Aphanomyces Root Rot Management In Alfalfa

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Topics

- Effect of sulfur treatments on the growth of *Aphanomyces euteiches* and severity of Aphanomyces root rot in alfalfa

- Evaluating genetic resistance to *Aphanomyces euteiches* in Round up Ready alfalfa varieties

Farm calls in 2009

Courtesy of Ted Bay

Alfalfa Yield Response to Sulfur

2010 Yields (2nd & 3rd cuttings)

	wo/Sulfur	w/Sulfur	Yield Response	
Normal Alfalfa	2.4	2.5	.1 ton/acre	4%
Yellowing Alfalfa	1.9	3.2	1.3 ton/acre	68%

2011 Yields (1ST, 2nd & 3rd cuttings)

	wo/Sulfur	w/Sulfur	Yield Response	
Normal Alfalfa	5.4	5.2	(.2) ton/acre	
Yellowing Alfalfa	3.2	4.9	1.7 ton/acre	53%

Study done by Ted Bay

Study done by Ted Bay

Hay Yield: (15% moisture)

	$CaSO_4$	Check	S	$(NH_4)_2SO_4$
2nd Cutting July 20				
Treatment	1	2	3	4
Rep 1	1.08 t/a	.41	.30	1.35
Rep 2	1.09	.57	.48	1.17
Rep 3	1.12	.69	.71	1.49
Average	1.10	.56	.50	1.34
3rd Cutting Sept. 5				
Treatment	1	2	3	4
Rep 1	.40 t/a	.17	.18	.61
Rep 2	.41	.27	.27	.70
Rep 3	.57	.21	.21	.81
Average	.46	.22	.22	.71
Total Yield	1.56	.78	.72	2.05

Laboratory Studies To Investigate Effect of Sulfur on Aphanomyces

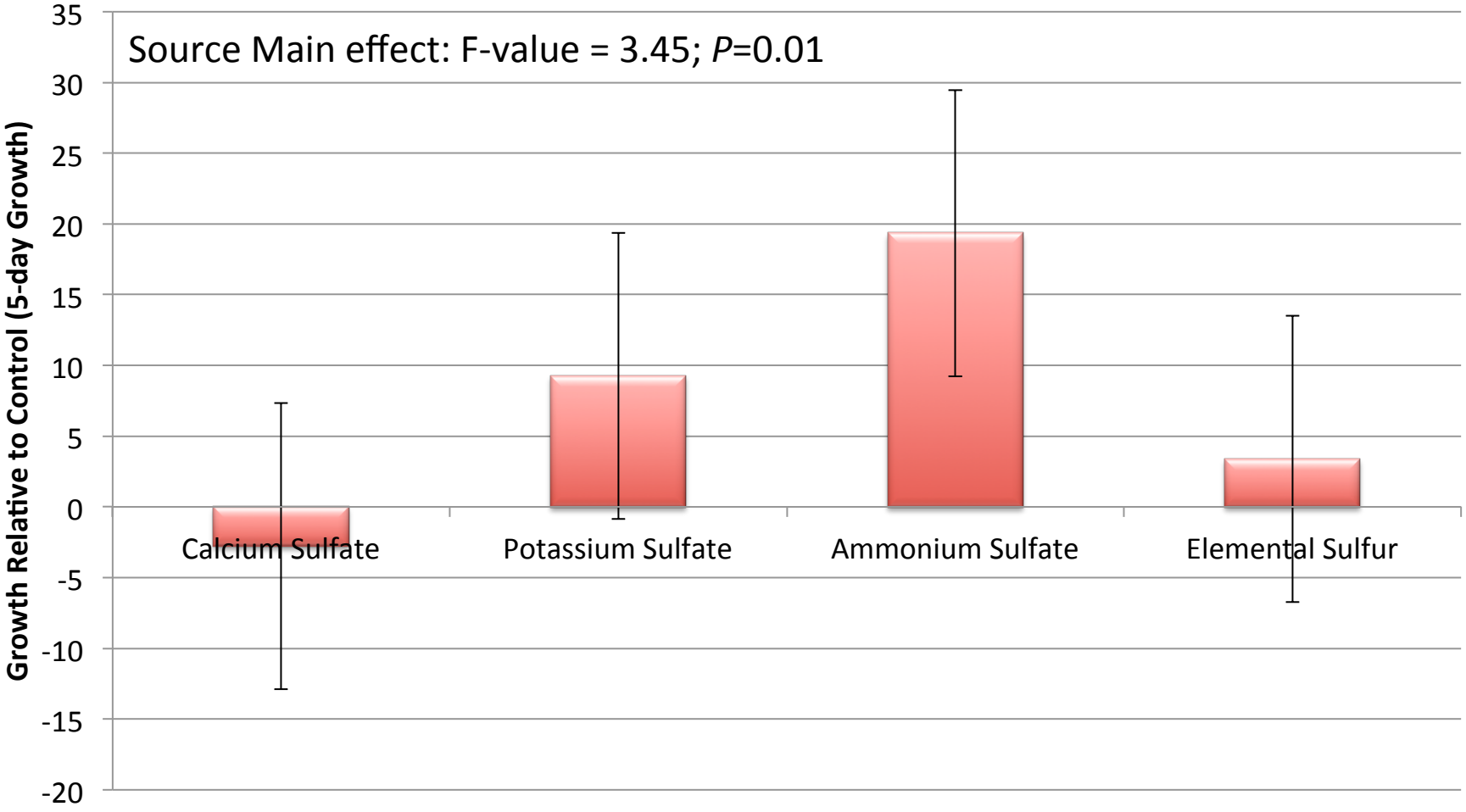
- Evaluate the effect of calcium sulfate, potassium sulfate, ammonium sulfate and elemental sulfur, or no sulfur, on the growth of different isolates of *A. euteiches* in culture.

