# Controlled Release Fertilizer Study

Tom Starkey and Ryan Nadel

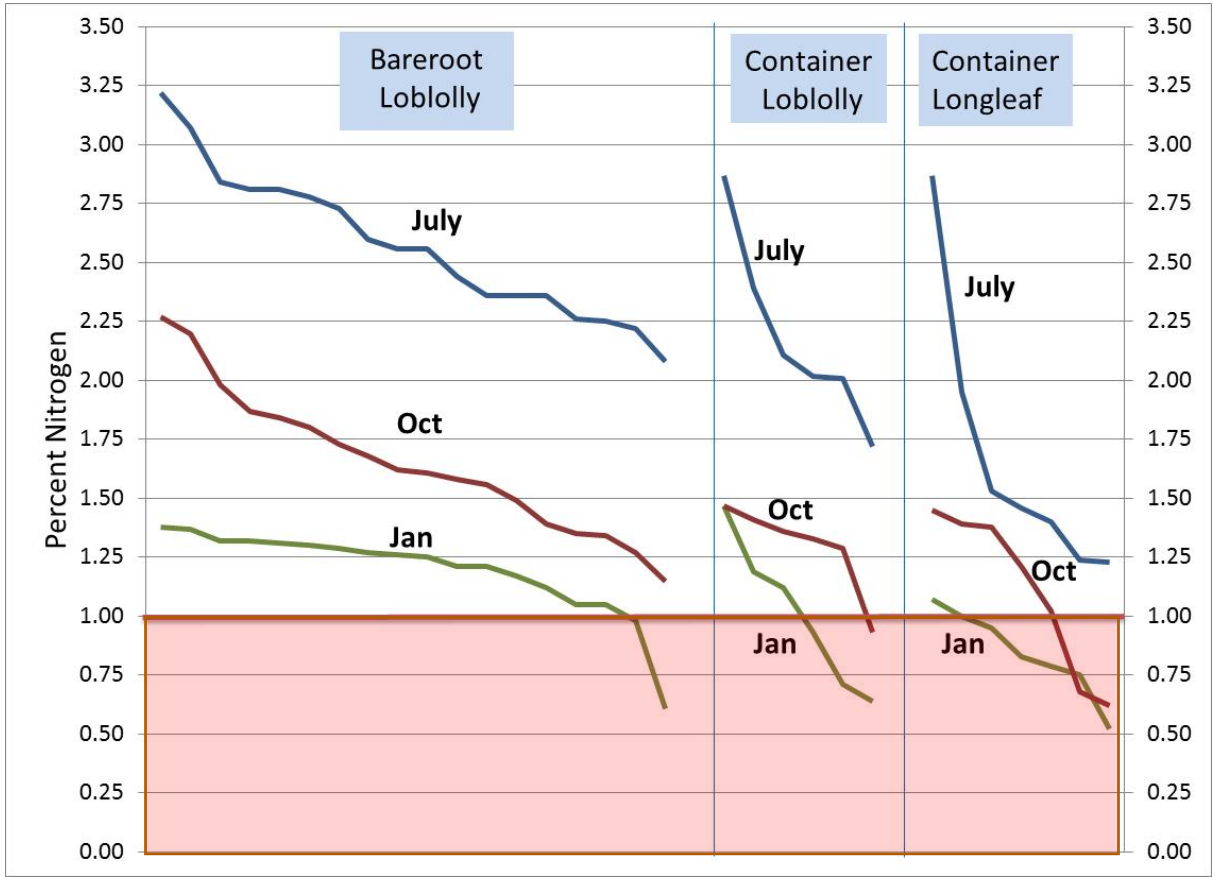
SOUTHERN FOREST NURSERY MANAGEMENT COOPERATIVE

# 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?

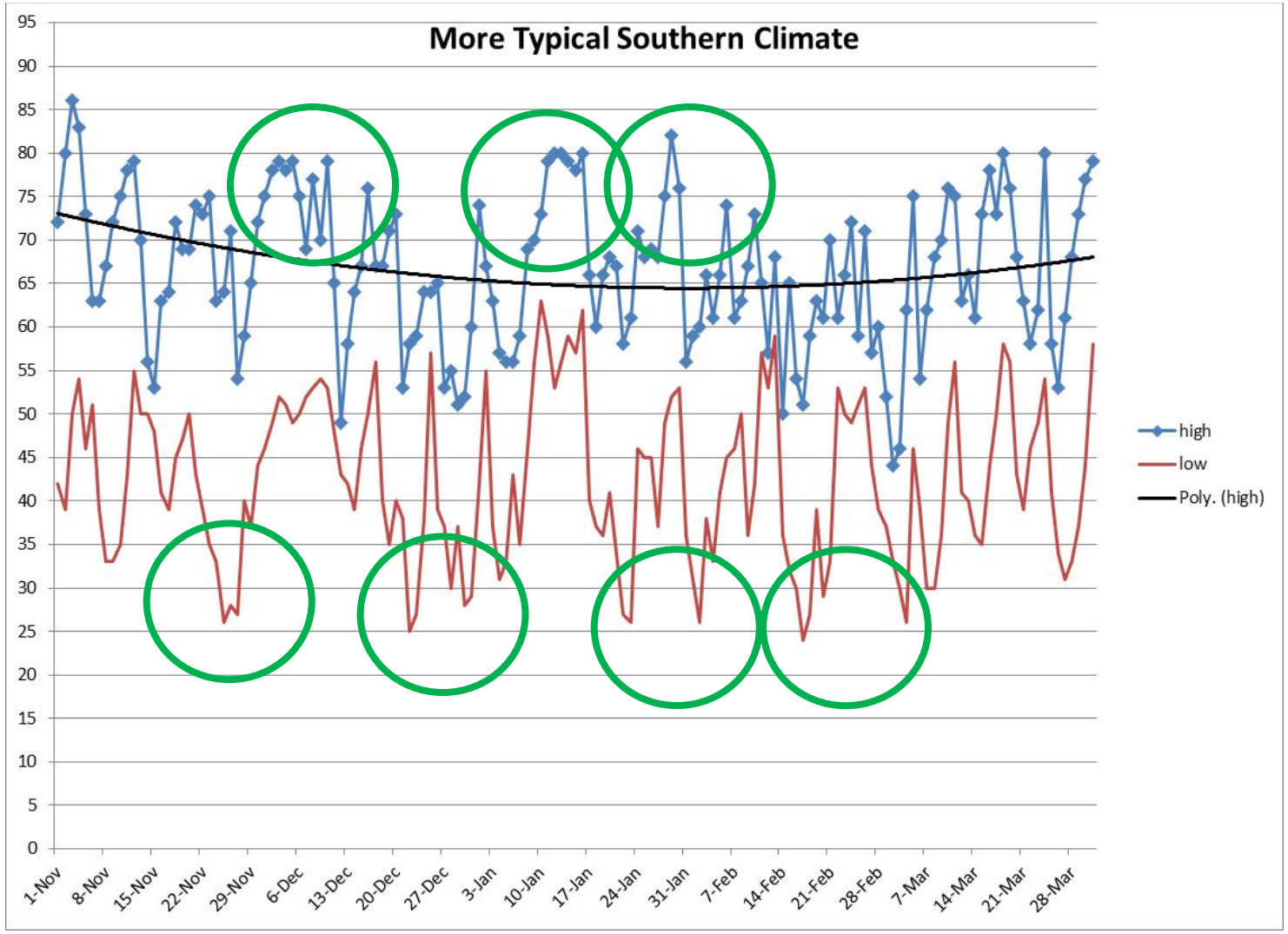
- Bareroot and container nurseries  manage seedling growth during the growing season so they reach their target size  at the beginning of the shipping season.
- Prior to and after this target size is achieved. Fertilization is normally reduced or totally stopped.
- Therefore. seedlings shipped early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




