has been to apply fertilizer to seedlings after growth has slowed/stopped in fall.

Nutritionally, when is the best time to ship seedlings?

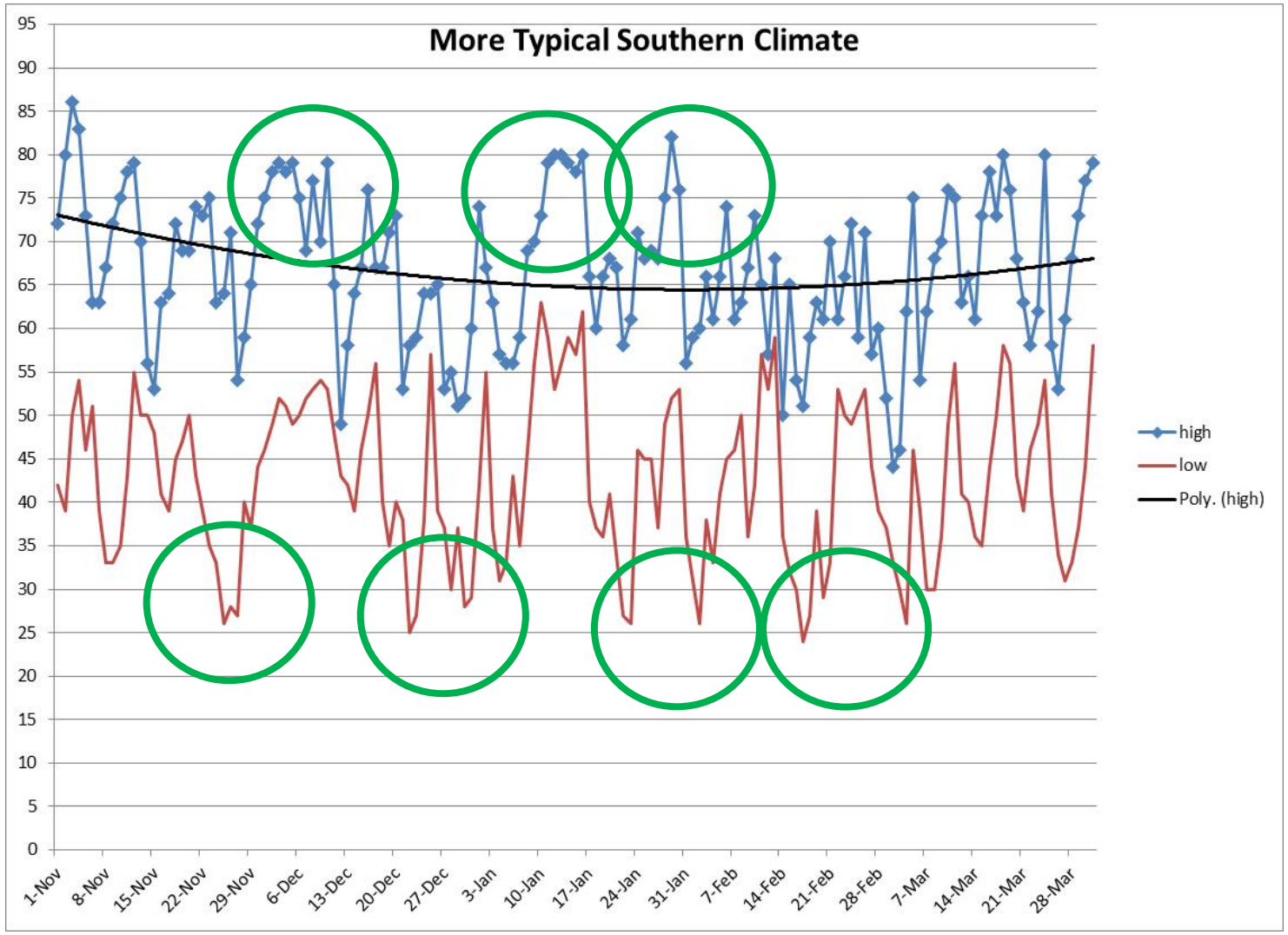
- Bareroot and container nurseries manage seedling growth during the growing season so they reach their target size at the beginning of the shipping season.
- Prior to and after this target size is achieved. Fertilization is normally reduced or totally stopped.
- Therefore. seedlings shipped early generally will have the highest seedling nutrition.



RR12-02 Starkey & Enebak "Foliar Nutrient Survey of Loblolly and Longleaf Pine Seedlings"

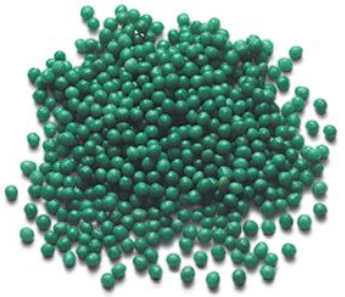
What have been the limitations to fall fertilization?

- Constant decrease in temperatures that favor seedling acclimatization does not occur year to year



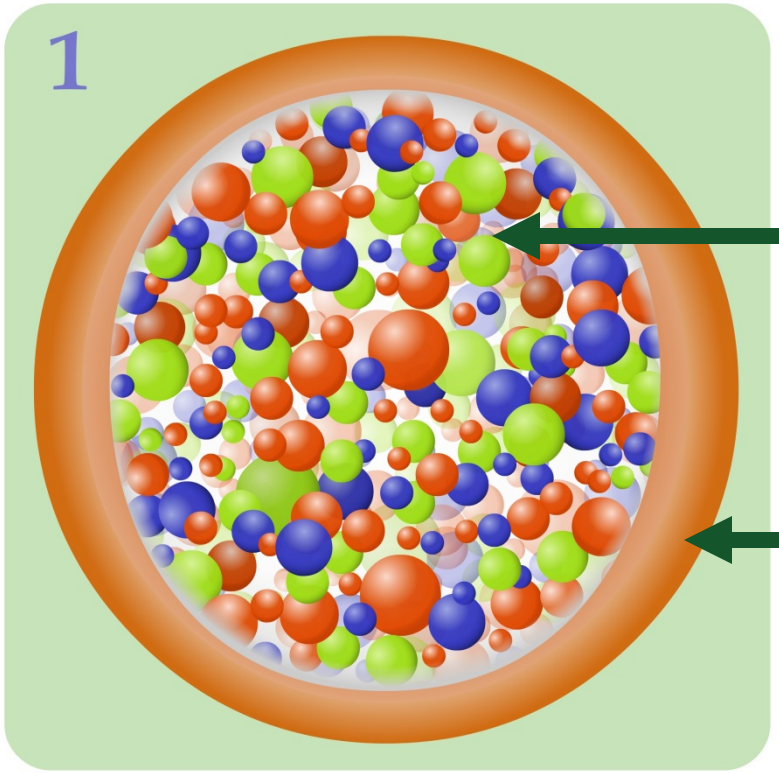
Controlled Release Fertilizer (CRF)

