Southern Forest
Nursery Management Cooperative
Spring 2011

3301 Forestry and Wildlife Sciences Building
Auburn University, Alabama 36849-5418
phone 334.844.1012
fax 334.844.4873

Director's Report

Another winter and lifting season has gone by since our Fall 2010 Newsletter and the chatter I've been hearing is that everyone wishes that they had sown just a bit more seed last April. Always fickle, the rise and fall of seedling planting is what makes growing seedlings interesting. If you have had anything like we've had in Alabama, things are bit dry in the moisture department. Rainfall in Auburn over the winter was below average for the area and is a far cry from 2009 when most areas in the southeast were experiencing record rainfalls. Nursery studies were taken down and data collected this past winter and put into Research Reports that will be published this year. As we have lost personnel to retirement (Tommy Hill, David South) and cross-country moves (Marietjie Quick) and wind down the USDA Areawide trials, we processed only 32,456 seedlings this past season which is down from last year's 41,298 seedlings measured. This included RCDs, seedling heights, rust galls, seedling dry weights and root scanning data. A special thanks to Blake Breland, Barry Brooks, and Paul Jackson for their efforts this past winter to measure and process all that seedling data. New studies have been worked out by me, Tom, and Paul, and those are getting ready to be installed this spring as outlined in the Work Plan approved last November. Other items of interest include the Contact Meeting that will be held in Augusta, Georgia on June 28-30, 2011 to be hosted by Weyerhaeuser's Quail Ridge Nursery in Aiken, South Carolina. Watch your e-mail and mail for specific announcements concerning the Contact Meeting. We continue to work on the MBr issue (both CUE and QPS), re-registration of pesticides and evaluation of alternative fumigants, fungicides, and herbicides. Many of these topics are discussed in more detail below.

Membership. The Nursery Cooperative staff is always making an effort to recruit new members that will benefit from the activities of the Nursery Cooperative. Recently, we had two more companies join the Nursery Cooperative: Native Forest Nursery - operated out of Chatsworth, Georgia (the old Bowater Nursery), run by Paul Ensminger and Rick Williams; and Crown Pine Timber Nursery of the Campbell Timberland Management group in Jasper, Texas, run by Tim Stewart and John Lock. We welcome these two new members to the Nursery Cooperative and hope that we can continue to meet their needs. Our current Membership for 2011 is 17 Full members and 1 Associate member.

People Moving On. Long-time faculty member David South measured his last seedling on December 31, 2010. So, after 33 years at Auburn, David has "retired" to spend more time with his wife, Mary, and daughter, Stevie, either in Auburn or at their new home in South Carolina. For those of you not in attendance at the Advisory Meeting in Auburn, David was given a plaque thanking him for his work and dedication to the Nursery Cooperative over the years. We wish David well in his "retirement!" He can still be reached at southdb@auburn.edu.

With Marietjie Quicke stepping down in April 2010 and relocating to Fort Collins, Colorado, we hired Paul Jackson in August 2010 to pick up the last 18 months of the USDA Areawide grant. Given the current economic conditions at Auburn University, there is no chance that the SFWS will fill David South's position (not that he could be replaced) with someone to pick up the tasks that he did for the Nursery Cooperative.

Contents

Thus, I have explored the option of getting some hard-dollar support from the new Dean of the SFWS for Paul Jackson when the USDA Areawide grant runs out in June 2012. After the completion of the USDA Areawide, Paul will focus on herbicides and seedling quality issues within the Nursery Cooperative. I'll keep everyone informed as this process moves forward.

Retirement Contacts. With a number a recent long-time nursery personnel retiring, we would like to create a contact list that would allow us to remain in touch. A few come to mind, for example: Steve Cantrell, Harry Vanderveer, Philip Wilson, etc. Thus, if you have any recent retirees (managers, long-time workers etc.), that may like to stay in contact with the seedling nursery community, please send their information to Robert Cross at (recross@arborgen.com) who has offered to collect the list. We will contact each person to verify they would like to be a part of the "Retirement List."

Contact Meeting. The 2011 Nursery Cooperative Contact Meeting is scheduled for Tuesday, June 28-30, 2011 in Augusta, Georgia. The two and a half-day meeting will be hosted by Weyerhaeuser's Quail Ridge Nursery in Aiken, S.C. We will begin registration on Monday evening, June 27, 2011. As is the normal practice, we will have an indoor session of Nursery Cooperative staff and invited speakers presenting their most recent research findings and have a field trip planned at the Savannah River Site to tour a number of the forestry research plots that have been established over the years. In addition to the Savannah River Site, Bruce Francis, along with Paul Jackson, is putting together a tour of the Quail Ridge Nursery. The meeting is shaping up to be another informative meeting, so be sure to put that week on your calendar so that you can plan to attend. Watch your e-mail for more information.

Nursery Production Survey. Now into our 8th year, the Nursery Cooperative will again survey regional seedling production and will survey as many nurseries as possible to obtain a complete and accurate picture of production levels. This mail-out survey will be sent in early June and I ask that you help us out and return the survey back to us. Last year's results are published as Technical Note 10-01. This can be accessed on the Nursery Cooperative web site or by dropping a note to Elizabeth Bowersock and she'll see that you get a copy. I have been approached by a number of agencies interested in the seedling production data for use in long-term planning. To protect the integrity of the Nursery Cooperative, I do not share this information unless it is 3+ years old. With the help of the Auburn University Technology Transfer Office, we have developed a cite license that, with an annual fee to the Nursery Cooperative, the most current seedling production data can be released to non-members.

Soil Fumigation Training Course. As part of the FY 2011 funding from the USDA Areawide program, the Nursery Cooperative will conduct a short course in Auburn in the fall of 2011 for nursery personnel to help those that use soil fumigation understand the new rules and regulations. The 12-module training program (estimated at 8 hrs) is currently being developed by University of Florida scientists with USDA and EPA approval/oversight. At this time, we are not sure what kind of certificate each trainee will receive from this program as the certification process is being worked out by the various state and federal agencies. A grant through USDA will be used to reimburse some of the travel costs for those that attend the training program. As soon as the Training Modules are ready for release, we will be in touch with each of the members about the training program, so watch your e-mail for further information.

Advisory Meeting. The Advisory Meeting is scheduled for Wednesday and Thursday, November 8-9, 2011 at the School of Forestry and Wildlife Sciences Building at Auburn University. This is one week later than usual due to the conflict with the Methyl Bromide Alternatives Meeting that is to be held in San Diego, CA this year. Place those days on your calendar and more information will be available in the Fall 2011 Newsletter.

