Auburn Nursery Cooperative Short Course: Seedling Inventory

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Why Do a Seedling Inventory?

- Seedling are sold on a per thousand basis
  - Procedures used to determine number of seedlings
- Inventory conducted twice yearly
  - Spring Inventory and Fall Inventory
- Help determine problem lots
  - Poor germination
  - Slow germination
- Assist in Management practices
  - Top-pruning
  - Under-cutting

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Determining Seedling Numbers

Number of Seedling in the Field

Number of Seedling per Bag

Lifting in the Field

Seedlings are lifted on a LBF basis. The seedling inventory tells the nursery manger how many seedlings there are per LBF; thus we know how many seedlings are being lifted.

Spring Inventory

- Conducted in June
- Determine seedbed density (seedling/linear bed ft)
- Determine total linear bed footage for each seedlot
- Spring inventory
  - Determine germination rates
    - *Some lots do better than others*
  - Help determine number of seedlings for allocation
    - *Internal use*
    - *Outside Sales*

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Spring Inventory - Field Procedures

- Twenty-five (25) three-quarter (¾) bed foot plots should be sampled from each nursery seed source.
  - A rigid 4 foot by ¾ foot sampling frame should be placed perpendicularly across the seedbed to define each sample plot.

- Sample plot locations should be evenly spaced across each nursery seedlot.
  - The precise spacing between plots should be determined by dividing the total seedlot bed footage by 25 (the total number of plots).
  - A plot should not be placed any closer than forty (40) feet and no further than two-hundred (200) feet from one another.

- The first plot placed in each seedlot should be randomly located in the first fifteen (15) feet of bed space occupied by that seedlot.

Spring Inventory – Field Procedures

- Each sample plot location should be recorded and labeled using the nursery field (unit) number, the unit (section) number, the bed number (within the unit/section), and the location, in feet, along the bed.
- On each sample plot, the total number of seedlings should be counted and recorded for both the left and right half of the sampling frame.
- Since the inside dimension of the sampling frame should be ¾ foot along the bed, any seedlings that are bent outward by the frame should not be counted. Seedlings that touch the frame, but are inside the frame, should be counted as in the plot.

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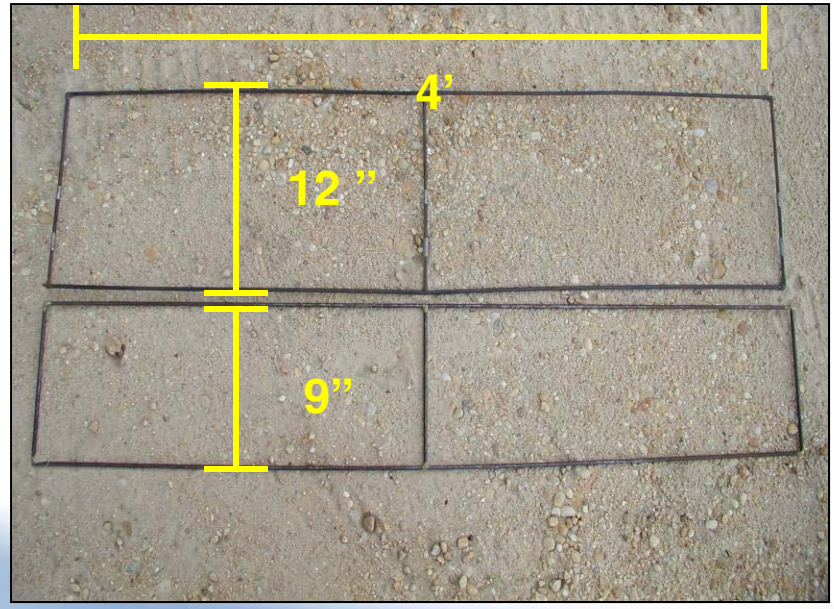
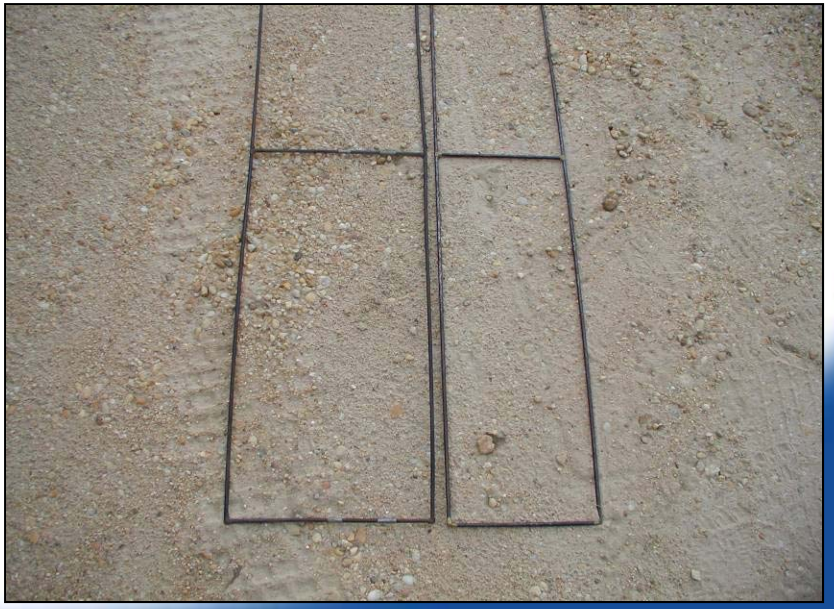
Seedling Inventory Sampling Frame

