

Viroids

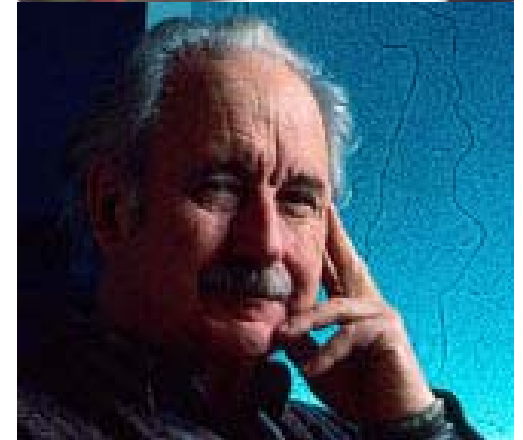
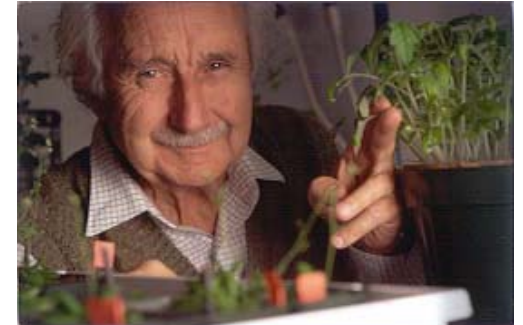
Discovery of Viroids

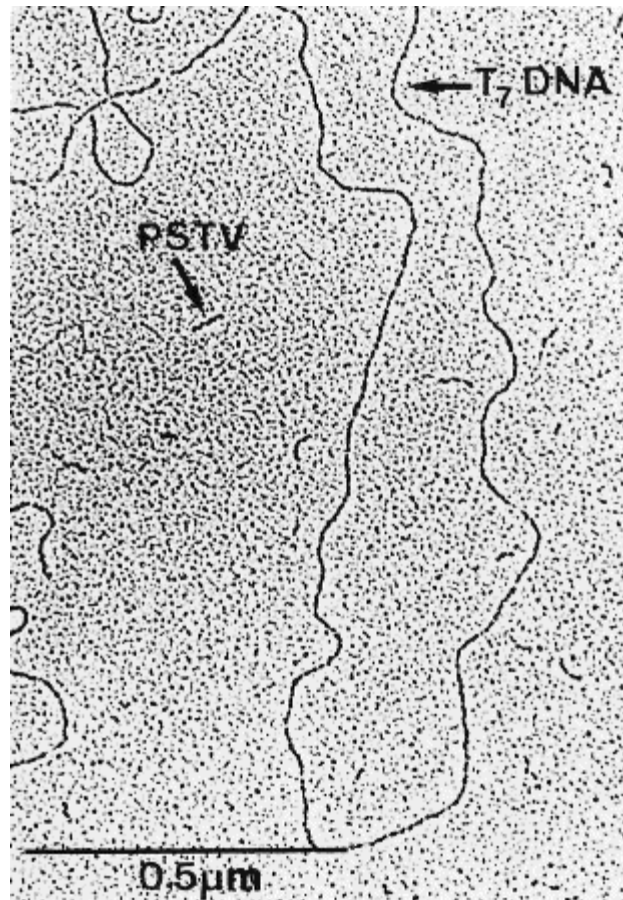
- The first identified: **Potato spindle tuber viroid** (PSTVd)
- PSTVd gets its name because of the oblong tubers produced from infected plants
- PSTVd can also infect tomato plants (indicator)



Discovery of Viroids

- Theodor O. Diener discovered a cell-invading plant pathogen 80 times smaller than a virus: **the viroid**
- Potato spindle tuber viroid (PSTVd)

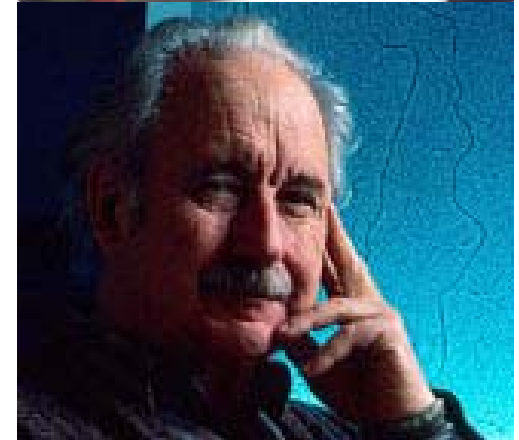
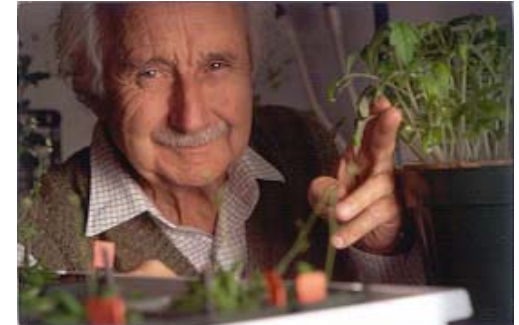




