

Infecting Solanaceous Crops



Robert L. Gilbertson
Department of Plant Pathology
University of California-Davis

striking diversity of viruses have evolved to infect plants

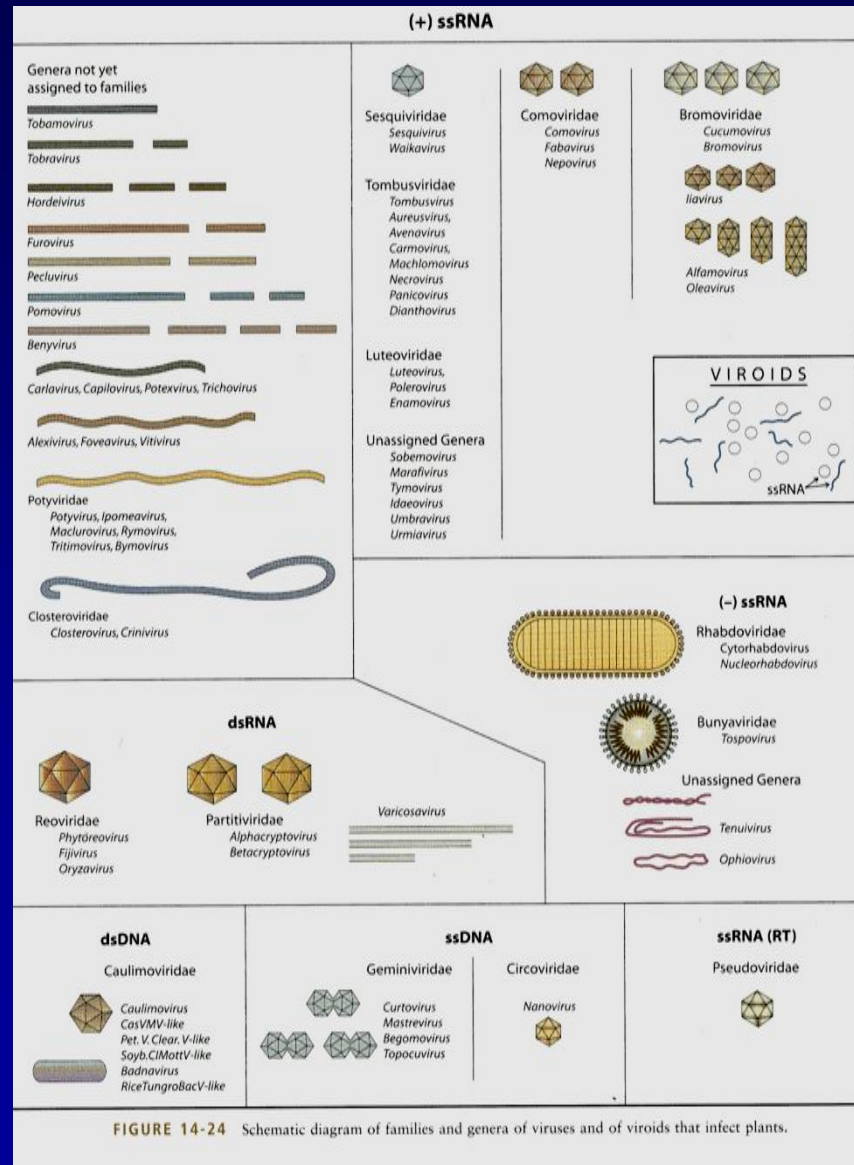


FIGURE 14-24 Schematic diagram of families and genera of viruses and of viroids that infect plants.

