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Beyond VFFNP

Breeding for "new" generation of California resistances

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“New” is a relative term

- Until 2000, commercial resistances focused on ‘VFF**N**P’
  - Verticillium race 1
  - Fusarium races 1 and 2
  - Root knot nematode (*Meloidogyne spp*)
  - Bacterial speck race 0 (in Europe, = race 1)
  - Heinz called this the “Basic Package” for California
    - Still wasn’t universal

- By 2000, “new” resistances began to emerge
  - Extended field storage (EFS)
    - H9665, H9775
  - Fusarium race 3
    - CXD215 in adaptive trials

- TSWV was barely on breeders’ radar for California

Options to control a disease

- Chemical Control
  - Often is better used as protective (proactive) control than curative
  - Some chemical control can be applied after infection (reactive)
  - May only be partial control – slow progress
  - Typically not effective on vascular and root diseases

- Crop Management
  - Field and equipment sanitation
  - Crop rotation
  - Can be implemented over 1 to 3 years
  - Most effective when started before a problem builds up

- Resistant Varieties
  - Most desirable - control is included in the seed cost
  - Long term effectiveness
    - until a new race develops
  - Can implement in 1 year IF a competitive, resistant variety is available
  - Longest development time if no varieties are available
  - Source of resistance may not be identified
  - Resistance may not be immunity

Disease control through breeding

- Breeding is a very long-term process
  - Inbred development – at least 6 years ~ perpetual
  - Hybrid development – 4 to 5 years of evaluation before commercialization

- Breeders rely on feedback from growers, factory managers, extension specialists and seed dealers to try to predict what the future will to look like.

- Breeders need to start long BEFORE there is a critical need

"If the Plant Breeder starts working on today's needs, he is starting ten years late. *Will today's problems be with us ten years from now?"* Jack Hanna

Allocating breeding resources

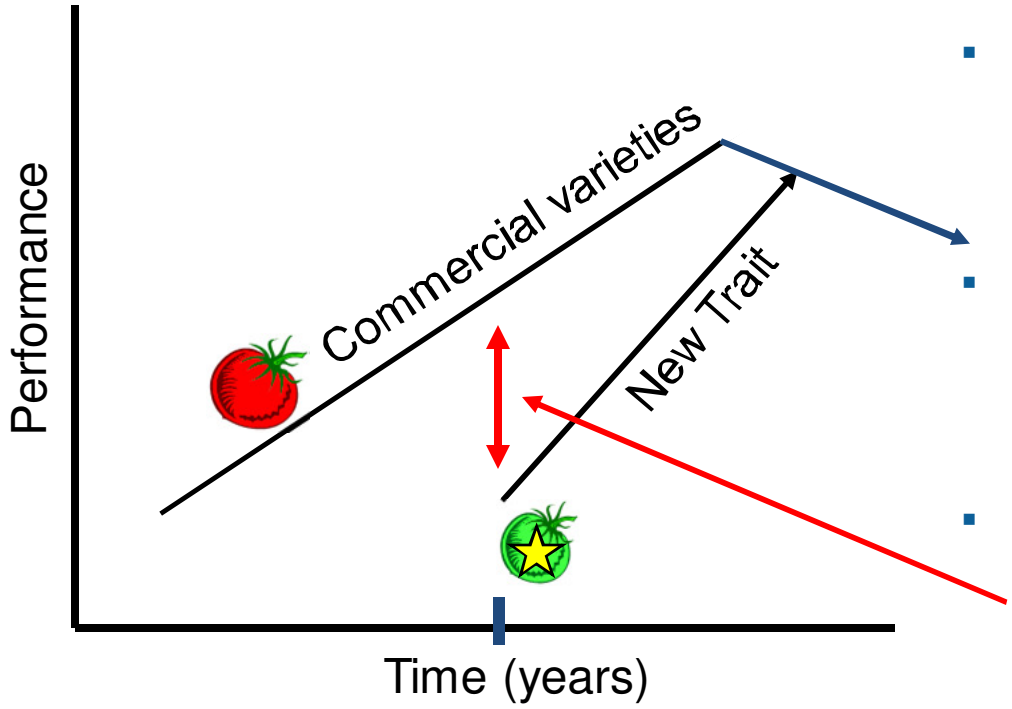
- *Accurate* definition of the problem
  - Fusarium race 3 vs FCR
  - Mi breaking strain or High temp breaking
  - Which powdery mildew?

- Extent of the problem
  - Production limiting?
- Grower demand
  - Compromises?
- Processor Demand

- Gene Availability
  - Identified?
  - Genetics
  - Does source “look like a tomato”?
- Reliable testing protocol

Fusarium race 3 – Los Banos

Bringing a new trait to market



- Performance:
  - Field yield, plant habit
  - Other needed resistances
  - Factory yield (Brix, viscosity)

- Breeders continue to make progress in the existing material without the new trait
  - Intercrossing “Good” x “Good” to get “Better”
- New trait incorporation invariably begins with “Good” x “Bad”
  - Result = “better but not good”
  - Crossing cycle repeats several times
- Lag time depends, in part, on the Performance Gap between source of gene and commercial varieties.
- When the new trait becomes a production limiting factor the dynamics change – Compromises must be made

TOMATO Heinz SEED

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"New" Resistances

- **Tomato Spotted Wilt Virus**
  - Heinz work started in 1996
    - Simple single gene
  - Industry dynamic changed in 2006
    - Major outbreak in Westside
    - Fruit are not usable for peeling
  - Varieties released in 2009 (H5608, H5508)
    - Lower NTSS was compromise by the industry
  - Industry has responded
    - 28 of 28 experimental varieties* contain SW
  - TSWV has quickly become part of the standard package for California

* As indicated in the 2016 AgSeeds Processing Tomato Variety Guide

"New" resistances

C.S.Stoddard, VCF Jan 2016

- **Fusarium race 3**
  - Heinz breeding work started in 1994
  - Has become a major breeding objective
  - Linkage drag – other genes around *I-3*
    - Major impact on yield & vine health
  - Poor performance of resistant varieties
    - Growers risked planting "tolerant" varieties instead of giving up yield

  - The production dynamic has changed in the past 3 years
    - Changes in industry cultural practices
    - Statewide concern
    - Not controllable by pesticides

Fusarium race 3 hybrids

- New material has fewer negative traits associated with fusarium 3 resistance
  - Yield, firmness, EFS
- 2014 Heinz Variety release
  - H1310
- 9 commercial resistant varieties*
- 11 of 28 experimental varieties* have resistance to fusarium race 3
  - H1422

* As indicated in the 2016 AgSeeds Processing Tomato Variety Guide

Other resistances coming on the market

- **Powdery mildew** (*L. taurica*)
  - 3 of 28 experimental varieties* with Lv resistance
- **Fusarium crown rot**
  - Resistance is distinct from fusarium race 3 resistance
  - 1 of 28 experimental varieties* with FCR resistance
- And not yet to the market
  - Beet curly top virus
  - Powdery mildew – *Oidium spp*.
  - Verticillium race 2
  - Bacterial speck race 1
  - Whitefly transmitted Geminiviruses (TYLCV)
  - Heat tolerant nematode resistance
  - Others?

* As indicated in the 2016 AgSeeds Processing Tomato Variety Guide

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Thanks

Any Questions?