

Managing Rhizoctonia Damping-off, Root and Crown Rot of Sugarbeet

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Rhizoctonia Damping-Off, Crown Rot and Root Rot

- **Causal agent – *R. solani* AG-2-2 IV and IIIB**
- ***R. solani* will cause infection at 65 F (and higher temperatures) in wet as well as in dry conditions.**
- **Infections are more severe in wet conditions.**

General Management Principles

- **Field selection – best fields; longer rotation with non-host crops such as wheat and barley**
- **Avoid planting host crops such as beans (soybean, edible beans) and corn that are favorable to the pathogen just before sugarbeet**
- **Control weeds - chenopods**
- **Improve drainage; do not throw infected dirt into crown**
- **Plant early in cool soils**
- **Use Rhizoctonia tolerant varieties**
- **Timely application of effective fungicides**

Rhizoctonia Tolerant Varieties

➤ Roundup Ready Varieties

-BTS 88RR31 (+Aph); BTS 89RR10

-hR* Hillehör 4022RR (+Aph); hR* Hillehör 4094RR(+Aph)

-Crystal 658RR (+Aph); Crystal 875RR (+Aph)

-hR** SESVanderhave H36811RR; (+Aph)

➤ Conventional Varieties

Beta 1301R (+Aph) ; Beta 1833R; Beta 1135R

Hillehör 3052Rz (+Aph); Hillehör 3035Rz (+Aph)

SESVanderhave H46714

www.crystalsugar.com; www.sbreb.org

Rhizoctonia Damping Off



Rhizoctonia Crown Rot





Rhizoctonia Root Rot







Rhizoctonia Root Rot





At What Soil Temperature is the Fungus Infective? Which Fungicides Control the Disease?

- ***R. solani* will cause infection at 65 F and higher temperatures in the presence of adequate moisture.**

Inoculated, Not Treated with Quadris, and at 50 to 80 F.



Inoculated, Treated with Quadris, at 50 to 80 F



80°F – Proline Effective



Prothioconazole

TREATMENT (D)
WITH PROLINE (5.7 g/w)
(100.0 (III))

No Prothioconazole

WITHOUT PROLINE
R. solanace AG2-2 (III D)
80°F/26.7°C

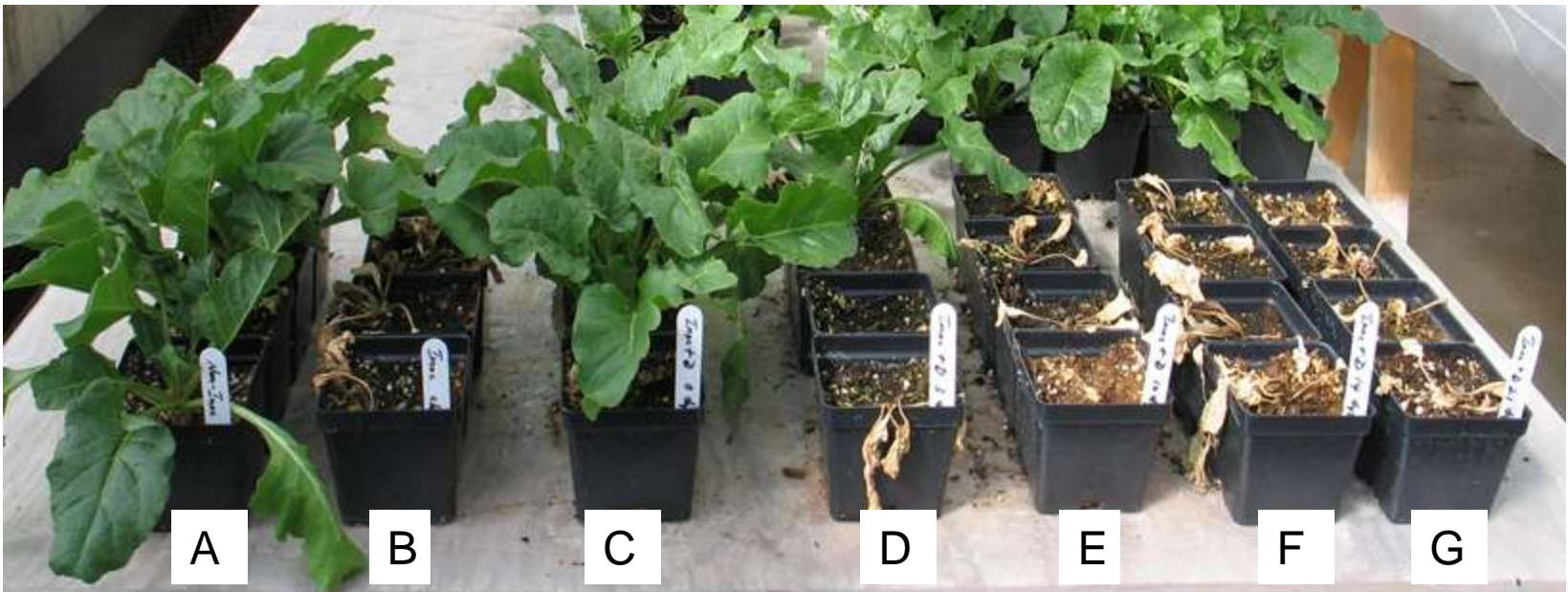
Control

TREATMENT (III)
CONTROL (100.0 PROLINE)
80°F/26.7°C

When Should Fungicides Be Applied for Rhizoctonia Control?

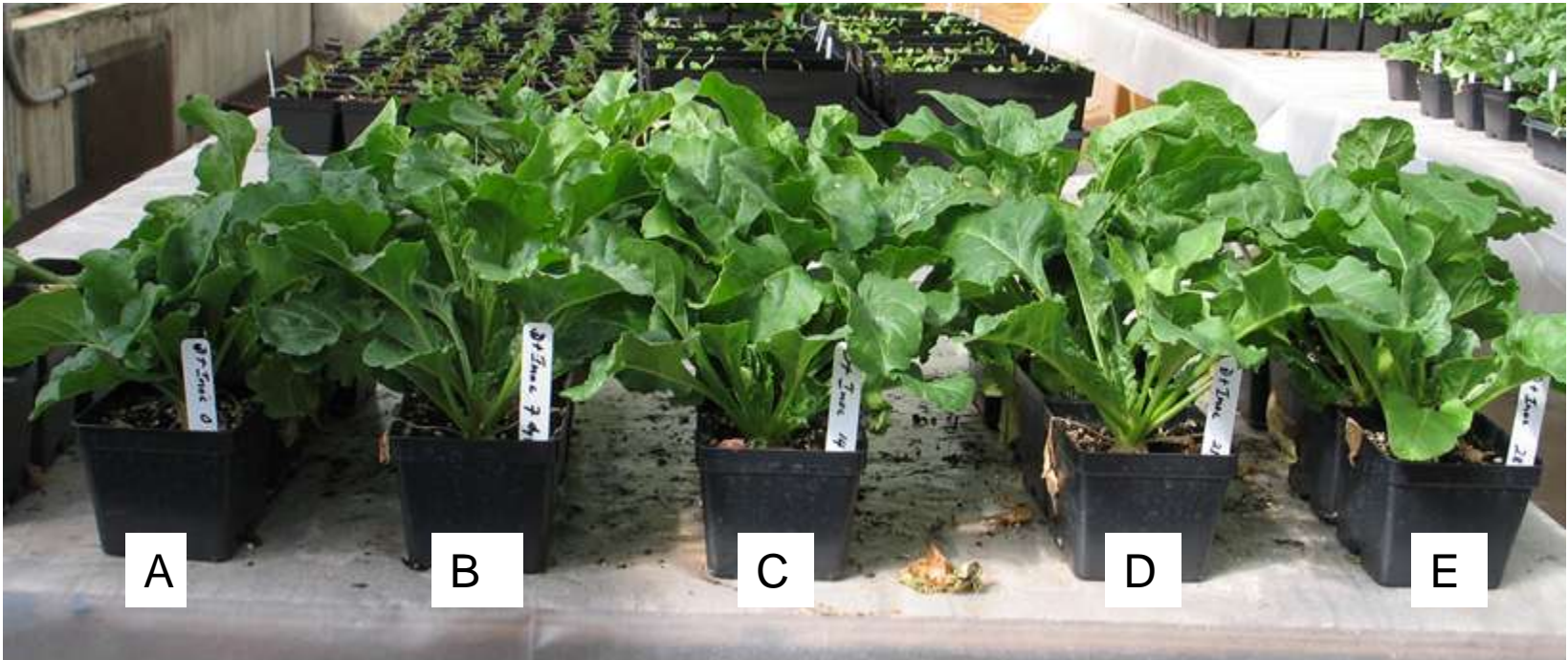
- **Fungicides such as Quadris, Headline and Proline should be applied before infection takes place.**

