Five Years of White Rot Research: What have we learned?

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CAGORAB 2014

White Rot of Alliums Disease Cycle

- Caused by the soil fungal pathogen *Sclerotium cepivorum*



- White rot overwinters and spreads as sclerotia, which are hardened spores.
- Sclerotia can remain viable in the soil for over 30 years, and are easily spread with equipment, wind, and water
- Sclerotia germinate in response to sulfur compounds which exude from Allium roots

Sclerotia Germination Stimulants

- Diallyl disulfide (DADS) (which mimics natural garlic and onion sulfur compounds) or garlic oil/juice is shank applied into a field at a depth of 8-12".
- The field can be planted with a non-host, but no onions or garlic can be planted for 1 year after application
- Sclerotia germinate, expecting host presence, and lacking a carbohydrate source, become exhausted and die.
- DADS can reduce sclerotia levels in the soil by 80-98%.

Questions

1. Does combining different fungicides increase efficacy?
2. Do multiple applications of fungicide increase efficacy?
3. What about tebuconazole and phytotoxicity?
4. Is there any evidence of fungicide resistance?
5. What do we do now that DADS isn't available?

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Fungicide Efficacy, Tulelake 2013

Treatment	Rate at planting	Rate at 30, 60 and 90 days after planting	Marketable yield (tons/acre)	Total yield (tons/acre)
tebuconazole (A) plus Fontelis (B) plus Cannonball C)	A) 20.5 fl oz/A, B) 24 fl oz/A, C) 7 oz/A	0	21.2 a	27.1
tebuconazole (A) plus Fontelis (B)	A) 20.5 fl oz/A, B) 24 fl oz/A	0	19.5 ab	26.5
tebuconazole	20.5 fl oz/A,	0	17.5 abc	25.7
tebuconazole (A) plus Cannonball (B)	A) 20.5 fl oz/A, B) 7 oz/A	0	15.8 abcd	24.2
Serenade (A) plus Luna Experience (B)	A) 2 qts/A B) 17 fl oz/A	0	14.2 bcd	24.0
Serenade (A) plus Luna Experience (B)	A) 2 qts/A B) 17 fl oz/A	A) 2 qts/A	13.6 cde	23.8
Mervion	11 fl oz/A	0	12.6 de	24.2
Fontelis	24 fl oz/A	0	11.1 ef	23.1
Cannonball	7 oz/A	0	7.1 f	21.0
Control	0	0	4.6 f	16.9
Serenade	2 qts/A	2 qts/A	4.5 f	18.2
Serenade	2 qts/A	0	4.4 f	18.4

