Forest Research Partnership

2008 Great Lakes – St. Lawrence Science Seminar

Canadian Ecology Centre, Mattawa
February 25 & 26, 2008

The Forest Research Partnership presented its annual regional science seminar again this year, at the Canadian Ecology Centre in Mattawa. The Forest Research Partnership is a partnership of OMNR, the Canadian Forestry Service, Tembec and the Canadian Ecology Centre.

Sixteen presentations were made on topics ranging from forest inventory to silviculture. The seminar was well attended by people from MNR, SFL forest management companies, forest products companies, universities and the consulting sector attended.

What follows is a summary made by Peter Hynard from his notes and from the presenters' Powerpoint presentations. A copy of the complete presentations may be seen at http://www.forestresearch.ca/Workshops/GLSLmattawa.pdf.

1. The role of integrated LiDAR and multi-band orthophotography in the production of enhanced forest inventories in the Great Lakes – St. Lawrence Forest: Murray Woods, Senior Analyst, OMNR, Southern Science and Information Unit, North Bay.

MNR is searching for ways to enhance forest inventories across Ontario through the use of new technologies. A current project of the Forest Research Partnership is examining ways to combine high-resolution, multi-band digital imagery with LiDAR at the stand and tree level.

"LiDAR" stands for "light detection and ranging". It involves sending and receiving rapid pulses of laser light from an airborne transmitter/receiver that strike the surface of the earth and are reflected back. Each pulse includes a measurement of the time and angle of return.

If a laser pulse hits a penetrable object like tree cover, it will produce a range and intensity measurement for each surface, rather than a single measurement. LiDAR is thus capable of producing 3-D images of both the tree canopy surface and the terrain surface at the same time. LiDAR pulses that strike water are absorbed rather than reflected, which gives LiDAR potential application in wetland classification.

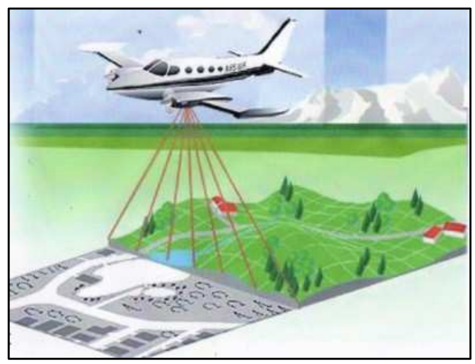

Figure 1

LiDAR can be used to provide direct measurements of stand heights and crown closure, and it can be used to make statistically-based predictions of other stand attributes, such as basal area, volume and average tree size. LiDAR can also support forest inventory by providing information on surficial geology and surface hydrology. It has shown itself 86% reliable in predicting stream locations for culvert installation. Understory attributes can also be identified in some situations, such as shelterwood cutovers.

While LiDAR has stand-alone application for some forestry purposes, it shows its best potential when combined with other remote sensing information. Using multi-band orthophotography, forest stand delineation and species composition can be automated or semi-automated. LiDAR's contribution to the resulting forest inventory is in providing accurate measurements of stand height and crown closure, and reliable predictions of basal area and volume.

In its present form, a fusion of multi-band orthophotography and LiDAR can be an aid to airphoto interpreters but an interpreter is still required to make it work. At the present time, LiDAR files are enormous and still too expensive for normal applications. The next steps are to continue developing tools for LiDAR and automated imagery systems, and to undertake a larger pilot study using these methods.

Tolerant hardwoods present a special challenge for these methods because they cannot provide the type of stand structure and stem quality data that is necessary in selection management.

2. <u>Modeling Ontario stand succession and yield (MOSSY)</u>: Fred Pinto, OMNR, Conifer Program Leader, Southern Science and Information Unit, North Bay.

MOSSY is intended to be a user-friendly software for developing yield curves and natural succession rules for use in Crown land forest management plans. It is intended to replace the expert-opinion approach currently in use, with the view to reducing bias and improving consistency.

Using 6,140 re-measurements of 1,553 temporary and permanent sample plots, the MOSSY project developed a series of equations to predict stand density height, basal area and volume for standard FMP forest units. Compared to MOSSY, standard Plonski and modified-Plonski yield tables over-predicted volume, whereas the MOSSY forest unit and leading species approach generally underestimated volume. In general, the forest unit approach had the lowest average prediction error for gross total volume.

