Development of Alternative and Sustainable Substrates for Container Nursery Crops

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James Owen, Jr., Oregon State Univ.

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Pine and Douglas fir bark

- Primary component of nursery crops in U.S.
  - 60% to 80% of substrate
- Excellent substrate
- Used for many years
  - Research
  - Grower knowledge

Pine and Douglas fir bark

- Decreasing availability, increasing price
  - More bark diverted for fuel in mills
  - Less forestry activity
- Energy Independence Security Act of 2007
  - Goal of 36 billion gal. ethanol by 2022
  - Pres. Obama elevated goal to 60 billion gal. by 2030
  - Wood, from southern pine, is viewed as the most likely source of ethanol.

Substrate sources

- Waste materials are no longer ‘waste’
- Competition for industrial and agricultural waste products.
- “No more free carbon”
  - Dr. Will Britton

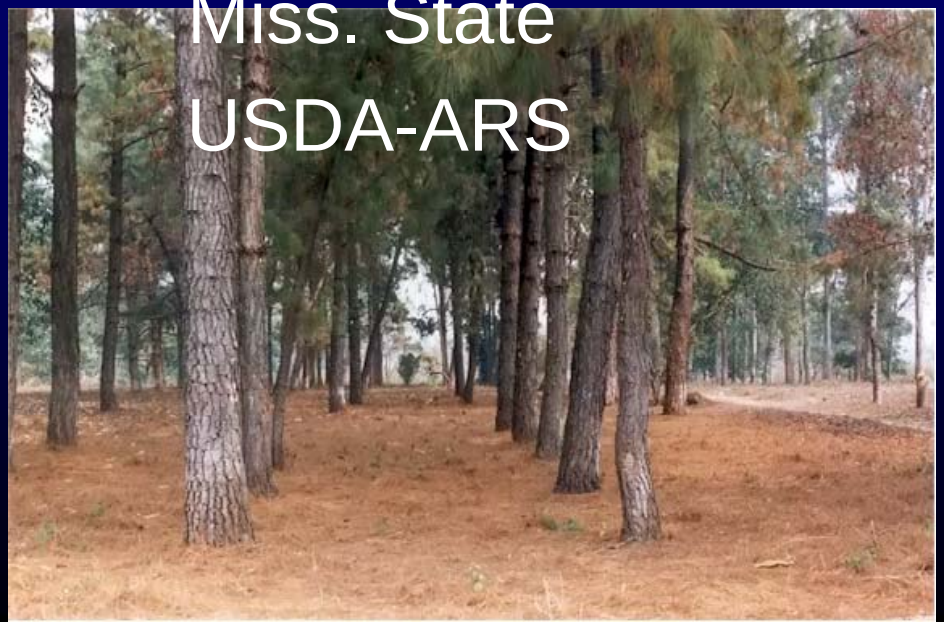
Substrate team

- James Altland
  - Agronomic biomass crops
  - Chemical and physical properties
  - N dynamics
- James Owen
  - Woody biomass
  - Water, nutrient use efficiency
- Cheryl Boyer
  - Invasive weed biomass
- Charles Gilliam
  - Pine biomass
- Glenn Fain
  - Floriculture




Substrate team

- Others
  - Robert Wright — VA Tech.
  - Brian Jackson — NC State
  - Ted Bilderback — NC State
  - Eugene Blythe — Miss. State
  - Anthony Witcher — USDA-ARS