Timing of Quadris Application – At or after Inoculation



Sugar beet plants inoculation with *R. solani* AG 2-2 IIIB followed by Quadris application at different times. Non-inoculated control (A), Inoculated control (B), 0 days (C), 3 days (D), 10 days (E), 14 days (F), 21 days (G).

Timing of Quadris Application – Early, Before Inoculation



Sugar beet plants treated with Quadris followed by inoculation with *R. solani* AG 2-2 IIB at different times. 0 days (A), 7 days (B), 14 days (C), 21 days (D), and 28 days (E).

When Should Fungicides be Applied to Control Rhizoctonia Root Rot?

- **Just before infection takes place.**
- **Since infection takes place when the soil temperature at the 4” depth is 65 F, fungicides should be applied when the soil temperature at the 4” depth is about 60 to 62 F (just before a rain event), irrespective of the plant size or leaf stage.**

**Which Fungicides are
effective at Controlling
Rhizoctonia Root Rot in Field
Conditions (*in a Normal
Year*)?**

Growers Field (Rob Ehlert, Foxhome, MN) – Natural Inoculum -Non-treated Check



1 Application Quadris 9.2 fl oz/A



1 Application Proline 5.7 fl oz/A



Infection in mid to late June - Fungicidal Control, 2009, MN

<u>Treatments/A</u>	<u>Application date</u>	<u>Mortality/100' row</u>
Non-treated Check	-	37
Quadris 9.2 fl oz	16 June	2
Quadris 9.2 fl oz	16, 29 June	2
Proline 5.7 fl oz		
+NIS 0.125% v/v	16 June	7
Proline 5.7 fl oz		
+NIS 0.125% v/v	16, 29 June	5
<i>LSD (0.05)</i>		12

Summary

- **In a typical year – cool (45 to 52 F) at planting and soil temperature reaching 65 F in mid-June – one application of Quadris or Proline when the average soil temperature is about 60 to 62 F will provide effective Rhizoctonia root rot control.**

What has Changed

- **In Minnesota and North Dakota, average soil temperature at the 4 inch soil depth reached 65 F in mid-May in 2010 and early June (2-5) in 2011; most fields were wet and thus environmental conditions were favorable for damping-off and root rot infections of sugarbeet that were present as seedlings to 4-leaf stage.**

**Will an In-furrow Application of
Fungicide Control Rhizoctonia
Root Rot?**

Effect of In-furrow Applications Glyndon, MN – 2011 - Check



6 row plots; Inner 4 rows are treated (or not treated) with fungicides

Quadris 9.2 fl oz/A



Headline 9.1 fl oz/A



Headline 6 fl oz/A



Non-treated Check



Quadris 9.2 fl oz/A



Headline 9.1 fl oz/A



Headline 6 fl oz/A



Glyndon 2011 Results

Treatment	Rate fl oz/A	Rec. Sugar Lb/Ac
1. Inoculated Check	-	3132
2. Quadris (<i>In-furrow</i>)	9.2	6126
3. Headline (<i>In-furrow</i>)	6	4687
4. Headline (<i>In-furrow</i>)	9.1	4532
5. Headline (<i>In-furrow</i>)/Quadris	6/9.2	4913
6. Headline (<i>In-furrow</i>)/Quadris/Proline	6/9.2/5.7	5030
LSD (0.05)		1326

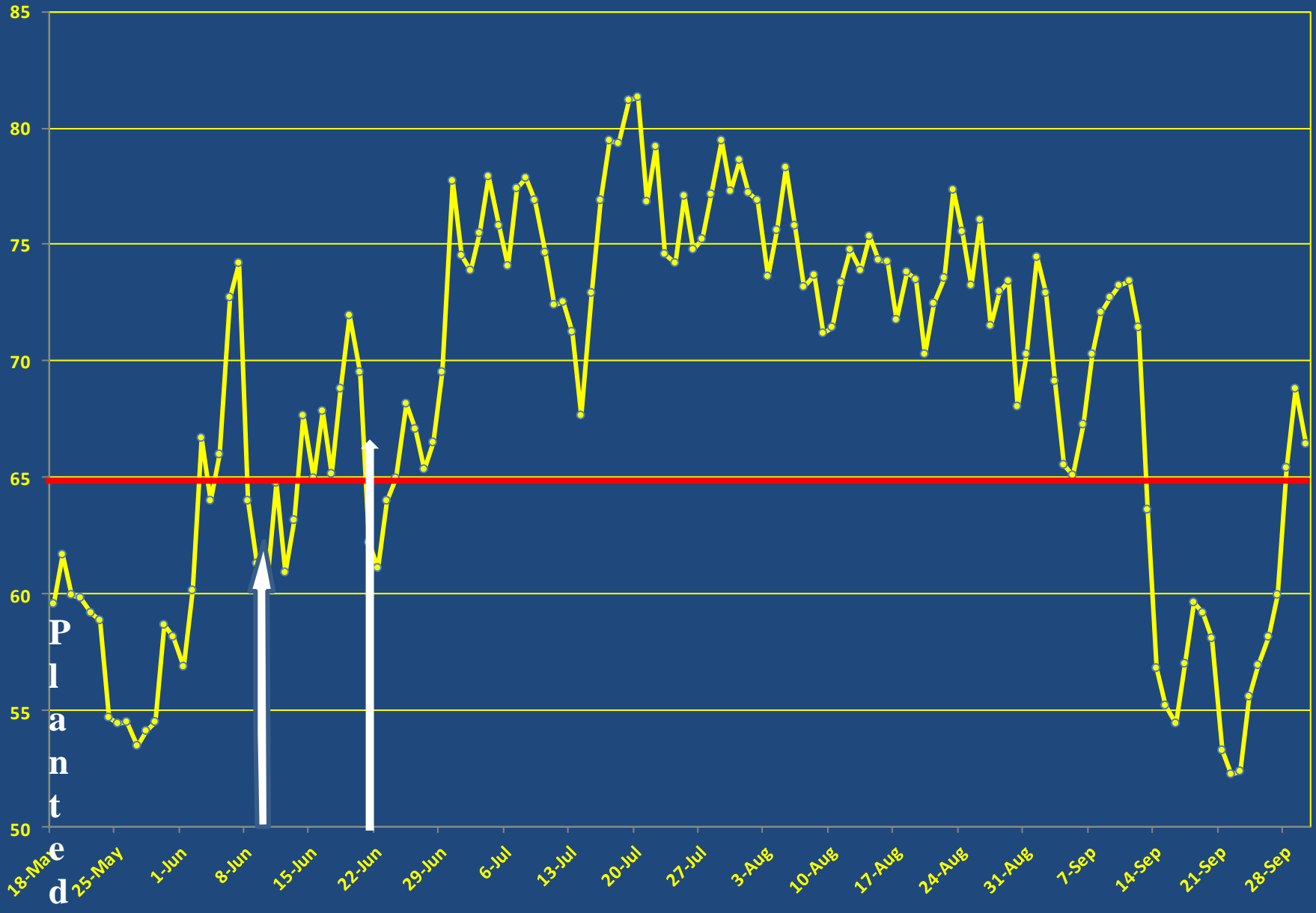
Summary

- **Quadris at 9.2 fl oz was most effective at controlling *Rhizoctonia solani* when applied in-furrow in an inoculated soil where conditions became favorable for infection soon after planting.**