- What if we had a CRF fertilizer (in the plug) that would have "minimal" release during the growing season in the nursery but then provide fertilization to seedlings on outplanting in the spring as the soils warmed up?
- Mixed in the growing media at beginning
- Could have 2 types CFR in media
    1. A 3-4 month or 6-9 month formulation
    2. A long-term temperature sensitive formulation with minimal release during growing season designed to release fertilizer after outplanting in spring
- Contacted 2 companies
    - Haifa - Multicote®
    - Harrell's - Polyon®
    - With both products. cold weather "shuts down" release. Release is controlled by temperature



Multicote® Technology

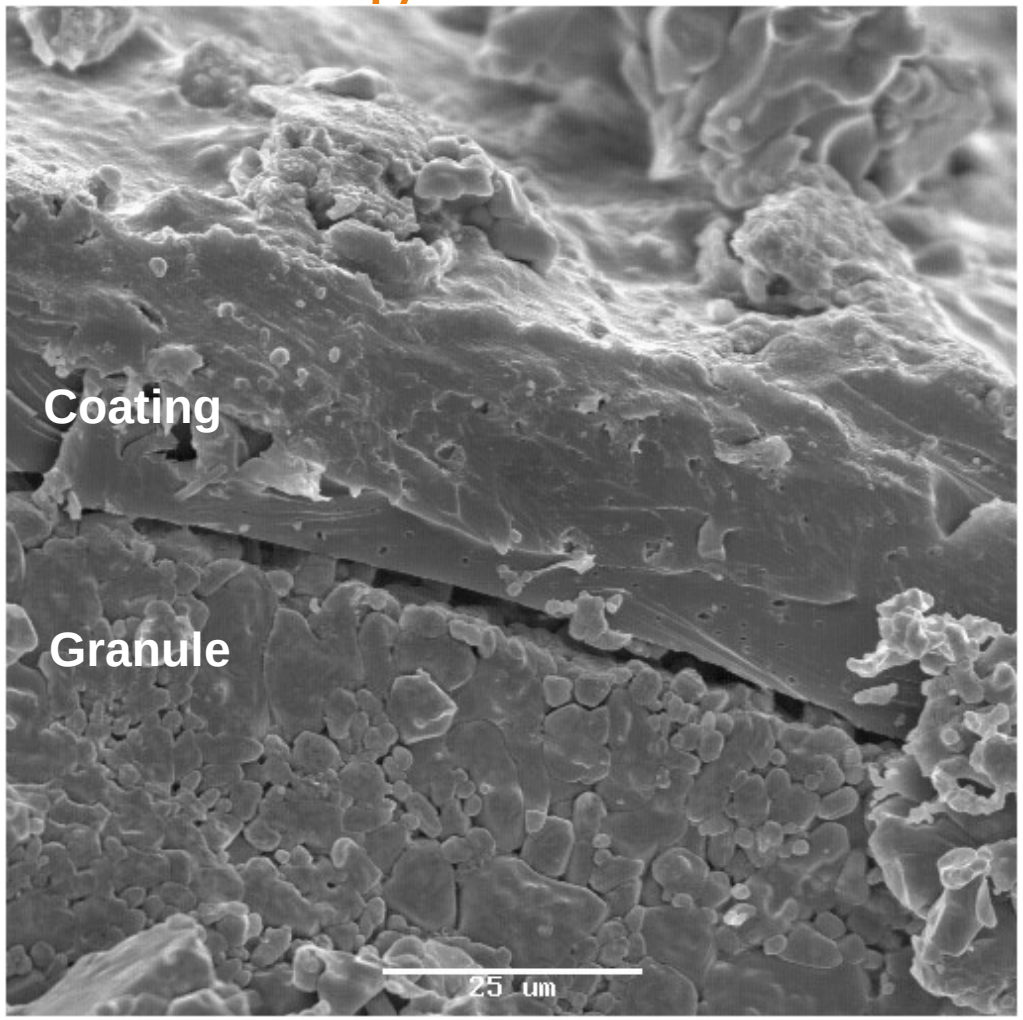
UREA
NPK
NPK+Micros



Core:
Soluble nutrients

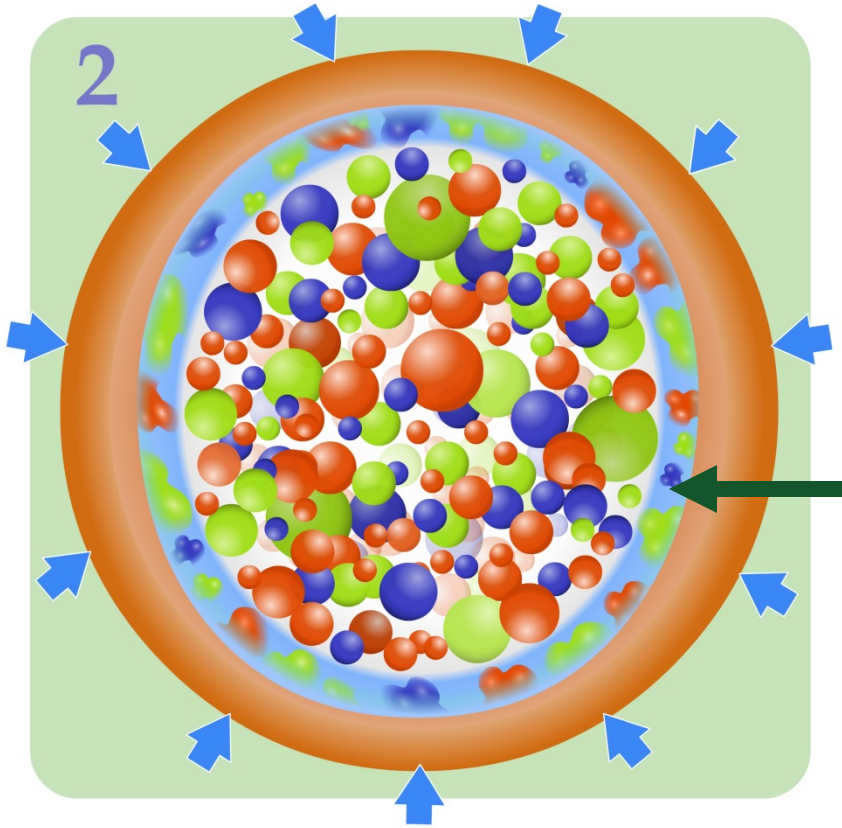
Shell:
Polymer coating

Multicote® Technology



Scanning Electron Microscope picture of NPK granule

Multicote® Technology

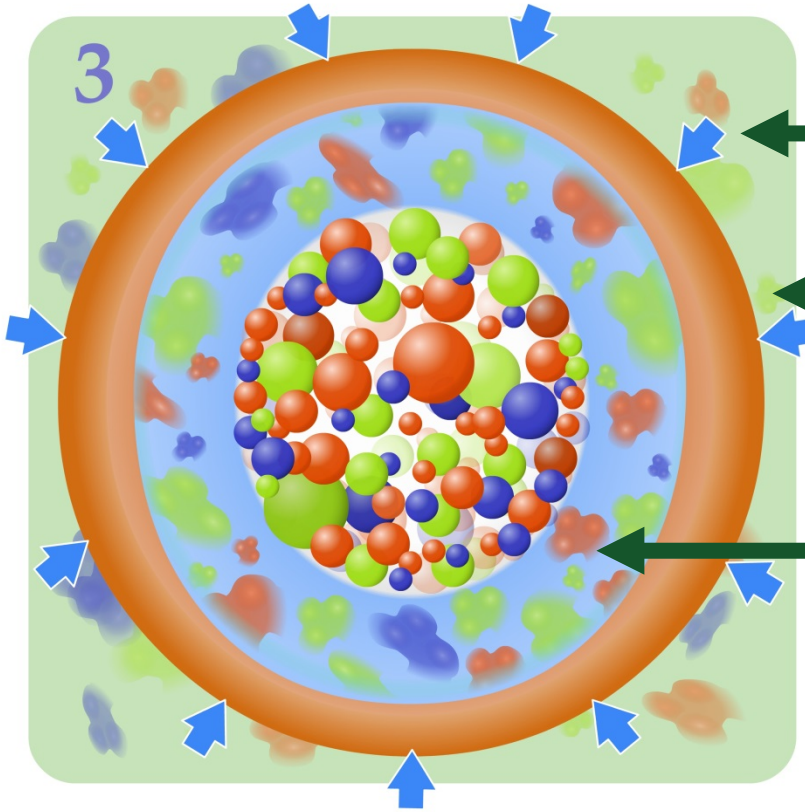


<u>After application in the soil:</u>

Water penetration

Gradual dissolution of the nutrients

Multicote® Technology



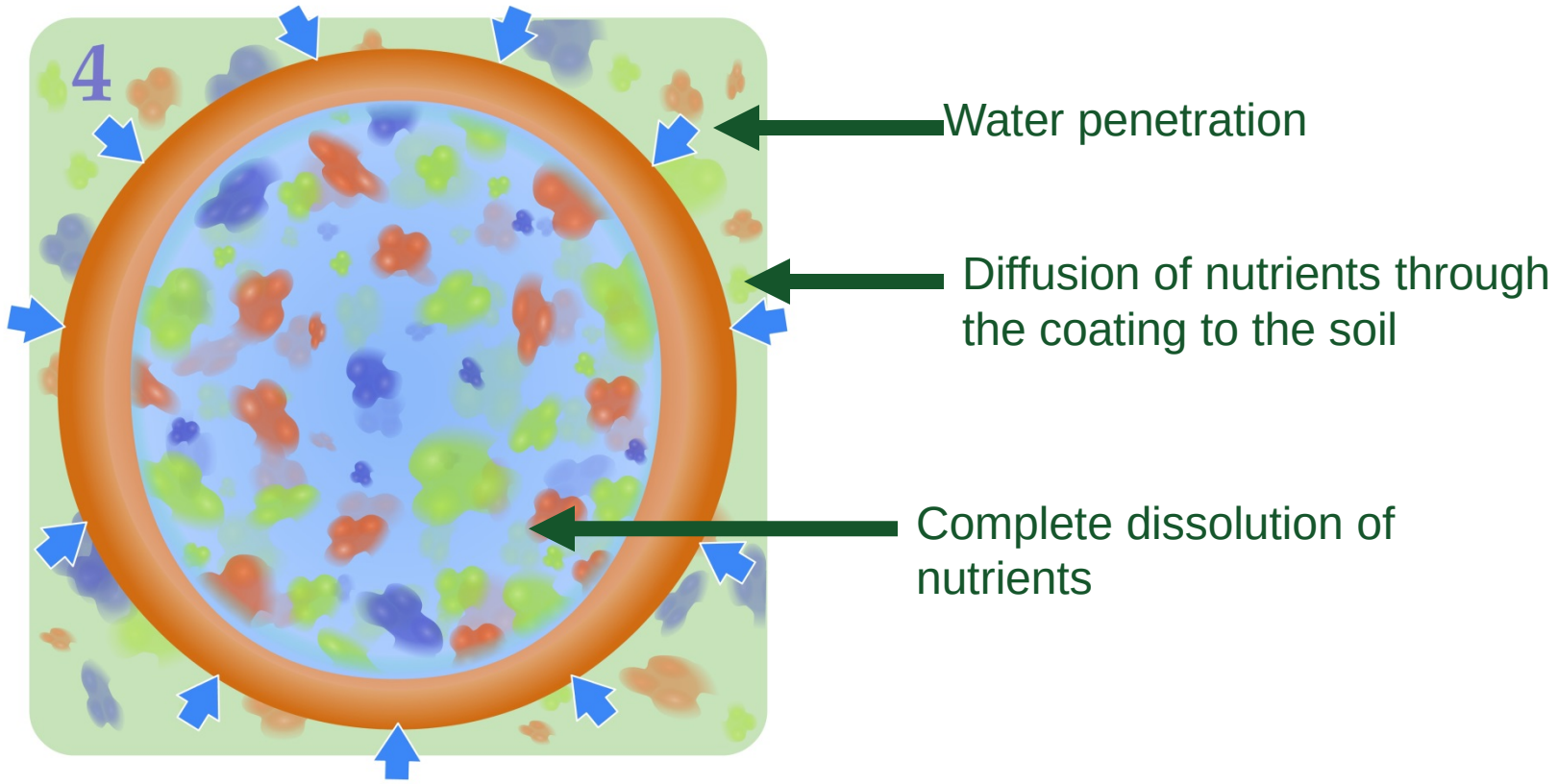
