Proline®

A New Fungicide for Forest Tree Nurseries?

Tom Starkey & Scott Enebak

Southern Forest Nursery Cooperative

Auburn University

School of Forestry & Wildlife Sciences

Nov. 2008

Outline for Today

- Brief history of prothioconazole
- Summary of Coop studies (completed & in-progress)
  1. Fusiform Rust studies
     - Greenhouse/USFS Lab
     - Field
  2. Pitch Canker
     - Lab
     - Greenhouse
     - Field
  3. Rhizoctonia Foliar Blight
     - Field
- Labeling possibilities and further research needs

PROLINE®

Bayer CropScience

GROUP	3	FUNGICIDE

PROLINE® 480 SC FUNGICIDE

For control of specified diseases on various crops.

Active Ingredient: Prothioconazole, 2-[2-(1-Chlorocyclopropyl)-3-(2-chlorophenyl)-2-hydroxypropyl]-1,2-dihydro-3*H*-1,2,4-triazole-3-thione	41.0%
Inert Ingredients:	59.0%
Contains 4 pounds Prothioconazole per gallon	100.0%

EPA Reg. No. 264-825 EPA Est. 3125-MO-01

Prothioconazole was introduced at the Brighton Conf. in 2002. Proline® was registered in the USA on March 27, 2007.

Nov. 2008

Prothioconazole

- Prothioconazole has the broadest spectrum of any azole currently available and possesses some unique properties.
  - Prothioconazole is xylem and phloem systemic
  - Behaves as an excellent long-term protectant on the leaf surface.
  - Re-invents itself inside the plant to give extended curative benefits.
  - Has unique greening effects not seen with other azoles.
- Efficiently stops all important steps of the fungal infection chain like appressoria and haustoria formation, mycelial growth as well as spore formation.

Prothioconazole

- Has shown very good fungicidal activity the control of ascomycetes, basidiomycetes, and deuteromycetes :
  - *Fusarium* **
  - *Rhizoctonia* **
  - *Sclerotium*
  - *Cylindrocadium*

Fusiform Rust Fungicide Alternative Study

Tom Starkey
Scott Enebak
- Southern Forest Nursery Management Cooperative
Auburn University

Nov. 2008

2008 Study Fungicides

Fungicide	*Manufacturer*	*Active Ingredient*	*Chemical Class*
Bayleton®	**Bayer Cropscience**	**Triadimefon 50%**	**Triazole**
Provost ® 433 SC	**Bayer Cropscience**	**Prothioconazole – 12.9%** **Tebuconazole – 25.8%**	**Triazole** **Triazole**
Proline ® 480 SC	**Bayer Cropscience**	**Prothioconazole – 41.0%**	**Triazole**

This Year - 2 Species of Pine:
Loblolly
Slash

Germination Results Following Seed Treatments

Seed Trt	% Germination following Seed Trt Loblolly	% Germination following Seed Trt Slash
Check (H_2O)	95%	93%
Bayleton	92%	96%
Provost	96%	93%
Proline	96%	93%

Nov. 2008

What has happened to date?

- Seed treatments applied and seed sown on 4/17/07.
- Seedlings for foliar and seed test taken to Asheville, NC Rust Lab on 5/6/08.
- Seedlings challenged with rust spores week of 5/12/07.
- 3 month & 6 month evaluations to be done at Rust Lab.


@ 3 months
Nov. 2008


@ 6 months
Nov. 2008

6 month results – seed treatment

		Loblolly	Slash
Seed Treatment	% Germination	6-Month Mean	6-Month Mean
Fungicides	Lob/Slash	% Infection	% Infection
Check	95%/93%	12.6% A	49.0% A
Bayleton®	92%/96%	0.0% B	5.7% B
Provost 433 SC®	96%/93%	0.0% B	7.5% B
Proline 480 SC®	96%/93%	1.0% B	1.8% B
	lsd	*6.7*	*6.7*

