



Accuracy of Genomic Selection for Resistance to Verticillium Wilt in a Strawberry Population Spanning 165 Years of Breeding

(And some Fusarium updates too!)

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Photos: Thomas (1932); Gordon & Subbarao (2008)

Prior Knowledge

- Despite being a century-old disease and past work, there is still a lot of unknowns when it comes to *Verticillium* wilt resistance in strawberry.
- Ambiguity across reports regarding resistance or susceptibility to cultivars, and much of the germplasm (varieties) available to breeders lack information altogether.
- Past work suggests a complex resistance.

Global Survey of Verticillium Resistance

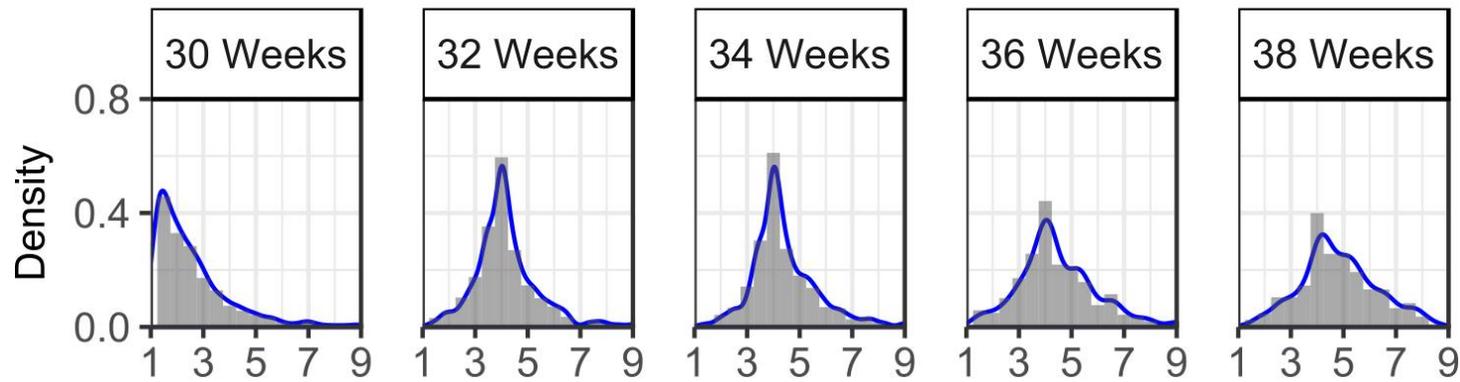


68% UCD

9 (Dead)



