



TOMATO VARIETY TRENDS

How Breeding Influences Your Seed Selection





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.



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.

7	8	9	10	11	12
201	240-09	240-17	240-25	241-08	241-16
02	240-10	240-18	241-01	241-09	241-17
03	240-11	240-19	241-02	241-10	241-18
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	240-15	240-23	241-06	241-14	BLANK
	240-16	240-24	241-07	241-15	BLANK



A little of this...



Ben and Kelsey taking samples for marker testing at Johnny's



...Can replace a lot of this!



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



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** (Johnny's)



Indigo Kumquat



Hot Streak



Cipolla's Pride



Green Bee

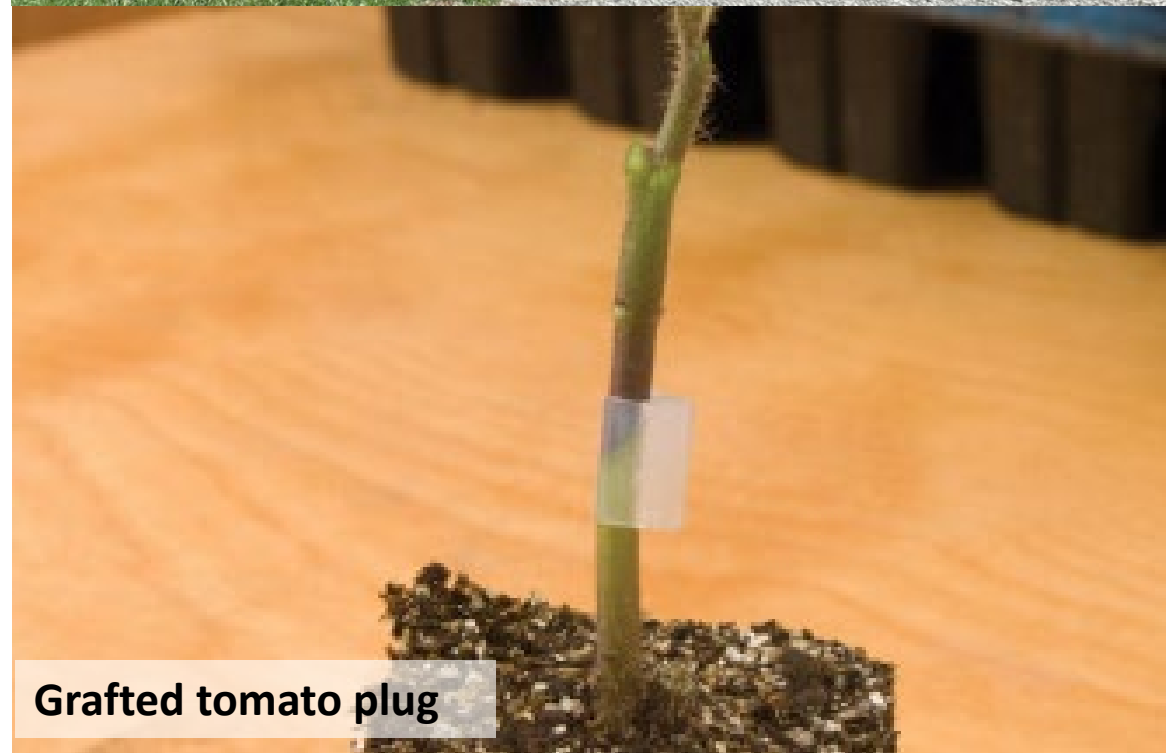


TREND: TUNNELS AND GRAFTING

- **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



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!

Top photo: Courtesy of Sandy Knapp

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



Solanum habrochaites



Solanum pimpinellifolium



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.

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

Disease	Phonetic Abbreviation (Johnny's)	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	PI
Grey Leaf Spot	GLS	Sbl/SI/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/>



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.**



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.

