Beyond VFFNP

Breeding for “new” generation of California resistances

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“New” is a relative term

- Until 2000, commercial resistances focused on ‘VFFNP’
  - 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 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

- 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

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

- **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
Thanks

Any Questions?