**Can Post-Applications of Quadris – After
Soil Temperature of 65 F has been Attained
– Help to Control *R. solani*?**



Glyndon - Average Soil Temperature (°F) at 4 inches soil depth

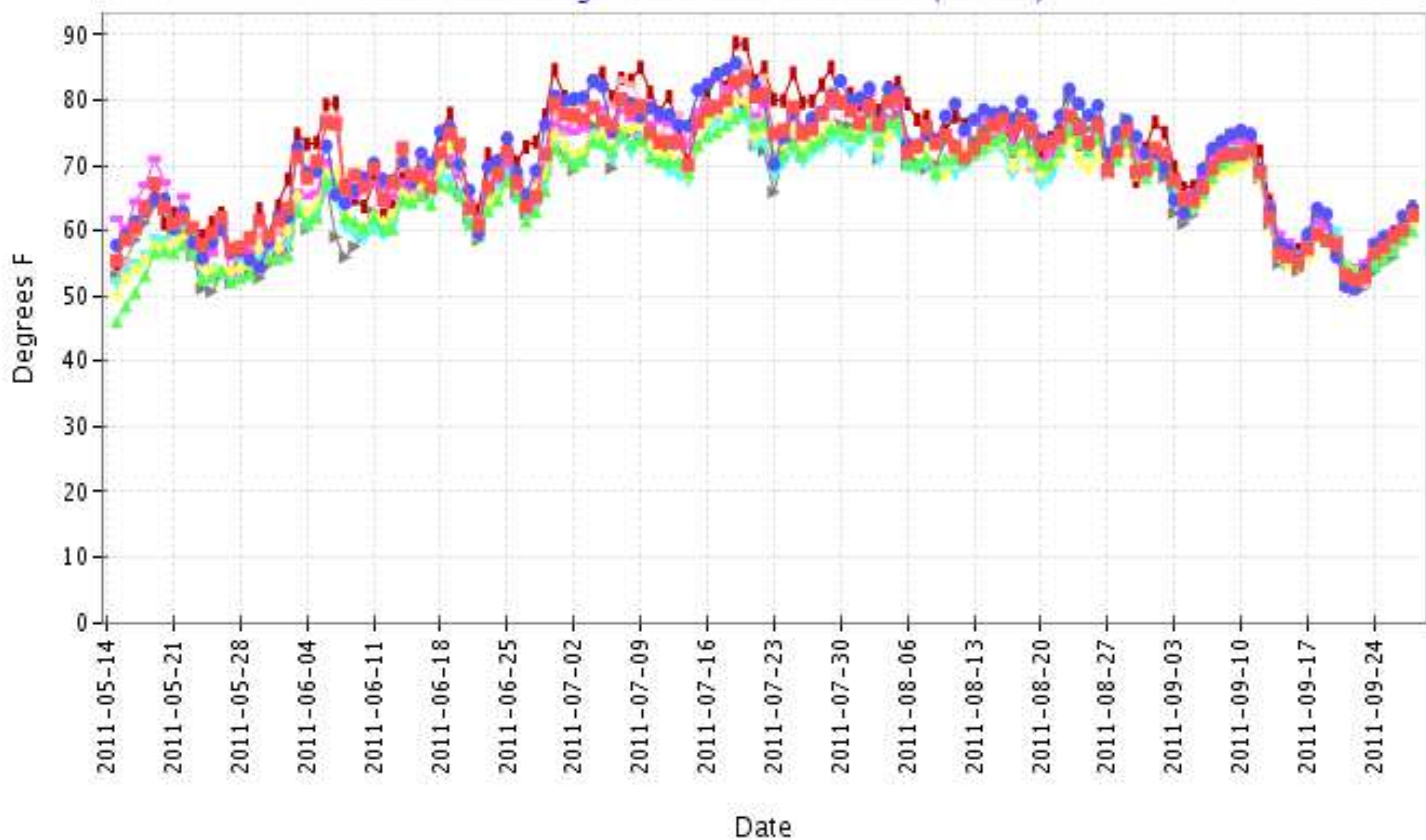


Plant
ed

Daily Average Bare Soil Temperature (4in Depth)

(2011-05-15 - 2011-09-28)

North Dakota Agricultural Weather Network (NDAWN)



Legend: Ada (red square), Cavalier (blue circle), Eldred (green triangle), Fargo (yellow diamond), Grafton (purple square), Grand Forks (cyan triangle), Hillsboro (pink square), St. Thomas (grey triangle), Wahpeton (dark red square)

Effect of Post Applications (Band and Broadcast) of Quadris on *R. solani*; (1 vs 2 Applications)

<i>Treatment</i>	<u><i>Stand/100 ft Row</i></u>			
<i>(Quadris 9.2 fl oz)</i>	<i>6/6</i>	<i>6/30</i>	<i>8/10</i>	<i>9/28</i>
Inoculated Check	197	134	68	42
Band, June 9	189	153	117	91
Broadcast, June 9	192	162	121	83
Band, June 9 and 20	209	195	178	159
Broadcast, June 9 and 20	189	172	158	132
LSD (P=0.05)	NS	21	38	45



Inoculated Nontreated Check



Quadris – Band June 9 & 20



Quadris- B/cast June 9 & 20

Effect of Post Applications (Band and Broadcast) of Quadris on *R. solani*; (1 vs 2 Applications)

<i>Treatment</i> (<i>Quadris 9.2 fl oz</i>)	<i>Stand 9/28</i> <i>Count/100'</i>	<i>Yield</i> (<i>T/A</i>)	<i>RSA</i> (<i>lb/A</i>)
Inoculated Check	42	9.4	3881
<i>Band, June 9</i>	<i>91</i>	<i>19.0</i>	<i>4852</i>
<i>Broadcast, June 9</i>	<i>83</i>	<i>16.4</i>	<i>4795</i>
Band, June 9 and 20	159	26.2	7451
Broadcast, June 9 and 20	132	23.0	6165
LSD (P=0.05)	45	6.1	1511