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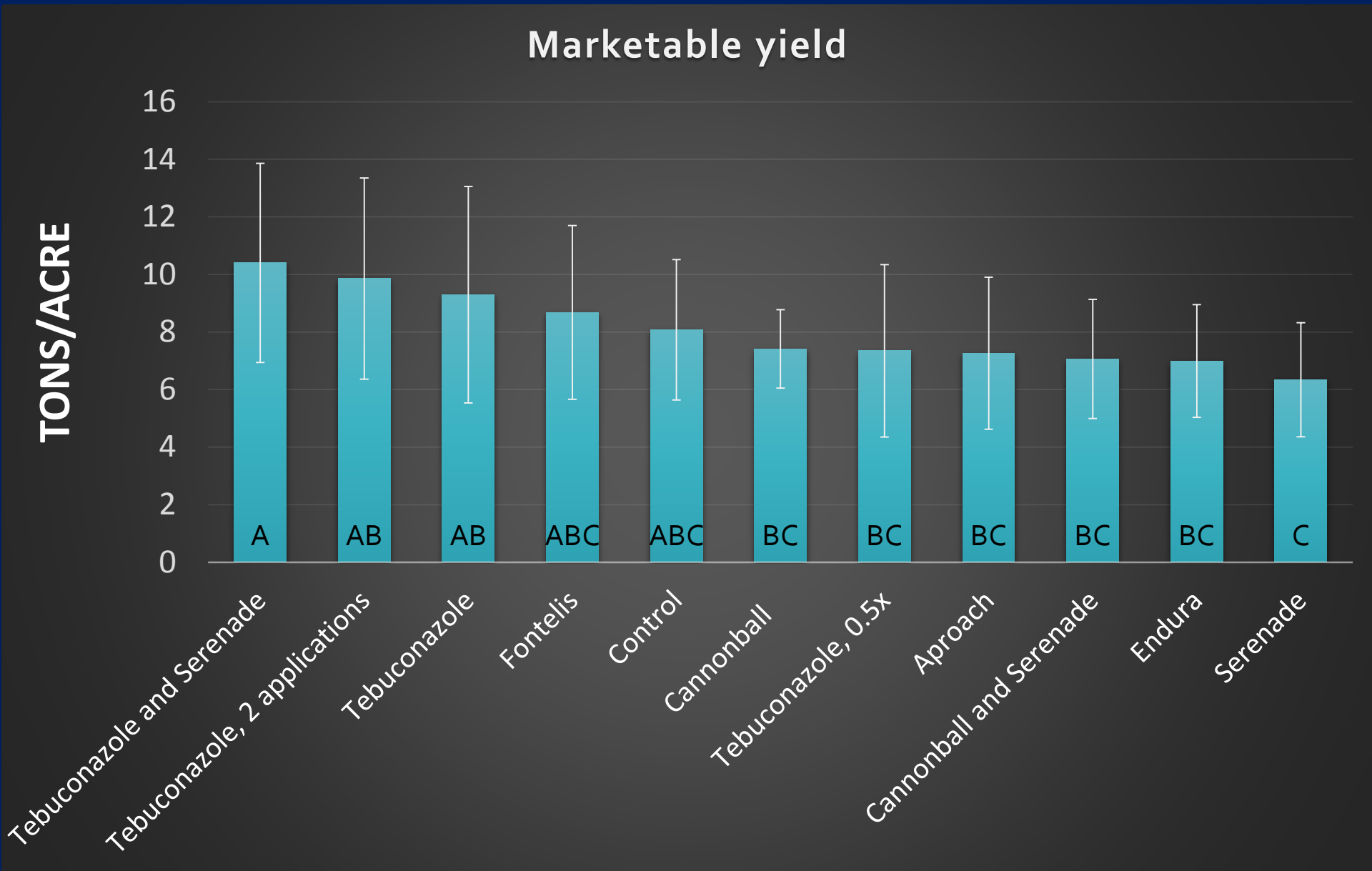
