Judy Rosovsky
VAAFM
State Plant Regulatory Official
State Entomologist

163 Admin Dr.
Randolph Center VT 05061

802-279-2212
judy.rosovsky@Vermont.gov

Tomato Brown Rugose Fruit Virus

AKA ToBRFV or TBRFV

What is it?

New plant virus

Similar to tomato and tobacco mosaic viruses (tobamo)

Overcomes genetically resistant plants

Stable and infectious virus plant pathogen

Where is it found?

2014 Israel

2015 Jordan

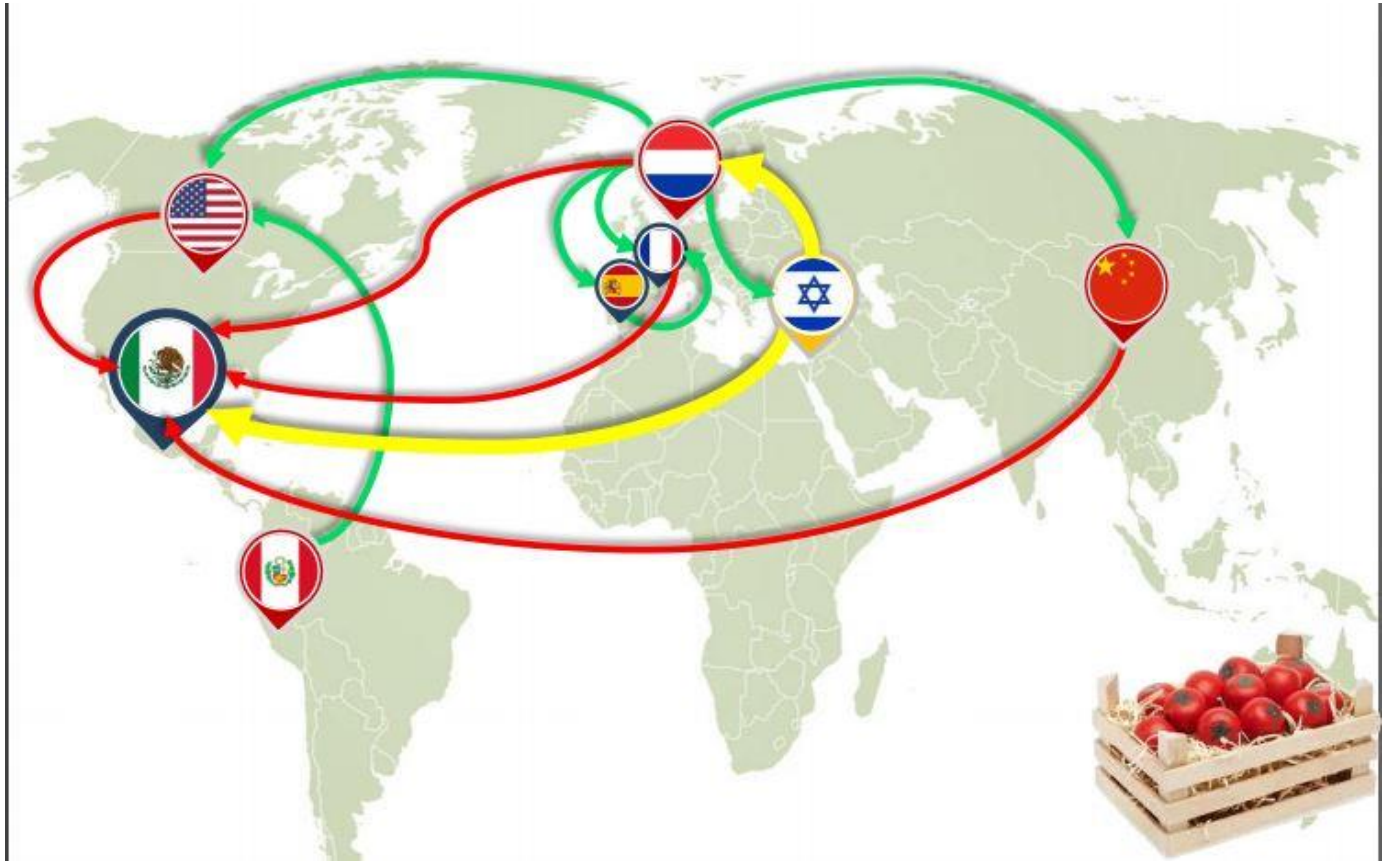
2018 Mexico, Italy

2018 California, Germany – eradicated (not established)

Greece, Netherlands, Turkey, England, China, Spain 2019 and NJ

Global routes

http://www.cesaveson.com/files/docs/eventos/Seminario%20Tomato/AntecedentesTomato.pdf



What are the hosts?