Water penetration

Diffusion of nutrients through the coating to the soil

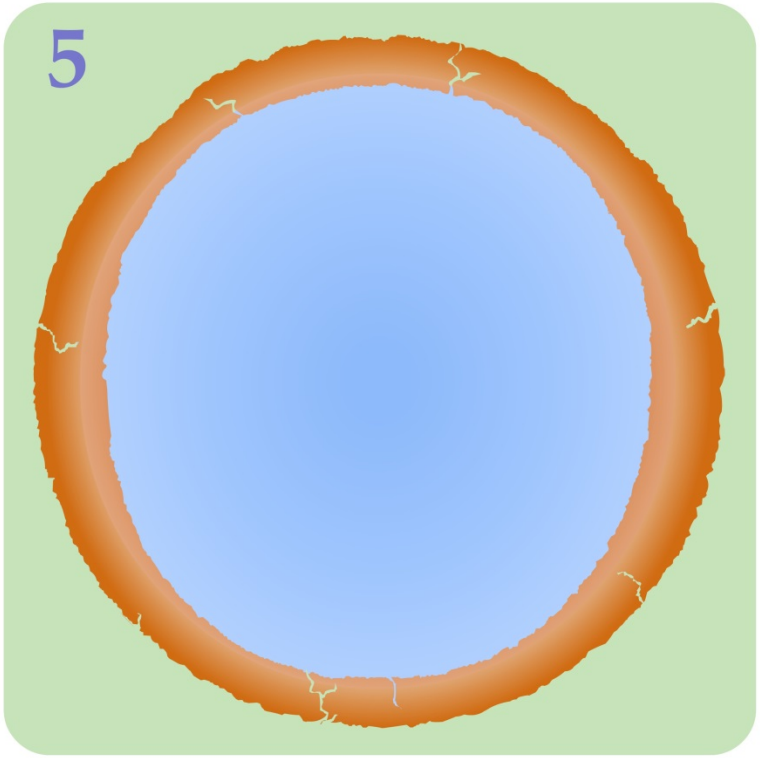
Further dissolution of nutrients

1. Rate of diffusion is solely based on soil temperature.
2. Other factors. such as soil type, humidity, pH, and microbial activity do not affect the release rate.

Multicote® Technology



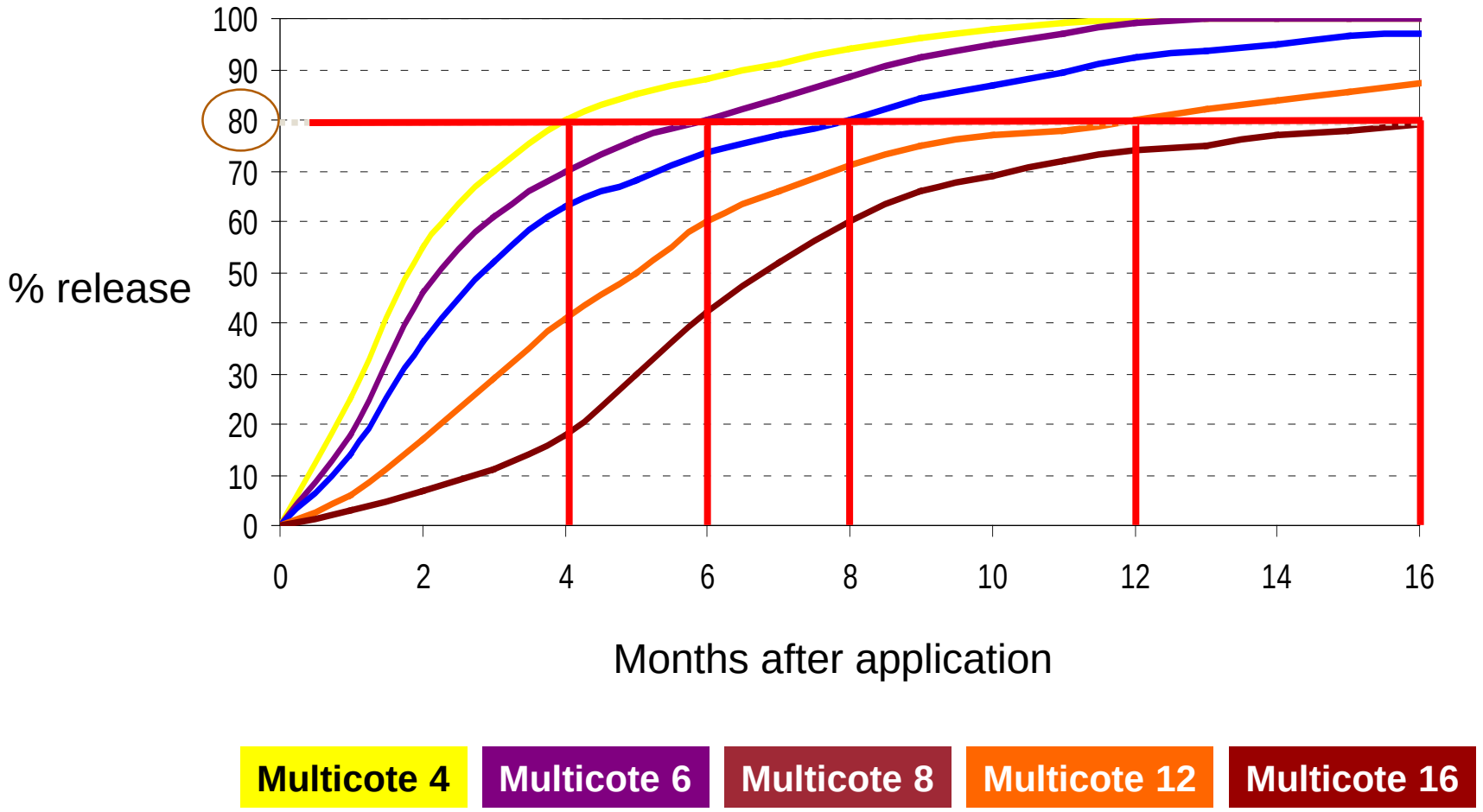
Multicote® Technology



- The rate of nutrient release from Multicote increases with temperature:
- Note: plant uptake rates also increase with temperature
- The longevity decreases as release rate increases