Electron micrograph of a mixture of purified preparations of PSTVd RNA and viral T7 DNA. The size differences and the rod-like structure of the viroid are clearly illustrated

Discovery of Viroids

- Theodor O. Diener discovered a cell-invading plant pathogen 80 times smaller than a virus: **the viroid**
- Potato spindle tuber viroid
- Viroids: pure RNA. No protein.
 - Active after DNase digestion
 - Inactive after RNase digestion
 - Active after Phenol extraction
- According to accepted scientific dogma, the discovery of the viroid was not supposed to happen.
 - An organism with no protein wasn't supposed to be able to replicate itself, even with a host cell's help
 - Scientists believed that the minimum weight necessary for infectivity was about 1 million daltons
 - An entity as small as PSTVd (130,000 daltons) wasn't supposed to be able to infect anything, even a potato.





Sequence and secondary structure of PSTVd

Citrus exocortis viroid (CEVd)



Bark sloughing caused by citrus exocortis viroid.
Photo by B. Sleeth, TAES, Weslaco, 1963



Foliar distortion of citrus induced by citrus exocortis viroid.



Foliar distortion of Gynura induced by citrus exocortis viroid.

Chrysanthemum chlorotic mottle viroid (CChMVd)



Hop Stunt Viroid (HSVd) and Peach latent mosaic viroid (PLMVd)



