Southern Forest
Nursery Management Cooperative
Fall 2007

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

Director's Report

It has been a few months since our last Newsletter and a lot has happened over the hot, dry summer. I hope there was adequate rainfall where you are and that your seedlings are ready to be lifted and outplanted. I hope that you soon will have another productive growing season under your belt. With a couple of new people working within the Nursery Cooperative, we had a lot of nursery-related research conducted this summer. 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 including Bayleton, warm/cold weather problems, water quality, & more...

Membership

Dave Gerwig of MeadWestvaco notified us earlier this summer that they would not be renewing their membership within the Nursery Cooperative next fiscal year. With the company selling their landholdings and the uncertainty of the new ownership, I can understand their decision. Perhaps we can get Dave Gerwig and Don Stringfield back as members with another company in the near future. I know that I will miss them both at the Contact and Advisory Meetings, as Mead, Westvaco and MeadWestvaco have been long-time cooperators. Bill Carey and I had a number of research trials with them that covered hardwoods, fumigation, and other nursery research that was beneficial to all seedling producers.

In a flurry of activity a couple of weeks ago, we had a number of nursery contacts with respect to membership in the Nursery Cooperative This included the states of Kentucky and Florida, Meeks Farms, another request from CellFor, a contact with Gulf States (Westervelt) and some discussion with three smaller bareroot nurseries in Georgia. Tom and I will continue to cultivate relationships with these organizations to see if their needs fit the Nursery Cooperative and vice versa.

Advisory Meeting

The Advisory meeting is scheduled for Wednesday and Thursday, November 7 & 8, 2007 at the School of Forestry and Wildlife Building at 602 Duncan Drive here in Auburn. We will begin the meeting after lunch on Wednesday and adjourn around noon on Thursday. We will have video conferencing available for those who may not want to travel to Auburn. If you would like to get access to the meeting please call or e-mail Elizabeth Bowersock at 334.844.1012 or bowerep@auburn.edu. She will let you know what you need to access the meeting. Place those days on your calendar and more information will be available shortly.

Contact Meeting

The Nursery Cooperative Contact meeting was held July 10-12, 2007 in St. Simon's Island, GA and was attended by 51 Coop members. For those who were unable to attend, we have posted all presentations on the Coop's website for your convenience. Next year's Contact Meeting will be held in conjunction with the Southern Forest Nurseryman's Association in Ashville, NC. The Nursery Cooperative will have a half-day meeting beginning Monday, July 21st and ending with the SFNA icebreaker that evening. We are working with the North Carolina Forestry Division for the nursery tour and research plots. We will have an indoor session of Coop Staff presenting their most recent research findings. Please note that the registration for the Contact meeting is done through the Coop and NOT through the SFNA organization. Block that week on your calendar so that you can plan to attend.

Pesticide News

MBr Issues

The 2008 CUE application was submitted to EPA in early July for the Agency to include in their report to the State Department and subsequent request for MBr from the Parties of the Montreal Protocol. However, the "forest seedling sector" for 2008 CUE MBr was evaluated by MeBTOC and they were "unable to assess" due to "insufficient information on the application". The Nursery Cooperative was contacted by EPA and asked to address four concerns outlined by MeBTOC:

- "why alternatives in recent studies (Pic and metam sodium) are not considered effective alternatives?"
- "does 67/33 combinations of MBr/ Chloropicrin meet certification requirements"
- "why can't nurseries use glyphosate, 1, 3-D (telone) and metam sodium over MBr/Chloropicrin"
- "growers in Europe use VIF, why can't forest-tree nurseries in the US use VIF?"

Tom Starkey and I responded to Dr. Leonard Yourman at EPA about MeBTOC's questions who passes the answers on to the State Department and then on to MeBTOC. The Meeting of the Parties was held in Montreal this past September and they approved the US nominations for Critical Users for 2008.

In the process of working with EPA and the State Department, the Nursery Cooperative was contacted again by EPA trying to clarify the certification of nurseries by individual states:

"Scott: One area where we are a bit hazy is the issue of certification in the forest

nursery industry. I'm wondering if at some point you could help to clarify if certification is an internal quality-control requirement of forest nurseries or whether there are state-mandated quality requirements, or something else. For example, is there an official state certification program that specifically lists use of either methyl bromide or 1,3-D for nematode control. We at the EPA are trying to prepare for upcoming meetings with MBTOC when they may ask if alternatives can be used to treat forest nurseries. We understand that nurseries have incentives to produce and maintain pest-free seedling stock so as not to transmit pests to forest lands. We'd like to get a picture of the process and any official certification that's involved--for example, do state inspectors go to forest nurseries? does it depend on the state? or is it nursery folks who internally inspect and "certify" seedling stock? - Leonard Yourman, EPA"

Because of the initial leg work by Bill Carey and weekly contacts by Tom Starkey to the various southern Plant Boards; Alabama, Arkansas, Georgia, Louisiana, Mississippi, Oklahoma, Mississippi, North & South Carolina and Texas have specific language in their plant protection rules that mention the preferred use of MBr to ensure pest-free planting material and certification process. The various states' rules were forwarded to EPA for use in negotiations with MeBTOC.

Risk Mitigation

One of the more relevant topics under the Pesticide Heading is the "Risk Mitigation Options to Address Bystander and Occupational Exposures from Soil Fumigant Applications Fumigant Mitigation" which is currently in Phase 6. This will affect the re-registration of Methyl Bromide, 1,3-Dichloropropene (telone), Metam-sodium/potassium, Dazomet/ Basamid, Chloropicrin and Iodomethane. In the process of re-registration, EPA is looking at steps and methods that "lower the exposure risk" to users, growers and bystanders.