Understanding the biology of the virus is necessary for effective disease management

É Properties of the virus (virion structure and genetic material)

É Host range

É Vector (insect or other)

É Sources of inoculum

- seed

- weeds/other reservoir hosts

- old crops

- insects

É Means of survival in the absence of the economic hosts

Viruses that infect tomato and pepper

- É **Tobamoviruses** (*Tobacco mosaic* and *Pepper mild mottle*)
- É **Potexvirus** (*Pepino mosaic virus*)
- É **Cucumovirus** (*Cucumber mosaic virus*)
- É **Potyvirus** (*Potato virus Y*, *Tobacco etch*, *Pepper mottle*)
- É **Tospovirus** (*Tomato spotted wilt virus*)
- É **Closterovirus** (*Tomato chlorosis virus*, *Tomato infectious chlorosis*)
- É **Geminivirus** (*Tomato severe leaf curl*, *Pepper huasteco yellow vein virus*, *Tomato Havana virus*, *Pepper golden mosaic virus* and others)
- É **Others**: *Tomato bushy stunt*, *Alfalfa mosaic*, *Tobacco streak* and *Tomato necrotic spot*
- É **New**: *torrado viruses*

Viruses that infect tomato and pepper

Family/group: Tobamovirus

Tobacco and tomato mosaic (TMV)/

Pepper mild mottle virus (PMMV)

Particle: rigid rod

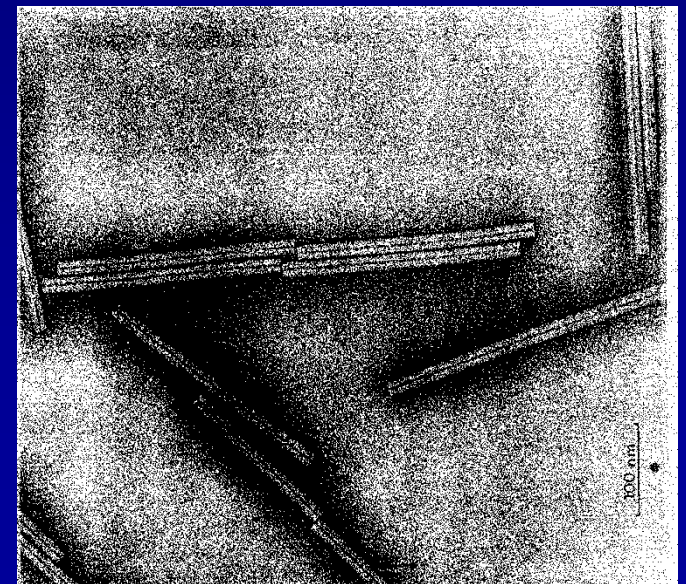
Genetic material: RNA

Vector: None (mechanically
transmitted)

Inoculum sources:

- On seed (treat with
10% Na_3PO_4 2 hrs)
- Crop debris
- Benches, stakes, trays
- Humans

Host range: Narrow (tomato/pepper)



Viruses that infect tomato and pepper

EPMMV can be very serious on pepper
and **ToMV** on tomato in field and
greenhouse

É Symptoms include **mottling and yellow/
green mosaic** on leaves and **small,
malformed fruits**

É **Highly infectious** and easily spread by
contact

É **Seedborne** probably on **seed coat** with
virus spread to plants **during transplanting
and other cultural practices**

É **Control:** Resistance, seed treatment (TSP
for 1-2.5 hours), sanitation, roguing
rotation



infect tomato and pepper

É **Family/group:** Potexvirus

É ***Pepino mosaic virus***

É **Particle:** flexous rod

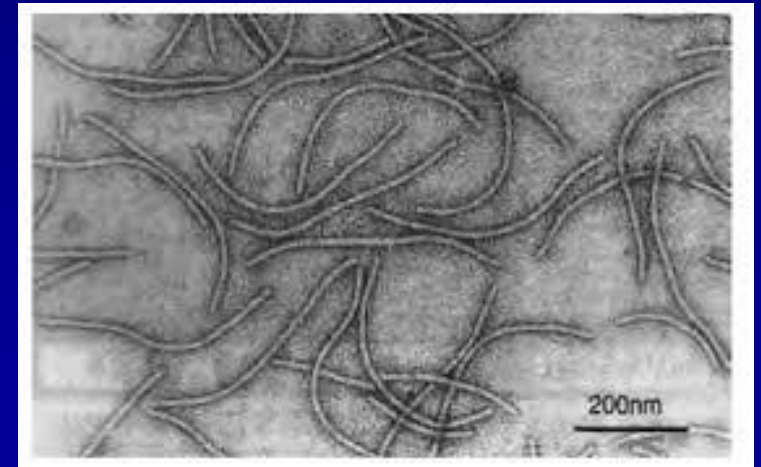
É **Genetic material:** RNA

É **Vector:** None (mechanically
transmitted)

