Using Proline® (Prothioconazole) in Forest Seedling Nurseries

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The Nursery Cooperative has tested Proline® on…..

Fusiform Rust

Pitch Canker

Rhizoctonia Foliar Blight

A Brief History of Nursery Fungicides

- 1637 Brine
- 1755 Arsenic
- 1760 Cooper Sulfate
- 1824 Sulfur
- 1833 Lime Sulfur
- 1885 Bordeaux mixture
- 1891 Mercury chloride
- 1942 Thiram
- 1952 Captan
- 1964 chlorothalonil (Bravo®)
- 1965 ferbam
- 1968 benomyl (Benlate®)
- 1970 thiophanate methyl (Cleary 3336)
- 1st 1973 triadimefon (Bayleton®)
- 1974 iprodione (Chipco-26019®)
- 1977 metalaxyl (Subdue®)
- 1977 fosetyl-AL (Aliette®)
- 2nd 1979 propiconazole (Alamo®, Banner®, Tilt®)
- 3rd 1986 tebuconazole (Folicur®)
- 1988 difenoconazole (Dividend®)
- 1990 fludioxonil (Medallion®)
- 1992 azoxystrobin (Heritage®, Abound®)
- 4th **2002 prothioconazole (Proline®)**

adapted from : http://www.apsnet.org/online/feature/fungi/

The active ingredient, prothioconazole, was introduced at the Brighton Conference in 2002.

Proline® was registered in the USA on March 27, 2007.

Registered in 44 countries

Initial Registration -
Peanuts, Soybean, Wheat, Barley, Beans , Sugar Beets, Rapeseed

5.0 – 5.5 fl. oz. per acre for foliar applications

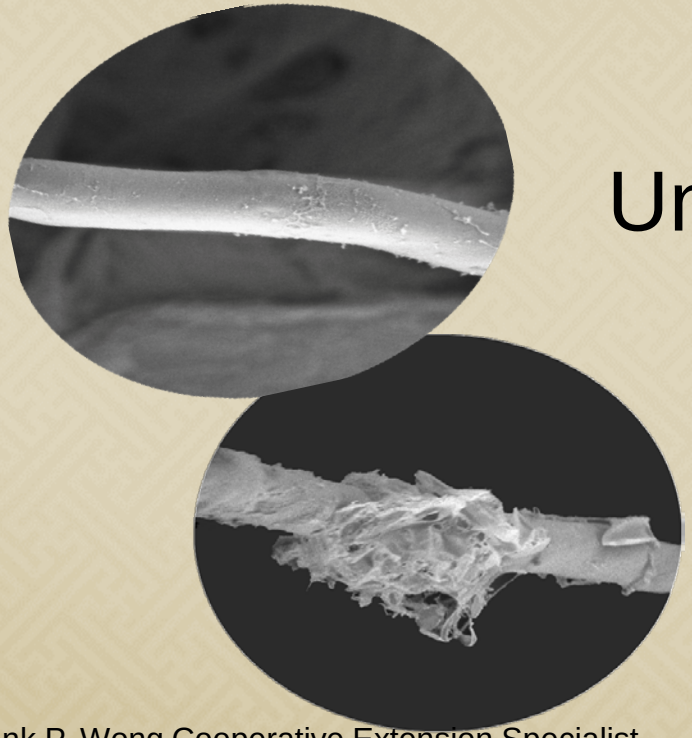
SC – Suspension Concentrate (Flowable)

Prothioconazole

- Prothioconazole is xylem and phloem systemic
- Long-term protectant on the leaf surface
- Unique greening effects not seen with other azoles
- Stops fungal appressoria and haustoria formation, mycelial growth and spore formation
- Has shown good fungicidal activity in the control of ascomycetes, basidiomycetes, and deuteromycetes
  - It is not registered for *Pythium & Phytophthora sp.* and has shown inconsistent results.

Prothioconazole

- Inhibits the production of sterols in the membrane of the fungus.