In February, the Nursery Cooperative supplied buffer zone and area of impact data from our membership to EPA. In addition to written comments, EPA took comments from the public, the private meeting in Washington, and online comments and then released Phase 6 of Fumigant Mitigation in April 2007. At that time, a few things stood out, among others: 1) 100-2600 ft buffer zones for fumigant use, 2) moving neighbors prior to fumigation, 3) notifying neighbors prior to fumigation, 4) rate reduction based on proximity to neighbors, and 5) field size limits (there were other issues). Again, EPA had two public comment meetings, one in Washington state and the other in Ft. Myers, FL. Tom Starkey, Dean McCraw and Bruce Francis attended the meeting in held in Florida and each gave a 4 minute comment to EPA about the proposed rules.

EPA was soliciting comments for the Phase 6 rules with an original deadline of July 3, 2007. This was extended to September 3, 2007 and was recently extended again to November 3, 2007. It is imperative that absolutely everyone who operates a forest-tree seedling nursery sends comments to EPA with respect to what they are proposing.

- Buffer zones, 100-2600 ft from an occupied building (this includes nursery structures).
- Limiting field application sizes
- Paying for moving neighbors while you fumigate
- Notifying neighbors days in advance of fumigation
- Lowering application rates

Your comments will be collected and EPA will come up with a rule/law that indicates how, where and when you will be able to use these fumigants.

QPS

The ability to use MBr in forest-tree nurseries for QPS requirements for intra-state and inter-state seedling production continues to move along in the southern plant boards.

We are working with the remaining two states, TN and VA. TN indicated they were waiting for NC to enact their legislation and they would now start the process. Hopefully we will know something definite by spring. VA, on the other hand, may not be as easy. The QPS legislation has the approval and blessing of everyone from the State Forester on down. However, in VA, the Secretary of Agriculture alone determines what new regulations are to be presented to the Legislature each session. QPS is on that list, but when.....?

Tom and I will continue to work with the State Plant Protection Officers throughout the southeast to get their help in drafting language to support intra-state use of MBr and let you know of the progress.

Bayleton

On July 15, 2007, Bayer CropScience received EPA's cancellation order for Bayleton – triadimefon. Most of the food and non-food crops, such as apples, pears, grapes and raspberries were dropped, however, pine seed and seedlings uses were still allowed. However, given the loss of the other crop uses, the sole distributor of Bayleton, AMVAC, opted not to continue selling Bayleton. The use of existing stocks will be allowed until supplies are exhausted. Bayer's Environmental Science group is moving triadimefon and pine seed, pine seedling and Christmas tree uses to their residential label. Generally, the residential label is the more "expensive" label with respect to fungicides, but apparently there is no getting around this new label. The new formulation will come in a liquid formulation in dissolvable packets, minimal size 5.5 oz per packet. In determining usage for various crops, Bayer CropScience has asked me for an estimate of annual triadimefon use by nurseries for seed treatment and foliar sprays. Based on 20 or so nurseries that shared their pesticide usage data with me, and extrapolating to the other 60+ nurseries (both Coop members and non-members) I estimated an annual use of 2800-3200 lbs of triadimefon.

Research

Bayleton Replacement: 3-Month Results and We're Holding Our Breath!

Tom Starkey

This question warrants repeating once again: "What is the single most important chemical that I use in my nursery? If I didn't have this chemical, I could not grow trees." What would be your answer? If methyl bromide was your answer – you are wrong. If Goal® was your answer – strike two. What would your loblolly seedlings look like without Bayleton®? How much of a market is there for seedlings with knots on the stems? Can you name an alternative for Bayleton®? Some have not fully appreciated the importance of Bayleton® in our arsenal of chemicals. Here we are again looking at another round of fungicides, but ***this time*** the 3-month data looks very good. We are holding our breath for the outcome of the final evaluation at six months.

Table 1. List of the fungicides we tested in 2007.

Fungicide	Manufacturer	Active Ingredient	Chemical Class
Bayleton®	Bayer Cropscience	Triadimefon 50%	Triazole
Eagle®	Dow Agroscience	Myclobutanil 19.7%	Triazole
Inspire®	Sygenta	Difenconazole 25%	Triazole
Dividend Extreme® (Seed trt only)	Sygenta	Difenoconazole 7.73% Mefenoxam 1.93%	Triazole Phenylamide
Provost 433 SC®	Bayer Cropscience	Prothioconazole 12.9% Tebuconazole 25.8%	Triazole Triazole
Absolute 500 SC®	Bayer Cropscience	Tebuconazole 22.6% Trifloxystrobin 22.6%	Triazole Stobilurin
Folicur® (Seed trt only)	Bayer Cropscience	Tebuconazole 38.7%	Triazole

Bayleton® is always included in our studies as well an untreated control. Last year we tested Folicur® and found poor results as a seed treatment. After reviewing our methodology from last year, we realized we did not apply the seed treatment properly. We changed our methodology this year and included Folicur® as a seed treatment again. Dividend Extreme® is only labeled as a seed treatment so we did not test it as a foliar spray. Eagle® was included this year because it is labeled for fusiform rust on loblolly pine. However, we could not find any research data to verify its efficacy. When we approached David Hunt, a technical rep for Bayer Cropscience about obtaining some samples of fungicides to test we had two other fungicides in mind. He, however, persuaded us to try two other fungicides, Provost 433 SC® and Absolute 500SC®. We are glad we listened to him!

Seed Application. On April 18, 2007, loblolly pine seed that had been stratified for 4 wks were treated with either Eagle®, Inspire®, Provost 433 SC®, Absolute 500SC®, Dividend Extreme®, or Folicur®, as well as a Bayleton DF® check and non-treated seed for both positive and negative controls (Table 2). Bayleton® was the only dry formulation fungicide tested. After the seed was moistened in a seed tumbler, Bayleton® was added at the rate of 2 oz/50 lbs of seed. For all others, 1 ml of the fungicide was slowly added to the dry seed in the seed tumbler. The seed remained in the tumbler until dry. Treated seed were double sown to Ray-Leach containers and then thinned to one seedling per cell as they germinated. Eight replications were used and twenty seedlings were considered the treatment unit.

