UF IFAS UNIVERSITY of FLORIDA

UF/IFAS GULF COAST RESEARCH & EDUCATION CENTER

FSGA Florida Strawberry Growers Association

Application of molecular tools to develop superior strawberry cultivars

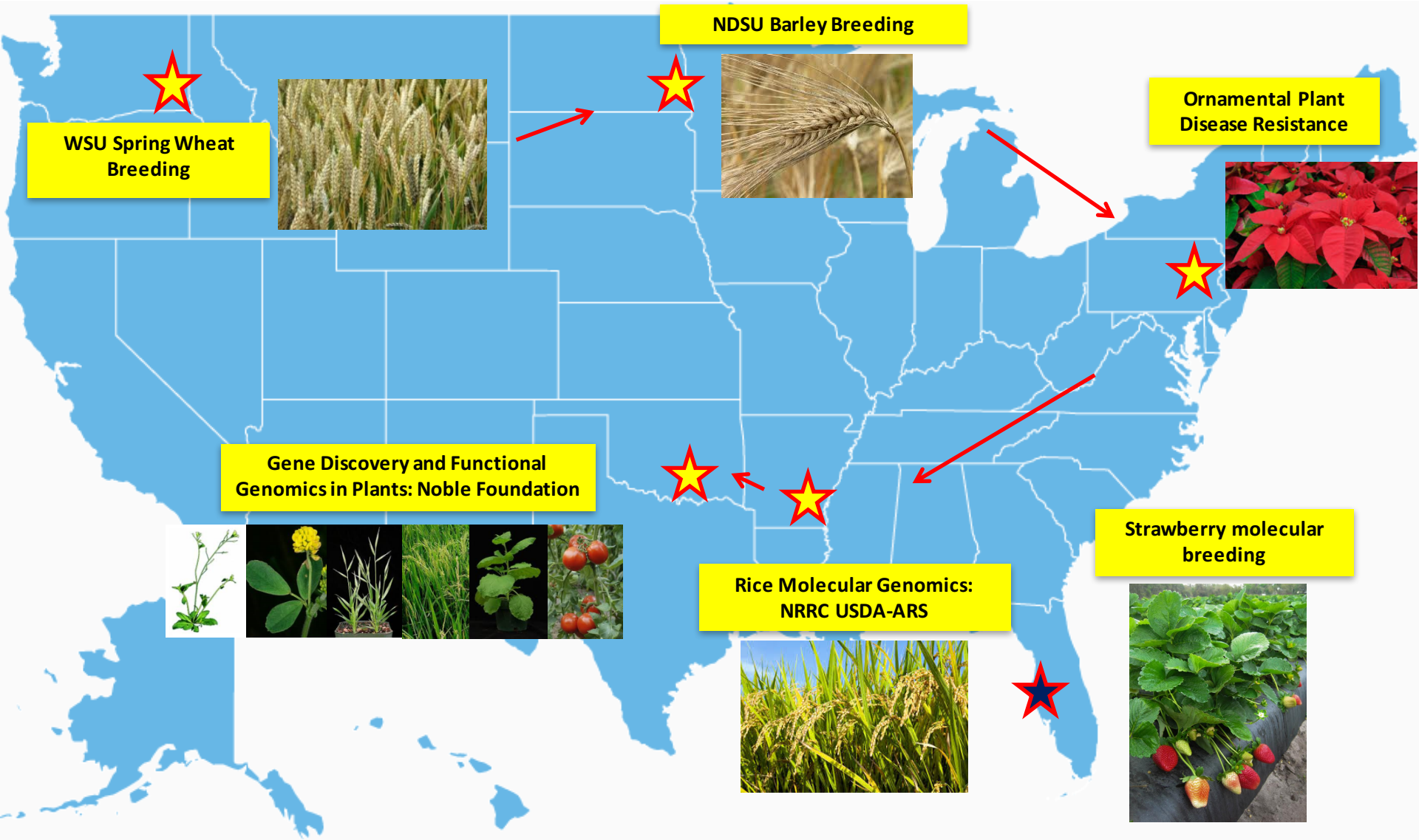
Seonghee Lee, UF/IFAS GCREC

Vance Whitaker, Young-Hee Noh, Jozer Mangandi, Jack Roach, Sujeet Verma, Kelsey Cearley

UF UNIVERSITY of FLORIDA

The Foundation for The Gator Nation

My scientific journey in the US



Outline

1) Gene discovery and DNA test development for fruit quality and disease resistance

2) A new system for marker-assisted selection (MAS) in the UF strawberry breeding program

UF IFAS UNIVERSITY of FLORIDA

Target traits

Disease resistance

Bacterial angular leaf spot

Xanthomonas fragariae (Xf; ALS)

Phytophthora crown root rot

Phytophthora cactorum (Pc)