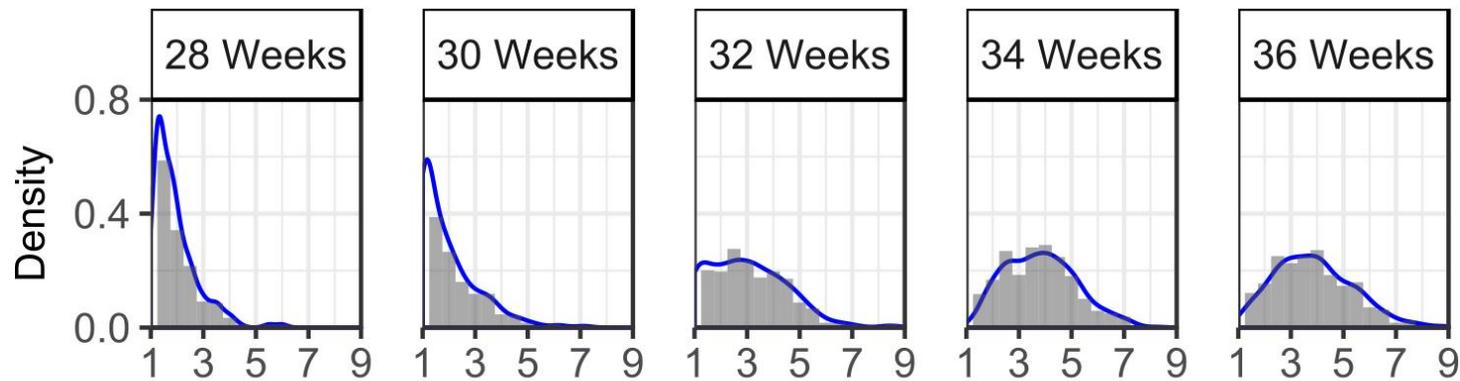
2017



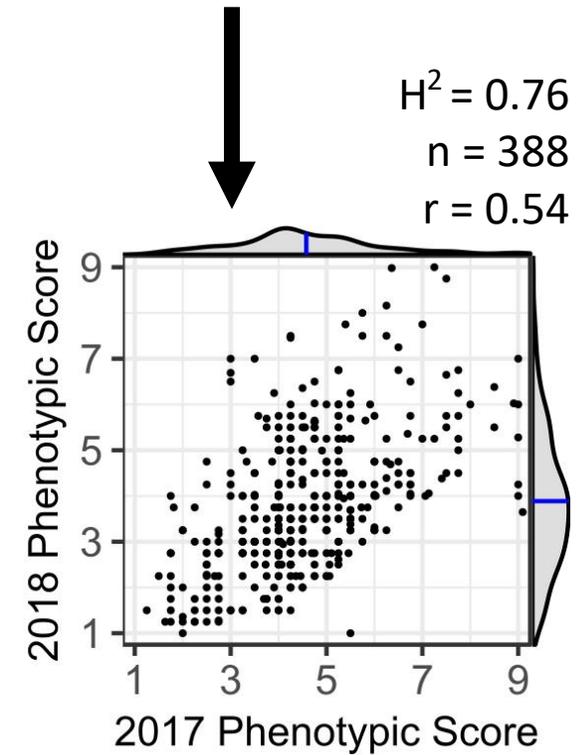
1 (Resistant)