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

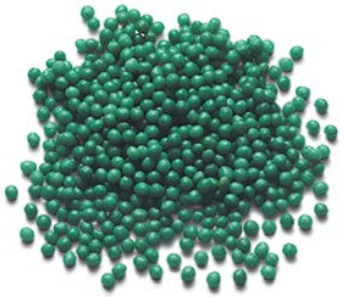
# What have been the limitations to fall fertilization?

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



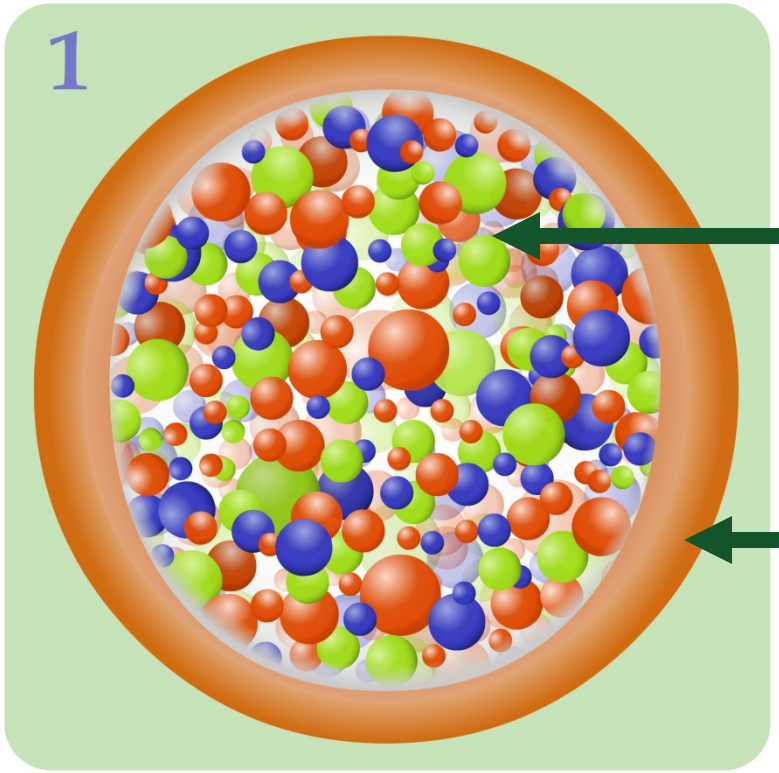
# Controlled Release Fertilizer (CRF)

