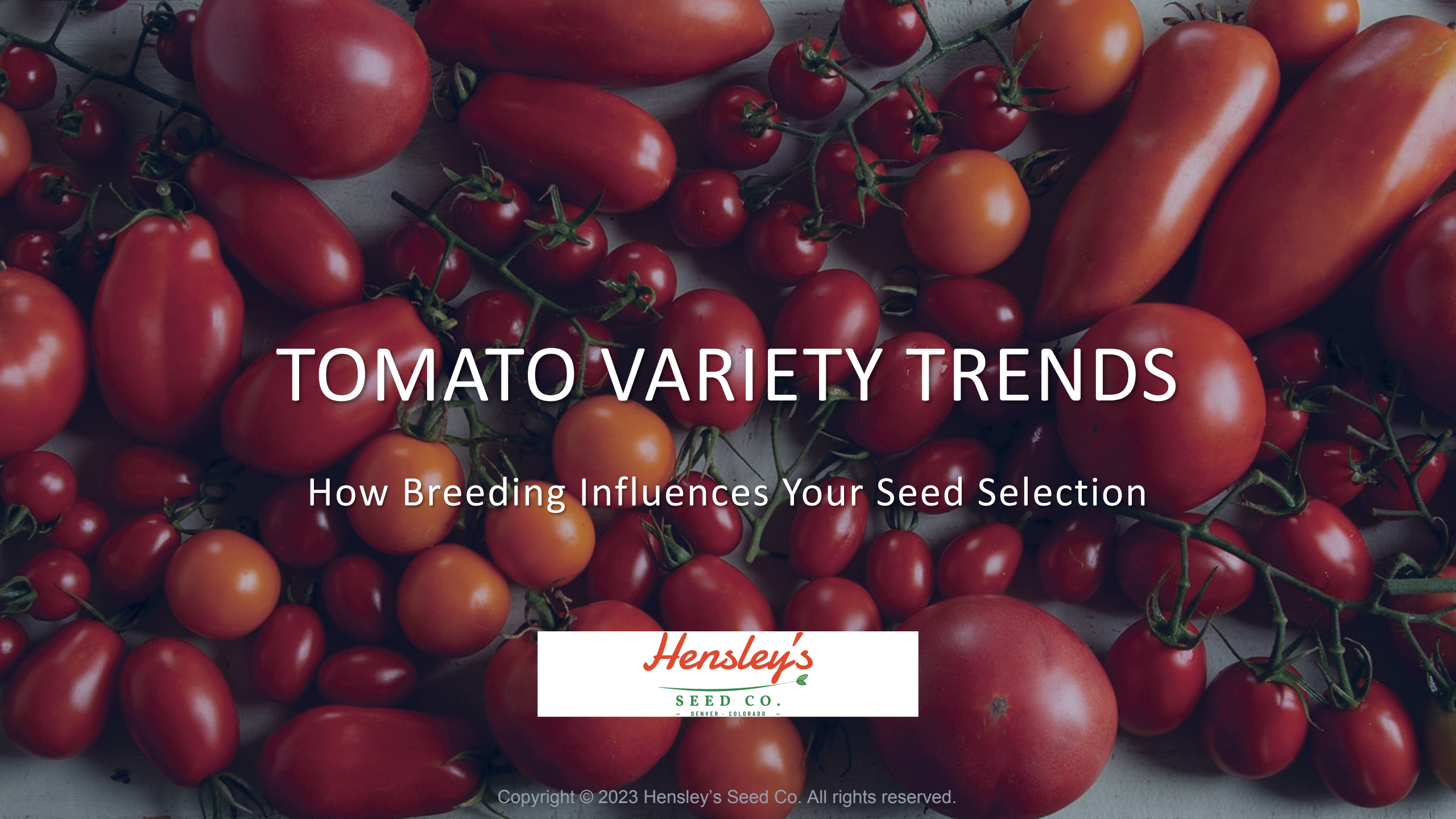


TOMATO VARIETY TRENDS

How Breeding Influences Your Seed Selection

Hensley's SEED CO. – DENVER · COLORADO –

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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.





