# Land Application of Biosolids to Forests

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VirginiaTech
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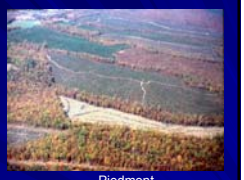
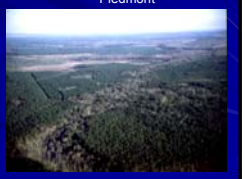
# Forests in Virginia

| Forest Type | Acres |
|---|---|
| Upland Hardwoods | 10,072,400 |
| Bottomland Hardwoods | 549,800 |
| Oak-Pine | 1,532,100 |
| Natural Pine | 1,374,100 |
| Pine Plantations | 1,666,000 |

(VDOF 2006)

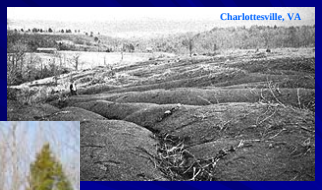


Piedmont



Coastal Plain

## In The Piedmont Forests Have Been Established On Abandoned Agricultural Land




Picture from
Soil Conservation by
H.H. Bennett, 1939

Biosolids Application Study Site

## Impact of Fertilization on Growth of Pine Plantations

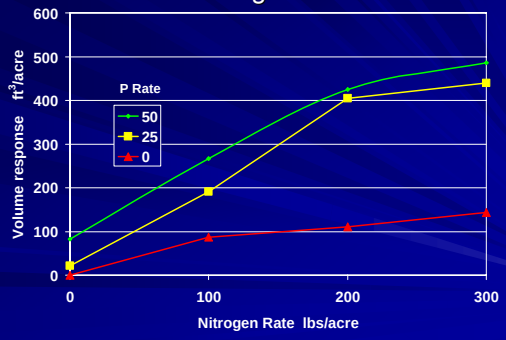
The Growth of Most Pine Plantations in the South is Limited By Nutrient Deficiencies

Check

Fertilization

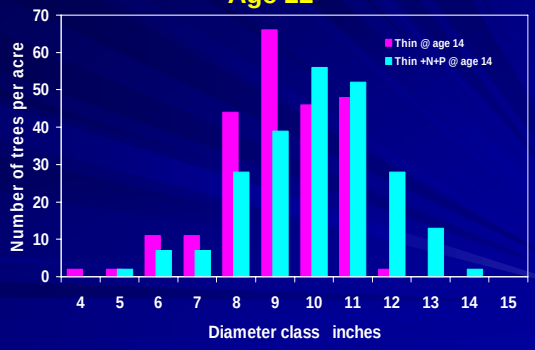
Age 5 Loblolly Pine in North Carolina


## Eight-Year Cumulative Response in Loblolly Pine Following Fertilization



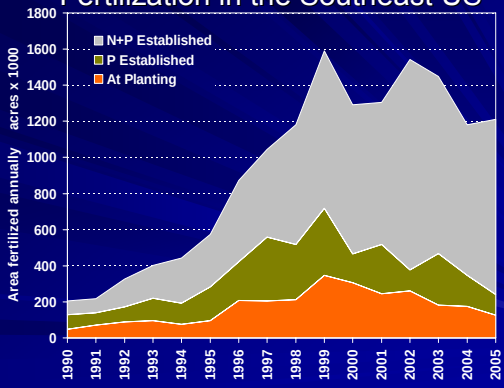
Loblolly Pine Age 15
Row Thinned + Light Selection