Update on Revision of the Hardwood Nursery Guide. The guide revision is moving along pretty much on schedule. A small workshop was conducted in November of last year to present and discuss the "state-of-the-art" for hardwood nurseries. Southern and northern hardwood nursery managers, as well as the USFS and Auburn University, contributed to the discussion. Following that workshop, Auburn and the USFS refined a draft outline for the guide revision and discussed formatting, timeline, and authorship. Authors have been contacted verbally for nearly all the components of the guide and we are in the process of preparing contracts and formatting guidelines. The due date for the first draft of all chapters is August 15. -- Ken McNabb

In Memoriam. Irene "Rena" Katherine Miller, 27, died Friday, January 21, 2011. Rena was one of our forestry/laboratory technicians with the Nursery Cooperative and was an integral part of the USDA Areawide trials that we were involved with throughout the southern U.S. over the last three years. Some of you may have met Rena in the nursery as plots were being set up/taken down or at Contact and Advisory Meetings. Rena filled a big gap in our data collection and Cooperative research when Marietjie Quicke moved with her husband to Colorado last year and when Barry Brooks went on a 6-month medical leave. We simply could not have accomplished what we did last year without her help.

Two days prior to her death, we had celebrated Rena's going away

with a party as she had taken a new job in Maryland with a forestry consulting company to run their GIS program in the Chesapeake Bay area. At the time of the accident, Rena was just outside of Auburn on her way to her father's home in Maryland who was awaiting her return. Rena's last note to us at the Nursery Cooperative laboratory was drawn on a dry erase board on the door using the sharpies she used to label the 100s of seedling bags for all of our seedling biomass measurements and that she was at "home not measuring pine trees."

Rena was born and raised in Berlin, MD and graduated from Stephen Decatur High School. She went on to graduate from Salisbury University with her bachelor's degree. She attended Auburn University in Auburn, Alabama and was working toward her master's degree. She is survived by her mother, Katherine Miller; father, Robert Lee Miller Sr.; and brother, Robert Lee Miller Jr. "Rena Bean" will be greatly missed by her loving family and friends.

Pesticide News

CUE and QPS. An ongoing process within the Nursery Cooperative has been to continue to stress to EPA, USDA and APHIS the importance of MBr either as a critical use exemption (CUE) or quarantine pre-shipment (QPS) to the forest-tree industry. This past July 2010, Tom Starkey and I applied for the annual Critical Use Exemption through EPA and the United Nations and, as in previous years, applied for **ALL** forest-tree nurseries in the southern United States (member and non-member nurseries). In this most recent EPA request for a CUE, there was a notice that 2013 could be the last year for CUE application, which would be in line with other industrial nations and their complete phase-out of MBr use. Thus, it is possible that there will be only three more seasons (2011, 2012, 2013) of MBr available under the Critical Use Exemption process. With respect to MBr under the Quarantine Pre-shipment process (QPS), the Nursery Cooperative was asked by EPA and USDA APHIS last summer (2010) for information pertaining to the pre-plant use of MBr for the production of forest-tree seedlings. The information requested was to be used by US officials to bolster the need for QPS use in the United States. At the Meeting of the Parties (MOP) in late November 2010, the European Union (EU) tried and failed to get QPS rules modified and changed such that it would limit the use of MBr for QPS uses worldwide. I've copied below a portion of the text that gives a good summary of the events.

"The EU CRP was forcefully objected to by Australia, New Zealand, Canada and the US. It is understood that Tom Land of EPA was particularly forceful on this issue. The presence of a substantial contingent of USDA at the MOP has also been helpful on addressing the issues that have been raised. As a result of the foregoing, the EU was not successful in its efforts on restricting the use QPS, but we can expect that they will regroup and redouble their efforts for next year. Despite their rhetoric, it is clear that the EU wants to impose CUE type controls on the QPS use of methyl bromide."

QPS has been an issue that has been simmering on the back burning with the EU for years and is now on the front burner on boil. Thus, QPS uses for intra- and inter-state use of MBr for the production of forest tree seedlings is still in place (for now).

Risk-Mitigation of Soil Fumigants. EPA's timeline for the new soil rules continues to follow the modified schedule with partial adoption in December 2010 and complete adoption by December 2011. Since there is not much soil fumigation going on in December, those that fumigate in the fall of 2011 will follow the rules as listed for 2010. The biggest change from fall 2011 soil fumigation and spring 2012 fumigation will be the Fumigation Management Plan (FMP) and the Buffer Tables. The FMP is a 13 page document and will need to be filled out by both the nursery and the applicator for each block fumigated. This will be a huge time sink the first time this document is required, but after each block is worked out, you'll be able to modify the dates, rates, etc as you move into future fumigation events down the road. If you have not looked at the document I urge everyone to begin the process of filling out the FMP and understand the Buffer Tables early so that when it comes time to really need the document in the spring of 2012 that all your questions have been answered.

Risk Mitigation Measure	Dec 2010	Dec 2011
Restricted Use - metam sodium and dazomet	●	●
New Good Agricultural Practices	●	●
Rate reductions	●	●
Use site limitations	●	●
New handler protections	●	●
Tarp cutting and removal restrictions	●	●
Extended worker re-entry restrictions	●	●
Training information for workers	●	●
Fumigant Management Plans		●
First responder and community outreach		●
Applicator training		●
Compliance assistance and assurance measures		●
Restrictions on applications near sensitive areas		●
Buffer zones around all occupied sites		●
Buffer credits for best practices		●
Buffer posting		●
Buffer overlap prohibitions		●
Emergency preparedness measures		●

Proline Update. We have been testing Proline for about 3 years for the control of Fusiform Rust, Pitch Canker and Rhizoctonia Foliar Blight. In December 2009, after the withdrawal of the Special Use Labels, Bayer CropScience and the Nursery Cooperative began the application process to support the full label of Proline on hardwood and conifer forest tree seed and seedlings. At that time, EPA had 15 months to approve the label and permit nurseries to use Proline by the spring of 2011. However, their examination has been slow and after a few questions concerning the fungicides potential use, we

Know Weeds!

PROSTRATE SPURGE

In a survey done by James Boyer and David South in 1980, only one nursery out of 47 reported spurge as a troublesome weed problem. In recent years, controlling spurge has been a primary concern in weed control programs. Spurge can become a problem in non-fumigated areas or in fields two or three years following fumigation. Of the many spurge types, prostrate spurge (*Euphorbia supina*) is the most common species found in forest-tree nurseries. It is a summer annual in the Euphorbiaceae family.