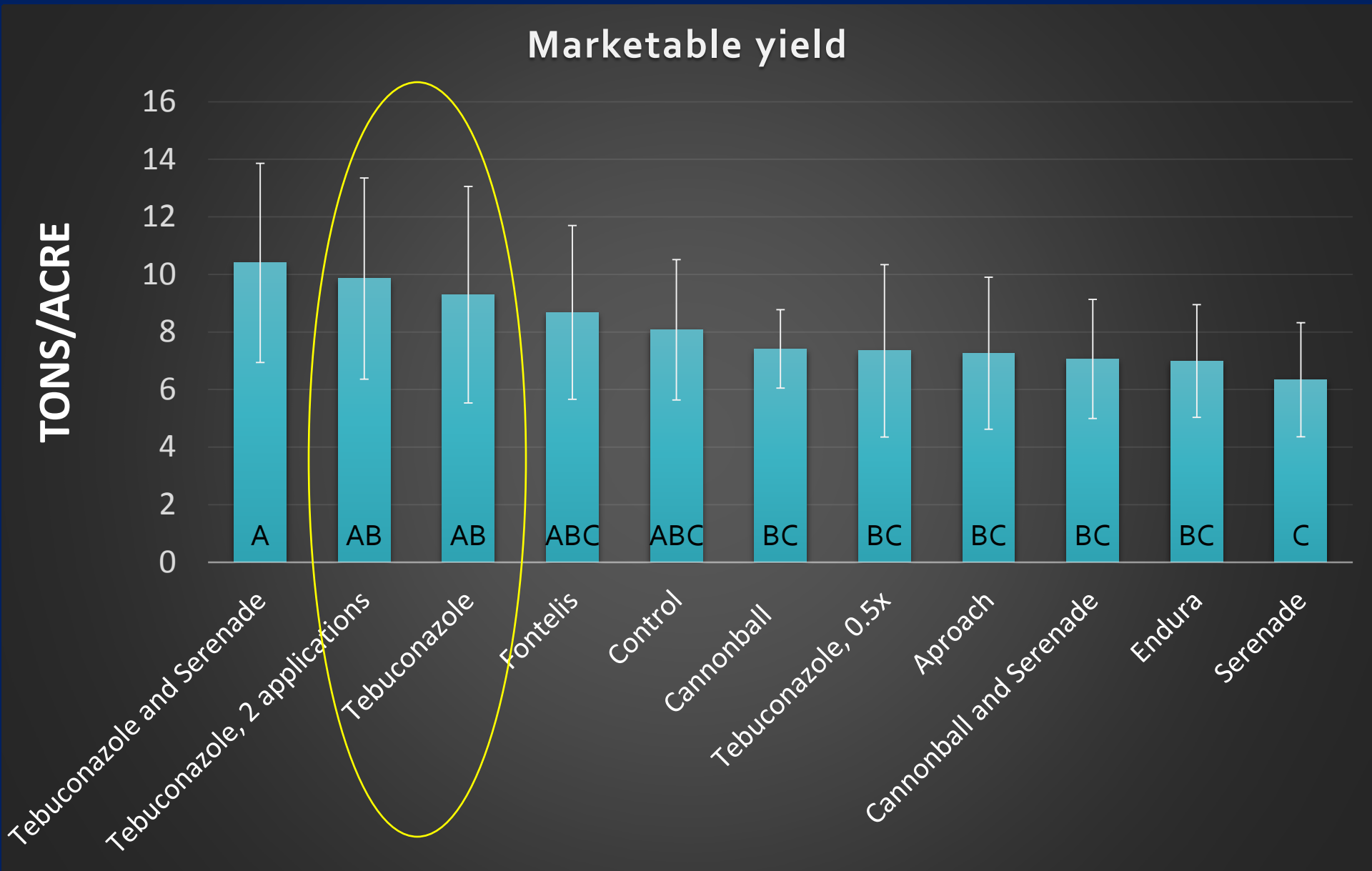
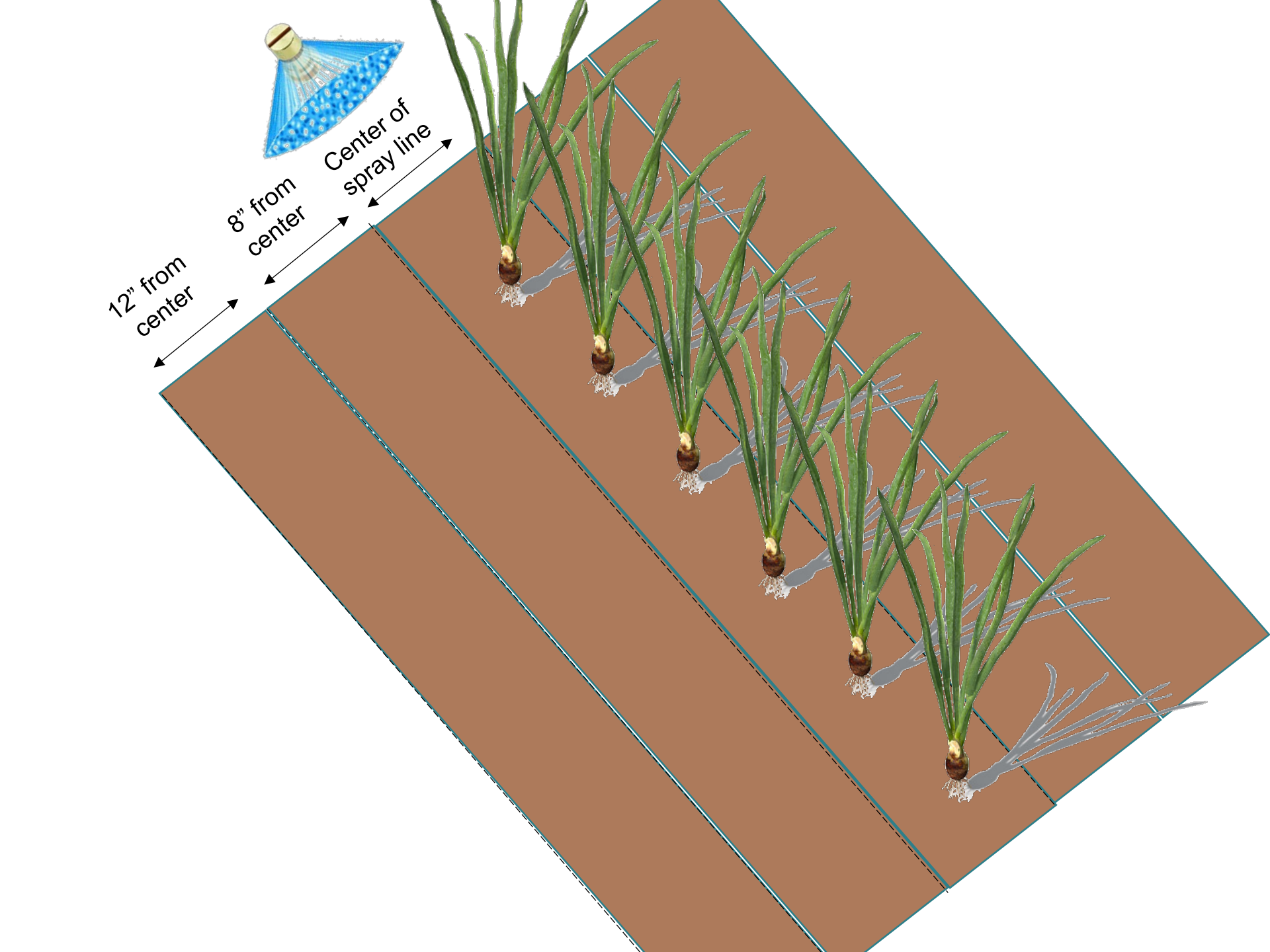
