

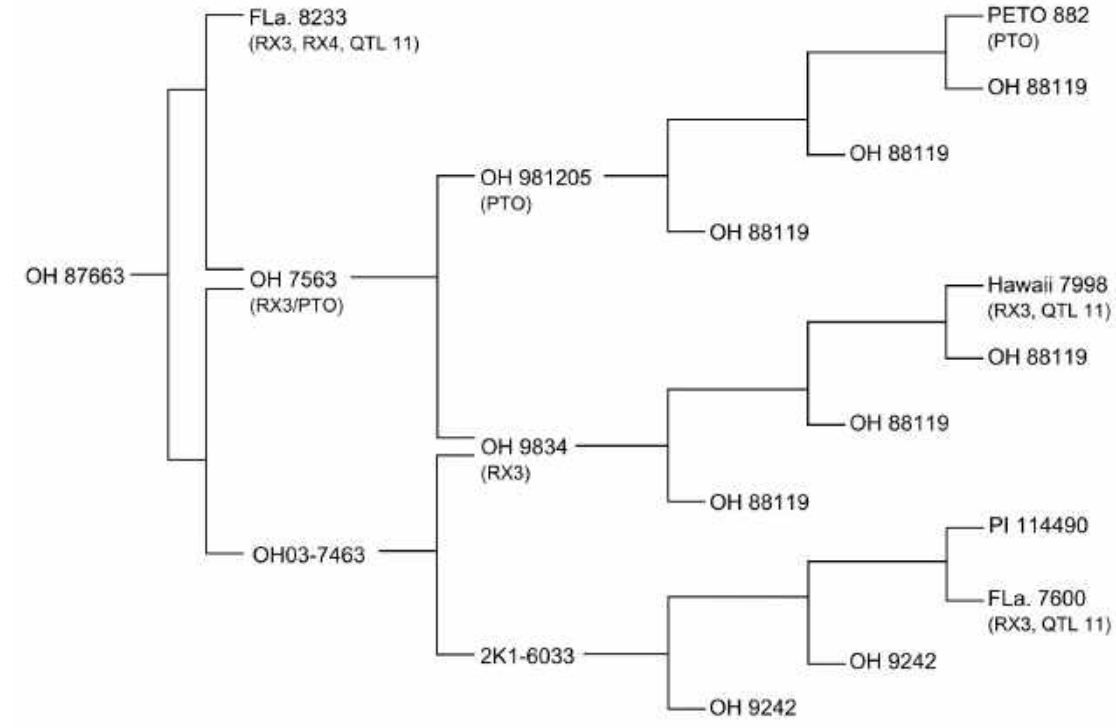


PUBLIC BREEDING AND THE FUTURE OF PROCESSING TOMATO IMPROVEMENT

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The Ohio State University

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Take home messages/opinions:

Public breeding has made outsized contributions to the processing tomato industry

We are at an inflection point where private spending has eclipsed public spending

Public and private efforts have different priorities

Discovery and bridging role remain an important contribution of public breeding

New models are needed



Special Collections/General Library, University of California, Davis, CA

A reminder of what public breeding has done for the processing tomato industry

History:

What has public breeding done?