Prostrate spurge grows "prostrate" on the ground, branching out from a central taproot, and can be found in green to pinkish-red mats as much as 3 feet wide. Leaves (½ in) are opposite on stems and are egg-shaped without hairs. Pinkish to white flowers are inconspicuous within the leaf axils and produce sparsely hairy fruit (1/16 in) from July to November each year. When broken, prostrate spurge stems can exude a milky sap that has been studied as a cure for skin cancers, but is known to cause eye and skin irritation.

Prostrate spurge plants can produce thousands of seed as soon as 5 weeks after germination. Seed may lay in the soil for weeks until temperatures initiate germination. Germination can begin at around 60°-70° on up to 90° towards late May to June. Controlling prostrate spurge with herbicides is dependent on timing of application along with spurge germination. Oxyfluorfen (Goal®) and metsulfuron (Escort®) have shown some postemergence activity in Nursery Cooperative trials, but once established, spurge is difficult to eradicate with the exception of hand weeding.

Preemergence applications (to both prostrate spurge and loblolly pine) with pendimethalin (Pendulum AquaCap®) have controlled prostrate spurge. However, once a single spurge cotyledon is visible, pendimethalin is not effective. The chemical must be in the soil as the radicle forms from the germinating spurge seed. Applying pendimethalin before spurge germinates, but after loblolly pine seedlings are actively growing, is risky due to the potential for herbicide galls forming on seedlings in some nurseries. Trials are planned in 2011 to test another formulation of pendimethalin (Pendulum 3.3 EC®) for pre- and postemergence control of spurge and herbicide gall formation on loblolly pine. -- Paul Jackson

were told that the 30-day public comment period for Proline use in forest-tree nurseries would begin in May 2011. When this becomes available, we will be contacting you to write a letter of support for this fungicide.

USDA Areawide MBr Alternative Program. The Nursery Cooperative was awarded the fifth year of funding for the south Atlantic USDA Areawide MBr Alternative program in November 2010. This year's award of $155,000 will be used to examine and quantify the large-scale testing of MBr alternatives in the production of forest tree seedlings. Paul Jackson and Tom Starkey will be coordinating these trials for two studies in Camden, AL. As part of these trials, nurseries used the low soil impact rig that was developed by Dr. Dan Chellemi at USDA-ARS and demonstrated at the Contact Meeting in June 2009 in Daphne, AL. These large-scale fumigation trials will examine 1) the effects of using the low soil impact and reduced rates of soil fumigation and 2) the effects of TIF and reduced rates of soil fumigation on the production of seedlings over the nurseries normal rotation. In addition to the final growing season, additional funds were requested and awarded for training nursery personnel this fall. More on that later in the Nursery Short Course section below.

2011 Pesticide Registration Review Process
Tom Starkey

The Environmental Protection Agency (EPA) has updated its schedule for the review of pesticide re-registrations for 2011. This is an ongoing, continuing process in which EPA looks at the current registered uses of a pesticide. Data is evaluated to determine if its use has caused unreasonable risks to either humans, or the environment when used as directed on the product label. If changes have occurred since the last registration, public comments are invited by the Agency to aid in the determination as to whether to keep, modify to withdraw the current label.

Dependent on how the EPA review process evolves, we may ask the membership for specific use data or ask that you write a letter of support for the chemicals used. We can't stress enough how much

a letter writing campaign has influenced previous EPA decisions. We know how busy everyone is in their day-to-day tasks, but your previous responses has allowed EPA to recognize the southern forest nursery community as a group that provides valuable and well documented information that has benefited continued pesticide use in forest-tree nurseries.

This year, the following pesticides used in forest-seedling nurseries are up for review:

Active Ingredient	Trade Name
Prodiamine	Barricade (Herbicide)
Flumioxazin	Broadstar (Herbicide)
Fludioxonil	Medallion (Fungicide)

Research News

Fulvic and Humic Acid Studies: Black Gold or Pixie Dust?
Tom Starkey

I once asked a soil scientist the following question: "What one product should I consider using that will give me better quality seedlings"? His answer was humic acid. I bought some and added to my fertilization program at IFCO. Although I did not have a control set aside (I strongly, urge all managers to have controls when they use something new or different), the results of those non-experiments has promoted an increased interest in humic acids. I saw this same scientist about a year later and shared my observations. He then encouraged me to try fulvic acid. Both humic and fulvic acids originate from humic substances. I tried some fulvic acid, not on a regular basis that growing season but did not observe any appreciable differences.

Puzzle This!

The answer to the "puzzler" in the last newsletter involves row spacing.

One forester planted slash pine on a 10x8 foot spacing (545 trees per acre) while the other forester planted two rows of longleaf pine and then a row of slash pine (16x 5 foot spacing = 545 trees per acre). Although the cost of seedlings was $36 more per acre, the cost of machine planting and banded herbicide was $56/acre less. This is because the contractor charged by the mile instead of by the acre. Here is the math; machine planting plus banded herbicide = $180 per mile. Therefore, a 10x8 foot spacing required 0.86 mile ($155) and the 16x5 foot spacing required 0.55 mile ($99). When combining the extra cost of seedlings with the savings in miles per acre, the overall cost of establishment was less with the wider row spacing.

Since starting at the Nursery Cooperative, we frequently receive telephone calls from product representatives or referral contacts from the nursery community to test a particular product or "magic potion." I have noticed that a common feature of these products is that many of these compounds use humic acid as a carrier for their active ingredients. (see Research Report 09-05). As a result, I now include humic acid as one of the controls when testing unknown products hoping to determine whether the observable results are due to the "magic potion" or the humic acid carrier. One comment I recently read by Laure Metzger in "New Ag International" said that the use of humic and fulvic acids will continue to increase if the exaggerated claims as to the miracle effectiveness of products containing these acids can be stopped and an international standard for their analysis found. The point she was making in the article was that these humic substances have gotten a "bad rap."

The term humic acid and fulvic acid can be confusing since, collectively, both are examples of the larger class of organic compounds called Humic Acids (plural). The importance of soil humic compounds dates back to the middle of the 18th century. Humic and fulvic acids can be extracted from soil using various reagents. Humic acids represent the largest component of soil humic substances. It includes large molecular weight compounds appearing dark brown to black in color and is water soluble at all pH levels above 2. Fulvic acids, are small molecular weight compounds light yellow to yellow-brown in color and soluble at all pH ranges.

Applications of humic substances to the soil seem to have the greatest benefits in soils with low organic matter. Humic and fulvic acids have been reported to increase soil and plant productivity by facilitating the uptake of essential nutrients and chelate formation. The larger molecular weight humic acids have more effect on the soil properties whereas the lower molecular weight fulvic acids primarily influence micronutrient transport in the rhizosphere. Humic acids have a cation exchange capacity (CEC) of in the range of 500 to 600 meq/100g soil. This is about five times greater than the CEC of peat moss and twice as high as the CEC of soil humus. Our southern nurseries, with a high sand content, have range of CEC from 3 to 10 meq/100g soil.