MOSSY includes a model to predict species changes over time in the absence of a stand-replacing disturbance. The model can be applied at the stand or forest unit level and is compatible with the forest management planning process for Crown lands.

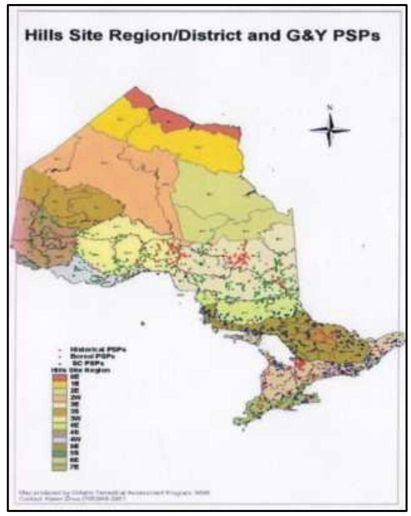

Fig. 2: Location of the sample plots used.

3. <u>Red pine response to spacing and</u> thinning: Margaret Penner, Forest Analysis Ltd.

This project studied the effects of initial spacing and subsequent thinning on volume production and product potential in red pine plantations. The study area was one of Will Stiell's old spacing trials on the Petawawa National Forest Institute dating from the 1950s.

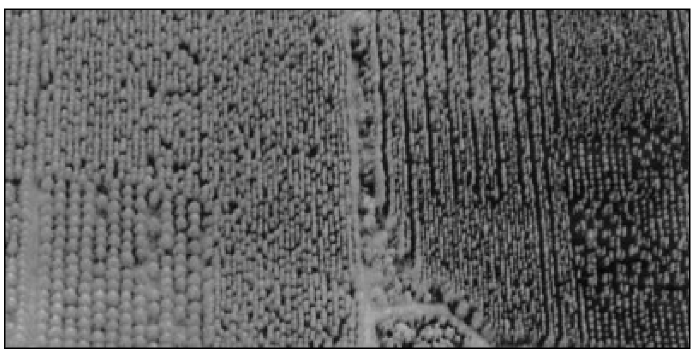

Fig. 3: Aerial view of the PNFI spacing trials.

The study area was planted in 1953 on abandoned farmland at six trial spacings ranging from 1.2 metres to 3.0 metres. A portion of the 2.1-metre spacing trial was re-spaced to 4.3 metres in 1965. Following snow damage in 1981-82, other portions of the study area were thinned to various residual basal areas. Permanent sample plots were established throughout the study area in 1962 and re-measured every five years.

The results confirm earlier findings that narrow initial spacings (<1.8 m) can provide increased volume production but only if future mortality is captured by commercial thinnings. Initial spacings greater than 2.4 metres show reduced production, indicating that the site is under-occupied. Initial spacing greater than 2.4 metres also results in a significant loss of utility pole potential due to knot size. The best initial spacing for red pine planted in an old-field situation appears to be between 1.8 and 2.4 metres.

4. <u>Structural stand density management diagrams</u>: Peter Newton, Research Scientist, Canadian Forest Service.

Stand density management means regulating the number and spatial arrangement of the trees in a stand, either through the initial spacing at the time of planting or through a subsequent spacing or thinning operation of some type. The goal is usually to improve piece size and product value at the time of harvest, or to increase overall yield through the targeted salvage of prospective mortality (or both).

Stand density management diagrams (SDMDs) are yield/density tables based on field experimentation and ecological theory that allow forest managers to predict yield under different stand densities. SDMDs can be an aid to foresters in setting initial tree spacing, and in setting the timing and residual densities of thinning treatments.

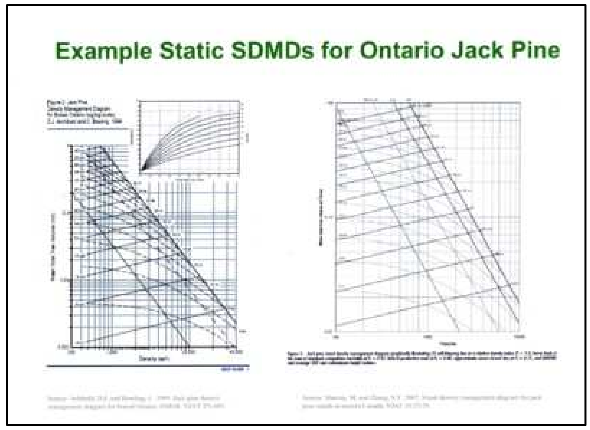

Figure 4

Early SDMDs, which are of the static type, are unable to account for ingress and natural mortality. More recent <u>dynamic</u> SDMDs incorporate these functions, but are unable to address size-dependent objectives such as product level maximization.