Plum Dapple by HSVd



Peach infected with PLMVd

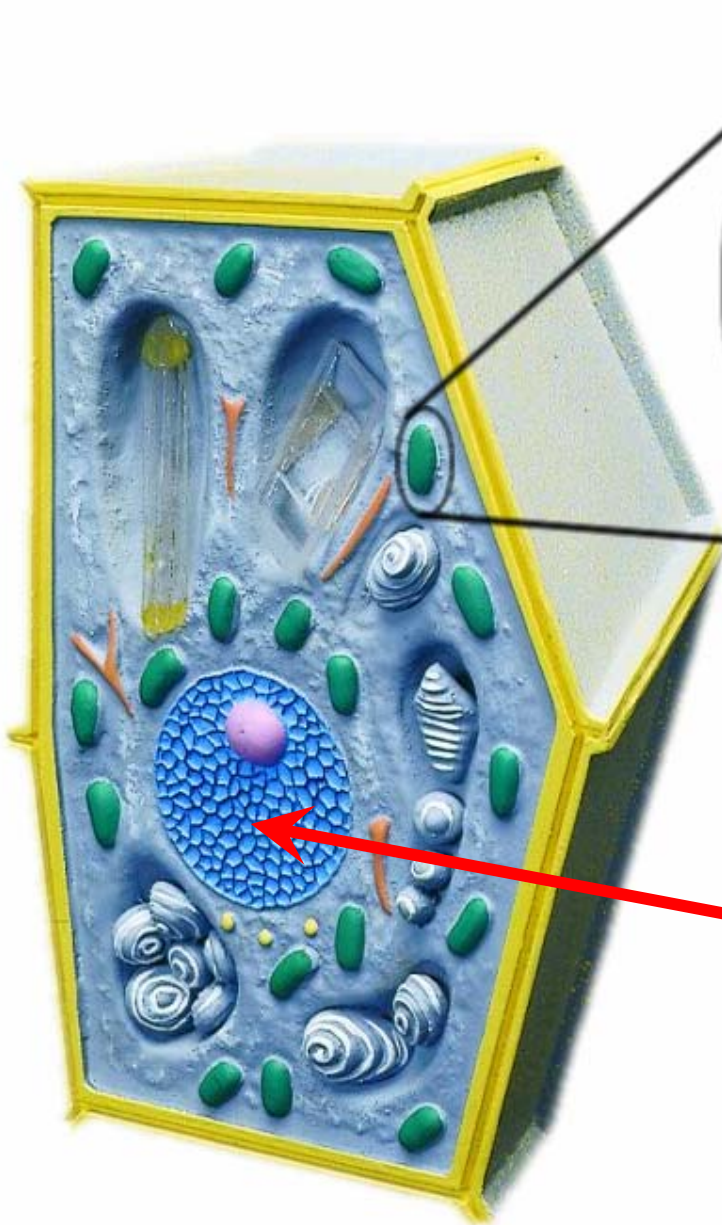
Viroids

- **Small RNA pathogens infecting plants (240 – 400 nt)**
- **200–10,000 copies per cell**
- **Single-standed and circular genomes**
- **Not encapsidated**
- **No coding regions**
- **Formed by Quasi-species**
- **Symptoms that are as varied as those caused by plant viruses**
 - ✓ **stunting**
 - ✓ **epinasty**
 - ✓ **chlorosis**
 - ✓ **localized necrosis**
 - ✓ **death**
- **Despite their small sizes, and therefore extremely limited genetic information, viroids are replicated autonomously (requiring no helper virus) in susceptible cells**
- **Replicated by a host RNA-dependent RNA polymerase**
 - **host DNA-dependent RNA polymerase that can act also on RNA templates**

Viroids

- Infect many hosts (ex. PLMVd):
 - **Peach**
 - Plum
 - Cherry
 - **Nectarin**
 - Pear
 - Almonds
 - Apple
 - Apricots
- Transmission:
 - By mechanical breaks
 - ✓ Tools, breaks, insects
 - Biologiquement
 - ✓ Germs, co-infection
- May be latent for many years

Viroid localization



Avsunviroidae

- avocado sunblotch (ASBVd)
- peach latent mosaic (PLMVd)
- chrysanthemum chlorotic mottle (CChMVd)
- eggplant latent viroid (ELVd)

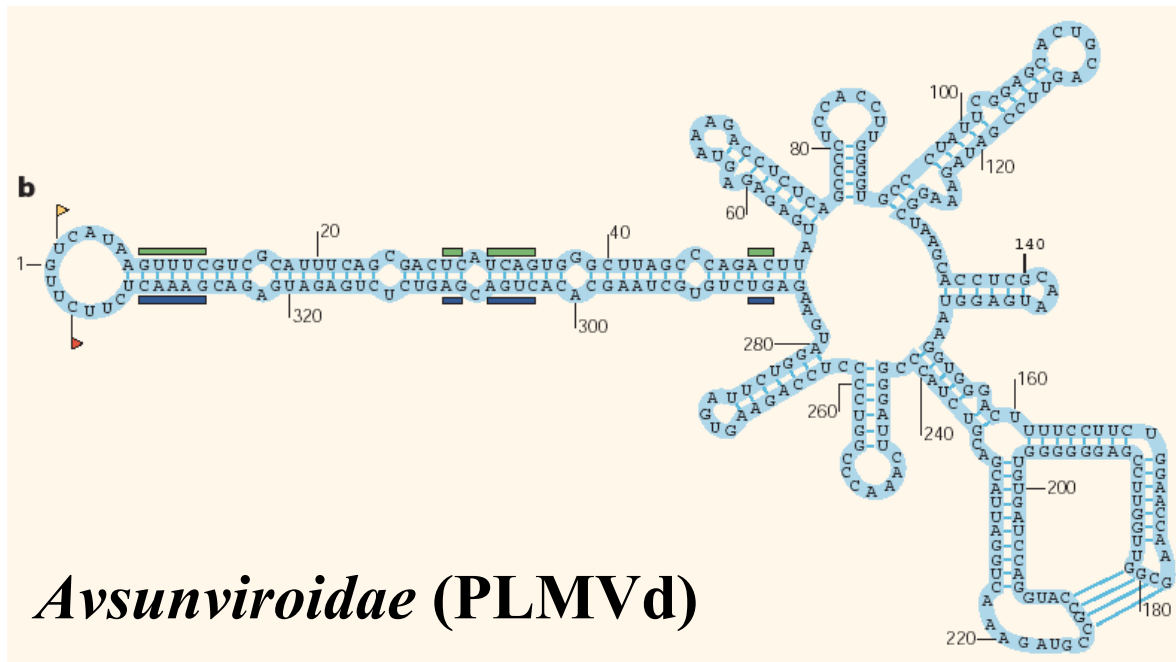
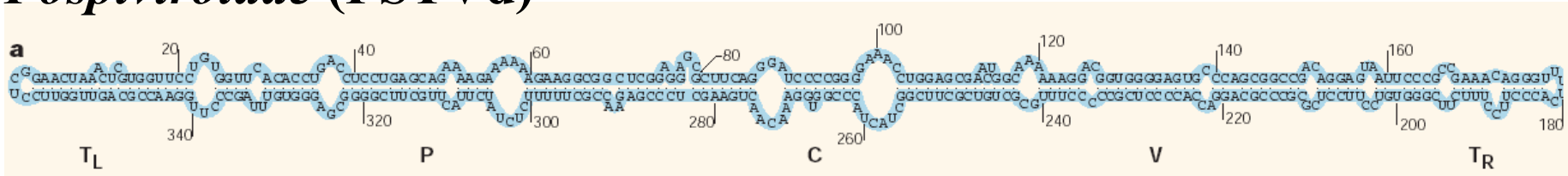
Pospiviroidae