É **Inoculum sources:**

- On seed (?)
- Crop debris
- Benches, stakes, trays
- Humans

É **Host range:** Narrow (tomato, potato
and tobacco)



infect tomato and pepper

É First IDed in 1974 in Peru

É In 1990s appeared in greenhouse tomatoes in Europe and US

É Symptoms vary depending on strains

É Includes mosaic/mottle and fruit blotching and marbling

É Highly infectious and easily spread by contact

É Seedborne but some question about this

É May be very low level of seed contamination on the seed coat

É Control requires strict sanitation

É Cross protection has been used



Viruses that infect tomato and pepper

É **Family/group:** Cucumovirus

É ***Cucumber mosaic virus (CMV)***

É **Particle:** spherical

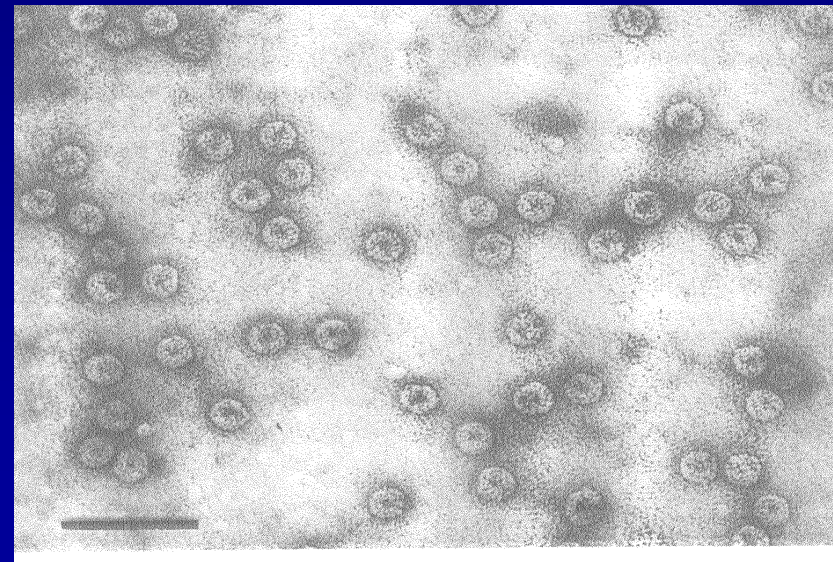
É **Genetic material:** RNA

É **Vector:** Aphids (non-persistent)

É **Inoculum sources:**

- Weeds and other reservoir hosts
- Crops in old fields
- Aphids
- Not seedborne in tomato or pepper**

É **Host range:** Wide (tomato/pepper/
cucurbits/beans and many others)



Viruses that infect tomato and pepper

Family/group: Potyvirus

**É Potato virus Y (PVY), Tobacco
etch (TEV), Pepper mottle (PeMV)**

É Particle: flexuous rod

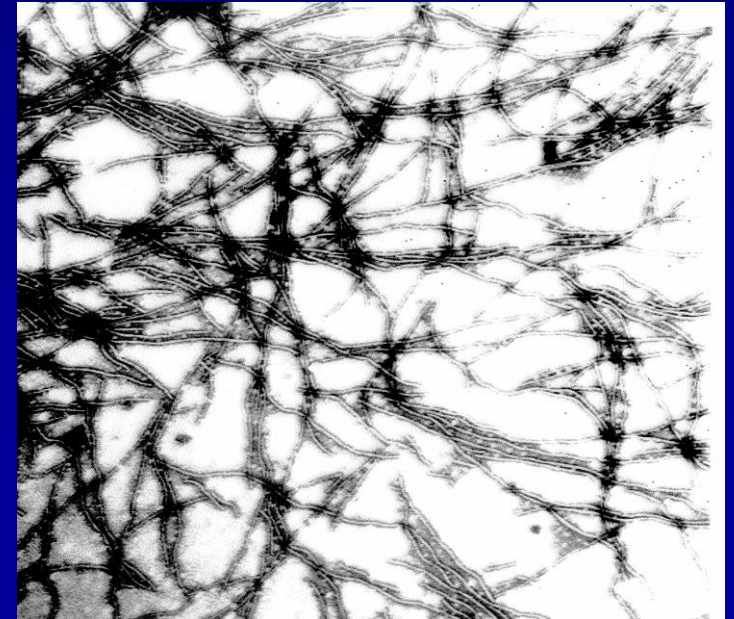
É Genetic material: RNA

É Vector: Aphids (non-persistent)