Quality

Day Neutrality

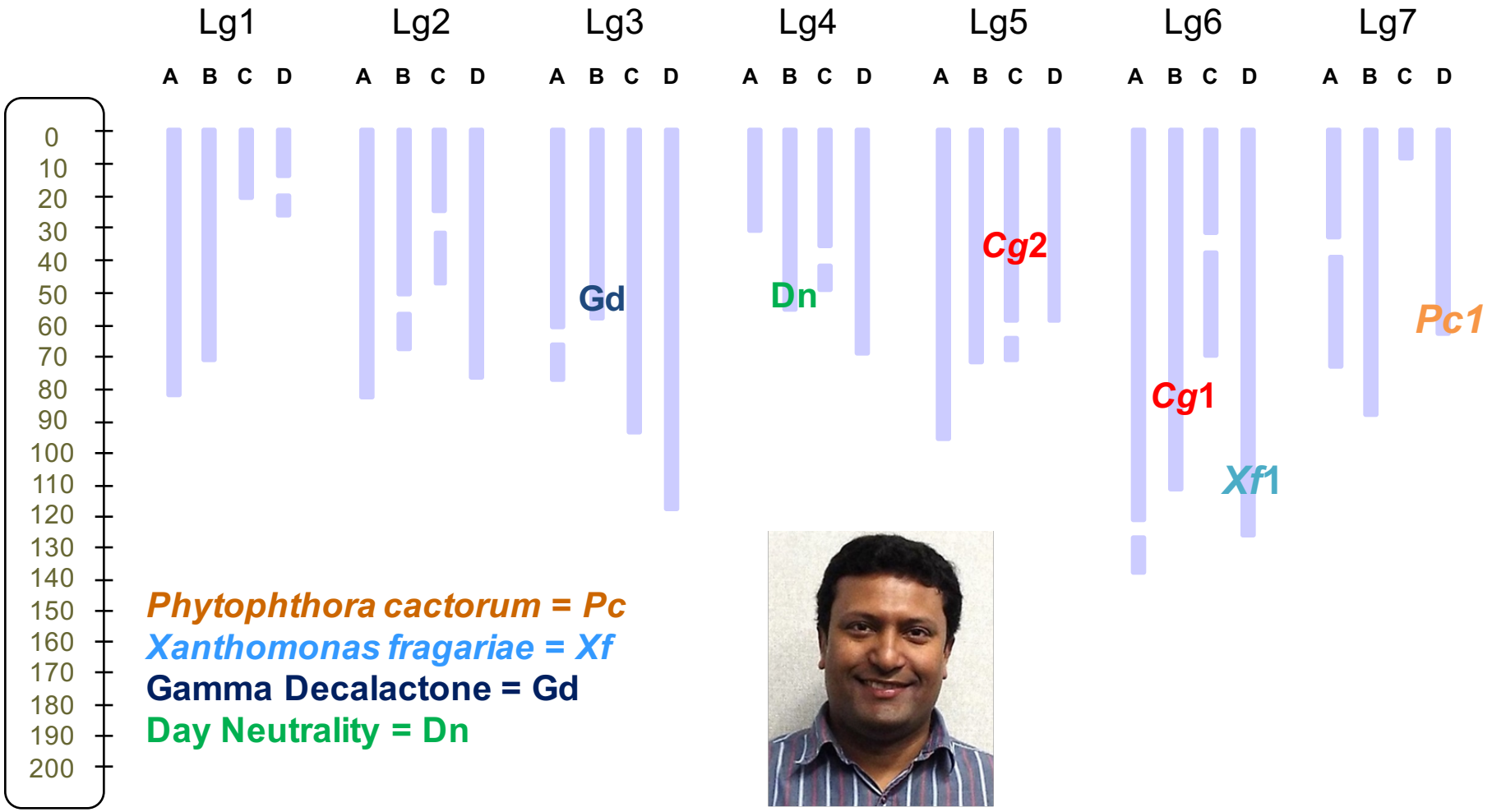
(Dn)

Gamma-decalactone

(Gd)

UF IFAS UNIVERSITY of FLORIDA

Gene discovery overview

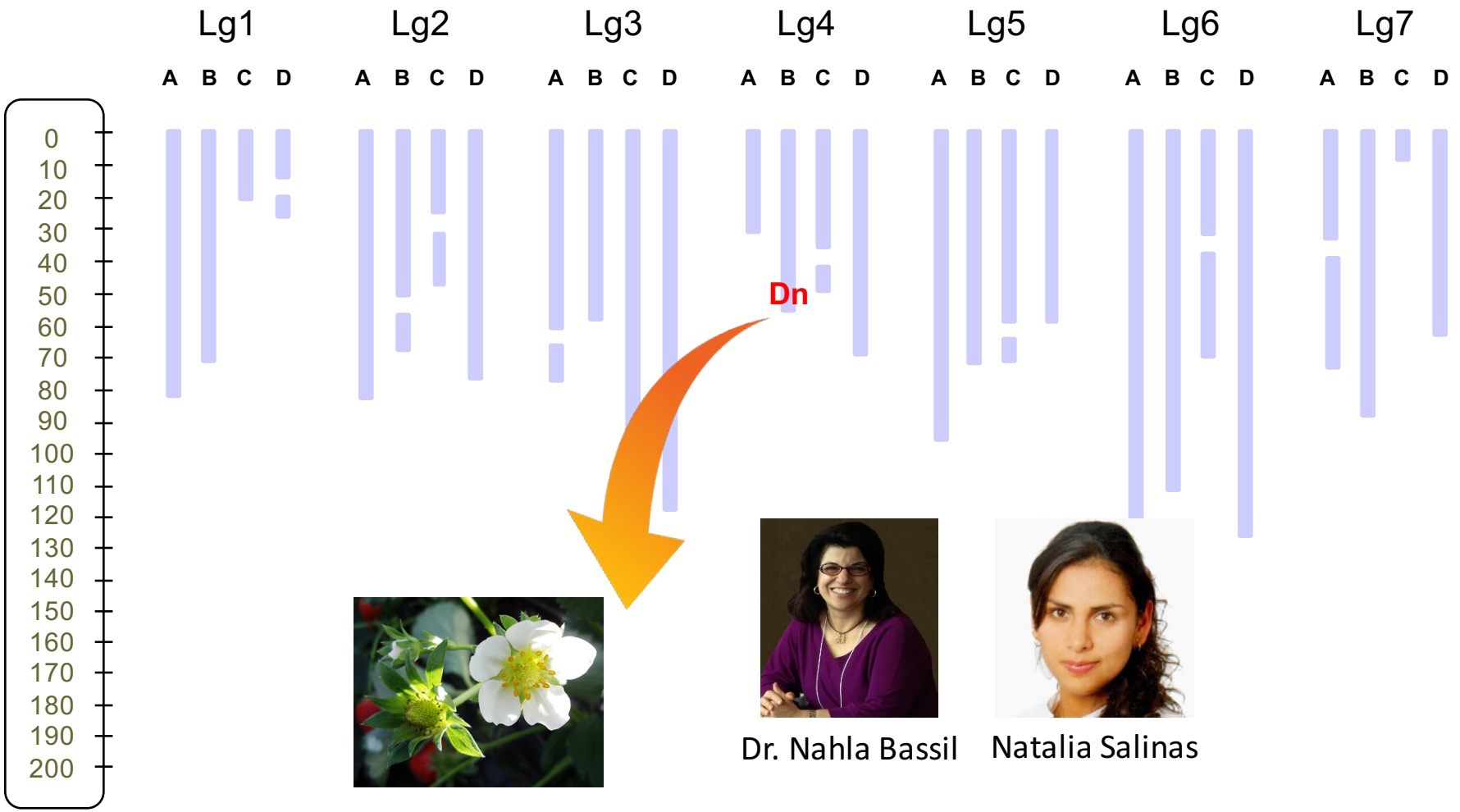


Phytophthora cactorum = Pc
Xanthomonas fragariae = Xf
Gamma Decalactone = Gd
Day Neutrality = Dn