- 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

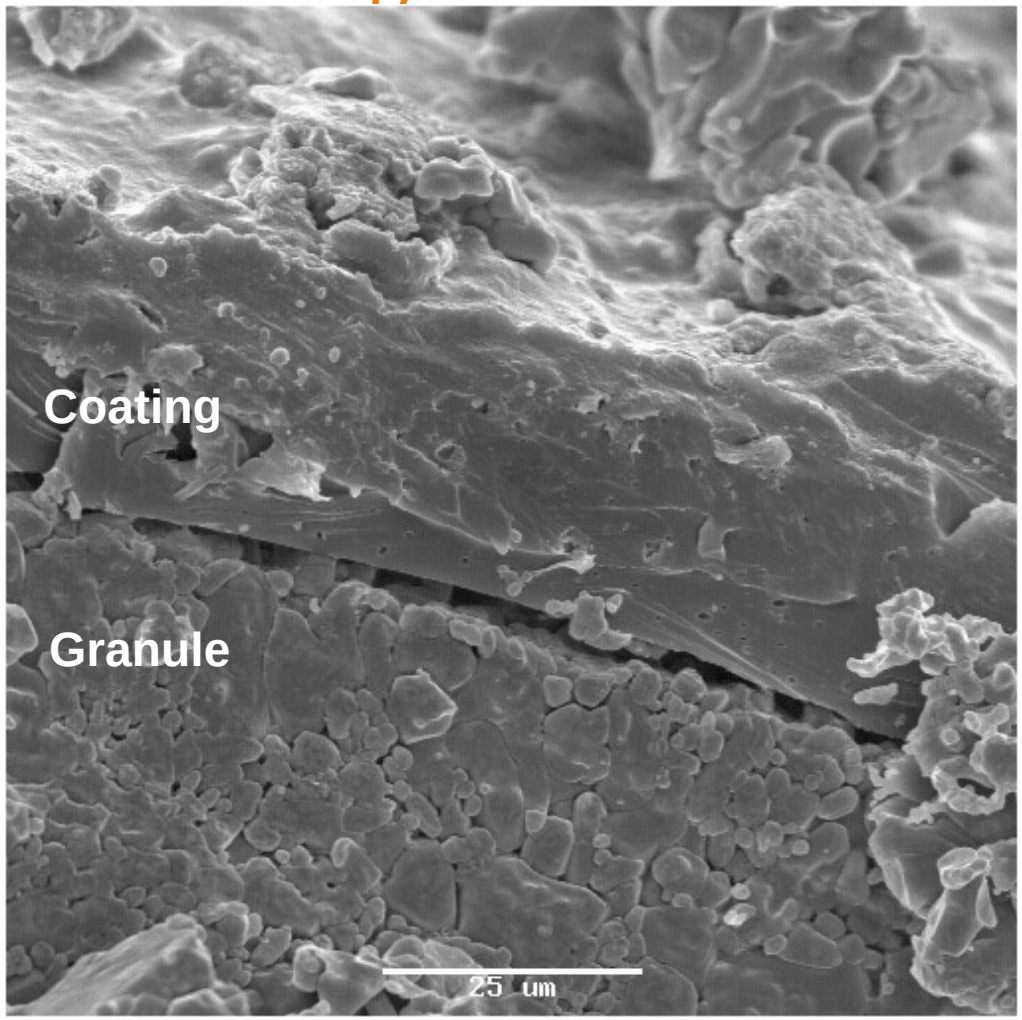
UREA
NPK
NPK+Micros




Core:
Soluble nutrients

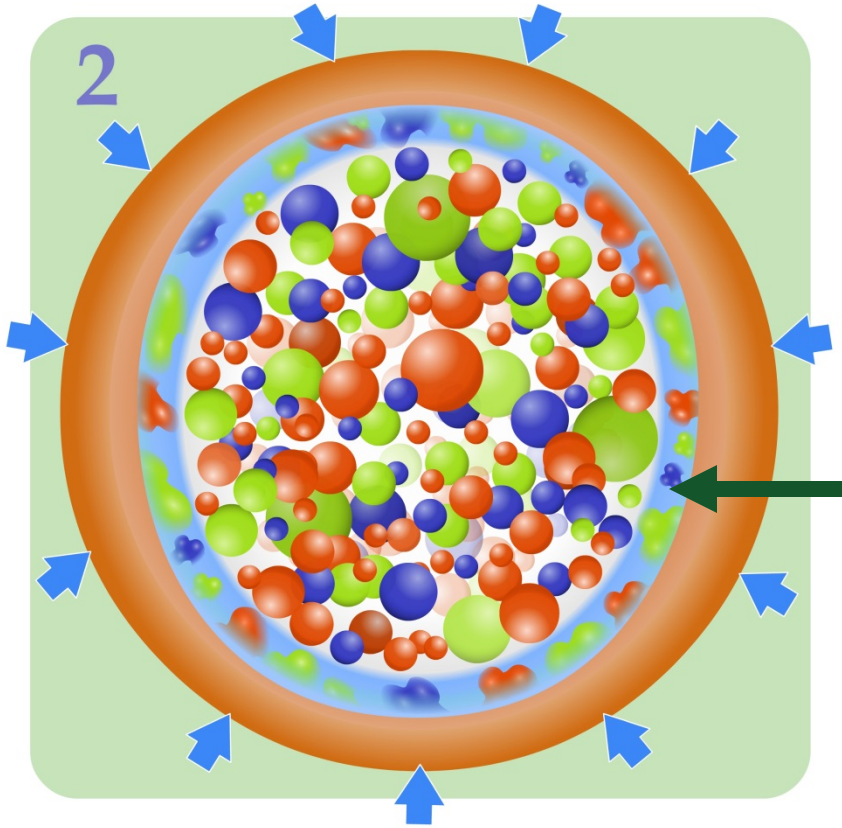
Shell:
Polymer coating

# Multicote® Technology




Scanning Electron Microscope picture of NPK granule

# Multicote® Technology

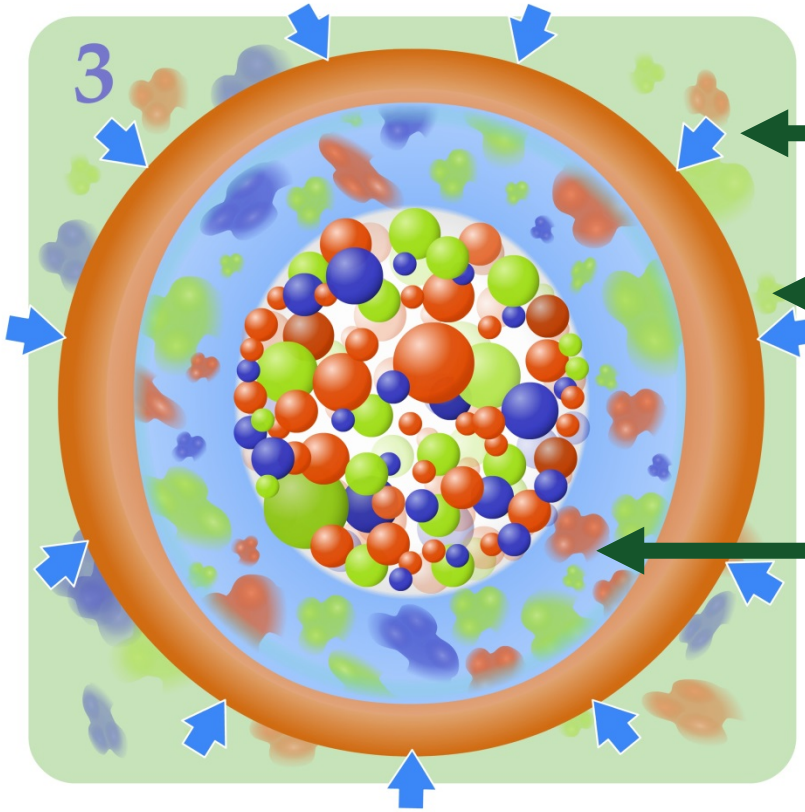