In a 2009 greenhouse experiment on loblolly and slash pine, the effect of 2 products that were being promoted to increase plant growth were tested. Both of these products came to our attention as a result of a salesman's contact at a nursery. One product was a liquid extract from metal tailings used in the production of Ironite. We could not determined the exact composition of this product or find any information on the web. The other product is readily available on many web sites and contains extracts of seaweed in addition to humic, fulvic and ulmic acids. Forty elements and compounds were listed on the MSDS sheet for this product. Our controls in this study were humic and fulvic acid and fertilizer alone.

When we examined RCD, shoot height, and top and root biomass, the fulvic acid treatment was as good as or better than the next best

product which was the extract of the metal tailings. When product price was factored in, the fulvic acid gave the best results at the lowest price. The seedling response to the addition of fulvic acid surprised me. I had seen seedlings respond in the past using humic acids, but now my interest in fulvic acid was kindled.

This past year we examined three rates of humic and fulvic acid with a fertilizer control on both loblolly and slash pine. Reports in the literature indicate that plant growth effects from humic and fulvic acids are rate dependent, i.e., more is not always better.

Here are a few bullet points of the results.

- Slash pine responded more to the use of humic and fulvic acids than loblolly pine.
- For most parameters measured, the lowest rate of fulvic acid was best while it appears that the higher rates of humic acid were more beneficial.
- All rates tested of fulvic or humic acid gave greater slash pine RCD than fertilizer alone.
- All rates tested of fulvic or humic acid gave greater slash pine total seedling biomass than fertilizer alone.
- The slash pine total seedling biomass was greatest with lowest rate of fulvic acid compared to any other treatment.
- The loblolly pine total seedling biomass was greatest with 2 lowest rates of fulvic acid compared to any other treatment.

Herbicide Galls Revisited
Paul Jackson

In previous Nursery Cooperative trials, herbicide galls have been reported at the ground-line on loblolly pine after pendimethalin (Pendulum AquaCap) applications (Research Report 09-01). In those trials, herbicide galls occurred on 16% (34 fl oz/ac) to 34% (68 fl oz/ac) of seedlings that received postemergence applications in May or June. When applied at sowing (preemergence), Pendulum AquaCap applications of 68 fl oz/ac resulted in less than 7% galls. Apparently, applying Pendulum AquaCap on loblolly pine at sowing lowers the chance of herbicide galls at a particular nursery. While, it is possible that other factors such as genotype, soil type, organic matter, and temperature may play a role in whether herbicide galls occur, studies by the Nursery Cooperative have yet to find a link.

In 2010, Pendulum AquaCap was applied at sowing on loblolly pine at five nurseries. Treatments included Pendulum AquaCap at 34 fl oz/ac (1X), 68 fl oz/ac (2X), and 68 fl oz/ac plus pine bark. The pine bark treatment was an attempt to see if an increase in temperature after application would affect gall formation. Applying Pendulum AquaCap preemergence to seedlings (at sowing) resulted in zero galls on 3,125 seedlings examined in all five nurseries. The addition of pine bark did not contribute to the formation of galls in these trials.

In another 2010 trial, Pendulum AquaCap was applied postemergence to loblolly pine seedlings at the "matchstick stage" (15 days after sowing; during the time seed are being casted off of the cotyledons). In this trial, herbicide galls were observed on seedlings examined in October (Table 1).

All of the herbicide treatments produced galls; however, instead of forming at the ground-line, galls were higher on the stem at the point of the cotyledon scar. As the herbicide rate increased, the percentage of galls increased. One possible explanation for this new gall location on the seedling is that after treatment, the herbicide flowed down the cotyledons and collected in the "umbrella" area of the seedling that later becomes the main stem. Seedlings without main stem galls may have yet to cast off their seed coat, thus, minimizing their exposure to Pendulum AquaCap.

Based on trials to date, it is clear that timing of application, the rate used, and the specific nursery are factors involving herbicide gall formation with Pendulum AquaCap. Nursery managers are still encouraged to install limited "watch" trials using Pendulum AquaCap to determine the effects on seedlings in their nursery before incorporating its use into their herbicide regime. More trials are planned in 2011 with Pendulum AquaCap and an emulsifiable concentrate formulation of pendimethalin (Pendulum 3.3 EC) to effectively control spurge and determine herbicide gall formation on pine seedlings.

Table 1. Herbicide treatments and gall percentages from a postemergence Pendulum AquaCap trial in 2010.

Treatment (oz) (prod/acre)	Herbicide	Gall %
Non-treated	----------	0
34	Pendulum AquaCap	10
68	Pendulum AquaCap	14
34+21	Pendulum AquaCap + Tower	12
68+42	Pendulum AquaCap + Tower	17

2009 Methyl Bromide Alternatives Trials in Alabama: Second Year Results
Paul Jackson

Fall 2010 brought an end to the second growing season for the 2009 Areawide Methyl Bromide Alternatives trials at Joshua Timberlands Nursery in Elberta, AL and Weyerhaeuser's Pine Hill Nursery in Camden, AL. Presented below are some results from each trial. The soil fumigants, rates, and types of plastic used are given in Table 1.

Of the soil fumigants and rates used in Elberta, 100% Chloropicrin, MBrC 70/30, and Chlor 60 were the only treatments that met the target seedling density of 17/ft^2 with 100% Chloropicrin having the highest density (22/ft^2). Root morphology measurements (length, surface area, average diameter, volume, and number of root tips) resulted in Pic+ with the largest root diameters, greatest surface

area, and root volume compared to 100% Chloropicrin. Root tips and lengths were similar among all soil treatments.

At Camden, there were no differences between soil fumigants, as all treatments exceeded the target seedling density of 21/ft^2. There were no significant differences in root morphology measurements among any of the fumigants tested.

The main objective of the USDA Areawide trials is to identify a possible alternative to methyl bromide. The results at both nurseries indicate that certain alternative fumigants may have the potential to provide similar seedling quality characteristics as to methyl bromide. Due to the future elimination of methyl bromide, nursery managers must identify the best alternative in their nursery. We will continue to monitor the Weyerhaeuser plots to determine the efficacy of these fumigants and rates on the seedling production 3 years post-fumigation.

Table 1. Fumigants, rates, and types of plastic used in 2009 Areawide demonstration plots.

