TRENDS IN COMMERCIAL TOMATO BREEDING

An inside look at what's influencing your seed selection.

Johnny's Selected Seeds

DISCLAIMERS

- I am not a plant breeder!
- I will primarily be discussing trends in modern, hybrid tomatoes bred for the professional grower.
- This is not a sales pitch. That version will be online 1/19 at 2:00PM.
- There are some things I can't talk about!
- Not all disease resistance is created equal.
- It's pretty much a lecture.
- This is my first time doing this talk.

INTRO: WHY WE SOURCE OUR SEEDS

- Retail dealers have limited capacity for breeding and production.
- Research-focused companies breed tomatoes that deliver on the fundamentals:
  - Yield
  - Marketability
  - Uniformity
  - Disease resistance (with caveats – more on that later)
  - Plant habit and vigor
- Allows everyone to focus on what they're good at.

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THE DOWNSIDES TO SOURCING

- Limited varieties available with adaptation to New England, other less economically important growing regions.
- Very limited control over product life cycle.
  - Not the right market/Low sales
  - Poor seed producer
  - Distribution arrangements
- It can be very expensive.

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WHY IS TOMATO SEED SO @#%*! EXPENSIVE?

- SUPPLY SIDE
  - Breeding costs
    - Crop maintenance, tedious labor, testing, travel, seed production, inventory risk, etc.
    - For every variety that makes it, there are thousands that don't.
  - Hybrid tomato seed production and yield
    - Labor intensive
    - Yield varies greatly, e.g. grape tomatoes
  - Nobody likes seedy tomatoes.
  - Virus testing/cost of failure (more later…)
  - GSPP (Good Seed and Plant Practices)
    - High-tech GH varieties
    - More info at: www.gspp.eu
  - Organic adds a lot to cost, not many doing it at scale.
  - Risk mitigation – It's still agriculture

- DEMAND SIDE
  - European market will bear a higher retail price for seed.
  - Indoor growing uses a lot less seed.

Breeding: It's a lot of work.

TOMATO SEED PRICE TRENDS

- Bad News:
  - 15 – 20% average increase in cost for sourced varieties over 2019
  - Labor costs rising.
  - Seed-borne diseases causing havoc.
    - APHIS: Six posiviroids of concern
    - ToBRFV testing often required for sale
    - Testing consumes expensive seed
    - Increased odds of 'crop failure'
    - Production locations in flux
- Good News:
  - Favorable exchange rates helping at the moment.
  - Tunnel tomato seed prices trending down (some, not all!)
    - LM resistance, other traits are no longer limited to high-tech Euro varieties.
    - GSPP not required outside of high-tech market.

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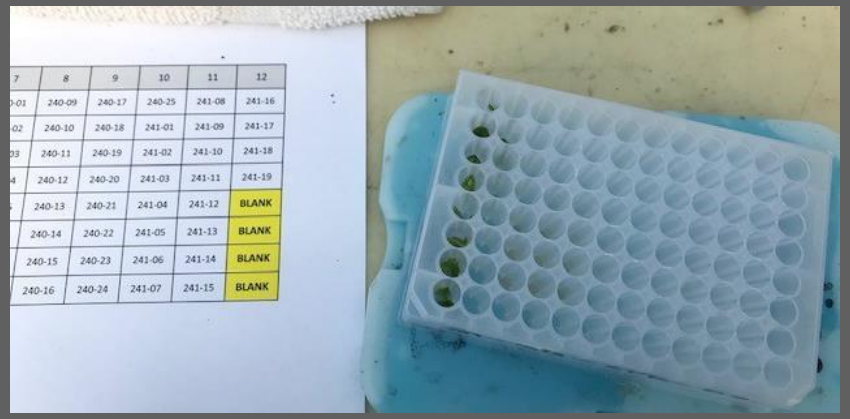
TREND: VARIETIES ARE FASTER TO MARKET

- Marker Assisted Selection
- Counter-seasonal breeding - Up to 3 generations per year.
- Driving forces:
  - Rapid development of disease issues.
  - Intense competition.



TREND: INDEPENDENT BREEDERS – CLOSING THE GAP ON THE BIG GUYS!

- Improved access to technology, lower cost also helping them.
- Less 'commercially-important' breeding targets, regions can be served.
- More creativity in the products.
- More agile, flexible, collaborative as business entities. Benefits to the seed dealer!

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DISEASE RESISTANCE TRENDS

- Warm-climate diseases DOMINATE the tomato breeding world.
  - TYLCV, TSWV, F3, N, others.
- Temperate-climate diseases are getting more attention.
  - Late Blight, Early Blight, Septoria, etc.
- Southern diseases moving slowly north
  - Stemphylium, TSWV, TYLCV
- Listing specific resistance genes is becoming more common.
  - Like downy mildew in spinach and lettuce.
  - Tomato Examples: Ph-3, sw-5, I-3, Mi-1, Tm-2
- Novel resistances may come with baggage.