Structural SDMDs are a further refinement of the dynamic SDMD, in which the underlying diameter/frequency distribution is recovered from stand-level variables via the inclusion of a parameter prediction equation system. The resulting <u>S</u>SDMD enables forest managers to associate economic values for a given stand density management regime.

Current R&D efforts are aimed at developing structural SDMDs for Ontario's main boreal conifer types, for both natural and managed stands. The goal is to provide analytical solutions that:

- can account for response delays after thinning,
- can account for thinning shock (negative growth after treatment – common in jack pine)
- are tied to operational thinning methods (mechanical operations have a systematic thinning element)
- can accurately predict product recovery, and that
- incorporate economic analysis.

Currently, no SDMD work is going on in tolerant hardwoods. Tolerant hardwoods pose special problems, in that half or more of the trees in a stand can lack the stem quality necessary to produce the desired forest products.

5. <u>Forest Research Partnership - Studies of Logging Impacts</u>: Scott McPherson, OMNR, Forest Productivity Specialist, Southern Science and Information Unit, North Bay

Three research studies were examined in this presentation:

- a comparison of conventional cut-and-skid operations vs. feller-buncher operations, by season of operation,
- the relationship between logging damage, lumber recovery and dollar value, and
- the impact of skid trails on tree diameter increment growth.

The first study reinforced what is already known about logging damage. Stem wounding is the leading type of injury, as shown on Figure 5. There was little difference between the two logging methods but season of operation had a big effect. Damage levels overall were about 3½ percent in winter, 7% in summer and 11% in spring.

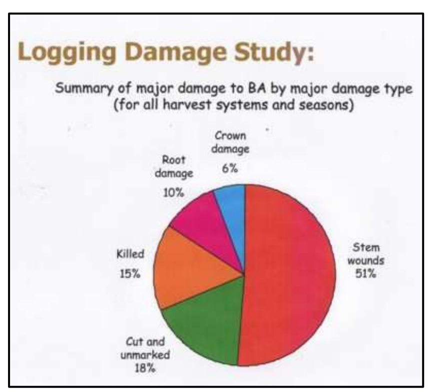

Figure 5

The second study showed that, 23 years after injury, damaged trees had lower lumber grade recovery and lesser lumber value than undamaged trees. Undamaged sawlog trees are worth, on average, 67% more. In the case of the skid trail study, trees whose root systems were impacted by skid trails showed slower BA growth than unaffected trees, and evidence of soil compaction could still be seen 20 years later.

6. <u>Wharncliffe White Pine Study</u>: **Wayne Bell, OMNR, Researcher, OFRI**

The Wharncliffe white pine study near Thessalon is part of a larger study re-measuring well-designed studies across Ontario to quantify the effects of various forest management practices on fibre production, biodiversity and early succession.

At Wharncliffe, 15m X 15 m plots were installed in a white pine shelterwood understory in 1994, one year before planting. Treatments were conducted variously to control either 1) beaked hazel, 2) balsam fir, 3) bracken fern or 4) all competition, on 46 randomized plots. Measurements were taken to determine white pine survival, height, diameter, crown closure, light levels, photosynthesis and snowshoe hare damage. The site is a deep outwash sand.

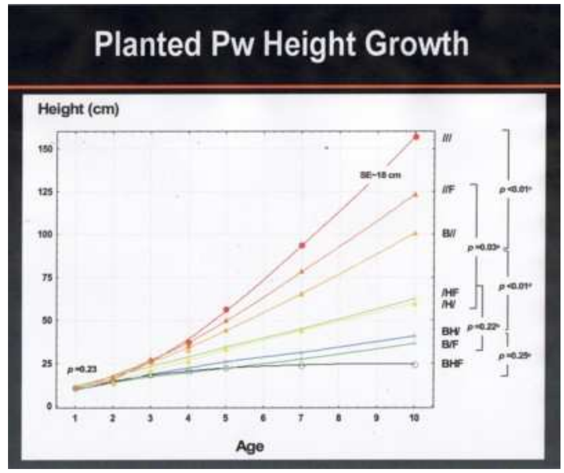

Figure 6: Height growth was best where all competition types were controlled.