- potato spindle tuber (PSTVd)
- coconut tinangaja (CTiVd)
- citrus exocortis (CEVd)
- australian grapevine (AGVd)
- columnnea latent (CLVd)
- apple dimple fruit (ADFVd)
- chrysanthemum stunt (CSVd)
- apple scar skin (ASSVd)
- iresine (IRVd)
- citrus bent leaf (CBLVd)
- mexican papita (MPVd)
- citrus viroid-III (CVd-III)
- citrus viroid-IV (CVd-IV)
- citrus viroid-OS (CVd-OS)
- hop latent viroid (HLVd)
- grapevine 1B (G1BVd)
- hop stunt (HSVd)
- pear blister canker (PBCVd)
- coleus blumei-1 (CbVd-1)
- tomato apical stunt (TASVd)
- coleus blumei-2 (CbVd-2)
- tomato planta macho (TPMVd)
- coleus blumei-3 (CbVd-3)
- tomato chlorotic dwarf (TCDVd)
- coconut cadang-cadang (CCCVd)
- grapevine yellow speckle-1 (GYSVd-1)
- grapevine yellow speckle-2 (GYSVd-2)

<u>Avsunviroidae(ASBVd-type (group A))</u>				
<i>Species Name</i>	<i>Abbreviation</i>	<i>Number of sequences</i>	<i>Size (in nucleotides)</i>	<i>Secondary Structure (Connect files)</i>
<u>ASBVd subgroup</u>				
Avocado sunblotch viroid	ASBVd	88	120 - 251	asbvd.connect
<u>ELVd subgroup</u>				
Eggplant latent viroid	ELVd	10	332 - 335	
<u>PLMVd subgroup</u>				
Chrysanthemum chlorotic mottle viroid	CChMVd	14	397 - 401	
Peach latent mosaic viroid	PLMVd	115	335 - 351	plmvd.connect plmvd2.connect

Viroid conformations

Pospiviroidae (PSTVd)

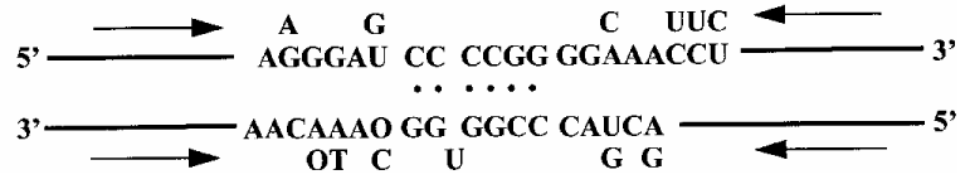


Avsunviroidae (PLMVd)

Subgroups of Pospiviroids are based on the sequences of the central conserved region