Dr. Sujeet Verma

UF IFAS UNIVERSITY of FLORIDA

Day neutral vs. short day



Dr. Nahla Bassil

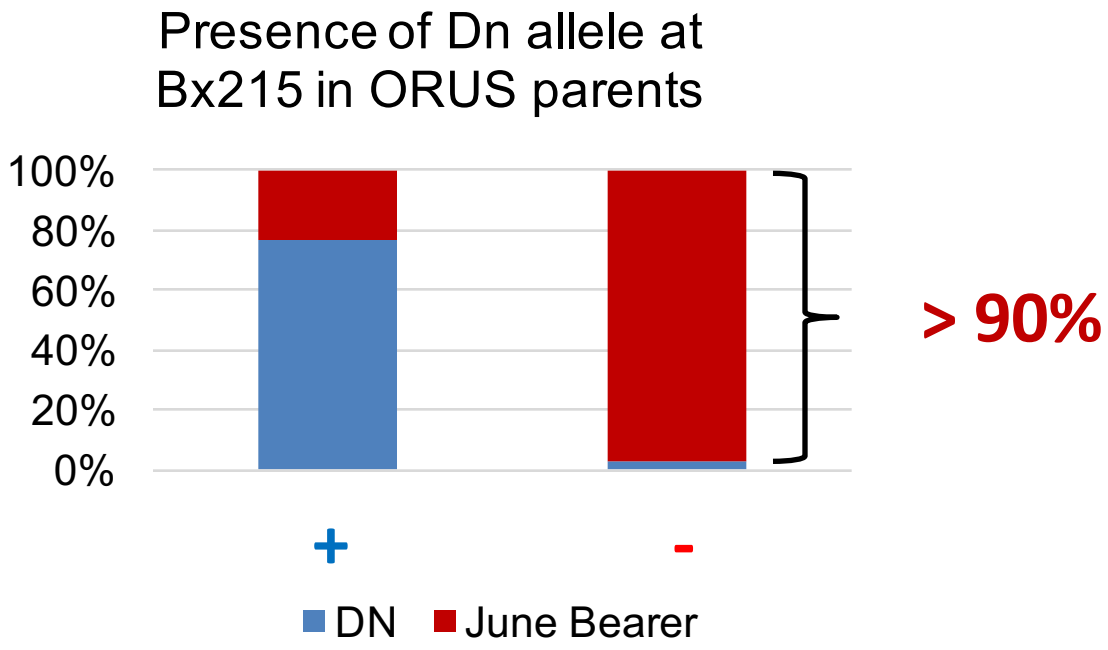
Natalia Salinas

Day neutrality = Dn

UF IFAS UNIVERSITY of FLORIDA

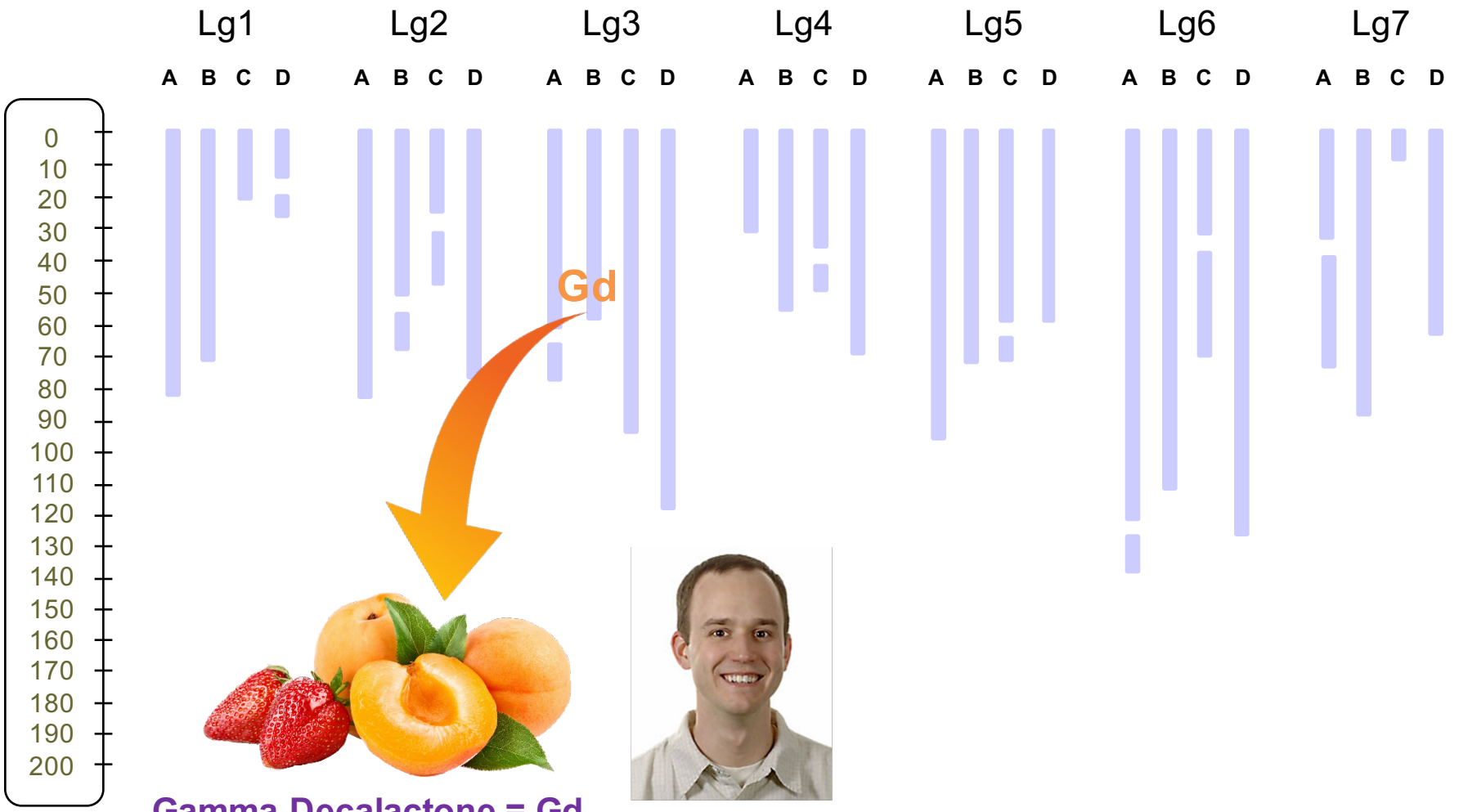
DNA test for day neutrality

Absence of Dn allele: >90% prediction of Short Day



UF IFAS UNIVERSITY of FLORIDA

Gamma decalactone (Gd)