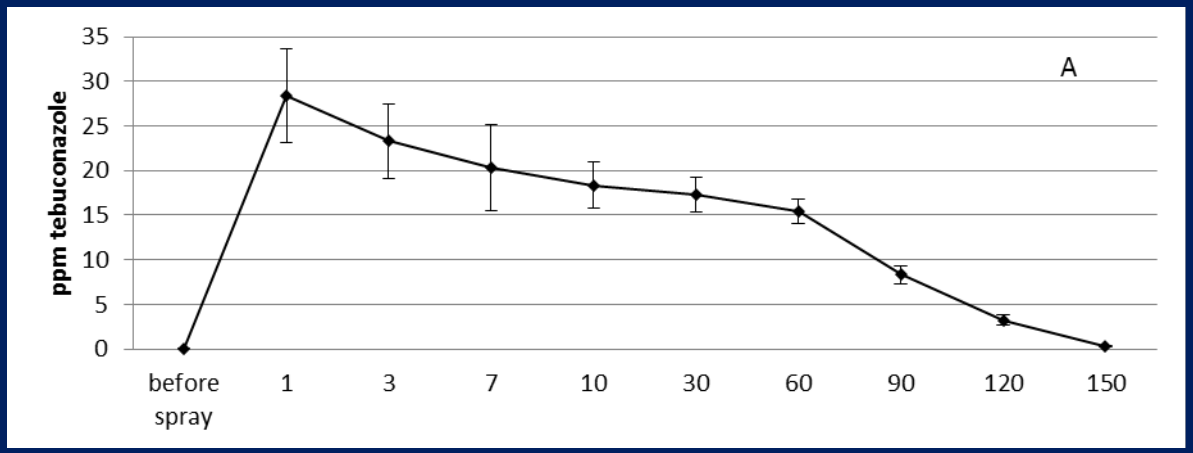
Efficacy of Fungicides to Control White Rot, Tulelake 2012