<u>After application in the soil:</u>

Water penetration

Gradual dissolution of the nutrients

# Multicote® Technology



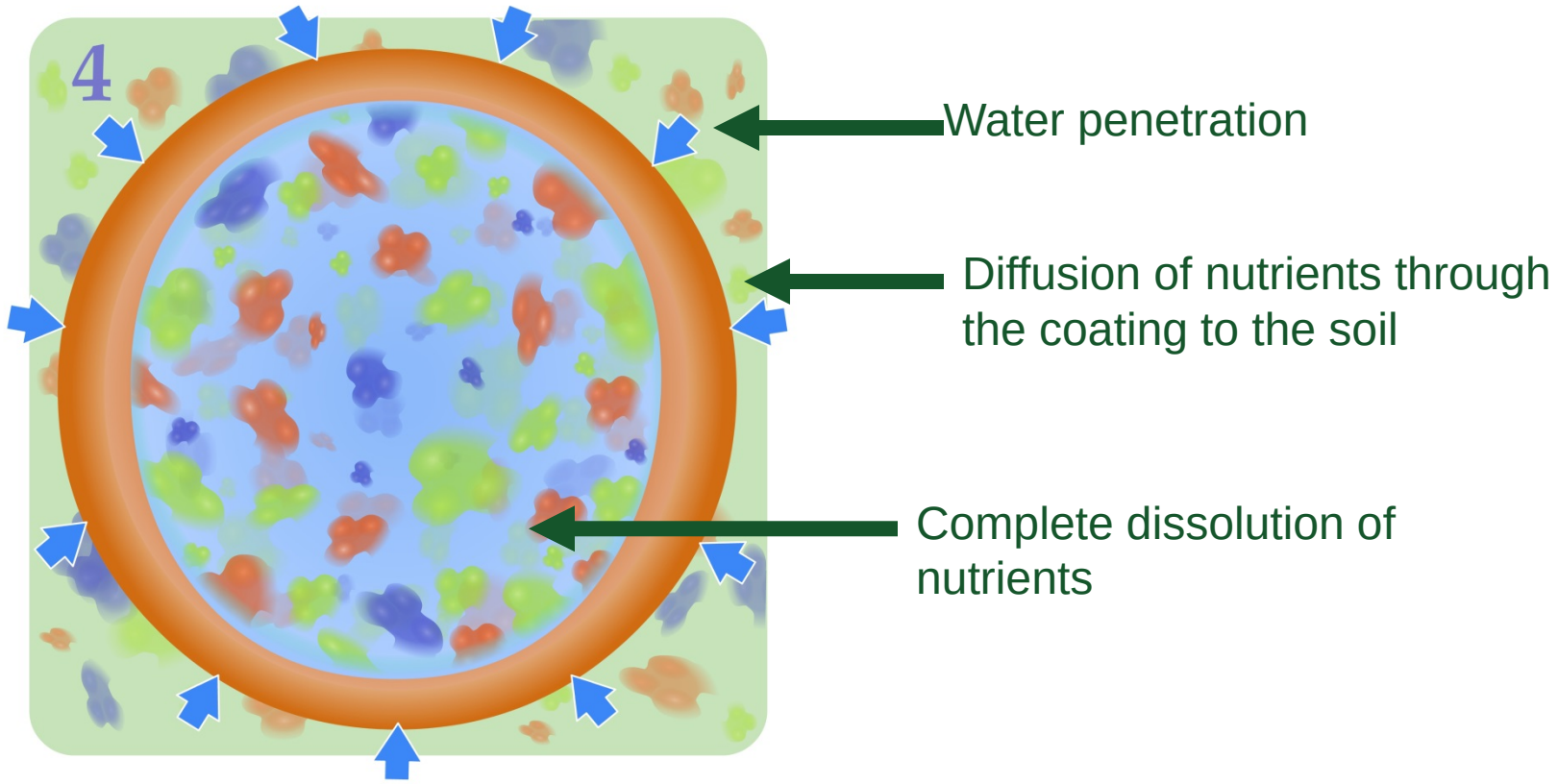

Water penetration

Diffusion of nutrients through the coating to the soil

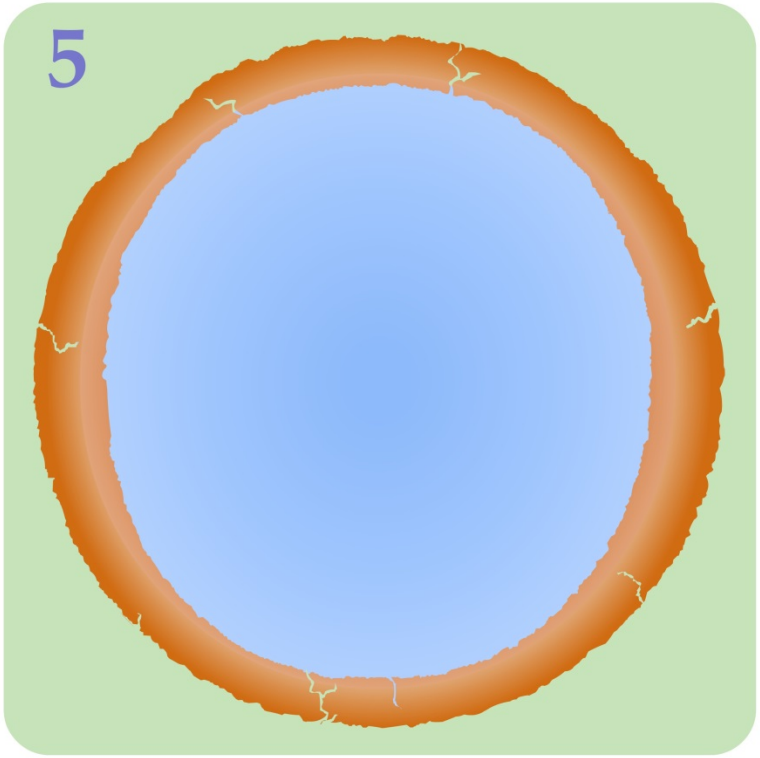
Further dissolution of nutrients