Gamma Decalactone = Gd

Dr. Alan Chambers

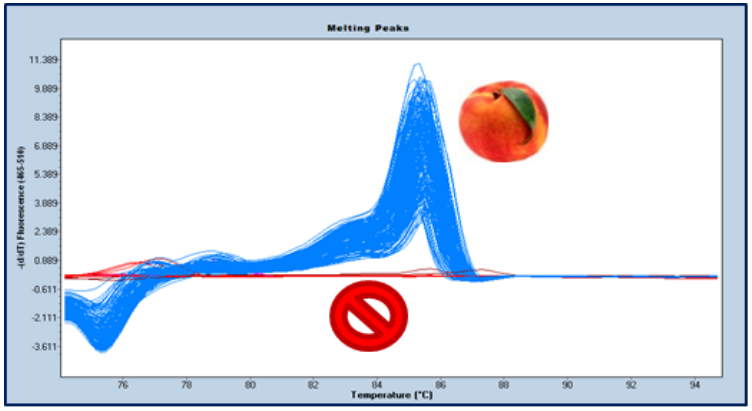
UF IFAS UNIVERSITY of FLORIDA

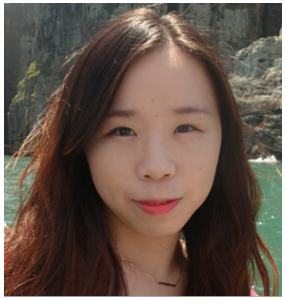
Gamma decalactone (Gd)

- **Present in about half of cultivars tested in consumer panels**
- **‘Florida Elyana’, ‘Sweet Charlie’, Florida Sensation™**
- **Single gene *FaFAD1***