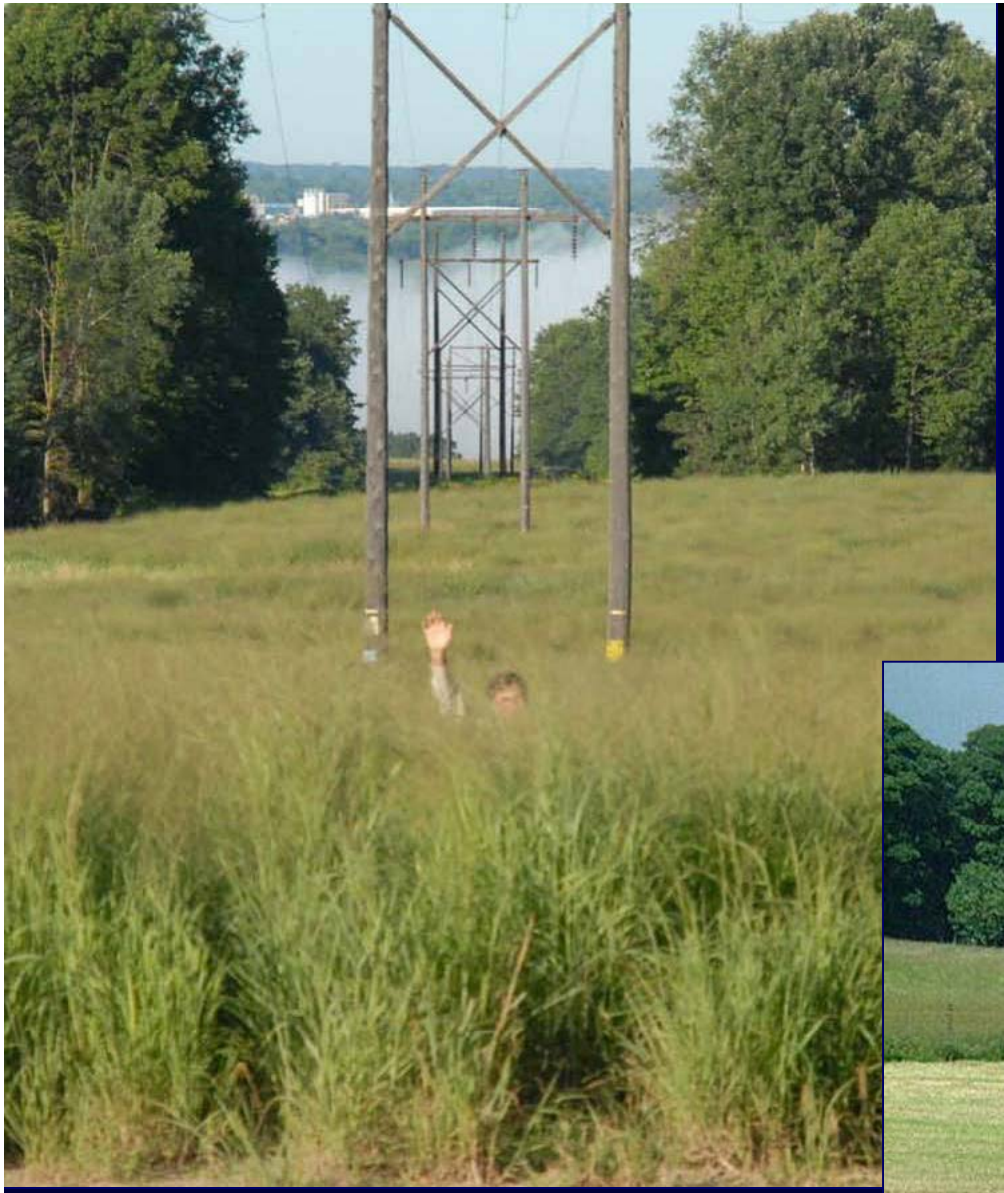


New substrate

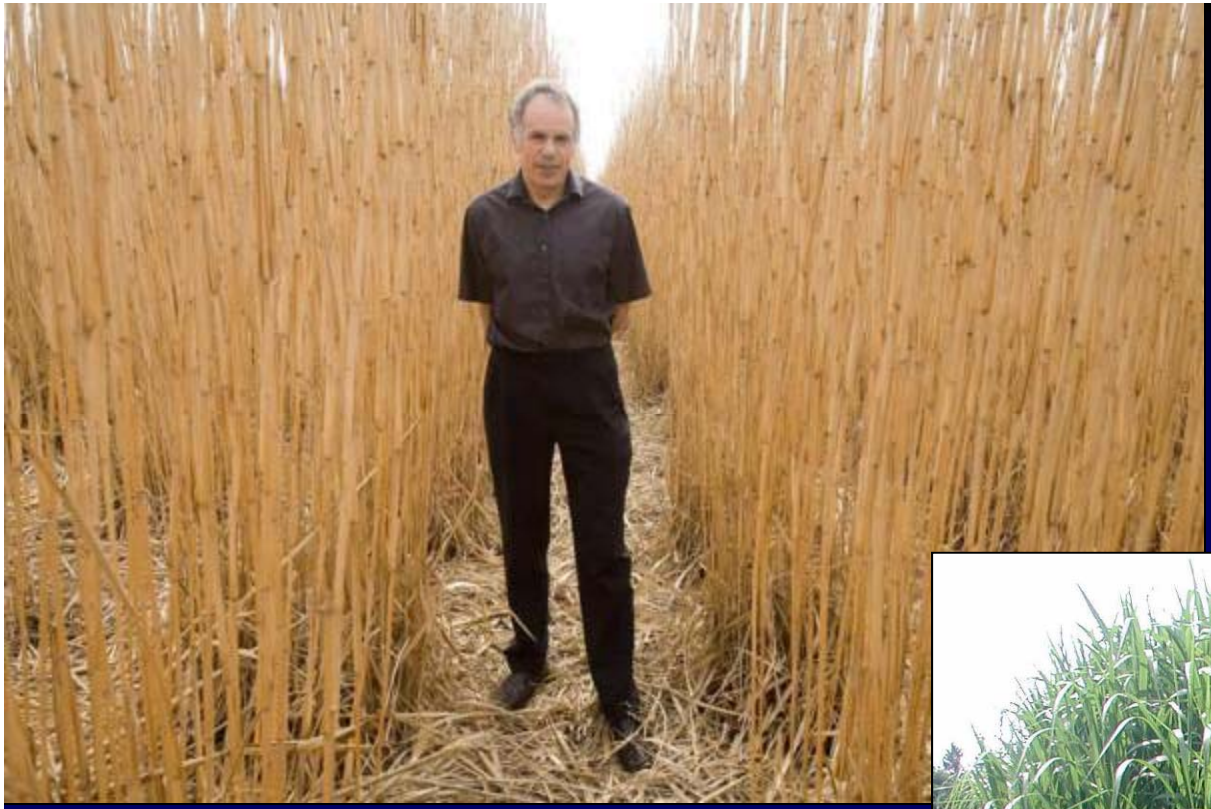
- Regionally abundant/available
- Affordable
- Effective
- Manageable with current technology
- Inventory is controlled by nursery producer.

Source materials

- Biomass or biofuel crops
- Harvestable invasive weeds
- Forest biomass



- Switchgrass (*Panicum virgatum*)
- Native perennial grass.
- Technical resources.
- 2 to 6 ton/acre
- $4 to $6 per yd^3



Giant miscanthus

Sterile hybrid

10 to 15 ton/acre

Not as widely grown…yet

Bamboo (*Phyllostachys*)

- Grows in Ohio
  - grows better further south
- Yield is unknown
- Trials just started
- Invasive?
- Gregarious flowering

Eastern red cedar

- *Juniperus virginiana*
- Native to eastern seaboard
- Prairie fires kept ERC at bay in the past.
- Now a nuisance species that has become invasive.