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



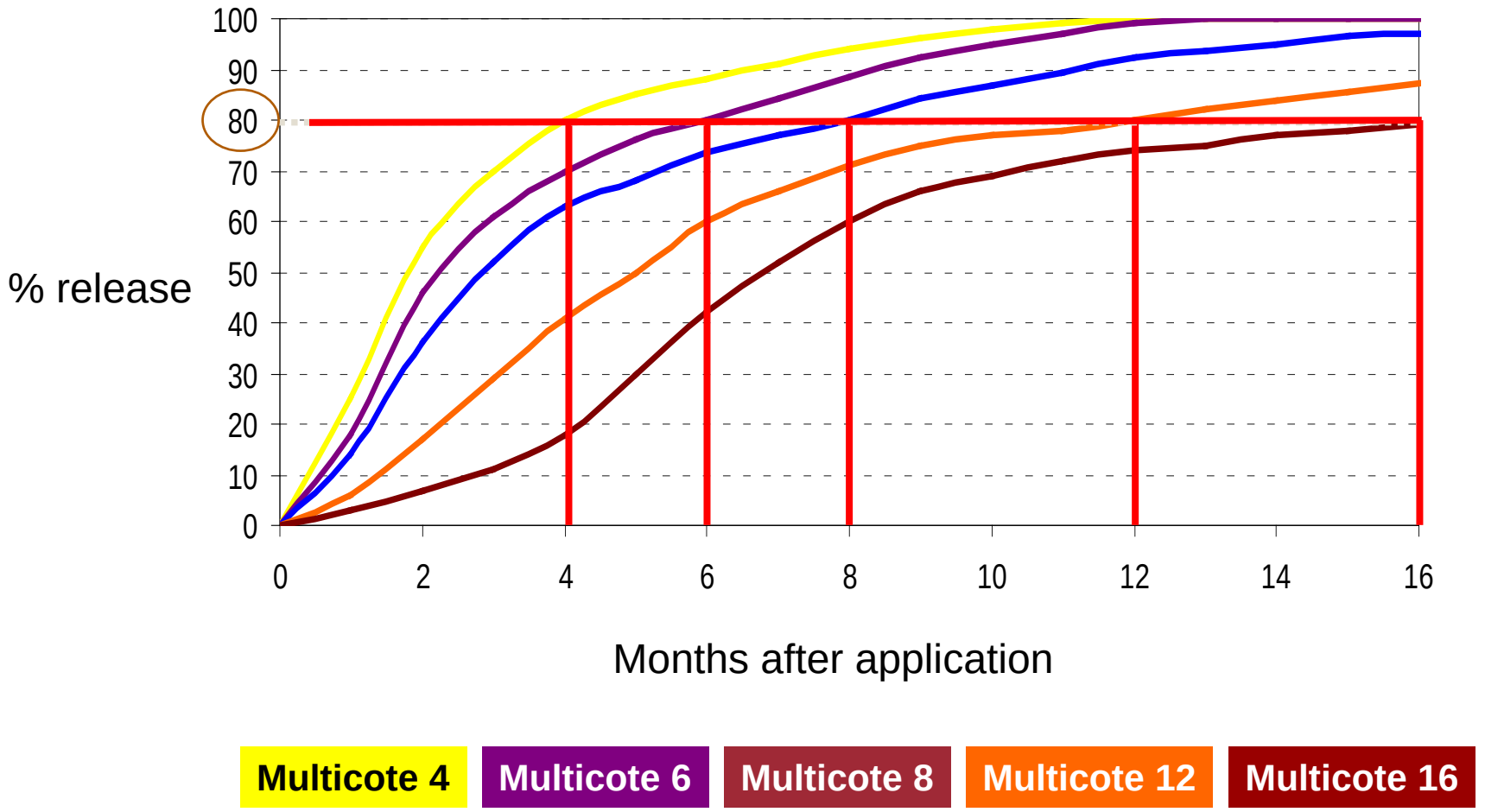
# Multicote® Technology




- 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

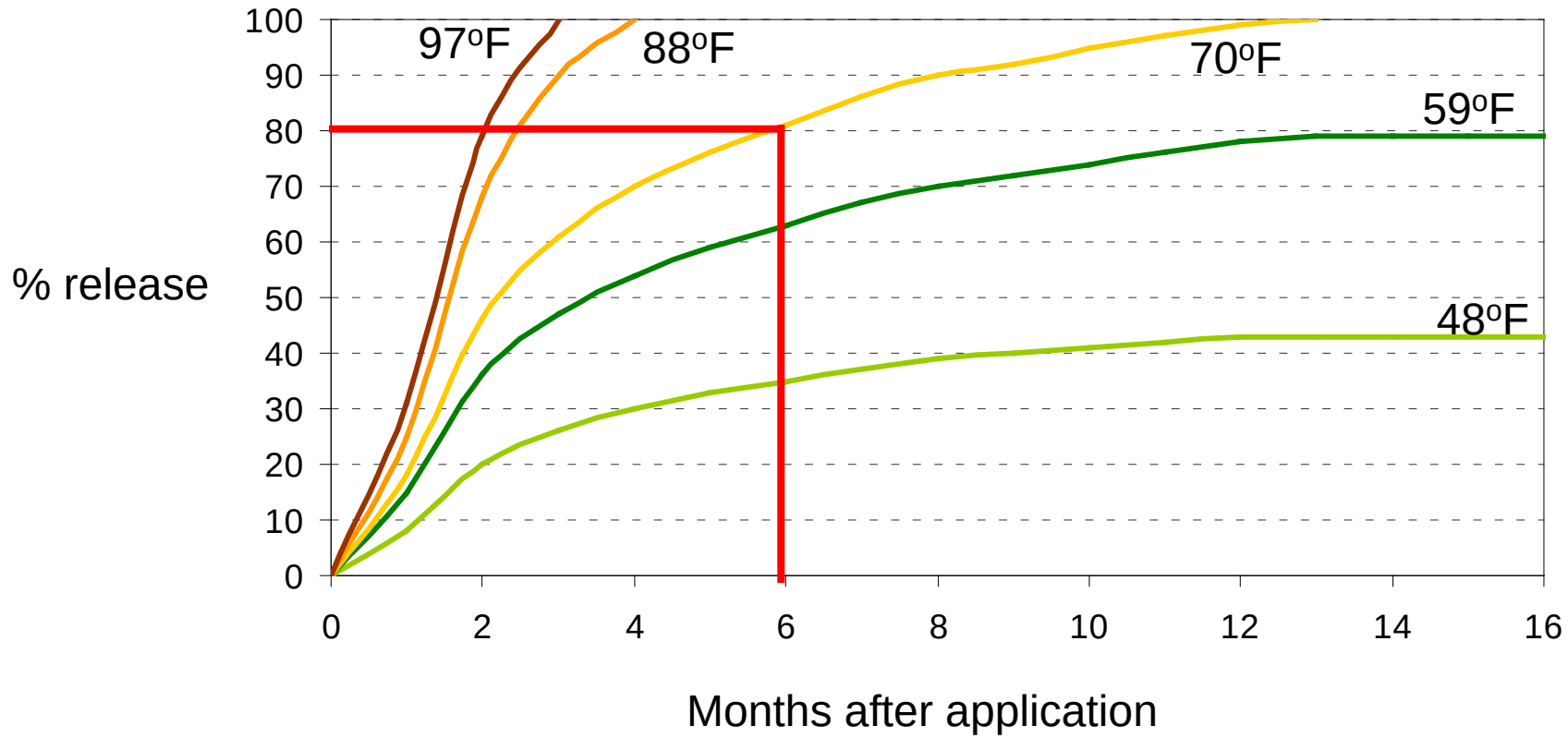
After the release is complete. the coating will degrade gradually. leaving no residues in the soil.