2018



“Core” Set

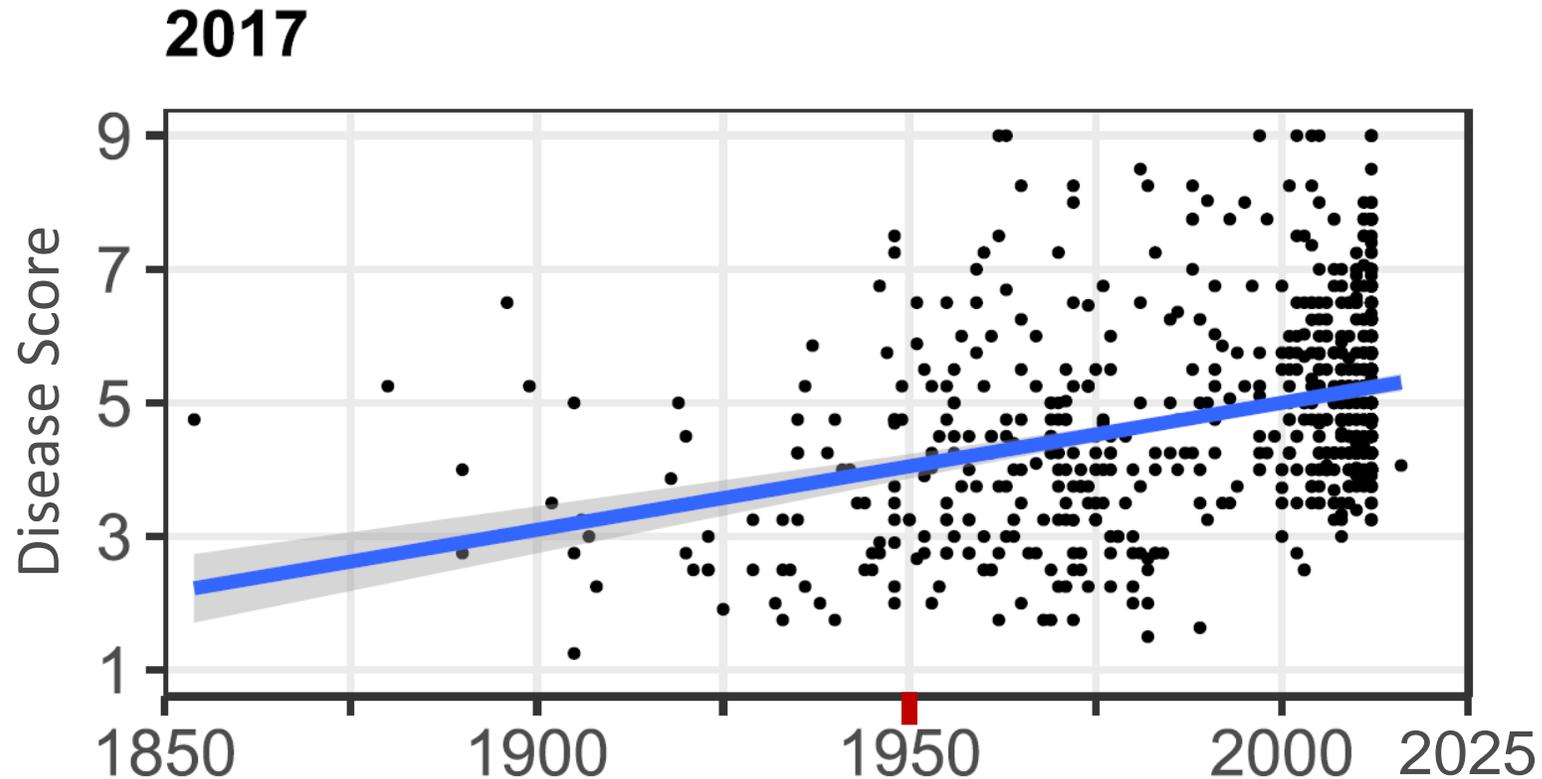


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Pincot et al. (2020, in review)

Evolution of Resistance

- Average resistance has decreased over time



9 (Dead)



1 (Resistant)



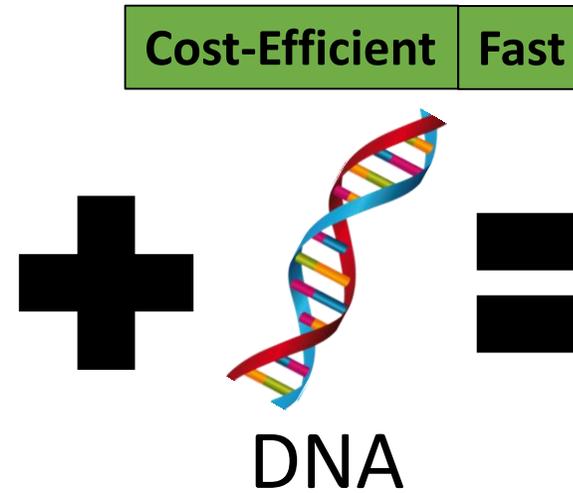


- Higher proportion of resistance at higher latitude
 - Likely due to environment that is favorable to *Verticillium*, leading to higher rates of infection and co-evolution

Resistance is Complex

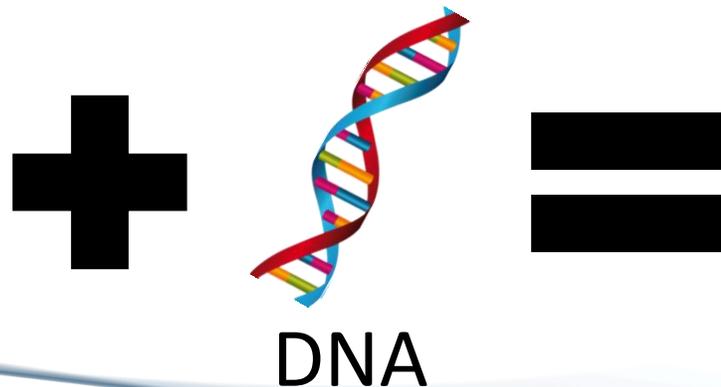
- Survey of the genome showed no significant DNA markers tied to resistance. This is not unexpected, given past work.
- Genome-informed breeding approaches (eg: genomic prediction) have been used successfully for these types of traits in other economically important crops, like tomato and wheat.
 - These breeding approaches are now options due to the new genomic technologies developed by the breeding program at UC Davis (eg: new SNP array).