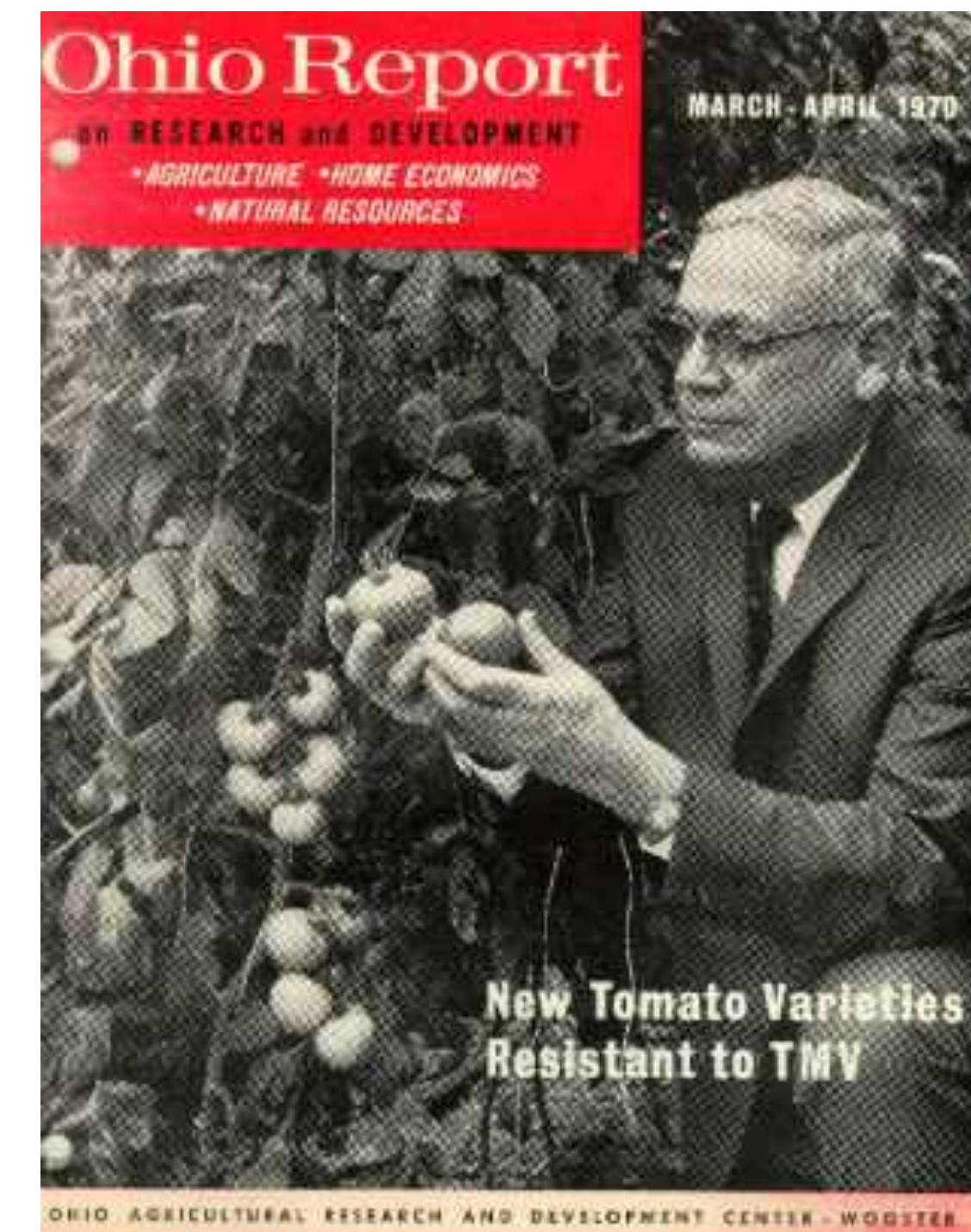
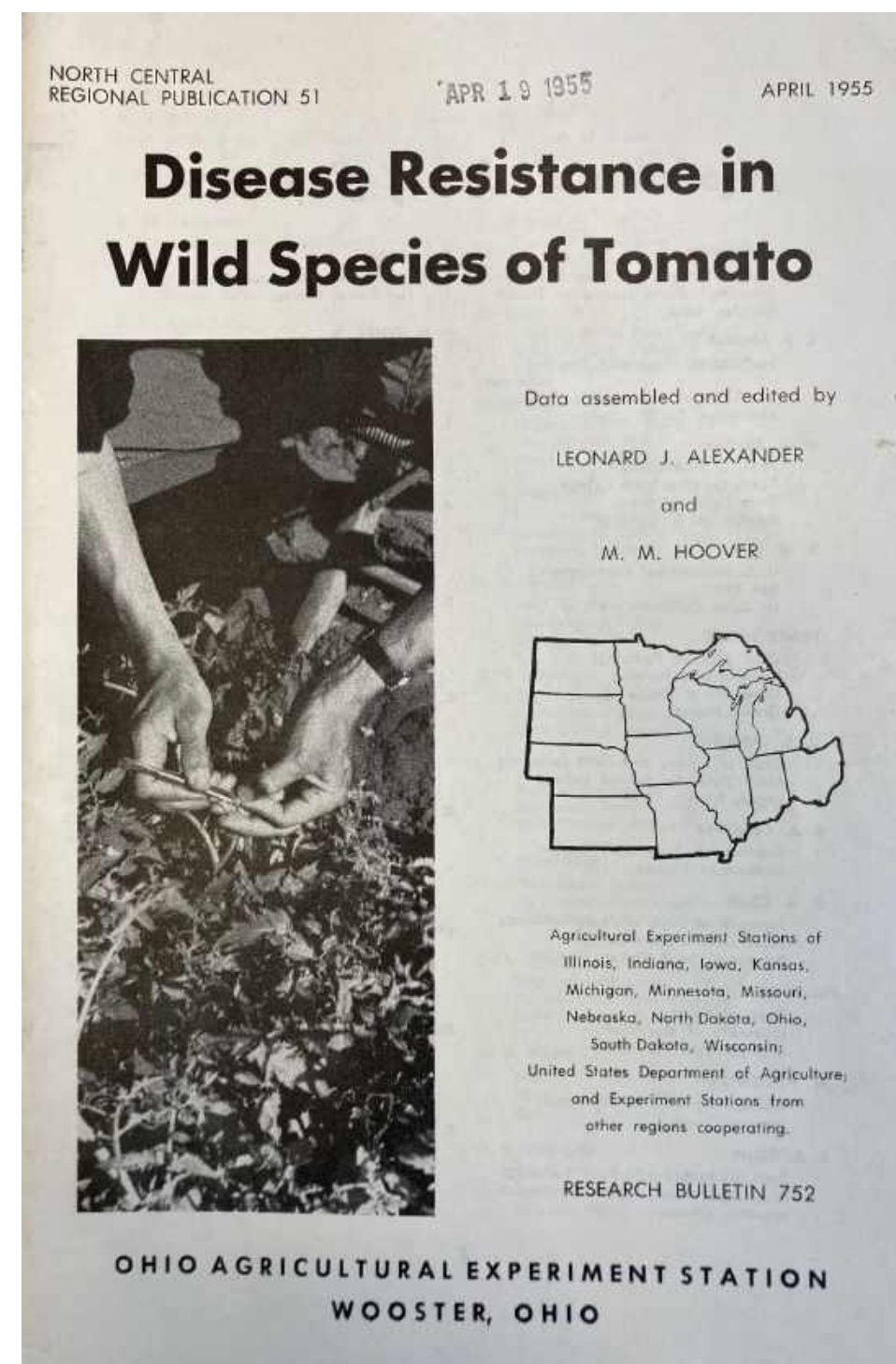
- Germplasm collections
- Germplasm evaluation