- Investigate the development of Aphanomyces root rot in alfalfa seeded to growth medium amended with calcium sulfate, potassium sulfate, ammonium sulfate and elemental sulfur, or no sulfur.

Sulfur "Poison Plate" Assay

- Tests performed in Petri Dishes with cornmeal agar amended with 0, 10, 20, 30, 40 ppm of following sulfur sources:
  - K_2SO_4 (potassium sulfate)
  - Ca_2SO_4 (calcium sulfate)
  - $(NH_4)_2SO_4$ (ammonium sulfate)
  - S (elemental sulfur)
- *Aphanomyces euteiches* isolates used
  - Larsen MF-1 (Race 1)
  - Larsen NC-1 (Race 2)
- Experiment performed on bench top ~70F
- Growth Measured on plates using digital caliper
- Experiment repeated twice

"Poison Plate" Results



**Bars indicate 95% confidence intervals

Greenhouse Study to Investigate the Effect of Sulfur on Aphanomyces root rot

- No direct toxic effect on Aphanomyces
- Is there an effect on the root rot response in plants challenged with Aphanomyces and fertilized with sulfur compounds?
  - Induced resistance?
  - Healthier plants better able to handle disease?

Greenhouse Study

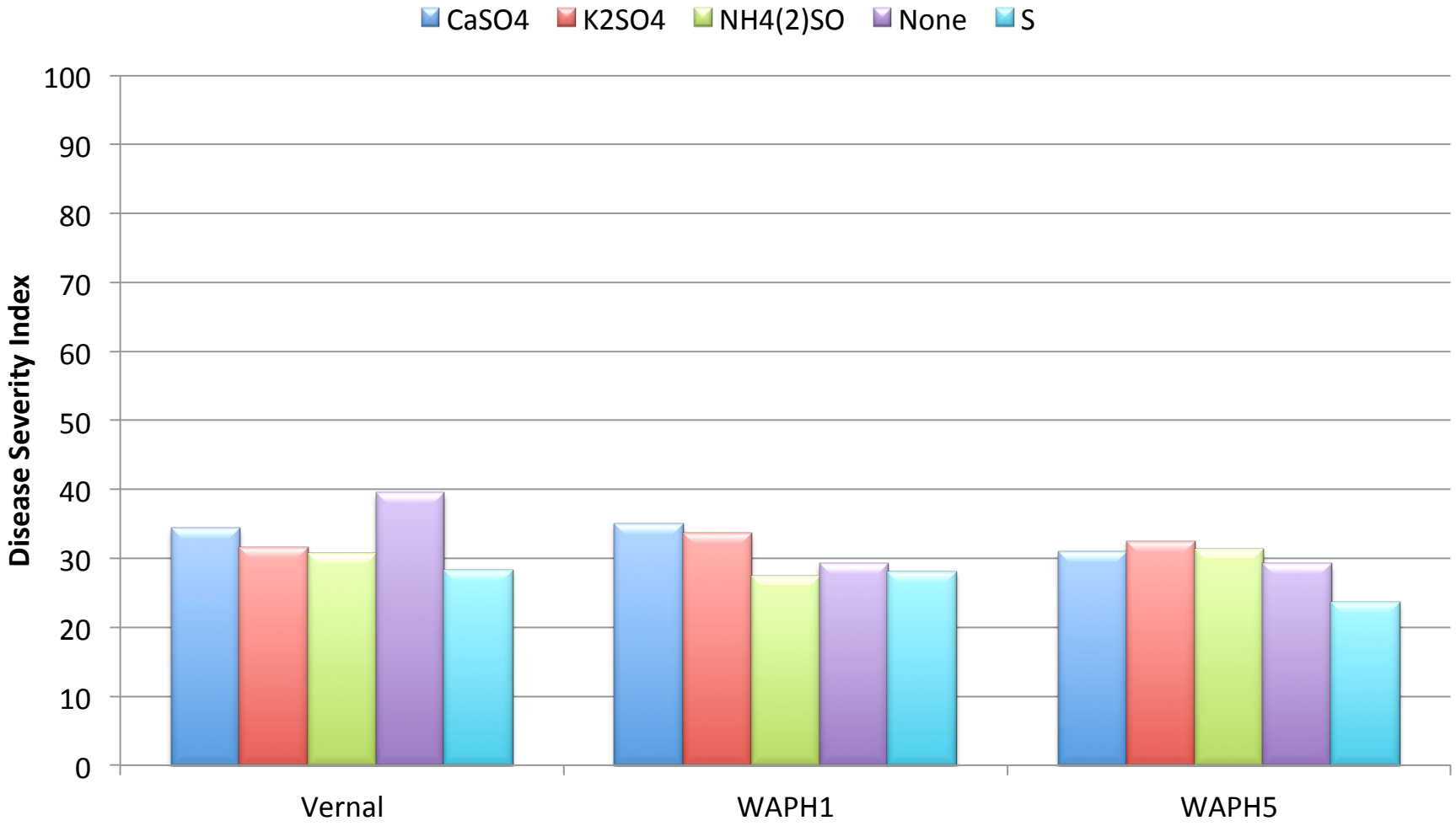
- Tests performed using rates of 10, 20, 30, 40 ppm of following sulfur sources:
  - K_2SO_4 (potassium sulfate)
  - Ca_2SO_4 (calcium sulfate)
  - $(NH_4)_2SO_4$ (ammonium sulfate)
  - S (elemental sulfur)
- *Aphanomyces euteiches* isolates used
  - Larsen MF-1 (Race 1)
  - Larsen NC-1 (Race 2)
- Varieties used included
  - Vernal (Susceptible to Race 1 & 2)
  - WAPH1 (Resistant to Race 1 ONLY)
  - WAPH5 (Resistant to Race 1 & 2)
- Experiment performed in cone-tainers
- Disease severity index calculated

