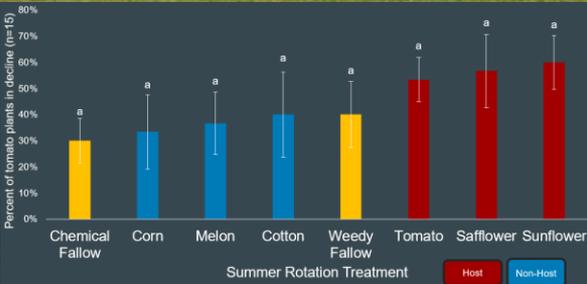
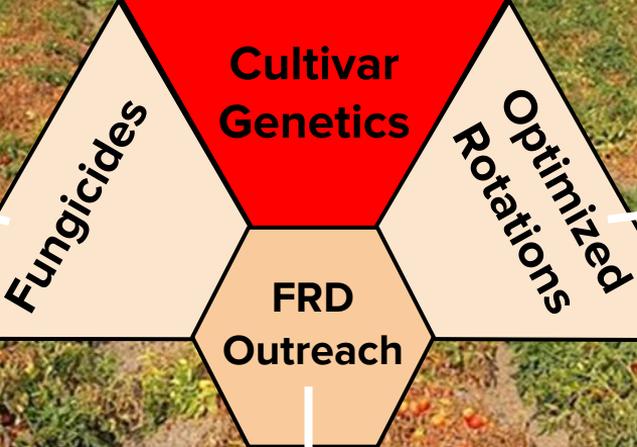


Expanding the Toolkit:
**Characterizing sources of genetic
resistance to *Fusarium* stem rot and
decline as part of an IPM toolkit**

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Developing and effective integrated toolkit for FRD in processing tomato

FRD Integrated Toolkit



Treatment and rate /A	Total rot incidence (%) ^a	Crown rot incidence (%) ^b	AG stem rot incidence (%) ^c	Total fruit (t/A)	Marketable red fruit (%) ^d	Damaged fruit (%) ^e	Microbial activity (µg/g soil) ^f
K-Pam HL 10 gal	72.5 a*	40.0 a	2.5 a	46.6 ab	95.2 a	2.3 a	0.82 a
K-Pam HL 15 gal	80.0 a	31.3 a	10.0 a	51.0 a	93.7 a	2.0 a	0.90 a
K-Pam HL 20 gal	78.8 a	36.3 a	10.0 a	46.7 ab	95.3 a	2.7 a	0.99 a
Untreated control (water)	72.5 a	50.0 a	1.3 a	38.0 b	94.4 a	1.9 a	0.76 a

Treatment and amount/A	Total rot incidence (%) ^a	Crown rot incidence (%) ^b	AG stem rot incidence (%) ^c	Total fruit (t/A)	Marketable red fruit (%) ^d	Damaged fruit (%) ^e
Miravis 13.7 fl oz	43.9 <i>negl</i> ^f	5.9 <i>med</i>	2.2 <i>small</i>	46.9 <i>small</i>	60.5 <i>negl</i>	29.1 <i>negl</i>
Propulse 13.7 fl oz	35.1 <i>small</i>	6.7 <i>med</i>	0.0 <i>large</i>	44.9 <i>negl</i>	53.8 <i>large</i>	29.4 <i>small</i>
Velum One 6.84 fl oz ^g	16.2 <i>large</i>	5.3 <i>med</i>	0.0 <i>large</i>	41.8 <i>small</i>	60.6 <i>negl</i>	29.5 <i>small</i>
Untreated control (water)	46.9	23.3	10.0	43.8	61.8	26.8



Reduce Yield Losses

Goals for FRD cultivar resistance/tolerance

1) Managing FRD with existing cultivars already available (qualitative resistance):

Identifying what commercially available traits are connected to:

- >Tolerance to fruit impacts

- >Reduced susceptibility to vine decline/stem rot

2) New sources of complete resistance (quantitative resistance) or reduced susceptibility



Goals for FRD cultivar resistance/tolerance

1) Managing FRD with existing cultivars already available (qualitative resistance):