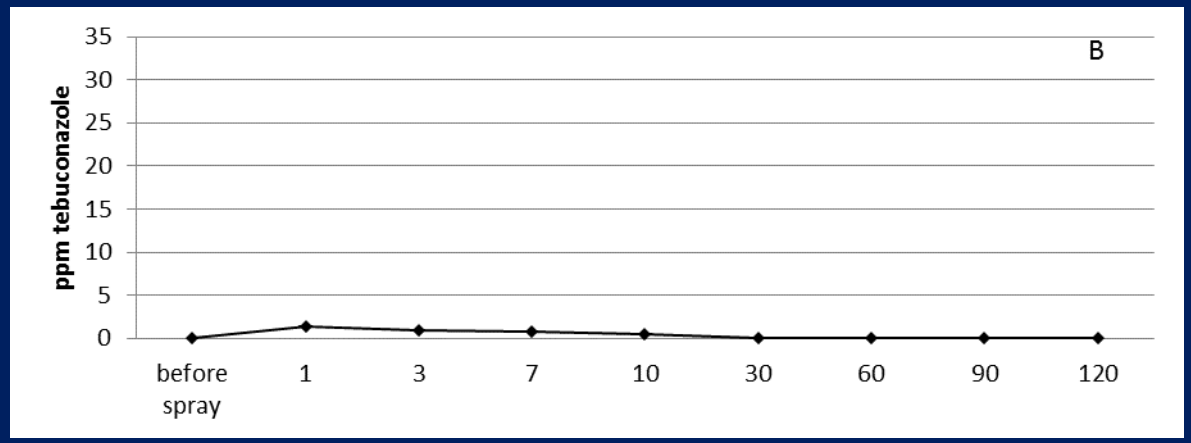


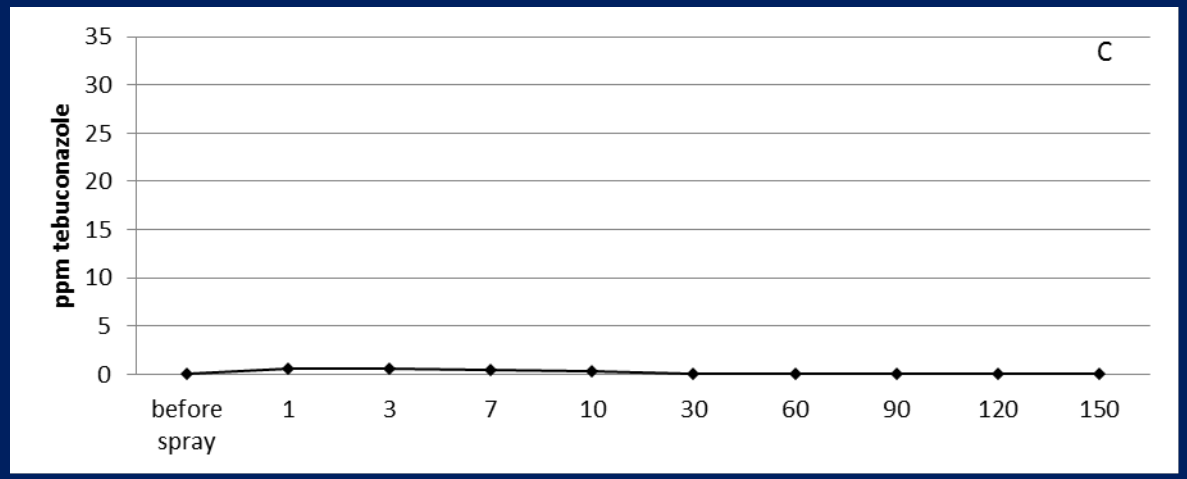
Efficacy of Fungicides to Control White Rot, Tulelake 2012