  DSI = [(Average Visual Severity (1-4) / Number of Emerged Plants)/4]*100
- Experiment repeated twice

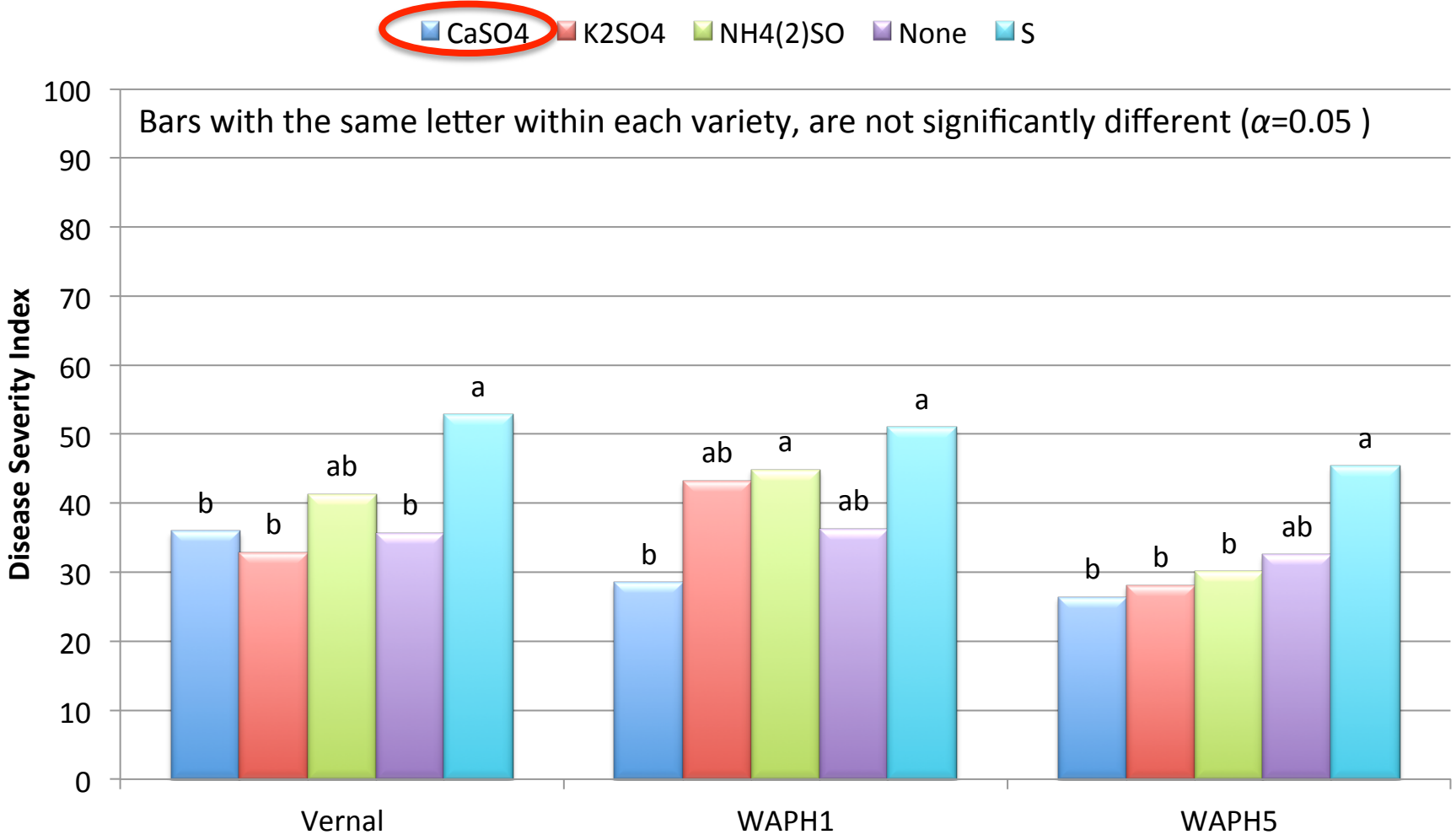
Greenhouse Study Results

- Wide variation in emergence and damage
- Race x Variety x Sulfur Source Interaction**
- No differences in Rate main effect or interactions with Rate