- TOMATO – *Solanum lycopersicum*
- PEPPERS - *Capsicum annuum* – Mexican infestation only

Experimentally induced hosts:

- Petunias – *Petunia* spp
- Black nightshade – *Solanum nigrum*
- *Chenopodium* spp, *Chenopodiastrum* spp (goosefoots)
- *Nicotiana* spp

From 1) CDFA https://blogs.cdfa.ca.gov/Section3162/?p=5843
2) https://www.fdacs.gov/content/download/83755/file/pest-alert-tomato-brown-rugose-fruit-virus.pdf
3) https://ahdb.org.uk/knowledge-library/tomato-brown-rugose-fruit-virus

Photo by: Dr. Aviv Dombrovsky

Photo by: Diana Godínez (MX)

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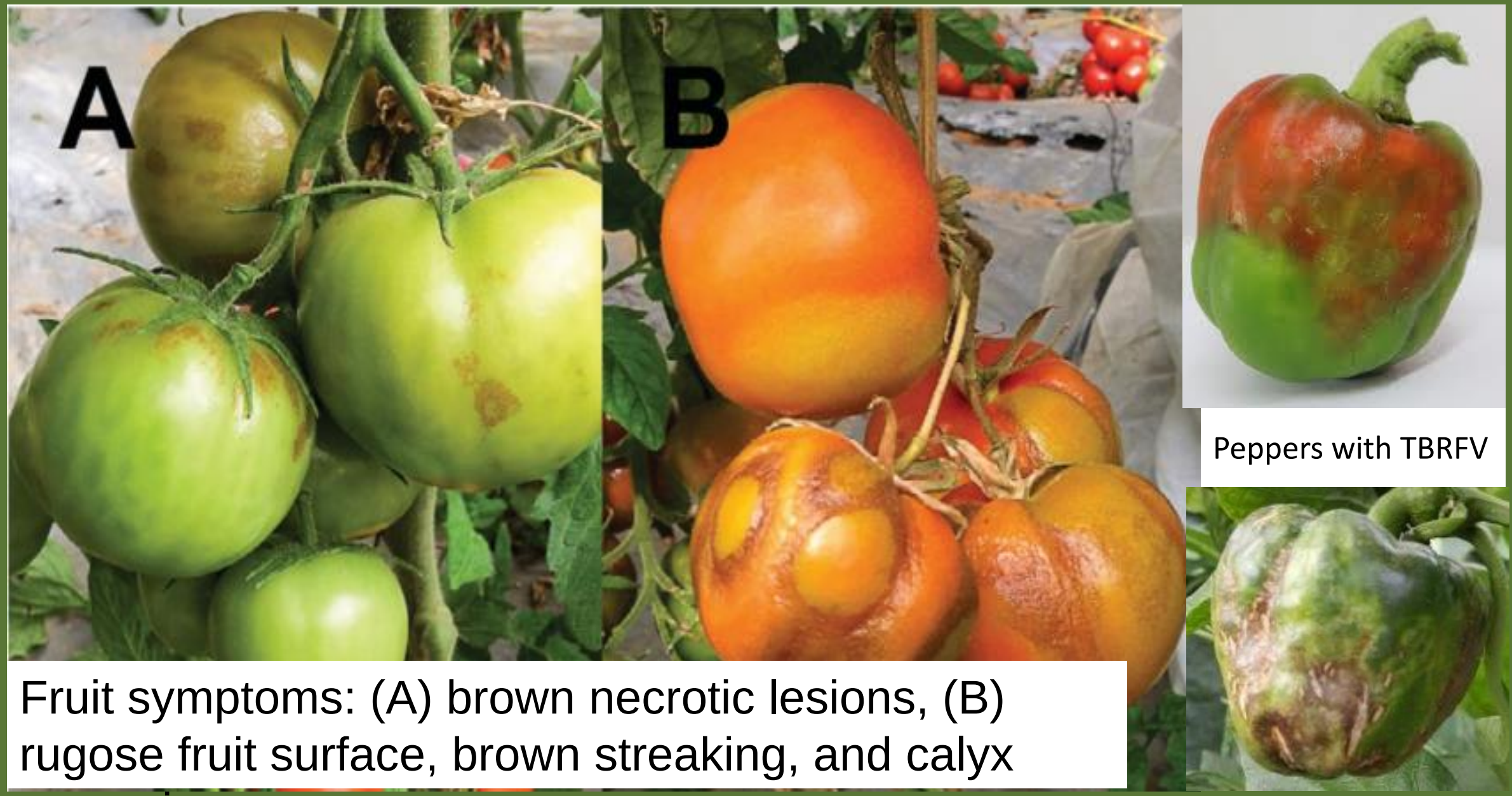
Symptoms

On tomato, foliar symptoms include chlorosis, mosaic and mottling with occasional leaf narrowing. Necrotic spots may appear on peduncles, calyces and petioles. Fruit show yellow or brown spots, with rugose symptoms rendering the fruits non-marketable. Fruits may be deformed and have irregular maturation.