# Longevity

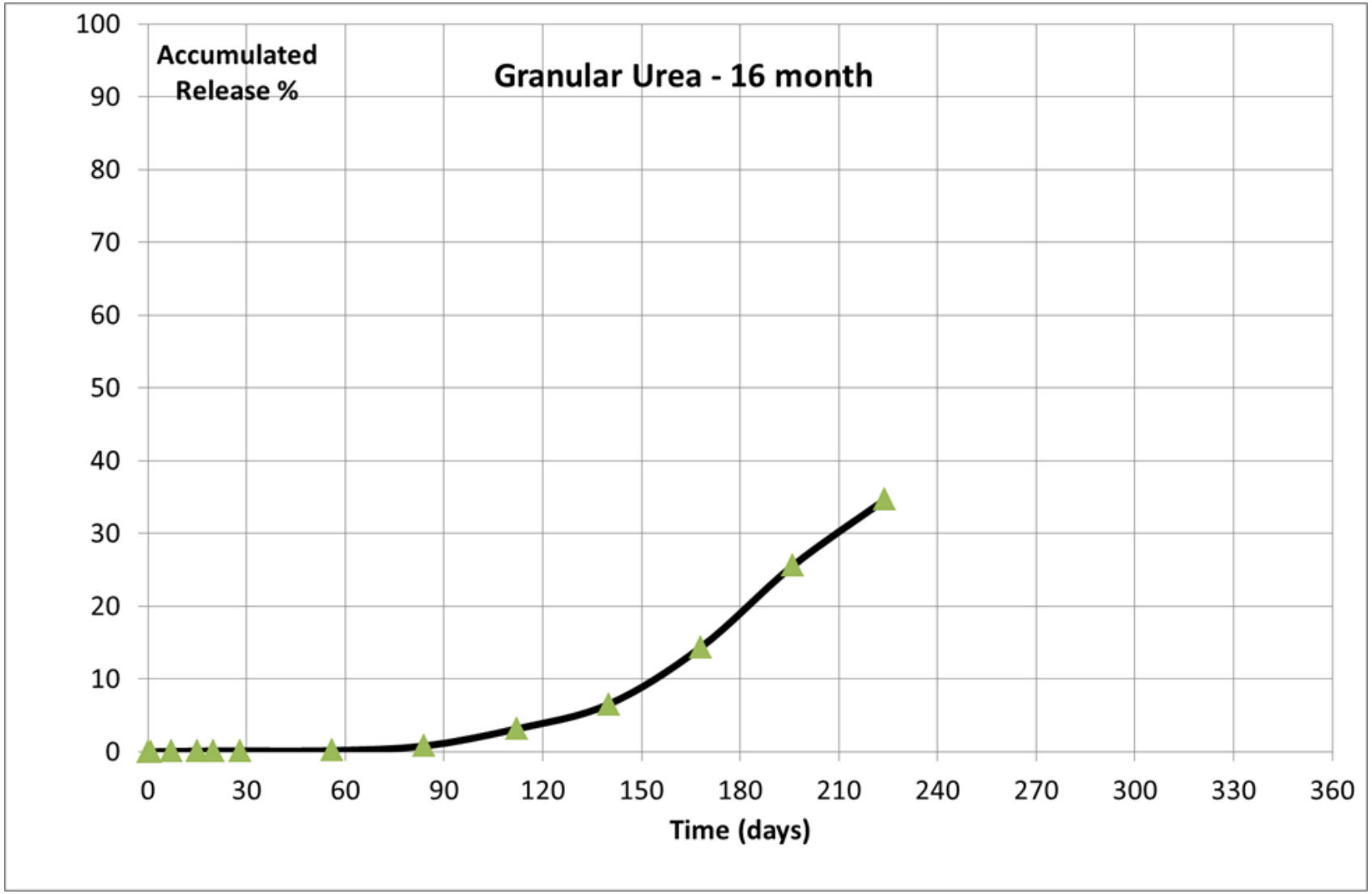

% release
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
Months after application
Multicote 4
Multicote 6
Multicote 8
Multicote 12
Multicote 16

