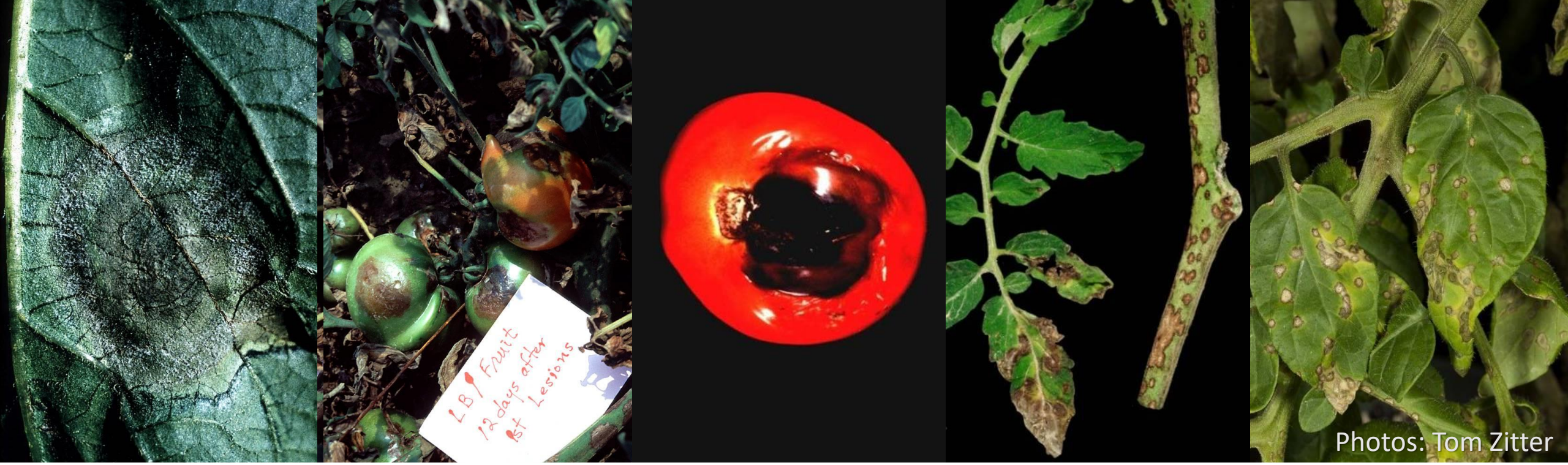
Pyramiding Resistances to Bacterial Speck and Bacterial Spot in Elite Fresh Market Tomato

Taylor Anderson, Plant Breeding and Genetics Section, SIPS, Cornell University

Martha A. Mutschler, Plant Breeding and Genetics Section, SIPS, Cornell University

David Francis, Department of Horticulture and Crop Science The Ohio State University



Late Blight

Phytophthora infestans

Early Blight

Alternaria spp.

Leaf Spot

Septoria lycopersici

Impact of diseases vary with environmental factors.
All three diseases must be controlled to protect tomato yield & fruit quality

CU151095-146
and
CU151011-170

Campbell 1943 Derived Early Blight Control

Susceptible: 85% defoliation

Blight-Control: 10% defoliation

Tolerance controls of disease on stems, modest disease control on foliage: need to use one or two low environmental impact (EIO) sprays during season.

Septoria Leaf Spot Resistance Under Natural Infection

SLS susceptible
95% SLS defoliation

Hybrid heterozygous SLS-1 & SLS-2
12% SLS defoliation

Bacterial speck

- Pto resistance:
  - Derived from *S. pimpinellifolium* PI 370093
  - Successfully controls the predominant race of *Pseudomonas syringae* pv tomato, race 0
  - Maps to CH5, has been cloned
  - Marker developed in gene
  - Remains an effective source of resistance.

Bacterial spot

- Race-specific:
  - Resistance to *X. euvesicatoria* (T1) based on the Rx-3 locus (CH5) from Hawaii 7998
  - Resistance to T3 strains of *X. perforans* derived from Rx4/Xv3 from either Hawaii 7981 or *S. pimpinellifolium* PI 128216 (CH11)
- Broad-spectrum:
  - QTL-11 (CH11) from Hawaii 7998

Strategy Considerations

- Transfer resistance genes for bacterial diseases into elite Fresh Market tomato that has fungal, and oomycete resistances
- Transferring bacterial resistance genes from Processing tomato into Fresh Market tomato (QTL 11 epistasis?)
- Impact of wild species introgressions on Fresh Market tomato horticultural characteristics?
- Penetrance of resistance?