Foliar Application. Loblolly pine seed were stratified for 4 weeks after which they were double sown to Ray-Leach containers on March 13, 2007. Containers were thinned to one seedling per container and then randomly assigned fungicidal treatments. Six replications of twenty seedlings each were considered the treatment unit. The foliar experiment contained Eagle®, Inspire®, Provost 433 SC®, Absolute 500 SC® as well as a Bayleton DF® check and non-treated control seedlings for both positive and negative controls. Application rates for each fungicide included a 1x and 2x rate (except Bayleton® which only had a 1x rate) as listed in Table 3. On May 7, 2007, seven weeks post sowing, seedlings were treated with the various fungicides at the Auburn University's Pesticide Research Facility. After treating seedlings they were returned to the greenhouse.

On May 8, 2007 foliar-treated and seed-treated seedlings were transported to the USDA Rust Screening Laboratory, Asheville, North Carolina. Seedlings were allowed to acclimate to the new growing conditions until May 15, 2007, when they were challenged with 25,000 spores/ml of *Cronartium quercum f.sp. fusiforme* using the laboratories inoculation protocols. Seedlings remained under the care of the Rust Lab for the duration of the growing season. On August 17, 2007 the seedlings were examined for swellings along the main stem. The results of this 3 month evaluation are presented in Table 2 and 3. In late October, 2007 a final evaluation will be made by the personnel at the Rust Lab. After this final evaluation the seedlings will be returned to Auburn University where height, RCD and seedling biomass will be measured.

Table 2. Seed treatment rates, germination and mean percent infection.

Seed Treatment Fungicides	% Germination Following Seed Trt	3-Month Mean % Infection
Check	99%	39.0%
Bayleton®	92%	2.4%
Eagle®	31%	0.0%
Inspire®	30%	6.4%
Dividend Extreme®	71%	15.9%
Provost 433 SC®	100%	0.0%
Absolute 500SC®	95%	8.0%
Folicur®	100%	3.7%

Table 3. Foliar treatment rates and mean percent infection.

Foliar Treatment Fungicides	Foliar Rate[1] 1X	Foliar Rate 2X	3-Month Mean % Infection 1X	3-Month Mean % Infection 2X
Check (water)	N/A	N/A	24.2%	N/A
Bayleton®	8 oz/a	N/A	10.0%	N/A
Eagle®	15 fl oz/a	30 fl oz/a	2.4%	0.0%
Inspire®	7 fl oz/a	14 fl oz/a	25.3%	20.0%
Provost 433 SC®	8.5 fl oz/a	17 fl oz/a	0.0%	0.0%
Absolute 500SC®	5 fl oz/a	10 fl oz/a	10.6%	8.3%

[1] Based upon 30 gal of water /acre

Results

Germination Following Seed Treatment. We were disappointed to see the adverse effect of Eagle®, Inspire® and Dividend Extreme® on germination. The germination results with Dividend Extreme® were especially surprising since this fungicide is labeled as a seed treatment fungicide. The germination reported in Table 2 was taken at the time the seedlings were transported to the Rust Lab. We were informed by personnel at the Rust lab that germination continued after inoculation. This extended germination period, of course, is unsatisfactory for a nursery. Both Folicur® and Provost® had 100% germination. There was a slight reduction in germination with Bayleton® and Absolute®.

Rust Control. The three month test results are encouraging. The fungicides Eagle® and Provost® both had 0% infection as a seed treatment (Table 2). However, since Eagle® inhibited seed germination, we could not recommend it as a seed treatment. Provost®, however, did not inhibit germination and also had 0% infection at the three month evaluation. Both Bayleton® and Folicur® had a low level of infection as a seed treatment. However, last year, Folicur® did not perform well as a foliar treatment, so we will not consider it as a foliar option.

Of the fungicides tested as a foliar spray (Table 3), only Provost® had 0% infection at the two rates tested. We were surprised that Bayleton® had 10% infection at the three month evaluation. Eagle® had a low infection rate at the 1x foliar rate and 0% infection at the 2x foliar rate.

Future Investigations

To be considered as an alternative to Bayleton DF® a chemical (or combination of chemicals) must show a good level of control as both a spray and seed treatment. The results of the three month evaluation and germination indicated Provost® was effective in preventing infection by *Cronartium quercum f.sp. fusiforme*. Provost® is registered as a fungicide for control of foliar peanut diseases. We hope that the next evaluation at six months Provost® will continue to show good activity against the fungus.

Provost® is a combination of two fungicides. The first ingredient is tebuconazole which is the active ingredient in Folicur®. In our study last year, Folicur® did not show good foliar activity. However, the second ingredient in Provost® is prothioconazole. According to Bayer CropScience, *"Prothioconazole ..., is a unique molecule belonging to a new advanced class of azole - triazolinthiones. Prothioconazole has the broadest spectrum of any azole currently available and possesses some unique properties. ....prothiaconazole gains new fungicidal properties after penetration into the leaf. What's more, prothioconazole has unique greening effects which help develop yield."* The good response we had with Provost® can probably be attributed to the prothiaconazole fraction.

This next season we are planning both a field and laboratory study to look at possible Bayleton® replacements. Provost® will be included as will another Bayer Cropscience fungicide, Proline®, which has prothiaconazole as its only active ingredient.

Preliminary Results of Response of Loblolly Pine Seedlings to Warm Temperatures Following Cold Weather Acclimation

Tom Starkey

Background: Many times when there is an issue with poor seedling performance in the field, the nursery commonly is held suspect. Meeting target seedling criteria (such as RCD, root mass and shoot height) are indeed the responsibility of the nursery. However, improper handling of target seedlings before planting, incorrect planting depth or prolonged droughts are conditions for which the nursery cannot be held responsible.

Seedlings that undergo a freeze while in the nursery may result in poor performance after outplanting if they are shipped before symptom expression. Since freeze injury is affected by genotype, sometimes weather conditions that result in a deacclimation of seedlings is often overlooked. Guidelines that help nursery managers watch out for potential freeze events do not exist. In particular, there exists only a few research studies that define the temperatures or amount of time required to deacclimate pines.