## Diameter Distribution in Loblolly Pine Age 22

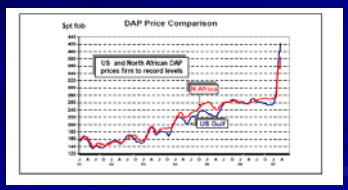



## Forest Fertilization

## Fertilization in the Southeast US




## Fertilizer Prices Continue to Increase

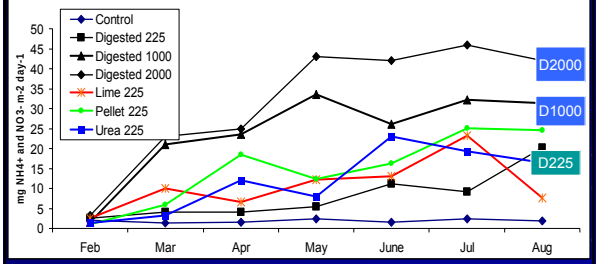



THE MARKET
FERTILIZER NEWS AND ANALYSIS

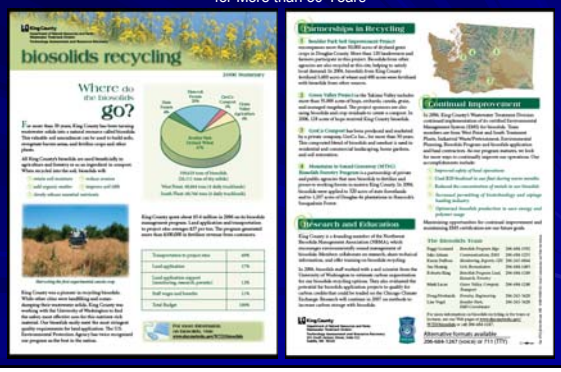
## Biosolids Are a Source of Nutrients

| | Alexandria Digested | Blue Plains Lime Stabilized | Potapsco Pelletized |
|---|---|---|---|
| pH | 8.5 | 12.2 | 5.6 |
| Nitrogen (%) | 5.00 | 3.73 | 5.66 |
| Phosphorus (%) | 2.11 | 1.16 | 1.61 |
| Potassium (%) | 0.09 | 0.10 | 0.27 |
| Sulfur (%) | 0.54 | 0.47 | 0.55 |
| Calcium (%) | 2.34 | 10.86 | 1.12 |
| Magnesium (%) | 0.24 | 0.19 | 0.22 |

## Soil Nitrogen Availability Following Biosolids Application
## Amelia County, Virginia




Seattle (King County), Washington
Biosolids Have Been Applied to as a Fertilizer to Forests
for More than 30 Years




**King County has developed a cost-effective and environmentally-friendly technology for applying dewatered biosolids to forests.**

**Biosolids are loaded into the spreader. About 30,000 wet tons of biosolids are applied to forests each year.**


This Douglas-fir tree was cut when it was about 30 years old. When it was 20 years old, the tree was fertilized with biosolids resulting in wider growth rings.

http://dnr.metrokc.gov/wtd/biosolids/Forest.htm

Biolsoids Application to
Pine Forests in North Florida
Prior to Planting

Growth Response of Slash Pine in North Florida
Eight Years after Application of
Biosolids Prior to Planting

No Biosolids

Biosolids

Biosolids Applied to Young Pine Plantations in Florida

## Effects of Biosolids on Two-Year Growth of Young Loblolly Pine in Florida

| Treatment | Height Growth (ft) | Diameter Growth (in) |
|---|---|---|
| Check | 4.8a | 0.6a |
| N+P Fertilizer | 5.6b | 0.9b |
| Biosolids | 6.0b | 1.1b |

Values within a column with the same letter are not significantly different (α=0.05)

## Application to Young Pine Stands in Virginia

## Application to Midrotation Stands Following Thinning in Virginia

## Questions About Biosolids Application to Forests in Virginia

- Do trees grow faster after application of biosolids?
- What are the effects of biosolids on nutrient dynamics in forest soils?
- What is the potential for offsite movement of nutrients following biosolids application in forest ecosystems?
- Are there differences among the various types of biosolids?

