Silvicultural Methods to Increase Survival and Growth of Planted Riparian and Wetland Woody Vegetation

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Why Restore Wetlands and Riparian Areas?

- Created and restored wetlands and riparian areas are used to offset permitted activities authorized by Section 404/401 of Clean Water Act and various State statutes.
- Afforestation of old field agricultural areas and marginal areas historically have a very poor success rate due to low woody stem survival rates.
- Success of forested and scrub-shrub compensatory sites have been documented to be as low as 27% due to woody stem mortality.
- Ecosystem services provided by these areas include greenhouse gas storage, nitrogen and phosphorus sequestration, sediment storage, and wildlife habitat.

Common Causes of Restoration Failure

Failure of restored wetland and riparian areas, most commonly associated with low survival rates, may be caused by a variety of factors, including:

1. Poor species selection
2. Compacted soils
3. Incorrect hydrology (excessive wetness)
4. Low soil organic matter
5. Lack of microtopographic relief
6. Predation

Study Background

- Compensatory mitigation is clearly defined and required by Federal and State regulatory agencies in order to offset any permanent anthropogenic impacts to wetlands and stream buffers.
- The societal value of restoring forested buffers and wetland systems has been estimated to be between $30 and $425/acre/year
- Commercial forestry operations have been successful in harvesting and planting in marginal areas, such as wet mineral flats and bottomland hardwood areas of the southeastern United States.

Commercial Forestry Practices

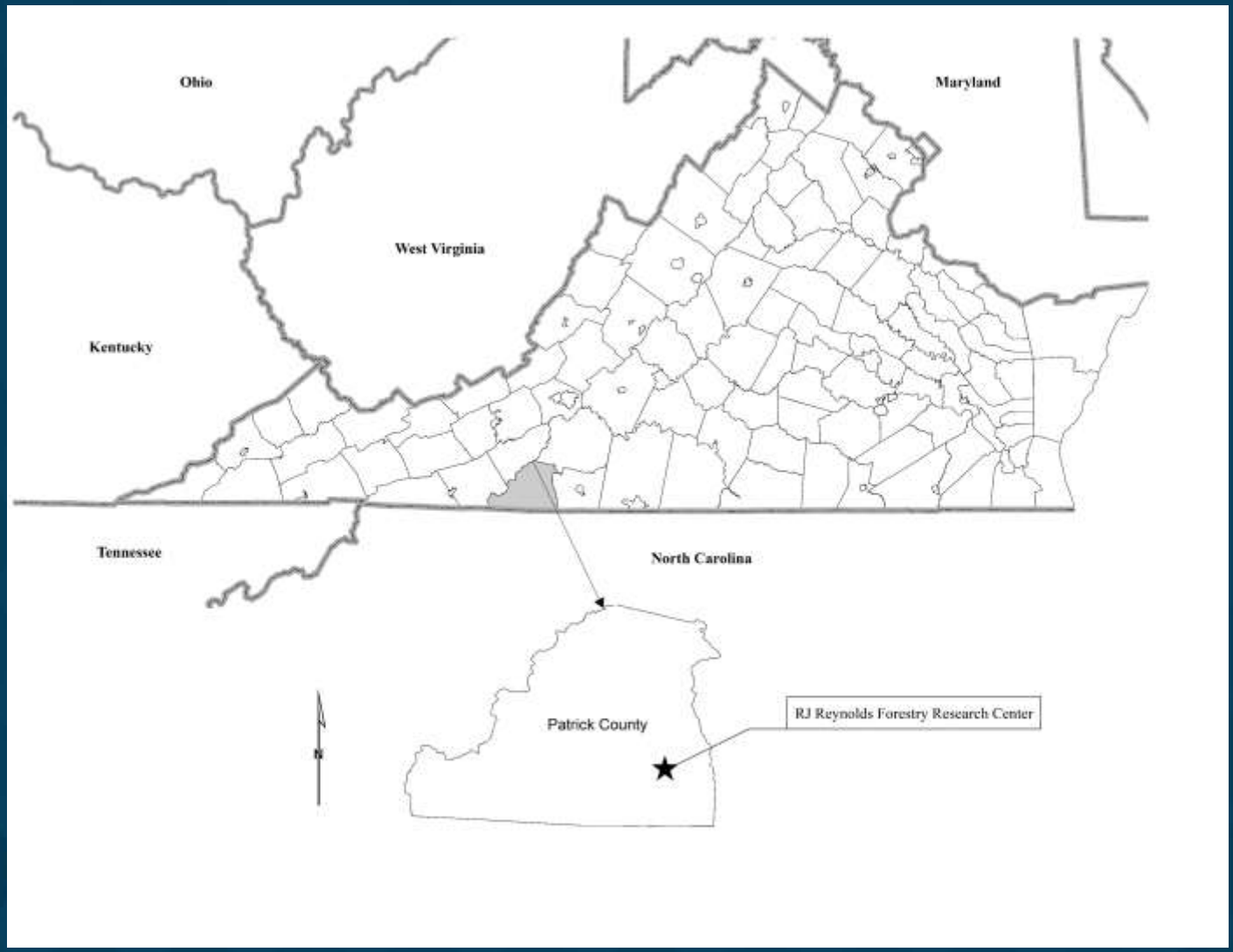
- The reduction of soil compaction, creation of site microtopography and competition control from undesirable species are the primary benefits of mechanical site preparation in forested wetlands.
- Commercial forestry operations traditionally use a variety of planting stock optimized for the specific site conditions. These options typically include direct seeding, bare root seedlings, tubelings, and containerized seedlings.
- Planting aids, such as tree tubes and planting mats, have been utilized to promote survival of seedlings by limiting competition with early successional herbaceous and woody species.

