



Tobacco Mosaic Virus

Dr Shilpa Deshpande Kaistha
Department of Biotechnology
School of Life Sciences & Biotechnology
CSJM University Kanpur

Tobacco mosaic virus

TMV

- Genus *Tobamovirus*
 - 15 members
 - naked, rigid rod,
 - + unsegmented ss RNA

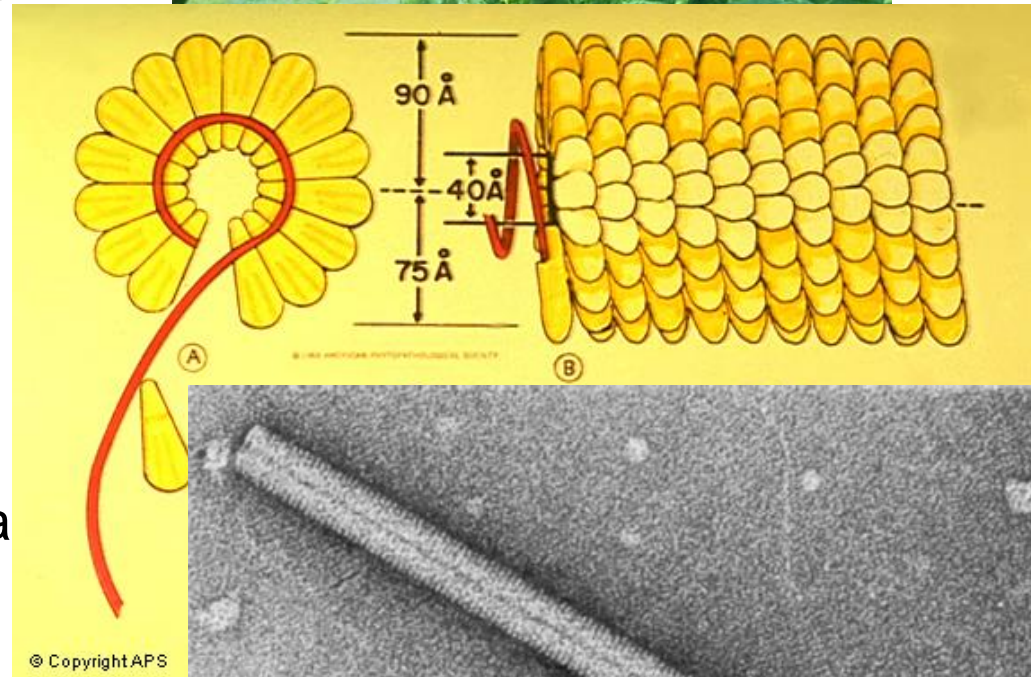
Classification

- Realm: Riboviria
- Family: Virgaviridae
- Genus: Tobamovirus
- Species: Tobacco mosaic virus