Peppers with TBRFV

Fruit symptoms: (A) brown necrotic lesions, (B) rugose fruit surface, brown streaking, and calyx necrosis.

https://seminis-us.com/resources/agronomic-spotlights/tomato-brown-rugose-fruit-virus/

Symptoms of tomato brown rugose fruit virus (ToBRFV) on infected tomato (*Solanum lycopersicum*) plants. **a, d**: Brown wrinkled (rugose) patches developed on fruits. **b, c**: Chlorotic spots on fruits. **a, e–g**: Mosaic pattern (chlorotic/pale patches) developed on leaves, often on younger leaves in the head and side shoots; and narrowing accompanied by mottling leaves. **g:** Brown necrotic symptoms on pedicle (stem), calyces, and petioles.

Pictures reproduced by kind permission of EPPO; Dr Aviv Dombrovsky and Elisheva Smith, (source Dombrovsky and Smith, 2017, Seed Transmission of Tobamoviruses: Aspects of Global Disease Distribution, from Seed Biology Ed. Jose C. Jimenez-Lopez); and Dr Wulf Menzel (as published in Menzel et al. (2019). New Disease Reports 39, 1)

More symptoms

Mosaic formation on the younger leaves which may also be crumpled, puckered or deformed. Leaves may also be narrowed.

Chlorotic (yellow) spotting and marbling of fruit can appear to be similar to infection with PepMV.

Leaf symptoms

Figure 2: Mosaic symptoms in the young leaves of ToBRFV and PepMV-affected tomato plants (NPPO of the Netherlands, 20191007)

Figure 3: Narrowing of young leaves, typical symptoms of several tobamoviruses in tomato plants. (NPPO of the Netherlands, 20191007)

https://english.nvwa.nl/topics/pest-reporting/documents/plant/plant-health/pest-reporting/documents/official-confirmation-of-tomato-brown-rugose-fruit-virus-tobrfv-in-solanum-lycopersicum-at-two-professional-fruit-production-companies-closed-conditions

ToMV mosaic pattern

ToMV leaf symptoms

TBRFV leaf symptoms

Tomato Mosaic Virus Symptom Comparison

More photos at this site

- http://www.cesaveson.com/files/docs/eventos/Seminario%20Tomato/AntecedentesTomato.pdf

- Please note that this is a Spanish language site.

AHDB does not endorse the sanitation regime outlined at this site (see their recommendations at https://ahdb.org.uk/knowledge-library/tomato-brown-rugose-fruit-virus)

Detection

It is impossible to distinguish the tobamo viruses from TBRFV without testing.

- Be suspicious if:

1) Symptoms like tobamo viruses occur in tomatoes with the Tm-22 gene

2) Very severe symptoms occur

3) It is mixed with Pepino mosaic virus (PepMV)

- See https://www.seedquest.com/News/pdf/2019/tobrfv.pdf

Detection continued

- Agdia immuno strip detects tobamo's – needs lab confirmation
- ELISA detects – for viability use local lesion assay

https://www.betterseed.org/wp-content/uploads/ToBRFV-QA.pdf

How is it transmitted?

- common cultural practices such as:
- contaminated tools
- equipment
- hands
- clothes
- soil
- plants
- seed

Was experimentally transmitted by bumble bees

Transmission continued

- Direct plant-to-plant contact
- Propagation techniques (grafts, cuttings)
- Plant sap
- Externally contaminated seeds
- Circulating water
- Reservoir plants (weeds)

Survival

SURVIVES FOR YEARS ON:

CROP DEBRIS

SOIL

IMPLEMENTS

Control options are limited

- SANITATION!
- Wash hands regularly
- Clean boots if entering greenhouse
- Restrict access to facilities
- Disinfect all in contact with plants
- Elimination of infected plants and 5’ beyond

Control continued

- Bury (deep) or incinerate

- Disinfect with:
- bleach (0.5%-10% sodium hypochlorite)
- Virkon ™ S (potassium peroxymonosulfate)
- Lysol (50%)

- In greenhouses, non fat dry milk (3.5-20%) decreases spread

Regulatory response

As of Nov 22 2019:

USDA APHIS is restricting tomato and pepper seed lots and transplants from all countries where the virus exists

USDA APHIS is restricting tomato and pepper fruit imported from Mexico, Israel, and the Netherlands.

Because Canada imports fruit from Mexico that may be re-exported to the US, USDA will require Canada to ensure disease free imports of tomato and pepper fruit via inspections

Regulatory response continued:

SEEDS	Require TESTING AND CERTIFICATION from all tomato and pepper seed lots imported from countries where the virus exists
PLANTS	Require TESTING AND CERTIFICATION of all tomato and pepper transplants imported from countries where the virus exists
FRUIT	Require all tomato and pepper fruit imported from Mexico, Israel, and the Netherlands to be INSPECTED at the point of origin
CANADA	Require Canada to INSPECT all tomato and pepper fruit prior to export to the United States

QUESTIONS?

For more detailed information see excellent FAQ at:
https://www.betterseed.org/wp-content/uploads/ToBRFV-QA.pdf

And slide show by pathologist at http://citrusexpo.net/wp-content/uploads/2019/09/Tomato-brown-rugose-fruit-virus-OBatuman-Citrus-Expo-2019-final.pdf