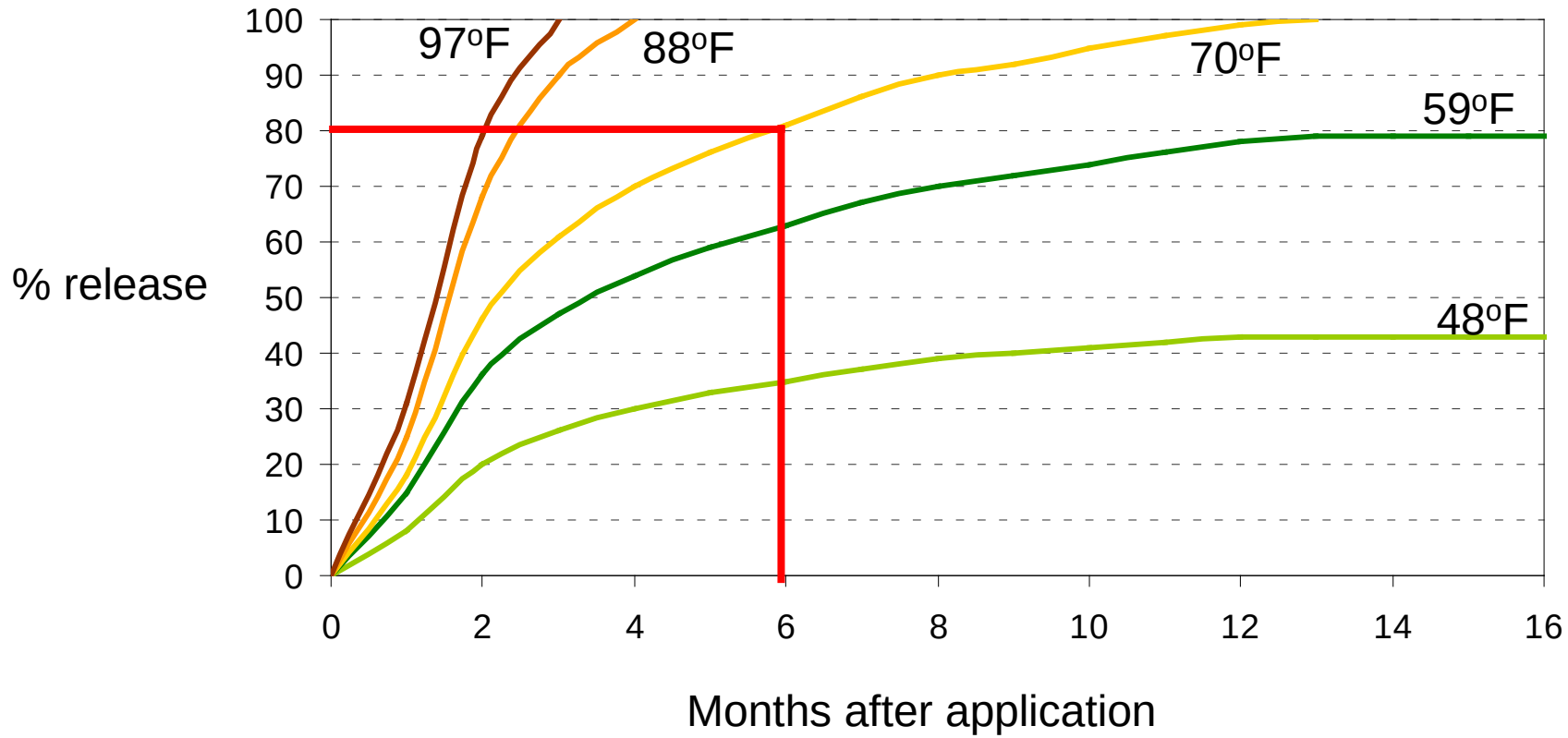
After the release is complete. the coating will degrade gradually. leaving no residues in the soil.

Longevity

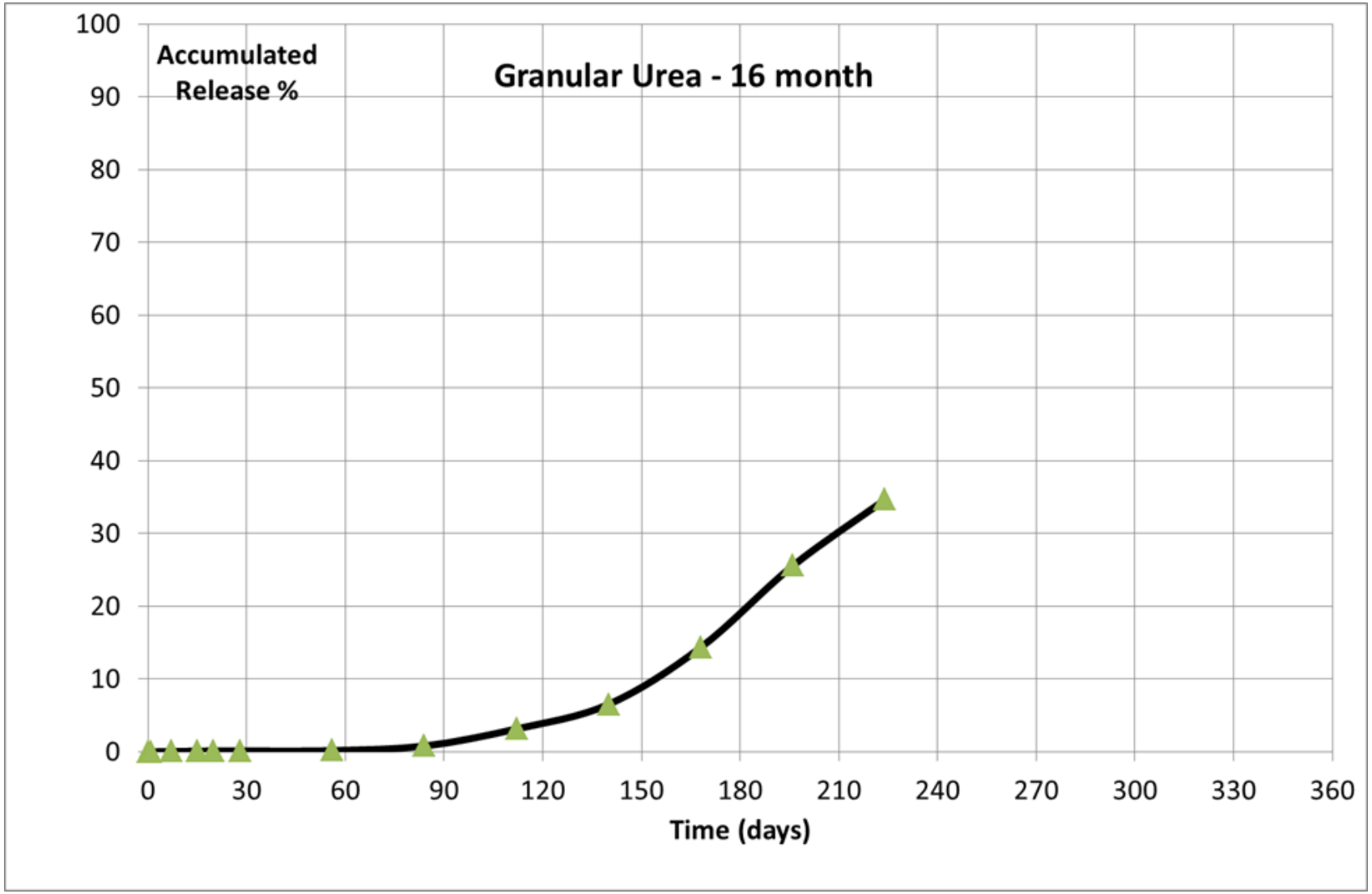

% release
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
Months after application
Multicote 4
Multicote 6
Multicote 8
Multicote 12
Multicote 16