Research Objective

Evaluate the application of bottomland silvicultural techniques on the survival and growth of early successional and mid-successional hardwoods.

Study Location

- RJ Reynolds Homestead Forestry Research Extension Center
- Former tobacco plantation
- Excessive hydrology
- Compacted soils from intensive agricultural activities
- Poor microtopography



Project Site

- Located in the riparian area of second order unnamed tributary of Mill Creek
- Site soils are predominantly Braddock fine sandy loam (downstream section) and French loam (upstream section)
- French loam is a classified as hydric by NRCS

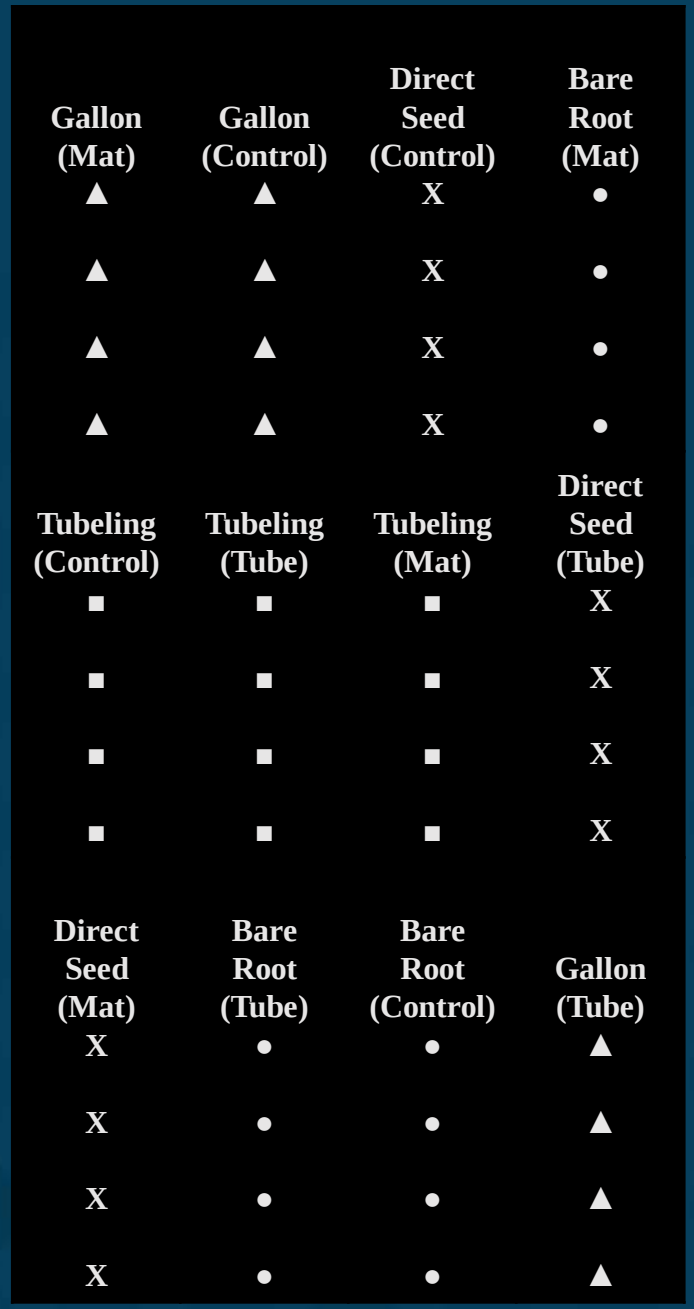
Project Location

Study Objectives

- Previous studies indicate that mechanical site preparation, type of planting sock, and use of planting aids may be beneficial to survival and growth of woody species planted in marginal old field settings.
- Evaluate the effects and interactions of five silvicultural mechanical site preparations, four common planting stock types, and three planting aids with the overall goal of improving survival and growth of planted woody species in Piedmont old field riparian areas.
  - Piedmont is an analog for a wide variety of areas due to historical practices, soil types, and erosion.
- Species
  - American sycamore (early successional)
  - Willow oak (mid-successional)

