Chemical Application Definitions

- Pre-emergent – applications conducted before seedlings or weeds begin to grow (emerge or break dormancy) in the spring.
- Post-emergent – applications conducted after crop trees or weeds have emerged or broken dormancy
- Release – the removal of woody or herbaceous weed competition from developing young stands to improve their growth

Research Justification

Diameter Limit Harvesting Effects

- The practice of diameter limit harvesting (high-grading) leads to "impoverished" stand conditions
  - "Take the best, leave the rest!"
  - Favors low-valued, shade tolerant species
  - Loss of desirable parent seed stock
- Reduces potential management options

Research Justification

Diameter Limit Harvesting Effects

- This type of "poor" management is conducted on vast acreage of forestland across Tennessee
  - Noss and others (1995) proposed that high-quality oak/hickory stands are in decline across the southern and central Appalachian

Research Justification

- Renovation of High-Graded Stands (How?)
- Potentially most cost-effective application: the clearcut
  - Use of the clearcut method favors the establishment of desirable natural hardwood regeneration over uneven-aged methods (Clatterbuck et. Al. 1999; Ward and Stephens 1999; Jensen and Kabrick 2008)

Research Justification

- Even-aged methods including the clearcut and shelterwood method can regenerate between 10,000 – 40,000 seedlings per acre (Johnson and Krinard 1988; Romagosa and Robinson 2003)

Research Justification

- Natural regeneration has greater rate of growth compared to artificial regeneration
  - According to Jackson (2006), naturally regenerated oak seedlings have greater growth (94% for white oak; 228% for red oak) compared to planted oak seedlings 36 years after establishment
- Natural hardwood regeneration is economically superior compared to artificial regeneration

Research Justification

Pre-commercial Thinning

- Pre-commercial thinning can be applied 10 years after establishment to enhance tree diameter growth
  - What about an earlier release? Year one?
- Hilt and Dale (1987) concluded that higher levels of thinning intensity resulted in increased diameter growth for stands 13, 17 and 21 years of age

Research Justification

Chemical Seedling Release

- Release by herbicide applications can improve survival and growth in young hardwood stands
  - Chemical seedling release in planted hardwoods can improve early diameter and height growth (Zutter et al. 1987; Robinson et al. 2003)
  - Self and others (2008) found that seedling diameter growth was reduced following repeated and routine three year herbicide applications compared to pre-emergent and pre-emergent plus one time foliar release treatments

Research Justification

- Clatterbuck and Hodges (1988) suggested that chemical release will accelerate diameter growth and potentially shorten harvest rotation age
- Previous research by Gingrich (1967) found that quadratic mean stand diameter increases with reduced stocking levels

Research Justification

- Numerous research studies (Kennedy and others 1987; DeBell and Harrington 2002; Kennedy 1993) depict that greater average stand diameter increases with wider planting spacings

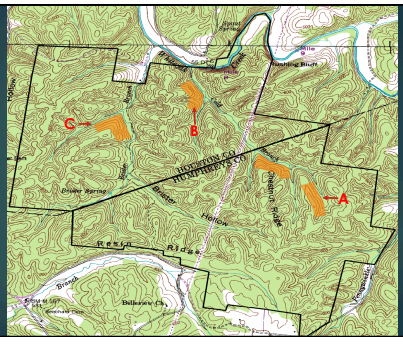
▶ *Clearcut implementation → natural regeneration + pre-commercial thinning/chemical release* = enhanced diameter growth in a future stand containing acceptable abundance of desirable species

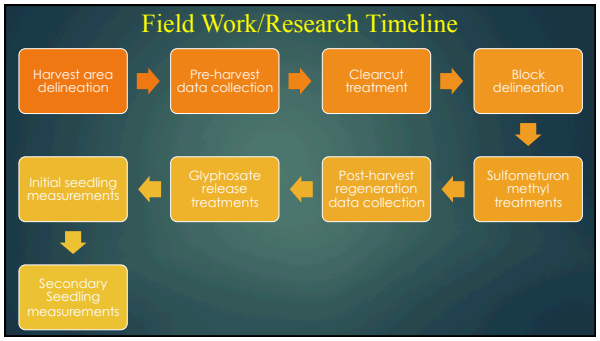
Questions:

1. Will the well-established natural regeneration (heavy component of shade tolerant species) dominate future stand composition after a clearcut?
2. Will herbicide release applications enhance natural regeneration growth?
3. Are these practices economical and applicable to "real world" situations?
4. Will this information benefit foresters and private landowners?