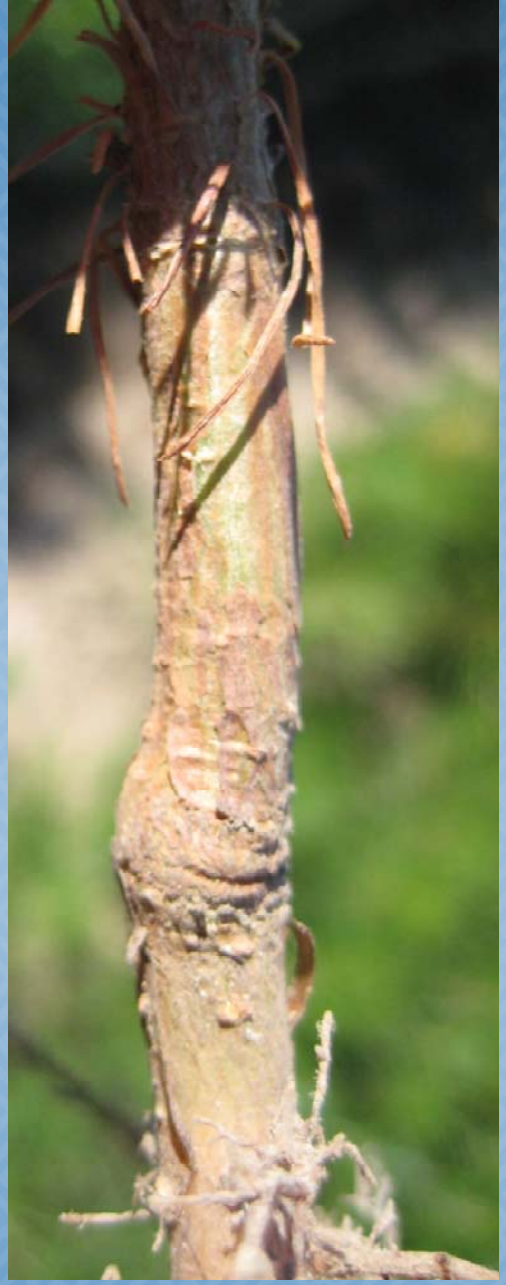
6 month results – foliar treatment

		Loblolly	Slash
Foliar Treatment		6-Month Mean	6-Month Mean
Fungicides	Foliar Rate[1]	% Infection	% Infection
Check (water)	N/A	7.5% A	40.2% A
Bayleton®	8 oz/a	7.1% A	35.5% A
Provost 433 SC®	8.5 fl oz/a	2.5% A	9.4% C
Proline 480 SC®	5 fl oz/a	6.9% A	22.6% B
	lsd	*6.6*	*12.8*
USFS Check Seedlings		45%	76%

Nov. 2008

Nursery Fusiform Rust Study

- Thanks to: Steve Cantrell – SC Taylor Forest Tree Nursery & Robert Cross – GA Supertree Nursery Arborgen
- Seed at both nurseries treated operationally with Bayleton.
- Foliar Sprays:
  - Provost
  - Proline
  - Bayleton
  - Control
- Randomized complete block design. Total area of each treatment 2/3 – 1 acre in size.



Nov. 2008

Trenton - # galls/rep/100 trees

	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Control	3	1	1	0	5
Bayleton	0	0	0	0	0
Proline	0	1	1	0	0
Provost	0	0	0	0	0

Nov. 2008

Shellman, GA data to be collected 1st week of December

Nov. 2008

Report of Efficacy of Proline® and Pagaent® Fungicides on *Fusarium circinatum* in the Laboratory: the causal agent of Pitch Canker in Southern Pines

Tom Starkey
Scott Enebak
Southern Forest Nursery Management Cooperative
Auburn University

Nov. 2008

What is the importance of this study?

- Pitch Canker is considered by some to be the most threatening tree disease in the world. PC is the limiting disease in South African nurseries. In Calif. it has caused significant losses on Monterey Pine
- There are no fungicides registered for the control of Pitch Canker on seedlings.
- Labeling benefit