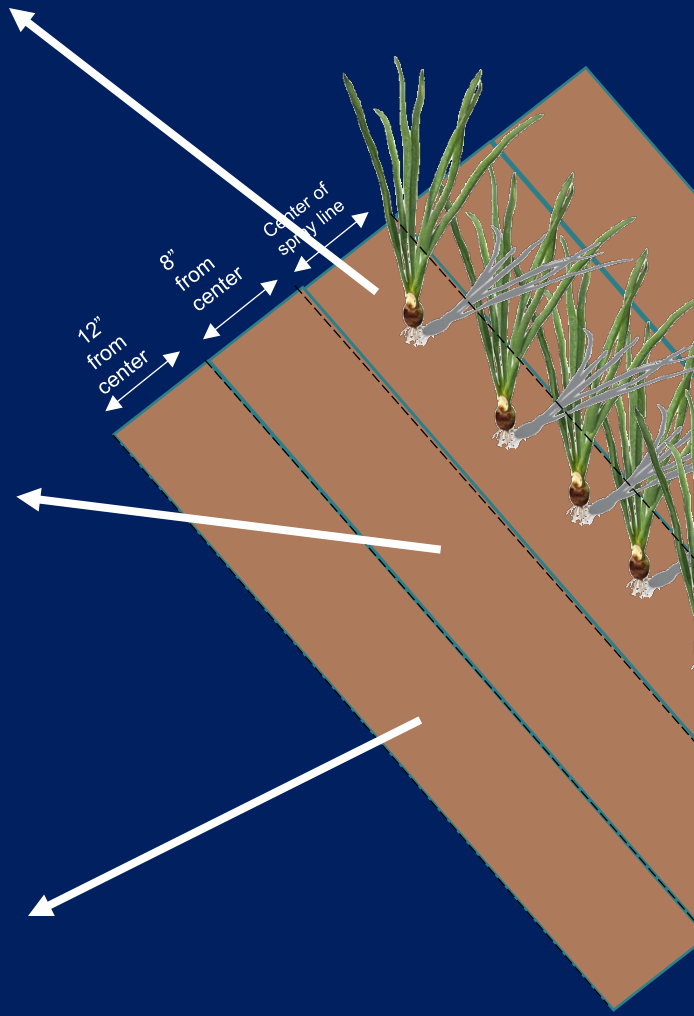



12” from center
8” from center
Center of spray line


A
ppm tebuconazole
35
30
25
20
15
10
5
0
before spray
1
3
7
10
30
60
90
120
150


B
ppm tebuconazole
35
30
25
20
15
10
5
0
before spray
1
3
7
10
30
60
90
120


C
ppm tebuconazole
35
30
25
20
15
10
5
0
before spray
1
3
7
10
30
60
90
120
150


Center of spray line
8" from center
12" from center

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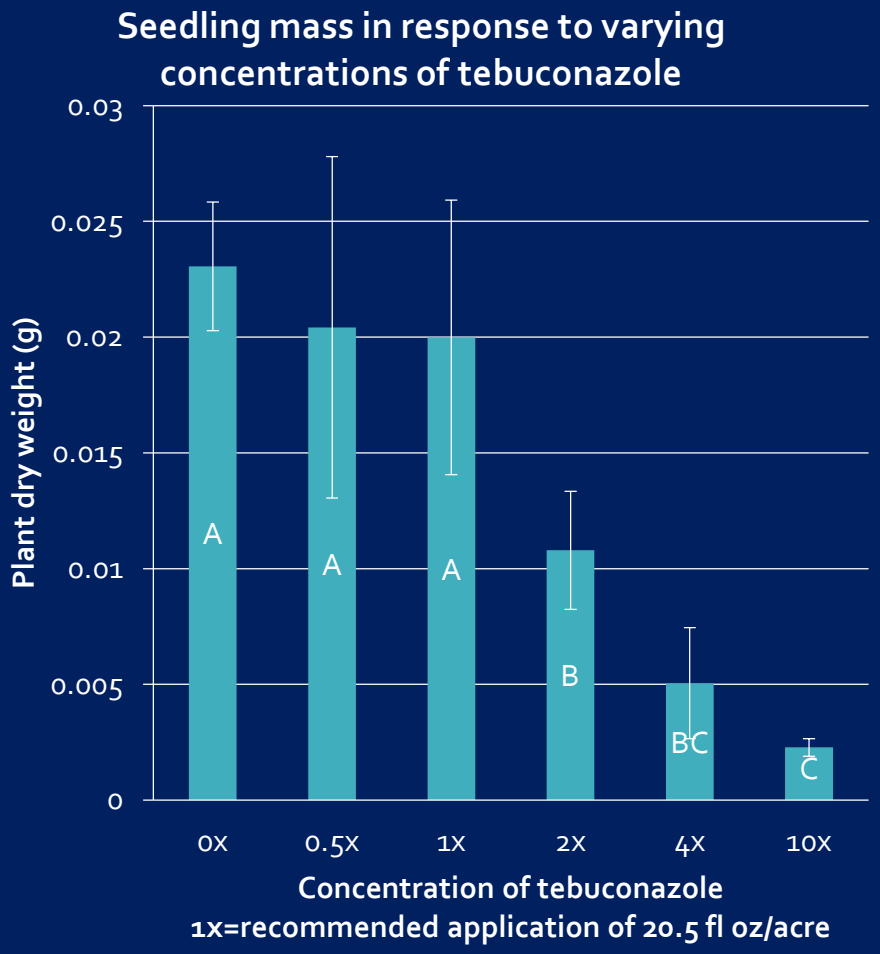
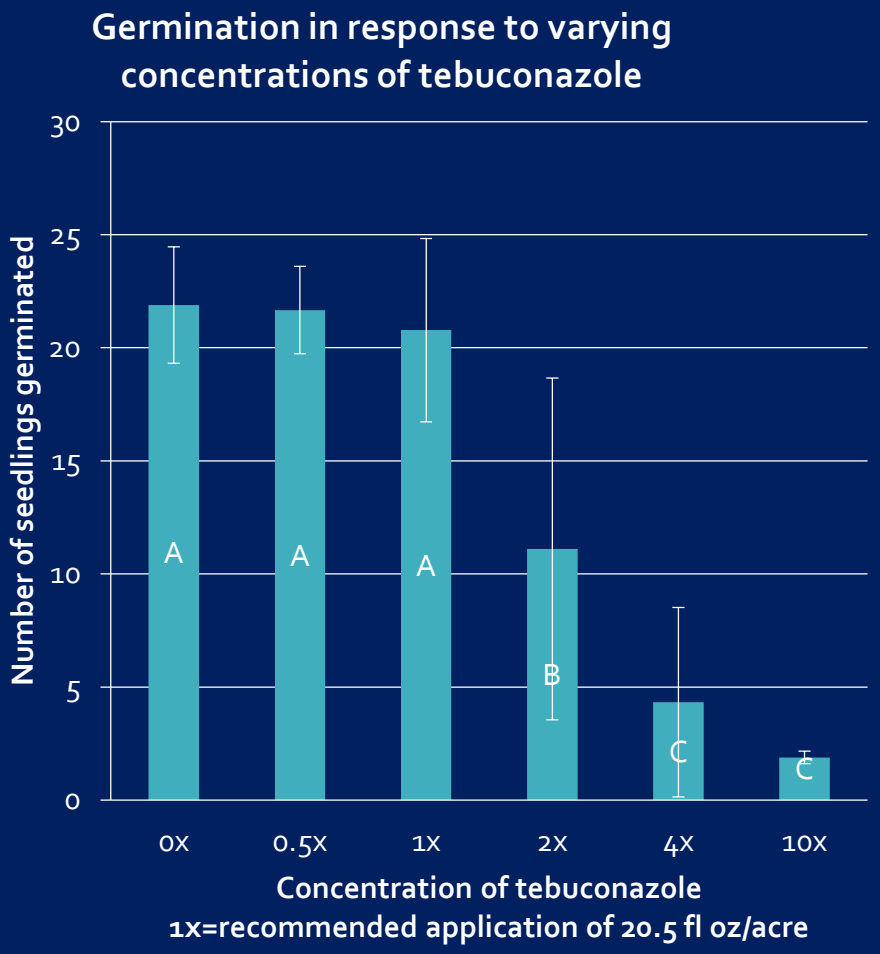
Phytotoxicity of tebuconazole