Breeding

- Mechanical harvested tomato
- Genetic linkage and marker assisted selection (APS linkage to Mi first large-scale practical application)
- Introgression strategies (e.g. inspired by Allard and Bliss, pioneered by Tanksley in tomato)
- Most major gene resistance

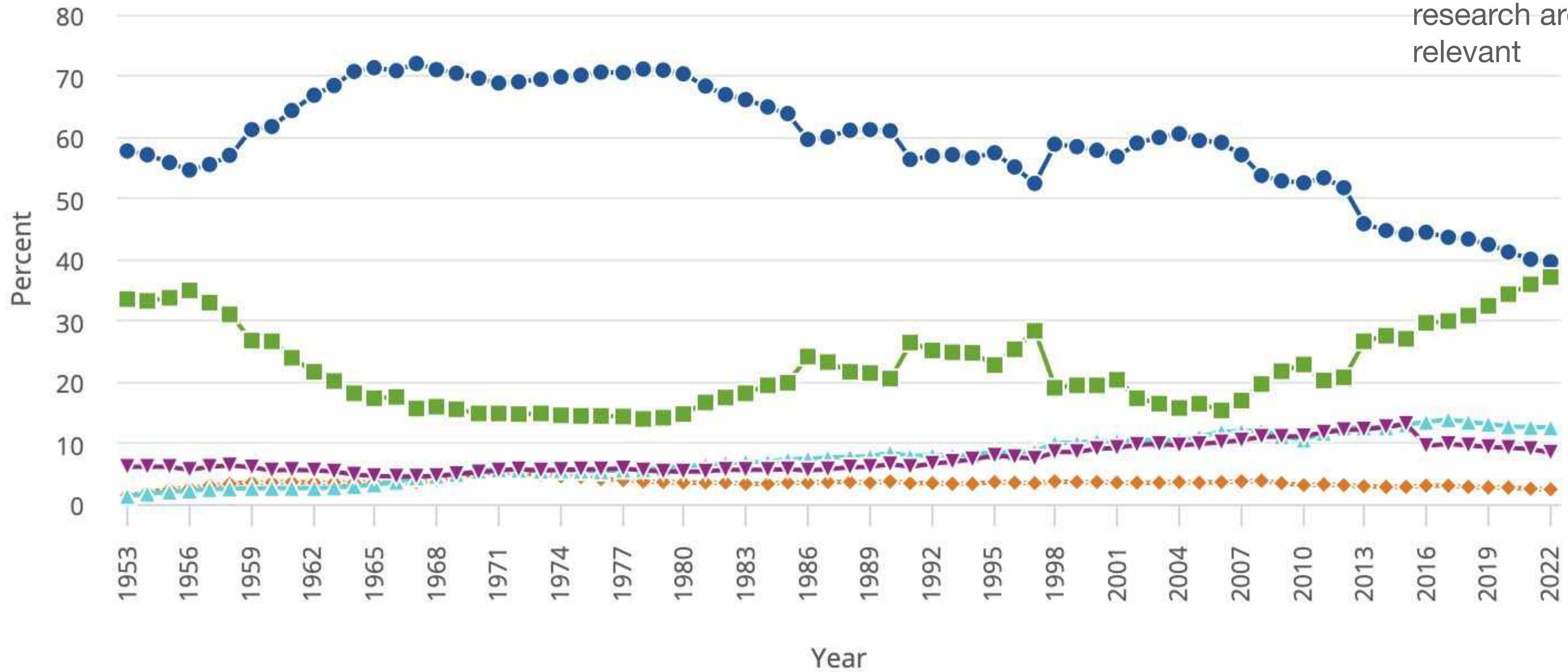
Question worth discussing:

Is public breeding it still relevant?



U.S. basic research expenditures, by source of funds: 1953–2022

Discussions at this symposium and congress about the role of public research are timely and relevant



- Federal government
- ◆ Nonfederal government
- Businesses
- ▲ Higher education institutions
- ▼ Nonprofit organizations

Do we need public plant breeding?

Where is germplasm curation happening?

Where is innovation happening?