Sampling frames

- 4 ft in length
- 6, 9, or 12 inches in width
- Smurfit-Stone uses the 9 inch frame based on a previous study





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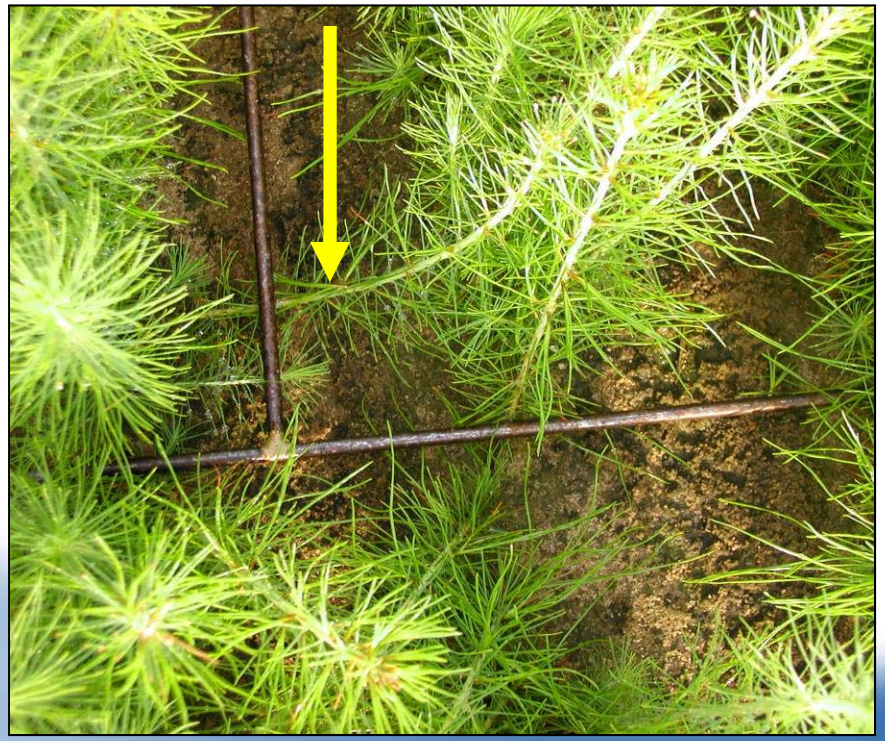
Inventory – Field Procedure

Included in Inventory or Not?