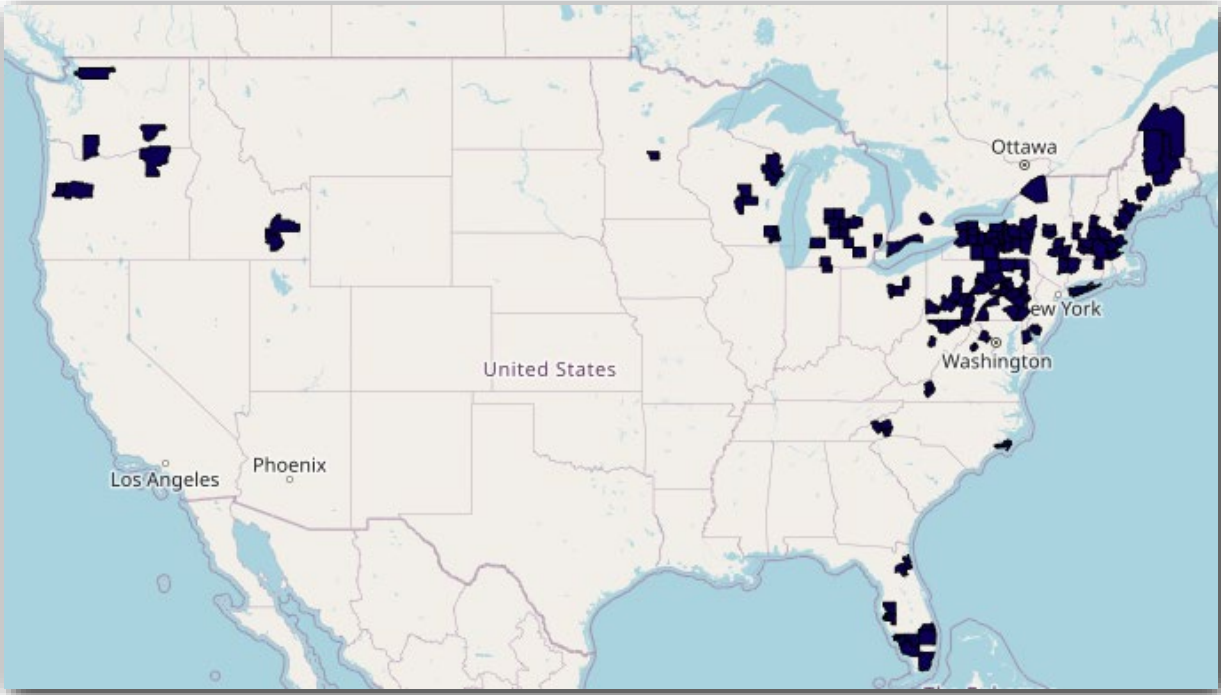


Bottom photo: American Phytopathological Society

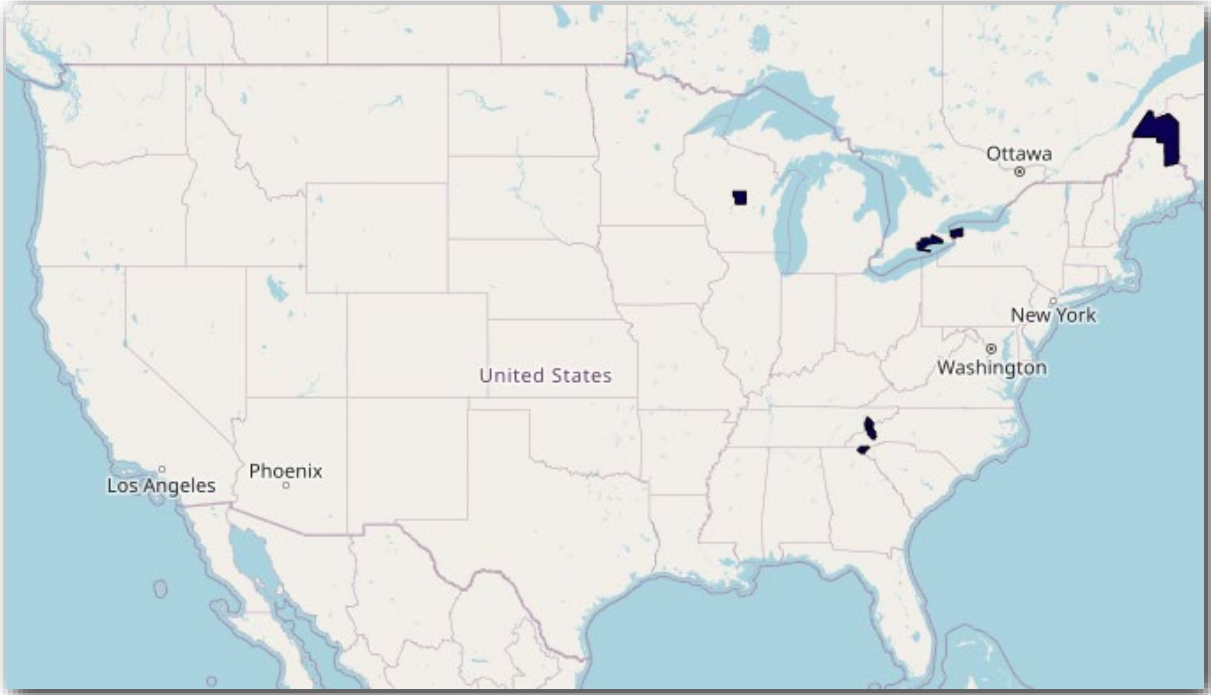


LATE BLIGHT DISTRIBUTION

▪ 2014 Late Blight Map



▪ 2021 Late Blight Map



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

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



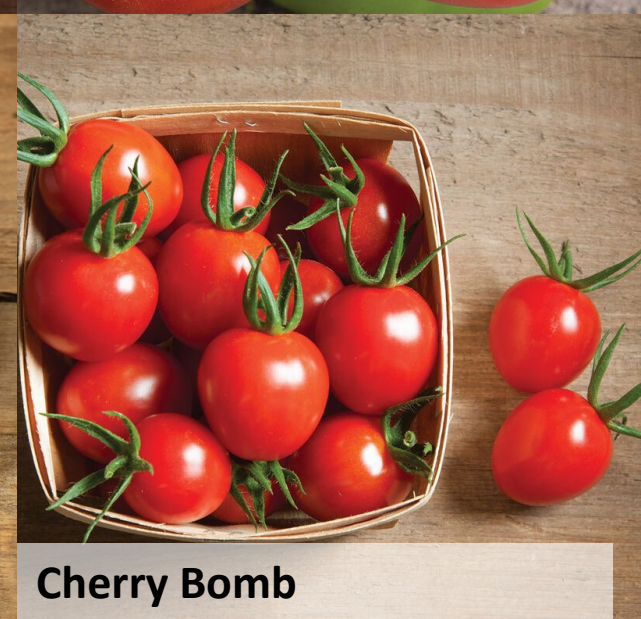
Abigail



Defiant PhR



Apple Yellow



Cherry Bomb



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)