Three clear conclusions emerged from the study:

1. Complete removal of competition leads to greater volume growth of white pine.
2. Single applications of herbicide may control beaked hazel, but are unlikely to control either balsam fir or bracken fern and hence may not release white pine.
3. Where snowshoe hare populations and damage are high, competition control may also help by reducing cover for snowshoe hare.

7. <u>Effects of Early Herbaceous and Woody Competition Control on Eastern White Pine</u>:
Doug Pitt, Canadian Forestry Service, Research Scientist, Canadian Wood Fibre Centre, Sault Ste. Marie.

The goal of this study is to improve the understanding of forest managers of ***how*** and ***when*** to target vegetation management efforts in order to maximize white pine growth and quality. The study was carried out on the McConnell Lake research block near North Bay. It examined a large number of plots in both clearcut and shelterwood settings, in which only herbaceous or woody vegetation, or both, were controlled.

Figure 7: Part of the McConnell Lake research area.

The study aimed to answer questions like:

- What are the impacts of low-growing herbaceous vegetation?
- Does woody vegetation provide any benefits?
- Can vegetation management affect pest management?

The conclusions of the study were clear and simple: 1) weed control is important, 2) competition control efforts must be taken early, 3) in clearcut situations, herbaceous control alone is sufficient, but 4) in shelterwood situations where the overstory represents competition too, herbaceous AND woody control is essential.

In clearcut situations where herbaceous control alone is sufficient, the overtopping poplar provided some benefit in the form of weevil control.

An elaboration of these finding was provided by Bill Parker in the next presentation.

8. <u>Using Ecophysiology Research to Understand Growth Response of White Pine to Competition Control Treatments</u>: Bill Parker, OMNR, Researcher (OFRI)

There are several attributes of white pine important to its management. It is intermediate in shade tolerance and shows slow initial growth. White pine favours a sheltered, moderate microenvironment. It reaches its best height growth at 50% sunlight and its best diameter and volume at 100% sunlight. It is most vulnerable to its two most damaging pests – white pine weevil and blister rust – in an open-grown environment.

Test were conducted at the McConnell Lake site described earlier by Doug Pitt to determine differences in light, available soil moisture and seedling photosynthesis by treatment type. Treatments were conducted to control herbaceous vegetation, woody vegetation (and both), in both a clearcut and shelterwood situation.

Results showed that white pine was able to meet its threshold 50% light requirement at the clearcut site with control of herbaceous vegetation only (at least until year four of the study). In the clearcut site, the overtopping poplar was actually beneficial by reducing weevil damage and increasing net height growth. At the shelterwood site, treatment had less effect on both light and available soil moisture due to the dominant effect of the overstory on microclimate and resources. There, control of both herbaceous and understory woody vegetation was necessary for seedlings to meet the minimum 50% sunlight requirement. Seedling survival in either situation depends on maintaining light at adequate levels.

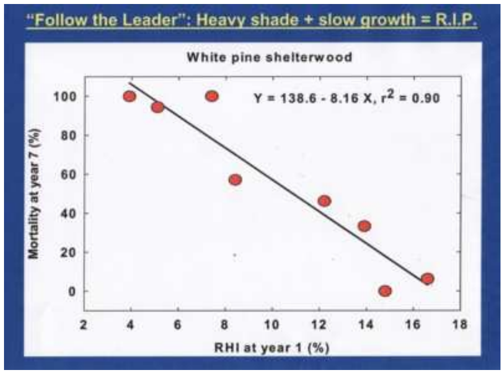

Figure 8

9. <u>Site Preparation in White Pine Shelterwoods – How Much is Enough?</u> Andrée Morneault, OMNR, Vegetation Management Leader, Science and Information Unit, North Bay.

MNR silvicultural guides call for the use of shelterwood methods in the harvest and regeneration of white pine but success is poor on competition-prone sites. This study examined the effect of site preparation on a number of ecological parameters, including white pine regeneration after shelterwood cutting.