CH5: Bacterial Speck + Spot (Pto, Rx3) + Septoria (SLS-2)

Donor Line: OH 7536

J. Amer. Soc. Hort. Sci. 130(5):716–721. 2005.

Marker-assisted Selection for Combining Resistance to Bacterial Spot and Bacterial Speck in Tomato

Wencai Yang and David M. Francis[1]
Department of Horticulture and Crop Science, The Ohio State University, Ohio Agricultural Research and Development Center, 1680 Madison Avenue, Wooster, OH 44691

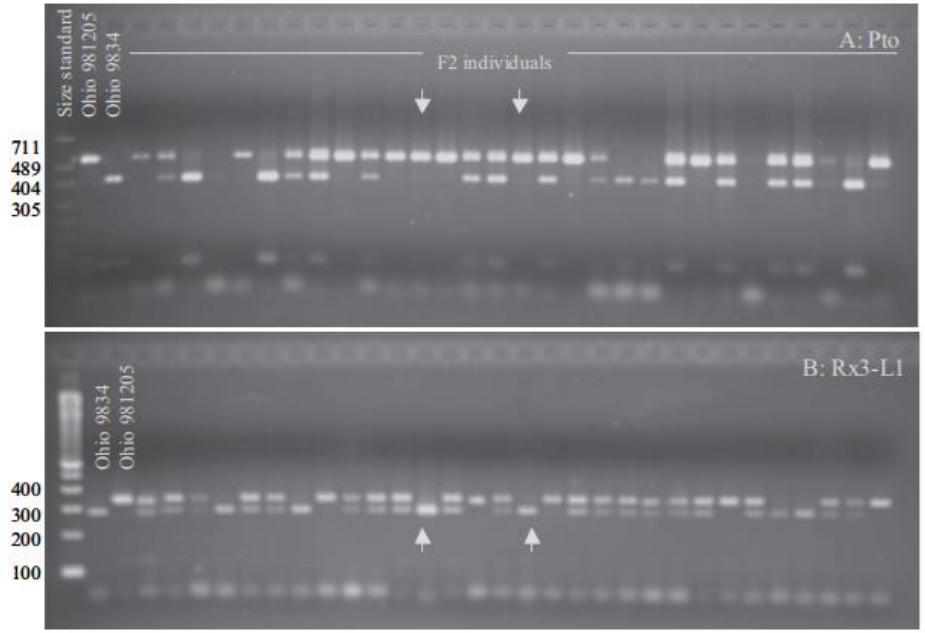
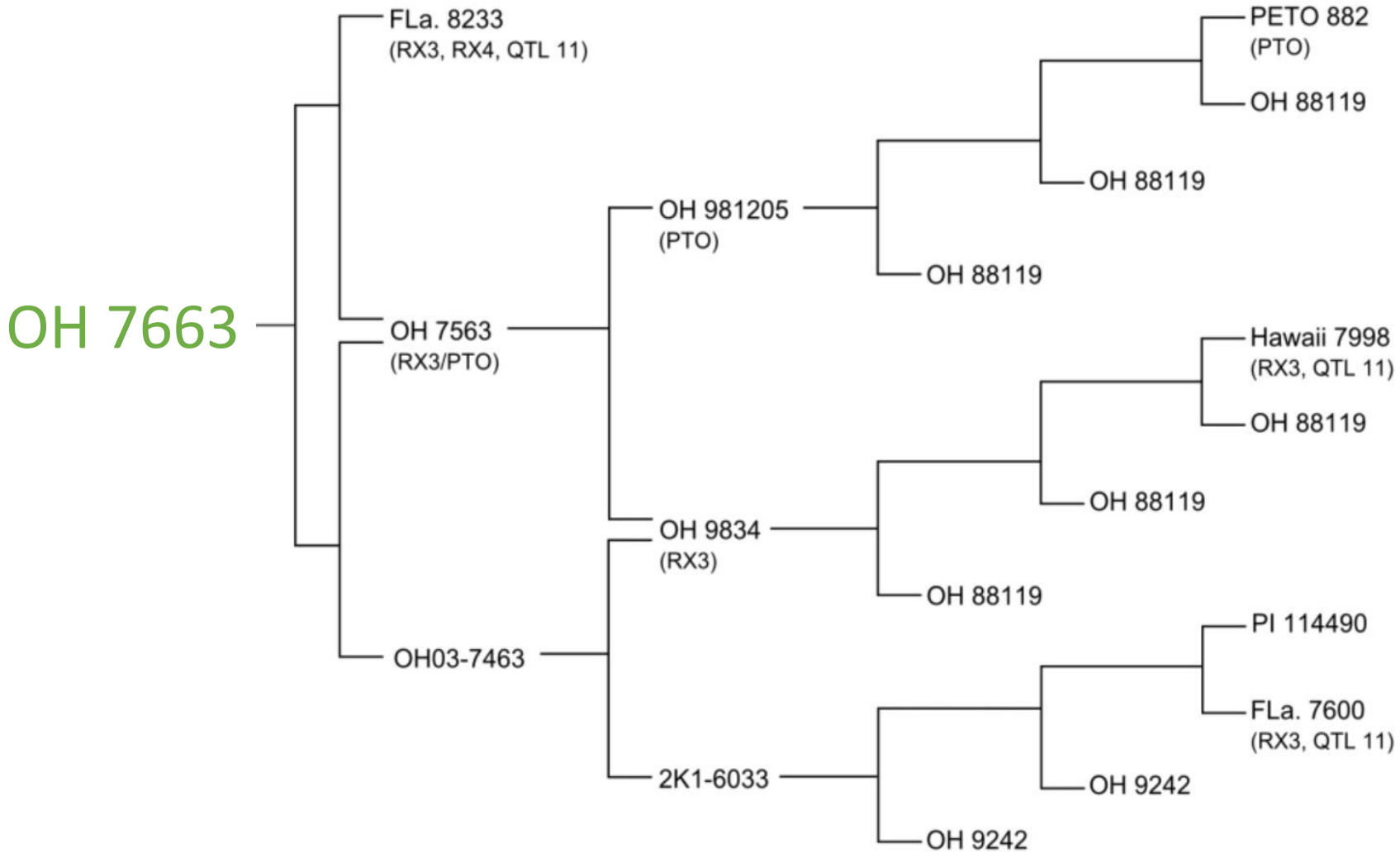
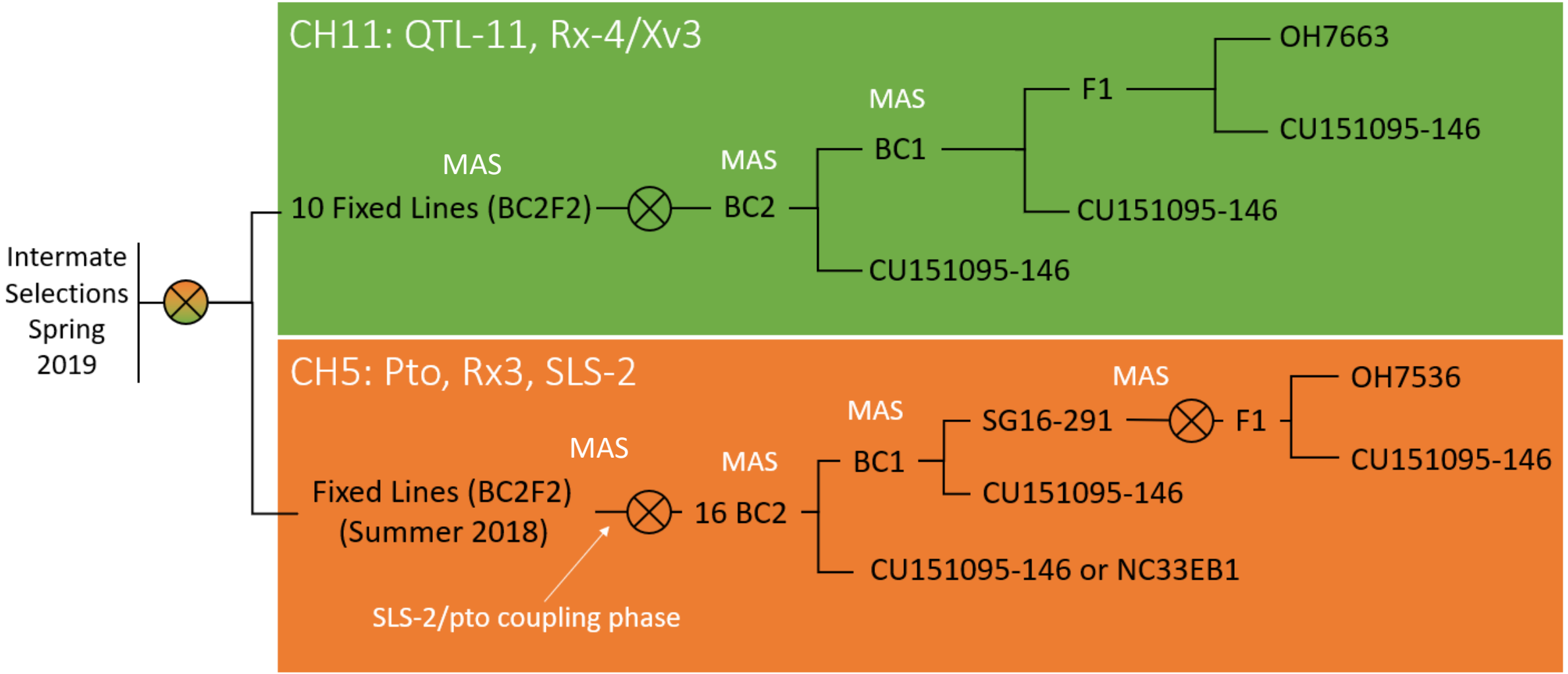