Multicote® Technology

Release rate. longevity & temperature (6M product)



Multicote® 16m Coated Urea (40-0-0)

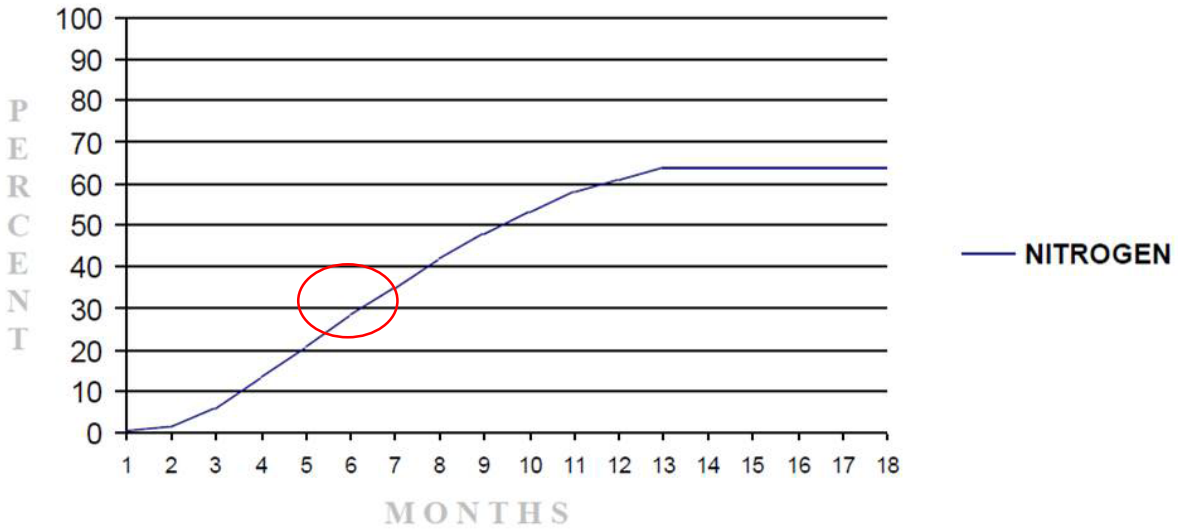


Polyon® 16-5-11 (NPK only)

14-16 Month Fertilizer **Application/Growing Method:**

Application Date: 4/1/2014 **Longevity (Months):**

Cumulative Release of Nutrients (%) by Month



GUARANTEED ANALYSIS

* Total Nitrogen (N)		16.0000%
8.8960%	Nitrate Nitrogen	
7.1040%	Ammoniacal Nitrogen	
** Available Phosphate (P_2O_5)		5.0000%
*** Soluble Potash (K_2O)		11.0000%

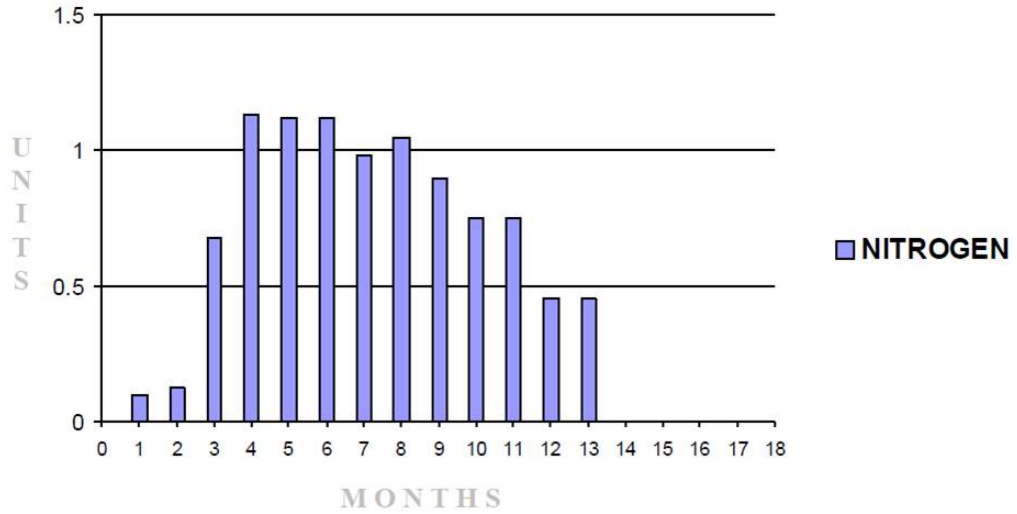
Derived From: Polymer Coated Ammonium Nitrate, Polymer Coated Ammonium Phosphate, Polymer Coated Potassium Sulfate

* 16% slow release NITROGEN derived from Polymer Coated Ammonium Nitrate, Polymer Coated Ammonium Phosphate