Untreated fungal hyphae

Treated fungal hyphae

Dr. Frank P. Wong Cooperative Extension Specialist
University of California

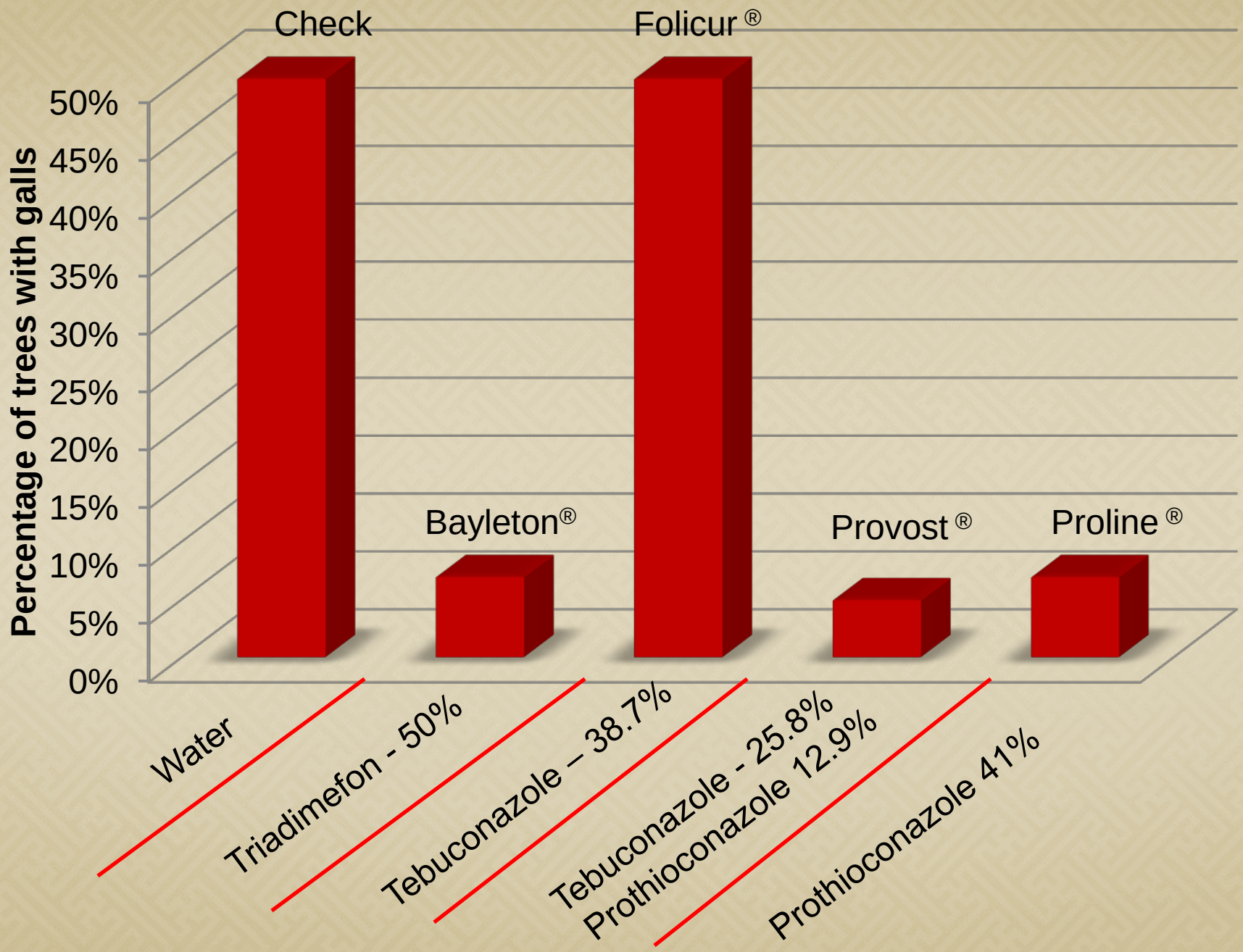
:

Fusiform Rust

Cronartium quercum
f. sp. *fusiforme*

Fungicides Tested by Southern Forest Nursery Management Cooperative

- Bayleton®
- Heritage®
- Folicur®
- Eagle®/Nova®
- Inspire®
- Dividend Extreme®
- Medallion®
- Provost®
- Absolute®
- Top Guard®
- Proline®


Check
Folicur ®
Bayleton®
Provost ®
Proline ®
Percentage of trees with galls
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Water
Triadimefon - 50%
Tebuconazole – 38.7%
Tebuconazole - 25.8%
Prothioconazole 12.9%
Prothioconazole 41%

Fusiform Rust - Nursery Trials

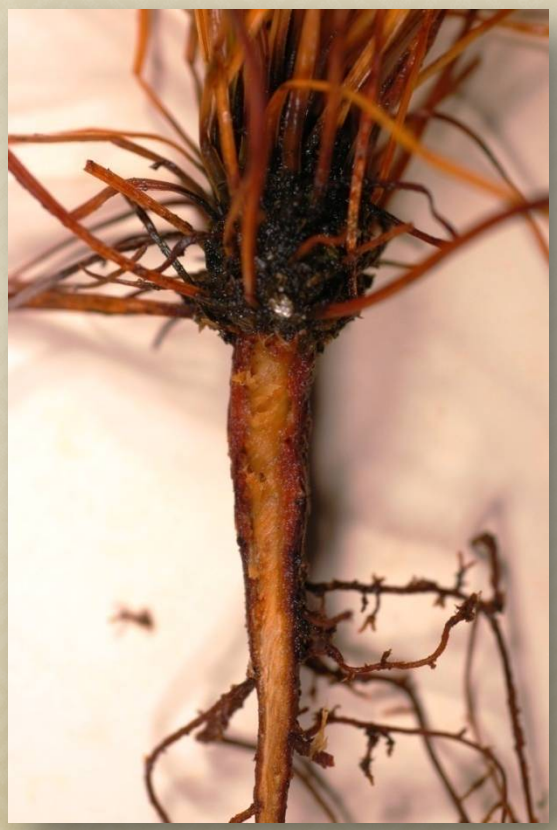
- Proline® has been tested for 3 years in commercial nurseries using full riser sections and standard nursery spray equipment on both loblolly and slash pine.
- Bayleton®, Provost® & Proline®