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.**





WHY IS SOME 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 & yield**
  - Labor intensive
  - Seed yield varies greatly, e.g. grape tomatoes.
- **Virus testing/cost of failure** (***more later…***)
- **GSPP** (Good Seed and Plant Practices)
  - High-tech GH varieties
  - More info at: www.gspp.eu
- **Risk mitigation** – *It's still agriculture*



Breeding: It's a lot of work.





WHY IS SOME TOMATO SEED SO EXPENSIVE?

DEMAND SIDE

- **European market** will bear a higher retail price for seed.
- **Indoor growing** uses a lot less seed.
- **Nobody likes seedy tomatoes.**
- **Organic adds a lot to cost,** not many doing it at scale.





TOMATO SEED PRICE TRENDS

THE BAD NEWS

- **Virtually all seed** just got much more expensive.
- **Labor costs rising**.
- **Seed-borne tomato 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

THE 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.

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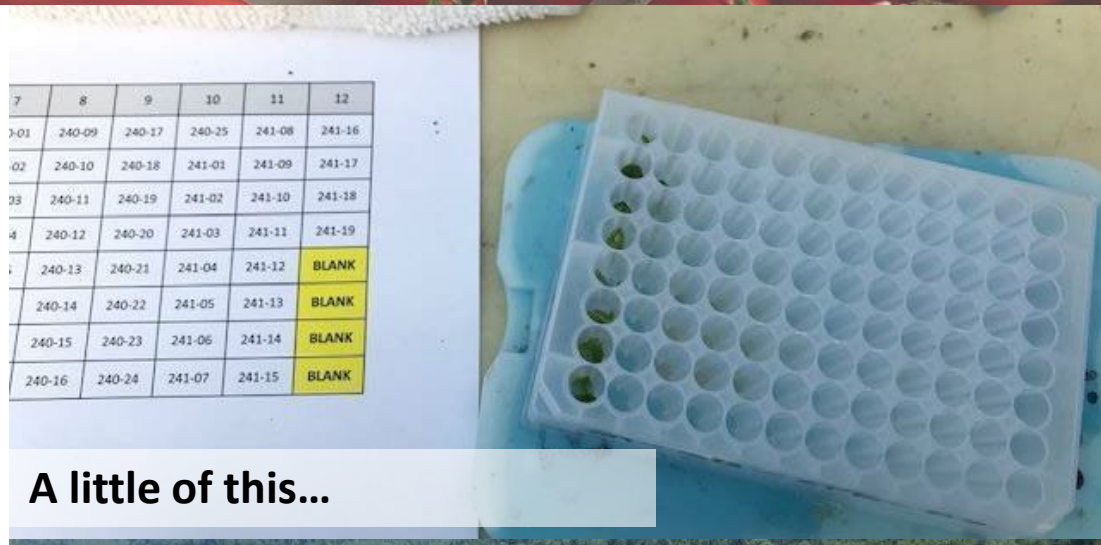


TREND: VARIETIES ARE FASTER TO MARKET

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



Taking samples for marker testing at the original source



A little of this…



…Can replace a lot of this!

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TREND: INDEPENDENT BREEDERS ARE GAINING GROUND!

- **Improved access to technology, lower cost**
- **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!**





Pictured (*l-r*): Jason Cavatorta of Earthwork Seeds; Fred Hempel of Artisan Seeds

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INDIE TOMATO VARIETIES

- **Hot Streak** (Mark McCaslin)
- **Green Bee** (Fred Hempel)
- **Damsel** (Earthwork Seeds)
- **Pink Berkeley Tie Dye** (Wild Boar Farms)
- **Cipolla's Pride** (Larry Cipolla)
- **Indigo Kumquat** (Peter Mes)

□Cherry Bomb (the original source)


Indigo Kumquat


Hot Streak


Cipolla's Pride


Green Bee

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TREND: TUNNELS AND GRAFTING

- **Tunnel culture:**
  - More control over environment
  - Maximized productivity
  - Higher profit
- **Grafting:**
  - For limited rotations/disease resistance
  - For longer-season growing
  - For higher yields
  - For more manageable plants, fruit quality



A typical high tunnel



Grafted tomato plug

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WHERE DOES DISEASE RESISTANCE COME FROM?