The study was done north of Parry Sound in white pine mixedwoods on shallow, sandy till soils. The area was shelterwood cut in 1996, with residual white pine BAs ranging from 18 to 30 m^2/ha. Fifteen test plots, each 50 m X 100 m, were installed in the test area. Nine plots were treated by either mechanical site preparation, chemical site preparation, or both. Three plots were harvested without site prep and three control plots were left uncut and untreated. A chemical tending treatment was carried out 9 years after planting and results were assessed in year 10.

The study showed that white pine cannot meet free-to-grow standards on sites like these without competition control. Site preparation increases early survival and sets back competing vegetation to give white pine a head start but tending treatment is also necessary to prevent later suppression. Chemical site preparation was more effective than mechanical site preparation alone in reducing competition and increasing seedling growth in the test plots. In the total treatment plots (mechanical site preparation, chemical site preparation, planting and chemical tending, FTG averaged 42% ten years after planting.

Figure 9: One of the test plots in the Britt study.

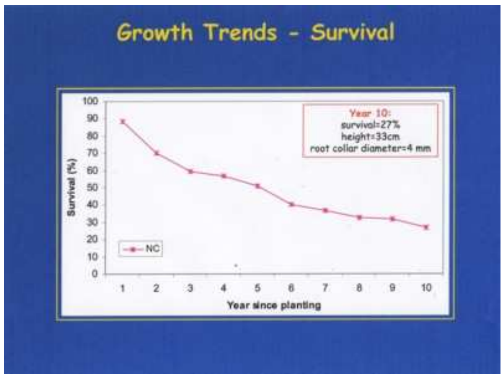

Figure 10: This graph shows how white pine survival deteriorates over time without competition control.

10. Parkside Gully Tolerant Hardwood Selection Harvest and Product Recovery Study:

Bill Cole, OMNR, Science Management Coordinator, Ontario Forest Research Institute, Sault Ste. Marie.

This project is part of ongoing research at Swan Lake in Algonquin Park, where various aspects of tolerant hardwood selection management have been studied since the research station opened in 1965. Using data from the last cut in 2005, the present project examined differences in growth rates, stem quality, downed woody debris and woody vegetation between harvested and uncut areas. Logs from the harvested area were sawn at Tembec's Huntsville sawmill, which provided the volume and value data for the study.

Parkside Gully, which had little or no previous high-grading history, has been selectively cut four times since 1967, as shown on Figure 11.

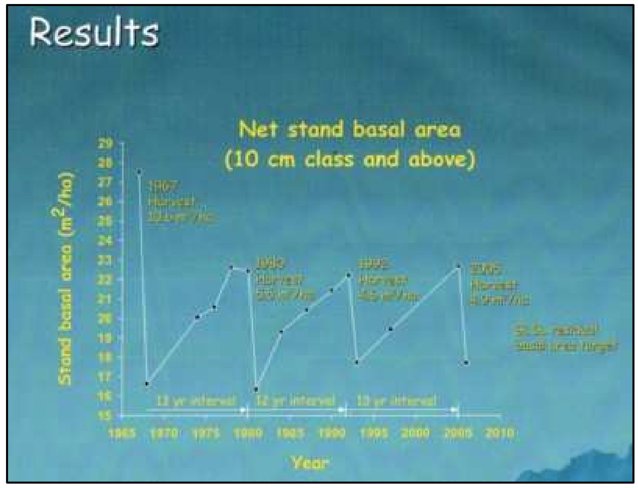

Figure 11: The first cut in 1967 reduced stand BA from more than 27 to less than 16 m²/ha. Since then, cuts have been on a 12-13-year cycle, cycle, with BAs cycling from about 18 to about 22 m²/ha.

Results show that Parkside Gully is closer to the desired diameter distribution of Q=1.38 than it was when harvesting began in 1967. BA increment since the last cut in 1992 was 0.38 m^2/ha/year, compared to a net loss of 0.15 m^2/ha/year in the uncut control. Logging damage was very low, with 2.2% of residual BA showing major damage, compared to a regional average of 9.4%.

Economically, selection management at the test site has produced very good results. Based on actual logging costs and actual product value recovery, the test site yielded $121/ha/year in net revenue, compared to an Algonquin Park average of $24.

From a species composition point of view, the repeated harvesting at Parkside Gully appears to have had little effect. Over the years there has been a slight increase in maple and beech and a slight decrease in yellow birch in both the harvested and control areas, with a slightly greater effect in the harvested area. The shrub layer on both the harvested and control areas is mostly hobblebush and striped maple, with lesser amounts of mountain maple and beaked hazel.