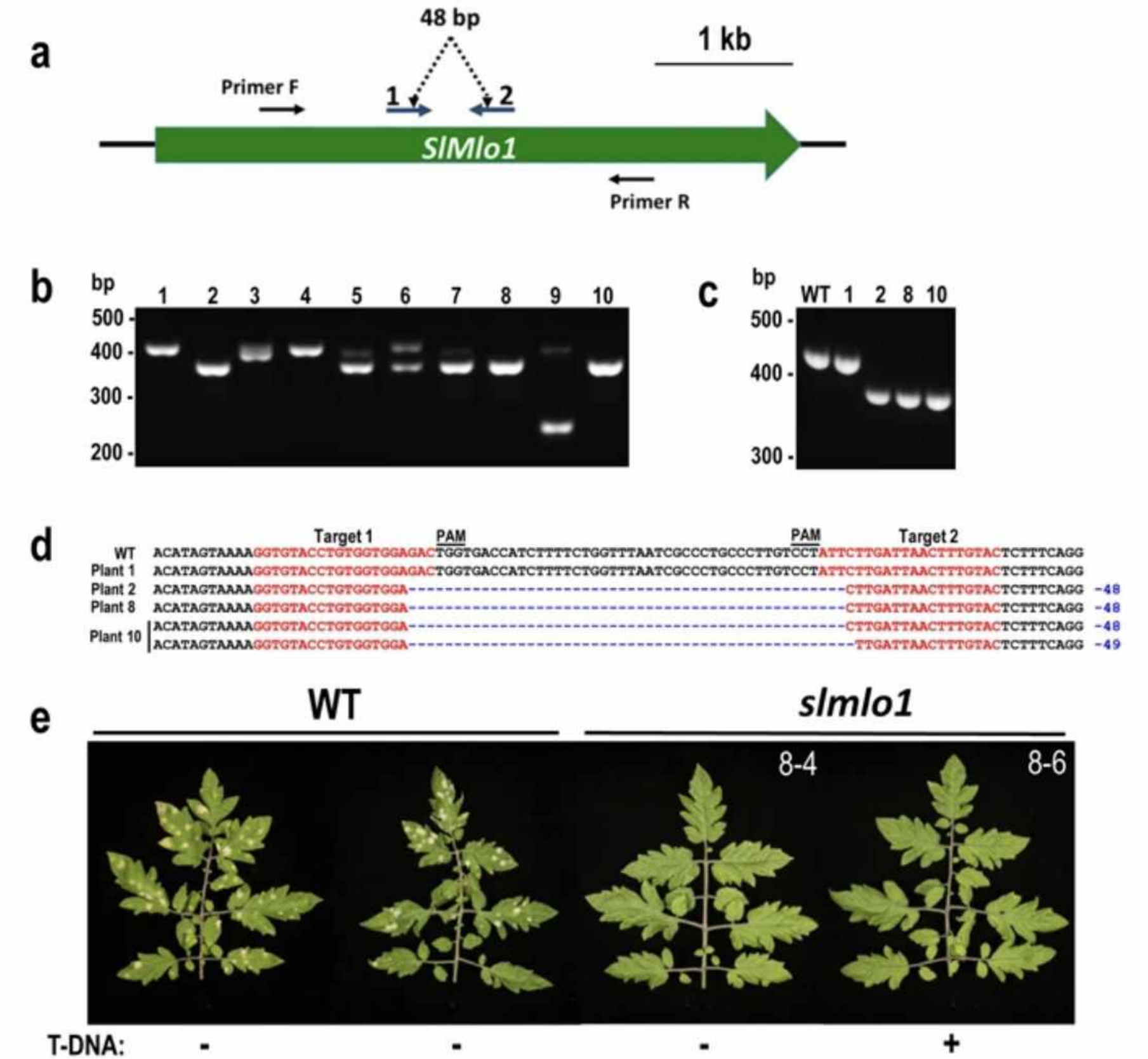
Gene editing

Gene Edited Tomato Tomato (Tomato MLO)

bs5

Prime editing

From: [Rapid generation of a transgene-free powdery mildew resistant tomato by genome deletion](#)



A few of Zach's core questions:

- Is there sufficient genetic diversity?
- Are we leaving potential on the table?

Approaches/Tools

- Applied/Development: Introgression populations to discovery and use genetic diversity
- Basic/Foundational: Prediction of function from primary sequence