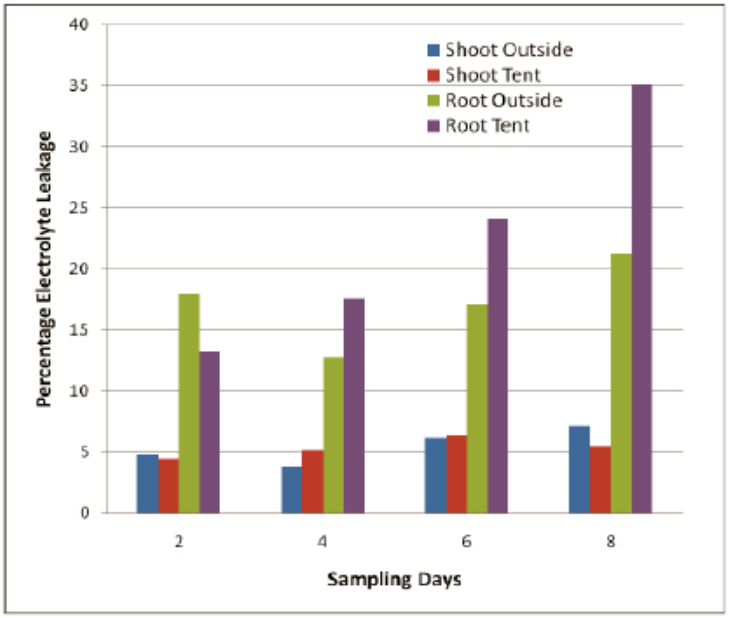
Laboratory tests which measure electrolyte leakage have been used to measure cold hardiness. All plant tissues contain electrolytes within the cell membranes. Electrolytes leak from membranes when an environmental stress such as a freeze occurs. An estimation of the amount of cellular damage can be made by measuring the electrical conductivity of the stressed as compared to unstressed tissue Needles, roots and stems have been used by researchers to measure electrolyte leakage and to estimate the resistance of conifers to freezing temperatures.

Methods: Loblolly family (7-56) is known to be susceptible to freeze damage. Seed from this family was sown at two nurseries in Tennessee and Virginia. The seedlings were cultured using current operating practices. After sufficient natural chilling had occurred, two separate heated plastic tents were erected over the 7-56 seedlots. Heat was provided at night using a propane gas heater. After 2, 4, 6 and 8 days, samples were taken and sent to Purdue University for electrolyte leakage evaluation. Additional seedlings were collected for a freezer test and then were outplanted at the Coop facilities at Auburn University.

Due to heater problems, we are going to modify our methods and

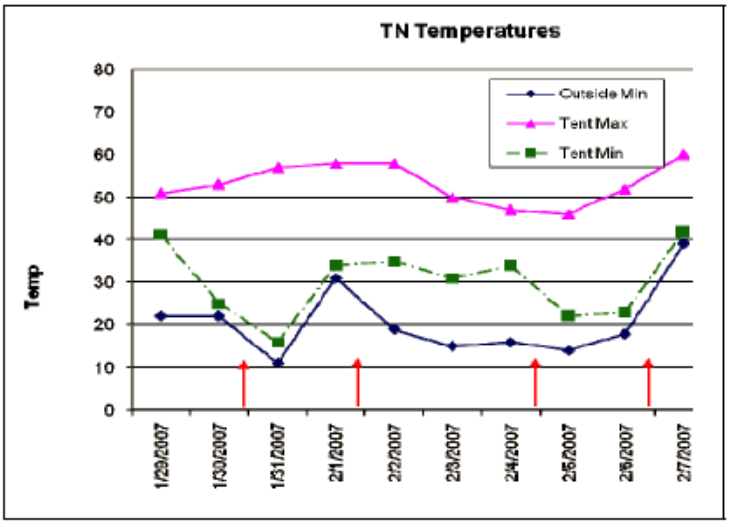
repeat the study this winter. However, we were able to obtain some preliminary data from this study.

Results & Discussion: The figure below, from the Tennessee nursery, represents percentage of electrolyte leakage at -8°C. At both nurseries seedling shoots sampled both under the tent and outside had less percent electrolyte leakage than the roots. This is consistent with other reports in the literature indicating that roots do not go "dormant" in the winter and that cold weather acclimation of the shoots is not translocated from shoots to roots.



Sampling days in the above graph indicate the number of consecutive nights in which the tent was heated. After four nights of heat (simulating deacclimation) samples of roots from within the tent had significantly more electrolyte leakage than those outside the tent. This indicates that over the sampling time, the roots under the tent became biologically active due to the warmer temperatures.

The graph below shows the minimum and maximum temperature under the tent and the outside minimum temperature. The four arrows near the horizontal axis are the sampling dates. We had some problems with the heater and also the colder-than-expected



some problems with the heater and also the colder-than-expected ambient temperatures which effected the minimum temperatures within the tent.

Thus, there was little difference in the minimum temperature inside and outside of the tent between the first and second sampling period. However, between the second and third sampling times there was approximately a 16°F difference. This could be an explanation for the increase in electrolyte leakage of roots under the tent compared to those outside the tent.

We intend to repeat this study again this winter. We hope the information gathered from this study will identify the time/ temperature required to deacclimate seed sources which are sensitive to freeze damage. Nursery managers must be aware of this relationship so they can better monitor temperatures during winter months when night and day temperatures are fluctuating greatly.

Area–wide Demonstration of Methyl Bromide Alternatives

Marietjie Quicke

The studies reported herein are part of the USDA – ARS Area-wide Pest Management Project for Methyl Bromide Alternatives – South Atlantic Region. This is a long-term effort by the Auburn University Southern Forest Nursery Management Cooperative to identify and evaluate alternatives to methyl bromide (MBr). Fumigation with methyl bromide has been the most commonly used method for producing high quality, pest-free forest tree seedlings in the Southeast. This study is a large scale demonstration of seven fumigants managed under normal best management nursery practices. This is a report of data collected during the first of a two year study.