- **Fundamental sources:**
  - ‘Wild-type’ tomatoes.
  - Field selection of breeding material.
  - University breeding programs
- **Existing commercial varieties**
  - Could be older public domain genetics.
  - May be patented.
  - Patents becoming more common in tomatoes.
  - When in doubt, ask permission first.
- **Breeding work needed to develop the other traits you desire.**
  - Crossing and selecting.
  - A whole other lecture, and one I’m not qualified to give!



Solanum habrochaites



Solanum pimipnellifolium

Top photo: Courtesy of Sandy Knapp
Bottom photo: Courtesy of Scott Peacock and the C.M. Rick Tomato Genetics Resource Center

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THOUGHTS ON ‘LINKAGE DRAG’

- **What is linkage drag?**
- **When drag is a problem, there are two breeding strategies:**
    1. Introduce a variety with compromises to get that resistance out there (Defiant).
    2. Keep working until you get everything you want (Abigail).
- **What does this mean for you?**
    - Sometimes, varieties with new resistance genes have issues.
    - You may have to wait a few years to get what you want.



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DISEASE RESISTANCE CODES: THEY'RE NOT ALL THE SAME!

Disease	Phonetic Abbreviation (the original source)	International Abbreviation (Latin name-based)
Alternaria Stem Canker	AS	Aal
Leaf Mold	LM	Ff, Pf, or Cf, A-E
Fusarium Crown Rot	FCR	For
Powdery Mildew	PM	Lt, On
Late Blight	LB	Pi, Ph2, Ph3
Corky Root Rot	CRR	Pl
Grey Leaf Spot	GLS	Sbl/Sl/Ss
Nematodes	N	Ma/Mi/Mj
Verticillium	V	Va/Vd

You can find a complete list of tomato disease codes on the International Seed Foundation (IFS) website:
https://worldseed.org/document/recommended-codes-for-pest-organisms-in-vegetable-crops-january-2022/

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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.**



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DISEASE RESISTANCE TRENDS

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.





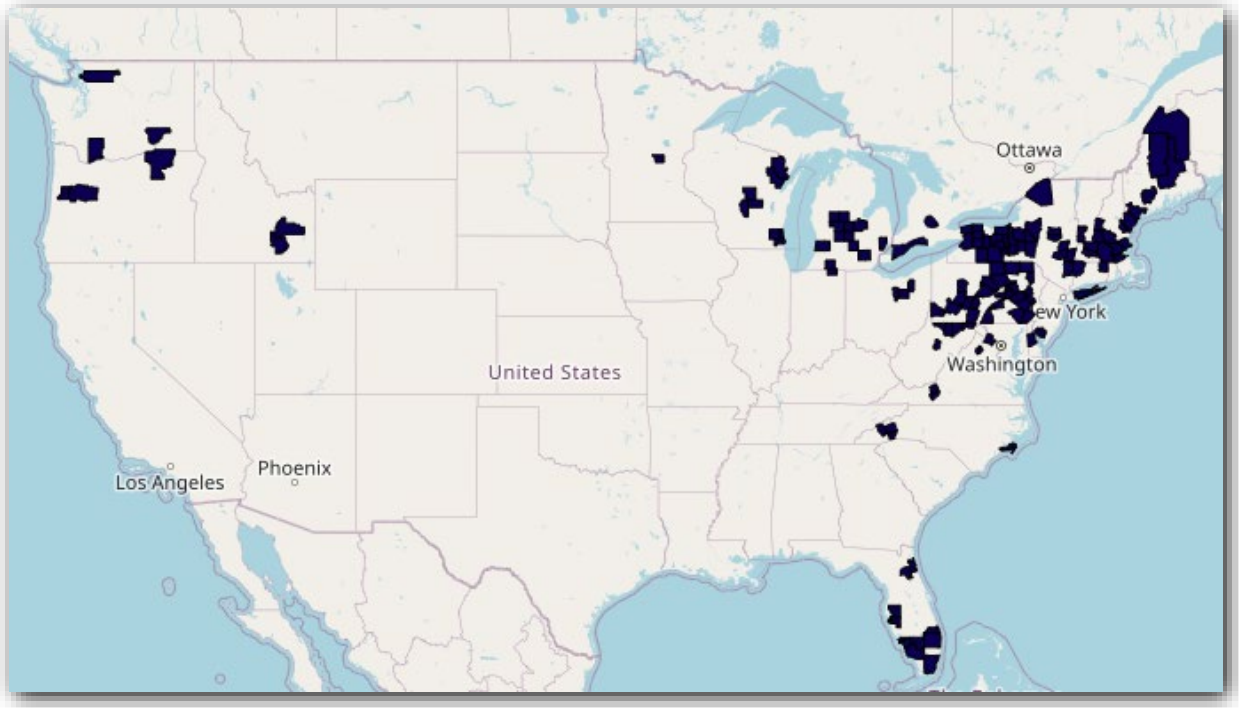
Bottom photo: American Phytopathological Society