Traits

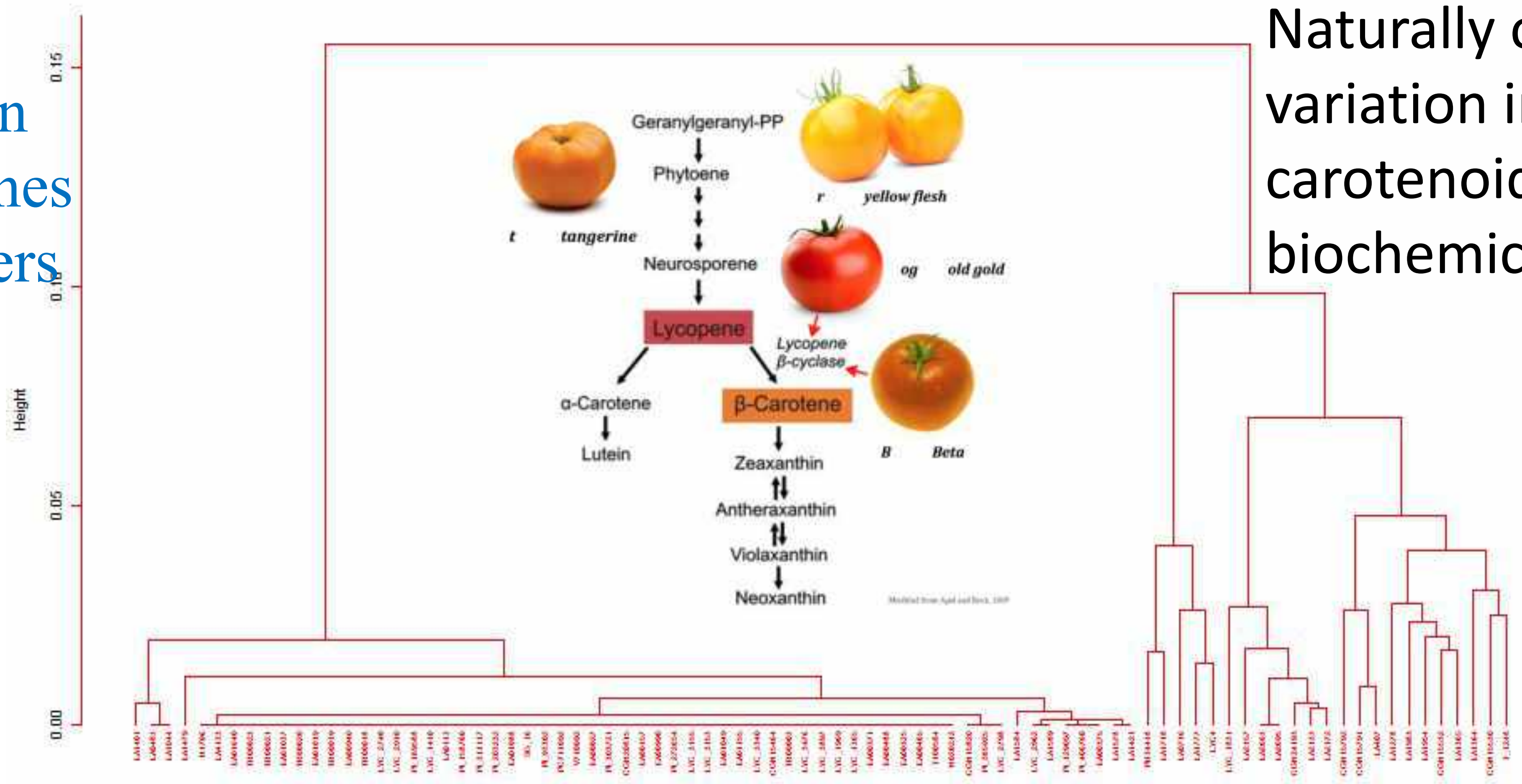
- Adaptation
- Resistance
- Interaction with beneficial microbes
- What is the biggest bottleneck preventing discovery from turning into grower value?

Backup questions if time allows:

- Models that work
- What problems do AI, machine learning, and genomic prediction help solve, and what problems still require breeders, populations, and field testing?
- If you could add one additional public breeder to the industry tomorrow, what would you have them work on?