Study Design

- Randomized Complete Block Design with Split Plot (Box & Jones, 1992)
- 5 blocks
- 5 mechanical site preparation methods
- 4 planting stock types
- 3 planting aids
- 4 stems of each combination = 1 EU
- Plan allows for 1,200 stems for each species
- Analyzed using the Restricted Maximum Likelihood (REML) Method with Analysis of Variance to generate least square means
  - Allows for analysis of fixed and random (mixed) effects
- Least square means with multiple comparisons among means calculated using post hoc Tukey's HSD
  - $\alpha = 0.05$



Site Preparation Treatments

Disk

Rip

Bed

Pit and Mound*

Planting Stock Sources

Direct Seed

Bare Root

Gallon

Tubeling

Planting Aids

Tubex Tubes

None

Vispore Mats

Timeline

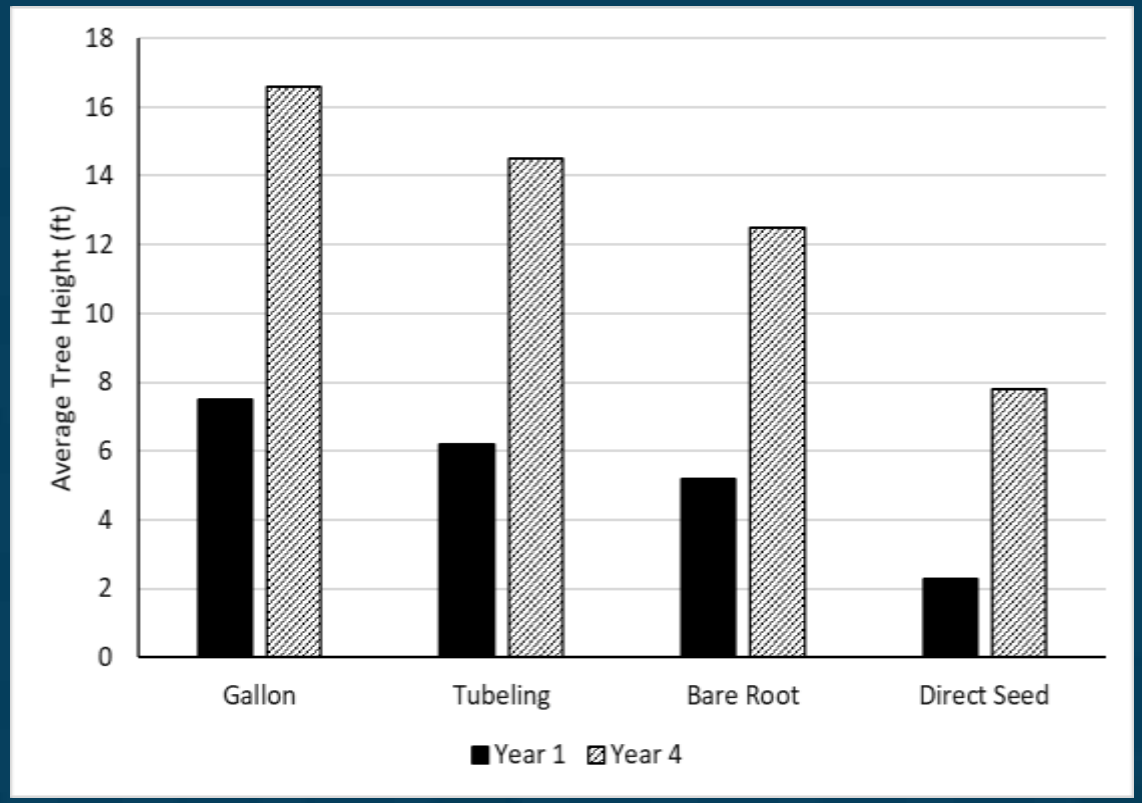
- Planting - May 2011
- Year 1 – 2012
- Year 2 – 2013
- Year 3 – 2014
- Year 4 - 2015

- Measurements
  - Survival (Yes/No)
  - Ground-line diameter
  - Total height
  - Diameter at Breast Height (dbh)