UF IFAS UNIVERSITY of FLORIDA

DNA test for Gd



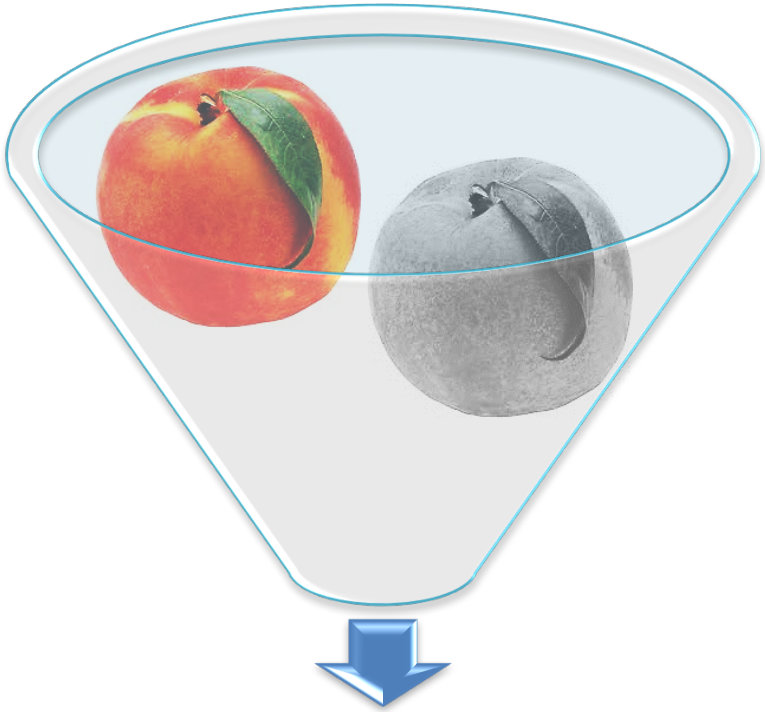


Younghee Noh

UF IFAS UNIVERSITY of FLORIDA

Breeding gain for Gd with MAS

Screened 6,300 seedlings, 2015



50% Cull

50% Keep

UF IFAS
UNIVERSITY of FLORIDA

Bacterial angular leaf spot

Jack Roach

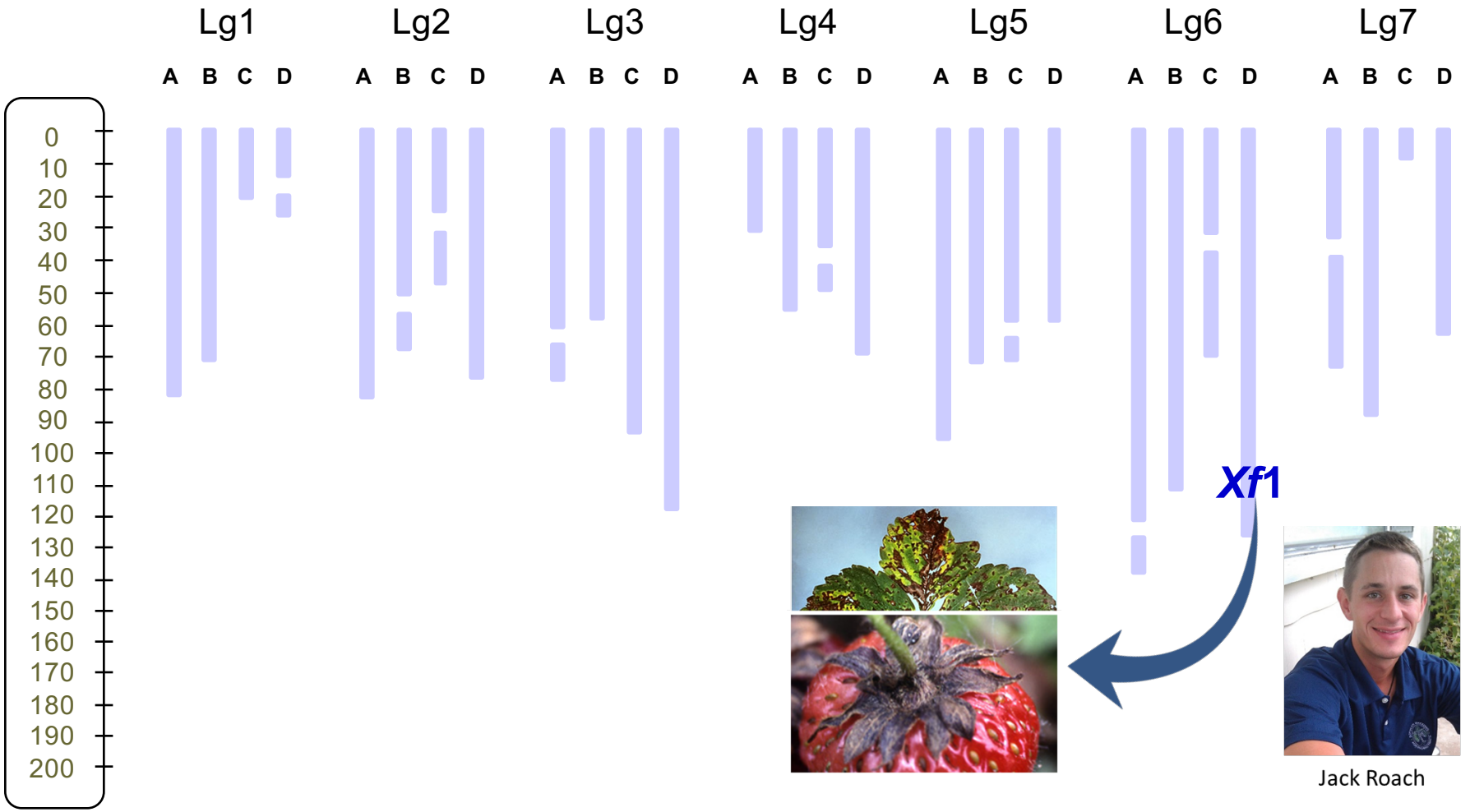
UF IFAS UNIVERSITY of FLORIDA

Bacterial angular leaf spot resistance

- Up to 8% yield loss in annual strawberry
- Currently, no resistant cultivars available
- Two wild resistance donors identified