# Multicote® Technology

## Release rate. longevity & temperature (6M product)



# Multicote® 16m Coated Urea (40-0-0)

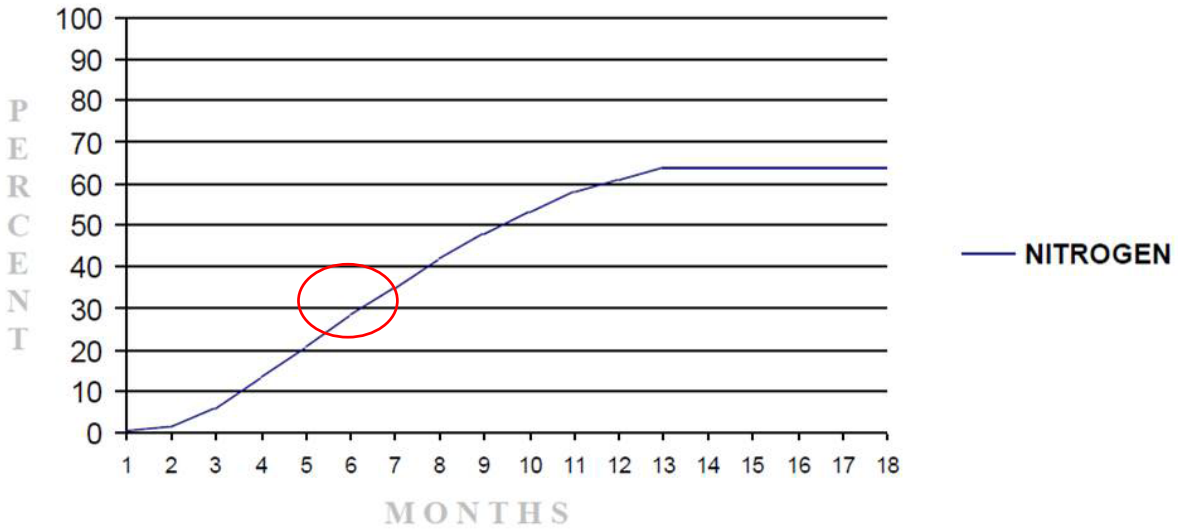


# Polyon® 16-5-11 (NPK only)

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

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

**Cumulative Release of Nutrients (%) by Month**




6 month – Oct – est 30% release

**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% |

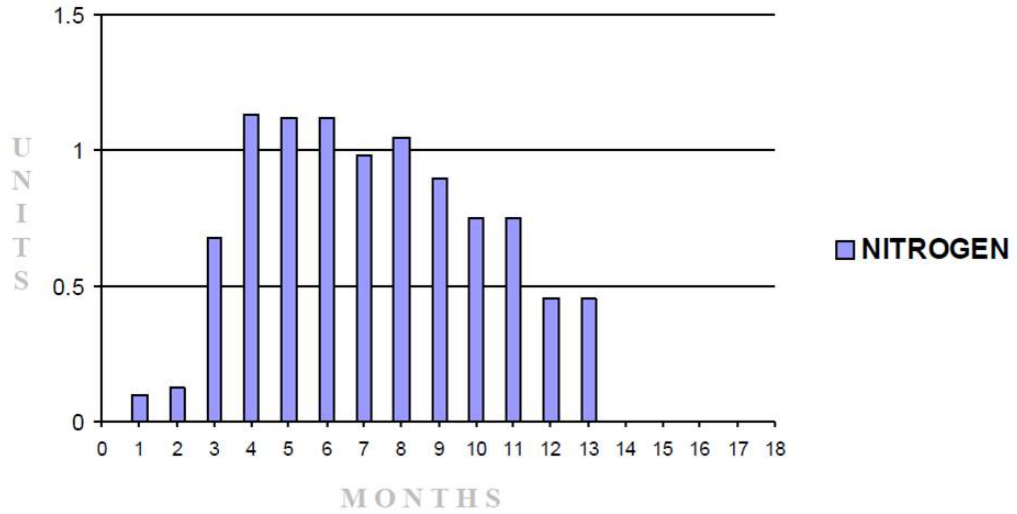
Derived From: Polymer Coated Ammonium Nitrate, Polymer Coated Ammonium Phosphate, Polymer Coated Potassium Sulfate

* 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

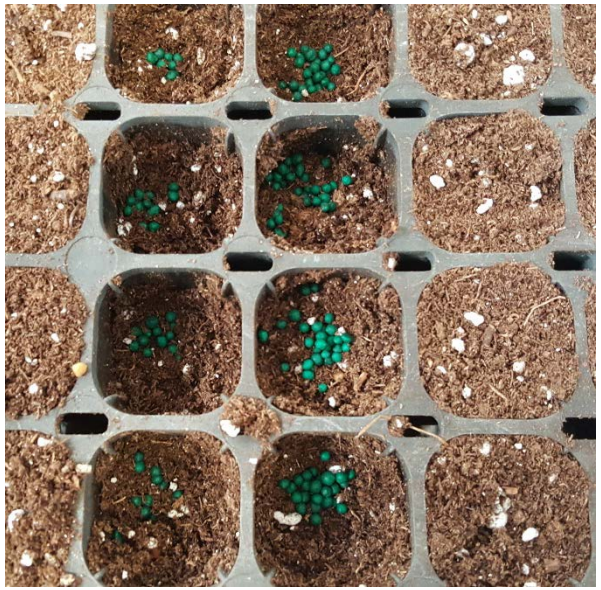
**Actual Units of Nutrients Released by Month**



# Southern Forest Nursery Management Cooperative trials

# Two Trials

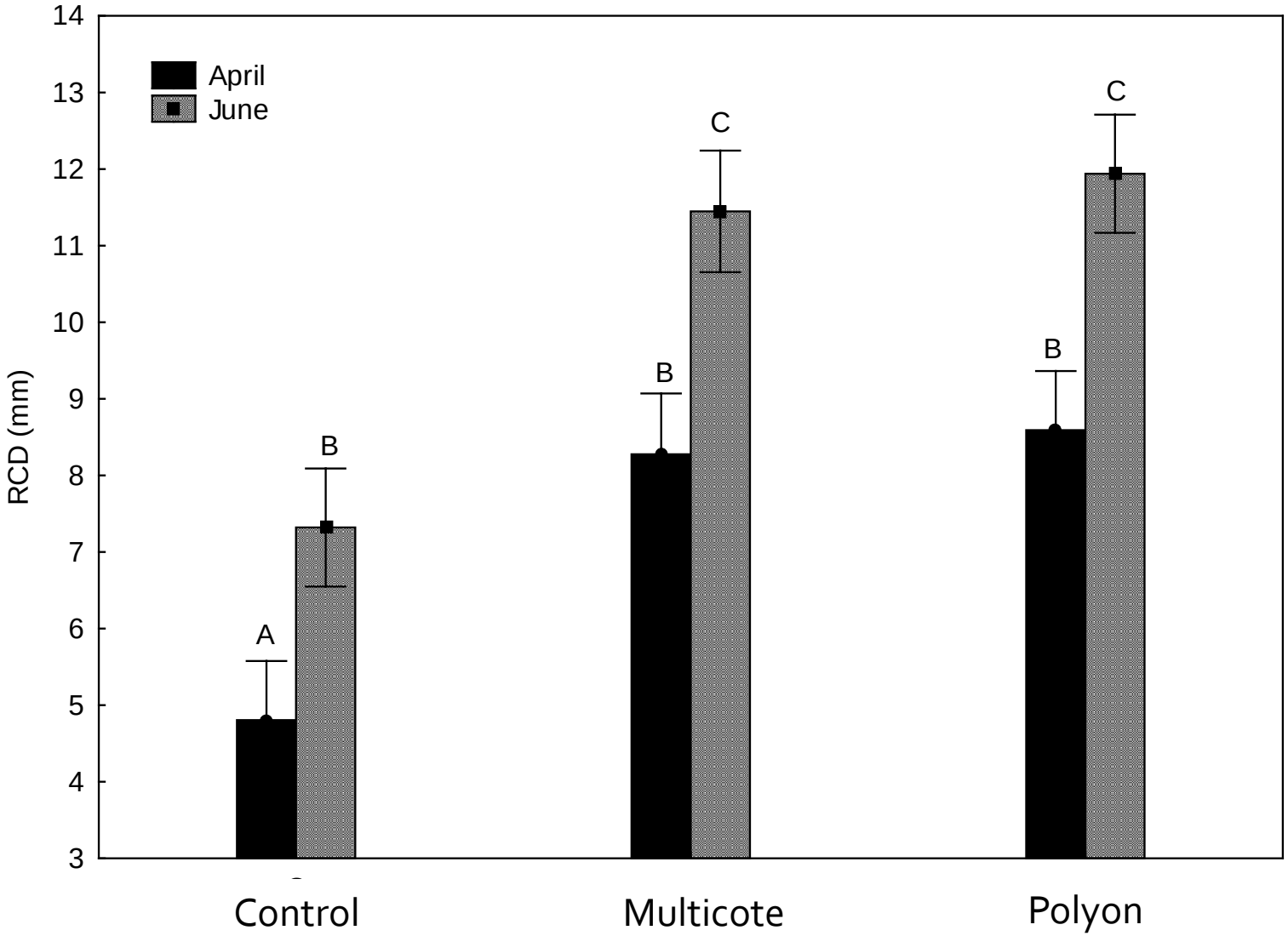
1. Involved three nurseries mixing CRF fertilizer with their standard media mix at rate of 8 lb/cu yd  and hand filled container sets. At the end of the growing season seedlings were provided for outplanting, seedling quality evaluations in addition to foliar and media nutrient analyses undertaken
2. 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.