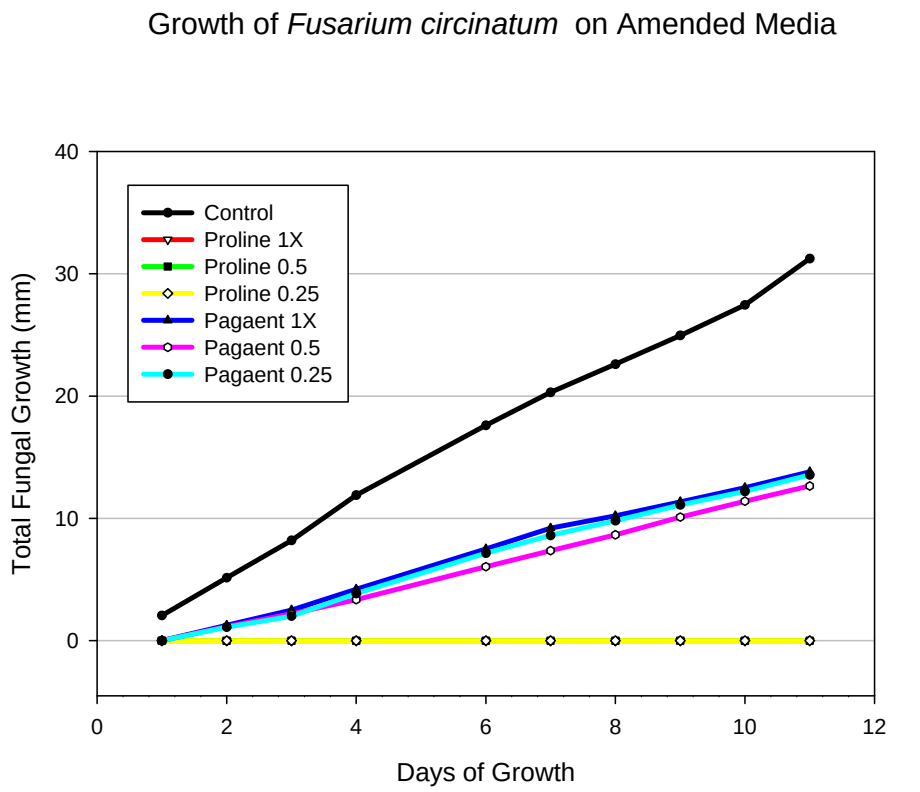
Proline Fungicide

- Proline 480 SC®
- Manufactured by Bayer CropScience
- Active Ingredient – prothioconazole 41%
  - Rates used:
    - 1x = 5 fl oz acre based upon 30 gal water/acre
    - 0.5x = 2.5 fl oz acre based upon 30 gal water/acre
    - 0.25x = 1.25 fl oz acre based upon 30 gal water/acre

Pagaent Fungicide

- Pagaent®
- Manufactured by BASF
- Active Ingredients – pyraclostrobin 12.8% & boscalid 25.2%
  - Rates used:
    - 1x = 14 oz/100 gal
    - 0.5x = 7 oz/100 gal
    - 0.25x = 3.5 oz/100 gal

Results



Each data point for each treatment represents the average of 20 plates

Observations:

- No fungal growth was observed on the Proline ® amended PDA plates for any concentration over the 11 day period.

On some Proline ® plates the fungus grew out from the original plug for several mm, never touching the amended PDA . The appearance was that of a mushroom cap suspended over the soil.

Fusarium circinatum was inhibited, but did grow on all concentrations of Pageant ®. There were no differences between the concentrations of Pagaent ®.

Nov. 2008

Photographs

Nov. 2008

Photographs

Control at 11 days

Photographs

Proline ® Plug
after 11 days

Nov. 2008

Photographs

Pageant ®
Plug after 11 days

Follow- up

- After 11 days, when the plugs were placed back on unamended PDA.
- Purpose – to see if the fungicide was:
  1. Fungicidal - killed the fungus
  2. Fungistatic – inhibited fungal growth
- *Fusarium circinatum* grew from the all Pagaent® amended media but not from any of the Proline® amended media.