Cost To Use Proline®

- Bayleton® approx. $32/a application cost
- Proline ® approx. $18/a application cost

Pitch Canker

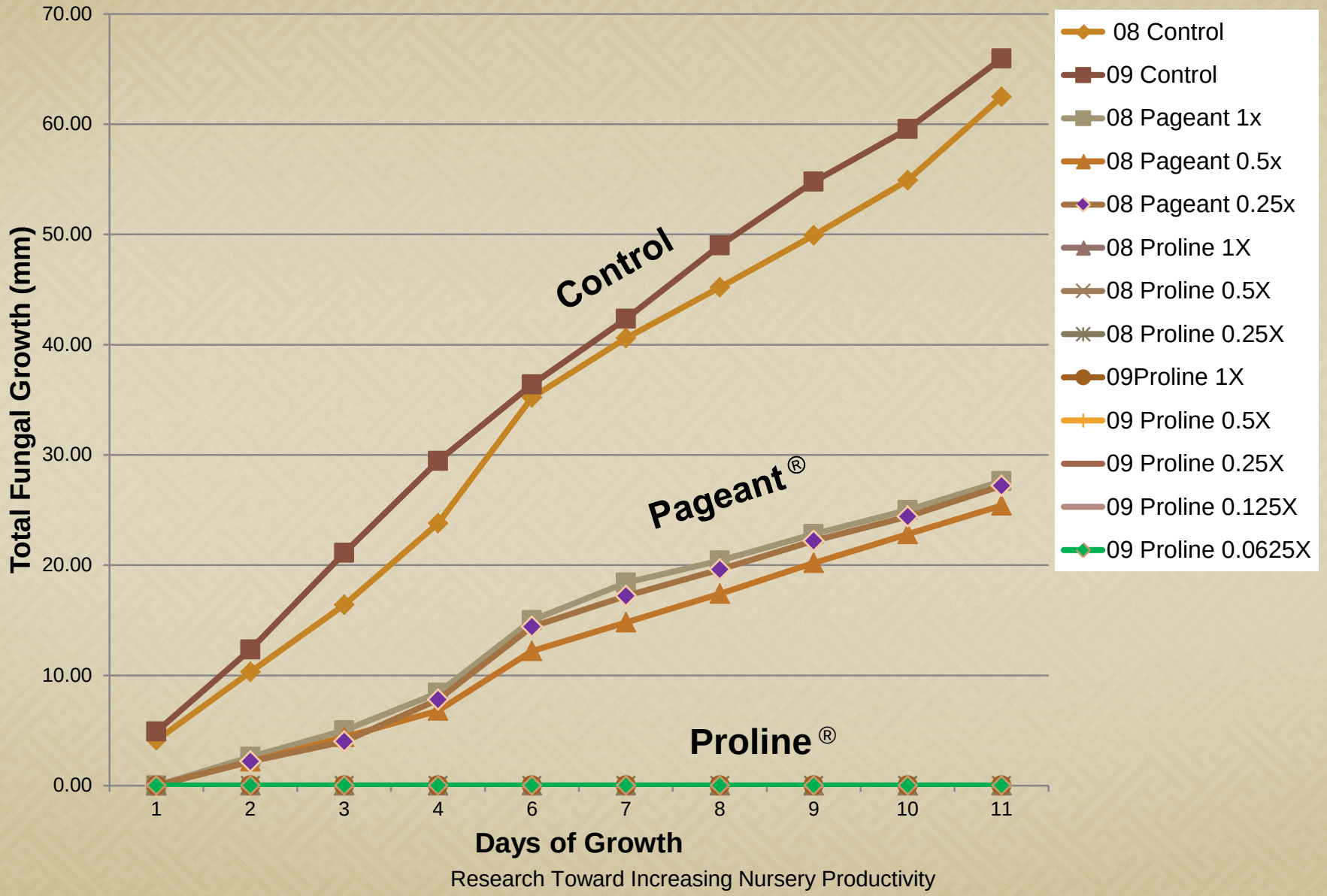
Fusarium circinatum = F. subglutinans



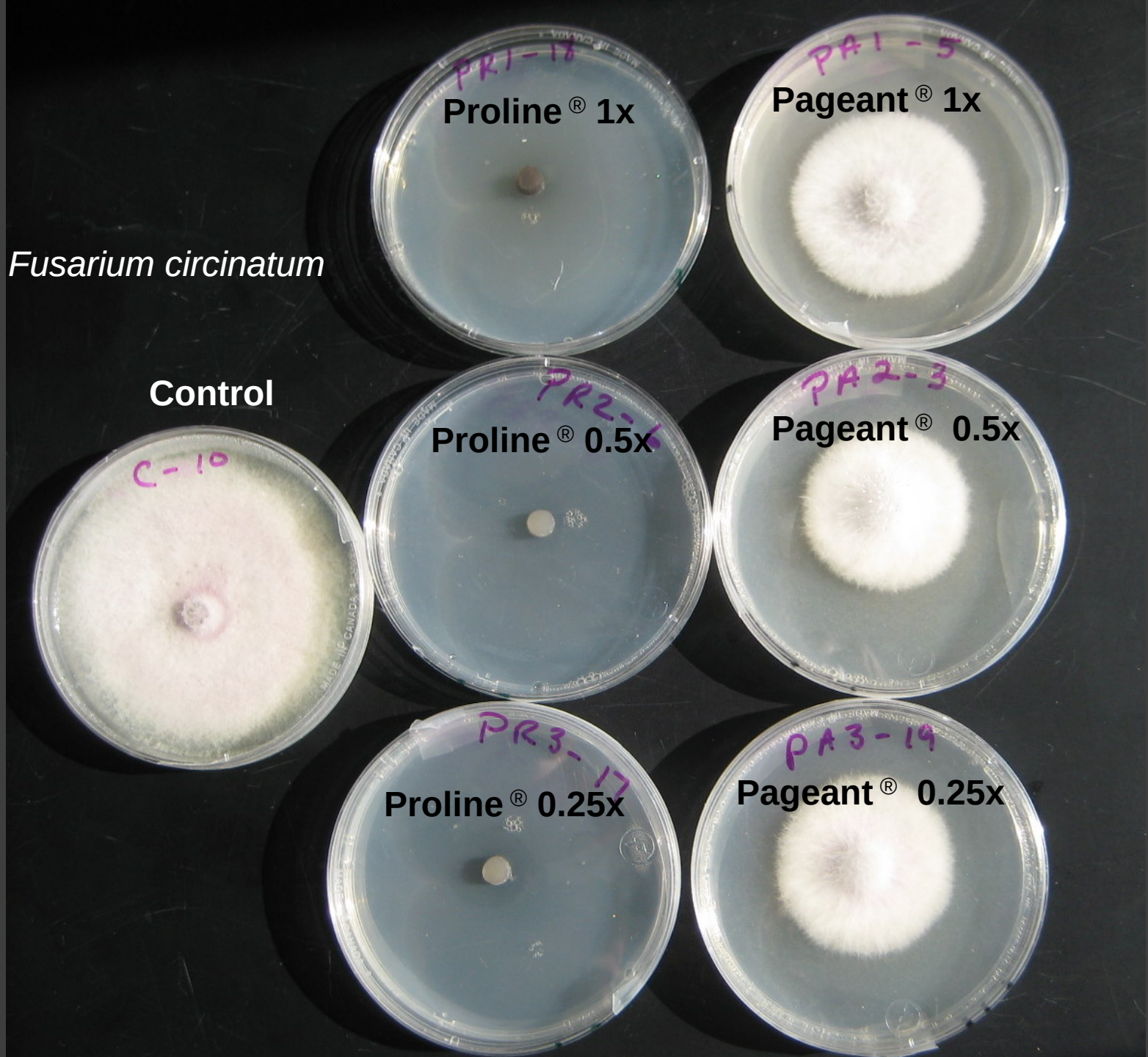
Pitch Canker

- Lab study
  - *in vitro* fungal growth on amended PDA agar
  - Proline® - 5 rates – replicated 2 times
  - Pageant® (pyraclostrobin 12.8% & boscalid 25.2%) - 3 rates
  - 20 plates for each fungicide/rate

Growth *of Fusarium circinatum* on Amended Media 2008 & 2009



Research Toward Increasing Nursery Productivity


Fusarium circinatum
Control
C-10
Proline® 1x
PR1-18
Pageant® 1x
PA1-5
Proline® 0.5x
PR2-6
Pageant® 0.5x
PA2-3
Proline® 0.25x
PR3-17
Pageant® 0.25x
PA3-19

Pitch Canker/Proline Year 1 Greenhouse - Longleaf

				Dry Weight	
	Proportion of Cavities Filled	Height (in)	RCD (mm)	Top (g)	Root (g)
Proline®	0.80 A	12.5 A	4.7 A	1.42 A	0.58 AB
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*

11% more seedlings for a 10,000,000 seedling container nursery @ 80% shippable >$114,000 revenue

Pitch Canker Greenhouse Study Year 2

- Longleaf , Loblolly, Slash, Shortleaf .
- To increase fungal pressure, an 8mm agar plug containing *Fusarium circinatum* was added to ½ of the cavities at time of sowing.
- Treatments: (each trt replicated 18 times)
    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
- Proline® sprayed at sowing and every 2 wks following germination @ label rate.