DSI Ratings for Larsen MF-1 (Race 1) Isolate



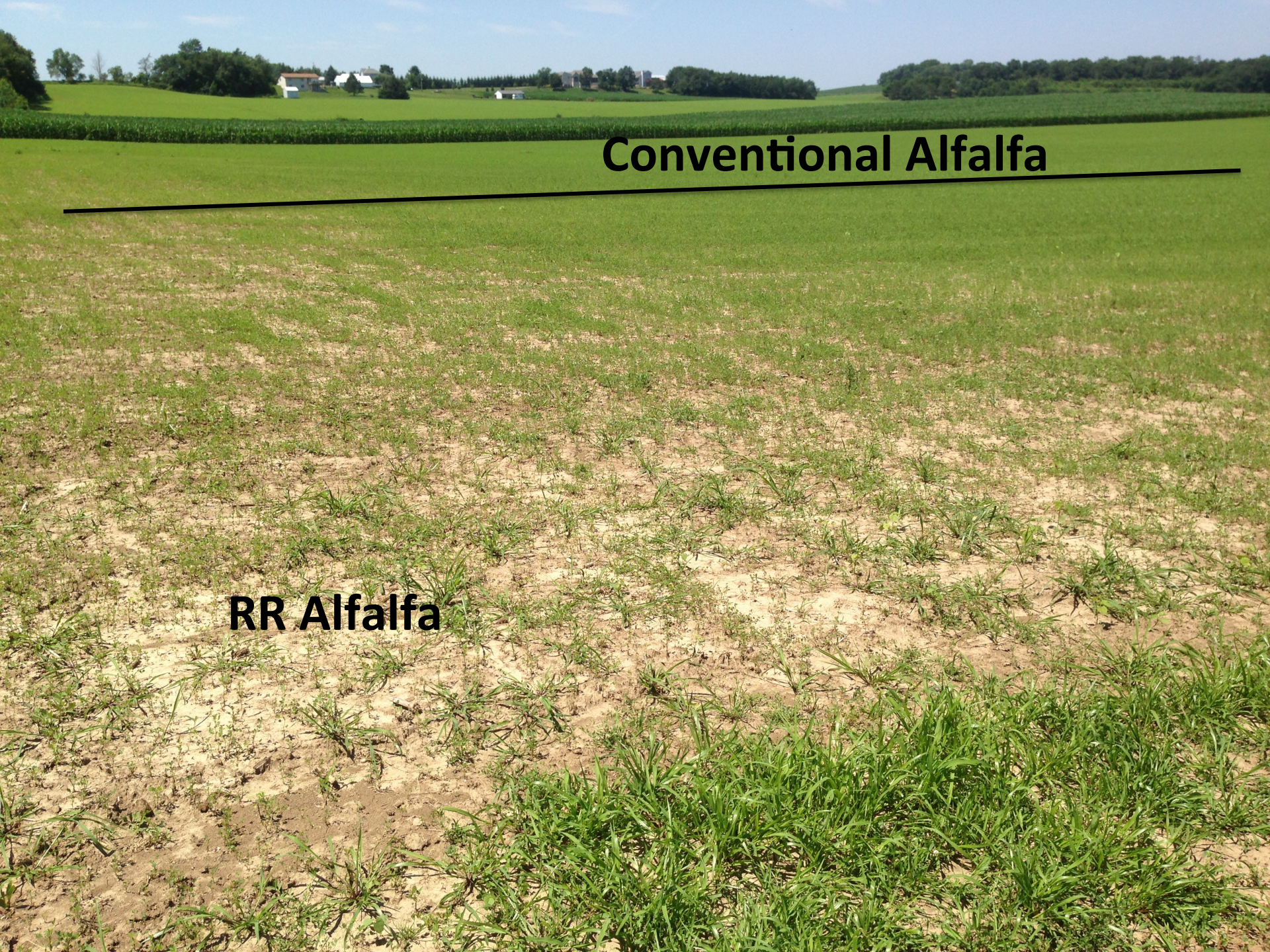
DSI Ratings for Larsen NC-1 (Race 2) Isolate



Summary on Sulfur

- Sulfur compounds are NOT directly toxic to *A. euteiches*
- Effect of sulfur on ARR might be dependent on the isolate present
  - Sulfur has limited effect on Race 1
  - Sulfur had significant effect on Race 2
- Ca_2SO_4 (calcium sulfate) generally provided a reduction in ARR across all alfalfa varieties
- Future work
  - to focus on reduction in ARR in response to calcium vs. sulfur
  - Is the reduction in ARR an artifact of a healthy plant or induction of an active resistance system??