- Control only by fire or manual removal.

Willow

- Biofuel crop in NY.
- 5 to 10 ton/acre/year
- 3 year rotation cycle
- Technical resources.

Pine based alternatives

- Various wood products have been researched in the Southeast
  - Clean Chip Residual
  - WoodGro®
  - WholeTree™

Courtesy of C. Boyer

Overall approach

- Identification of raw materials
- Processing raw material into usable substrate
- Short-term evaluations
- Long-term evaluations

Progress to date

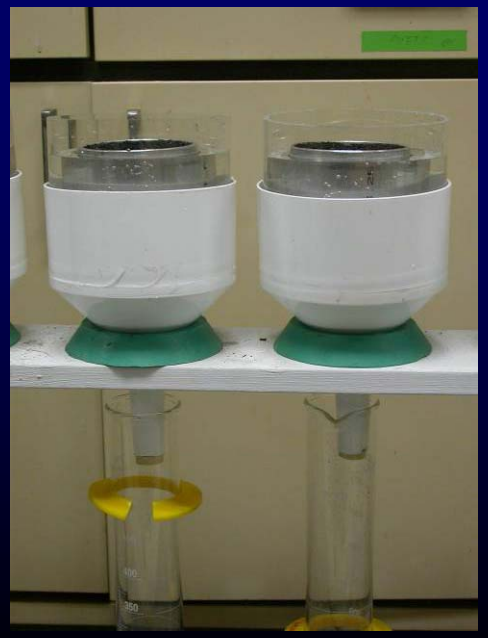
- Many short-term trials:
  - Effect of processing on physical properties
  - pH dynamics
  - Ca, Mg, and Fe nutrition
  - Weed control
  - Water use efficiency
  - Si availability
  - Susceptibility to pathogens
  - N dynamics
- Long-term trials
  - Change in physical properties over time