Plugging & Sowing

With Proline

Shortleaf Pine

No Proline

Slash, Loblolly &
Longleaf Pine


Shortleaf Pine


Slash Pine


Shortleaf Pine


Slash Pine





Characteristic Pitch Canker resin soaking in root system

Longleaf Pine

	Percentage Fill		Final		
Longleaf Pine	Week 5	Week 17	RCD (mm)	HT (cm)	Biomass (gm/sqft)
Proline + No Plug	88.3 a	88.3 a	4.8 c	14.1 ab	80.6 a
No Proline + No Plug	83.1 a	71.7 b	5.7 a	14.4 a	60.9 b
Proline + Plug	85.8 a	85.3 a	5.3 ab	13.6 b	77.7 a
No Proline + Plug	74.4 b	66.1 b	5.2 b	14.5 a	57.7 b
lsd	6.1	7.2	0.4	0.5	6.7

Shortleaf Pine

	Percentage Fill		Final		
Shortleaf Pine	Week 5	Week 17	RCD (mm)	HT (cm)	Biomass (gm/sqft)
Proline + No Plug	93.9 a	93.6 a	2.9 b	23.0 a	54.7 a
No Proline + No Plug	84.2 b	43.3c	3.1 a	21.0 b	20.1 c
Proline + Plug	93.1 a	92.8 a	3.0 ab	22.9 a	58.3 a
No Proline + Plug	87.8 b	60.6 b	3.1 a	21.4 b	38.6 b
lsd	4.6	10.4	0.1	1.2	6.7

Slash Pine

	Percentage Fill		Final		
Slash Pine	Week 5	Week 17	RCD (mm)	HT (cm)	Biomass (gm/sqft)
Proline + No Plug	91.9 a	91.7 a	3.7 ab	26.8 a	92.3 a
No Proline + No Plug	86.4 a	72.5 b	3.6 b	24.4 b	64.0 b
Proline + Plug	91.1 a	91.1 a	3.7 ab	25.5 ab	84.6 a
No Proline + Plug	83.3 b	74.4 b	3.8 a	25.6 ab	66.3 b
lsd	5.9	8.2	0.1	1.4	8.5

Loblolly Pine

	Percentage Fill		Final		
Loblolly Pine	Week 5	Week 17	RCD (mm)	HT (cm)	Biomass (gm/sqft)
Proline + No Plug	91.4 a	91.4 a	3.1 b	25.4 c	77.7 a
No Proline + No Plug	90.6 a	88.3 a	3.4 a	29.3 ab	75.8 a
Proline + Plug	93.6 a	93.6 a	3.1 b	30.2 a	78.2 a
No Proline + Plug	91.6 a	90.3 a	3.3 a	28.5 b	78.9 a
lsd	4.6	5.9	0.1	1.0	7.0

Rhizoctonia Foliar Blight

More often, symptoms are visible only on needles below the beds surface.

Aerial Web Blight

Healthy Seedling

Rhizoctonia Foliar Blight in Pines

- Both longleaf & loblolly pine are susceptible (variation in seed source, coastal most susceptible) – but apparently not slash.
- Usually worse on 2nd+ year land following fumigation.
- Within any one nursery – isolated disease foci rather than entire beds.
- Symptoms develop from inside canopy and move up and out.
- Usually first noticed after top clipping which exposes disease foci
- Fungicides normally applied @ canopy closure


Slash
Loblolly

Fungicides tested

Proline® - 41% prothioconazole
Abound® - 23% azoxystrobin

- **2008**
  - **Proline®** @ 5 fl oz/ac – 2 wk intervals beginning July 15
  - **Abound®** @ 24 fl oz/ac – 2 wk intervals beginning July 15
- **2009**
  - **Proline®** @ 5 fl oz/ac – 3 wk intervals beginning July 15
  - **Abound®** @ 24 fl oz/ac – 3 wk intervals beginning July 15
- **2011**
  - **Proline®** @ 5 fl oz/ac – 2 wk intervals beginning July 15
  - **Proline®** @ 3 fl oz/ac – 2 wk intervals beginning July 15