Genomic Prediction

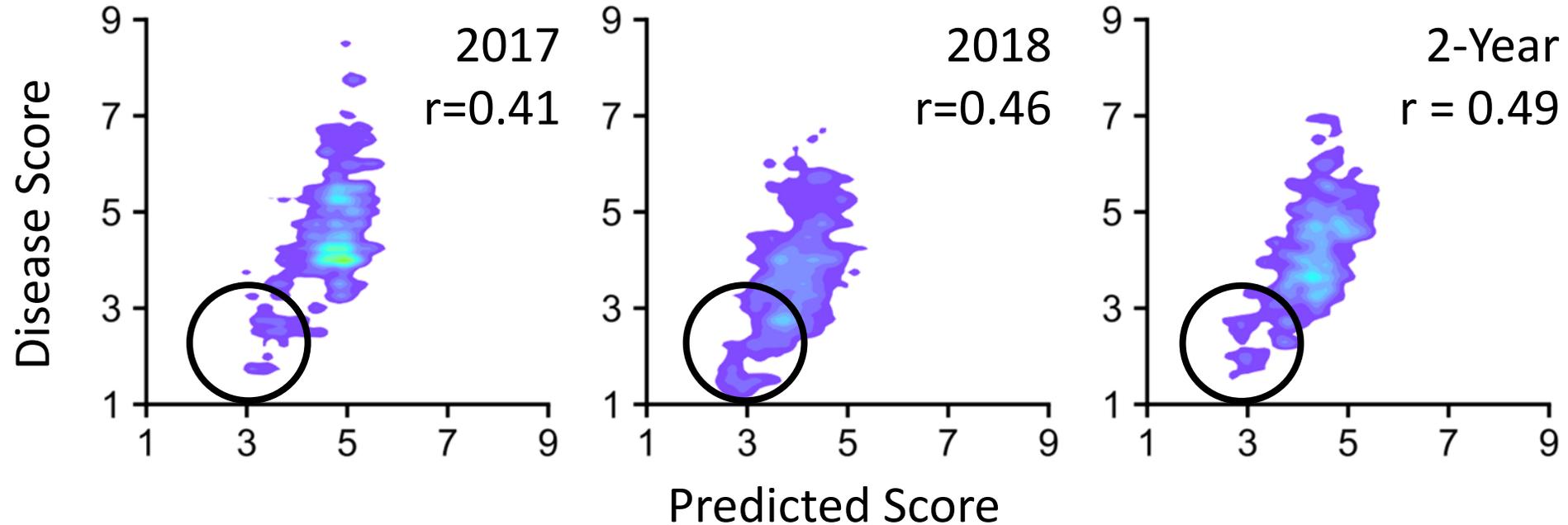


Prediction Equation
 $y = Xb + Zu + e$

Prediction Equation
 $y = Xb + Zu + e$



Genomic Prediction works well!



Takeaways

- Genome-informed selection (genomic prediction) has significant potential in the breeding of accessions more resistant to Verticillium wilt, which is slow, difficult, and expensive to evaluate in the field.
- With genomic prediction, we can breed faster, cheaper, and better.