É Inoculum sources:

- Weeds other reservoir hosts
- Crops in old fields
- Aphids
- Not seed-transmitted**

É Host range: Relatively narrow
(tomato/pepper)



that infect tomato and pepper

É **Family/group:** Tospovirus

É *Tomato spotted wilt virus*

É **Particle:** large spherical

É **Genetic material:** RNA

É **Vector:** Thrips (persistent
propagative)

É **Inoculum sources:**

- Weeds other reservoir hosts
- Crops in old fields
- Thrips
- Not seed-transmitted**

É **Host range:** Wide (tomato/pepper
and many other crops, weeds,
ornamentals)



Viruses that infect tomato and pepper

É **Family/group:** Closterovirus

É *Tomato chlorosis virus* and *Tomato infectious chlorosis*

É **Particle:** large flexuous rods

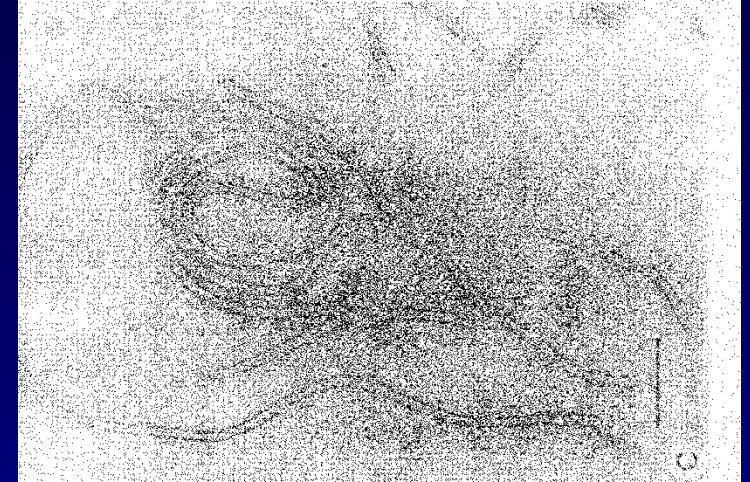
É **Genetic material:** RNA

É **Vector:** Whiteflies (semi-persistent)

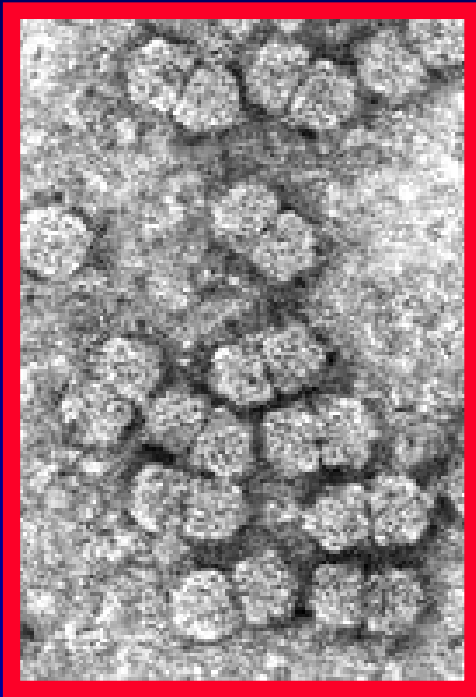
É **Inoculum sources:**

- Weeds other reservoir hosts
- Crops in old fields
- Whiteflies
- Not seed-transmitted**

É **Host range:** Narrow



Geminiviruses


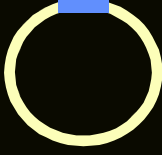
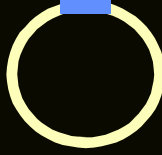