Allelic variation in tomato genes & promoters

Cluster of tomato accessions based on B promoter

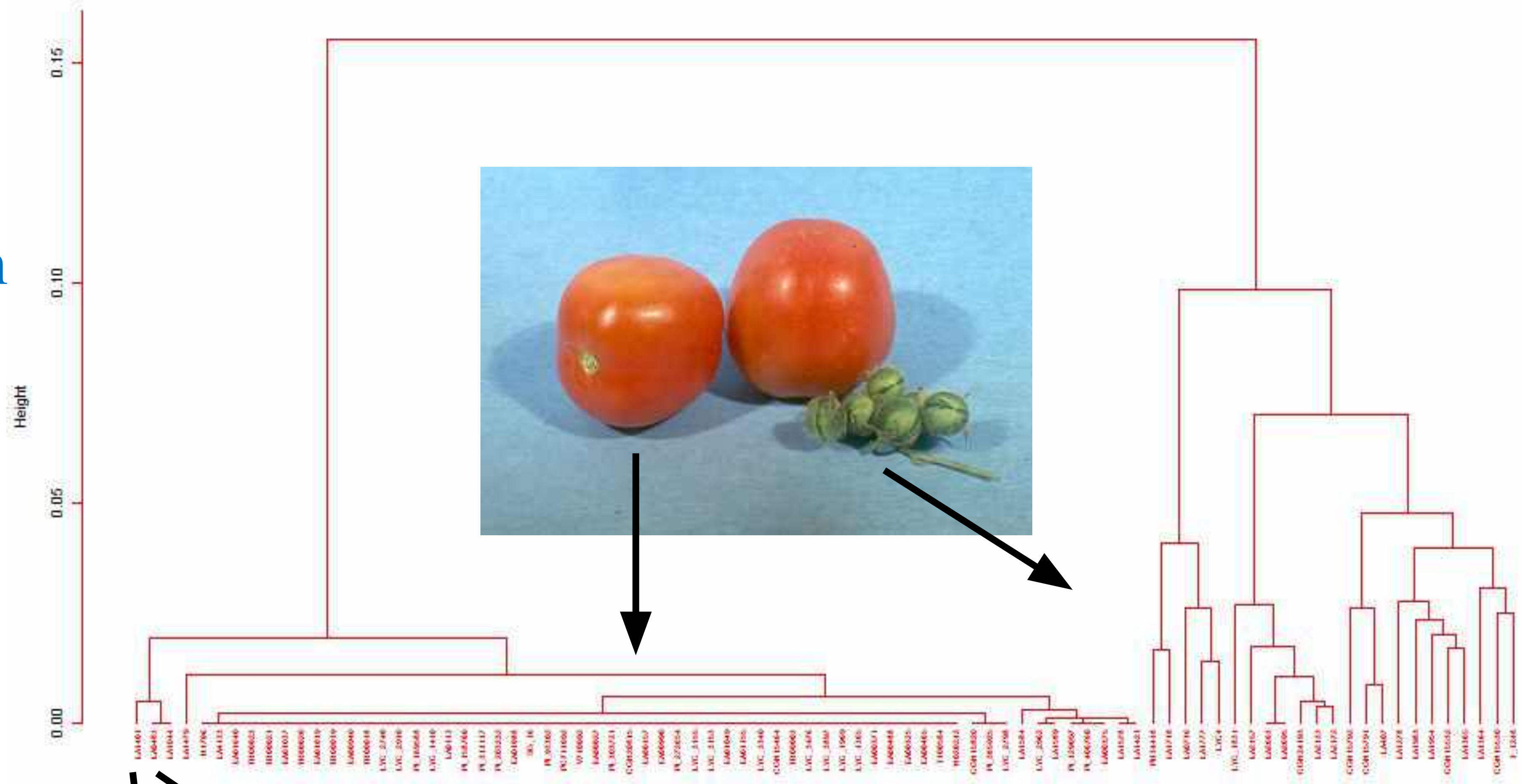


Naturally occurring variation in the carotenoid biochemical pathway

- 25 or more alleles within structural genes
- 25 or more alleles within 5' untranslated region (promoter)

Allelic variation in β promoter

Cluster of tomato accessions based on B promoter



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Are we leaving potential on the table? Important “basic” research question predicting function from primary sequence. Example: Which of the sequences below is a “better” resistance allele

Solyc11g069020.1.1
OH88119
PI128216
Hawaii7981

```
AGCTGGAAGCTGTTGCAAAAGAAGATTTTGGATTAGATGATCCAAGCTGCTGCTGCTGC
AGCTGGAAGCTGTTGCAAAAGAAGATTTTGGATTAGATGATCCAAGCTGCTGCTGCTGC
AGTTGGAAGCTGTTGCAAAAGAAGATTTTGGATTAGATGATCCAA-----GCTGCTGC
AGTTGGAAGCTGTTGCAAAAGAAGATTTTGGATTAGATGATCCAA-----GCTGCTGC
** *****
```

Solyc11g069020.1.1
OH88119
PI128216
Hawaii7981

```
GATGACGAAATGGAAAGGATTGGAATGGAAATTTCAAAAAAATGCAAAGGATTACCACTA
GATGACGAAATGGAAAGGATTGGAATGGAAATTTCAAAAAAATGCAAAGGATTACCACTA
GATGACGAAATGGAAAGGATTGGAATGGAAATTTCAAAAAAATGCAAAGGATTACCACTA
GATGACGAAATGGAAAGGATTGGAATGGAAATTTCAAAAAAATGCAAAGGATTACCACTA
*****
```

Solyc11g069020.1.1
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Hawaii7981

```
GCAATTGTTATGGTAGCTGGGATACTTTCTAAAGAAAGCGCGACAGCAAGTAAATGGAGT
GCAATTGTTATGGTAGCTGGGATACTTTCTAAAGAAAGCGCGACAGCAAGTAAATGGAGT
GCAATTGTTATGGTAGCTGGGATACTTTCTAAAGAAAGCGCGACAGCAAGTAAATGGAGT
GCAATTGTTATGGTAGCTGGGATACTTTCTAAAGAAAGCGCGACAGCAAGTAAATGGAGT
*****
```

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Are we leaving potential on the table?

There are “basic” and “applied” gaps (e.g. predicting function from primary sequence)