Progress on Fusarium Wilt Resistance

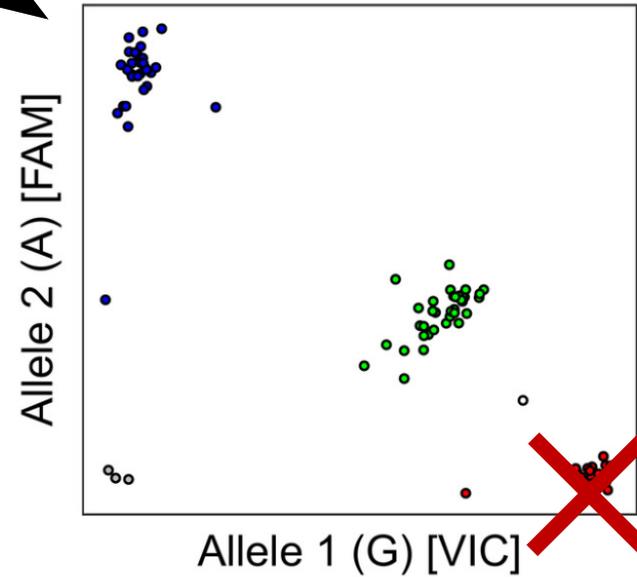
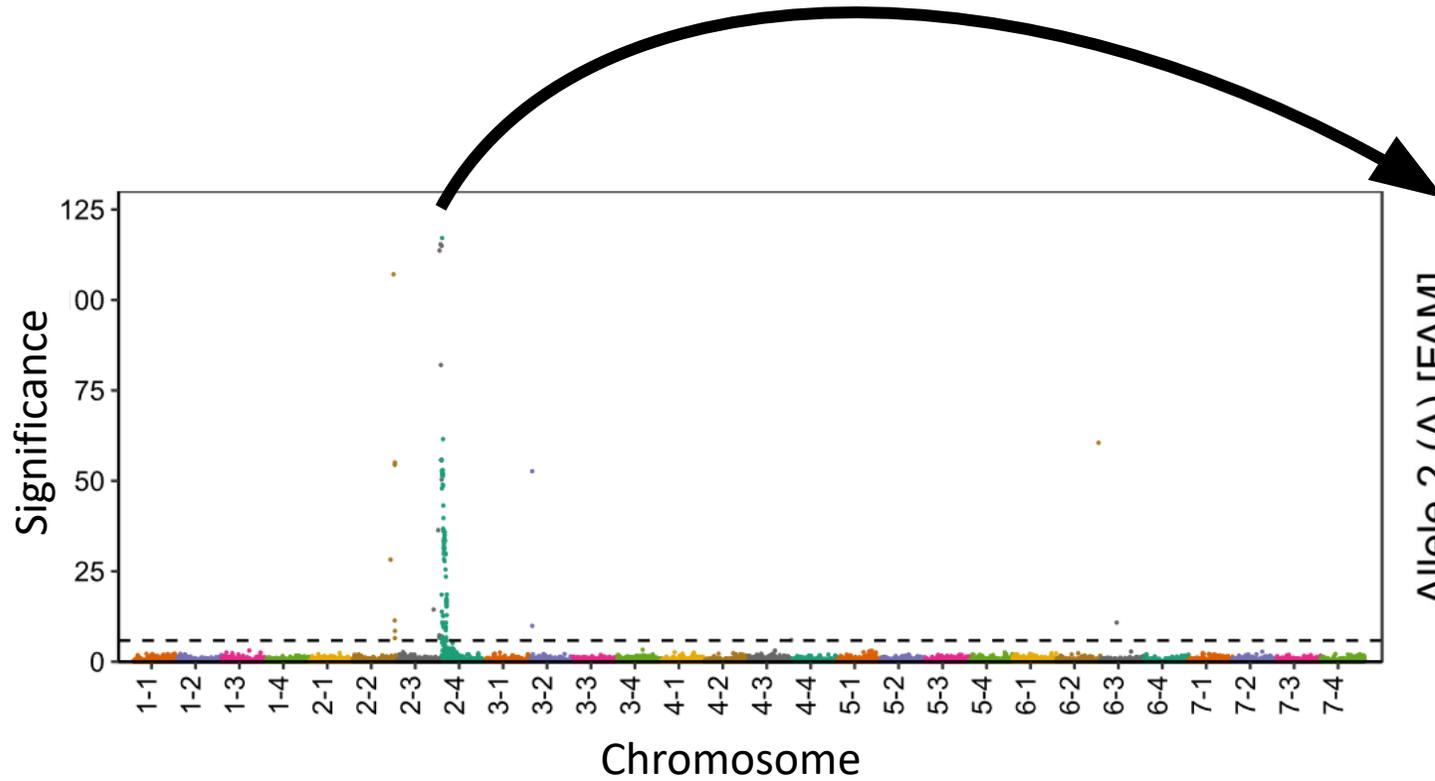
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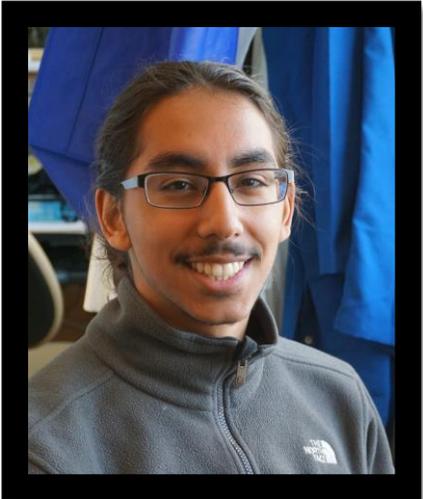
Photo: Koike and Bolda (2013)