Inoculated Nontreated Check



Quadris – Band June 9 & 20



Quadris- B/cast June 9 & 20

Summary – Quadris Post Application

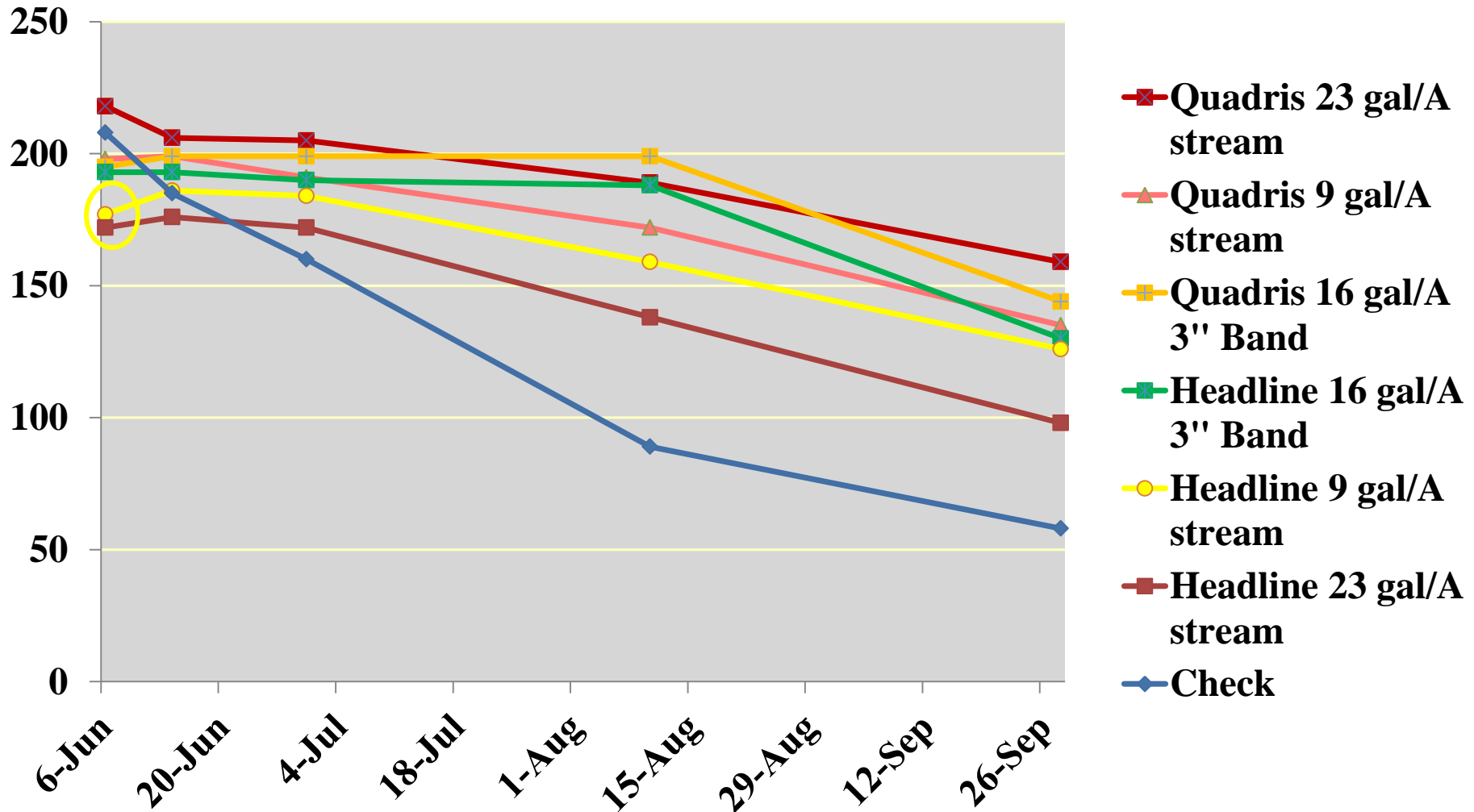
- **Two post-applications of Quadris, with the first applied about one week after average soil temperature of 65 F at the 4” depth was attained, generally provided better plant stand, yield and recoverable sucrose than one post-application and the non-treated check.**
- **Note plants were at Cotyledon-2 lf and 4-6 lf stages at fungicide applications.**

**Is it better to Apply Fungicides
in a T-Band Compared to a
Stream Application In-Furrow?
You Apply Fungicides in Water
@ 23 GPA; Will Growers Get
Similar Disease Control When
Using Lower Water Volumes?**

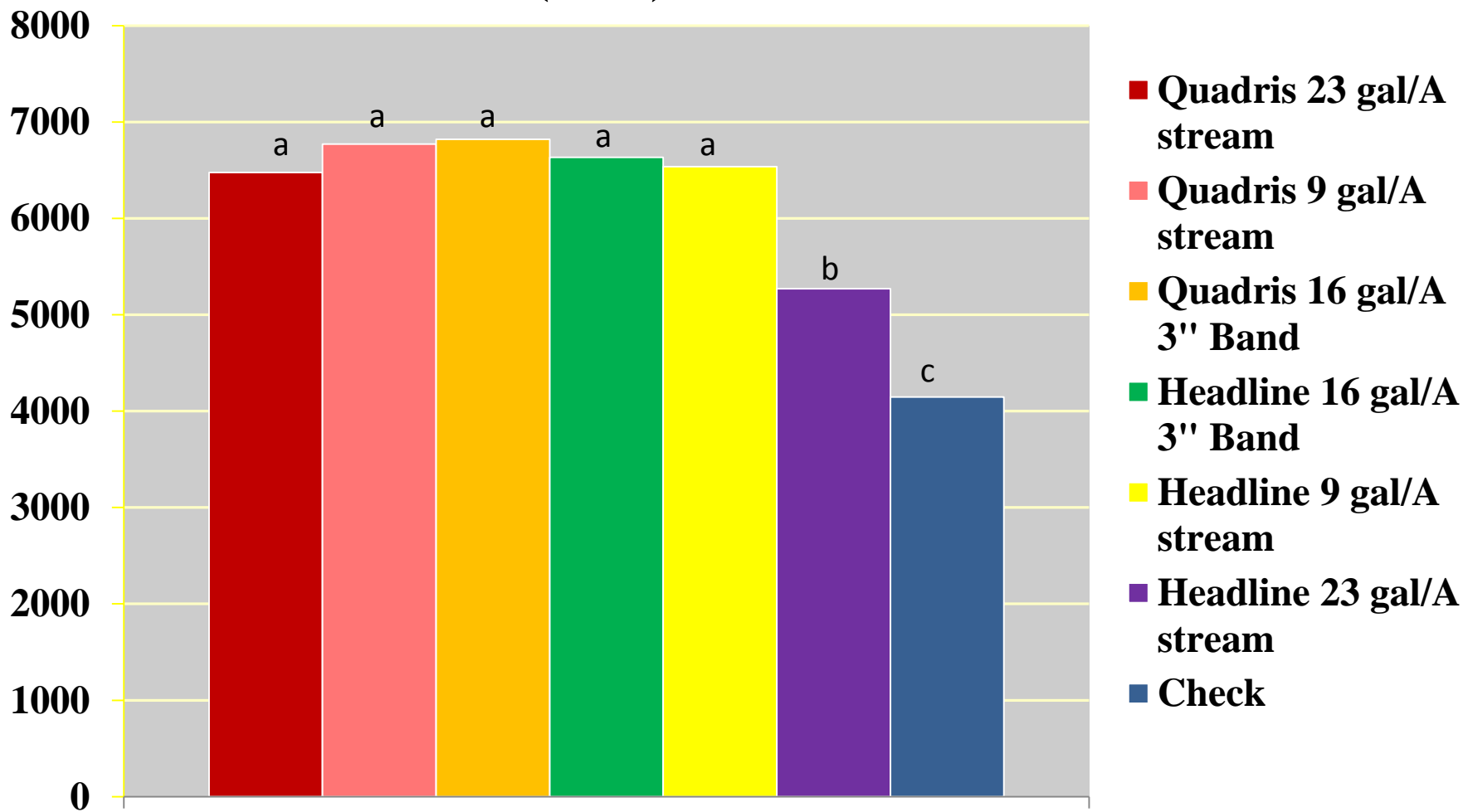
In-Furrow Application Method

- **Fungicides**
 - **Quadris @ 9.2 fl oz/A**
 - **Headline @ 12 fl oz/A**
- **Nozzle Configurations**
 - **TeeJet 0004 StreamJet nozzle**
 - **23 gal/A – solid stream**
 - **#35 orifice plate**
 - **9 gal/A – solid stream**
 - **TeeJet 4002 E flat fan nozzle**
 - **16 gal/A – 3” T-band**