The reference population problem

Lack of commercially relevant germplasm to use for basic and applied research

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Approaches/Tools

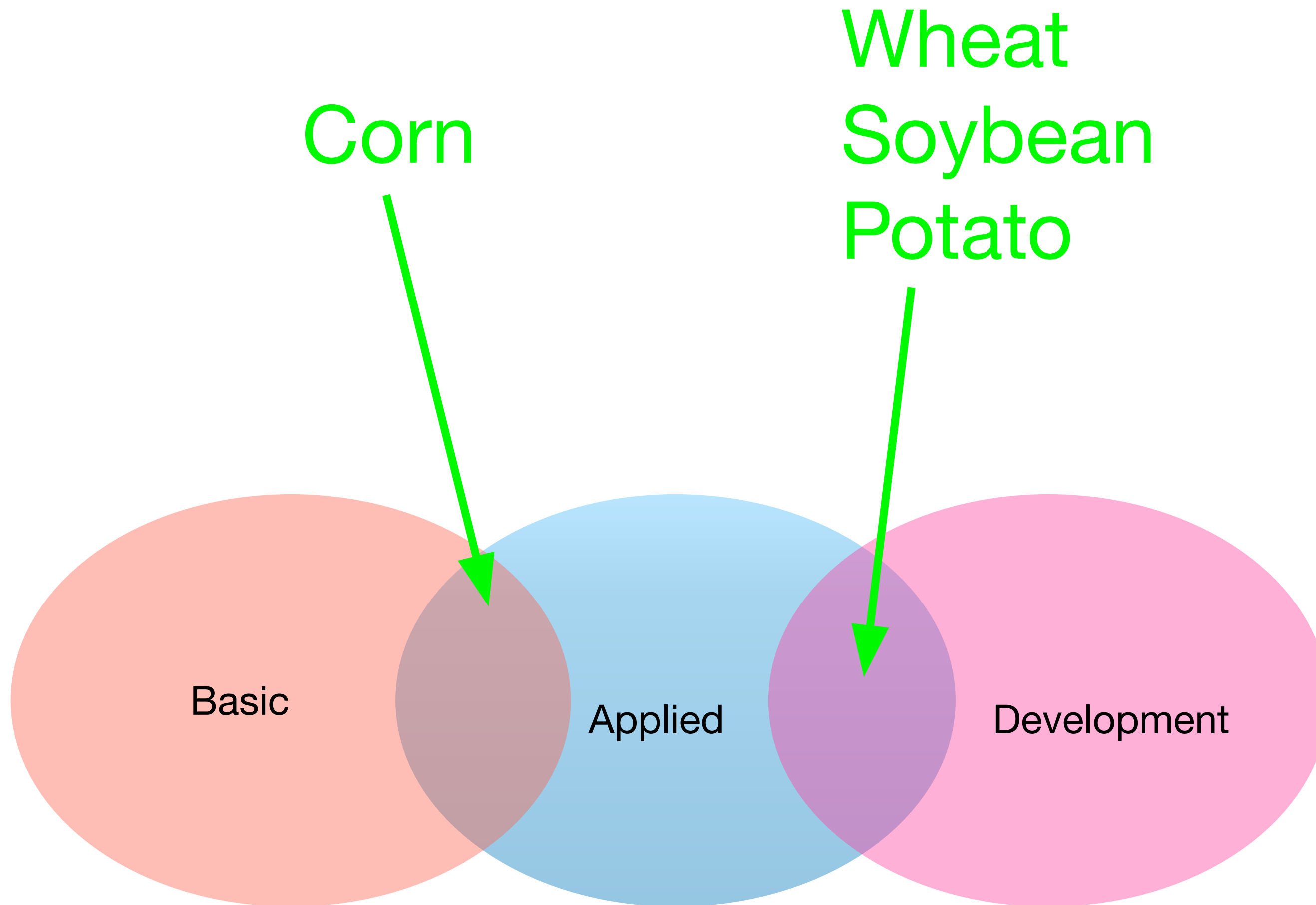
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Models that work

Where public breeding remains strong (a few models that I know of)

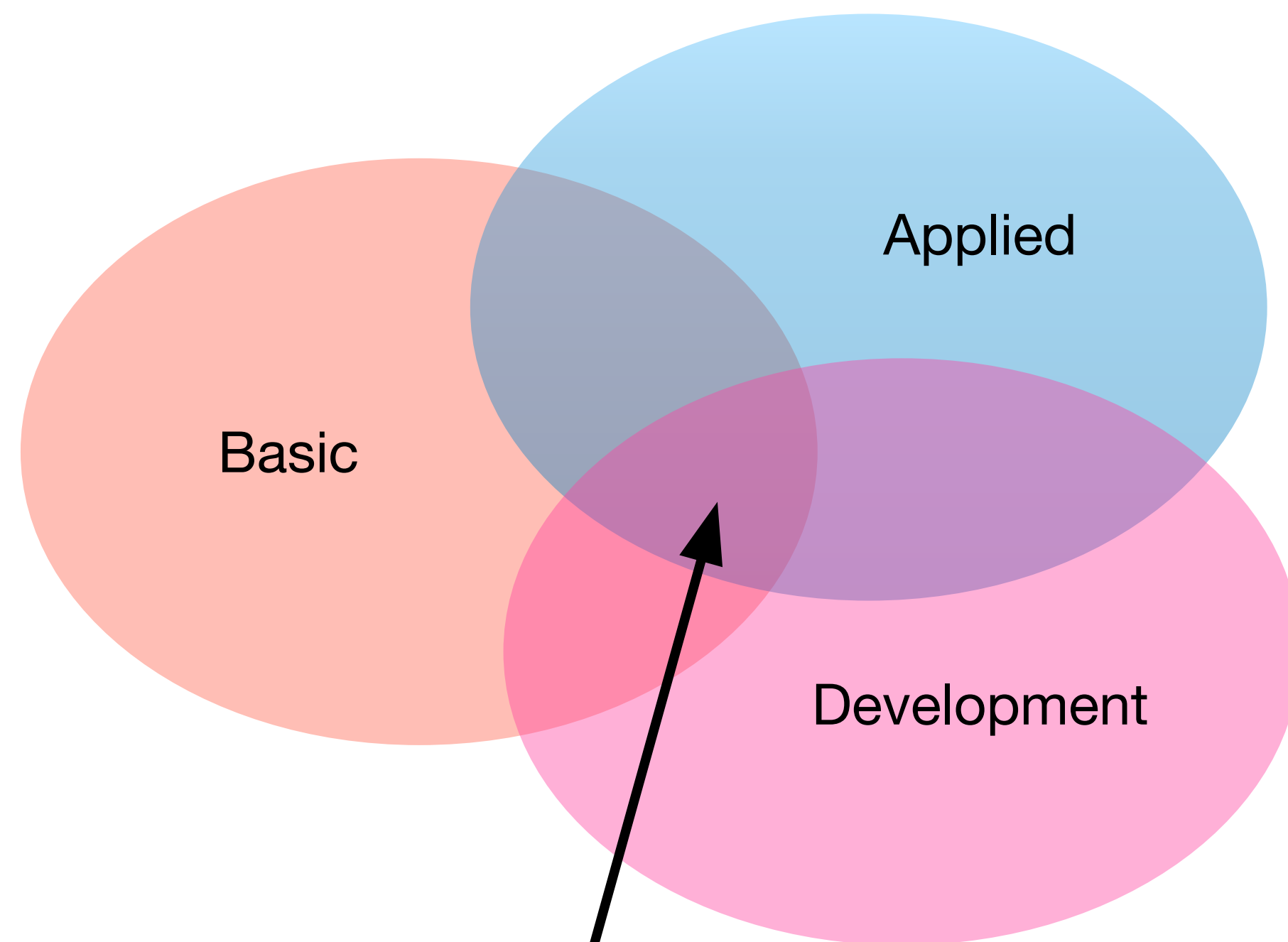
CGIAR (foundation support)