Photographs

Proline ® (Left) and Pageant ® (Right) Plugs replated on unamended PDA

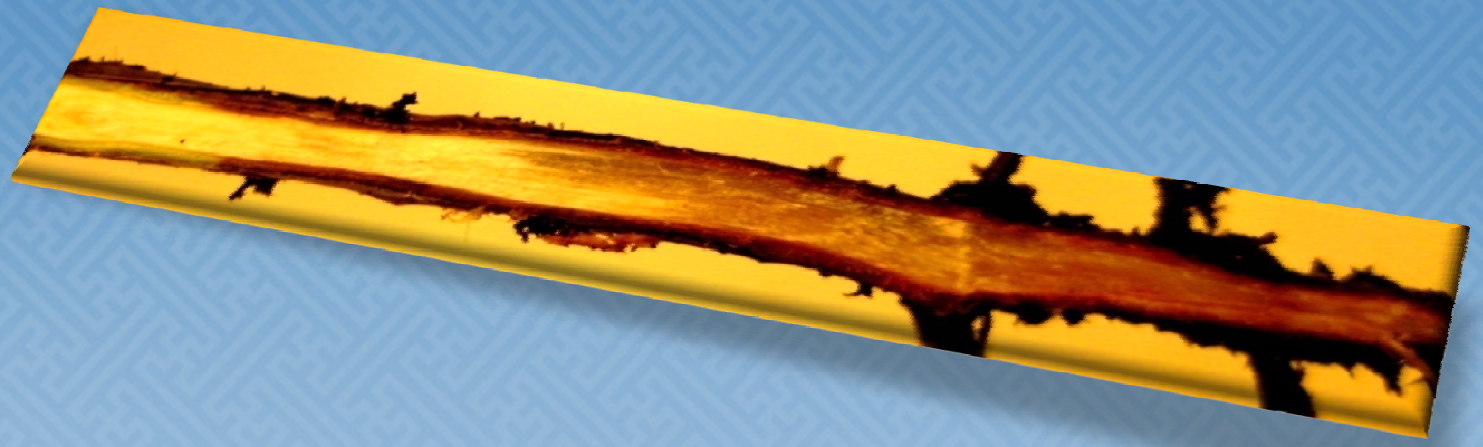
Nov. 2008

Photographs

Proline ® Plugs
Replated on
unamended PDA

Conclusions

- Proline®
  - No fungal growth on plates after 11 days.
  - All three rates controlled the fungus.
  - The fungus was killed on the plates and did not grow when placed on unameded PDA at the end of the study.
- Pagaent ®
  - Fungal growth was suppressed at all levels tested compared to the control.
  - There was no difference between the rates tested.
  - The fungus was not killed but started to regrow when placed on unamended PDA at the end of the study.



Pitch Canker – Proline Greenhouse Study

Tom Starkey
Scott Enebak
Southern Forest Nursery Management Cooperative
Auburn University

Nov. 2008

Study Details

- Longleaf seed from a family known to have had Pitch Canker in the past was used.
- To increase fungal pressure, a 8mm agar plug of *Fusarium circinatum* was added to ½ of the cavities at time of sowing
- Treatments:
    1. Fungal plug added, no Proline spray
    2. Fungal plug added , Proline spray
    3. No fungal plug added, no Proline spray
    4. No fungal plug added, Proline spray

