

Introduction to plant viruses

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1898 Dmitry Ivanovsky (Russia)
and



Martinus Beijerinck
(The Netherlands)

described the first virus:



Tobacco mosaic virus

Viruses are the major players in the genetic universe



1 cm³ of seawater contains 10⁶-10⁹ virus particles

Suttle, C.A. (2005) *Nature* 437:356



There are millions of diverse bacteriophage species in the water, soil, and gut

Edwards and Rohwer (2005) *Nat. Rev. Microbiol.* 3:504

Viruses dominate biosphere: there are 10-100 viruses per each living cell
The metagenomes of viruses and cellular organisms have comparable complexities

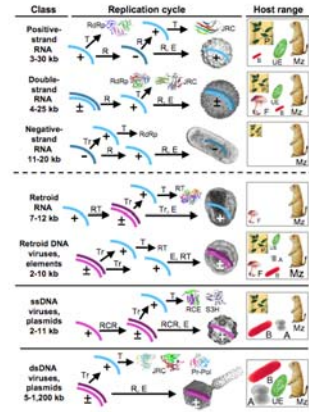
VIRUSES

- **Non-cellular form of life**
- **Obligate intracellular parasites**
- **Exist as inert particles (virions) outside the cell**
- **Virions harbor viral genome protected by protein shell**

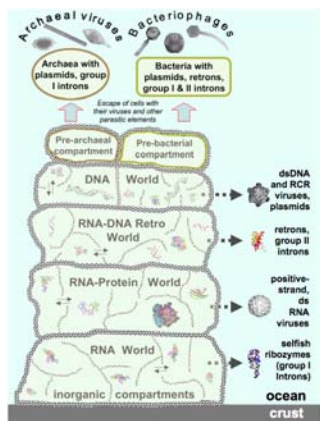
Viral form of life

	CELLS	VIRUSES
Reproduction	Binary fission	Assembly from the pools of components
Membrane	All phases of the life cycle	Only enveloped viruses when outside the cell
Translational machinery	All types of cells	None of the viruses
Genome	dsDNA	ds or ss DNA or RNA

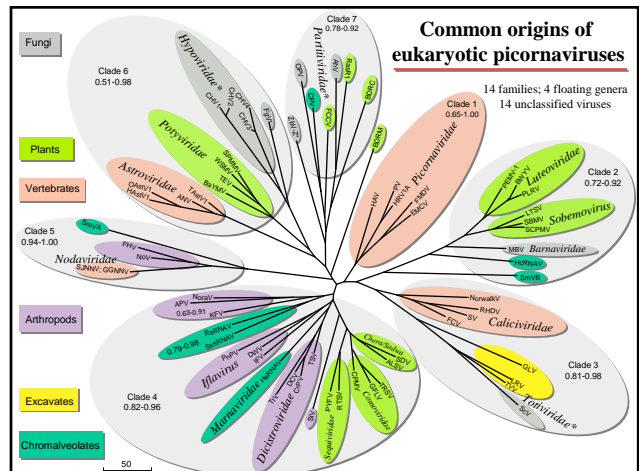
Genetic Diversity and Host Ranges of Viruses



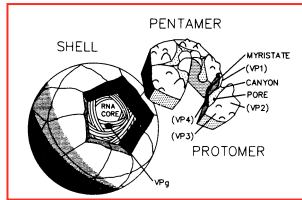
Virus origins from Precellular Gene Pool



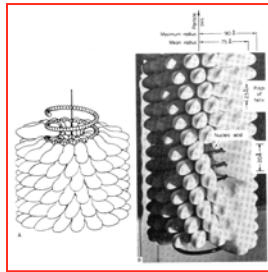
Common origins of eukaryotic picornaviruses



