Viral Diseases of Pepper: An International Perspective

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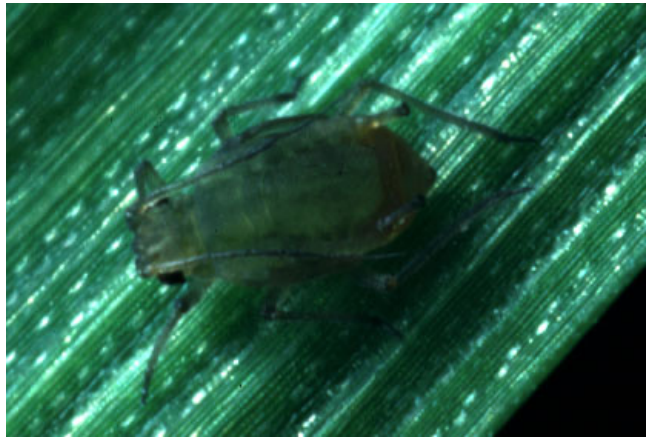
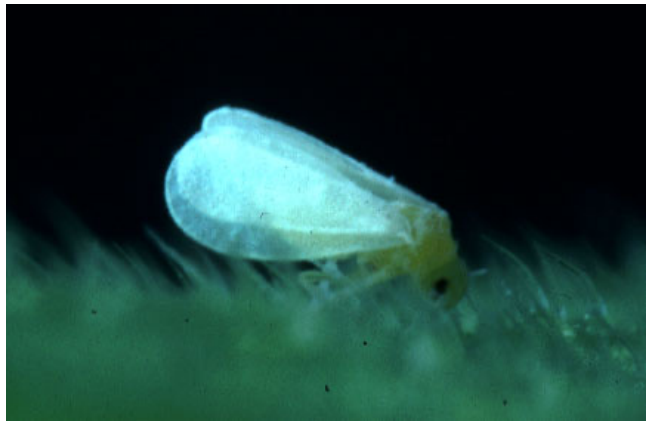
Plant viruses limit pepper production

- Viruses limit pepper production worldwide
- There are more than 100 viruses reported infecting peppers
- Importance of a particular virus depends on:
  - transmission
  - severity of symptoms
  - diagnostic tools available
  - ease of management
  - geographic distribution
  - mixed infections of viruses

Virus Transmission

- Sap/mechanical
  - tobamoviruses
- Nonpersistent
  - Aphids
    - Potyviruses
    - Alfamoviruses
    - cucumoviruses
- Persistent circulative
  - Aphids
    - poleroviruses
  - Leafhoppers
    - curtoviruses
  - Whiteflies
    - begomoviruses
- Persistent propagative
  - Thrips
    - tospoviruses





Tobacco mosaic virus TMV/tomato mosaic virus ToMV

- Tobamoviruses
- Sap/mechanical transmission
  - Handling, tools, pruning, transplants, seed
- Global distribution
- Moderate to severe losses
- Mosaic, distortion, stunting, necrosis
- Resistant varieties available
- Sanitation of tools, hands with TSP, seed treatment

Pepper mild mottle virus PMMoV

- Tobamovirus
- Sap/mechanical transmission
  - Sap, worker tools, handling, seed
- Europe – Spain
- Significant losses to fruit
- Mosaic to mottle of leaves, very small misshapen fruit
- Plant resistance to some strains
- Sanitation of tools, hands with TSP, clean seed with TSP

Tobacco mild green mosaic TMGMV

- Tobamovirus + satellite tobacco mosaic virus STMV
- Sap/mechanical
  - Handling, tools, seed
- North America, Asia, Europe, North Africa
- Jalapeno> pimiento> bell peppers
- Chlorotic lesions >mild mosaic
- Sanitation of tools, hands, care with transplants, clean seed

Nonpersistently transmitted viruses

- Aphid vectored
- Common species
  - *Myzus persicae*
  - *Macrosiphum euphorbiae*
  - *Aphis fabae*
  - *Aphis gossypii*
  - *Aphis craccivora*
  - *Aphis spiraecola*
  - *Acyrthosiphon pisum*
  - *Acyrthosiphon kondoi*
- Transmission by alate non-colonizing aphids
- Rapid acquisition and transmission, retention 1-2 min
- Viruses adhere to aphid stylets

Alfalfa mosaic virus AMV

- Alfamovirus
- Transferred by many aphid sp. and mechanically
- Global losses
- Yellow mosaic on leaves, stunting, fruit distortion
- Hosts – many weeds and alfalfa
- No plant resistance
- Plant distant from sources, do not mow fields

Cucumber mosaic virus CMV

- Cucumovirus
- Transferred by many aphid sp.
- Global losses
- Mild mosaic, chlorosis, necrosis of leaves, largest losses to seedlings
- Hosts – many crops and weeds
- Plant resistance or tolerance to some virus strains
- Remove weed hosts, change planting date to avoid vectors and delay disease, reflective mulch