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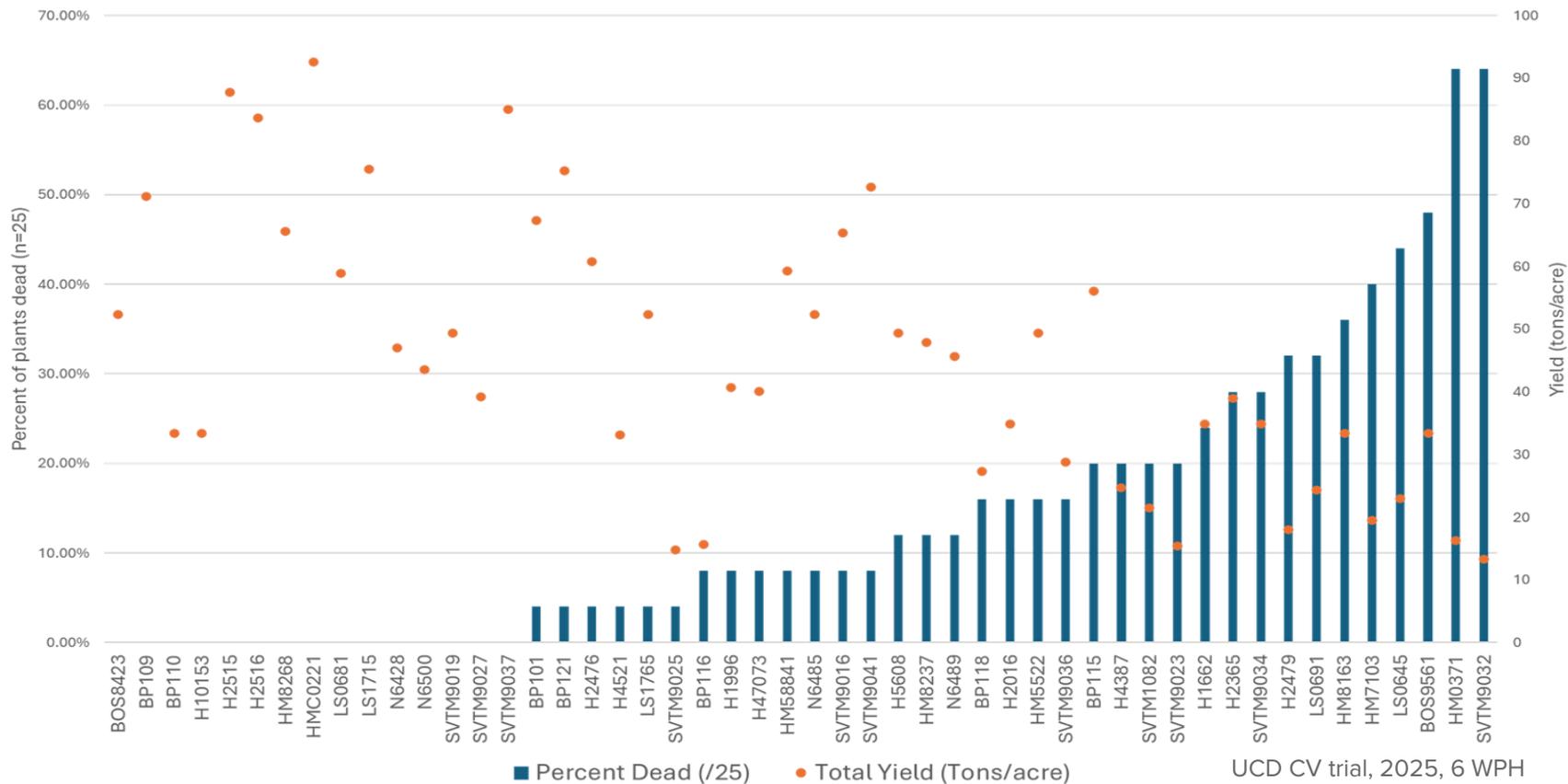
>Tolerance to fruit impacts

>Reduced susceptibility to vine decline/stem rot

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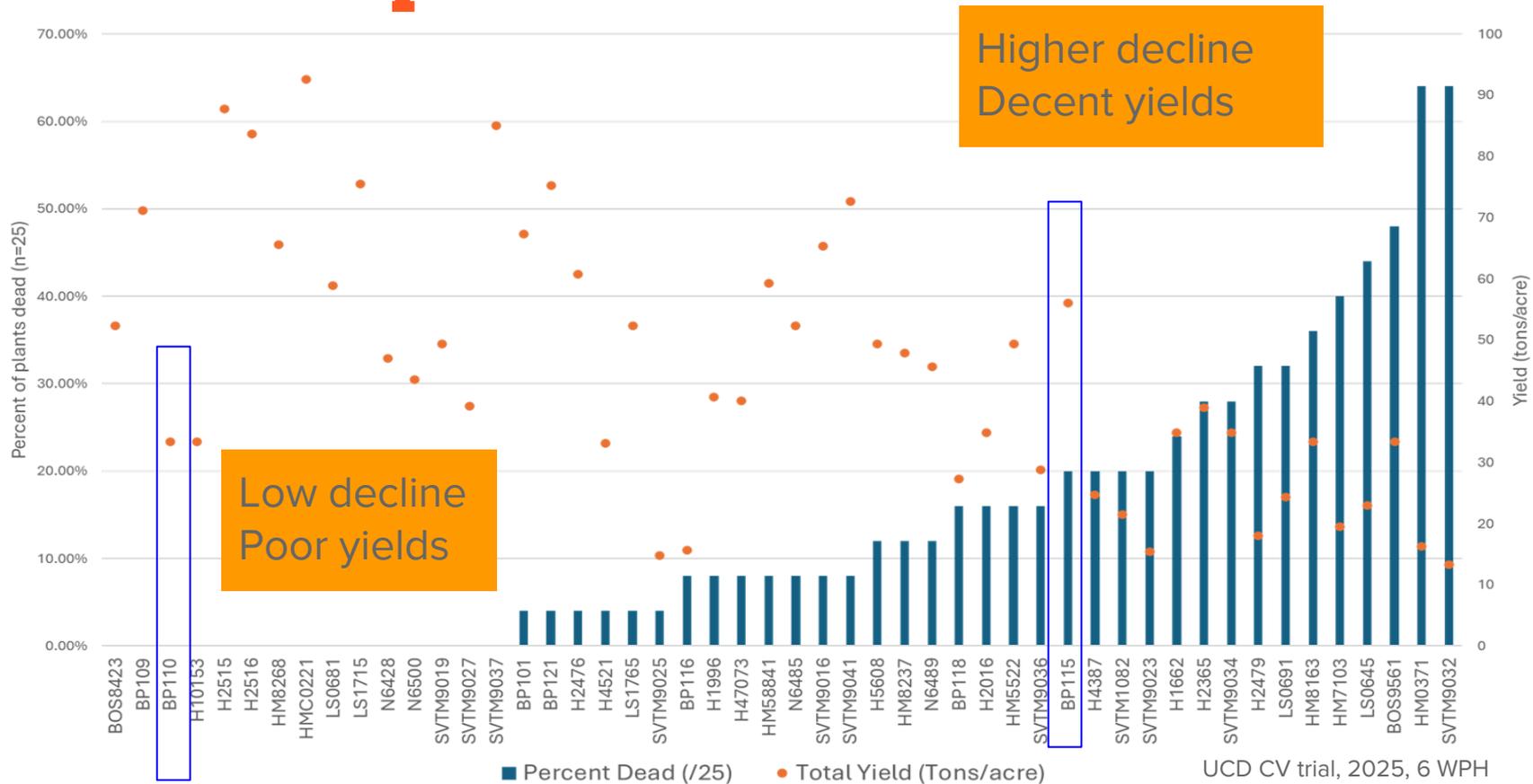