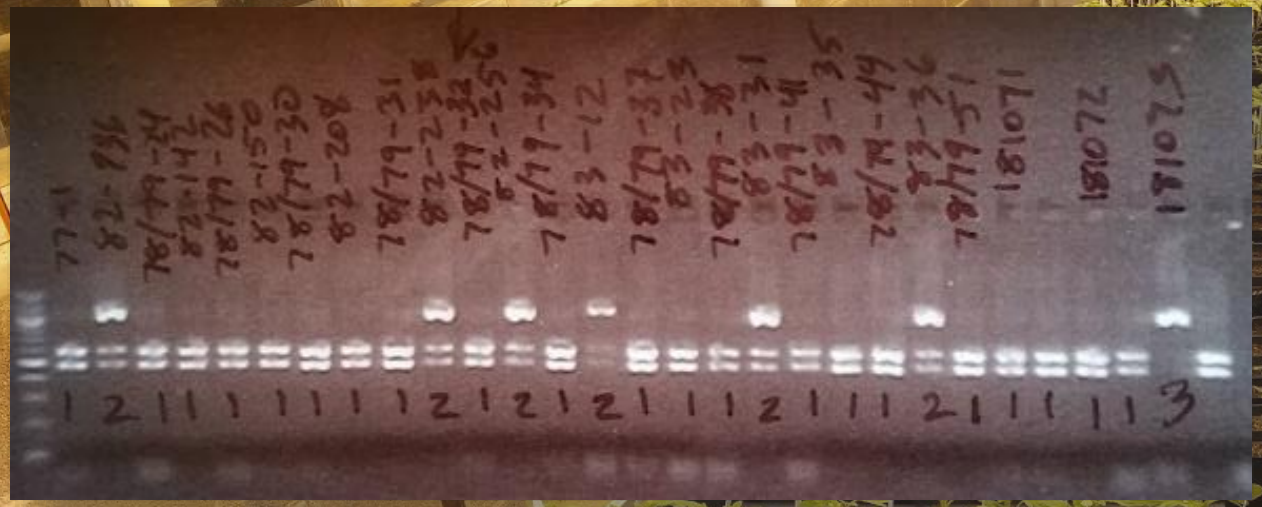
Fig. 1. Molecular marker banding patterns for tomato parental lines, Ohio 981205 and Ohio 9834, and F_2 progeny. For the marker Pto (**A**), fragment sizes are 552 bp for the Ohio 981205 allele (resistant) and 113 bp and 439 bp for the Ohio 9834 allele (susceptible). Fragment sizes for marker Rx3-L1 (**B**) are 323 bp for the bacterial spot susceptible parent, Ohio 981205, and 275 bp and 48 bp for the resistant parent, Ohio 9834. Recombinant individuals with resistance in coupling phase are indicated by arrows.

CH11: Bacterial Spot (QTL-11 and Rx4)