Experiments and Measurements: A five section (9 bed rows each) fumigation trial was established in loblolly pine seedbeds at Plum Creek Timber Company in Jesup, GA and Rayonier Regeneration Center in Glennville, GA to look at alternative

Table 1. Fumigants and rates used in 2007 Area–wide demonstration plots.

Fumigant	Rate	Components
MBr	350 lbs/a	67% MBr & 33% Chlor
DMDS + Pic	74 gal/a (731 lbs/a)	79% DMDS & 21% Chloropicrin
MBC 70/30	400 lbs/a	70% MBr (98/2) & 30% Solvent A
New Pic+	300 lbs/a	85% Chloropicrin + 15% Solvent B
Pic+	300 lbs/a	85% Chloropicrin + 15% Solvent A
Chloropicrin	300 lbs/a	100% Chloropicrin
Pic-Chlor 60	400 lbs/a	60% Chlor. & 40% 1,3-D

Table 2. Trial information for each location

	Jesup, GA	Glennville, GA
Fumigation	3-Apr-07	20-Mar-07
Fumigation type	Broadcast/flat tarp	Broadcast/flat tarp
Area in trial	4 acres	10 acres
Air temperature range	67° to 88°F	50° to 78°F
Wind speed	3 – 6 mph	3 – 13 mph
Soil moisture	8.5%	5.5%
Soil series	Norfolk loamy sand	Tifton loamy sand
Plastic in place	7 days	7 days

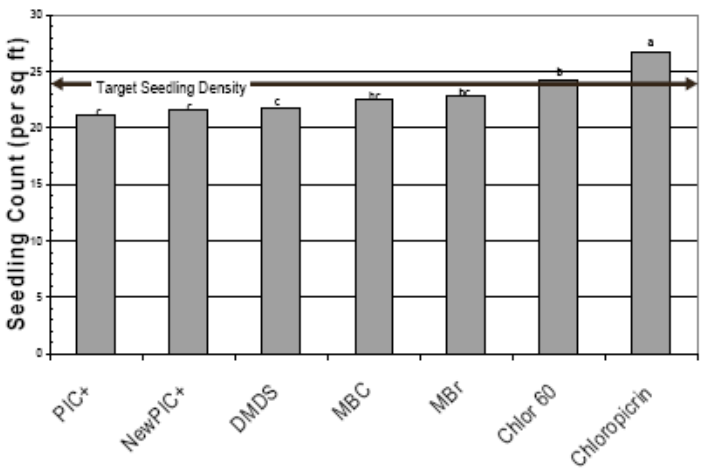
Table 3. Four week post fumigation soil fungi data.

	Jesup		Glennville	
Treatment	Mean cfu/g soil of total fungi[1]	Proportion of *Trichoderma*	Mean cfu/g soil of total fungi	Proportion of *Trichoderma*
MBC	61 b[2]	0.37 bc	178 c	0.50 bc
DMDS + Pic	118 a	0.48 ab	103 d	0.82 a
Chloropicrin	127 a	0.38 bc	197 bc	0.29 d
PIC+	133 a	0.27 c	184 c	0.35 cd
NewPIC+	140 a	0.31 bc	211ab	0.38 cd
MBr	144 a	0.60 a	222 a	0.60 b
Chlor 60	146 a	0.35 bc	196 bc	0.22 d

[1]cfu/g = colony units per gram.

[2] Letters within a column indicate significant differences at the 0.05 level.

Figure 1. Four week post-sowing seedling counts from Jessup, GA nursery. Letters for each treatment indicate significant differences at the 0.05 level.



fumigants for the production of forest tree seedlings over a typical two-year rotation. Methyl bromide and six alternatives were applied during the spring 2007 fumigation (Table 1) and covered with 1 ml High Density Polyethylene Tarp (Cadillac Plastics Inc.) as broadcast/flat tarp. The choices of fumigant alternatives were determined, with the exception of New Pic+, from previous small plot studies conducted by the Nursery Cooperative. New Pic+ is a reformulation of Pic+ which was previously tested.

At the Rayonier Regeneration Center, Glennville, GA, 10 acres out of a total 45 production acres were fumigated in March 2007 (Table 2). The experimental design is a randomized complete block replicated five times with each treatment being 600 linear bed feet. At Plum Creek Timber Company, Jesup, GA, 4 acres out of a total 51 production acres were fumigated in April 2007 (Table 2). The experimental design used a randomized complete block design replicated four times with each treatment 300 linear bed feet.

Soil samples were collected pre-sowing, post-sowing and midsummer. One sample was plated onto media selective for the soil fungus, *Trichoderma,* which was quantified for each treatment and the other half was examined for nematodes using the Nematode Laboratory, Auburn University. Seedling counts were conducted at four and eight weeks. Seedlings were collected at eight weeks. Root collar diameter, height, dry weight and weeds were recorded following the eight week sample. Soil and seedling samples were collected at 12 weeks, as well as pre- and post-sowing, midsummer and fall the second year.

Results and Discussion: At four weeks post-sowing, seedling counts at Jesup resulted in chloropicrin having two seedlings per square foot more than the other treatments (Figure 1). A small increase or decrease in seedling counts on a total nursery production basis can affect revenue significantly. A two seedling per square foot increase for the whole nursery could result in as much as $117,000 additional revenue. At the Glennville nursery, the seedling count data was confounded due to severe wind damage that occurred shortly after sowing.

The soil data at four weeks post-sowing indicates significantly high levels of *Trichoderma* in the methyl bromide treatment (Table 3). This is consistent with previous Nursery Cooperative research showing *Trichoderma* is an important soil borne fungus necessary for proper growth of pine seedlings. Levels of *Trichoderma* in the DMDS + Chloropicrin treatment were encouraging since previous studies indicated that DMDS alone did not favor *Trichoderma* development.