Cultivars vary in FRD susceptibility/tolerance and fruit impacts



UCD CV trial, 2025, 6 WPH

Cultivars vary in FRD susceptibility/tolerance and fruit impacts



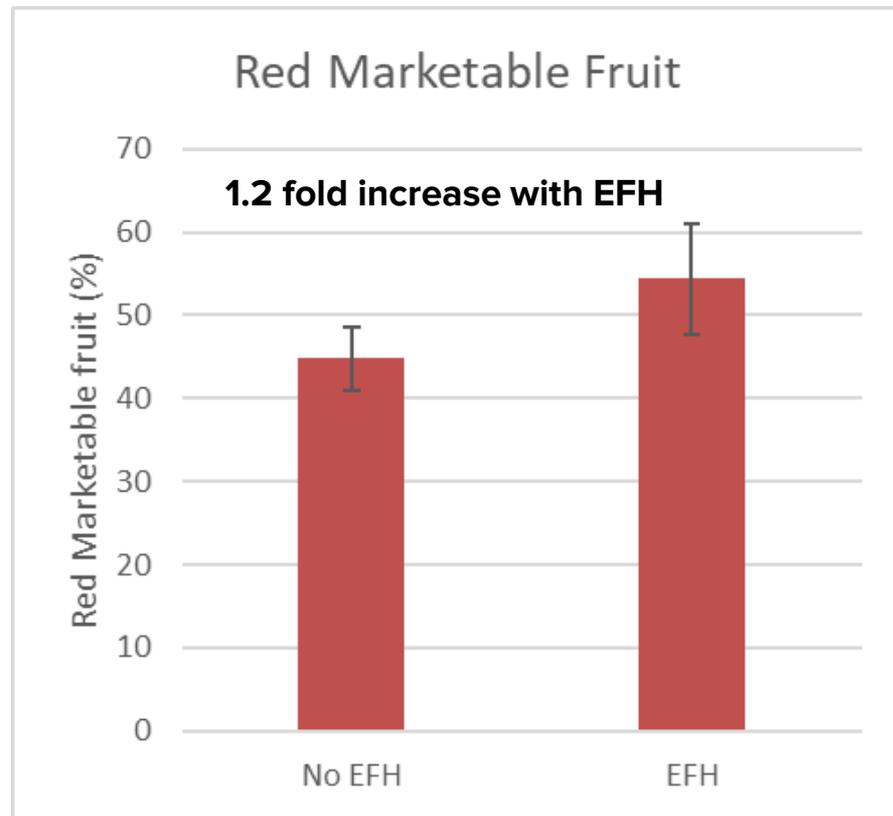
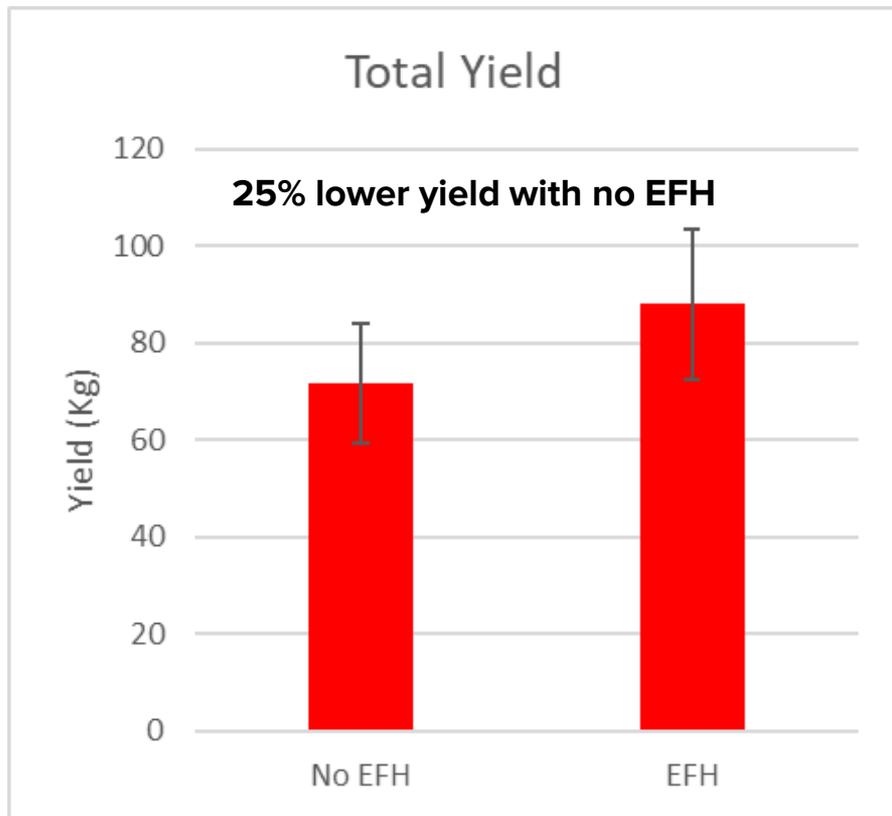
UCD CV trial, 2025, 6 WPH

Fruit holding traits (extended field holding) and tolerance to FRD

- >Extended field holding (also called extend field storage, EFS) is a fruit trait that slows fruit degradation after ripening
- >EFH controls the biosynthesis or action of ethylene gas
- >FRD impacts yield by causing canopy collapse, exposing the fruit to the sun prematurely, leading to fruit damage
- >If EFH slows fruit degradation, could it slow fruit damage after premature exposure?