Potato (Federal Support through USDA SCA's - semi competitive funding)

Wheat and Soybean (inbred crops, commercialization through state/regional seed improvement associations, state and national boards)

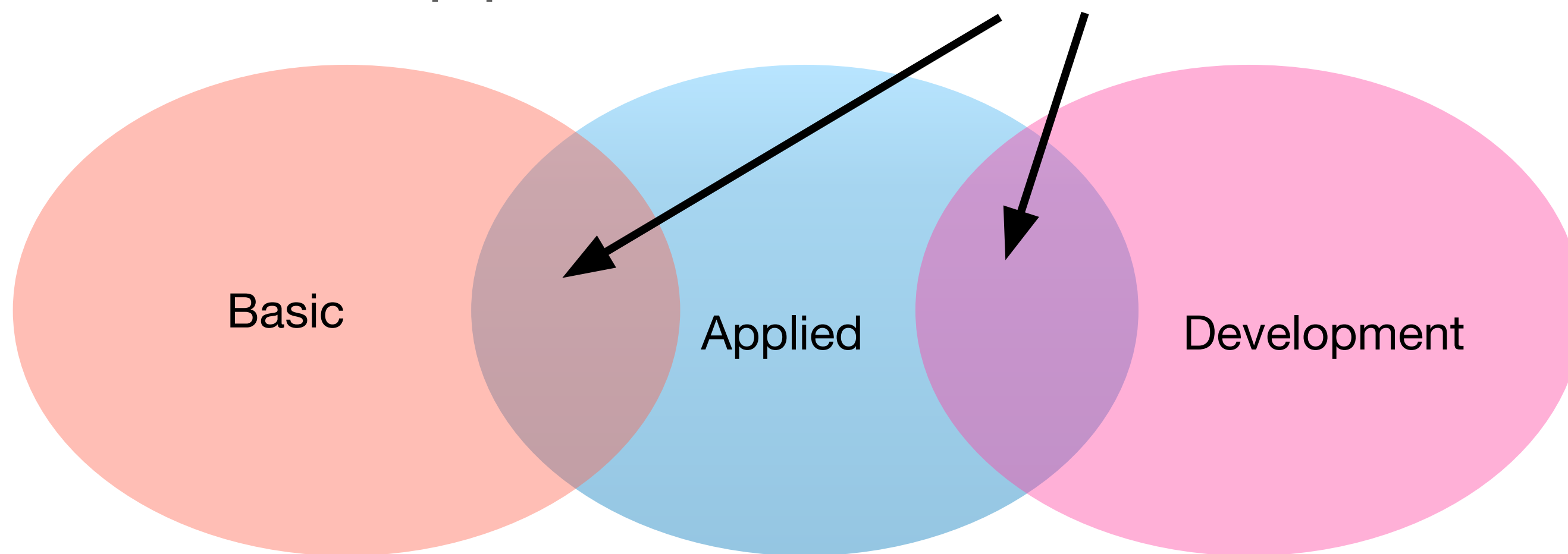


Do we need public plant breeding?



Discovery-to-deployment research pipeline

The public breeder works here, and maybe here





Now we can hear more diverse opinions



16th World Processing
Tomato Congress

AND

18th ISHS Symposium on
Processing Tomato