** 5% slow release PHOSPHATE derived from Polymer Coated Ammonium Phosphate

*** 11% slow release POTASH derived from Polymer Coated Potassium Sulfate

Actual Units of Nutrients Released by Month

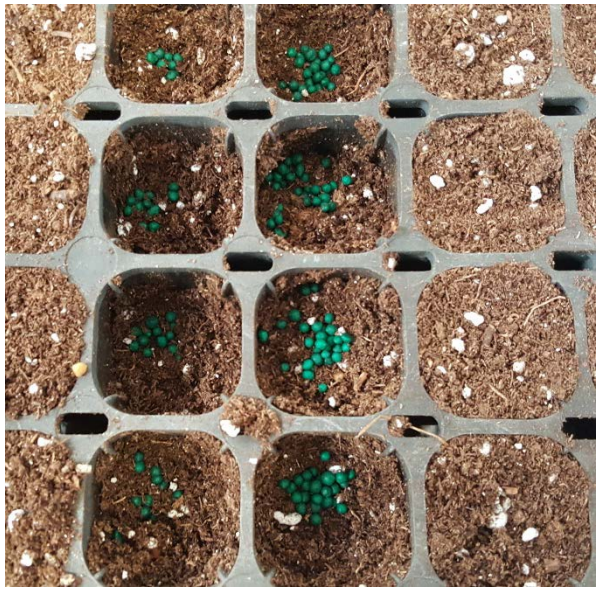


6 month – Oct – est 30% release

Southern Forest Nursery Management Cooperative trials

Two Trials

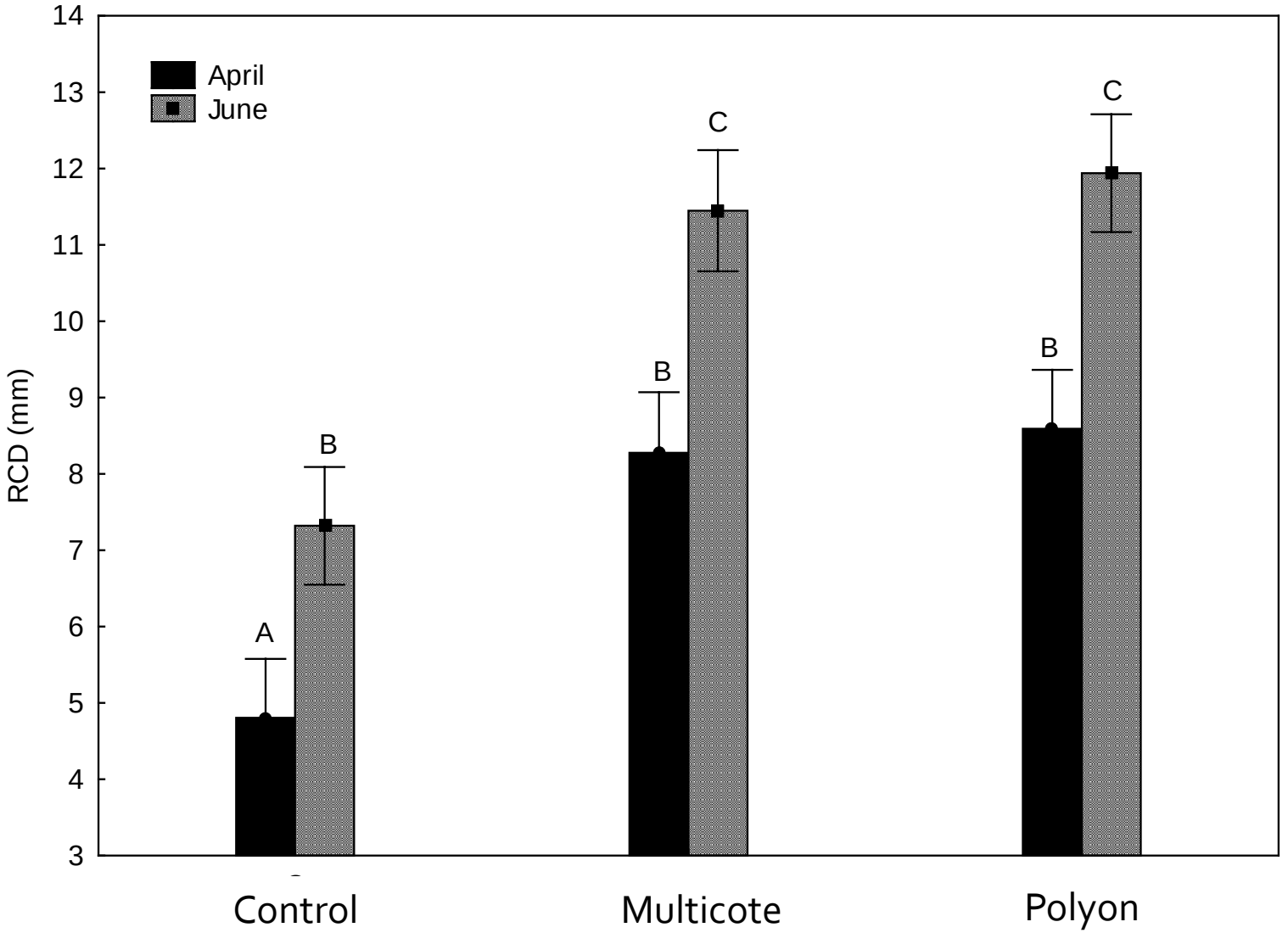
1. Involved three nurseries mixing CRF fertilizer with their standard media mix at rate of 8 lb/cu yd and hand filled container sets. At the end of the growing season seedlings were provided for outplanting, seedling quality evaluations in addition to foliar and media nutrient analyses undertaken
2. Two rates of each CRF were incorporated with the same container set along with a control which the nurseries standard rate of CRF. This was replicated 15 times.