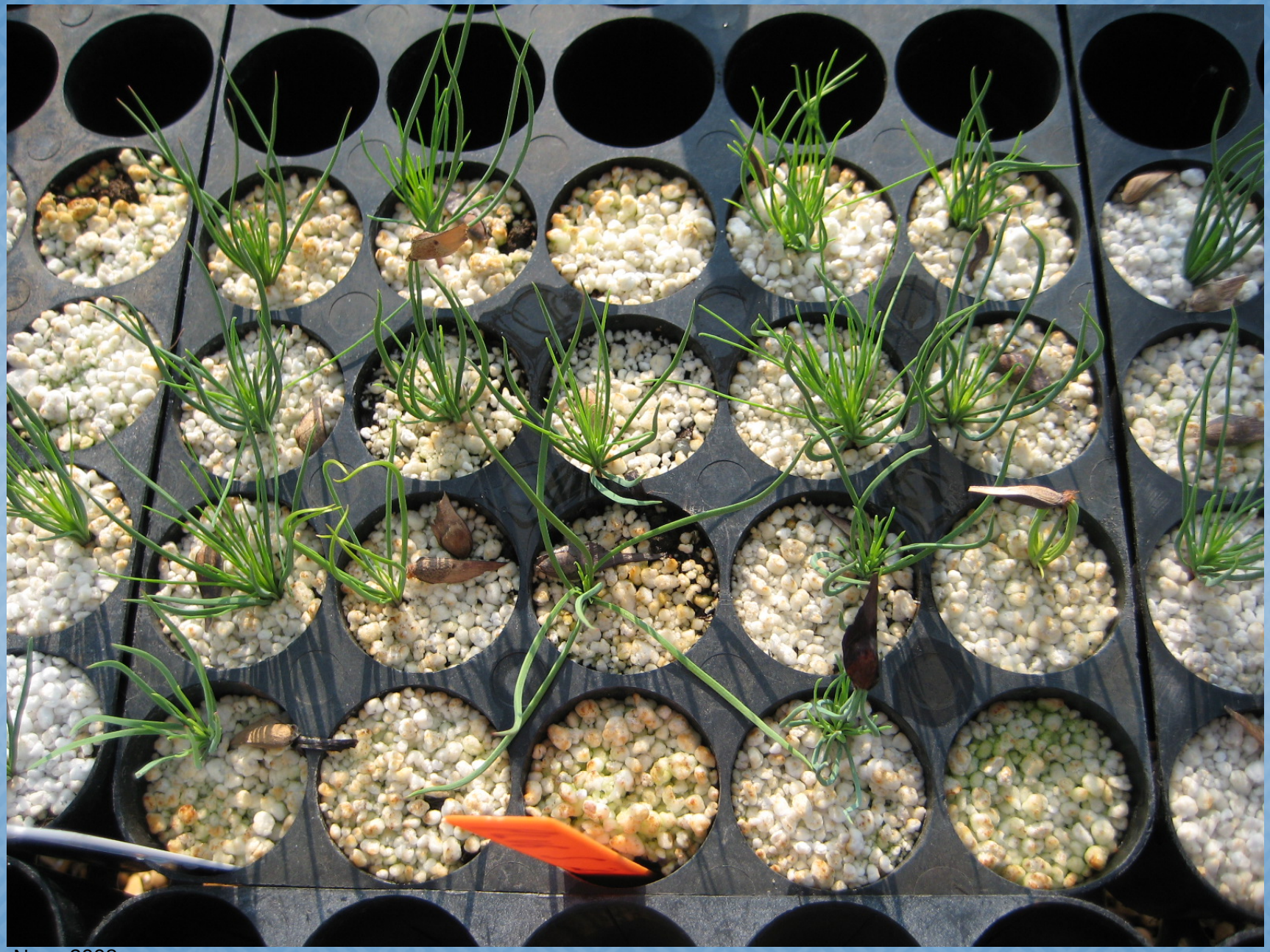
Study Details

- 20 container sets each with 20 cavities /trt.
- Cavity fill percentage was measured at week 1 (6/5/08), week 2, week 3, week 4, week 7, week 11 and week 18 (9/29/08).
- Proline @ 5.5 fl oz/a sprayed every 2 weeks beginning 6/5/08