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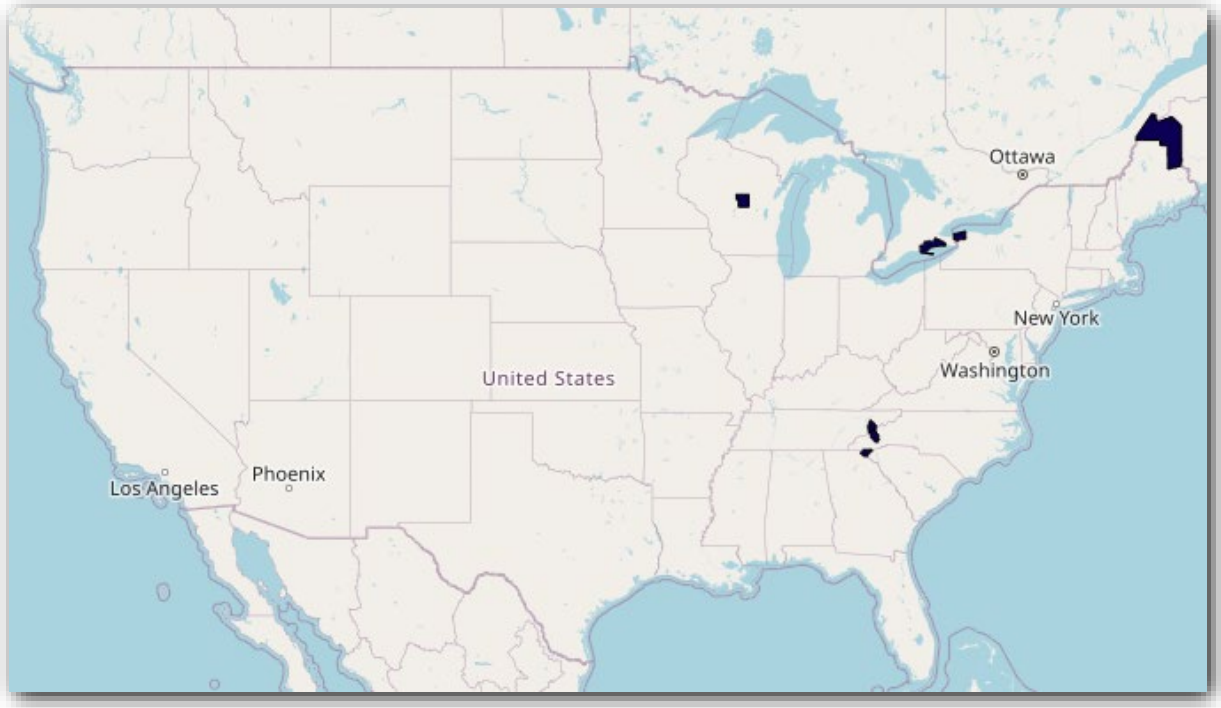


LATE BLIGHT DISTRIBUTION

- **2014 Late Blight Map**



- **2021 Late Blight Map**



Maps courtesy of North Carolina State University Extension. Find them at usablight.org

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LATE BLIGHT RESISTANT VARIETIES

Large-Fruited Indeterminate:

- Hot Streak
- Abigail
- Damsel

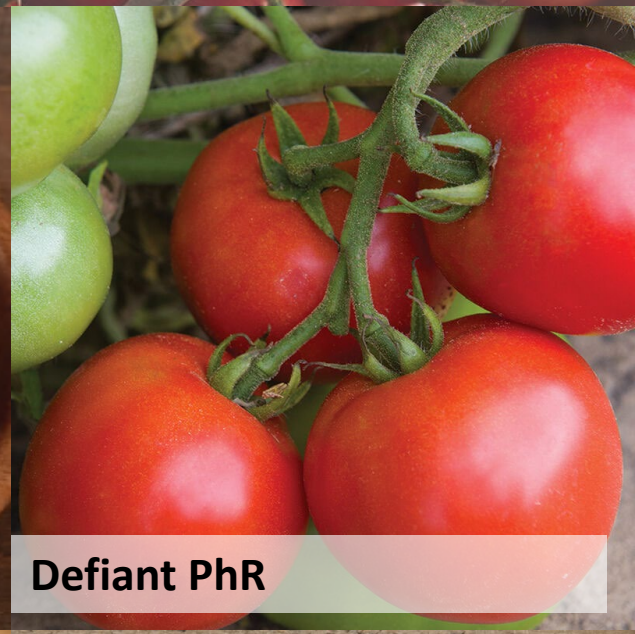
Large-Fruited Determinate:

- Galahad
- Defiant PhR
- Plum Regal
- Mountain Merit

Small-Fruited Indeterminate:

- Cherry Bomb
- Apple Yellow
- Red Pearl
- Jasper
- Mountain Magic


Abigail


Defiant PhR


Apple Yellow


Cherry Bomb

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DISEASE RESISTANCE TRENDS

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.





Top Photo: *Septortia* symptoms (U. of Maryland Extension)

Bottom photo: *Septortia* symptoms (U. of Maryland Extension)

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DISEASE RESISTANCE TRENDS

Leaf Mold (*Fulvia fulva, Cladosporium fulva, or Passalora fulva*)

AKA: Ff, Cf5, Cf9, Ff A-E, Cf 1-5, Pf, LMR (!)

- Nearly ubiquitous in greenhouses everywhere, and unheated structures in humid climates.
- Resistance traditionally found only in expensive, high-tech greenhouse tomatoes.
- 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

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LEAF MOLD RESISTANT VARIETIES

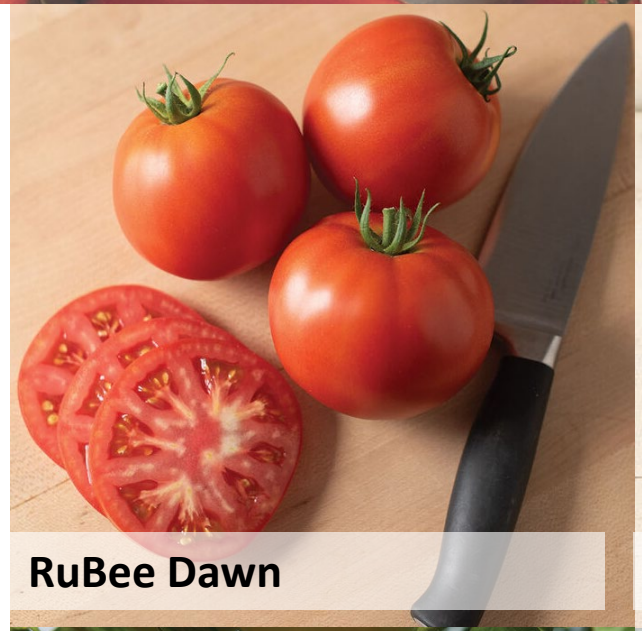
(All Indeterminate!)

Large-Fruited:

- RuBee Dawn
- Hot Streak
- GinFiz
- Marnouar
- Geronimo
- Enroza
- Margold
- Beorange
- Rebelski
- Marvori
- Tomimaru Muchoo
- Bigdena

Small-Fruited:

- Sakura
- Amai
- Favorita
- Edox
- Sunpeach



RuBee Dawn



Marnouar



Beorange



Sakura

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DISEASE RESISTANCE TRENDS

Powdery Mildew (*Oidium neolycopersici, O. lycopersici*.)