Control
9/26/08

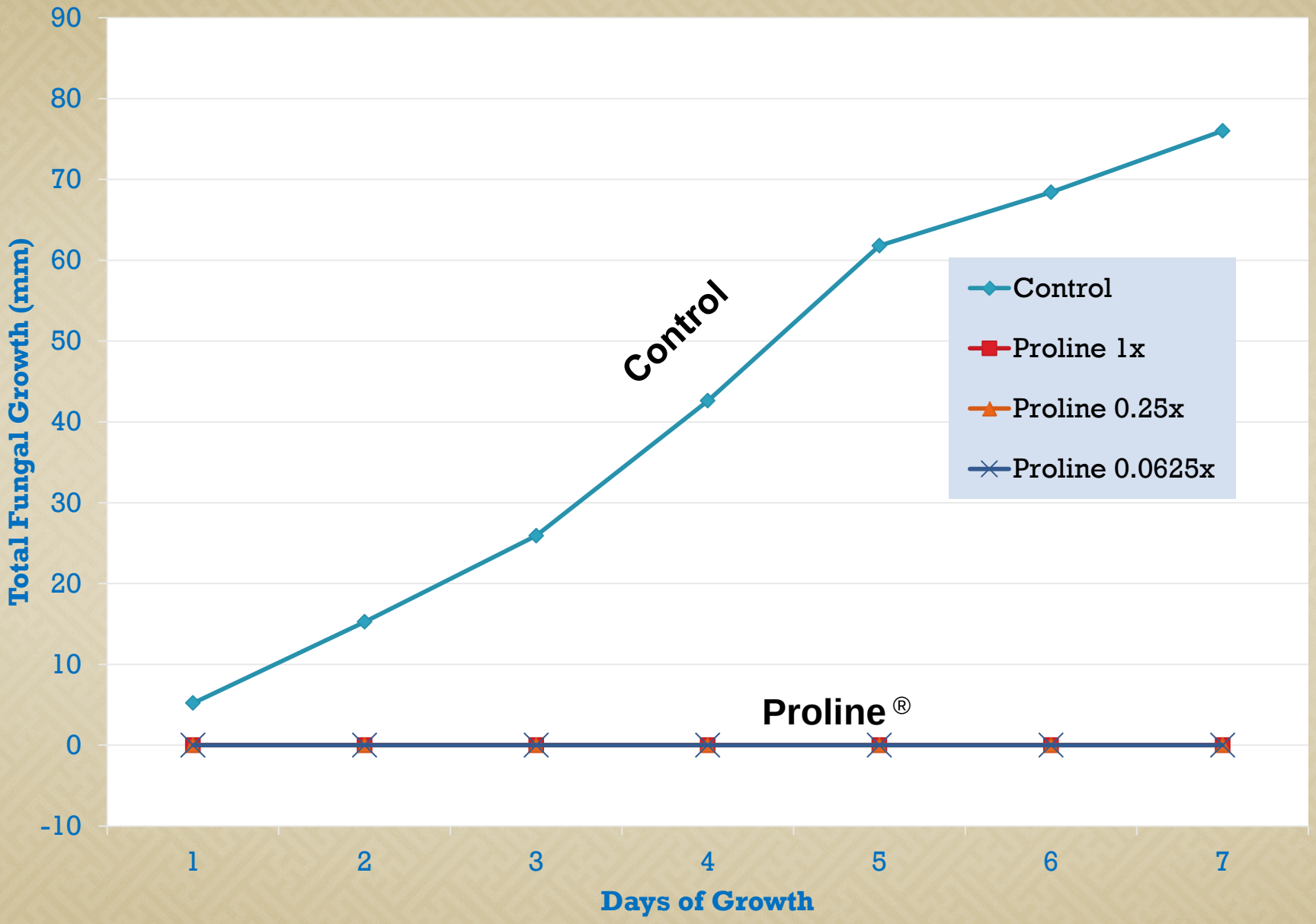

Abound®
9/26/08

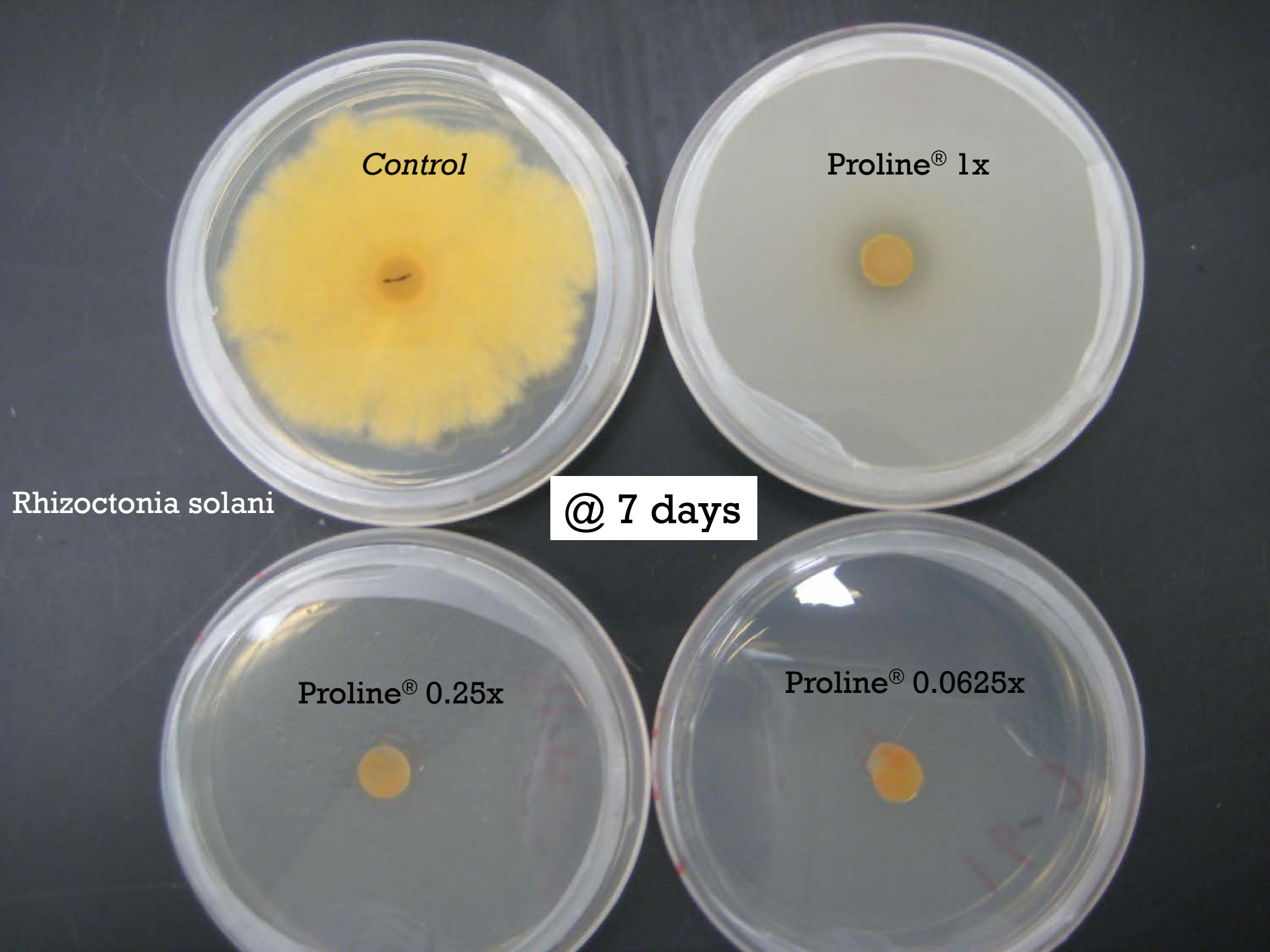

Proline®
9/26/08

Rhizoctonia

- Lab study
  - *in vitro* fungal growth on amended PDA agar
  - Proline® - 2009 - 3 rates, 1x, 0.25x and 0.0625x label rate
  - 20 plates for each fungicide/rate

Growth of *Rhizoctonia solani* on Amended Medai 2009




Control
Proline® 1x
Rhizoctonia solani
@ 7 days
Proline® 0.25x
Proline® 0.0625x

Proline® Registration Efforts

- Encouraged by test results