Fumigant	Rate	Nursery	Components	Plastic
MBr #1	400 lbs/acre	E	98% MBr + 2% Chloropicrin	HDPE
MBr #2	235 lbs/acre	E	98% MBr + 2% Chloropicrin	HDPE
DMDS + Chlor	70 gal/acre	E,C	79% DMDS + 21% Chloropicrin	HDPE
MBrC 70/30	400 lbs/acre	E,C	70 MBr (98/2) + 30% Solvent	HDPE
Pic+	300 lbs/acre	E,C	85% Chloropicrin + 15% Solvent	HDPE
Chloropicrin	300 lbs/acre	E,C	100% Chloropicrin	HDPE
Chlor 60	400 lbs/acre	E,C	60% Chloropicrin + 40% 1,3D (Telone)	HDPE
MBr	350 lbs/acre	C	67% MBr + 33% Chloropicrin	HDPE
Midas™ 50/50	160 lbs/acre	C	50% Iodomethane + 50% Chloropicrin	VIF
Midas™ 98/2	100 lbs/acre	C	98% Iodomethane + 2% Chloropicrin	VIF

*E=Elberta; C=Camden

2010 Methyl Bromide Alternatives Trials in Alabama and Georgia: First Year Results

Paul Jackson

The 2010 Areawide trials introduced the new USDA low disturbance fumigation rig at Rayonier's Regeneration Center in Glennville, GA and Weyerhaeuser's Pine Hill Nursery in Camden, AL. The low disturbance rig required that soils be rolled, not cultivated, and the fumigants were coulter injected into the soil rather than shank injected. The soil fumigants, rates, and types of plastic used at Glennville are given in Table 1.

In contrast to the Glennville study, trial areas at Camden were tilled (cultivated) before using the USDA low disturbance rig with HDPE plastic. Another fumigation rig, modified by Hendrix and Dail, used hot glue to seal the TIF plastic and beaver tails to close the shank trace. The fumigants, rates, and types of plastic used at Camden are given in Table 2.

At Glennville, seedling densities were similar among all soil treatments and each met the target seedling density of 20/ft^2. More Grade 2 seedlings were produced than Grade 1 seedlings. Root length, root surface area, and the number of root tips were similar among all treatments. However, Pic+ under low density polyethylene (LDPE) had larger root diameters and greater root volume than Chloropicrin under LDPE A surprising observation was the high nematode levels in all treatments.

Some possible reasons for the lack of fumigant efficacy at Glennville include:

- The low rate of fumigant (lbs/ac) used for a nursery with a history of nematode problems
- Fumigant was not injected deep enough by the low disturbance

Table 1. Fumigants, rates, and types of plastic used for Areawide demonstration plots at Glennville, GA in 2010.

Fumigant	Rate (lbs/a)	Plastic	Components
Pic +	200	LDPE*	85% Chloropicrin + 15% Solvent
	100	VIF**	
Chloropicrin	200	LDPE	100% Chloropicrin
	100	VIF	
Chlor 60	200	LDPE	60% Chloropicrin + 40% 1,3-D (Telone)
	100	VIF	

*LDPE=Low Density Polyethylene
**VIF=Virtually Impermeable Film

Table 2. Fumigants, rates, and types of plastic used for Areawide demonstration plots at Camden, AL in 2010.

Fumigant	Rate (lbs/a)	Plastic	Components
MBr	250	TIF*	80% MBr + 20% Chloropicrin
	150		
Pic +	250	TIF	85% Chloropicrin + 15% Solvent
	150		
Chloropicrin	250	TIF	100% Chloropicrin
	150		
Chlor 60	250	TIF	60% Chloropicrin + 40% 1,3-D (Telone)
		HDPE**	
	150	TIF	
		HDPE	

*TIF = Totally Impermeable Film
**HDPE = High Density Polyethylene

coulter injection rig.
- The compaction (rolling) of soil prior to fumigation may have prevented gas movement.
- Soil moisture may have been too high to allow gas (especially Chlor 60) movement through soil.

Due to the unprecedented numbers of stunt nematodes (*Tylenchorhynchus claytoni*) recovered from soil at Glennville in 2010, the fumigation trial will not be continued in 2011. However, we will continue to monitor second season data from the Camden, AL trials as this was a good test of the reduced rates under VIF film that will become standard with the new soil fumigation rules in December 2011.

At Camden, soils fumigated with 150 lbs of MBr, Chloropicrin, and Pic+ under totally impermeable film (TIF) produced seedlings below the target density of 21/ft^2. Under high density polyethylene (HDPE), 150 lbs of Chlor 60 yielded a significantly higher seedling density than both rates of Chloropicrin and 150 lbs of Pic+ under TIF. All soil treatments at Camden generated an average of 46% more Grade 2 seedlings than Grade 1 seedlings. Both rates of Chlor 60 under TIF had significantly more root tips than both rates of Chlor 60 under HDPE. More inclusive information for both 2010 Areawide trials will be included in a Research Report.

Where are your roots?
A Three-Nursery Lifter Study
Tom Starkey

When we think of factors that affect seedling survival in the field we immediately think of how the seedlings are handled when they leave our nurseries and the field environmental conditions after planting. The choices nursery managers make during lifting can also have a significant impact on seedling survival in the field. In 1987, Sam Rowan reported that an average of 44% of small roots were left in the soil at lifting. The more roots left in the soil at the time of lifting, the lower the root growth potential (RGP) will be. Factors such as soil texture, soil moisture, type of seedling lifter, speed of lifter, calibration of lifter, time of root pruning (lateral and undercut) and whether the lifter blade on the seedling lifter is utilized can all affect the quality (and root biomass) of lifted seedlings.

We recently completed a seedling lifter study at three nurseries to address the question as to how many roots are left in the soil after lifting. Table 1 describes the environmental conditions, species and seedling densities at these nurseries.

We collected hand lifted seedlings (from drill 3) using a shovel as a control and then compared RGP, seedling quality data, root and shoot biomass and root morphology from seedlings lifted using either a Mathis 2-row lifter (drills 3 and 6) or a Love full-bed lifter. Each lifter was operated at two speeds. The low speed (Normal) was what the nursery most frequently used and then a higher speed (Fast)

Table 1. Environmental conditions, species and seedling densities for the 3 nurseries.

Nursery	Species	Seedling Density	Date Lifted	Soil Moisture	Percent Sand	Percent Silt	Percent Clay
A	Slash	21/sqft	12/15/10	7.10%	84	9	7
B	Loblolly	23/sqft	2/9/11	10.10%	83	9	8
C	Loblolly	21/sqft	2/23/11	6.40%	74	15	11

Table 2. Seedling lifter speed and use of seedling lifter bar.