Roundup Ready Alfalfa and Aphanomyces Resistance


Conventional Alfalfa
RR Alfalfa

Varieties Tested

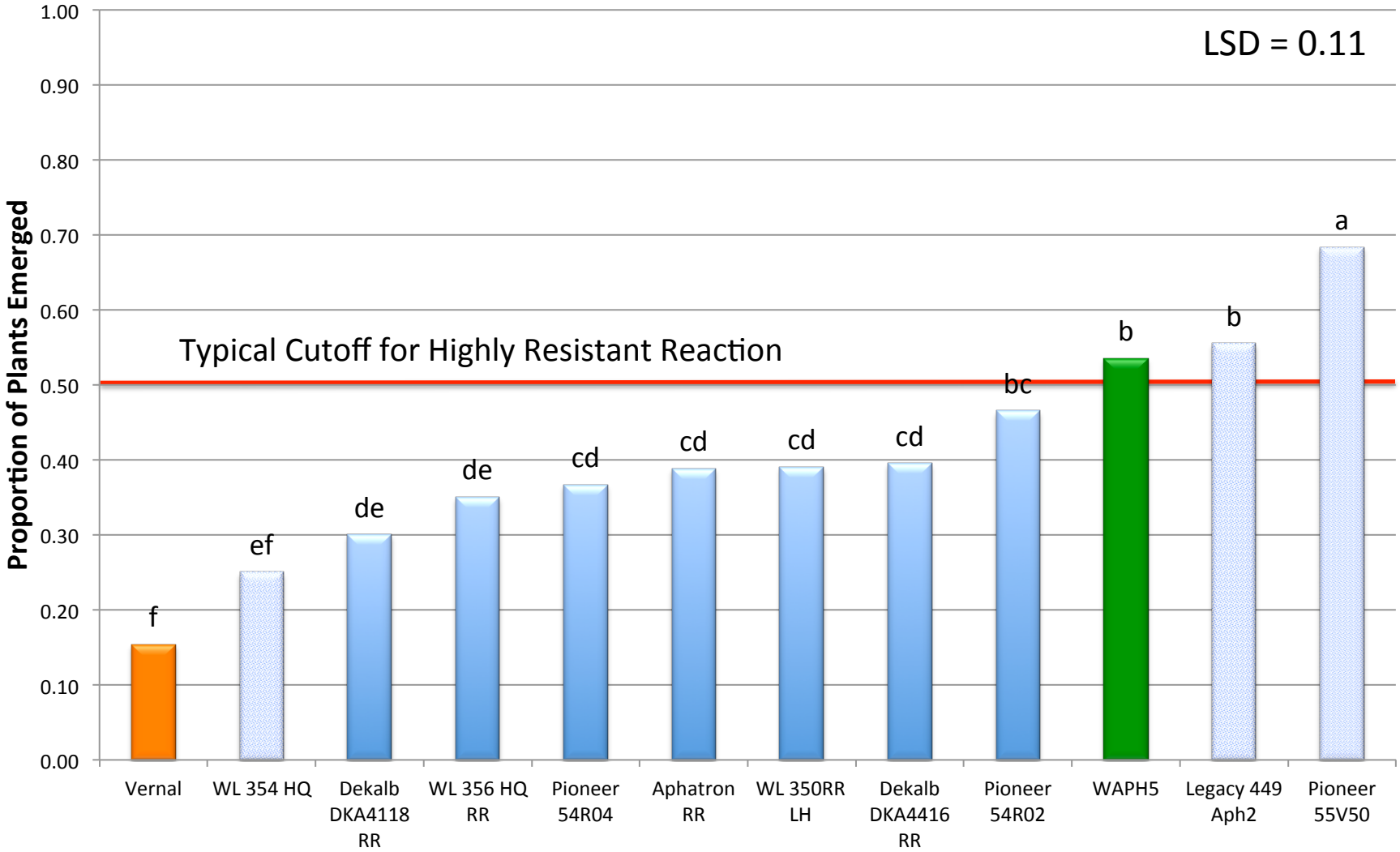
- Vernal (Universal Susceptible Check)
- WL 354 HQ
- Dekalb DKA4118 RR
- WL 356 HQ RR
- Pioneer 54R04
- Aphatron RR
- WL 350RR LH
- Dekalb DKA4416 RR
- Pioneer 54R02
- Legacy 449 Aph2
- Pioneer 55V50
- WAPH5 (Resistant Check)

The Assay

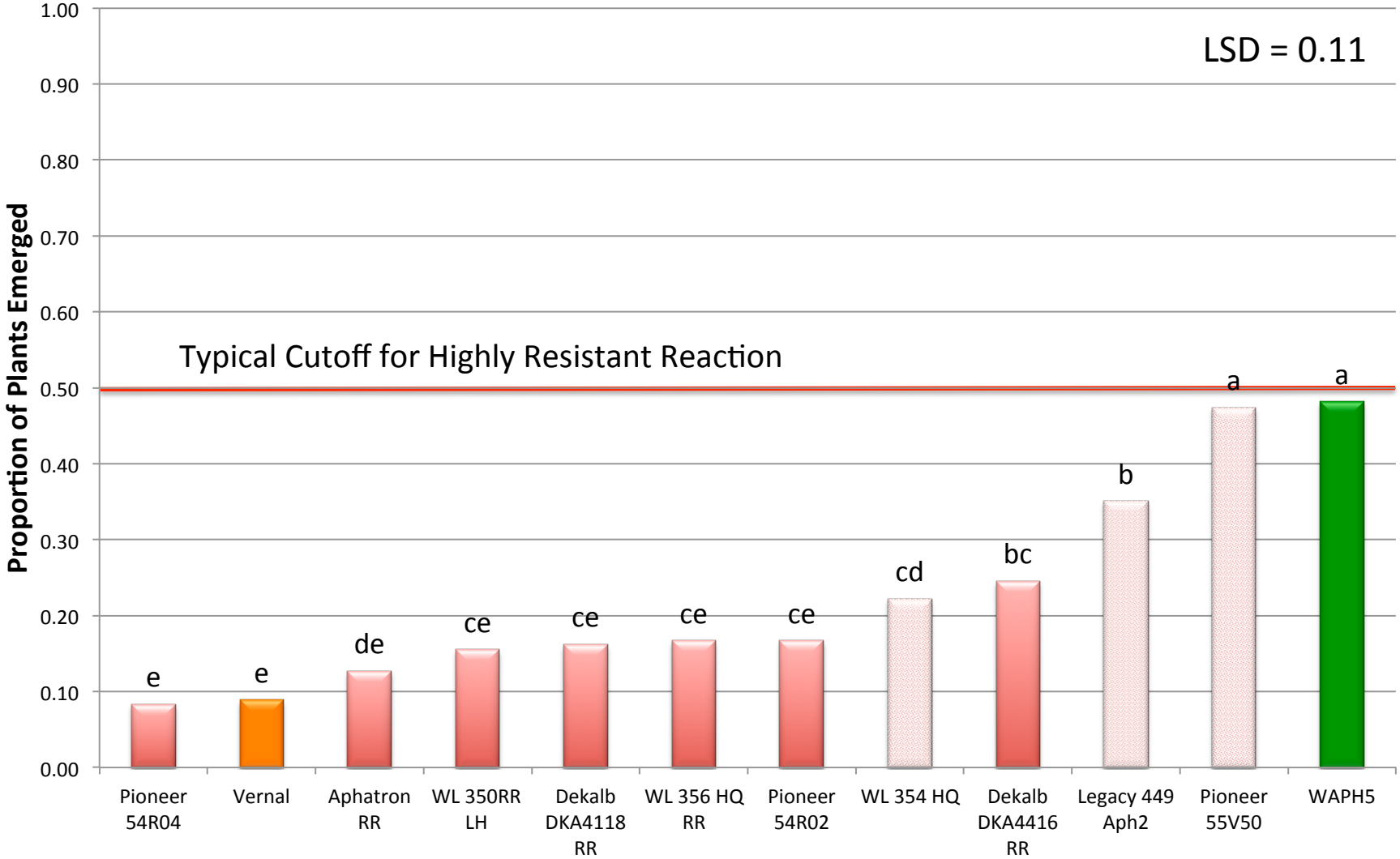
- 12 varieties
- 30 seeds per cell
- 3 isolates
  - Race 1: MF 1
  - Race 2: NC 1
  - Race 3: Seitz 9
- Assay duration: 3 weeks