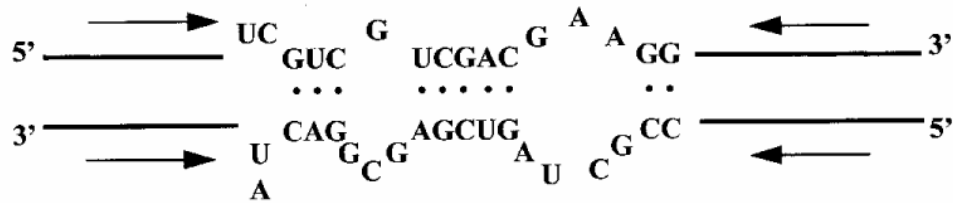
PSTV

Subgroup



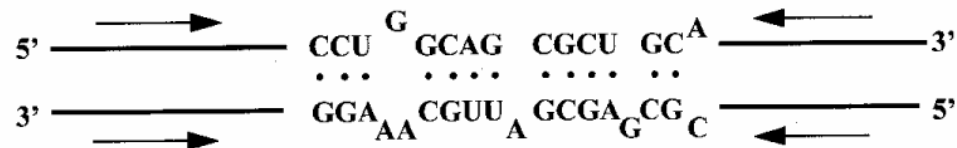
ASSV

Subgroup

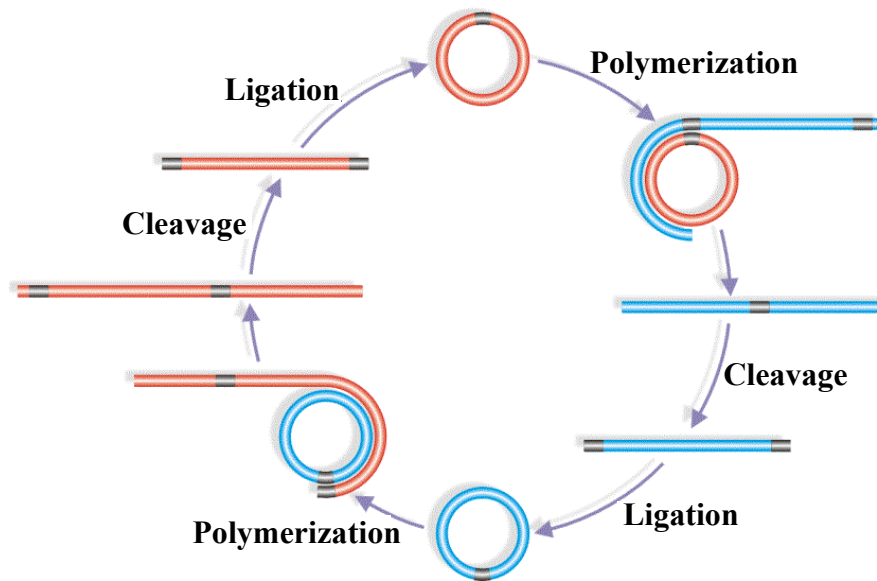


CbV

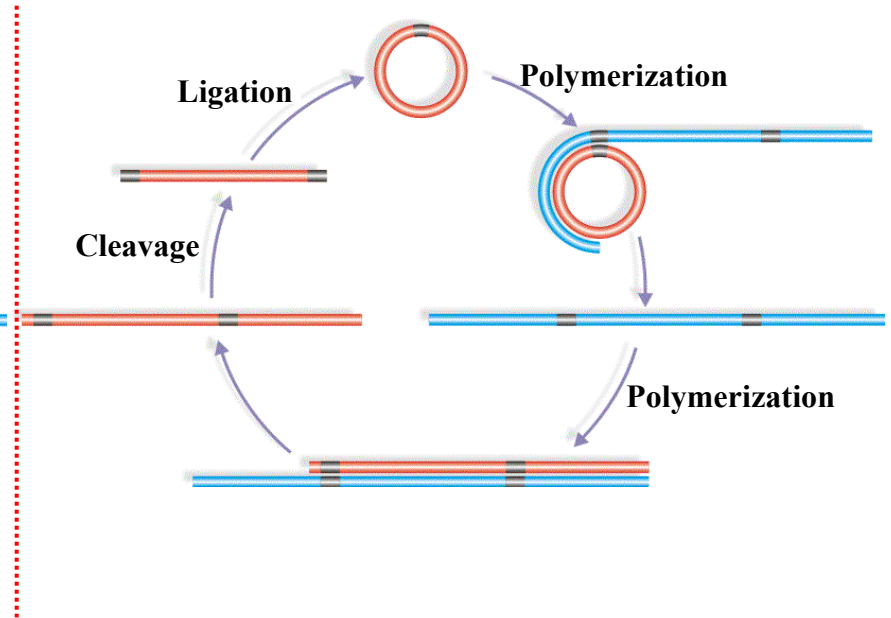
Subgroup



Rolling circle replication mechanisms



Symmetrical
(Avsunviroidae)



Asymmetrical
(Pospiviroidae)

Replication

Pospiviroids:

- Nuclear RNA polymerase II
 - ✓ Nuclear localization
 - ✓ α -amanitin sensibility
- RNase and Ligase activities unknown