Objectives

1. Determine if implementing a silvicultural clearcut will promote adequate stocking of desirable species regeneration
2. Statistically validate that chemical plant competition control will improve diameter growth for released natural regeneration
3. Perform an economic analysis to determine if chemical treatments yield acceptable results to the common landowner




Field Work/Research Timeline
Harvest area delineation
Pre-harvest data collection
Clearcut treatment
Block delineation
Sulfometuron methyl treatments
Post-harvest regeneration data collection
Glyphosate release treatments
Initial seedling measurements
Secondary Seedling measurements


Harvest Area Delineation

Pre-Harvest Stand Data

- Fifteen 1/10-acre plots per block for quantifying merchantable timber (45 total)
- Each plot also contained a 1/100 acre regeneration plot
- Additional regeneration subplots on all odd numbered plots (50' – 45° azimuth)
- Plot centers had lat/long coordinates recorded

Pre-Harvest Stand Data

- Regeneration plot data included:
  - 1. Species
  - 2. Height classes
  - 3. Diameter classes

Clearcut Treatments

Clearcut method applied to Blocks at different times:

Block A - March of 2014

Block B - March/April of 2014

Block C - May of 2014

Block A Clearcut

Post – Harvest Regeneration Data

- Re-measurement of regeneration plots to evaluate response to clearcut
- Measurements include:
  - 1. Tree species
  - 2. New or resprout from advance regeneration

Post – Harvest Regeneration Data

Difficulties:

1. PVC pipe displacement

2. GPS coordinate discrephrancy

Remedial Actions:

1. Triangulate using stump paint (if available)

2. Rely on GPS coordinates

Research Block Layout

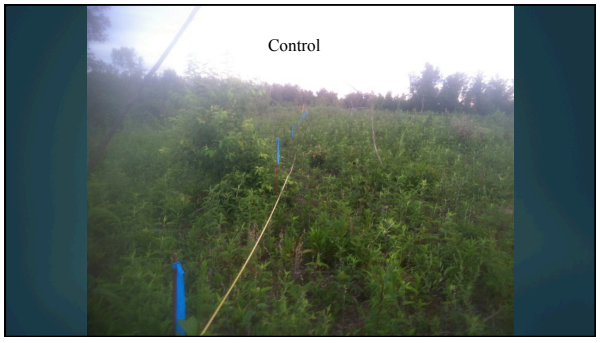
- Each block contains 6 treatment units
- Treatment Unit = ¾ Acre
- Blocks & individual treatment units measured with 100' tape/ loggers tape. Azimuth determined using hand compass
- Block dimensions = 155' x 210' (Block A) & 180' x 181' (B & C)

Research Block Layout

- Individual rows delineated with rebar and florescent flagging to categorize measured seedlings
- Alternate rows within banded units and had twine pulled to facilitate chemical applications
- Treatment units were installed in separate locations on blocks B & C due to incomplete timber harvest of marked area

Treatment Units

Radial Release	Banded Release + herbaceous control	Control + herbaceous control
Radial + herbaceous control	Banded Release	Control (clearcut only)



Herbaceous/Grass Control Herbicide Treatments

- SFM 75® herbicide (Sulfometuron methyl) by Alligare LLC
- Three units treated in each block:
  - 1. Control with herbaceous/grass control
  - 2. Radial release with herbaceous/grass control
  - 3. Banded spray with herbaceous/grass control

Herbaceous/Grass Control Herbicide Treatments

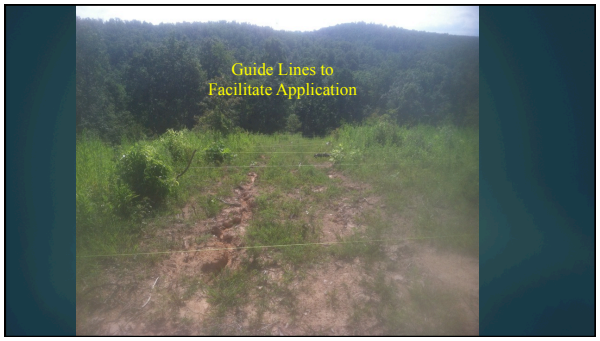
- Individual units were sectioned using either pin flags or rebar/twine
- Applications conducted in May – June of 2014

Radial Release Treatments

- Individual rows with 12' spacing between rebar
- Oak species and yellow-poplar seedlings selected (160 seedlings or more)
- Seedlings marked with fluorescent flagging for easy detection
- Area approximately 5 feet radius was treated using 5% glyphosate solution with surfactant

Banded Spray Treatments

- Individual rows were delineated with rebar at 8 foot spacing between rows
- Untreated rows are approximately 3 – 4 foot in width
- Treated rows are approximately 4 – 5 foot in width



Banded Unit

Control Treatments

- Rebar placed at 12' spacing to delineate individual rows
- "True" control was untreated (clearcut only)
- Control + pre-emergent treatment only received weed/grass control treatment

Treatment Unit Seedling Measurements

- 150 seedlings will be measured within each unit (900 per block; 2,700 total)
- Measurements will include:
  1. Ground line diameter
  2. Vertical height
  3. New or resprout regeneration

Treatment Unit Seedling Measurements

- Initial measurements taken in October of 2014 using digital calipers and tape measure
- Individual seedlings will be marked and numbered with metal tags
- 2-year measurements will be taken in October of 2016

Statistical Analysis

- Complete Randomized Block Design
  - Pitting individual treatments against one another
- Economic analysis investigating Rate of Return (ROR) using actual prices (herbicide, equipment, time/vendor costs)

Summary

- Relevance of Study
  - Improper previous management of TN forestland
- Treatments:
  1. Clearcut method
  2. Pre-commercial thinnings

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Questions?