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

LEAF MOLD RESISTANT VARIETIES

(All Indeterminate!)

Large-Fruited:

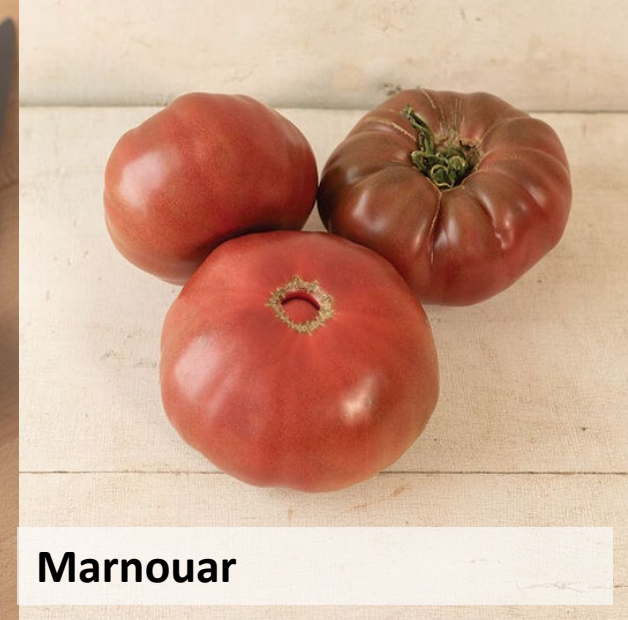
- RuBee Dawn
- Hot Streak
- GinFiz
- Marnouar
- Geronimo
- Enroza
- Margold
- Beorange
- Rebelski
- Marvori
- Tomimaru Muchoo
- Bigdena

Small-Fruited:

- Sakura
- Amai
- Favorita
- Edox
- Sunpeach



RuBee Dawn



Marnouar



Beorange



Sakura



DISEASE RESISTANCE TRENDS

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

- There are two kinds:
 1. **On** (*Oidium neolycopersicum*, or US strain)
 2. **OI** (*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



DISEASE RESISTANCE TRENDS

Grey Leaf Spot, *Stemphyllium spp.* (Sb1/S1/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

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

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

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



Edox



BHN 589



Estiva



Q&A
SESSION



HOW TO FILTER TOMATOES BY DISEASE RESISTANCE

First, visit our selection of tomatoes at Johnnyseeds.com/vegetables/tomatoes

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!

Vegetables / Tomatoes **Figure 1**

TOMATOES

- BEEFSTEAK TOMATOES
- CHERRY TOMATOES
- COCKTAIL TOMATOES
- GRAPE TOMATOES
- HEIRLOOM TOMATOES
- PASTE TOMATOES
- ROOTSTOCK TOMATOES
- SLICING TOMATOES
- SPECIALTY TOMATOES

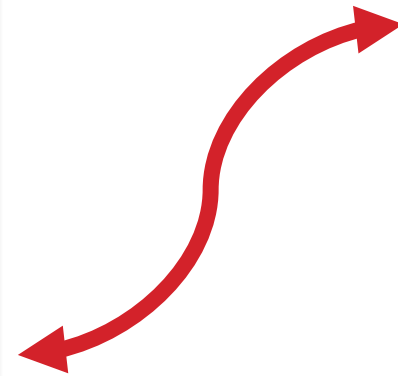
FILTERS

- GROWTH HABIT
- SEED TYPE
- FEATURED
- GROWING CONDITIONS
- ADDITIONAL CHARACTERISTICS
- DISEASE RESISTANCE

CLEAR FILTERS

DISEASE RESISTANCE **Figure 2**

- Alternaria Stem Canker
- Corky Root Rot
- Early Blight
- Fusarium Crown and Root Rot
- Fusarium Wilt
- Gray Leaf Spot
- Late Blight
- Leaf Molds A-E
- Nematodes
- Powdery Mildew
- Tobacco Mosaic Virus
- Tomato Apex Necrosis Virus
- Tomato Mosaic Virus
- Tomato Spotted Wilt Virus
- Tomato Yellow Leaf Curl Virus
- Verticillium Wilt



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](#)

[Johnnyseeds.com/growers-library/vegetable-library/tomatoes](https://johnnyseeds.com/growers-library/vegetable-library/tomatoes)

[Fundamentals of Tomato Grafting webinar](#)

[Heat Tolerant Tomatoes Filtered Search](#)

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