Beets per 100' of row



Ext. Sucrose (lb/A)



Nontreated Check



Quadris – 14.3 fl oz; 23 gpa; Stream In-furrow Application



Quadris – 14.3 fl oz; 9 gpa; Stream In-furrow Application



Quadris – 14.3 fl oz; 16 gpa; 'T'-Band Application



Headline 12 fl oz; 23 gpa; Stream In-furrow Application



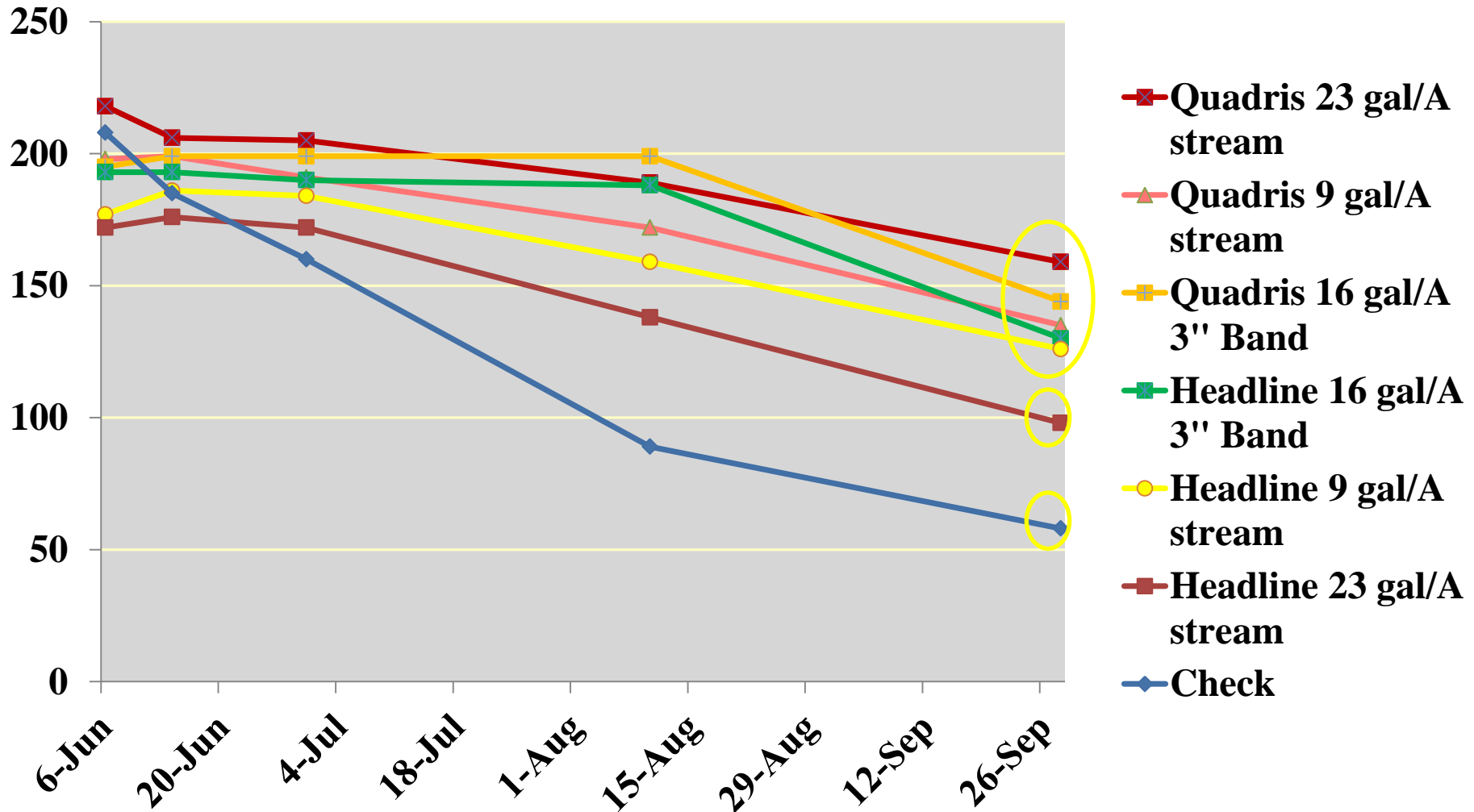
Headline 12 fl oz; 9 gpa; Stream In-furrow Application



Headline 12 fl oz; 16 gpa; 'T'-Band Application



Beets per 100' of row



Effect of Water Volume and Stream vs. 'T'-Band Applications

Treatment	Yield	Rec Sucrose
<u>Fl oz/GPA</u>	<u>T/A</u>	<u>lb/Ac</u>
Check	15.9	4146*
Quadris 14.3/23	22.5	6475
Quadris 14.3/9	23.5	6770
Quadris 14.3/16 'T'	24.7	6820
Headline 12/23	20.3	5269*
Headline 12/9	22.9	6537
<u>Headline 12/16 'T'</u>	<u>22.0</u>	<u>6632</u>
LSD (0.05)	2.8	935

Summary

- **Both Quadris (14.3 fl oz) and Headline (12 fl oz) at high rates were effective at controlling *Rhizoctonia solani* when applied in-furrow in an inoculated soil where conditions became favorable for infection soon after planting.**
- **Headline in water at 23 GPA resulted in significantly lower recoverable sucrose compared to when applied with water at 9 GPA and 16 GPA; 'T'-band may be safer than stream application.**

**Can Fungicides Mixed With
Starter Fertilizer (10-34-0 @
3 GPA) Provide Effective
Rhizoctonia Control and Not
be Phytotoxic to Plants?**

Non-treated Check



10-34-0 – 3 gpa



Quadris 14.3 fl oz +10-34-0



Quadris 9.2 fl oz +10-34-0



Headline 12 fl oz +10-34-0



Headline 6 fl oz +10-34-0



Experimental 1 + 10-34-0



Experimental 2 +10-34-0




Experimental 1 on Seed+10-34-0



Dynasty Seed Trt +10-34-0






Inoculated
Check




10-34-0
3 gal/A
In-Furrow




Quadris 9.2 fl oz/a
+
10-34-0 3 gal/a
In-Furrow




Quadris 14.3 fl oz/a
+
10-34-0 3 gal/a
In-Furrow



Vertisan 38 fl oz/a
+
10-34-0 3 gal/a
In-Furrow



Headline 12 fl oz/a
+
10-34-0 3 gal/a
In-Furrow

A photograph of a field of young green plants, likely a crop trial. The plants are arranged in rows on dark, sandy soil. A central plant has a white identification sign attached to it with yellow clips. The sign contains text describing the treatment: 'Headline 6 fl oz/a + 10-34-0 3 gal/a In-Furrow'. The plants are healthy and green, with some showing signs of being recently transplanted or sown.