## Forestry Biosolids Study

Virginia Tech
Department of Forestry
&
Department of Crop and Soil Environmental Science

Study 1: Soil Nutrient Dynamics and Growth Response of Loblolly Pine Following Biosolids Application

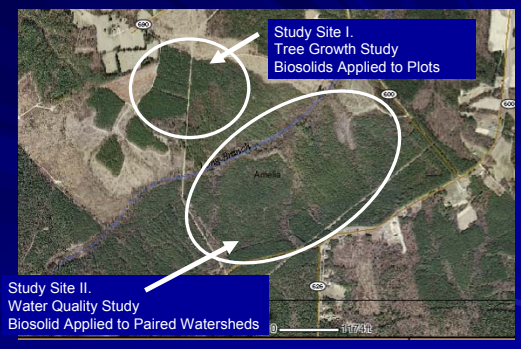
Study 2: SMZ Effectiveness and Water Quality Follow Biosolids Application

VirginiaTech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

## Research Objectives

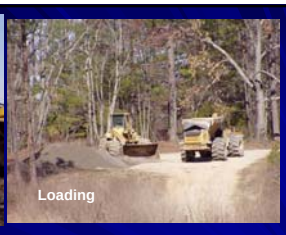
- Study 1: Compare types of bisolids, application rate and season of application on:
  - Growth of loblolly pine
  - Soil nutrient availability
  - Potential for leaching of nutrients
- Study 2: Evaluate effectiveness of streamside management zones to protect water quality following biosolids application

Location of Biosolids Study Site in Amelia County, Virginia




## Study 1: Treatments in Tree Growth Study

- **Fall Application**
  - Control
  - Lime Stabilized - 800 lbs/acre Plant Available Nitrogen
  - Anaerobic Digested - 800 lbs/acre Plant Available Nitrogen
- **Spring Application**
  - Lime Stabilized - 200 lbs/acre Plant Available Nitrogen
  - Anaerobic Digested – 200 lbs/acre Plant Available Nitrogen
  - Anaerobic Digested – 800 lbs/acre Plant Available Nitrogen
  - Anaerobic Digested – 1600 lbs/acre Plant Available Nitrogen
  - Pelletized – 200 lbs/acre Plant Available Nitrogen
  - Urea + Diammonium Phosphate – 200 lbs/acre

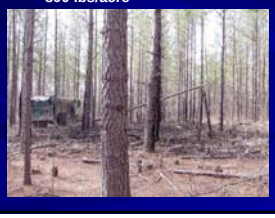






Control

200 lbs/acre

800 lbs/acre



1600 lbs/acre

## Measurements

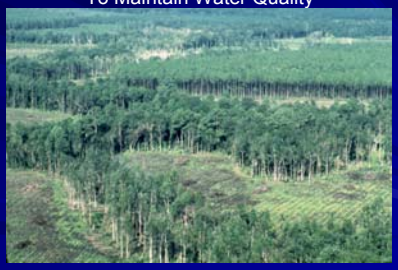
- Tree total height, dbh
- Foliage sample for nutrient analysis
- Soil characterization at 0/10/20/40/ 60+ cm depth
- Ion exchange membrane
- Mineralization cores
- Suction Lysimeters (80 cm depth)


Soil Samples

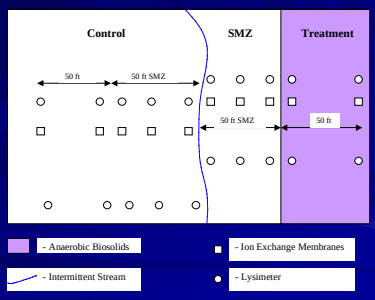

Mineralization Cores


Tension Lysimeter

Study 2
Evaluate Forestry Best Management Practices (BMPs)
Streamside Management Zones (SMZs)
To Maintain Water Quality



## Study Layout




## Biosolids Applied to Paired Stream Segments with 50 ft SMZs

200 lbs/acre Anaerobic Digested

## Measurements

- Ion exchange membrane
- Soil Solution Tension Lysimeters (80 cm depth)
- Streamwater samples


Intermittent Stream


Ion Exchange Membranes


Tension Lysimeter

## Poison Ivy