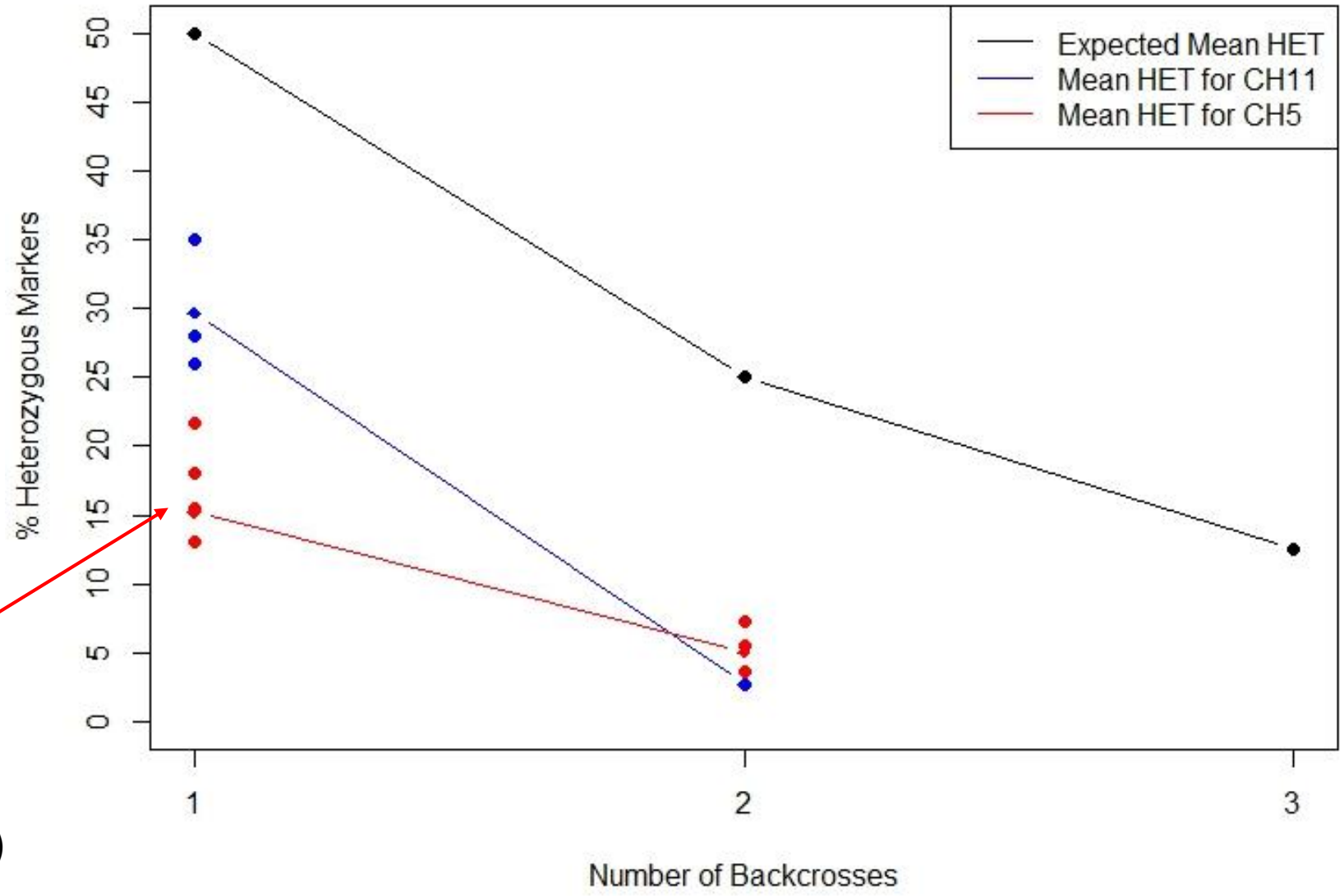


Resistance Pyramiding Scheme




77-1
82-196
78/79-34
82-142
78/79-26
82-150
78/79-30
82-208
78/79-31
82-225
78/79-32
82-256
78/79-34
83-12
78/79-37
83-23
78/79-38
83-31
78/79-41
83-35
78/79-49
83-36
78/79-51
181071
181072
181073
1 2 1 1 1 1 1 1 1 2 1 2 1 2 1 1 2 1 1 1 2 1 1 1 3

Case Study: Rapid Recovery of Recurrent Parent Genome



CH5: SG16-291
(Particularly good
F2 chosen to start)

CH5 Progress

- Selection from segregating populations to create lines homozygous for CH5 introgression
- Verify Rx3 and Pto effect on pathogens
- Intermate CH11 and CH5 lines to combine all resistances
- Screen for recombinants with pto/SLS-2 coupling

CH11 Progress

- Plants recovered FM appearance in greenhouse
- 2018 Trials in 3 Locations (Freeville, Long Island, Ohio)
- Field screening and selection for quality and yield
- Verify QTL-11 and Rx4/Xv3 effect on pathogen

Acknowledgements

Mutschler Breeding Program (Cornell)

- Martha Mutschler
- Darlene De Jong
- Stella Zitter

Francis Breeding Program (Ohio State)

- David Francis
- Eduardo Bernal

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

NORTHEAST SARE
Sustainable Agriculture Research & Education