Physical properties

- Air space, container capacity, bulk density
- Matric and hydraulic properties

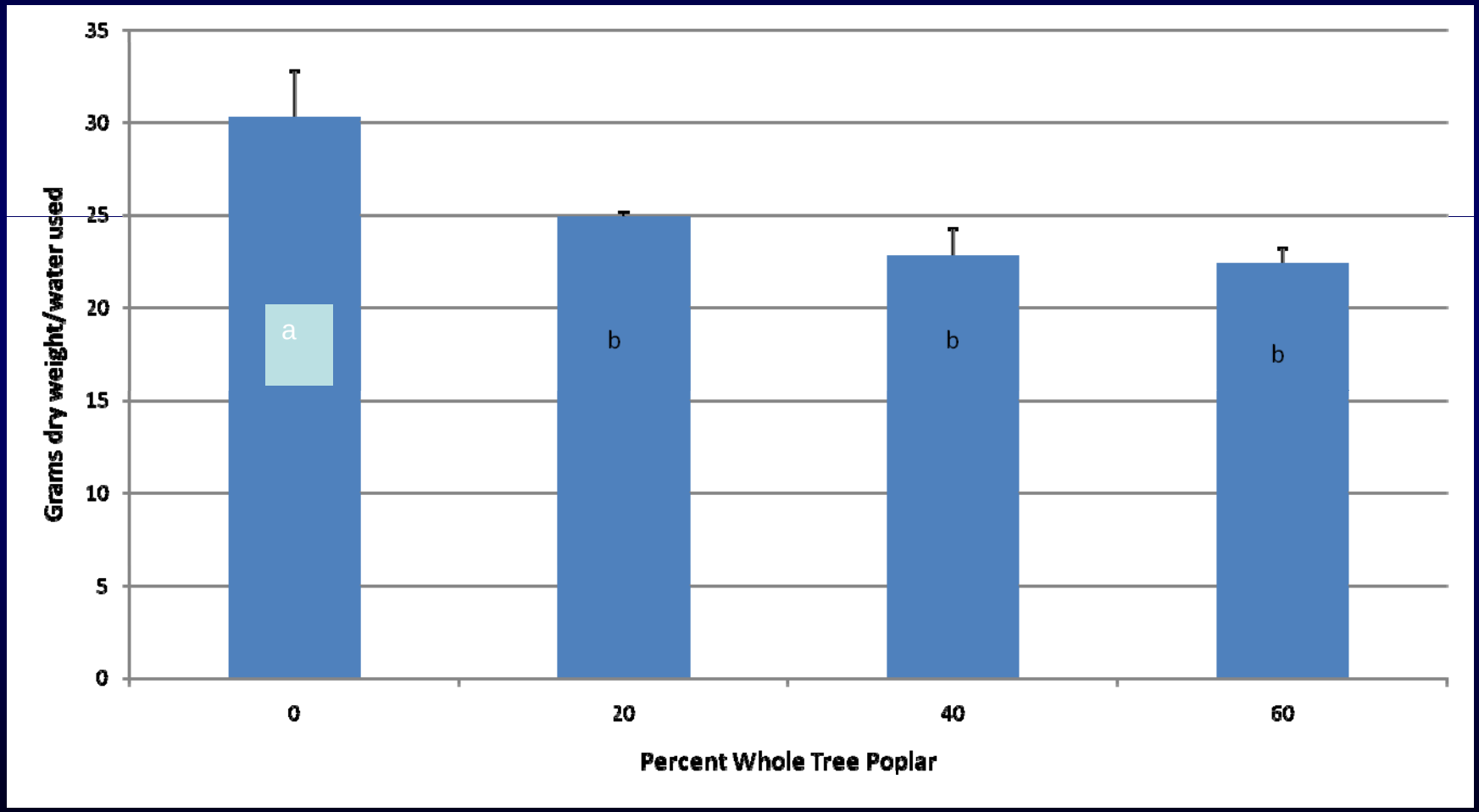
- Chipped materials
  - Coarse (0.25 to 1.5 in)
  - Filler

- Hammermill
  - Particle size distribution similar to pine bark
  - Requires only small levels of amendment



Owen et al., unpublished

Water Use Efficiency in Cotoneaster



Plant growth

- Broad spectrum of plant species
  - Unique substrate requirements
- Difficult to provide a substrate ‘recipe’
- Substrate empirical properties
  - Allows substrate tailoring.

