

THE EFFECTS OF FERTILIZATION AND COMPETITION CONTROL ON
CARBON AND NUTRIENT ALLOCATION AND PHYSIOLOGY IN LOBLOLLY
PINE PLANTATION

Quarterly Report for the Period October – December, 1999

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1. Status of Work

We are making good progress on our field and laboratory measurements. Analysis is proceeding on relevant datasets and laboratory samples.

Our progress on the specific tasks under each objective listed in our Statement of Work can be summarized as follows:

Objective #1: Understand the mechanisms by which fertilization and competition control affect the growth, development and productivity of loblolly pine stands by determining fluxes and allocation of carbon and nutrients.

1. Quantify biomass and nutrient (esp. N and P) allocation to leaf, stem and roots of individual loblolly pine within the plots.

Litter collections continue on a monthly basis from all Waycross, BF Grant and Whitehall plots. Litter has been sorted and weighed through the October collection. Soil cores for determination of root mass were collected in January, and are still being processed. All of our Waycross stands were harvested this winter. Stem, branch, foliage and bark samples were taken for determination of nutrient content. Measurements of the major cations have been completed, and the foliar data were presented in the last quarterly report.

We began harvesting the B.F Grant sites on January 3, 2000, and expect to complete our work on or before January 12, 2000. We will use the same protocols as were used in last year's Waycross harvests in all analyses.

Begin and completion dates: Oct. 1, 1998 - August 31, 2001

2. Quantify how biomass and nutrient content of above and below ground components of loblolly pine stands change with time by examining the growth of different-aged stands.

Both the data previously collected at Waycross and currently being collected at the B.F. Grant site in association with the preceding task will be used for this purpose.

Begin and completion dates: Oct 1, 1998 - August 31, 2001

3. Quantify rates of carbon flux, i.e. net photosynthesis, foliar respiration, root respiration and soil respiration.

Photosynthesis was measured during 5 separate sampling periods in two blocks of each age at both Waycross and BF Grant. The first flush of 1998 and the first flush of 1999 were measured on three trees in each plot. Measurements from the three trees were averaged and serve as the experimental unit. Measurements will continue at

approximately six week intervals. The needles used in the measurement of photosynthesis were collected and are partially prepared for chemical analysis.

Begin and completion dates: Oct 1, 1998 - August 31, 2001

4. Determine allometric, phenological and temporal relationships between loblolly pine canopy and fine root dynamics.

Indirect measurements of leaf area index (LAI, total one-sided, leaf area per unit ground area, m^2/m^2) are being taken each month in the intensively managed plantations of loblolly pine at Athens, Eatonton, and Waycross, Georgia. The LAI-2000 plant canopy analyzer (Li-Cor, Inc., Lincoln, NB) is being used. The instrument measures diffuse radiation and uses these readings to calculate LAI. A total of 12 readings are being taken on each of the 100 research plots. We will continue taking monthly measurements through February 2001, providing two full annual cycles of LAI development. This phase of the research is now 60% complete.

Begin and completion dates: Oct 1, 1998 - August 31, 2001

5. Calculate photosynthetic nitrogen use efficiency and nitrogen productivity as well as growth efficiency on a per needle area and per unit intercepted radiation basis.

Measurements commenced June, 1999, and will incorporate the gas exchange and nutrient measurements being made under #1 and #3 above.

Begin and completion dates: Oct 1, 1998 - June 30, 2001

6. Measure uptake, retranslocation, mineralization and immobilization of nutrients within stands of different ages.

Uptake will be determined from the measures of nutrient content and distribution in association with the work performed under Task 1. Retranslocation will be determined from comparisons of litter and live canopy foliar nutrients. Soil samples were collected during the winter to determine soil nutrient concentrations and have been analyzed.

Begin and completion dates: Oct 1, 1998 - July 31, 2001

7. Measure soil moisture and plant water status throughout the year.

As previously noted, the Waycross weather station was installed in early February, and weather data from Athens and the B.F. Grant sites are being downloaded from pre-existing stations. The collected data include temperature, wind, relative humidity, solar radiation and precipitation. Our supplemental soil temperature sensors were all defective from the factory, so we have instead been using TDR to measure soil water content.

Begin and completion dates: May 31, 1999 - September 20, 2001

Objective #2: Develop a schedule of silvicultural treatments (fertilization and competition control) to maximize growth of loblolly pine stands.