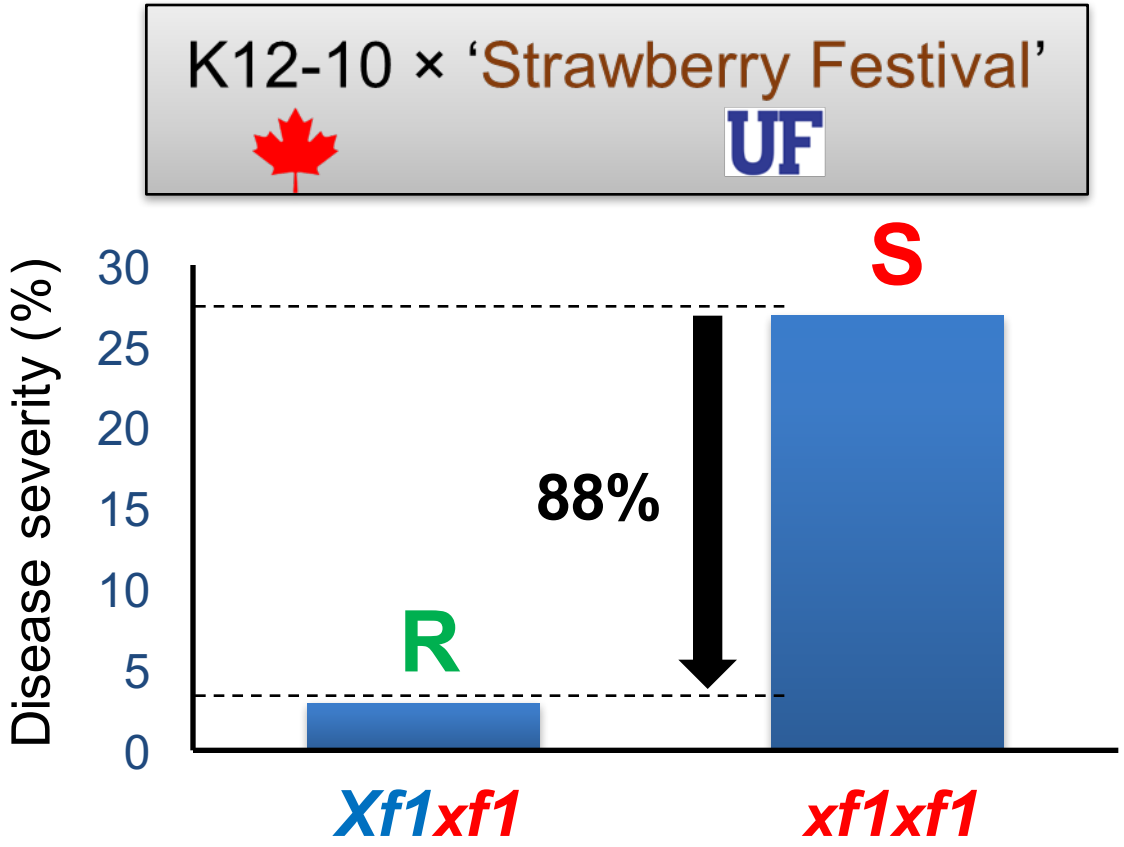
UF IFAS UNIVERSITY of FLORIDA

Bacterial angular leaf spot resistance: *Xf1*



UF IFAS UNIVERSITY of FLORIDA

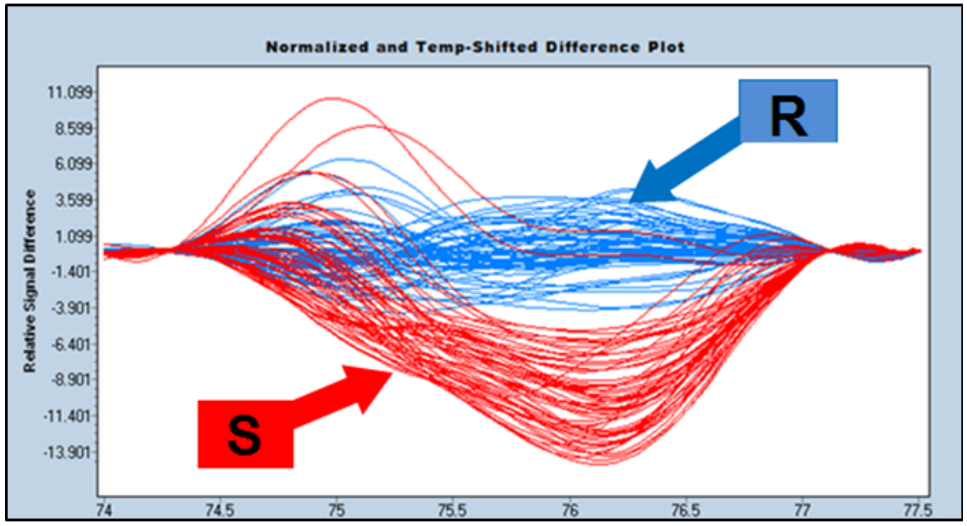
Breeding gain for *Xf1* from MAS



UF IFAS UNIVERSITY of FLORIDA

DNA test for *Xf1*

UFXf1



> 95% of selection efficiency for *Xf1*

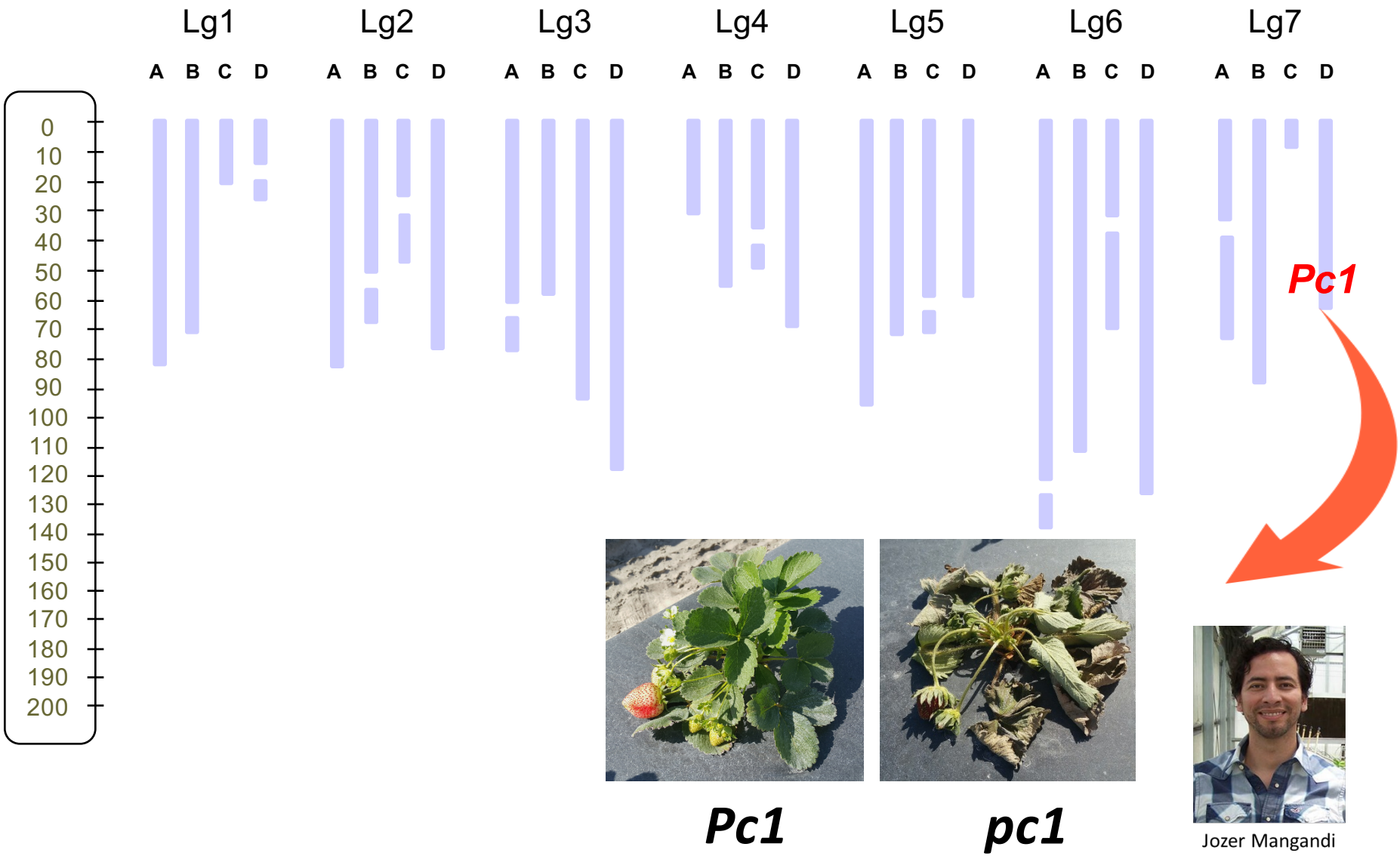
UF IFAS UNIVERSITY of FLORIDA

Phytophthora root and crown rot

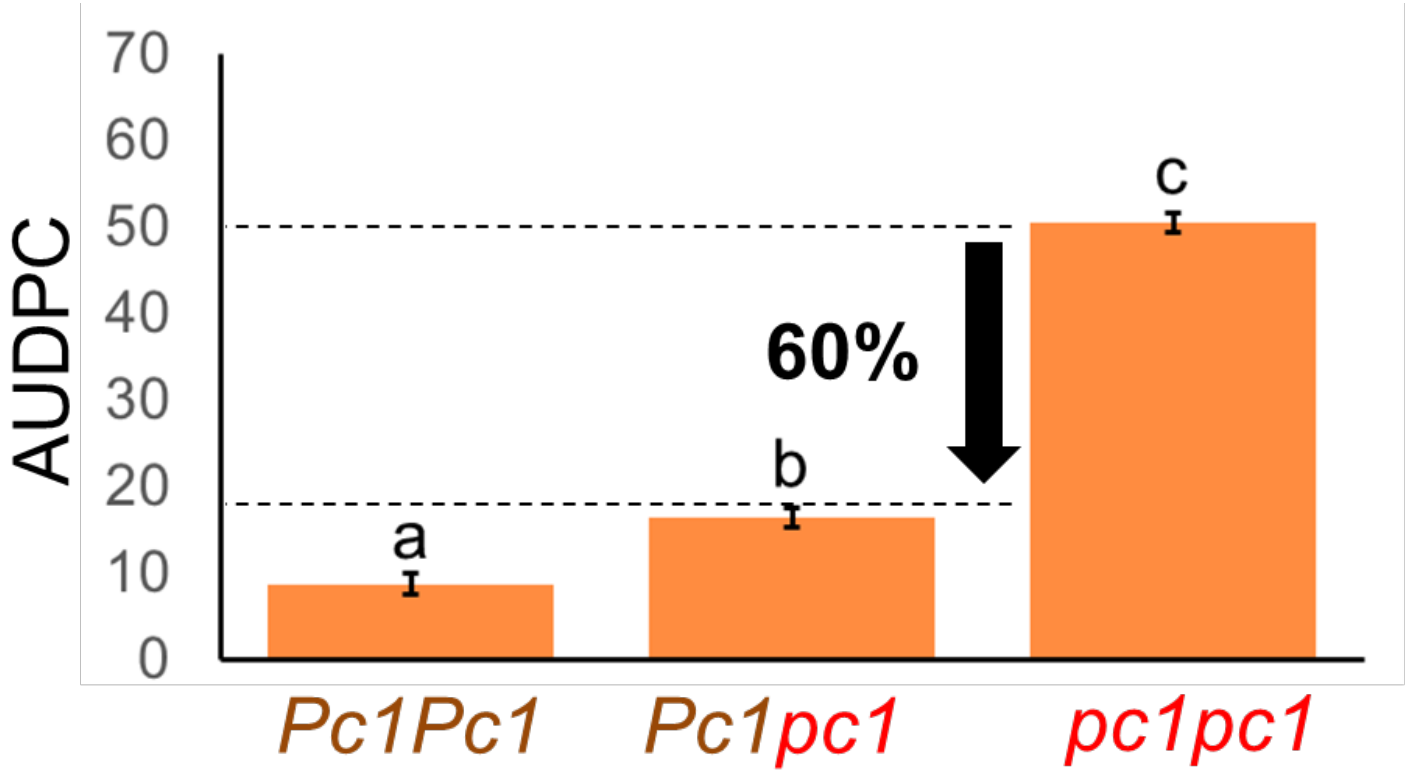
- **Resistance varies widely among cultivars, and breeding for this trait is time/labor consuming**

UF IFAS UNIVERSITY of FLORIDA

Phytophthora resistance: *Pc1*



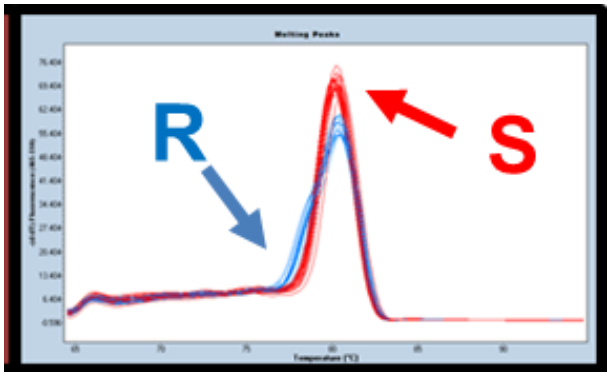
Breeding gain for *Pc1* from MAS



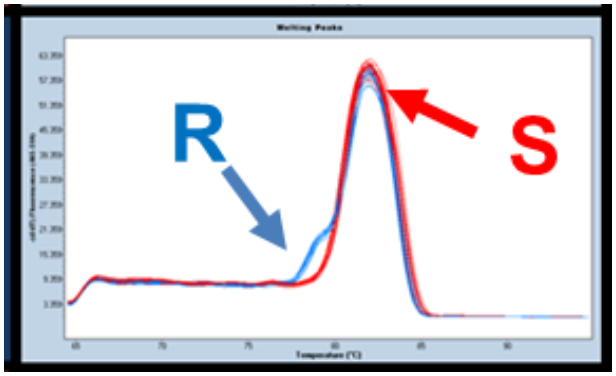
UF IFAS