Solanum pimipnellifolium: Source of many tomato resistances

LATE BLIGHT, *PHYTOPHTHORA INFESTANS* (PI, PH2, PH3, LBR)

- Common problem in Europe as well as the US.
- Found in many great tasting, high-performing varieties released in the past 10-12 years.
- Becoming more common in European home garden and US commercial varieties.
- Minor linkage drag, mostly overcome by now.
- Varying levels of resistance
  - Ph2
  - Ph3
  - Ph2+Ph3
- Currently holding up.

Credit: American Phyopathological Society

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SEPTORIA LEAF SPOT/*ALTERNARIA* (EARLY) BLIGHT

- Ubiquitous and potentially devastating in the temperate US.
- Resistance genes are very new to the breeding world.
- Very few resistant varieties available to date.
- More varieties on the way!
- Still doesn't seem to be a focus for many mainstream breeding companies.

Septortia symptoms (U. of Maryland Extension)

Early blight symptoms (University of Kentucky)

LEAF MOLD (*FULVIA FULVA, CLADOSPORIUM FULVUM, OR PASSALORA FULVA*)
AKA: FF, CF5, CF9, FF A-E, CF 1-5, PF, LMR

- Nearly ubiquitous in greenhouses everywhere, and unheated tunnel structures in humid climates.
- Resistance traditionally found only in high-tech, GSPP greenhouse tomatoe$.
- Temperate tunnel market is finally big enough that breeding companies care!
- Likely to be found in more and more commercial varieties in the near future, not just high-tech varieties.
- Resistance genes are readily available and present no significant challenges.

Photo Courtesy of MOFGA

POWDERY MILDEW (*OIDIUM NEOLYCOPERSICI, O. LYCOPERSICI.*)

- Two kinds: On (*Oidium* neolycopersicum, or US strain), and Ol (*Oidium* lycopersicum - what they get overseas).
- On Resistance does not come from a single gene!
- More difficult to breed for.
- Fewer sources available out there.
- More interest = more breeding to come.

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GREY LEAF SPOT, *STEMPHYLLIUM SPP.* (SBL/SL/SS, GLS)

- Becoming more talked-about in both field and tunnel.
- Creeping up from the South.
- Resembles Septoria and other ailments.
- Resistance is out there, somewhat scattered but it's found in some nice varieties.
- No known issues with resistance gene.

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OTHER TRENDS IN THE TOMATO WORLD

- Labor saving traits in demand
  - Determinates
  - Basket weave in tunnels
  - Truss harvest
  - 'Polite' plant habits
- Heat and drought tolerance
- 'Commercial' traits more desired by fresh-market growers
  - Firmness
  - Shelf life
  - Uniform ripening
- Fresh-market traits more desired by 'commercial' growers
  - FLAVOR
  - Heirloom looks
  - Vine-ripened
- Branding and licensing affecting variety access more.
- University breeding becoming increasingly privatized

THE END

GLOBALLY INFLUENTIAL DISEASES

TOMATO SPOTTED WILT VIRUS (TSWV)

- Spread by thrips, mostly a southern problem but can find its way into Northern high tunnels.
- Globally similar in scope and importance to TYLCV, but pathogen can survive farther north.
- Resistance very common in mass-market determinate tomatoes, but also found in a host of varieties you would actually want to eat.
- Breeding Issues
  - Difficult to combine with TYLCV resistance.


Photo: Utah State University

TOMATO YELLOW LEAF CURL VIRUS (TYLCV)

- Extremely common and damaging in many of the major tomato production regions worldwide. Whiteflies can't survive frost!
- Becoming almost ubiquitous in many international breeding programs across many markets and tomato types.
- In the US, TY varieties are bred mostly for the Fall planting slot in Florida and Southern Georgia.
- Genes (there are 6 of them) were sketchy, but it's getting better.
  - Old varieties – White-wall, limited truss setting in roma, rough shoulders.
  - New varieties – Major issues overcome, but TY tomatoes are not always bred for their flavor.

FUSARIUM (F, F2, F3 – AKA F0, F1, F2)

Florida has soil-borne disease issues. I wonder why? (Tomato field in Immokalee, FL).

- F3 becoming a big problem in warm climates.
- F, F2 resistance has been around a while.
- F3 gene becoming more common, particularly in mass-market tomatoes.
  - Issues – F3 resistance can convey high susceptibility to Bacterial wilt (*Ralstonia-* or *Pseudomonas soalneraceum*) – Big Bummer for the South.
- **Notice that you will rarely see a tomato that has TYLCV, TSWV, and F3.**

TOMATO BROWN RUGOSE FRUIT VIROID (TOBRFV)

- Catastrophic to GH production.
- Seed-borne.
- Testing now required by many governments and growers.
- Resistant varieties just beginning to hit the market.
- Top priority for international tomato breeding companies

TREND: FLAVOR FINALLY MATTERS!

- Small-fruited specialties

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DISEASE RESISTANCE TRENDS: DEFINITIONS, OTHER NOTES

- Long-term breeding projects
  - Wild-type tomatoes
  - Why University breeding programs are so important!

Solanum pimipnellifolium: Source of many tomato resistances

Credit: Scott Peacock and the C.M. Rick Tomato Genetics Resource Center