Snags in the harvested areas had a lower density and smaller diameter than in the control. Downed coarse wood had a similar density but a smaller diameter and much lower volume in the harvested areas.

These are much better results than have been found elsewhere in the region and are not intended to represent what should be expected in other situations. During the question period, Bill acknowledged that Swan Lake was chosen originally for its high site quality and pristine condition.

11. Group Selection in Tolerant Hardwoods:

Ken Elliott and Dawn Burke, OMNR, Southern Science and Information Unit, London.

There have been several phases to this study. It began with a retrospective study and then an experimental study in Carolinian hardwoods in 1999 and 2000. In 2006 the study was expanded to include Great Lakes – St. Lawrence tolerant hardwoods in and around Algonquin Park. The study's objectives were to investigate the ecological impact of harvesting, and to evaluate MNR's silvicultural guidelines for single-tree and group selection.

Fig. 12: One of three experimental group selection sites in Algonquin Park. Group openings are 25 m in diameter.

The retrospective part of the study looked at past single-tree selection cuts up to 25 years old, compared to control areas in which no cutting had occurred for 40 years or more. The experimental part of the study installed various sizes and arrangements of group selection openings in both Carolinian and Great Lakes – St. Lawrence hardwood types.

The experimental work is only one growing season old, so results are preliminary. So far, it appears that single-tree selection results primarily in hard maple and beech regeneration. There appears to be a connection between the presence of bare soil and the response of yellow birch and black cherry, which supports current knowledge. Late summer operations using feller-bunchers may provide the best conditions by deliberately exposing mineral soil.

The impact on songbirds was an integral part of the retrospective study. Songbird numbers, nest tree preferences, nest survival, fledgling success and cavity re-use were studied separately in fresh cuts, recent cuts, older cuts and control sites. It was found that forest bird diversity changes little with cutting and with time since cutting, but that community composition changes significantly due to the different responses of different species. By retaining cavity trees, there is a 60% chance that the cavity will be re-used and an 18% chance that it will be re-used by a primary cavity nester. In general, the population of nest predators did not vary between treatments; however, red squirrel populations were significantly higher in the intensive group selection areas.

The prenters summarized by saying that silviculture changes stands and the response, whether by flora or fauna, will be species-specific. There is the need to think on a longer timeframe and to consider a larger landscape scale.

11. Red Oak: Andrée Morneault, OMNR; Peter Nosko, Nipissing University; Jeff Dech, Nipissing University; Kelly Major, Nipissing Univeristy.

These were three separate presentations, all related to studies in some aspect of red oak regeneration. Andrée Morneault of the MNR Southern Science and Information Unit described acorn sowing trials, and Professors Peter Nosko and Jeff Dech and biology student Kelly Major of Nipissing University described studies by Nipissing students. The studies took place on the Phelps Township red oak trial area, which has been a location for various trials, research, demonstrations and education efforts in recent years.

As described by Ms. Morneault, acorns can be stored frozen for three years but viability diminishes with time. Viability was found to be 80% after two years of frozen storage and 60% after three years. Acorns can be sowed in the fall or spring and should be sown in clusters. The choice of planting tool had no effect on germination. There was a relationship between acorn predation and silvicultural method, with predation greatest in the group selection areas. More work is required on the role of predators in regenerating red oak by seed.

Professors Nosko and Dech of Nipissing's biology department described the university's interest in red oak. The department's goal is to determine the role of major abiotic and biotic factors that limit red oak regeneration and to develop effective strategies to overcome them. Five graduate and undergraduate students are looking at various aspects of stump sprouts, thinning sprout clumps, maple competition, acorn predation, leaf litter chemistry and herbivory. A large number of students have been involved in the data collection and analysis.

Figure 13: Nipissing students in Phelps Township.

Kelly Major is doing her graduate thesis on the competitive relation between red oak and sugar maple seedlings in oak and pine soils. Ms. Major collected soil from under six pine and oak stands and grew oak and maple seedlings in several interspecific- and intraspecific-competitive arrangements in a greenhouse environment. She found that maple outperformed oak on soil taken from under hardwood stands but that oak slightly outperformed maple on pine soils. The pH was similar for the two soils but N-P-K availability was better for the hardwood soil. Ms. Major noted that red oak puts out considerably more root mass than maple.