Headline 6 fl oz/a
+
10-34-0 3 gal/a
In-Furrow

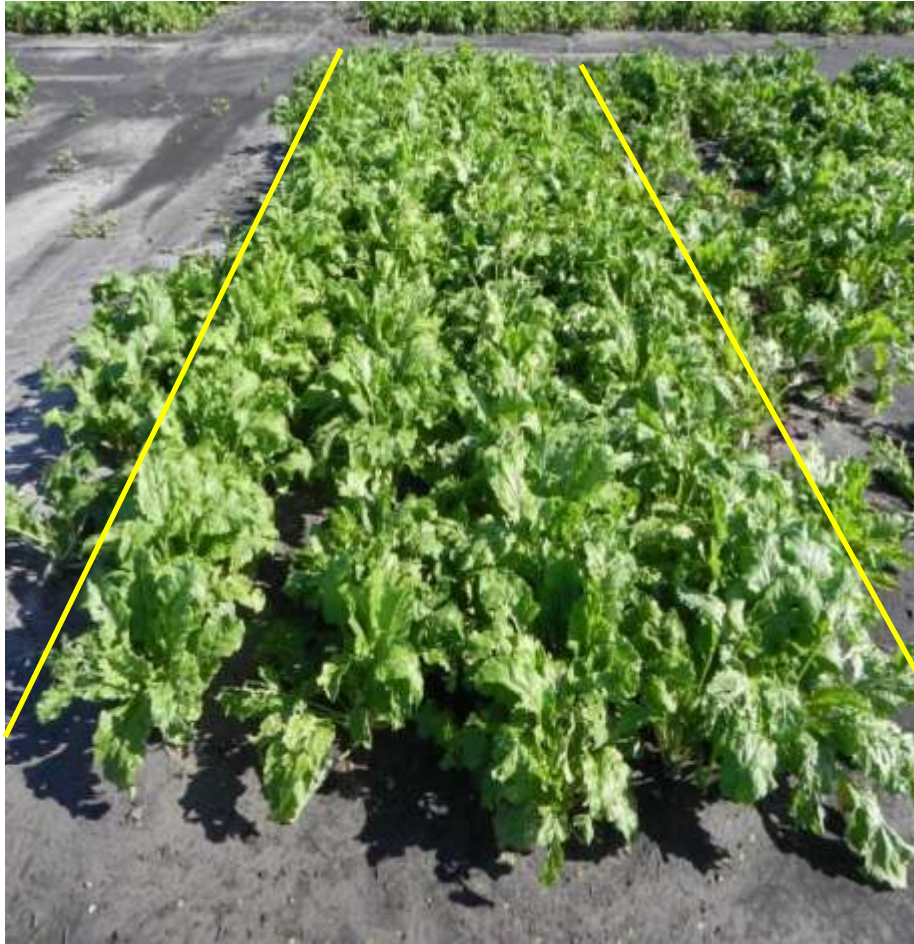
3 Rows Per Plot *3 Plot Size*
Penthiopyrrad / At plant
+
10-34-0 3 gal/a
In-Furrow