At four weeks post-sowing, nematodes were not detected in any treatment.

Nursery Technology 101

Does Water Quality Effect Pesticide Efficacy?

Tom Starkey

At the Contact Meeting in St Simons Island, we made a presentation on how pH can alter pesticide efficacy, especially the fungicide Captan®. However, pH is just one of the water quality factors that determine how your pesticide will behave.

Many nurseries use Captan® early in the season to control damping off. This fungicide is relatively cheap and is effective - if used in the proper manner. However, Captan® is a fungicide that is dramatically affected by water quality, specifically pH.

What is pH?

pH (**p**otential of **H**ydrogen) is a scale measuring the acidity or alkalinity of a solution. The pH scale uses a range from 0 to 14, with 7.0 indicating neutrality. Numbers moving from 7.0 toward 0 indicate acidity, while the numbers beginning at 7.0 and moving toward 14 indicate alkalinity. The pH scale is logarithmic. Each whole pH value below 7 is ten times more acidic than the next higher value. For example, a pH of 3 is ten times more acidic than a pH of 4 and 100 times (10 times 10) more acidic than a pH of 5. The same holds true for pH values above 7. For example, a pH of 10 is ten times more alkaline than a pH of 9.

When a chemical is added to water, it undergoes a process called "hydrolysis". This is a measure of the rate at which the chemical breaks down in the presence of water at a specific pH. Hydrolysis is expressed in terms of "half-life". For example, let's assume that chemical "A" which has a half-life of 1 hour at pH 8.0 is added to a spray tank with a water pH of 8.0. This means that if 1 hour has passed since the time you put chemical "A" in your spray tank until it dries on the plant surface, 50% of the active ingredient has broken down. For some chemicals, the hydrolysis of the original product continues to have biological activity; however, the research data on these chemicals is very limited.

For chemicals that are pH sensitive, you should be concerned how long the chemical remains in your spray tank. At some nurseries it is a standard practice to mix the chemical and spray immediately, leaving no chemical remaining in the spray tank. At other nurseries, a spray tank is mixed and the chemical is used, sometimes over a couple of days until the tank is empty. This practice can create problems with certain pesticides.

pH	Captan® half-life
5	32 hours
7	8 minutes
8	10 minutes
9	2 minutes

In general, insecticides are the most susceptible to hydrolysis. Herbicides are the most resistant with fungicides falling in the middle. There are exceptions within each group of pesticides. However, the fungicide Captan® is frequently cited in the literature as one of the most pH sensitive chemical to hydrolysis. This is readily seen in the following table. As the pH of the spray water becomes more basic, the half-life of Captan® rapidly decreases.

Hot, Dry Summer

This year we have seen more seedlings affected by heat than we have seen in a long time. In some cases, soils without a much may have reached 110 F in May. At some locations, the irrigation cycle using a center-pivot was too long to keep all seedlings cool. The following text is adapted from one of my students Liz Heidbreder.

Seedlings are most susceptible to heat stress in the first few week after germination (May 1984). The damage often occurs above the soil line where the tender cortical stem tissue is located. It manifests as a depressed area of necrotic tissue called a "heat lesion". Older seedlings are less susceptible to heat stress. Heat lesions may still occur, but the lignified stem provides insulation for the sensitive tissues (McDonald 1984).

The killing temperature for the stem is about 104° F. Irrigation can be applied in order to keep the stem below this critical temperature. Watering during the heat of the day can bring surface soil temperatures down 20° F and air temperatures down 10-15° F. Irrigation is suggested for young seedlings (in May) if the air temperatures exceed 90° F. The irrigation water makes its own microclimate that cools the seedlings. This allows the seedlings to continue growing that would otherwise be shut down due to excess transpirational losses of water compared to the amount the roots can take up (McDonald 1984; May 1984). Irrigation frequency is gradually decreased as seedlings develop, but this occurs at the same time of the year that they are most likely to be subjected to heat stress. Frequent, short irrigations are recommended to cool the soil surface (McDonald 1984, Israelson et al. 1980). -- DS

Israelson, O.W., V.E. Hansen and G.E. Stringham. 1980. Irrigation Principles and Practices. John Wiley and Sons. 4th edition. 417 pp.

May, J.T. 1984. Southern Pine Nursery Handbook. USDA Forest Service Southeastern Area State and Private Forestry. Atlanta, Georgia. ed. C.W. Lantz.

McDonald, S.E. 1984. Irrigation in forest-tree nurseries: Monitoring and effects on seedling growth. *In.* Forest Nursery Manual. Duryea, M.L. and T.D. Landis (eds.). Nijhoff/Junk Publishers. pp. 107-121.

What do you need to do if you want to continue using Captan®? First of all you need a recent pH measurement of the water you are using in your spray tank. If the pH is greater than 5.0 (which is the listed optimum pH for Captan®) you should consider buffering the water in your spray tank. These buffering agents are readily available from your chemical supplier and are added to the spray tank to alter pH of the water before the chemical is added. Not all buffers are suitable for all pesticides. Tell your chemical supplier which pesticide you are concerned about.

Wilbur-Ellis Company has provided a list of 95 pesticides listing the optimum pH, whether buffering is suggested and information on the chemical half life. I have listed a portion of some of the more familiar pesticides on the next page. The complete list can be viewed on the Coop web site in the same area as the Chemical Labels.

20 Years Ago . . .

...David South was the Coop Director. Here is a list of topics covered in the Fall 1987 Newsletter:

PPG Industries will pursue registration of Cobra. Results of a study of Cobra and Modown at Union Springs and Selma were reported. ICI America is enthusiastic about pursuing registration of Reflex for pines. EPTC control of nutsedge in Arkansas and SC. Weekly applications of Goal may reduce seedling growth. Post planting heights affect survival. The use of chemicals to control height growth. Seedling diameter is correlated with RGP. Field survival versus date of lifting. Effect of nitrogen on field growth. Irrigation uniformity and design factors was to be discussed at the Tyler, TX meeting. Terminology differences between "dormancy" and "hardening –off". Withholding irrigation during fall months reduces seedling growth in loblolly. Problems in planting pines in abandoned soybean and peanut fields.