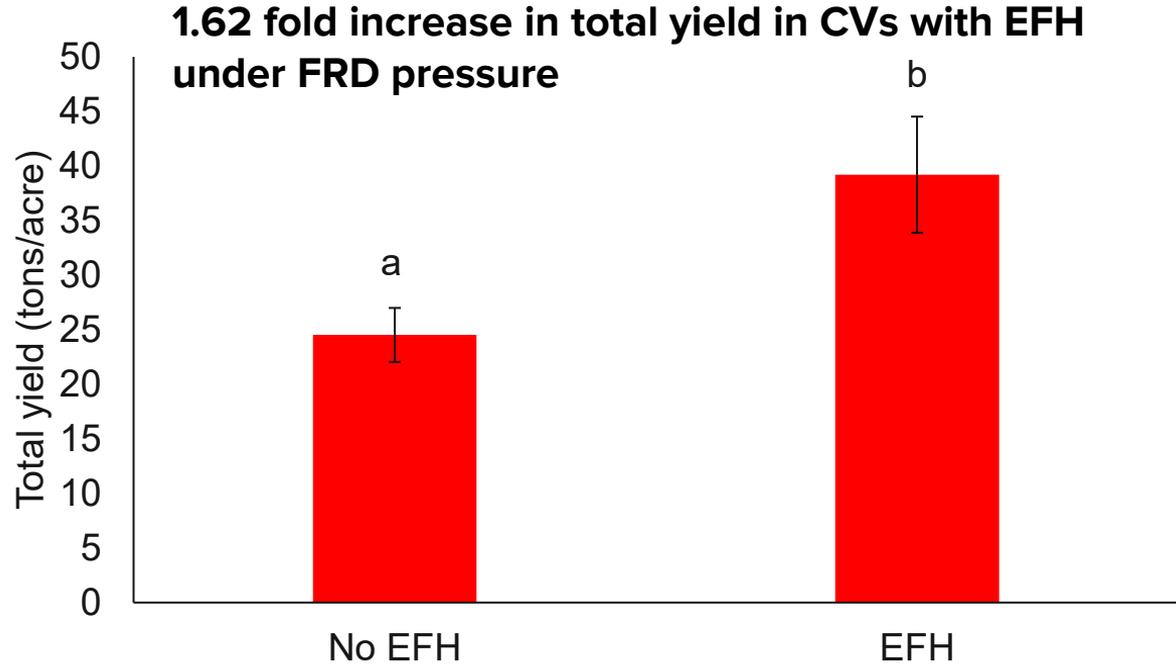


Preliminary data: EFH and FRD disease



EFH 2024 Trial - Results

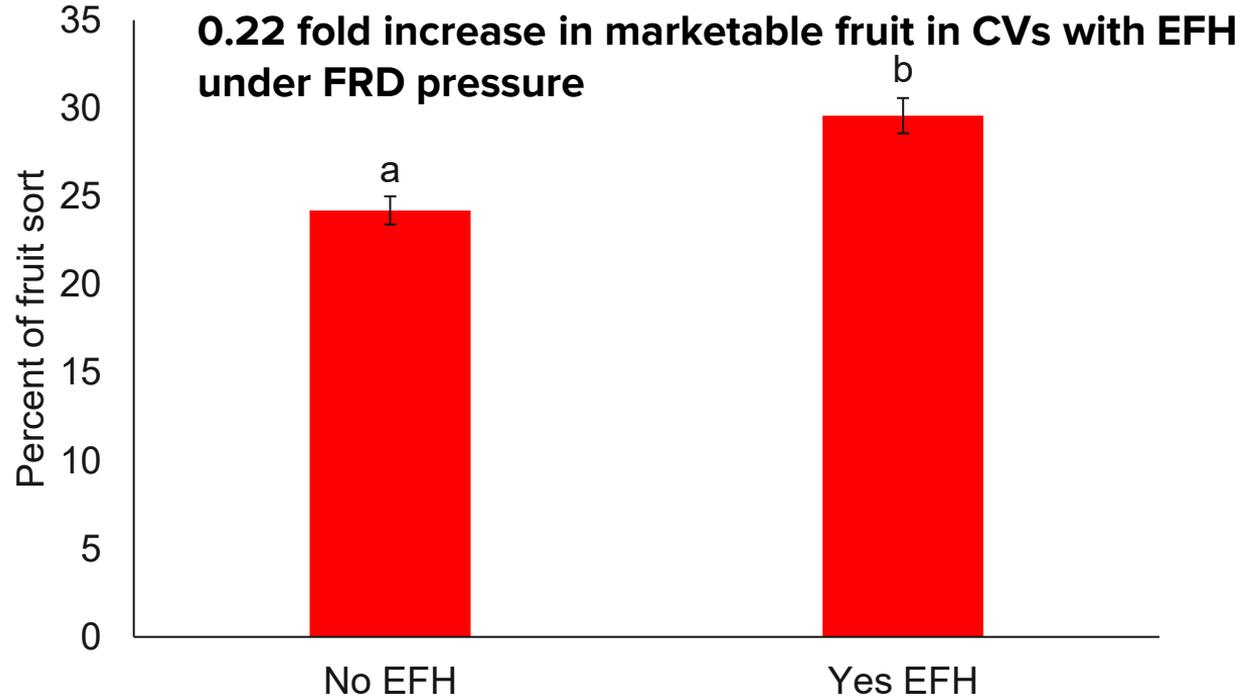
>Total yield data in cultivars grouped by the percent of plants dead and toast (same grouping at time point 1,2)



Fishers, P = 0.028

EFH 2025 Trial - Results

>Marketable red fruit data in cultivars grouped by the percent of plants advanced decline, dead, and toast (time point 2)