Emergence Data

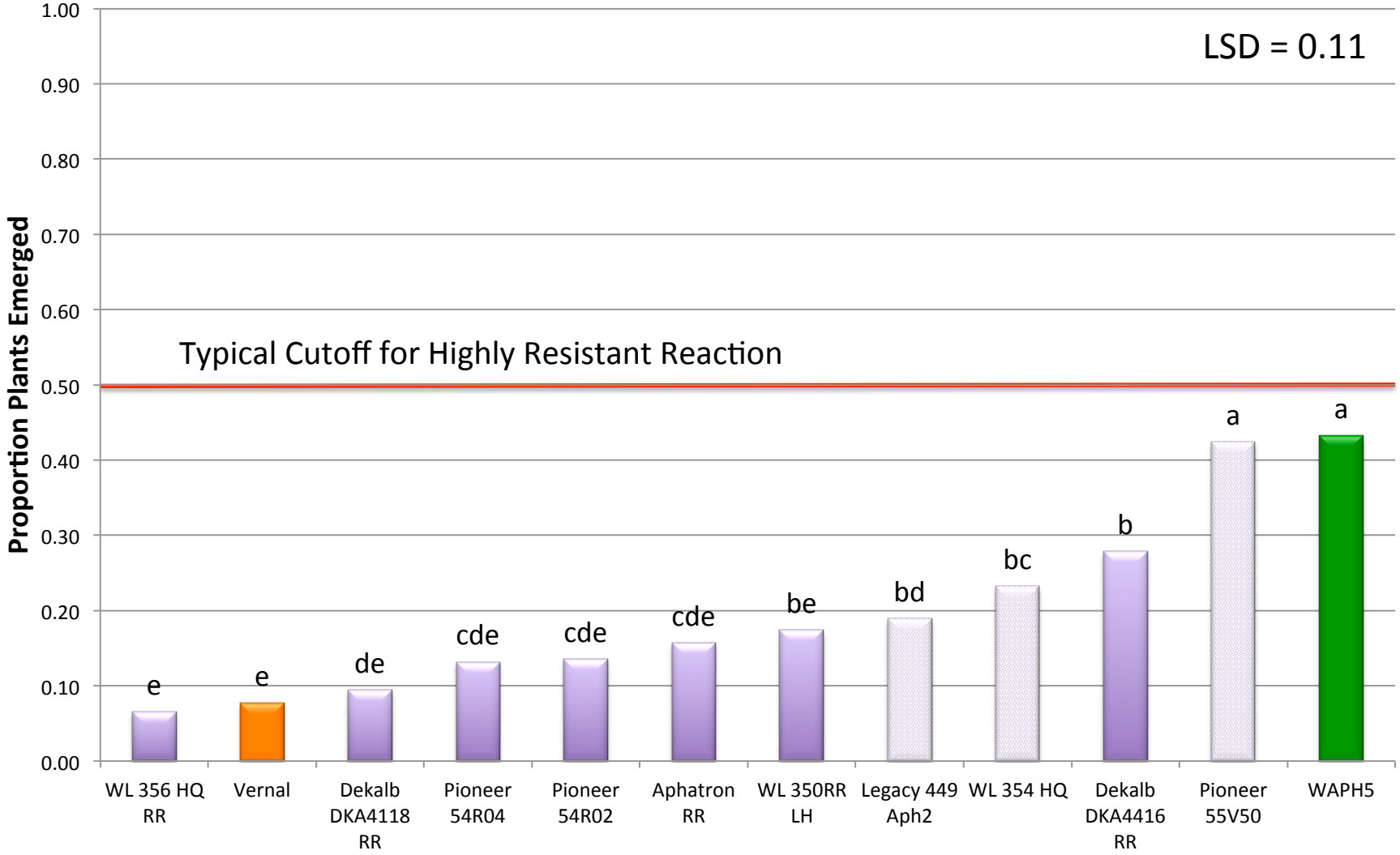
Alfalfa Emergence in the Presence of A. euteiches Race 1