Why Isn't My Roundup® Working? The following is part of an article obtained from Oregon State University Weed Science web page: http://oregonstate.edu/dept/nursery-weeds/feature_articles/spray_tank/spray_tank.htm written by Dr. James Altland, Oregon State University, North Willamette Research & Extension Center .

In this article the author discusses the broad topic of water qualities affect on herbicide efficacy. The author makes several interesting comments about the affect of water quality especially related to glyphosate (Roundup®).

Pesticides are measured for their ability to bind soil particles. Pesticides with a high soil organic carbon sorption coefficient (KOC) bind tightly to soil particles. Glyphosate has a high KOC values and is therefore rapidly and tightly adsorbed to soil particles and organic matter. This is why spraying the soil around the target weed is of no value. Glyphosate quickly binds with soil particles and is not available to the plant. This high KOC value is also important if you have turbid water or water containing suspended solids, soil or organic matter. Glyphosate is quickly tied up and never has the opportunity to get into the plant. Many herbicides have an affinity to bind to organic matter in the water. Actually, the finer the particles (harder to see), the more binding can occur. This means that the water may "look" free of organic matter, but it is still there and capable of tying up the herbicide.

Glyphosate kills plants by binding to an enzyme in the plant called EPSP synthase. When binding occurs, the enzyme cannot function and the plant cannot produce three critical amino acids. Plant death follows.

Hard water is generally considered water with high levels of calcium, magnesium, sodium or iron cations. When these are present in the spray water, glyphosate binds with these cations and is not able to bind with the EPSP synthase in the plant. If it cannot bind to the enzyme, it will not provide control. Check your water analysis and see if you have hard water.

I have frequently heard of nursery managers making a pesticide "hot" by the addition of ammonium sulfate to the spray tank. In this article, the author advocates that adding ammonium sulfate to water will enhance control with glyphosate. The ammonium cation preferentially attaches to the glyphosate molecule and thus prevents the calcium, magnesium, sodium or iron cations from doing so. With ammonium attached, the glyphosate molecule readily binds to the EPSP synthase in the plant. Plant death follows.

The importance of "good water" was recently brought to light in some test plots sprayed with the herbicide Scythe® using pond water and tap water for the control spurge. The Scythe® plus tap water was more effective than when pond water was used.

Product	Buffering?	Optimum pH	Comments
Aliette®	No	6.0	Stable pH 4.0 to 8.0
Arsenal®	No	7.0	Stable over wide range of pH
Bayleton®	No	7.0	Stable over wide range of pH
Bravo®	No	7.0	Stable over wide range of pH
Cleary 3336®	No	6.5	Subject to hydrolysis above pH 7.5
Chlorpyrifos®	No	7.0	pH 8.0 = 1.5 days, pH 7.0 35 days
Daconil®	No	7.0	Stable over wide range of pH
Fusilade®	No	7.0	pH 9.0 = 17 days, pH 7.0 = 21 weeks
Goal®	No	7.0	Stable at neutral pH
Imidan®	Yes	5.0	pH 8.0 = 33 min. pH 7.0 = 1 hr, pH 5.0 = 7 days
Roundup®	Yes	5.5	Optimum pH 5.0 to 6.0
Subdue MAXX®	No	7.0	Stable over wide range of pH
Terrachlor®	Yes	5.5	Rapid hydrolysis at pH > 7.0
Velpar®	No	7.0	Not effected by pH

Leadership Development

Whatever It Takes! – Keys to a "Can-Do" Attitude

The following edited article written by Dr. John C. Maxwell and appeared in "Leadership Wired" - August 2006.

There is a faint but discernable dividing line that separates achievers from dreamers. What makes the difference? Attitude. Achievers have a can-do attitude that sets them apart from mere dreamers.

Here are 10 keys to cultivating a can-do attitude.

Key #1: Disown Your Helplessness.
Can-do leaders take responsibility for the future. Rather than wallowing in helplessness, can-do leaders search diligently to overcome the obstacles in front of them.

Key #2: Take the Bull By the Horns.
Can-do people are fearless. People with a can-do attitude have an aggressiveness about them. They take the bull by the horns. They don't wait, they initiate.

Key #3: Enter the No Whining Zone.
Can-do people abstain from complaining. As George Washington Carver observed, "Ninety-nine percent of failures come from people who have a habit of making excuses."

Key #4: Put On Another's Pair of Shoes.
Can-do people empathize with others. They attempt to see any predicament from the other person's perspective in order to make the best decisions.

Key #5: Nurture Your Passion.
Can-do people are immune to burn-out. In leadership, the prize is not given to the person who's the smartest, or in a better position, but the prize goes to the person with passion.

Key #6: Walk the Second Mile.
Can-do people exceed expectations. They set expectations for themselves higher than what is dictated by the people or situations around them.

Key #7: Quit Stewing and Start Doing.
Can-do people take action. While others are crippled by worry, fear, and anxiety, they have the fortitude to press forward. Can-do leaders take risks.

Key #8: Go With the Flow.
Can-do people can adjust to change. They don't get caught griping about an unexpected curve in the road. They accept transition with an optimistic outlook.

Key #9: Follow Through to the End.
Can-do people not only initiate, they finish. They are self-starters with the capacity to close the deal.

Key #10: Expect a Return as a Result of Your Commitment.
Committed leaders will reap rewards and find open doors as others are drawn to the excitement and energy emanating from them.

Pesticide Labels: Read Them!