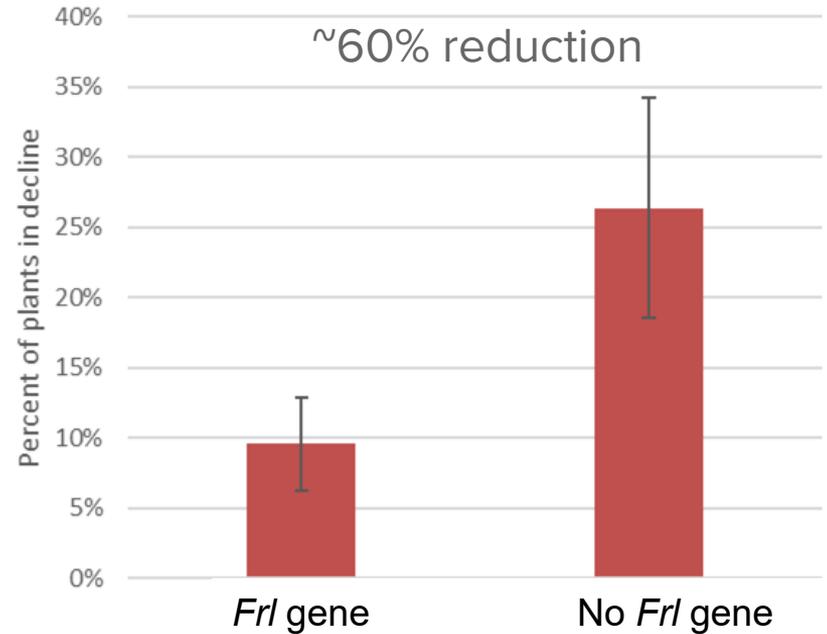
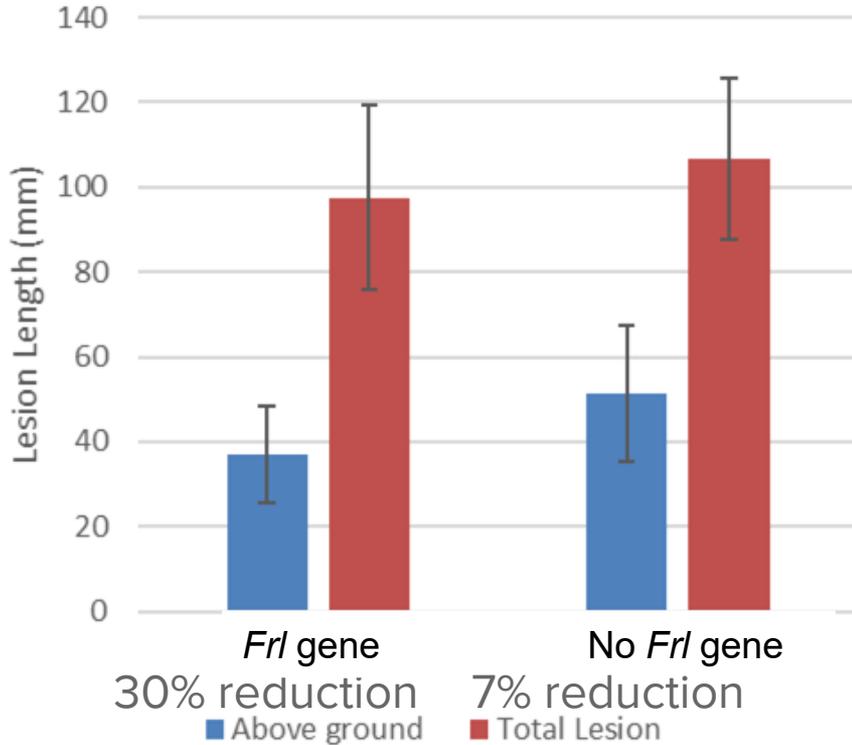
Fishers, $P < 0.001$

Is there cross resistance from other disease resistance traits?

- >There are many other traits in processing tomato cultivars, including disease resistance traits
- >Could any of these disease resistance traits have cross resistance for FRD?
- >Fusarium crown and root rot (FORL) is caused by a Fusarium necrotrophic pathogen that might have similar resistance pathways to FRD → *Frl* gene



Frl gene - Preliminary Data



2024 *Frl* gene trial - Results



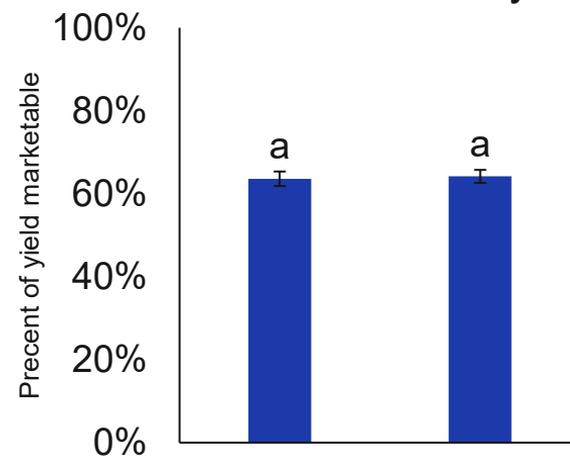
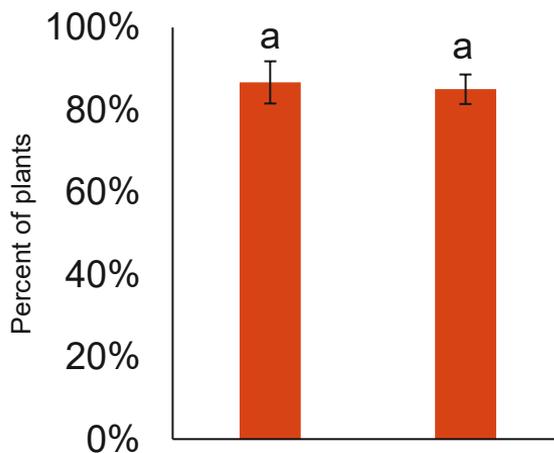
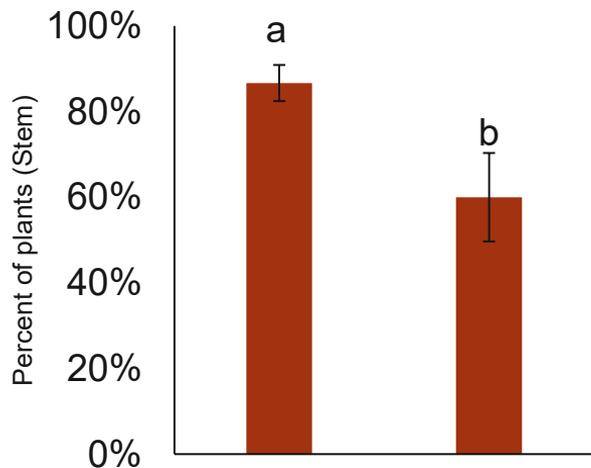
30% reduction