Deploying *Fw1* resistance gene



Nicolas Cobo

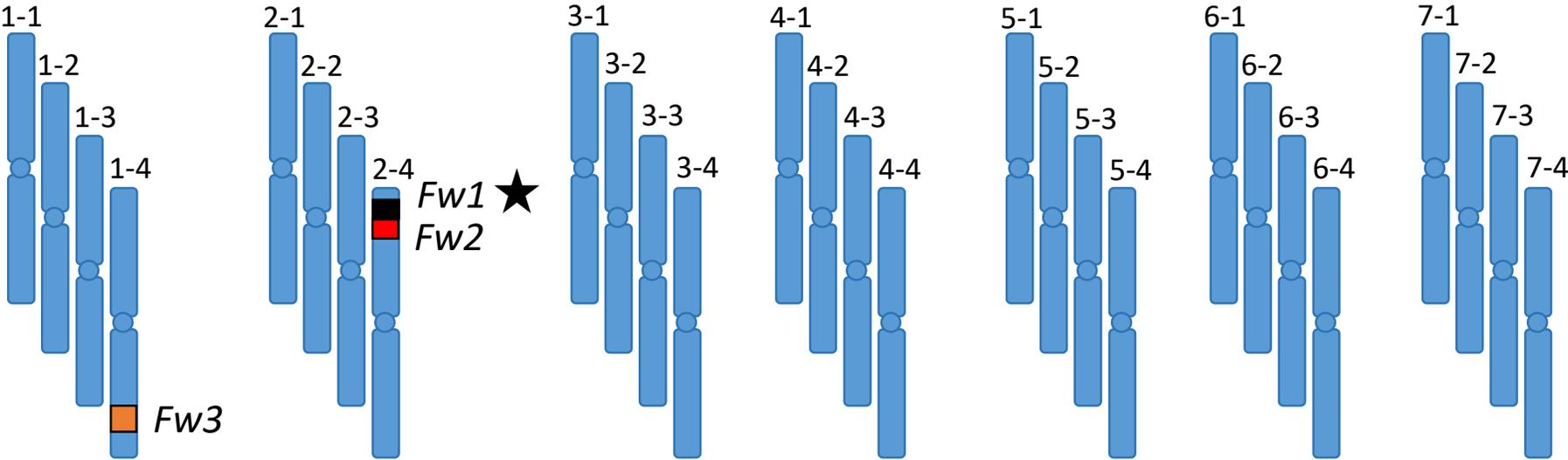




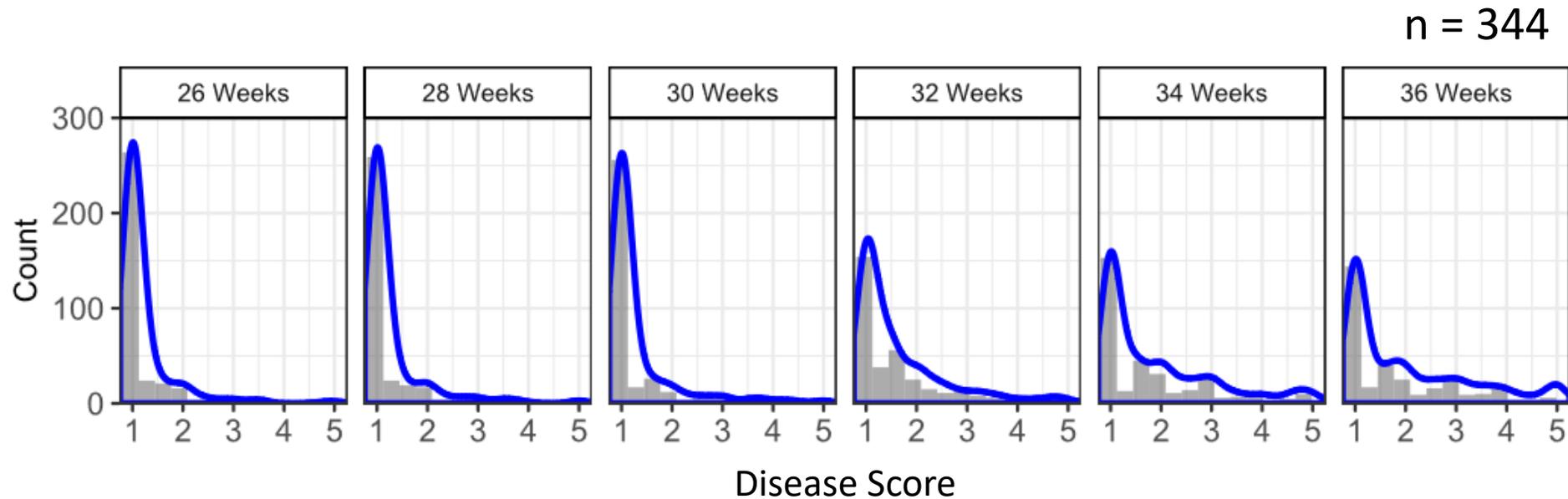
Fw2, Fw3...