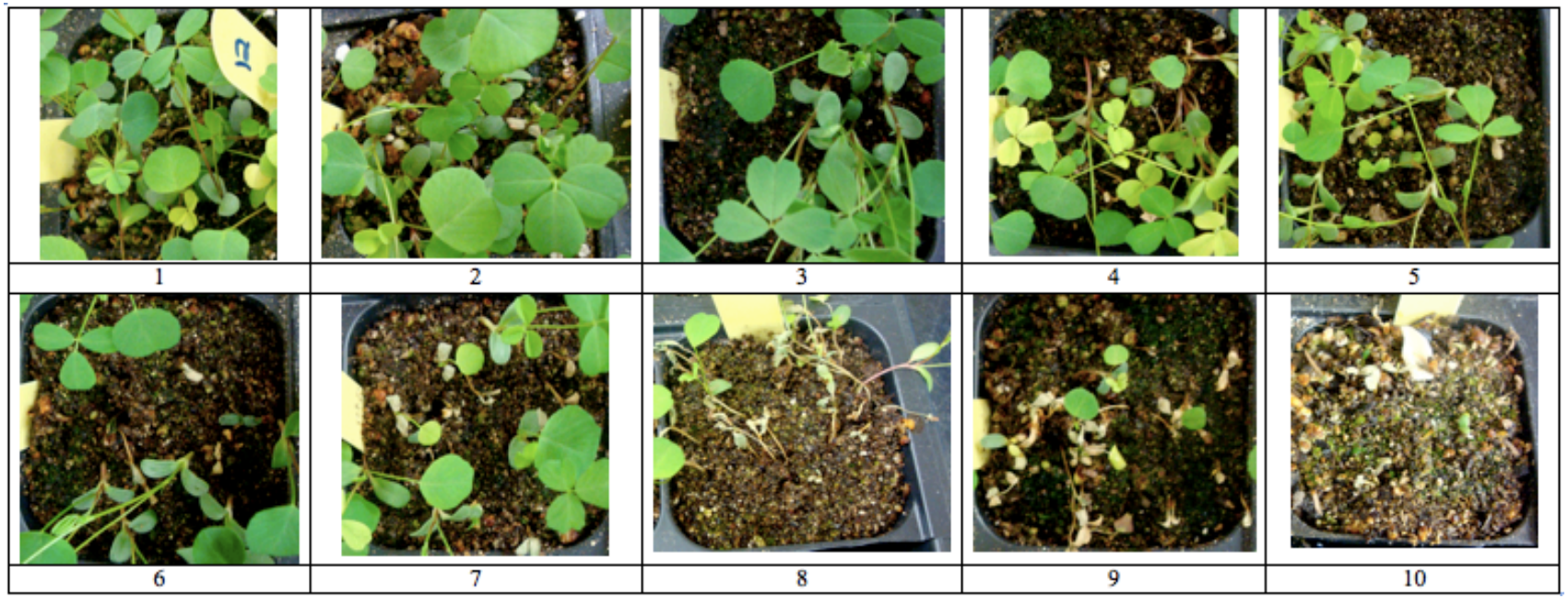
Alfalfa Emergence in the Presence of A. euteiches Race 2



Alfalfa Emergence in the Presence of A. euteiches Race 3



Visual Severity Index (VSI)



Visual Severity Ratings 1-10

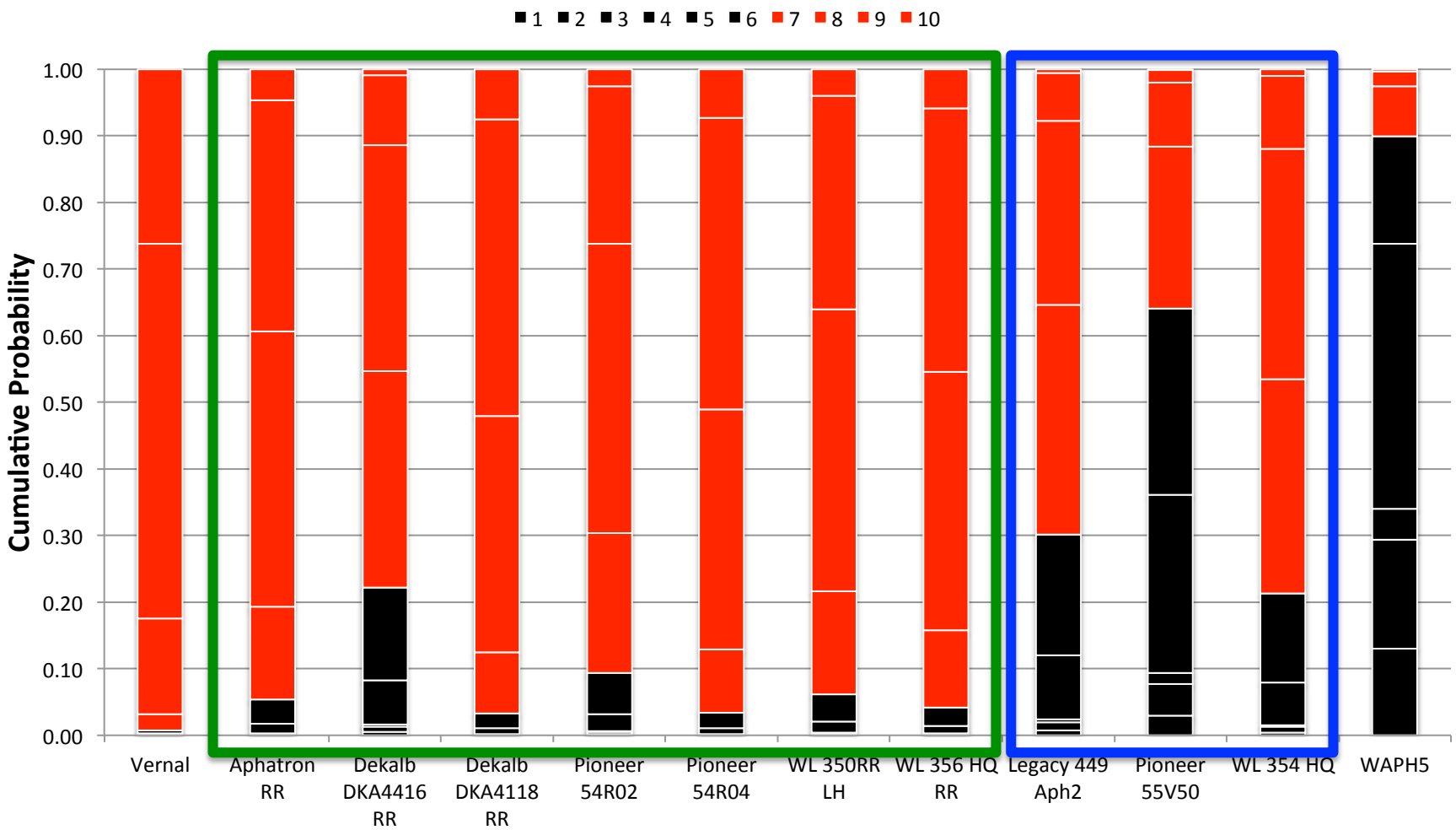
1-All plants look perfect, white hypocotyls, tall, well-leafed (most have 1st trifoliate)