Results

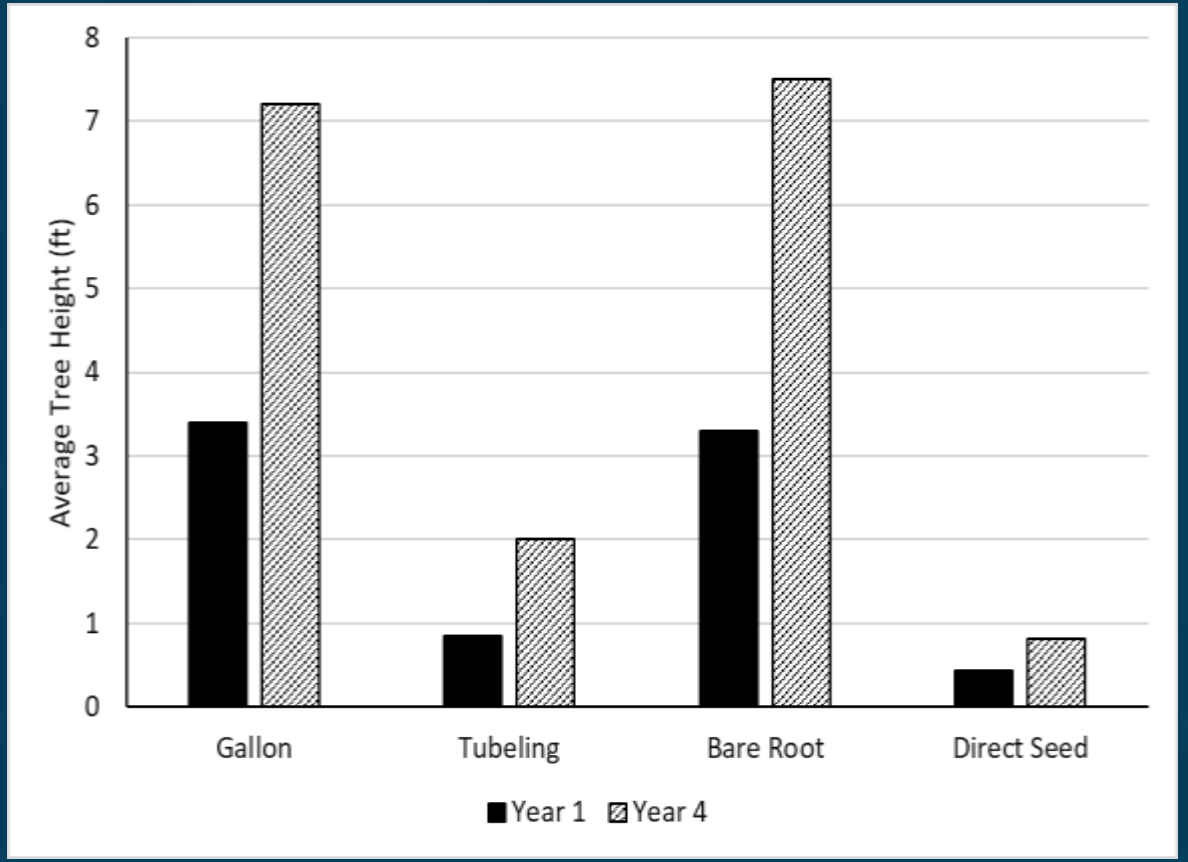
American Sycamore

- Interactions
  - Site prep and planting stock had significant interaction effect for survival only
  - Mounding and gallon had superior results, followed closely by mounding and tubeling.



Results (continued)

- Willow Oak
  - Planting Aids
    - Tubes had significantly greater survival 64%, although effect faded by year 3
    - Tube had greater heights for first two years
    - No differences between matting and no aid treatment




willow oak

Conclusions

- Site preparation increases survival
  - Mound >> Bed > Rip > Disk > Pit
- Planting stock has significant impact on survival and growth
  - Gallon >>> Tubeling >> Bare Root > Direct Seed
  - Gallon and tubeling the preferred stock for American sycamore
  - Gallon and bare root superior in willow oak, but **don't discount tubelings**
- Planting aids have a weak positive survival association for first two years
- A combination of site preparation and planting stock yields superior survival and growth results
  - Mound + Gallon and Tubeling superior in American sycamore
  - Mound + Gallon and Bare root superior in willow oak

Recommendations

- Match species to site conditions
- Consider your timeline
- Mechanical site preparation increases productivity potential, particularly mounding, bedding and ripping
- Larger planting stock reduces negative effects of site conditions
- Planting aids are marginally effective and may not have an economic return on investment beyond year 3

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Questions?