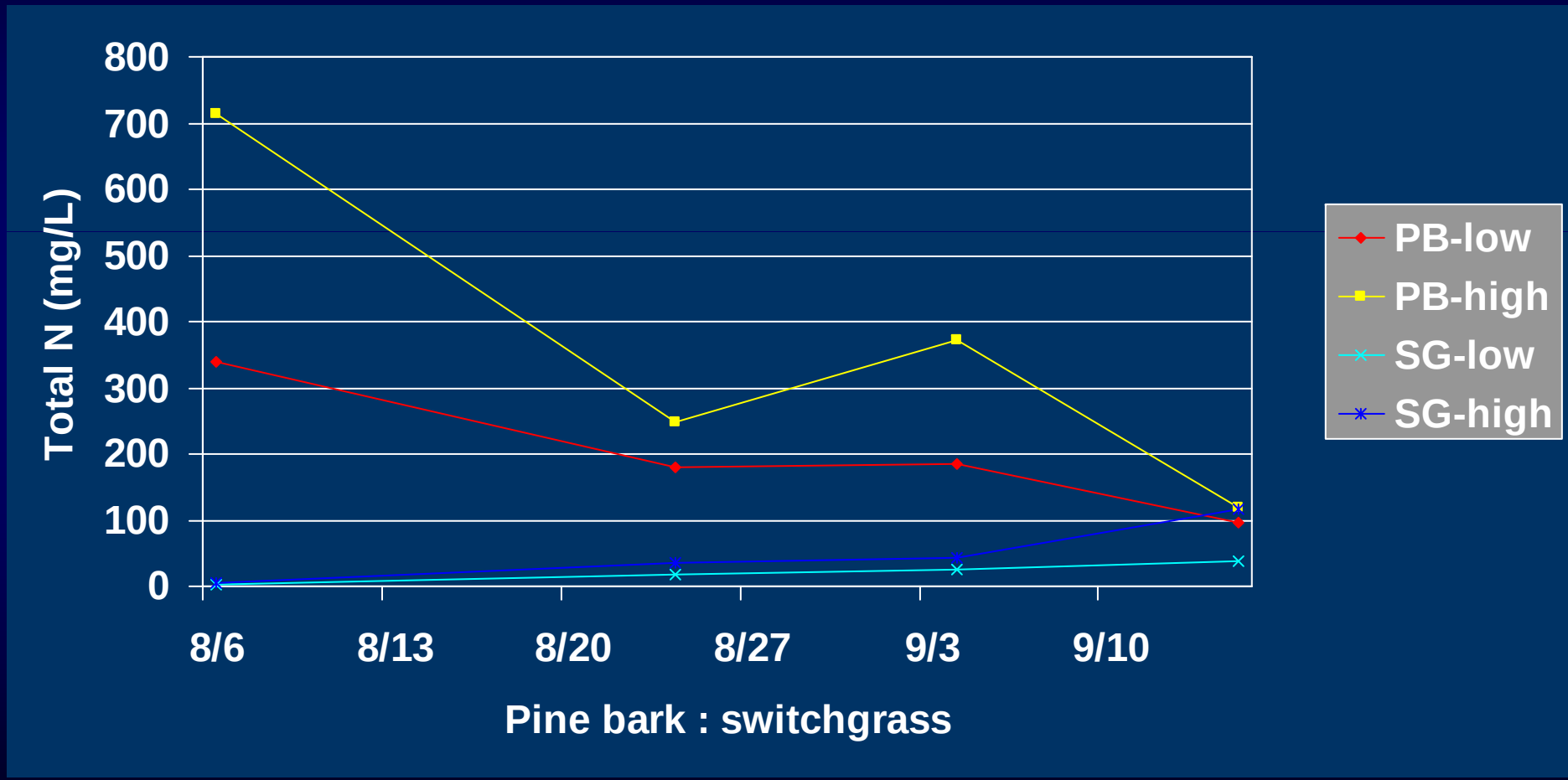

Low fertilizer
High fertilizer
0% C
5% C
10% C
20% C
40% C
80% C
0% C
5% C
10% C
20% C
40% C
80% C