No differences

Frl and Stem rot

Plant death and decline

Marketable yield



No Frl Frl

Tukeys, P = 0.04

No Frl Frl

Tukeys, P = 0.607

No Frl Frl

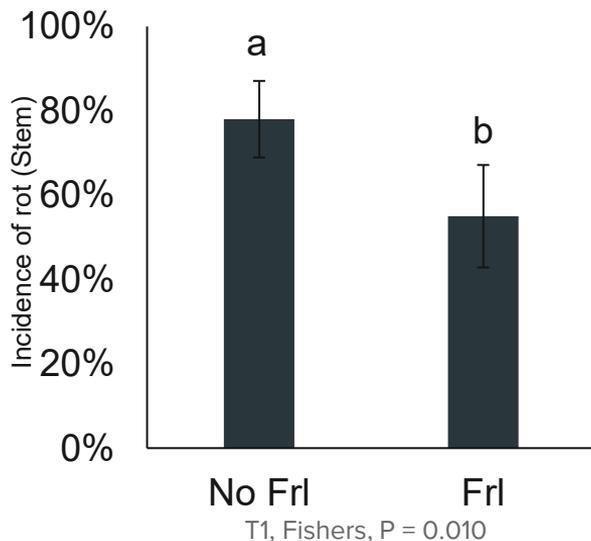
Tukeys, P = 0.872

2025 *Frl* gene trial - Results



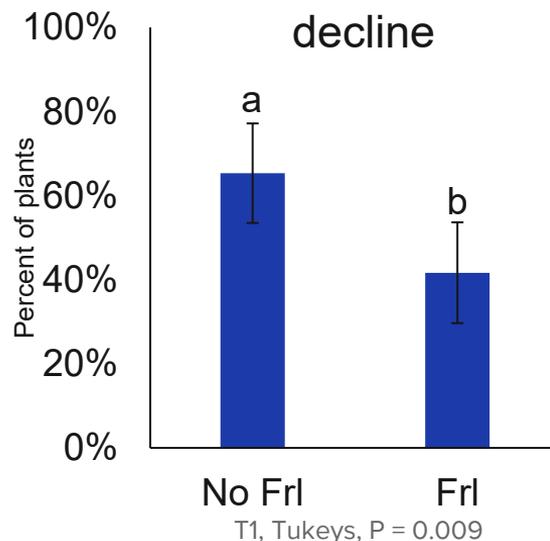
42% reduction

Frl and Stem rot



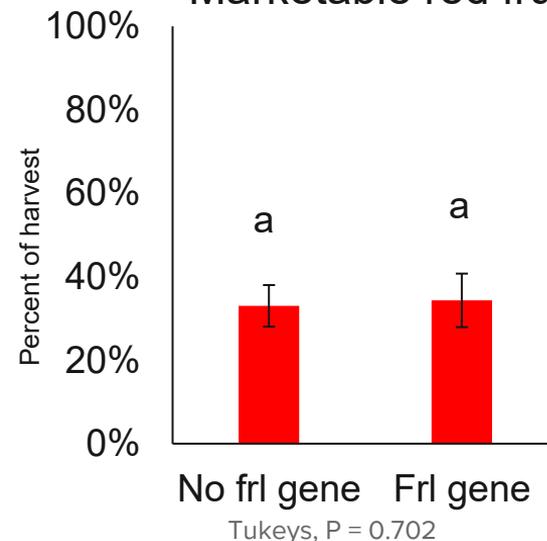
36% reduction

Plant death and decline



Negligible differences

Marketable red fruit



Summary: Traits correlated with cultivar tolerance

- >EFH – Cultivars with EFH had increased marketable fruit levels
- >*Frl* gene – Cultivars with the *Frl* gene had lower incidence of stem rot and sometimes vine decline, but not fruit damage

Caveats

- >There are two different types of EFH, may have different impacts on FRD associated fruit damage
- >There are two *Frl* alleles, one is more effective than the other and may affect FRD stem rot differently

Goals for FRD cultivar resistance/tolerance

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Identifying what commercially available traits are connected to:

>Tolerance to fruit impacts

>Reduced susceptibility to vine decline/stem rot

2) New sources of complete resistance (quantitative resistance) or reduced susceptibility



Where can we find novel genetic resistance traits?

- > Many genetic resistance traits to tomato diseases originated in tomato wild germplasm
- > Both single gene and QTLs
- > Might there be novel genetic resistance genes for FRD as well?



S. pennellii LA2719 starting to flower. [photo R.T. Chetelat]



Wild species	R gene	Disease
<i>S. pimpinellifolium</i>	<i>I, I-2 gene</i>	Fusarium wilt
<i>S. peruvianum</i>	<i>Frl gene</i>	Fusarium crown and root rot
<i>S. pennellii</i>	<i>I-3, I-y gene</i>	Fusarium wilt

Wild Germplasm Trials

Goals of this work:

>Ideal goal: Find complete resistance

→ Accession(s) with **no** rot or canopy symptoms

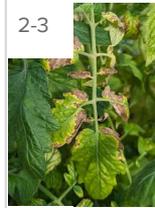
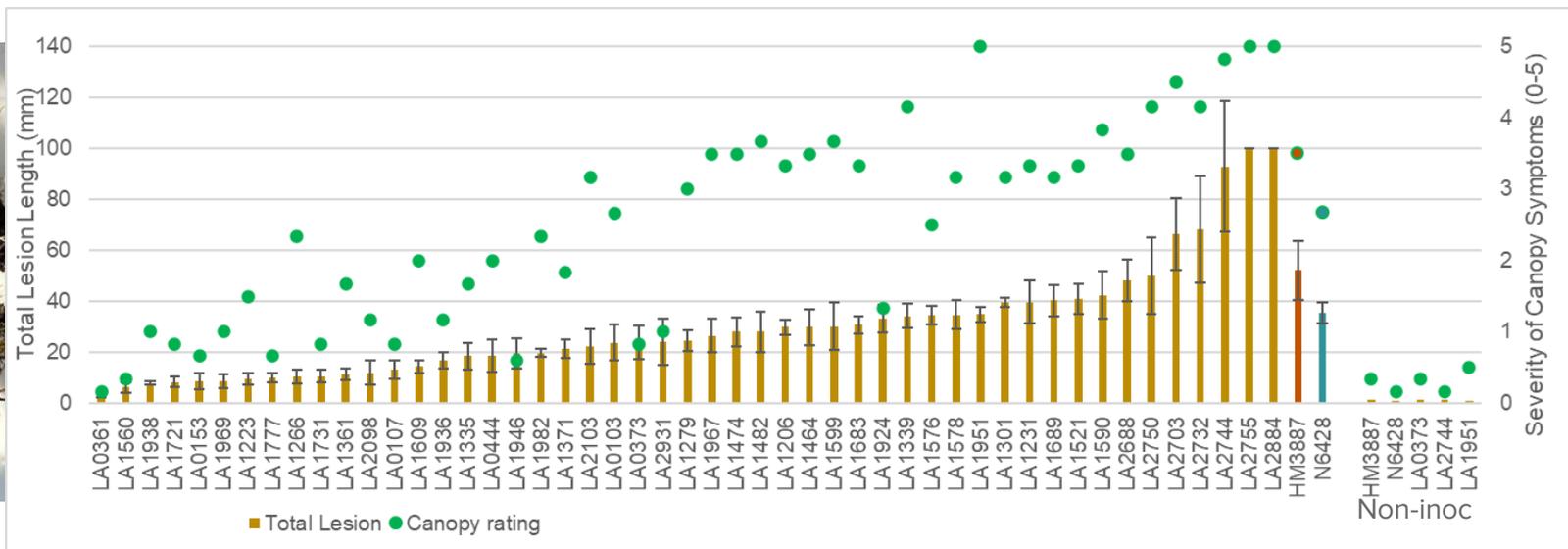
>If this is not possible, minimal goal: find lines that are more resistant

→ Accession(s) with **less severe** symptoms



Accession: a unique sample of plant material from a single species, collected at a specific time and place, representing a particular gene pool

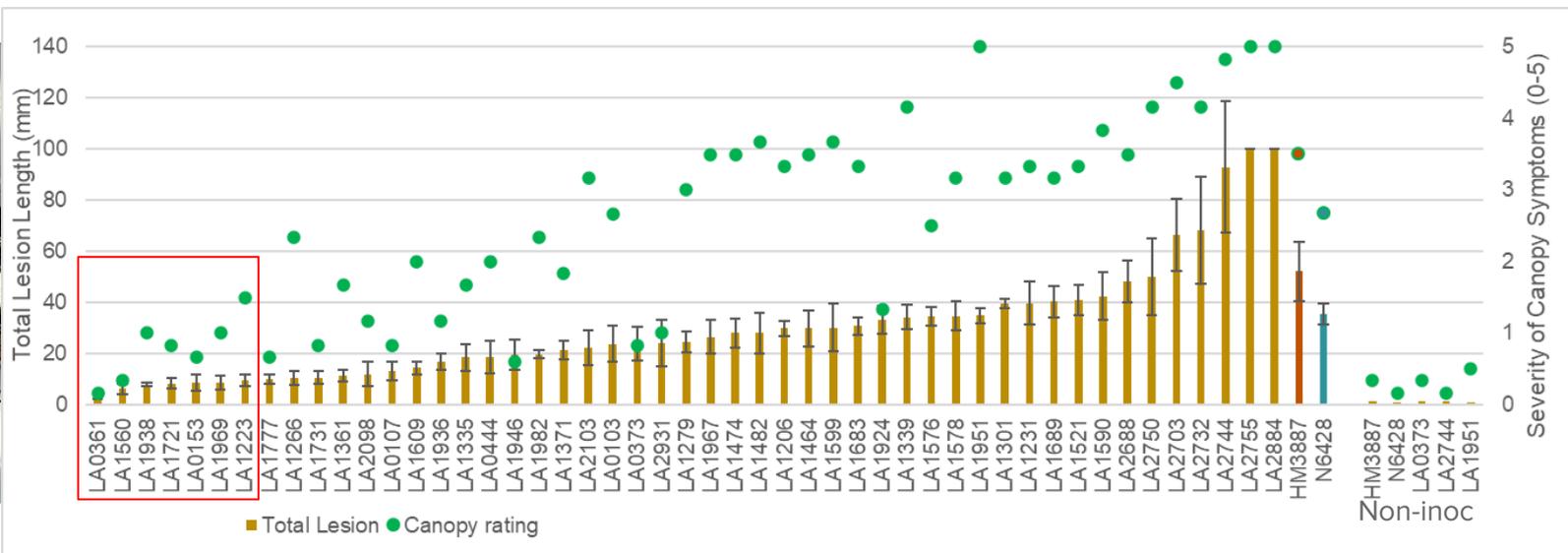
2024-25 Wild Germplasm Trials - Trial 1



Disease scale: 0 = healthy, 1-2 = mild canopy symptoms, 3-4 = decline, 5 = dead

2024-25 Wild Germplasm Trials - Trial 1

Goal 1: Complete resistance?