- Supported by Bayer CropScience - even though forest seedlings are a minor crop with little profit.
- In mid-March, 2009 - 5 states had approved the request for a 24(c) label.


EPA
Proline®
Registration

It's amazing! Late in 2009

- We were asked by Bayer CropScience to write the label.

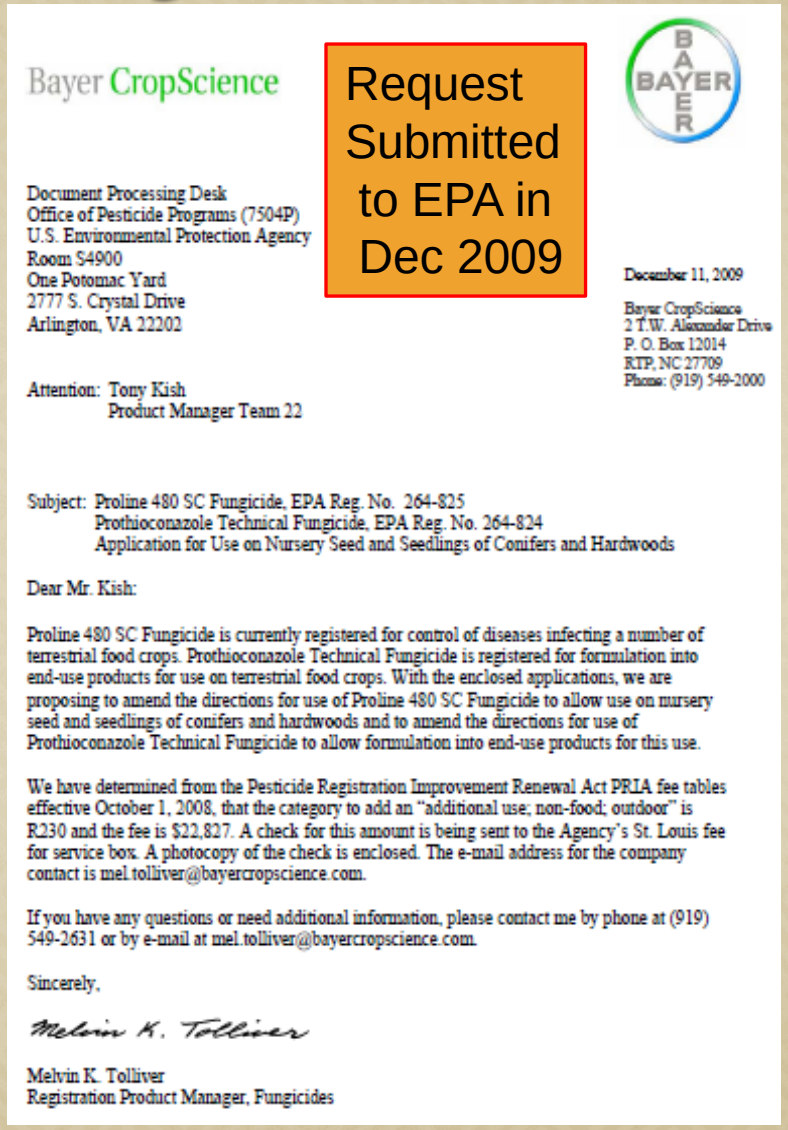
- The question became how inclusive do we make our request? Based on our experience and diseases controlled on current label, we felt Proline's application to be broad.