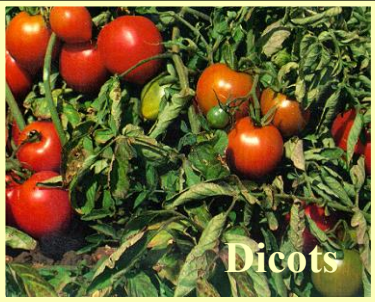
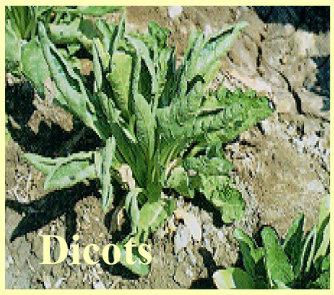
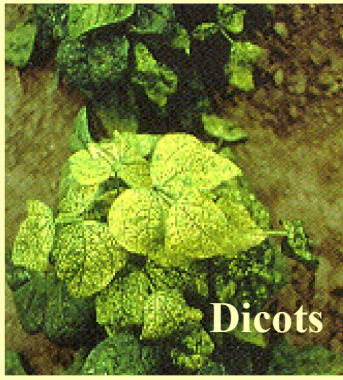


É Family *Geminiviridae*

É Twinned icosahedral virions
(18 x 30 nm)

É Circular ssDNA genome
(2.8-5.5 kb)

of the Family *Geminiviridae*

	Mastrevirus	Topocuvirus	Curtovirus	Begomovirus
Genome				
Vector	 Leafhopper	 Treehopper	 Leafhopper	 Whitefly
Host	 Monocots	 Dicots	 Dicots	 Dicots

iridae is composed of seven genera

Genus	Begomovirus	Curtovirus	Mastrevirus
Genome			
Vector	 Whiteflies (<i>Bemisia tabaci</i>)	 Beet leafhopper (<i>Circulifer tenellus</i>)	 Leafhoppers
Host	 Dicots	 Dicots	 Monocots/ Dicots
Distribution	NW and OW	NW and OW	Only OW

Becurtovirus

Turncurtovirus

Eragrovirus

Topocuvirus

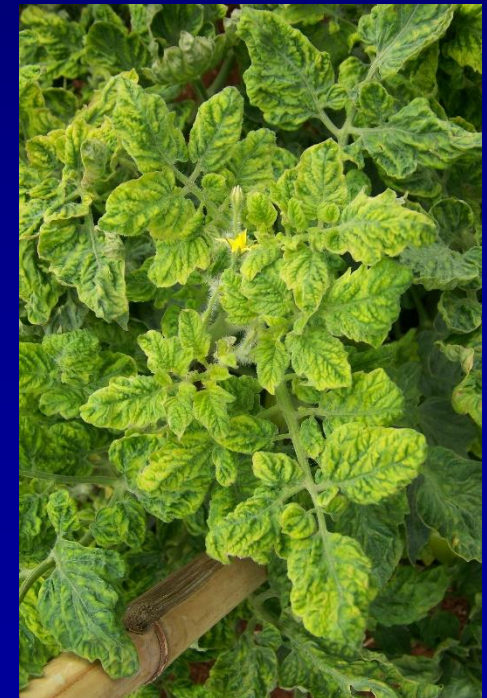
NW and OW

Only OW

Only NW

Tomato Mosaic Virus

- É **>60 different begomovirus species** infect tomato worldwide
- É **All are transmitted by *Bemisia tabaci***
- É **They are not seed- or mechanically (by touch) transmitted**
- É **Have relatively narrow host ranges, usually within the solanaceae (tomato family)**
- É **Cause similar symptoms including stunted and distorted growth; leaf curl, crumple, distortion, mosaic/mottle and yellowing**
- É **Cause considerable yield losses, particularly when plants are infected at an early stage of growth**



Tomato Diseases in Spain, Mexico and Central America

É Characterized as **'torrado'** (burned) in

Spain, **'mancha de chocolate'**
(chocolate spot) in Guatemala
and **'marchitez'** in Mexico

É Characterized by a mottling and
crumpling of leaves followed by
necrosis of leaves, stems and fruits
(less common)

É Caused by a **new type of RNA virus:**
torradovirus that is transmitted by
whiteflies

É Evidence of seed transmission?

É Would explain how these viruses
have recently appeared in many areas