- There are two kinds:
    1. On (*Oidium neolycopersicum*, or US strain)
    2. Ol (*Oidium lycopersicum* – occurring overseas/outside US).
- 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.
- Only a few varieties available:
    - Geronimo
    - Granadero
    - Rebelski



Photo: Courtesy of Cornell University

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DISEASE RESISTANCE TRENDS

Grey Leaf Spot, *Stemphyllium spp.*
(Sbl/Sl/Ss, Sm, GLS)

- Becoming more talked-about in both field and tunnel.
- More common in the South, but that's changing.
- Resembles Septoria and Bacterial spot.
- Resistance is out there, somewhat scattered but it's found in some nice varieties.
- No known issues with resistance gene.
- For more information on Stemphylium: https://portal.ct.gov/-/media/CAES/DOCUMENTS/Publications/Fact_Sheets/Plant_Pathology_and_Ecology/2019/Stemphylium-Gray-Leaf-Spot-of-Tomato.pdf



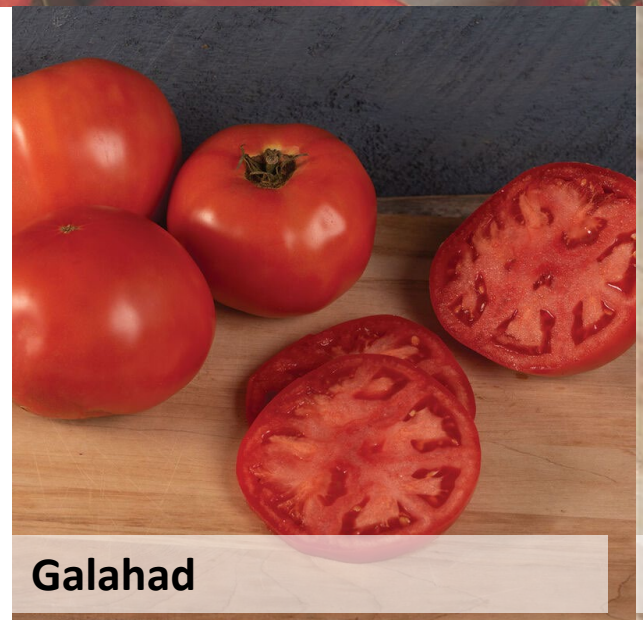
Photo: Courtesy of Cornell University

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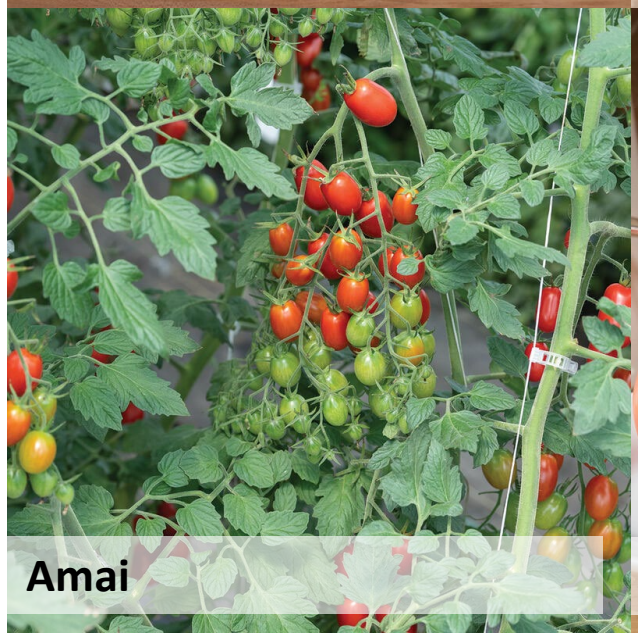


GREY LEAF SPOT RESISTANT VARIETIES

- Hot Streak
- Galahad
- Enroza
- RuBee Dawn
- Big Beef Plus
- Celebrity Plus
- Lemon Boy Plus
- Amai


Galahad


Lemon Boy Plus


Amai


Big Beef Plus

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FRUIT QUALITY AND THE ‘HYLOOM’ REVOLUTION

- ‘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


Rebelski


Marnero


Kakao


Margold

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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**


Basket-Woven Determinates


BHN 589


Estiva


Edox

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Q&A
SESSION



HOW TO FILTER TOMATOES BY DISEASE RESISTANCE

First, visit our selection of tomatoes at hensleyseeds.com

Next, Looking to the lefthand portion of the screen (*see figure 1*), scroll down past the tomato types until you see our filter Options.