1. Identifying patterns of growth response in relation to resource limitation of individual stands.

This task represents the culmination of the tasks listed under Objective #1, and awaits their completion.

Begin and completion dates: September 1, 1999 - August 31, 2001

2. Developing new process models for growth and yield that incorporate the timing of resource availability associated with competition control and fertilization.

Model construction will commence after this coming field season once we have a full year's data and the biomass and nutrient samples have been completely analyzed.

Begin and completion dates: : June 30, 2000 - September 30, 2001

3. Using (make available to industry) the process models to optimize scheduling of silvicultural treatments.

Iterative process performed in conjunction with task 2. Final version complete at termination of task 2.

Begin and completion dates: June 30, 2000 - September 30, 2001

4. Using data from the experimental portion of this study to help parameterize and calibrate existing regional assessment models in collaboration with Oakridge National Laboratory (Dr. Robert Luxmoore) and the University of Florida (Dr. Eric Jokela)

Will follow completion of task #2

Begin and completion dates: : June 30, 2000 - September 30, 2001

2. Level of Completion

Objective #1: Understand the mechanisms by which fertilization and competition control affect the growth, development and productivity of loblolly pine stands by determining fluxes and allocation of carbon and nutrients.

1. Quantify biomass and nutrient (esp. N and P) allocation to leaf, stem and roots of individual loblolly pine within the plots.

Destructive Harvests: 75%

Litter collection: 100% (of 1st year) collected and processed

Processing samples for biomass and nutrients: 80% (Waycross)

Stem biomass determination: 75%

Roots: 70%

Overall 70% (Waycross), 30% (B.F. Grant).

2. Quantify how biomass and nutrient content of above and below ground components of loblolly pine stands change with time by examining the growth of different-aged stands.

Same as for #1

3. Quantify rates of carbon flux, i.e. net photosynthesis, foliar respiration, root respiration and soil respiration.

Stem and Soil Respiration 50% (Overall)

Roots: 0%

Overall: 35%

4. Determine allometric, phenological and temporal relationships between loblolly pine canopy and fine root dynamics.

Canopy: 33%

Roots: 10%

5. Calculate photosynthetic nitrogen use efficiency and nitrogen productivity as well as growth efficiency on a per needle area and per unit intercepted radiation basis.

Overall 0%

6. Measure uptake, retranslocation, mineralization and immobilization of nutrients within stands of different ages.

Awaiting nutrient analyses and allometric equations for tree biomass.

Overall: 80% for plants, 66% for litter and soil. (Waycross)

7. Measure soil moisture and plant water status throughout the year.

Climate monitoring stations (radiation, temperature, RH, wind speed/direction): 100% set-up, 80% data collection. (1st yr.)

Plant water measurements commenced June 1999, 20% complete.

Soil moisture/temperature: ongoing.

Overall: 45%

Objective #2: Develop a schedule of silvicultural treatments (fertilization and competition control) to maximize growth of loblolly pine stands.

1. Identifying patterns of growth response in relation to resource limitation of individual stands.

Overall: 10%

2. Developing new process models for growth and yield that incorporate the timing of resource availability associated with competition control and fertilization.

Overall 0%

3. Using (make available to industry) the process models to optimize scheduling of silvicultural treatments.

Overall 0%

4. Using data from the experimental portion of this study to help parameterize and calibrate existing regional assessment models in collaboration with Oakridge National Laboratory (Dr. Robert Luxmoore) and the University of Florida (Dr. Eric Jokela)

0%

3. Significant Tests/Demonstrations Planned for Next Four Months

None

4. Upcoming Conferences at Which Work Will be Presented

1. Soils and above ground productivity data were presented at Soil Science Society of America annual meeting in October, 1999:

Markewitz, D, B.E. Borders, R.O. Teskey, R. Will and R.L. Hendrick. Nov. 4, 1999. Nitrogen Dynamics in Coastal Plain Soils under Intensively Managed Pine. 91st Soil Science Society of America Annual Meeting, Salt Lake city, UT

2. Overview of project at SIFRC (Southern Industrial Forest Research Council) meeting in Atlanta, Ga., Nov. 17.

3. Abstract to be submitted for 2000 Ecological Society of America annual meeting.

5. Variations to Costs or Schedule

None