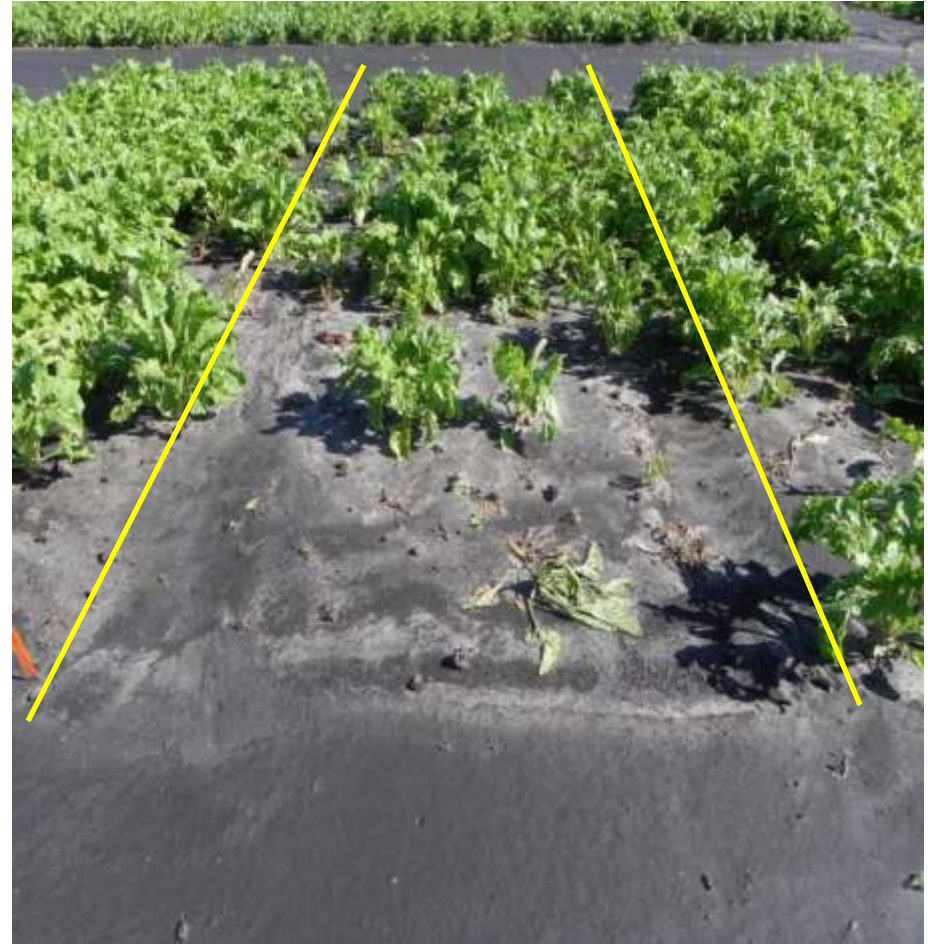


Dynasty / At plant
+
10-34-0 3 gal/a
In-Furrow

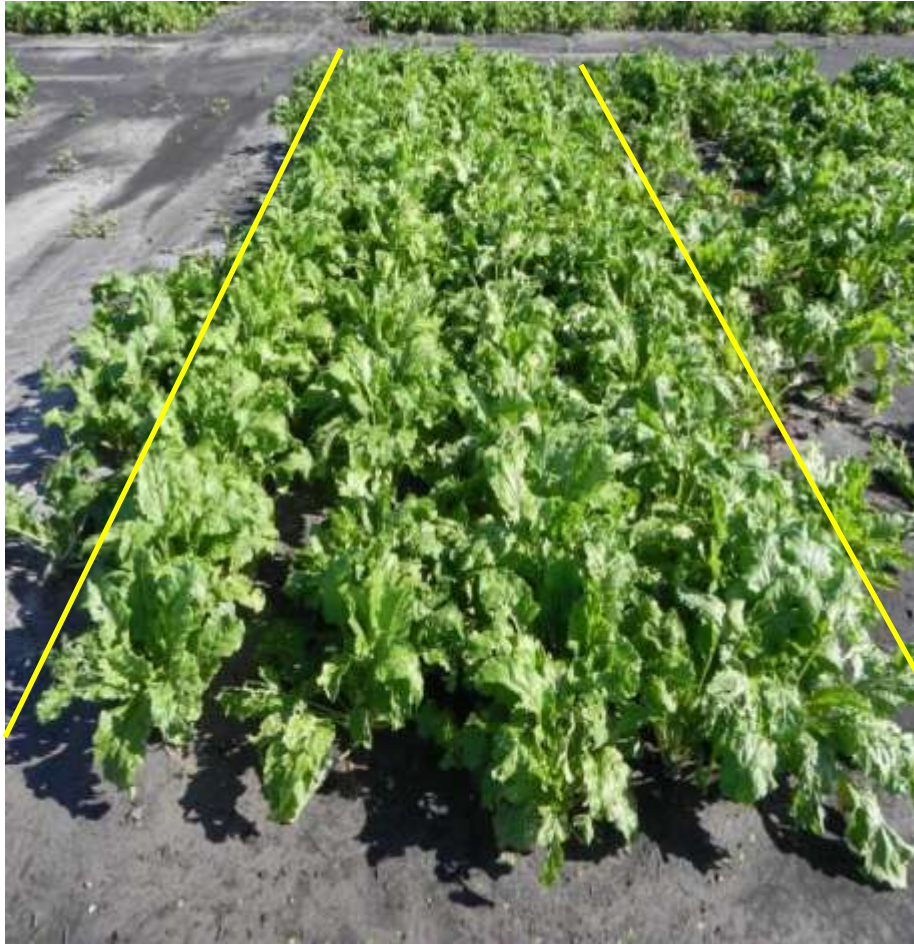
**Quadris 9.2 fl oz +
10-34-0 3 gal/A**



Check



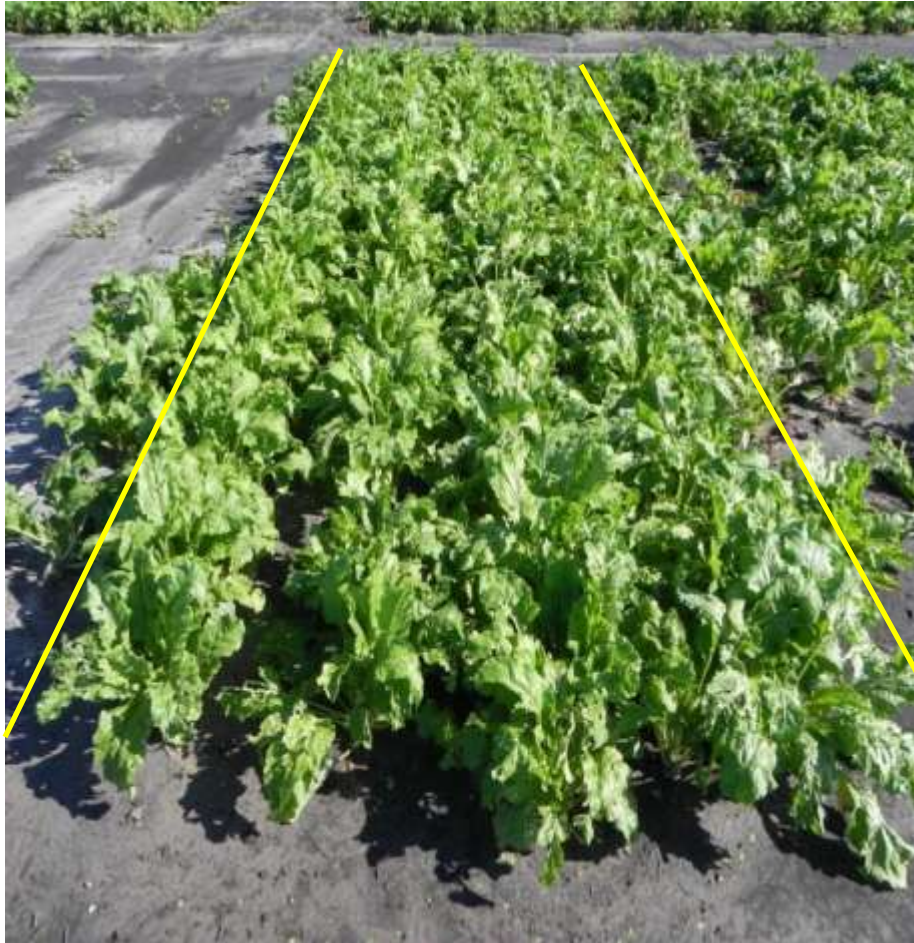
**Quadris 9.2 fl oz +
10-34-0 3 gal/A**



10-34-0 3 gal/A



**Quadris 9.2 fl oz +
10-34-0 3 gal/A**



**Quadris 14.3 fl oz +
10-34-0 3 gal/A**



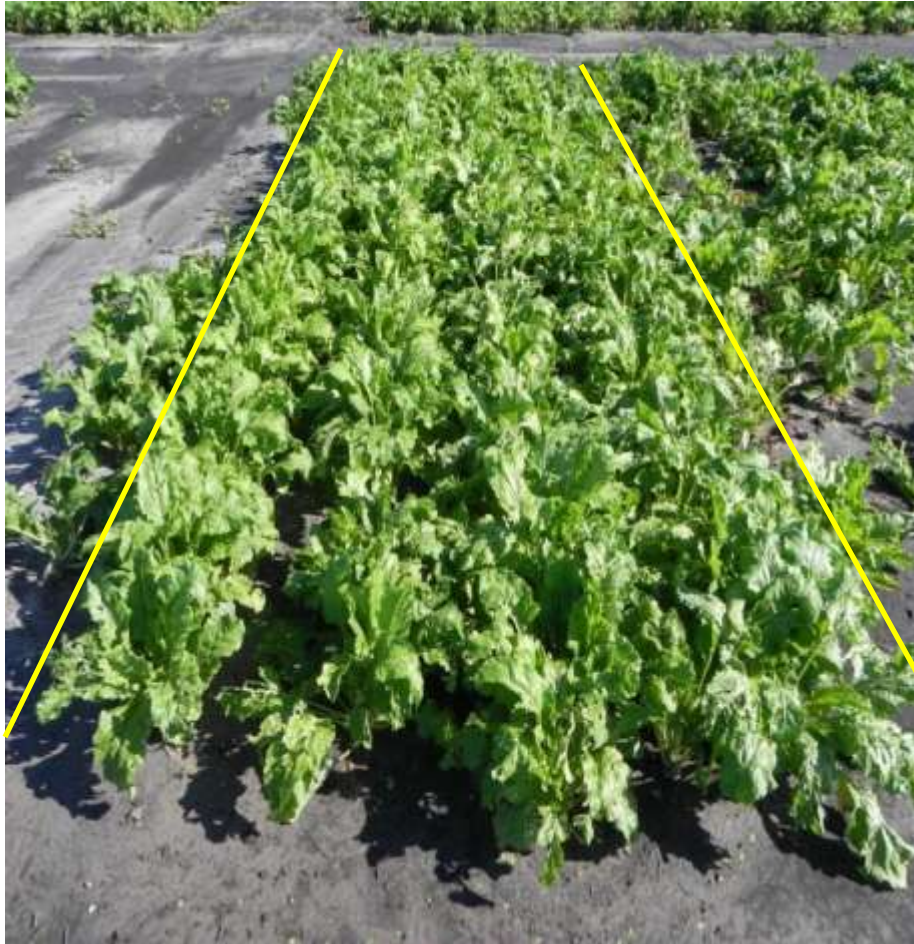
**Quadris 9.2 fl oz +
10-34-0 3 gal/A**



**Headline 12 fl oz +
10-34-0 3 gal/A**



**Quadris 9.2 fl oz +
10-34-0 3 gal/A**



**Headline 6 fl oz +
10-34-0 3 gal/A**



<i>Treatment +10-34-0</i>	<i>Yield</i>	<i>Sucrose</i>	<i>Rec Sucrose/A</i>
<i>fl oz/ 23GPA</i>	<i>T/A</i>	<i>(%)</i>	<i>(lb/Ac)</i>
Non-treated Check	18.0	14.5	4515 e
10-34-0 Check	16.4	14.8	4228 e
Quadris 9.2	27.2	15.8	7629 a
Quadris 14.3	25.2	16.3	7367 ab
Headline 6	20.5	15.4	5502 cde
Headline 12	22.0	15.8	6158 bc
LSD (0.05)	4.5	1.2	1373