2-Most plants are perfect, one or two with root rot

9-One or two nice plants have survived with no other plants or all others rotten, OR 1-2 rotten, small, OR all rotten

10-No plants alive, or one very small plant that has rotted

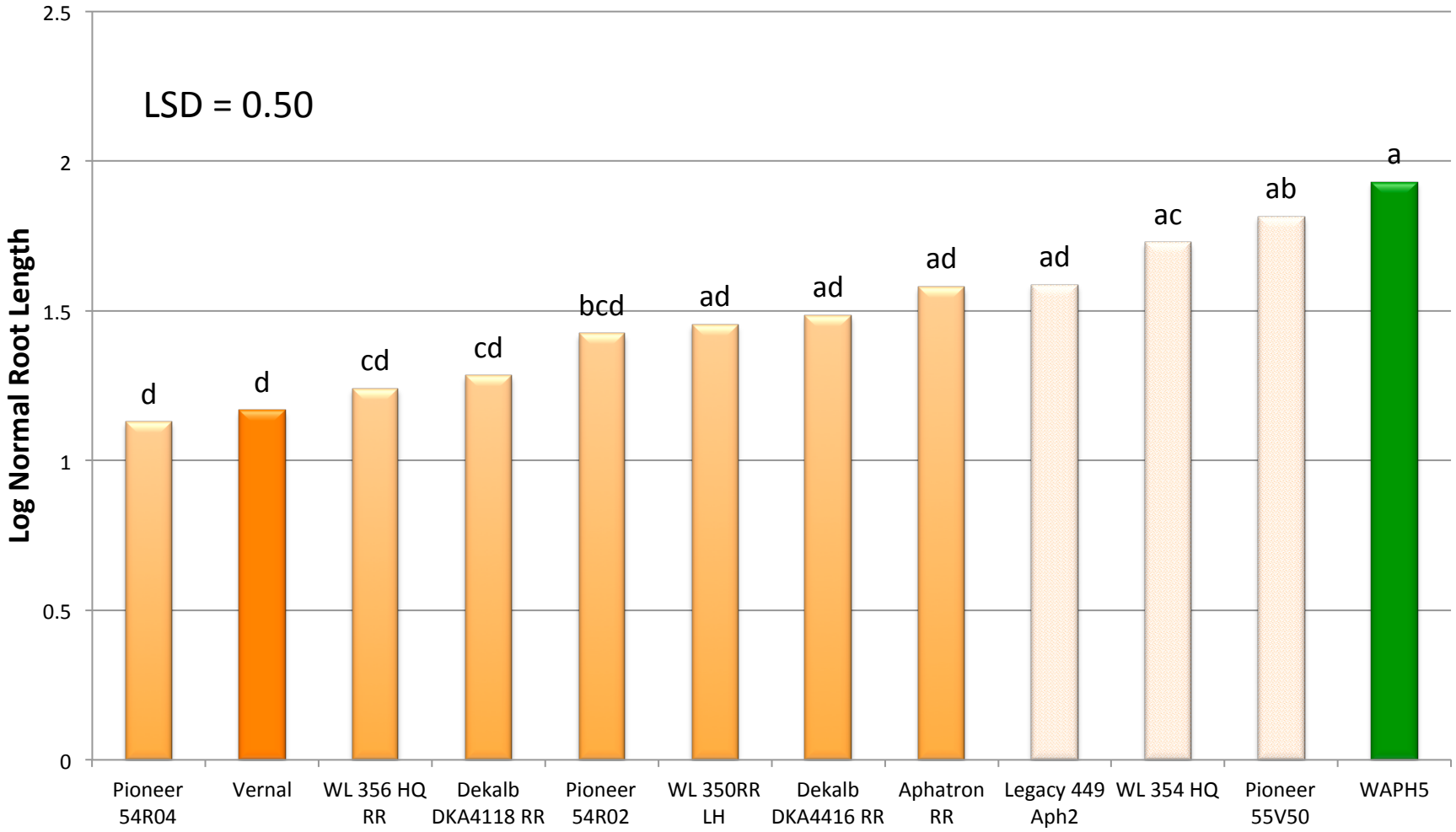
Cumulative Probabilities for VSI Ratings for Each Variety Treated with all Races



Root Scanner

- WinRhizo Pro 2013 root scanner package
- Powered by 2013 Dell CPU
- Plants washed to free roots of soil
- Placed on flatbed scanner
- Images saved and analyzed using WinRhizo Software
- Root length data

Alfalfa Root Length



Summary

- Alfalfa varieties varied in their resistance to Aphanomyces
- Pioneer 55V50 was the best performer among commercial varieties (similar to WAPH5)
- Roundup Ready varieties included in this study tended to lack good resistance to Aphanomyces, especially races 2 and 3
- Will newer generation RR alfalfa varieties have improved race 2 and 3 resistance?
  - We would like to test this, contact me if interested

Questions?

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