Ever make a mistake applying herbicides? Some might calibrate the sprayer incorrectly and apply more herbicide per acre than needed. In one case, a worker did not read the label and mistakenly applied Caparol® to young pine seedlings instead of Captan®. As a result, the young seedlings turned yellow. Before you apply an herbicide, you should read the label to make sure it contains ONLY the herbicide you want. Unfortunately, some companies now use the same trade-name when selling different herbicides. For example:

- Cimarron® contains only metsulfuron methyl.
- Cimarron Max® contains metsulfuron methyl plus dicamba and 2,4-D.
- Cimarron Xtra® contains metsulfuron methyl and chlorsulfuron.
- Cimarron Plus® contains metsulfuron methyl and chlorsulfuron.

Recently a manager ordered Cimarron® but the distributor delivered Cimarron Max®. Fortunately, the manager read the label and noticed the distributor's error. This is another example of why reading the label can avoid a costly mistake.

In the future, it may be best to order herbicides that cause less confusion. For example, Escort® and MSM 60® only contain metsulfuron methyl. There is a good chance that if you order one of these products, the distributor will likely deliver what you ordered. -- DS

Warm Temperatures Followed by a Hard Freeze

Reports of root injury are coming in again from the lower South this year! Freeze injury to roots occurred this time from Arkansas to South Carolina. As in the past, areas affected were confined to USDA hardiness zones 8a and 7b. This season, was a little different than in the past since multiple freeze events occurred. The coldest temperature occurred in late fall on Dec. 9th (this we believe was a pre-acclimation freeze). Temperatures dropped to 14 F to 19 F at some locations. In January, temperatures dropped again to 21-24 F and in February, temperatures dropped to 20-23 F. In early spring, temperatures were in the 80's (April 1-4) and then on Easter (April 8th), the temperature dropped to as low as 26 F. This late freeze devastated the SC and GA peach crops with estimates (in some places) exceeding a 50% loss in production. However, the Easter freeze likely did little damage to pines that were planted before March. We suspect the December, January or February freezes injured and killed some newly planted seedlings. This year we received several calls regarding seedlings that were planted in January or February but were dead by the first of April. We think in some cases, the severe drought this year may have some foresters thinking low survival is due to a lack of rain, when it might be due to planting trees just prior to a hard freeze. -- DS

Staff Updates

Changes

Ken Mc Nabb

As many of you know, I have considerable background in international studies, having lived overseas for close to 12 years. I have maintained regular interaction with colleagues from other countries and have hosted foreign groups as they come through Auburn. My interests and abilities in international studies recently resulted in a new professional opportunity.

The Provost of Auburn University, John Hielman, has asked me to take over the directorship of the Office of International Education for Auburn University. I have decided to accept this offer and began these duties effective Monday, August 27. This is a full time position and will require my complete attention. As such, I've had to give up my duties in the School of Forestry and Wildlife Sciences at Auburn. While I plan to complete the Production Survey this year, the future of the hardwood manual is in discussion among Coop Staff.

Once a nurseryman, always a nurseryman, so who knows, maybe I'll continue to join you at a meeting or two. Keep up the good work.

Introducing... Paul Jackson!

I am a new PhD student under the direction of Dr. Scott Enebak and Dr. Charles Gilliam (Horticulture) through the Southern Forest Nursery Management Cooperative (SFNMC) at Auburn University. I am proud to be part of the SFNMC's efforts towards understanding and enhancing pine seedling quality. The research staff is known all around the world for the information they provide, and it is a dream come true to have an opportunity to work alongside them.

I am from Montgomery, Louisiana, a small town in the Central part of the state just north of Alexandria. I received my B.S. in Biology from Northwestern State University in 2000. I began my career with the USDA Forest Service, Southern Research Station in Pineville, Louisiana in February 2001 as a Biological Science Technician. I worked with the Restoring and Managing Longleaf Pine Ecosystems research work unit. I was the principal container nursery manager, growing seedlings for my own research and for any projects of other scientists in the unit.

I was supervised and mentored by Dr. James P. Barnett, who is one of the most well-known pine tree regeneration researchers. He contributed substantially to seed and seedling quality for over 45 years. After, Dr. Barnett's retirement, I began working for Dr. Shi-Jean "Susana" Sung, an energetic researcher who gave me much insight and knowledge. Our focus was mainly plant physiology, where I learned to use many techniques related to chlorophyll extraction, nutrient analysis, oak regeneration, analyzing pine tree root systems, and measuring photosynthesis and water potential. I'll take this opportunity to thank them both for changing my life in so many positive ways and ultimately leading me to Auburn University.

As far as my research project at Auburn, nurseries in the south have been troubled with pine seedlings not surviving after outplanting from cold storage. Our research will focus on the presence and environment of Pythium, which is a common parasite in forest tree nurseries and may lead to diseases in storage. I am excited about putting my efforts towards finding answers that will protect nurseries from seedling mortality related to cold storage. I look forward to meeting all of the members in the years to come. Please feel free to contact me at any time (dpj0001@auburn.edu).

And... Marietjie (prn. "Marie-key") Quicke!

Hello, I am the new Research Associate with the Coop, working on the USDA Area-wide Methyl Bromide Alternatives project. I grew up in Cape Town, South Africa, and moved to Iowa in 1971.

I attended Iowa State University receiving a BS Forestry degree in 1981. Those of you who graduated around this time may recall that forestry classes were large and employment opportunities were scarce. I spent the first summer working for the USFS on the Fremont National Forest in eastern Oregon, before accepting a 3-year contract with the South African Government Department of Forestry. In South Africa, I worked as a silviculture research scientist, first in Natal (now Kwa-Zulu Natal) and then in the Southern Cape.

Upon returning to the USA, I accepted a Graduate Research Assistantship at Auburn University to complete a MS degree under David South. For my research project I investigated the use of electrical resistance strain gages to measure diameter changes in loblolly pine seedlings in response to various stresses.

Since graduating in 1989, I have raised 2 children and worked as a forestry consultant managing forest research studies and data bases.

Phone Numbers at a Glance

Scott Enebak	334.844.1028
David South	334.844.1022
Tom Starkey	334.844.8069
Tommy Hill	334.844.4998
Marietjie Quicke	334.844.4998
Elizabeth Bowersock	334.844.1012