Nursery	Lifter	Lifter Blade Used	Normal Speed	Fast Speed
A	Mathis 2-row	No	1.50 mph	2.00 mph
	Love Full Bed	No	0.25 mph	0.50 mph
B	Love Full Bed	No	0.33 mph	0.39 mph
C	Love Full Bed	Yes	0.50 mph	0.70 mph

Table 3. Statistical contrasts for root biomass and root weight ratio.

		Root Biomass (g)	Root Wt. Ratio
		Contrast	Contrast
Nursery	Contrast	Means	Means
A	2-row lifter vs hand lifted	0.75 vs 0.91 *	0.15 vs 0.16 *
	2-row normal vs 2-row fast	0.75 vs 0.76	0.14 vs 0.15 #
	Full bed vs hand lifted	0.86 vs 0.91	0.15 vs 0.16
	Full-bed normal vs Full-bed fast	0.87 vs 0.86	0.15 vs 0.15
B	Full bed vs hand lifted	1.08 vs 1.11	0.23 vs 0.24
	Full-bed normal vs Full-bed fast	0.96 vs 1.22 #	0.23 vs 0.23
C	Full bed vs hand lifted	1.34 vs 1.03 #	0.25 vs 0.23
	Full-bed normal vs Full-bed fast	1.39 vs 1.29	0.25 vs 0.24

- significant at the 10% level of probability
* - significant at the 5% level of probability

that is used when soil conditions and seedling demand warrant.

Seedling size among the nurseries was similar. The average RCD (4.4 mm) varied by 0.1 mm and the average height (11.5") by 0.2" between the nurseries. Table 3 represents some of the root biomass data.

Contrast statements were used to examine some of the results from the analysis of variance. At each nursery the lifter (both speeds) was compared to our hand lifted control. In addition, a contrast comparing the two lifter speeds was used.

At Nursery A, the root biomass from the 2-row lifter was significantly less than the hand lifted control. Visually, the seedlings from the

2-row lifted had appeared to have more small roots near the ground line as compared to lower on the seedling. In Research Report 01-1 "One or two-row lifters affect seedling survival," South and Carey commented that 2-row lifters leave more roots in the soil than full bed lifters. This appears to be the confirmed at Nursery A and was also seen in the root morphology data. The root weight ratio which is calculated by dividing the root mass by the total seedling mass was lower at Nursery A than the other two nurseries. The root weight ratio can vary between species and families within species, so use caution when comparing nurseries or species.

At Nursery B there was no difference between the full bed lifted and hand lifted seedlings. However, at the 10% level of probability, the faster speed had a larger root biomass. This same affect was also found in the root morphology data for this nursery. It is important the tractor driver keep an eye on the belts, beaters and lifter speed and calibrate the belt speed with the ground speed to optimize lifting.

The root biomass and root weight ratio was greater at Nursery C than at the other nurseries. At Nursery C the hand lifted root biomass appears to be less than the machine lifted seedlings. The soil texture at Nursery C is finer than at Nursery A and B. Although the seedlings were initially undercut several months prior to this study, the soil at the time of hand lifting as compact and even with a shovel, not all roots were extracted. The use of the seedling lifter bar at this nursery also facilitated the machine lifting of the seedlings. Although there was no statistical difference between the two lifter speeds, at the faster speed the seedlings came up en mass, and were not as easily separated at the lower tractor speed. If the lifter belt speed had been adjusted to match the increased ground speed this handling problem at the fast speed may not have occurred.

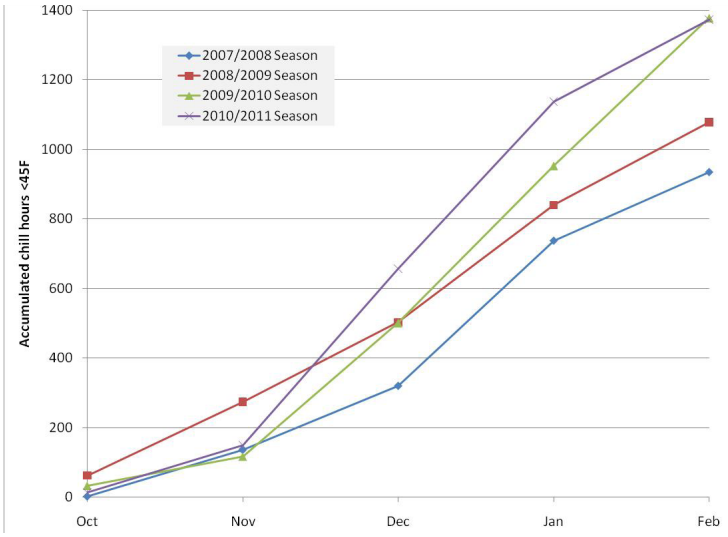
2007 – 2011 Every Winter is Different!
Tom Starkey

"Don't knock the weather. If it didn't change once in a while, nine out of ten people couldn't start a conversation." -- Kin Hubbard (1868 - 1930). Every year the winter weather provides us with conversation starters and a new set of challenges. Temperature fluctuations, rainfall amounts, or lack thereof, between November and March determine the number of seedling samples we see in the Plant Clinic each spring/summer.

The winters of 2007/2008 and 2008/2009 had numerous episodes of usually warm temperatures followed by temperature drops of as much as 40 - 50ºF. These warm temperature episodes caused deacclimation in seedlings resulting in numerous occurrences of subsequent freeze injury when temperatures suddenly decreased. During these two seasons we documented freeze injury to loblolly, slash and longleaf pine throughout the southern United States.

Over the past two winters (2009/2010 & 2010/2011) we have not seen the frequency of these deacclimation events (warm nights followed by freezing temperatures) that previously occurred. Last year we had relatively few freeze injured seedlings. Unless weather conditions change dramatically between now and early spring, this year may be similar to last year.

Let us examine the last 4 growing season winters for one location in the central coastal plain of Georgia. I used the chill hour calculator from the http://www.georgiaweather.net/ web site that determines chill hours based on number of hours <= 45ºF.



The accumulation of chill hours during the 2008/2009 was nearly a straight line. The other three seasons were identical through the end of November and then began to diverge. Just one month later, at the end of December the 2010/2011 season had accumulated almost 340 more chilling hours than 2007/2008 season. From the end of December on, the last 2 winters accumulated more chilling hours than either 2007/2008 or 2008/2009. The accumulation of chill hours during January of the 2009/2010 season continued to increase at greater rate than for the same month for other seasons.