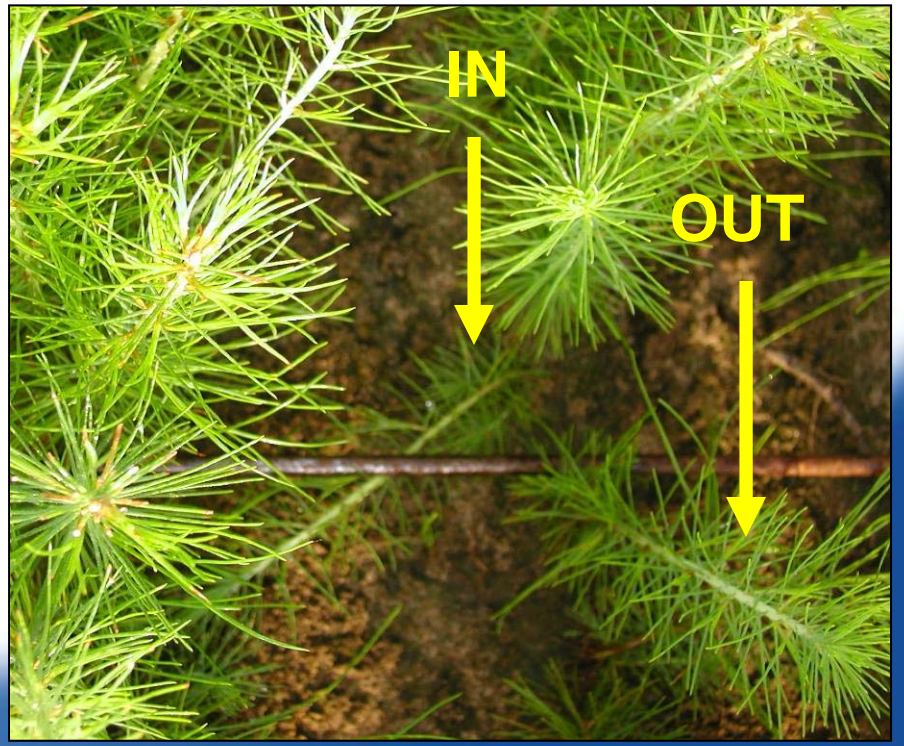
Example 1:

Even thought this seedling appears to be in the right side of the frame it would be recorded as being on the left.



Example 2:

Even though a majority of the seedling on the left lies outside the frame, the base of the seedling originates inside the frame and therefore is counted.



Spring Inventory – Data Analysis using the 9” Frame

- Excel Spreadsheet Example
- **# Pure Live Seed**
  - Seed/lb x total lbs
- **Seedlings/Ft^2**
  - (Left plot totals + Right plot totals)/1.5
- **Seedlings/LBF**
  - (Seedlings/Ft^2) * 4
- **Spring Inventory Totals**
  - Seedling/LBF * Total LBF
- **Approximate Germination**
  - Spring Inventory Totals/# Pure Live Seed
- **95% of Spring Inventory (estimated cull rate)**
  - Approximate Germination * 0.95

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Fall Inventory

- Conducted in September
- Goal is to provide estimates of the number of seedlings per bed foot for each seedlot
- Final estimates should have an allowable error (AE) of not more than $\pm$5% of the seedlot mean, calculated using an α=0.05 probability level
- Any adjustments to the total number of bed feet in each seedlot should be noted at this time.