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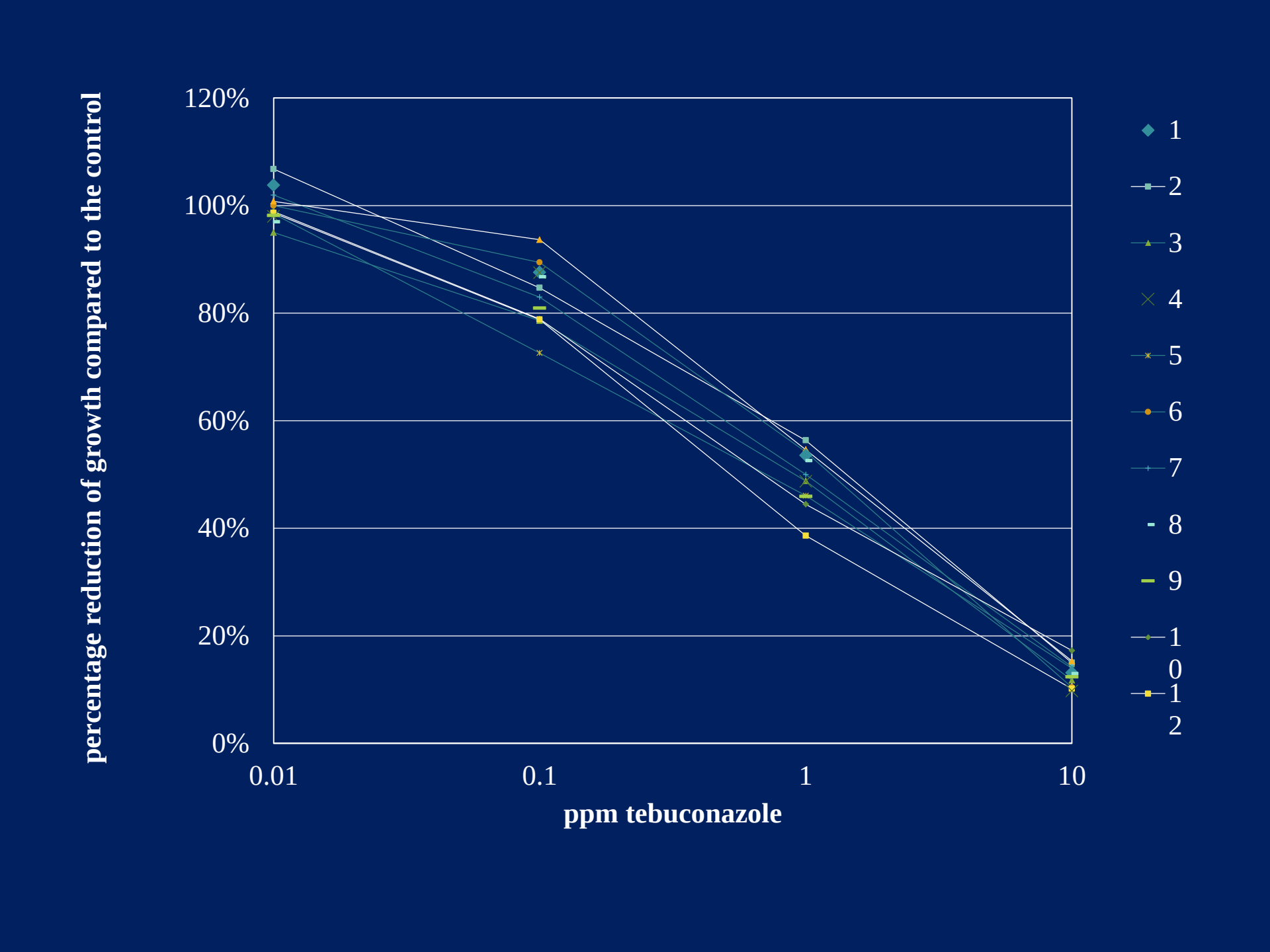
Isolate Collection

12 different locations in 3 areas

Collected over a course of 4 years

Over 130 individual isolates total


percentage reduction of growth compared to the control
120%
100%
80%
60%
40%
20%
0%
0.01
0.1
1
10
ppm tebuconazole
1
2
3
4
5
6
7
8
9
10
12

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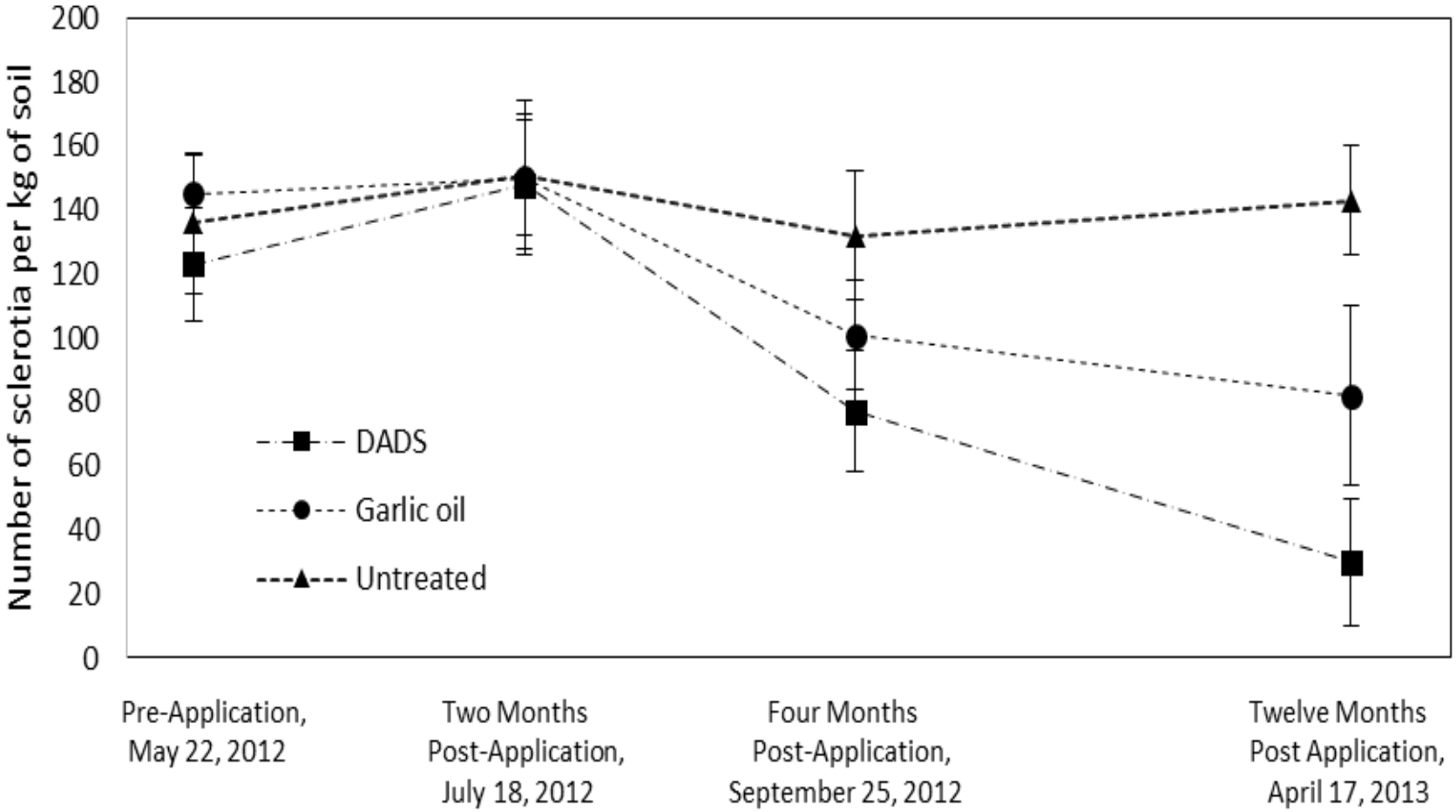
Sclerotia Germination Stimulants