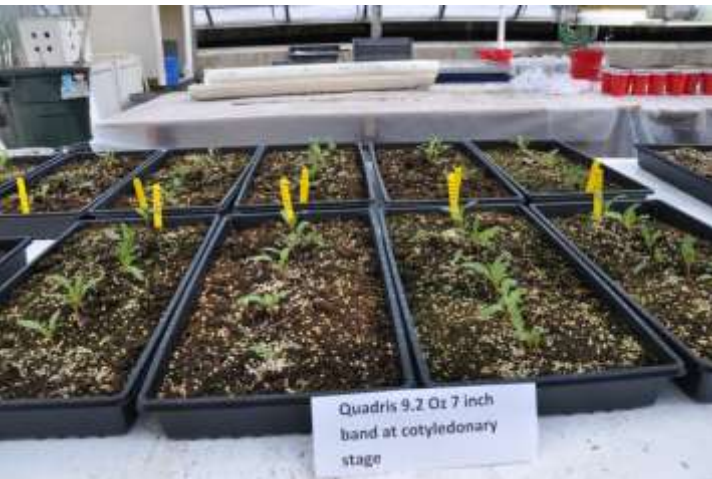
Summary

- **No phytotoxicity was observed when Quadris and Headline were mixed with 10-34-0. However, Headline reduced or delayed emergence.**
- **Headline at 12 fl oz generally resulted in better disease control and higher yield and recoverable sucrose than Headline at 6 fl oz.**
- **Quadris applied in-furrow at 9.2 fl oz/A resulted in greatest extractable sucrose.**

**Should Sugar Beet be Treated
with Quadris for Controlling
R. solani Before the 4-Leaf
Stage in Conditions
Favorable for Infection?**

Grower's Question

- I planted sugar beet in a field with a history of *Rhizoctonia* root rot when the soil temperature at the 4 inch depth was 55 F. My beets are just emerging. The meteorologist predicted that there will be very warm weather next week and the soil temperature will probably reach 65 F. Should I apply Quadris now or should I wait for the plants to become older (4 to 6 leaf beet)?



YES!!!



Quadris at 9.2 fl oz/A provided protection from *R. solani* in-furrow, banded soil surface, and foliar applications to sugarbeet as seed, cotyledonary, 2-lf and 4-lf stages.

Summary

- Since *R. solani* infects susceptible sugar beet when the soil temperature at the four inch depth averages 65 F and in the presence of adequate moisture, sugar beet, irrespective of growth stage, should be protected from *R. solani* infection with an application of Quadris before the average soil temperature reaches 65 F.

Is there any seed treatment that can be used to provide early season *Rhizoctonia* control?

Penthiopyrad – broad spectrum

Succinate dehydrogenase inhibitor (SDHI) – binds to ubiquinone binding pocket and inhibits mitochondrial activities



Managing *Rhizoctonia solani* with Seed Treatment + Quadris 9.2 fl oz/A; 2010

<i>Treatment</i>	<i>Stand</i> <i>Count/50'</i>	<i>Yield</i> <i>(T/A)</i>	<i>RSA</i> <i>(lb/A)</i>
<i>Inoculated Check</i>	48	16.0	5068
Quadris (Band; 2 Jun)	51	20.2	6396
<i>Quadris (If)/Quadris(B)</i>	<i>84</i>	<i>25.7</i>	<i>8397</i>
Penthiopyrad 14 g a.i (Seed treatment)	57	18.0	5788
<u><i>Pent. 14 g a.i/Quadris(B)</i></u>	<u><i>73</i></u>	<u><i>26.7</i></u>	<u><i>8506</i></u>
LSD (P=0.05)	14	6.6	2174

Resistant Variety: Quadris Foliar



Resistant Variety: Quadris In- furrow / Quadris Foliar



Resistant Variety: Penthopyrad 14 g ai



Resistant Variety: Penthopyrad 14 g ai / Quadris Foliar



Managing *Rhizoctonia solani* of Tolerant Variety with Seed Treatment + Quadris 9.2 fl oz/A; 2011

<i>Treatment</i>	<i>Stand</i> <i>Count/100'</i>	<i>Yield</i> <i>(T/A)</i>	<i>RSA</i> <i>(lb/A)</i>
Inoculated Check	133	21.2	5414
Quadris (In-furrow A)	169	26.2	7567
Penthiopyrad 14 g a.i (Seed treatment)	154	24.3	6443
Quadris (Band; B)	160	25.2	6839
Quadris (IF, A)/Quadris(B)	164	28.8	8153
Pent. 14 g a.i/Quadris(B)	181	26.2	7882

**Managing *R. solani* on Tolerant Variety with
Seed Treatment + Quadris 9.2 fl oz/A;
Early Planted - May 18, 2011**

<i>Treatment</i>	<i>Stand</i>	<i>Yield</i>	<i>RSA</i>
<u><i>May 18(A), June 9 (B)</i></u>	<u><i>Count/100'</i></u>	<u><i>(T/A)</i></u>	<u><i>(lb/A)</i></u>
Inoculated Check	133	21.2	5414
Pent. 7 g a.i	156	24.6	6586
Pent. 7 g a.i/ Quadris	186	25.2	6883
<i>Penthiopyrad 14 g a.i</i>	<i>154</i>	<i>24.3</i>	<i>6443</i>
<i>Pent. 14 g a.i/Quadris</i>	<i>181</i>	<i>26.2</i>	<i>7882</i>
Pent. 28 g a.i	174	26.5	7421
Pent. 28 g a.i/ Quadris	189	25.7	6925
LSD (P=0.05)	25	3	800

Summary – Seed Treatment

- **Penthiopyrad, as a seed treatment, provided good early season control against *R. solani*.**
- **The combination of penthiopyrad as a seed treatment and a timely foliar application of Quadris provided effective control of *Rhizoctonia solani* .**

Conclusions – In-furrow Applications

- Fungicide protection is needed when planting in warm, moist soils with a history of *R. solani*.
- There may be some stand loss when fungicides are applied alone or with starter fertilizers as an in-furrow application.
- Headline tend to reduce stand more than Quadris when applied in-furrow.
- ‘T’ – band may be safer than ‘stream’ in-furrow application.

Conclusions – In-furrow Applications

- **Please read and follow your fungicide labels – you use fungicides with a starter fertilizer/or insecticide/herbicide (or any other product at your own risk).**

Conclusions – Band vs Broadcast

- **7” band application typically provides better disease control than broadcast application.**
- **However, when it is wet and warm (approaching 65 F), it is better to apply a broadcast application (aircraft) rather than doing nothing.**

Conclusions - Action

- In fields with a history of very little Rhizoctonia – one post application of Quadris when the average temperature at the 4” soil depth is 60 to 62 F will adequately control the disease.
- In fields with a history of moderate to severe disease, use Rhizoctonia tolerant varieties, an in-furrow, and post application of fungicides when the average temperature at the 4” soil depth is 60 to 62 F.

Conclusions – Timeliness

- In fields with a history of severe disease, if an effective fungicide could not be applied before the average temperature at the 4” soil depth reaches 65 F, two post applications (with the first as soon as possible after 65 F) of Quadris 10 to 14 days apart may help to control *R. solani* (based on one year’s field data).
- Thank you!!!

Six rows – Fusarium Tolerant Variety



Six rows - Fusarium Susceptible Variety





← 0 t/A



5 t/A →

Effect of precipitated calcium carbonate (Waste lime) on Fusarium susceptible variety



← **Fusarium Tolerant variety**



← 10 t/A



15 t/A →

Symptoms on seedling





**Effect of precipitated calcium carbonate on
Rhizoctonia Root Rot**



Summary – Precipitated Calcium Carbonate

- **Precipitated calcium carbonate resulted in improved plant populations at both the Rhizoctonia and Fusarium infested sites. However, disease pressure was very severe resulting in poor yields of the surviving plants. An integrated management system that includes tolerant varieties, timely application of fungicides, and precipitated calcium carbonate will lead to better control of soil-borne diseases of sugarbeet.**
- **Thank you!!!**

Acknowledgements –Thank You

- **Growers through the SBREB for funding my research and educational programs.**
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