Potyviruses

- *Pepper mottle virus* (PepMoV)
- *Tobacco etch virus* (TEV)
- *Potato virus Y* (PVY)
- Pepper veinal mottle virus (PVMV)
- Chili veinal mottle virus (ChiVMV)
- Pepper yellow mosaic virus (PepYMV)
- Chili ringspot virus (ChiRSV)
- Wild tomato mosaic virus (WTMV)
- Nonpersistently transmitted by aphids

Pepper mottle virus PeMoV

- Southern USA, Mexico, Central America
- Leaf mottling, distortion, stunting
- Hosts – solanaceous crops and weeds
- Some resistance in bell peppers
- Reflective mulches, mineral oil + synthetic pyrethroid insecticide

Potato virus Y PVY

- Global
- Mosaic, mottle, vein banding, stunting, necrosis, defoliation, small fruit
- Hosts – solanaceous crops and weeds
- Plant resistance in bell peppers
- Rogue infected plants and remove weed hosts

Tobacco etch virus TEV

- Americas
- Leaf mottling, distortion, stunting
- Dicot hosts – largest losses to solanaceous crops
- Overwinters in weeds and tomatoes
- Plant resistance in bell peppers
- Reflective mulches to deter landing and mineral oil to deter feeding

More potyviruses

Pepper veinal mottle virus PVMV

- Africa, India, Southeast Asia, Middle East
- Mosaic, mottling, leaf distortion
- Solanaceous crops and weeds
- Overwinters in weeds
- Tolerance or partial plant resistance in bell peppers

Chili veinal mottle virus ChiVMV

- Asia
- Stunting, mosaic, mottle, leaf distortion
- Chile, experimental hosts of other solanaceous plants
- Plant resistance or tolerance
- Reflective mulches somewhat effective

Pepper yellow mosaic virus PepYMV

- Brazil
- Bright yellow mosaic, stunting, small fruit
- Tomatoes and solanaceous weeds
- Overwinters in weeds
- Plant resistance
- Reflective mulches and control of weeds

Yet more potyviruses

Chili ringspot virus ChiRSV

- Southeast Asia
- Ringspot, vein banding, leaf distortion, interveinal chlorosis
- Solanaceous crops and weeds
- Overwinters in peppers and weeds
- No resistance
- Suggest controlling weeds

Wild tomato mosaic virus WTMV

- Southeast Asia
- Yellow mosaic, vein banding, leaf distortion
- Solanaceous crops and weeds
- Overwinters in weeds
- No resistance
- Suggest controlling weeds

Pepper vein yellows virus PeVYV

- Persistent circulative transmission by *Myzus persicae* and *Aphis gossypii*
- Polerovirus - Luteoviridae
- Virus phloem limited
- 1-9 strains of PeVYV
- Pod pepper vein yellows virus
  - Recombinant with PeVYV as parent
- Global
- Leaf curl, interveinal yellowing, fruit discoloration
- Peppers and solanaceous weeds
- Overwinters in infected peppers and weeds
- Control difficult

Pepper golden mosaic virus PeGMV

- Persistent circulative transmission by *Bemisia tabaci*
- Virus complex within Begomovirus – Geminiviridae
- North and Central America
- Yellow mosaic, leaf distortion, chlorosis
- Also tomatoes, solanaceous weeds
- Moved from weeds or tomatoes by whiteflies or by transplants
- No plant resistance

More Begomoviruses –whitefly transmitted

Pepper leaf curl virus PepLCV

- Single DNA + satellite
- Asia, Africa, North America
- Leaf cupping, stunting, small leaves, fruit abortion
- Pepper primary host
- Some plant resistance
- Insecticides, crop rotation, mulches

Tomato yellow leaf curl virus TYLCV

- Single DNA
- Global
- Leaf curl, stunting, chlorosis or no symptoms
- Tomatoes, tobacco, beans, and weeds (peppers minor host)
- Moving from tomatoes or weeds via whiteflies
- Mulch, weed removal, insect sprays, crop rotation

Beet curly top virus BCTV

- Persistent circulative transmission by *Circulifer tenellus*
- Western North America and Middle East
- Chlorosis, small leaves, stunting, no fruit set
- Wide range of crop and weed hosts
- Overwinters on weed hosts
- Weed removal, predictive model, kaolin clay, delay thinning

Tomato spotted wilt virus TSWV

- Persistently propagative in thrips vector
- Global
- Stunting, necrotic spots on leaves, ringspots
- Very wide host range
- Virus overwinters on crops or weeds
- Use of virus-free transplants and removal of viral sources

Viruses of chile in New Mexico

- Beet curly top virus
- Pepper mottle potyvirus
- Tobacco etch potyvirus
- Potato virus Y potyvirus
- Cucumber mosaic virus
- Alfalfa mosaic alfamovirus
- Tomato spotted wilt tospovirus
- Often found in mixed infections

Mosaic virus weed hosts

- Silverleaf nightshade
- Field bindweed
- Russian thistle
- Jimsonweed
- Wrights groundcherry
- Hog potato
- Symptoms +/-
- 60-100% infection rate of CMV+PepMoV in 1992-1993

Conclusions

- Pepper viruses are found worldwide
- They can be very difficult to manage
- There is plant resistance to some of the viruses in bell peppers, but little to none in most chile pepper types grown in NM
- Viruses found in other areas of the world could get moved here on seed