Virus particles (virions) are built of a nucleic acid and a protein shell

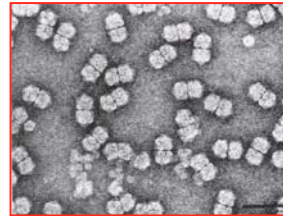


Icosahedral (spherical) virions

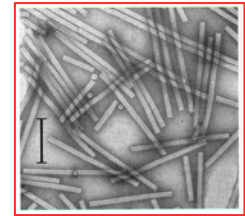


Elongated (helical) virions

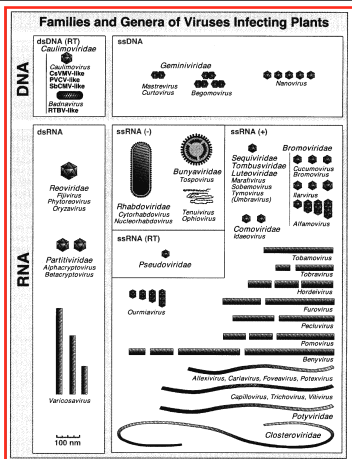
Virions under EM



Geminivirus (ssDNA within a double sphere)

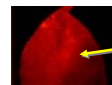


Tobacco mosaic virus (ssRNA within a helical rod)

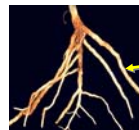


Virus Life Cycle

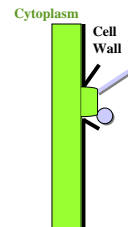
1 Invasion



Invasion through leaves:
vectoring insects;
mechanical damage



Invasion through roots:
vectoring nematodes or fungi;
mechanical damage

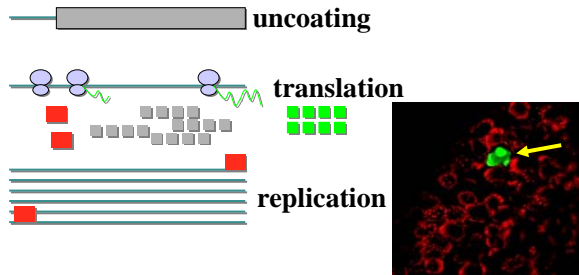


Exception: seed and pollen transmission

Virus Life Cycle

2

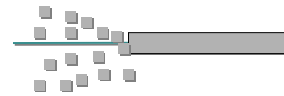
Genome uncoating, expression and replication



Virus Life Cycle

3

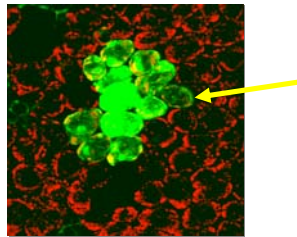
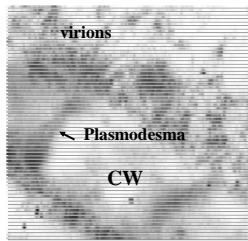
Particle (virion) assembly



Virus Life Cycle

4

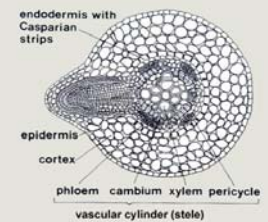
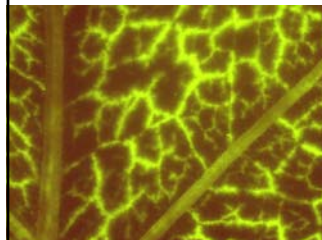
Cell-to-cell movement



Virus Life Cycle

5

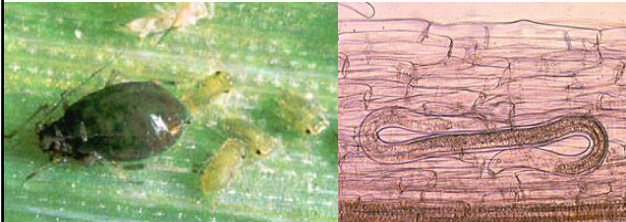
Systemic transport through phloem



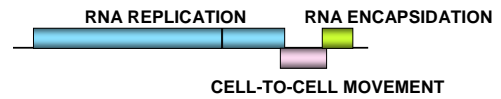
Virus Life Cycle

6

Plant-to-plant transmission



**RNA genome of TMV: ~6,400 nts,
three genes, and three major functions**



beet soilborn



citrus mosaic (satsuma)



tomato spotted wilt (peanut)



barley yellow dwarf



tomato spotted wilt (tobacco)