Nov. 2008

Nov. 2008

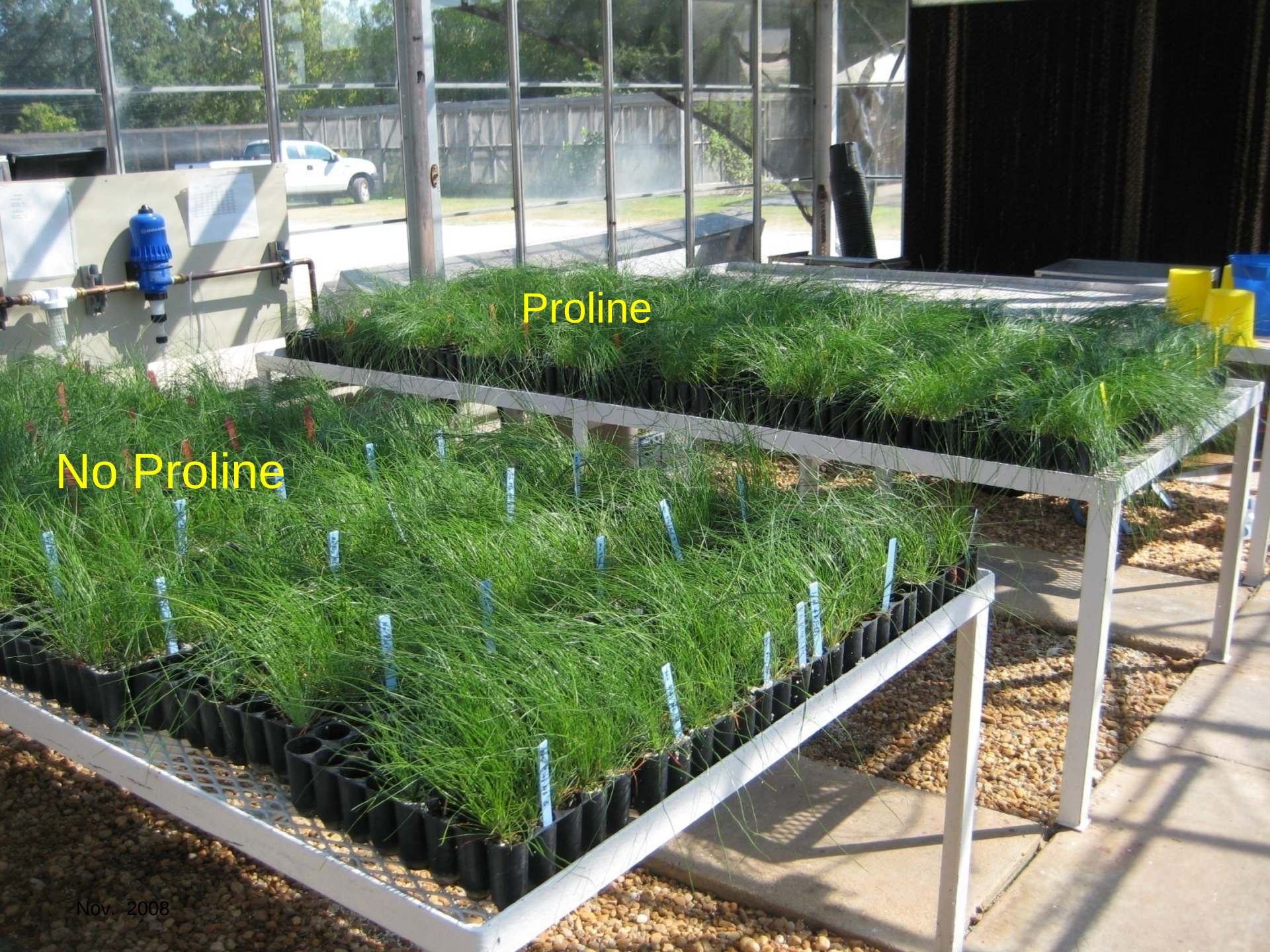
Nov. 2008



Nov. 2008


Nov. 2008


Nov. 2008


Proline
No Proline
Nov. 2008

Final Seedling Measurements

				Dry Weight	
	Proportion of Cavities Filled	Height (in)	RCD (mm)	Top (g)	Root (g)
Fungal Plug + Proline	0.79 A	12.6 A	4.6 A	1.40 A	0.56 B
Fungal Plug No Proline	0.62 C	11.1 B	4.7 A	1.23 B	0.64 A
No Fungal Plug + Proline	0.80 A	12.5 A	4.7 A	1.42 A	0.58 AB
No Fungal Plug No Proline	0.69 B	11.4 B	4.3 B	1.22 B	0.52 B
lsd	*0.07*	*0.5*	*0.2*	*0.11*	*0.07*

Nov. 2008

Future Outlook & Ongoing Work

- Optimistic that Proline can control Pitch Canker in LL seedlings.
- Proline is not phytotoxic on LL, Lob, Slash seedlings (foliar) .
- Proline is not phytotoxic as a seed treatment on Lob and Slash
- Currently testing Proline seed treatment on germinating longleaf and shortleaf seed.

Control of Rhizoctonia Foliar Blight on Loblolly Pine Using Proline®

Tom Starkey & Scott Enebak
Southern Forest Nursery Cooperative

Ken McQuage & Kevin Barfield
Plum Creek Pearl River Nursery

Nov. 2008

Rhizoctonia Foliar Blight

- First observed in 1986 – Virginia Dept. of Forestry, New Kent Nursery.
- Both Longleaf & Loblolly are susceptible – but apparently not slash.
- Within any one nursery – isolated disease foci rather than entire beds.
- Disease becomes a problem when:
  1. Canopy closes in
  2. Extended periods of free moisture
  3. Average daily temperatures begin to drop below 90°F.
  4. Worse on 2nd+ year land.

Rhizoctonia Foliar Blight

- The amount of loss is highly correlated with amount of free moisture and temperatures.
- At Pearl River Nursery the amount of disease is “spotty” (<0.5% to 1%); primarily on coastal lines.
- Symptoms develop from inside canopy and move up and out.
- Usually first noticed after top clipping which exposes disease foci.