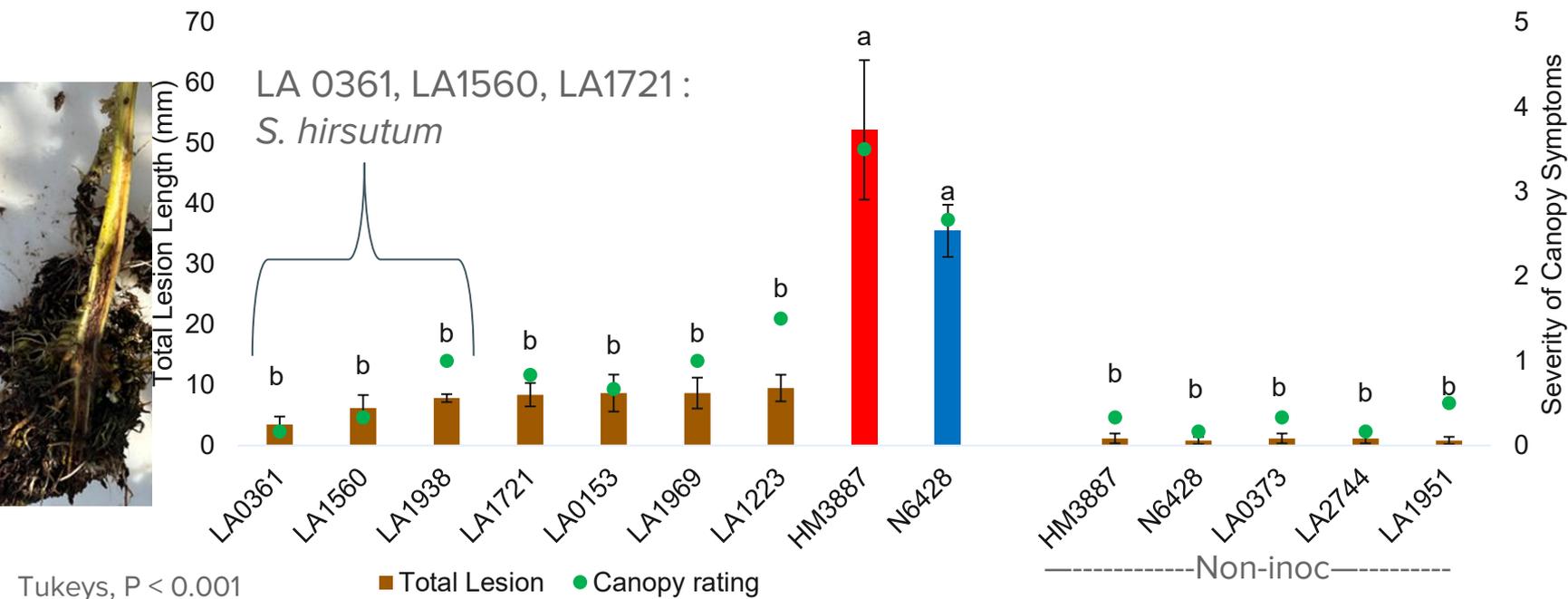


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2024-25 Wild Germplasm Trials - Trial 1

Goal 1: Complete resistance?

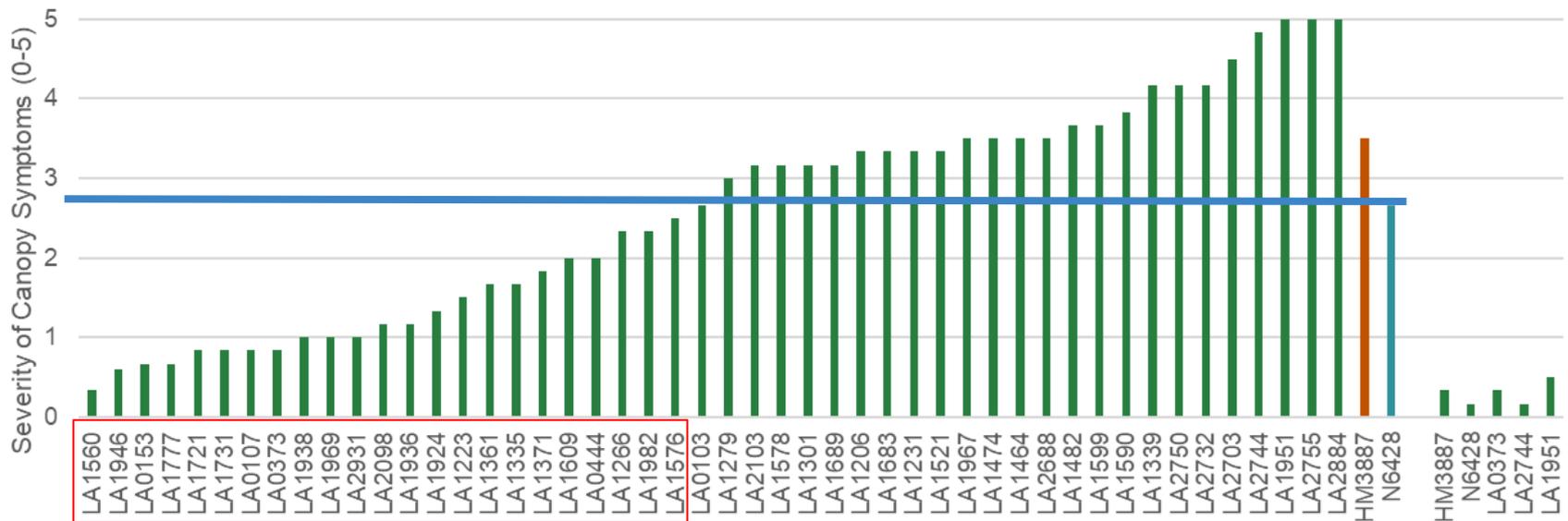


Disease scale: 0 = healthy, 1-2 = mild canopy symptoms, 3-4 = decline, 5 = dead

2024-25 Wild Germplasm Trials - Trial 1



Goal 2: Reduced susceptibility?



Disease scale: 0 = healthy, 1-2 = mild canopy symptoms, 3-4 = decline, 5 = dead

Wild Germplasm - Next Steps

- >Select the best performing accessions for replicated trials with additional commercial checks (better performance than N6428)
- >Use initial data to pick the best performing accessions with TGRC isogenic lines
- >Screen wild germplasm core collections for FRD resistance



Conclusions – Genetic resistance to FRD

Promising sources of genetic resistance/tolerance to FRD

>EFH - based on current analysis, higher total yields and marketable fruit in cultivars with EFH

>FRL - significant reduction in incidence and severity of foot/stem rot. Inconsistent effect on vine decline, no effect on yield/fruit

>Wild germplasm/novel resistance - LA0361, LA1560 (*S. hirsutum*) very low disease levels





Thank you! Questions?