Click “DISEASE RESISTANCE” to expand the list and check the boxes of the diseases (*see figure 2*) that you need tomato variety solutions for.

It’s as simple as that!

Figure 1

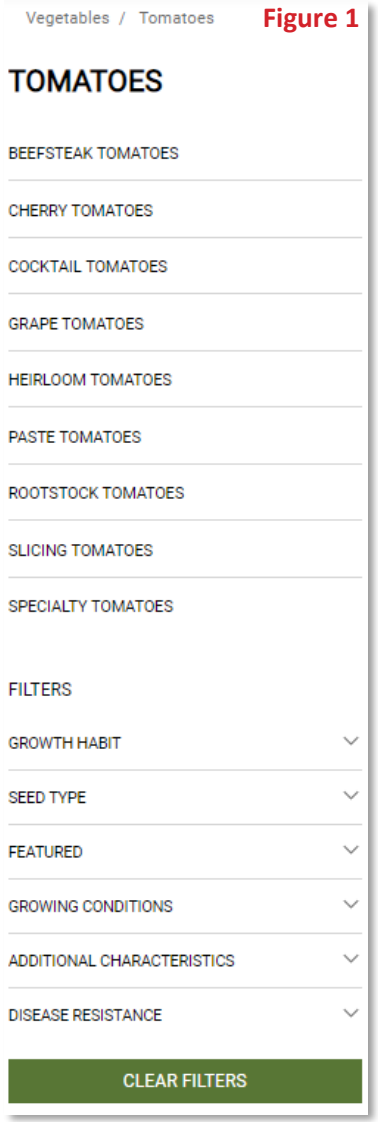
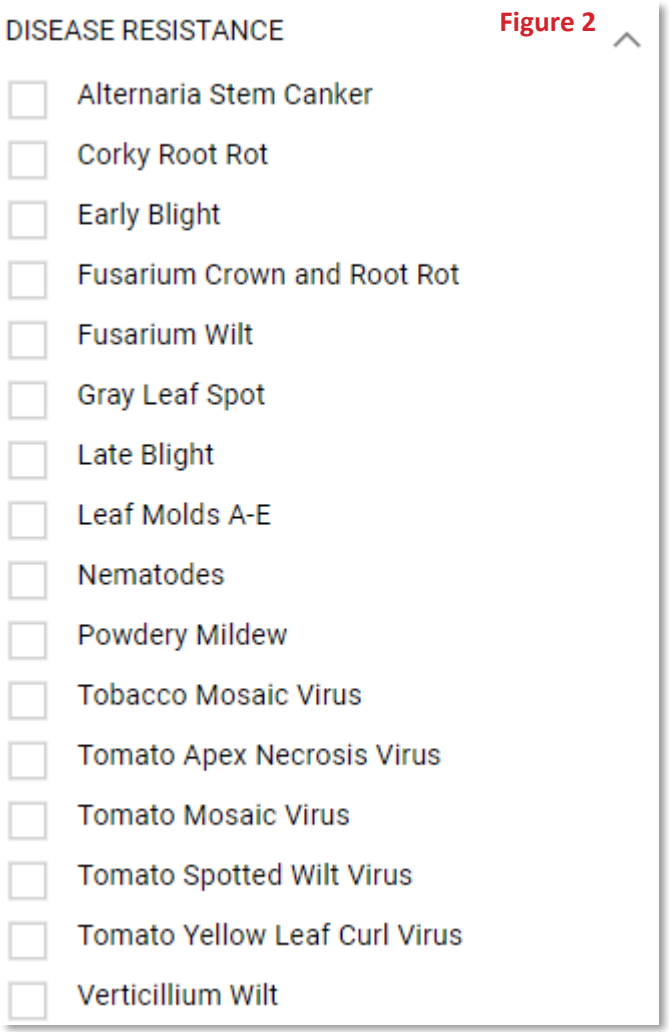


Figure 2



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RESOURCES

SHARED DURING THE EVENT

GSPP (Good Seed and Plant Practices

IFS List of Tomato Disease Codes

Late Blight USA Maps

Further Information on Stemphylium

hensleyseeds.com

Fundamentals of Tomato Grafting webinar

Heat Tolerant Tomatoes Filtered Search

Browse the current seed catalog

Browse the current seed catalog

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