UNIVERSITY of FLORIDA

DNA test for *Pc1*

UF-Pc1H2



UF-Pc1H3



R **S**

> 95% of selection efficiency for *Pc1*

UF IFAS UNIVERSITY of FLORIDA

A new system for marker-assisted selection (MAS) in the UF strawberry breeding program

UF breeding cycle

Crossing

Seed germination

Summer nursery

Evaluation

September - March

UF IFAS UNIVERSITY of FLORIDA

The need for a high-throughput MAS system

MAS

Seed Germination → **Summer Nursery**

UF IFAS UNIVERSITY of FLORIDA

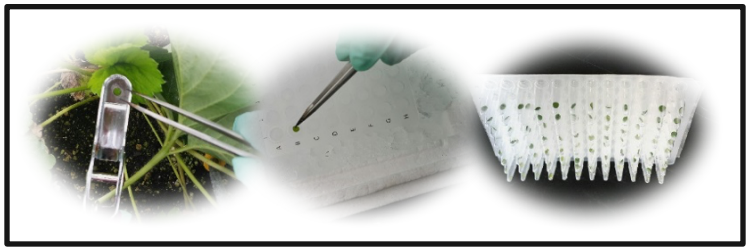
The need for a high-throughput MAS system

How can we screen 30,000 seedlings in 3 weeks?

Seed Germination → **Summer Nursery**

UF IFAS UNIVERSITY of FLORIDA

A new high-throughput MAS system



Rapid DNA extraction

No
DNA extraction!

No
Gel!