Mapped:

- *Fw2* : Guardian, USDA Heirloom
- *Fw3* : Wiltguard, UCD Heirloom

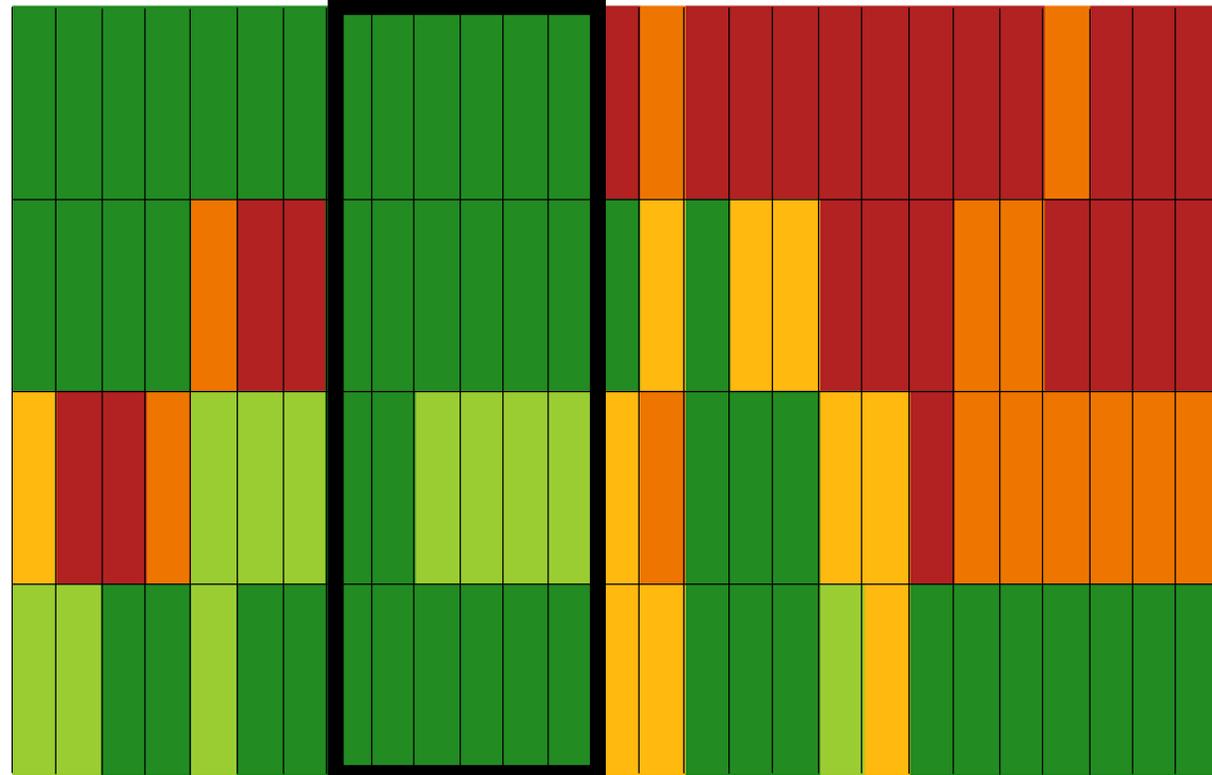


Fw4 (and beyond?)



- We hypothesize that many additional and novel resistances exist in heirloom and wild varieties of strawberry.

Breeding against future threats



27 Strawberry Varieties

Isolate

Californian



Japanese

Australian

Spanish



Peter Henry
USDA Scientist

- Sources of resistance against *Fw1*-breaking isolates has been identified and will be targeted in the future.

Takeaways

- DNA markers have been developed to predict the Fusarium wilt resistance (*Fw1*) in new breeding material.
- Novel sources of resistance against Californian Fusarium wilt have been identified and mapped (*Fw2* & *Fw3*), with many more possible options for further investigation.
- Novel sources of resistance against foreign Fusarium wilts have been identified and will be further investigated.