Fall Inventory - Continued

- Designing the seedling inventory
  - MOST IMPORTANT PART OF THE INVENTORY
  - Done in the Spring inventory, but more important for the Fall Inventory

- **Nursery manager should survey the crop prior to designing the inventory and make any needed adjustments to nursery seedlot ID that are warranted**

Designing Seedling Inventory with Extreme Variation in the Field

GOOD GERMINATION

POOR GERMINATION

Designing Seedling Inventory with Extreme Variation in the Field

- When germination is high and consistent across the entire seed lot:
  - Seedlot does not have to be divided
  - Observed precision should be low
  - No additional plots will be required

- When germination is poor or seedlots are inconsistent:
  - Seedlot will need to be divided up
  - Observed precision will most likely be > 5%
  - Additional plots may be requires

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- Sample plot locations should be evenly spaced across each nursery seedlot.
  - The precise spacing between plots should be determined by dividing the total seedlot bed footage by 25 (the total number of plots).
  - A plot should not be placed any closer than forty (40) feet and no further than two-hundred (200) feet from one another.
- The first plot placed in each seedlot should be randomly located in the first fifteen (15) feet of bed space occupied by that seedlot.

Fall Inventory – Field Procedures

- Sample plot locations are recorded and labeled as with the Spring inventory
- On each sample plot, the total number of seedlings **and culls (<3.2 MM RCD)** should be counted and recorded for both the left and right half of the sampling frame.
- Since the inside dimension of the sampling frame should be ¾ foot along the bed, any seedlings that are bent outward by the frame should not be counted. Seedlings that touch the frame, but are inside the frame, should be counted as in the plot.

Fall Inventory – Data Analysis using a 9” Frame

- Excel Spreadsheet Example
- **Calculated the same as with the Spring inventory**
  - # Pure Live Seed, Seedlings/Ft^2, Seedlings/LBF, Fall Inventory Totals,
- **Cull percentage**
  - (Total Culls/Total Plantables) * 100
- **Plantables/Ft^2**
  - (Average Plantables*1.33333)/4
- **Total Plantables**
  - Mean Plantables * LBF
- **CV, Observed Precision, and Additional Plots can then be determined**

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Statistical Terms

- **Coefficient of Variation (CV) –** measures the variability in the values in a population relative to the magnitude of the population mean.
  - CV = (σ/|μ|)*100
  - Where: σ is the sample standard deviation and
    μ is the sample mean

Example:

1) 34,17,24,28,25,28,33,13, and 40; μ = 26.9

2) 24,27,26,28,27,29,26,26, and 28; μ = 26.8

Statistical Terms

- **Observed precision of the mean:**
  - *Sqrt* of $[(4*CV^2)/n]$
  - Where n = the number of sample plots
- The result is the calculated percentage error estimate for the mean
- If the value calculated is less than 5 than no additional plots are needed
- If the value calculated is greater than 5 additional plots will be required
- **To determine the number of additional plots solve for n,**
  - where n = $[(4*CV^2)/25]$

Additional Sample Plots

- Plots should be allocated and located in a manner similar to those used in the initial samples
- The data from the additional plots should be added to original data and re-analyzed
- If additional plots still don't lower the observed precision below the 5% error than
  - Seedlot should be divided up and seedling inventory completed again
  - Additional plots may be required

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Double Checking Your Numbers

- A pre-determined number of bags will be checked from each seedlot
- All the seedlings are removed from the bag and counted
- Numbers of physical counts are compared to estimated seedling inventory numbers
- If numbers are statistically different than seedling inventory will have to be re-done
- Very important for seedling sales and auditing purposes

<u>Above</u>: Seedlings are being re-packaged following counting

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Hardwood Seedling Inventory

- Use the 9 inch sampling frames
- Samples collected every 40 ft
- A minimum of 10 samples is required
- Troubled areas are divided up
  - Deer browse
  - Poor Germination
- Analysis completed as with pine seedlings

Hardwood Seedling Inventory

Containerized Longleaf Seedling Inventory

- Spring and Fall inventory conducted
- Spring Inventory
  - Germination Rates
  - Determine if trays need to be re-sown
    - *Climatic conditions*
    - *Bird damage*
    - *Poor Germination*
- Fall Inventory
  - Seedling survival
    - *Brown spot and Rhizoctonia*
- Sample 50 trays for every 100,000 cells
  - Separate troubled areas and sample independently

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Containerized Longleaf Seedling Inventory

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QUESTIONS?

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