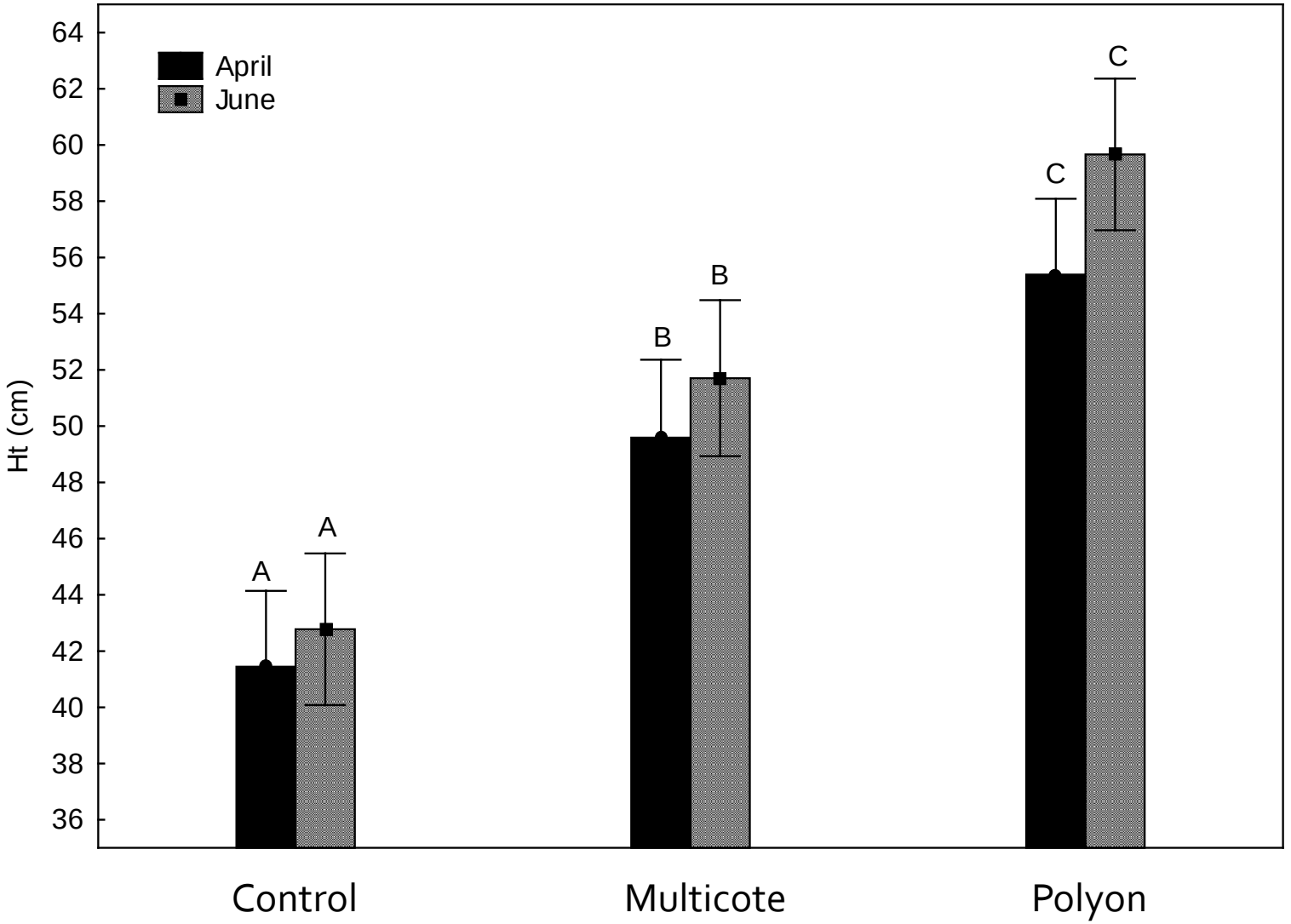
# Trial 1

| | 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 )

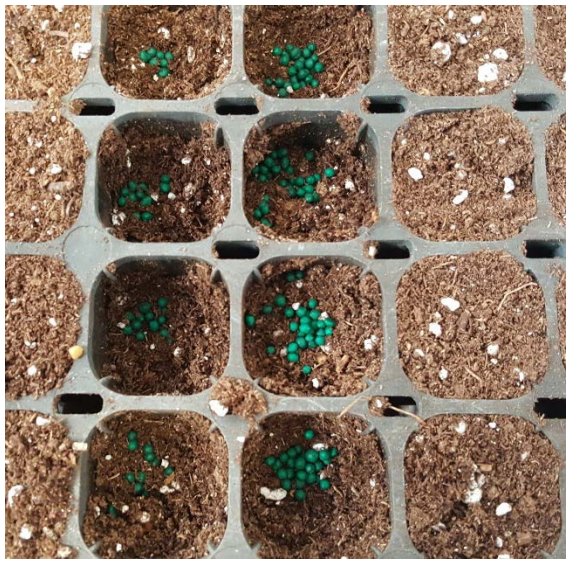
For nursery 3, prior to longleaf outplanting, the Polyon/ Multicote treatments were  visually not different from that of the nursery fertilization controls. 6 months following site establishment Polyon/ Multicote treatments show better growth

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 to be 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