Accumulation of chill hours is correlated with freeze tolerance in seedlings. In any one year, seedlings with more chilling hours are more tolerant of freeze injury than seedlings in the same year with less chilling hours. It needs to be emphasized that there is no "magical" number of chill hours above which freeze injury will not occur. Freeze injury can occur in any year and at any time if the following circumstances occur in the right sequence:

1. The presence of a freeze sensitive species, seedlot or family.
2. Assuming acclimation has occurred, a series of consecutive warm night/day temperatures are required to begin the deacclimation process.
3. The passage of a cold front shortly following deacclimation in which the daily minimum temperatures rapidly drop well below freezing. The severity of the freeze event will depend upon how low the temperatures go and for what period of time they last.

The following table shows the number of days for each season when the maximum temperature was greater the 65ºF and number of days

when the temperature was below 28ºF.

Season	Month	# Days Max Temp >65	# Days Min Temp <28
2007/2008	Nov	22	0
	Dec	15	1
	Jan	7	6
	Feb	18	3
2008/2009	Nov	16	2
	Dec	17	5
	Jan	10	7
	Feb	12	8
2009/2010	Nov	23	0
	Dec	3	1
	Jan	5	15
	Feb	3	10
2010/2011	Nov	21	0
	Dec	5	14
	Jan	3	10
	Feb	13	4

During the 2007/2008 and 2008/2009 season we had several freeze events resulting in dead seedlings. The number of days with temperatures above 65ºF for those two seasons were greater than for the 2009/2010 and 2010/2011 seasons. With this many night/days of warm temperatures, it is not surprising that deacclimation occurred. There were relative few days with temperatures below 28ºF during these seasons. Just one night of a rapid temperature drop following deacclimation is enough to cause seedling mortality. The large number of days with temperatures below 28ºF in the 2009/2010 and 2010/2011 confirm that the last 2 seasons have been cold. The combination of a lack of deacclimation days and the cold temperature probably explain why reported freeze injury cases where low last year and will most likely be low this year.

Root Weight Ratio
Tom Starkey

Everyone should be familiar with the USFS picture of "The Optimum Loblolly Pine Seedling." This picture describes some morphological characteristics that an "optimum" seedling should have. David South has suggested two modifications to these morphological characteristics. The first change was to indicate that a winter bud was not necessary. The second change was the descriptive characteristic of the desired balance between the shoot and root. The USFS criteria was a shoot:root ratio of 2 ½:1. This ratio is typically not defined and therefore has been interpreted to mean either: (1) a volumetric ratio, (2) a mass ratio or (3) a ratio of shoot length to root length. The latter interpretation is often used by field foresters. However, most nursery managers know that the indication of a good root system is the amount of fibrous roots, not simply a long tap root. David has suggested replacing the 2 ½: 1 shoot:root ratio with a root dry weight ratio of >27% which allows for a better evaluation of overall root quality. The root weight ratio is calculated by dividing the dry root biomass by total seedling dry biomass (roots + shoot). The ratio of >27% was derived from the USFS 2 ½: 1 ratio (1/(2.5 +1) = 28%.) He used >27% so as not to imply that only one number was best.

The root weight ratio is a good comparative number for seedlings lifted within a nursery since most nurseries prune their seedlings to some uniform height (length). In a recent study we found that the root weight ratio varied 7% among three loblolly families just prior to lifting in one nursery. A simple way to increase the root weight ratio is to pay closer attention to lifting procedures.

Here are some factors that can affect the quantity of roots lifted within a nursery:

1. Lifting date
2. Machine lifter speed
3. Lack of agreement between belt speed and ground speed
4. Lifter belt adjustment
5. Soil moisture
6. Clay content and soil bulk density
7. Use of seedling lifter blade on lifter
8. Timing and frequency of root pruning

The more roots you can lift, the higher the root weight ratio for each seedling which will increase you seedling quality out the door and into the field.

Nursery 101

Phosphonates - Fungicide or Fertilizer?
Tom Starkey

Trivia question: What class of fungicides is also known for their use as a fertilizer? The answer is phosphonate. I'll discuss this confusing fertilizer tie at the end of the article. In the broadest sense, the term phosphonate describes any compound with a carbon to phosphorous bond. Phosphonate fungicides were discovered in France during the 1970's and introduced into the United States during the 1980s when Rhone Poulenc (now Bayer Cropscience) began marketing Aliette® (fosetyl-AL). The mode of action of this class of fungicides is not understood and remains a source of controversy and mystery. Some scientists believe the mode of action is directly on the pathogen whereas others believe phosphonates acts on both the pathogen and the host by activating some natural defense system within a plant. This plant host response is called "systemic acquired resistance" (SAR) and has been shown in a number of different plant species.

Initially most of the research with this class of fungicides involved

the genus Phytophthora however, since the introduction of Aliette, other fungicides have been developed and the list of target organisms has expanded to include Pythium, Fusarium, Rhizoctonia, the downy mildews and bacteria.

To date there have been no confirmed reports of fungal resistance to phosphonates which may be due to multiple modes of action on the pathogen in disease suppression and the host defense response.

Phospohonates as fertilizers were first investigated in Germany and the US during the 1930s. Phosphonate fertilizers should not be confused with phosphate-derived fertilizers such as ammonium phosphate and TSP. Research has shown that the phosphonates are not effective substitutes for phosphate fertilizer. Despite these findings, phosphonate products are still marketed as a source of phosphorus and potassium fertilizer. Some example include: K-Phite (0-29-26); Plant Food Phosphite 29 (0-29-26); Ele-Max Foliar Phosphite (0-28-26); Nutri-Phite P+K (0-28-26); PK Plus (3-7-18) 14% phosphate; Starphite (Two different analysis-2-40-16; 0-28-26).

Table 1. Comparison of phosphonate fungicides labeled for ornamentals.*

Fungicide	Manufacturer/ Source	Active Ingredient	Drench Rate per 100 Gallons	Re-entry Interval (hours)
Aliette WDG	Bayer (DHP)	Aluminum tris (O-ethyl phosphonate)	6.4-12.8 ounces	12
Alude	Cleary Chemical	Mono- and di-potassium salts of phosphorous acid	6.25-12.75 ounces	4
Avalon WDG	PROKoZ	Aluminum tris (O-ethyl phosphonate)	6.4-12.8 ounces	12
Fosphite	JH Biotech	Mono- and di-potassium salts of phosphorous acid	12-24 ounces	4
K-Phite 7LP	Plant Food Systems	Mono- and di-potassium salts of phosphorous acid	12-24 ounces	4
Magellan	Nufarm Turf & Specialty (Riverdale)	Mono- and dibasic sodium, potassium and ammonium phosphates	6-12 ounces	4
Vital	Phoenix Environmental Care	Potassium phosphate	0.65-1.25 quart	4

http://www.greenhousemanagementonline.com/gmpro-0910-mode-of-action-33-phosphonates.aspx

Article Sources:
http://www.greenhousemanagementonline.com/gmpro-0910-mode-of-action-33-phosphonates.aspx
http://cropsoil.psu.edu/turf/extension/factsheets/phosphonate-products

Leadership 101

Leadership 101 - Motivation - who is responsible?
Tom Starkey

Recently, the Nursery Cooperative staff attended a Webinar at the School of Forestry & Wildlife Sciences entitled "Best Practices for Motivating Scientists" by Principal Investigators Association. I'd like to share a few points I found applicable from this seminar and other material.