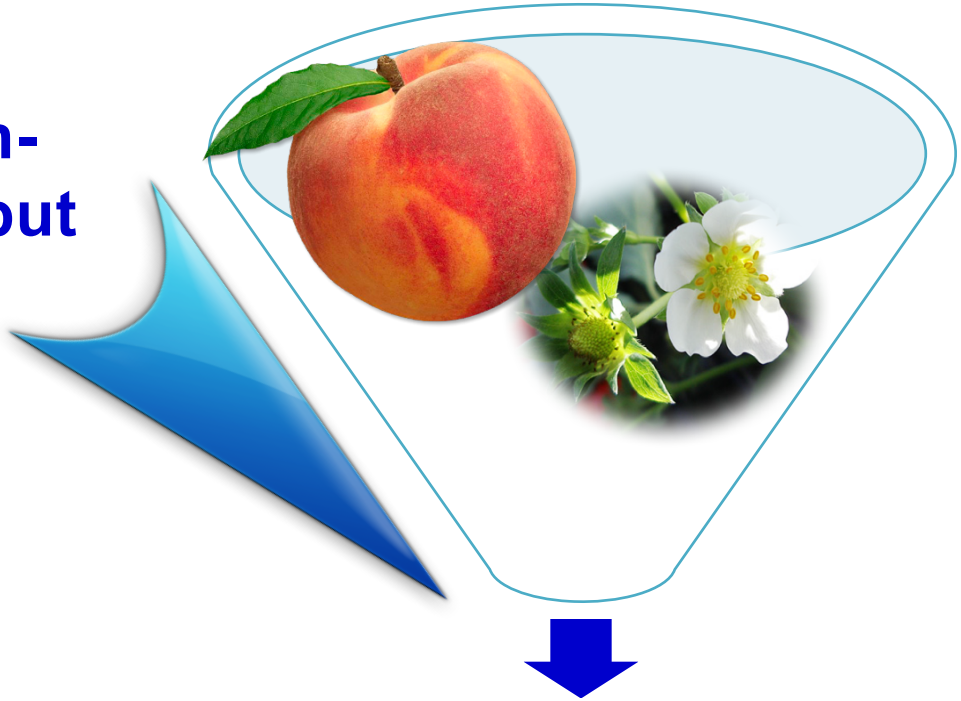
High-throughput DNA testing

UF IFAS UNIVERSITY of FLORIDA

Marker-assisted seedling selection in 2015

Population size: ~ 16,500 in 2015

UF high-throughput MAS



- ✓ *Gd*
- ✓ *Dn*

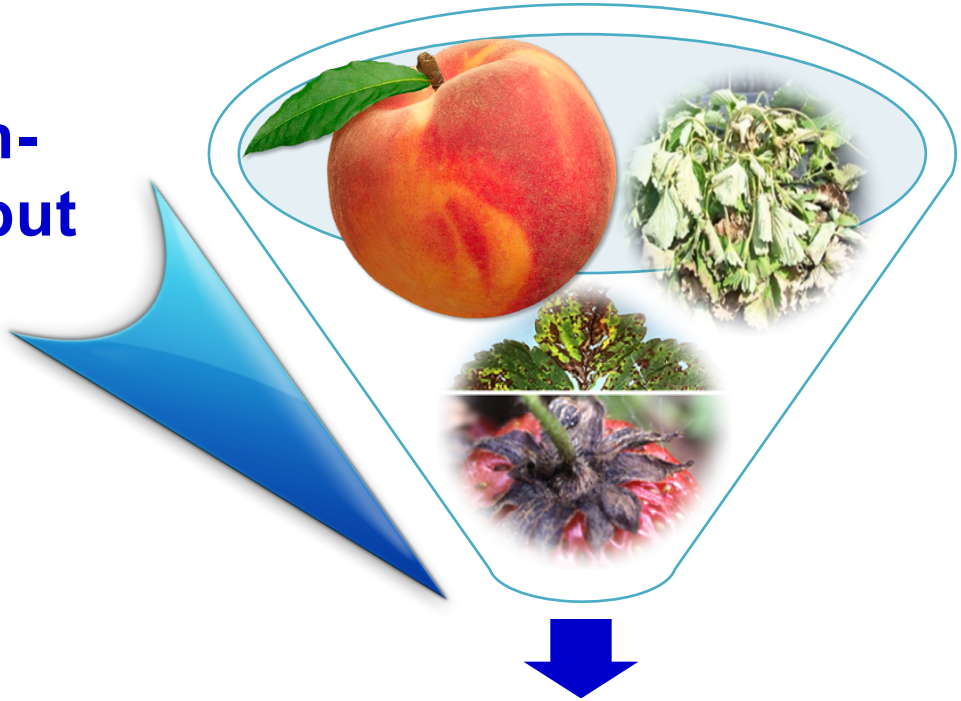
12,500 field tested

UF IFAS UNIVERSITY of FLORIDA

Marker-assisted seedling selection in 2016

Population size: ~ 32,000 in 2016

UF high-throughput MAS



- ✓ *Gd*
- ✓ *Pc1*
- ✓ *Xf1*

12,500 field tested

UF IFAS UNIVERSITY of FLORIDA

Summary

1) High-throughput DNA tests for four traits, with more to come
2) Effectively increases size of breeding program
3) New cultivars with better trait combinations

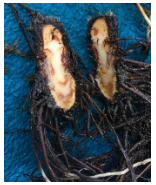
UF IFAS UNIVERSITY of FLORIDA

Future DNA tests to be developed…

1) Soluble solids content 

2) New volatile compounds  

3) Acutatum fruit rot (*Colletotrichum acutatum*) 

4) Colletotrichum crown rot (*C. gloeosporioides*) 

5) Charcoal rot (*Macrophomina phaseolina*) 

UF IFAS UNIVERSITY of FLORIDA

Acknowledgements

UF Strawberry Breeding Lab

- Luis Osorio
- Catalina Moyer
- Tomas Hasing
- David Moore
- Angelita Arredondo
- Wantanee Prescott
- Fan Zhen
- Jose Hernandez
- Teresa Seijo

Other Collaborators

- Nahla Bassil (USDA-ARS, OR)
- Sachiko Isobe (KDRI, Japan)
- Natalia Peres (UF)

FSGA
Florida Strawberry Growers Association

UF UNIVERSITY of FLORIDA
Gulf Coast Research and Education Center

UF IFAS
UNIVERSITY of FLORIDA

Questions ?