All they can do is say no….

Nursery seeds & seedlings of Shortleaf, Loblolly, Slash, Longleaf and other pines and other Conifers and Hardwoods

Final approval received December 2011

Request Submitted to EPA in Dec 2009



Bayer CropScience

Document Processing Desk
Office of Pesticide Programs (7504P)
U.S. Environmental Protection Agency
Room S4900
One Potomac Yard
2777 S. Crystal Drive
Arlington, VA 22202

December 11, 2009

Bayer CropScience
2 T.W. Alexander Drive
P. O. Box 12014
RTP, NC 27709
Phone: (919) 549-2000

Attention: Tony Kish
Product Manager Team 22

Subject: Proline 480 SC Fungicide, EPA Reg. No. 264-825
Prothioconazole Technical Fungicide, EPA Reg. No. 264-824
Application for Use on Nursery Seed and Seedlings of Conifers and Hardwoods

Dear Mr. Kish:

Proline 480 SC Fungicide is currently registered for control of diseases infecting a number of terrestrial food crops. Prothioconazole Technical Fungicide is registered for formulation into end-use products for use on terrestrial food crops. With the enclosed applications, we are proposing to amend the directions for use of Proline 480 SC Fungicide to allow use on nursery seed and seedlings of conifers and hardwoods and to amend the directions for use of Prothioconazole Technical Fungicide to allow formulation into end-use products for this use.

We have determined from the Pesticide Registration Improvement Renewal Act PRIA fee tables effective October 1, 2008, that the category to add an "additional use; non-food; outdoor" is R230 and the fee is $22,827. A check for this amount is being sent to the Agency's St. Louis fee for service box. A photocopy of the check is enclosed. The e-mail address for the company contact is mel.tolliver@bayercropscience.com.

If you have any questions or need additional information, please contact me by phone at (919) 549-2631 or by e-mail at mel.tolliver@bayercropscience.com.

Sincerely,

Melvin K. Tolliver

Melvin K. Tolliver
Registration Product Manager, Fungicides

Current label implications for nurseries

- We are comfortable with current label rate of (**5 fl oz/a**) for foliar applications on southern pines.

- The label seed treatment rate of 10 fl oz per 50 lbs of seed is probably higher than it needs to be.
  - Compared to other crops it is 66X more than needed.
  - 2012 we are currently testing 5 rates as seed treatment.

Potential label applications for nurseries

- Other diseases listed on label (for other species) but not tested by SFNMC – *Cylindrocladium*, Powdery Mildew, *Septoria.*
- *Blotch, leaf spots, leaf blights, mold, rusts*
- Proline® is an extremely efficacious fungicide.
- For other non-conifer species – test for phytotoxicity
- Use label rate (5.0 fl oz/a) or lower.

- Since it is impossible to test every species, every rate, every tank combination under every environmental condition – if it is new to you – spot test first!

A few closing comments….

- **<u>Tank mixes:</u>** (pg 3) *"Proline 480 SC Fungicide is compatible with most insecticides, fungicides, herbicides and foliar nutrient products. However, the physical compatibility of Proline 480 SC Fungicide with tank-mix partners should be tested before use."*
- *(Pg 12) Forest Seedlings: "The crop safety and mix compatibility on all tree species and in tank-mixes with other products (spray surfactants, fertilizers, insecticides, etc.) has not been confirmed. Bayer CropScience recommends small scale testing with your planned use pattern. The user assumes all risks with the use of this product on trees."*

A few closing comments….

- Don’t stop using Bayleton
  - We need as many fungicides as possible
  - Bayleton has proven to be effective in nurseries
- Proline and Bayleton are in the same fungicide resistance class (3)
  - Growing season application alternates – Proline and Cleary’s 3336 (3 & 1)

Research Toward Increasing Nursery Productivity