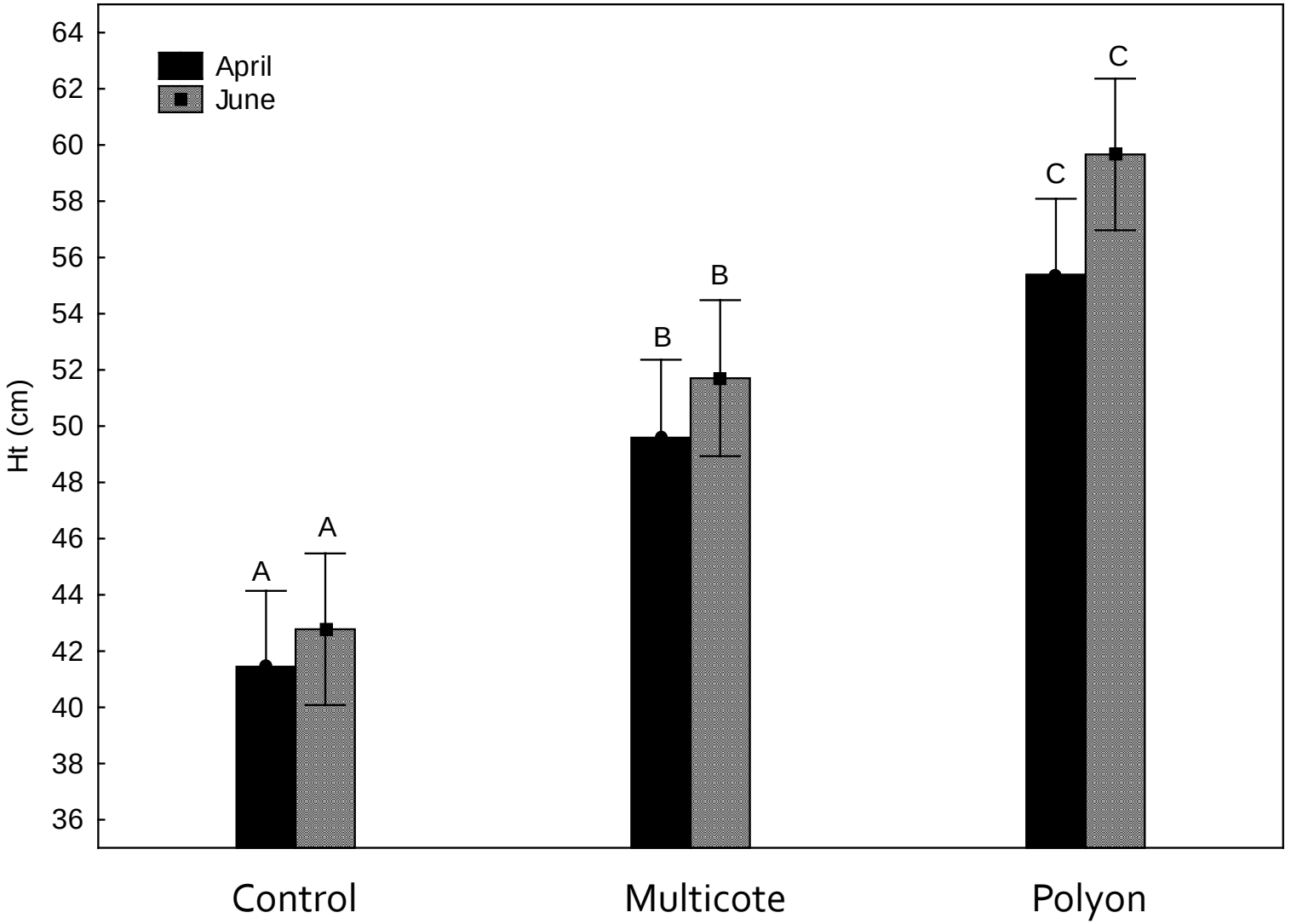
Trial 1

	Polyon	Multicote	Control
Nursery 1 – Loblolly in container sets with vol. of approx. 113ml			
RCD mm	**5.5** [A]	**5.8** [A]	**4.5** [B]
Foliar N %	2	2	1.9
Media Ammonia N ppm	51.1	51.8	11.2
Media Nitrate N ppm	61.2	56	9.4
Nursery 2 – Loblolly in container sets with vol. of approx. 60ml			
RCD mm	4.3 [A]	4.2 [A]	4.3 [A]
Foliar N %	1.2	1.9	1.9
Media Ammonia N ppm	8.4	7	5.2
Media Nitrate N ppm	17.1	14	10.1
Nursery 3 – Longleaf in container sets with vol. of approx. 113ml			
RCD mm	6.3 [A]	6.7 [A]	6.3 [A]
Foliar N %	1.5	1.4	1.2
Media Ammonia N ppm	7.3	9.1	6.3
Media Nitrate N ppm	9.4	11.2	10.9

Trial 1 – Seedling establishment Nursery 1
(4 & 6 months after outplanting)



Trial 1 – Seedling establishment Nursery 1
(4 & 6 months after outplanting)



Trial 1: Loblolly seedling establishment Nursery 1 (6 months after outplanting)

Control

Polyon treatment

Trial 1: Longleaf seedling establishment Nursery 3 (6 months after outplanting)

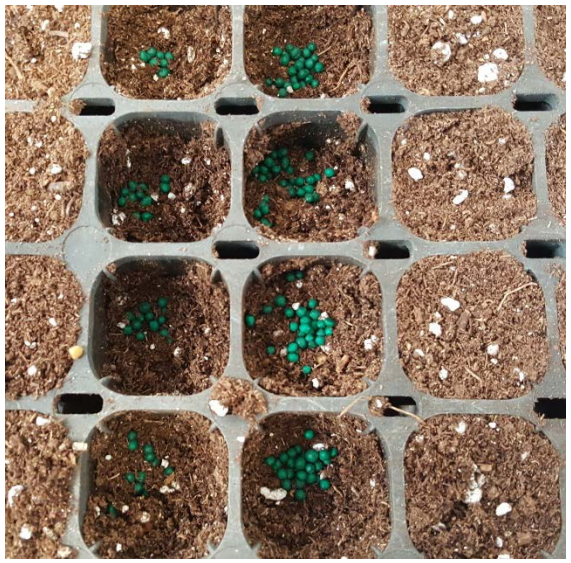
For nursery 3, prior to longleaf outplanting, the Polyon/ Multicote treatments were visually not different from that of the nursery fertilization controls. 6 months following site establishment Polyon/ Multicote treatments show better growth

Control

Polyon treatment

Trial : Two rates of CRF

	Polyon 1	Polyon 2	Multicote 1	Multicote 2	Control
Average # Prills/cavity	16	32	12	23	-
RCD mm	4.5 B	5.5 A	5.3 A	5.3 A	3.3 C
Foliar N %	1.2	1.5	1.4	1.7	1.2
Media Ammonia N ppm	10.5	10.1	4.9	9.1	7.3
Media Nitrate N ppm	13.3	11.2	8.7	10.5	11.9



Conclusions

TRIAL 1

- For nursery 1. prior to loblolly outplanting. the Polyon/ Multicote treatments RCD were significantly greater than that of the nursery fertilization control. This trend has continued four months following outplanting.
- For nursery 2. differences in RCD between Polyon/ Multicote treatments and that of the control were not observed. The small volume container used at this nursery. may have lead to an insufficient number of Polyon/ Multicote prills in each cavity to provide a difference

TRIAL 2

- All rates of the Polyon/ Multicote treatments were visually much greener and larger than the standard nursery control.
- The greatest differences observed were in the RCD of the Polyon/ Multicote compared to the nursery controls
- Results from these studies are promising and thus trials will be repeated in 2016 in addition to being outplanted so as to observe growth differences during seedling establishment

2016 Studies

- Study 1 - Four nurseries (PC, WV, NC, BV) were provided with equivalent of 8 lb/cu yd of Multicote and Polyon to hand mix and fill sets. Loblolly sown.
- Study 2 - 2015 IFCO study repeated with slash.
- Late Nov/Early Dec
  - Study 1 - Seedlings collected from each nursery
    - Outplanted
    - Seedling Quality measured
    - Foliar and media nutrient analysis
    - Estimation of # of prills per cavity
  - Study 2- Seedlings collected from IFCO
    - Outplanted
    - Seedling Quality measured
    - Foliar and media nutrient analysis