Baldcypress 2009
C=Cedar
all have 20% sand
Remainder is Bark
Low fertilizer
High fertilizer
0% C
5% C
10% C
20% C
40% C
80% C
0% C
5% C
10% C
20% C
40% C
80% C

Nitrogen

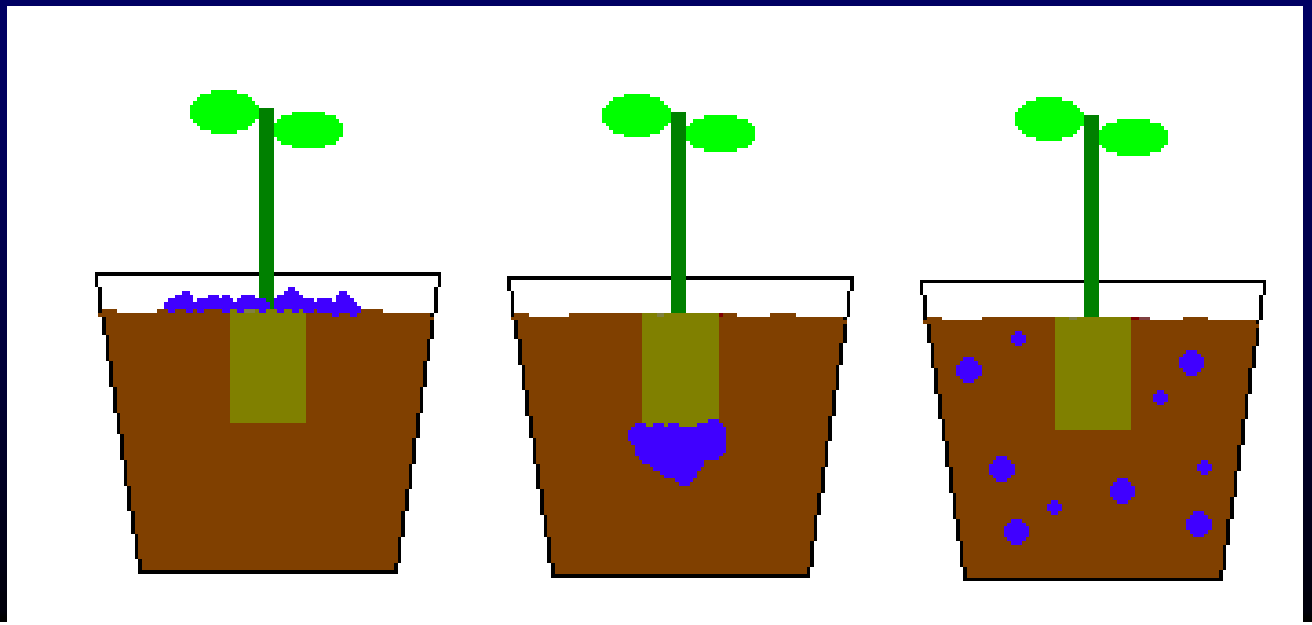
- N dynamics in switchgrass substrates differ from pine bark.
- Develop N application methods to capitalize on differences.

Nitrogen leaching from PB or SG substrates



Cultural practices - fertilization

- Fertilizer placement affects weed growth.
  - Topdress
  - Dibble
  - Incorporate



Summary

- Variety of materials and concepts are being developed.
- Will focus on 2 or 3 concepts next year.
- Still evaluating long-term stability of these materials.

Challenges of industry driven research

- Desire for immediate results
- Desire to jump in head first with new ideas
- Don’t mess with my recipe!

Advantages of industry driven research

- Great source for ideas
- Provide perspective
- Increase our chances for adoption

Questions

- Funded by
  - Floriculture and Nursery Research Initiative
  - Horticulture Research Institute