Combining Sclerotia Germination Stimulants and Fungicides, Tulelake 2012/2013

Main Plot Treatment and Rate: Applied 2012	Sub-plot Application Treatment and Rate: Applied 2013	Marketable Yield (tons/acre)	Total Yield (tons/acre)
DADS: 1 gallon/A	tebuconazole: 20.5 fl oz/A, Cannonball: 7 oz/A	26.8 a	31.1
DADS: 1 gallon/A	tebuconazole: 20.5 fl oz/A	24.2 ab	27.6
DADS: 1 gallon/A	Fontelis: 20 fl oz/A	21.9 abc	26.0
DADS: 1 gallon/A	Cannonball: 7 oz/A	15.4 bcdef	23.5
DADS: 1 gallon/A	Serenade: 4 qts/A	13.3 cdefg	21.4
DADS: 1 gallon/A	Control: 0	9.3 defg	19.7
garlic oil: 1 gallon/A	tebuconazole: 20.5 fl oz/A, Cannonball: 7 oz/A	21.8 abc	28.1
garlic oil: 1 gallon/A	tebuconazole: 20.5 fl oz/A	20.3 abc	25.8
garlic oil: 1 gallon/A	Fontelis: 20 fl oz/A	9.9 defg	22.1
garlic oil: 1 gallon/A	Cannonball: 7 oz/A	9.4 defg	19.9
garlic oil: 1 gallon/A	Control: 0	5.7 fg	16.9
garlic oil: 1 gallon/A	Serenade: 4 qts/A	3.8 g	16.7
untreated	tebuconazole: 20.5 fl oz/A, Cannonball: 7 oz/A	16.4 bcde	24.5
untreated	tebuconazole: 20.5 fl oz/A	16.4 bcd	24.2
untreated	Fontelis: 20 fl oz/A	13.3 cdefg	22.3
untreated	Cannonball: 7 oz/A	10.7 defg	21.5
untreated	Serenade: 4 qts/A	3.8 g	16.7
untreated	Control: 0	3.6 g	16.4

Future Directions

- Find a suitable replacement for DADS
  - Change the application rates of garlic oil/juice
  - Composted garlic waste

-Mike Davis

-The California Garlic and Onion Research Advisory Board and Bob Ehn

-Rob Wilson and the rest of the staff at IREC

-Karina Perez, Hung Doan, Nilesh Maharaj and the Davis Lab

-Norm McKinley and Steve Colbert (DuPont)

-Arlene Kurokawa (Bayer)

-Curtis Rainbolt (BASF)

-Ryan Bounds and Allison Tally (Syngenta)

-Sensient

Many Thanks

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Questions

Fungicides Tested

Currently Labeled Fungicides in California

- **tebuconazole: Group 3, DMI**
- **Cannonball (fludioxonil): Group 12, MAPHK osmotic signal transduction**
- **Endura (boscalid): Group 7, SDHI, complex II**

New Fungicides (not currently labeled)

- **Luna Privilege (fluopyram): Group 7, SDHI, complex II**
- **Fontelis (penthiopyrad): Group 7, SDHI, complex II**