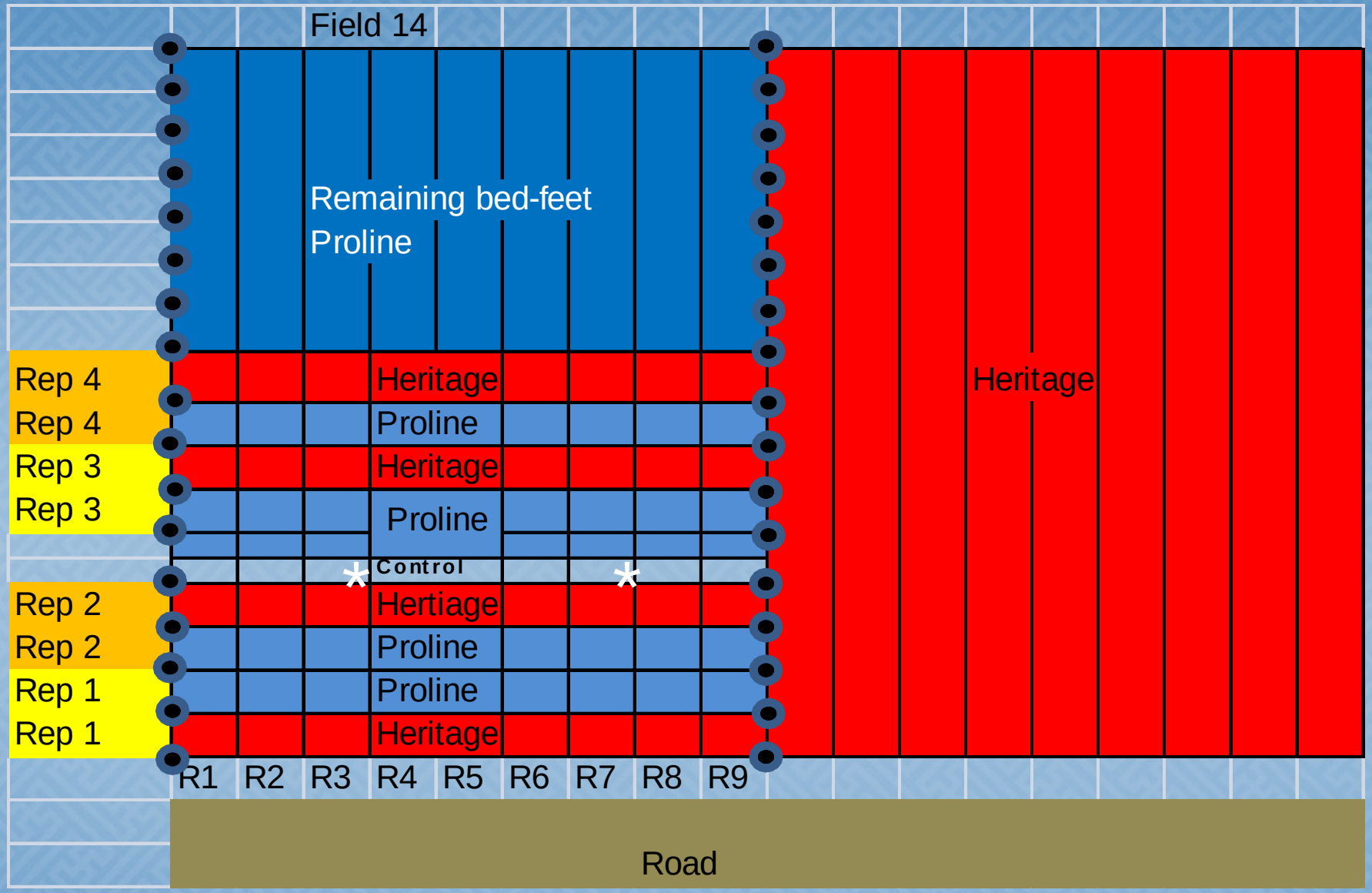
Research Reports 03-04 & 04-03 Carey & McQuage

- Found that the following provided effective control:
  1. Chipco-26019 - iprodione
  2. Medallion – fludioxonil
  3. Heritage - azoxystrobin

2008 Applied Chemicals

- **Proline®** - 41% prothioconazole – Bayer Cropscience @ 5.5 fl oz/ac – 2 wk intervals beginning July 15

- **Heritage®** - 50% azoxystrobin – Sygenta @ 24 oz/ac – 2 wk intervals beginning July 15