The word "motivation" is derived from a word that means "to move to action". The ability of a leader to move to action an employee begins with determining whether you are a good or bad leader.

One of the biggest myths on motivation is the assumption you can motivate people. Motivation is an internal, personal drive. People must motivate themselves. Except in the short-run, you can't coerce, bully or intimidate a person to be motivated. However, your interpersonal skills as a leader will set up the environment to foster positive or negative motivation. Enthusiasm is contagious, and creates an environment for others to be enthusiastic. In the same light, a leader who is negative and abusive creates an environment that hampers positive motivation in coworkers and encourages negative attitudes in others.

Motivator	Supervisor's Ranking of Perceived Importance	Employee Ranking of Importance
High Wages	1	5
Job Security	2	4
Promotion Potential	3	7
Good Working Conditions	4	9
Interesting Work	5	6
Personal Loyalty of Supervisor	6	8
Tactful Discipline	7	10
Appreciation of Work Done	8	1
Help with Personal Problems	9	3
Feeling of Being "In" on Things	10	2

Another myth in motivation is that everyone is motivated by the same thing (no, it is not money). If you are married then I think you will agree that the specific things (tangible or intangible) that motivate you are different from what may motivate your spouse. It is the same in the work environment. You may personally be motivated by the good feeling and sense of pride you get when you finish a task. Remember, not everyone is like you (this may be good). Your coworkers may become motivated when you express verbally, or in writing, recognition of a job well done. Still others may be motivated by time with family, autonomy, training, coaching, job titles, good work environment, knowledge of their career path,

feeling a part of the team.

Here is an interesting survey in which employees were asked to rank 10 specific motivators in their job and then the supervisor was asked to rank their perceived importance of these same 10 motivators (http://www.gaebler.com/Boosting_Productivity_Tips.htm)

Qualities of a Good Leader	Qualities of a Bad Leader
Caring and compassionate	Abusive – blaming or berating others
Effective in communication (listening well)	Publicly humiliating others
Effective in resolving conflicts	Providing only negative feedback
Organized	Unable to deal with conflict (avoids it)
Technically accomplished	Selfish and exploitive
Good role model	Dictatorial
Encourage open discussion and new ideas	Disrespectful
	Micromanage

How well do you think you know what motivates your coworkers? Try listing 3 important motivators for each coworker and then use one to motivate that person.

Article Sources:
http://www.gaebler.com/Boosting_Productivity_Tips.htm
http://www.principalinvestigators.org/

David's Den

Colder winters?
David South

This January was relatively cold. Since 1895, January 2011 was among the 16 coldest recorded (for GA, SC, NC). For the Southeast (AL, FL, GA, SC, NC, VA), the average temperature in January was 42 F. This was -4.1 F cooler than the 1901-2000 (20th century) average and it was the 19th coolest January in 117 years. The temperature trend for January in this region (1895 to present) is -1.6 F per century, but this trend is not statistically significant (P =0.16; n = 117). In some places, the temperature dropped to 12 F on January 14th. In general, we had more chilling temperature (by December 15) than we had in 2009. Temperatures on December 14 were as low as 15 F (Rome, GA) and 17 F (Auburn, AL). Even though the temperatures were low, we may have escaped a "deacclimation freeze" this season. Apparently, the cold this winter kept our seedlings from "waking up" early and this reduced the occurrence of freeze injury to the cambium.

The cold winter this year started us wondering about the trends in temperature over the past century. Most nursery managers in hardiness zone 8 have experiences some freeze injury over the past 3 decades, and we wondered if this might be due to a change in temperature patterns. We collected data from 21 weather stations from Louisiana to South Carolina. We expected to see a warmer trend in average maximum daily temperature (MAXDT), but what we found was unexpected. We found that in 15 stations, MAXDT for January declined by -2.6 to -7.1 F (per century). In addition, the average minimum daily temperature (MINDT) also declined for 19 of the stations (-2 to -7.7 F). What was really curious is the average daily fluctuation in January temperature increased by 1.5 to 4.9 F at 10 of the stations.

20 Years Ago...

The Spring 1991 Newsletter begins with a discussion of how wet of a year it was. Some nurseries in 1991 had more rain in the first four months than they usually have during an entire year. Delayed sowing and sowing failures were widespread. "This is one year that the use of Geotech has really paid off." The Nursery Cooperative staff consisted of Walt Kelly(Director), Ken McNabb, David South, Bill Carey, Tommy Hill, Dan Gorham, Andy Barnes and Linda Kerr. Research reports included studies on seed treatments, a growth regulator and a nursery monitoring program for nitrates. An interesting report described a nursery that culled over 5 million plantable slash pine seedlings at the cost of $150,000 because the seedlings did not have a winter bud. A new idea was shared with the membership about applying Goal with the irrigation system on using an enclosed tractor. Of course, no newsletter would be complete with a discussion of an EPA ruling. Members were informed that EPA had again confirmed that it was the intent of the Federal Insecticide, Fungicide, and Rodenticide Act to consider nursery forest trees as ornamentals. Research to find an alternative for Bayleton continued noting that "…Bayleton won't be around for many more years…." News from Members reported that the Stauffer (AL) nursery was closing after 41 years in operation. Larry Foster accepted a position as manager of the IP nursery in Selma, AL and Randy Rentz became nursery manager at the Columbia, LA nursery. Some of the equipment for sale included a 1-row and 2-row seedling lifter and a Hydra spreader. There were 4 nursery workshops being held that year.

Contact Us!

Scott Enebak	enebasa@auburn.edu / 334.844.1028
Tom Starkey	starkte@auburn.edu / 334.844.8069
Ken McNabb	mcnabkl@auburn.edu / 334.844.1044
Paul Jackson	dpj0001@auburn.edu / 334.844.4917
Barry Brooks	jbb0005@auburn.edu / 334.844.4998
Elizabeth Bowersock	bowerep@auburn.edu / 334.844.1012