40 foot treatments plots x 9 bed rows

Nov. 2008


Nov. 2008

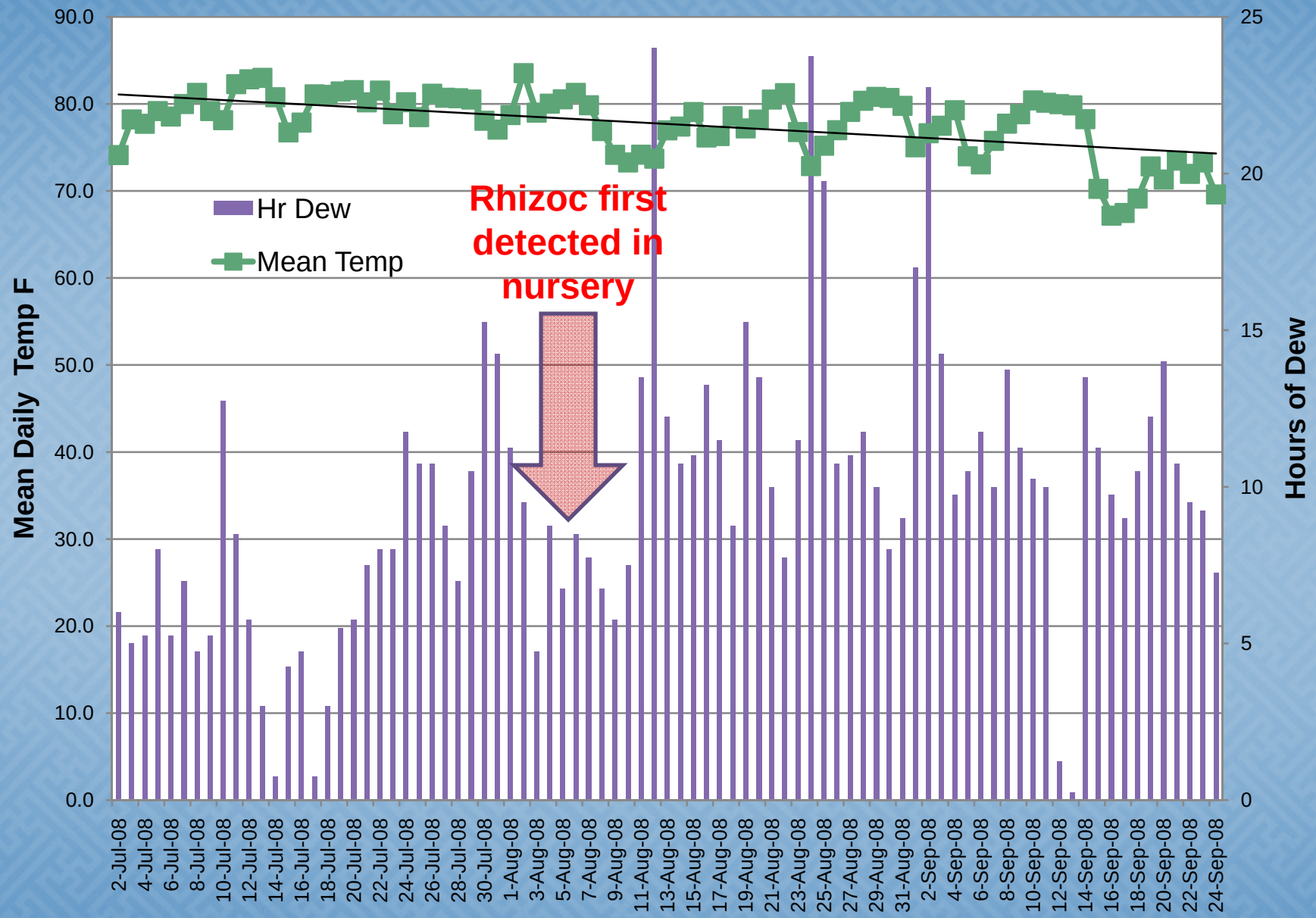
Nov. 2008


Control
Nov. 2008


Heritage®
Nov. 2008


Heritage®
Nov. 2008


Proline®
Nov. 2008


2008 Temp and Dew @ Pearl River, MS - Rhizoctonia/Proline Study
Mean Daily Temp F
Hours of Dew
Hr Dew
Mean Temp
Rhizoc first detected in nursery
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
25
20
15
10
5
0
2-Jul-08
4-Jul-08
6-Jul-08
8-Jul-08
10-Jul-08
12-Jul-08
14-Jul-08
16-Jul-08
18-Jul-08
20-Jul-08
22-Jul-08
24-Jul-08
26-Jul-08
28-Jul-08
30-Jul-08
1-Aug-08
3-Aug-08
5-Aug-08
7-Aug-08
9-Aug-08
11-Aug-08
13-Aug-08
15-Aug-08
17-Aug-08
19-Aug-08
21-Aug-08
23-Aug-08
25-Aug-08
27-Aug-08
29-Aug-08
31-Aug-08
2-Sep-08
4-Sep-08
6-Sep-08
8-Sep-08
10-Sep-08
12-Sep-08
14-Sep-08
16-Sep-08
18-Sep-08
20-Sep-08
22-Sep-08
24-Sep-08

Nov. 2008

Data to follow….

- We will be collecting treatment & weather data the week of Dec 15th.
  - Seedling quality
    - Seedling Density Counts
    - RCD
    - HT
    - Dry Weights
    - Root Morphology
  - Incidence and severity of foliar symptoms

Next Step with Proline®

- Bayer CropScience will assist in obtaining 24-c or Section 18

Rhizoc Foliar Blight on Lob	Pitch Canker on Lob, LL & Shortleaf
Mississippi	South Carolina
Georgia	Georgia
South Carolina	Alabama
	Arkansas
	Mississippi

Next Step with Proline®

- Field & lab/ GH studies for next year
  - Fusiform Rust
    - GH/Rust Lab – interval between application (seed & foliar)
    - Repeat foliar Slash study
  - Pitch Canker
    - Greenhouse
      - Repeat inoculation study (Lob & LL)
      - Seed treatment study
    - Lab – determine lower control rate
    - Nursery study – AU collect data
  - Rhizoctonia Foliar Blight
    - Nursery timing interval study