Helical symmetry

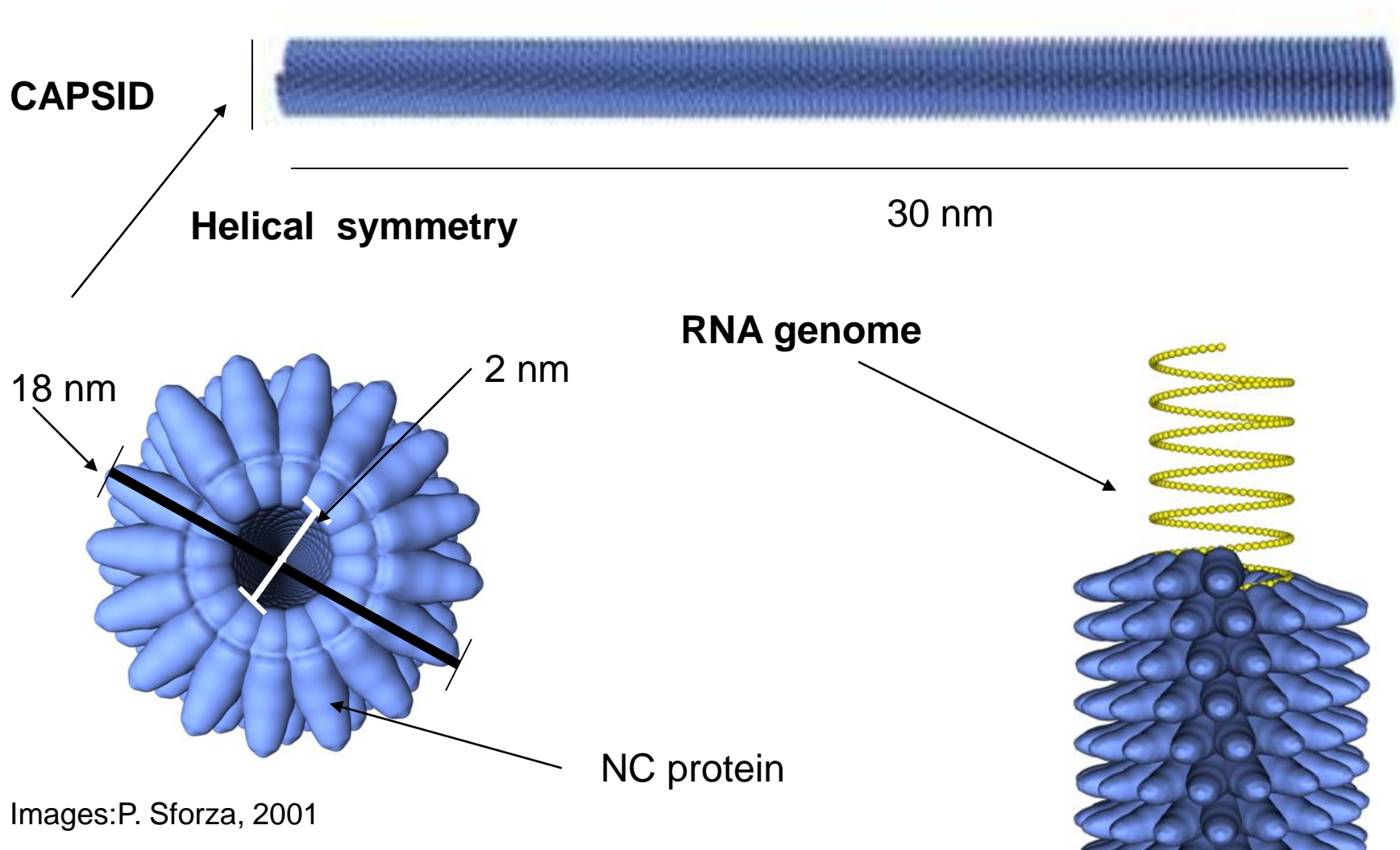


- ***Tobacco mosaic virus*** is typical, well-studied example
- Each particle contains only a single molecule of RNA (6395 nucleotide residues) and 2130 copies of the coat protein subunit (158 amino acid residues; 17.3 kilodaltons)
 - 3 nt/subunit
 - 16.33 subunits/turn
 - 49 subunits/3 turns
- TMV protein subunits + nucleic acid will self-assemble *in vitro* in an energy-independent fashion
- Self-assembly also occurs in the absence of RNA



TMV rod is 18 nanometers (nm) X 300 nm

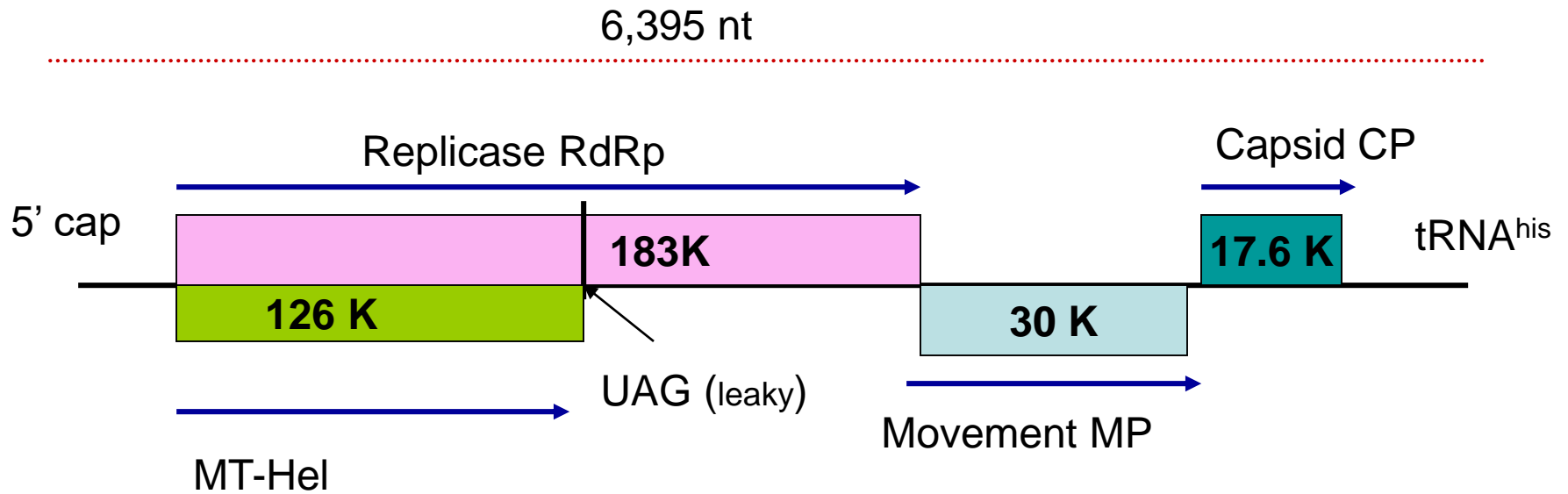
STRUCTURAL FEATURES OF TMV



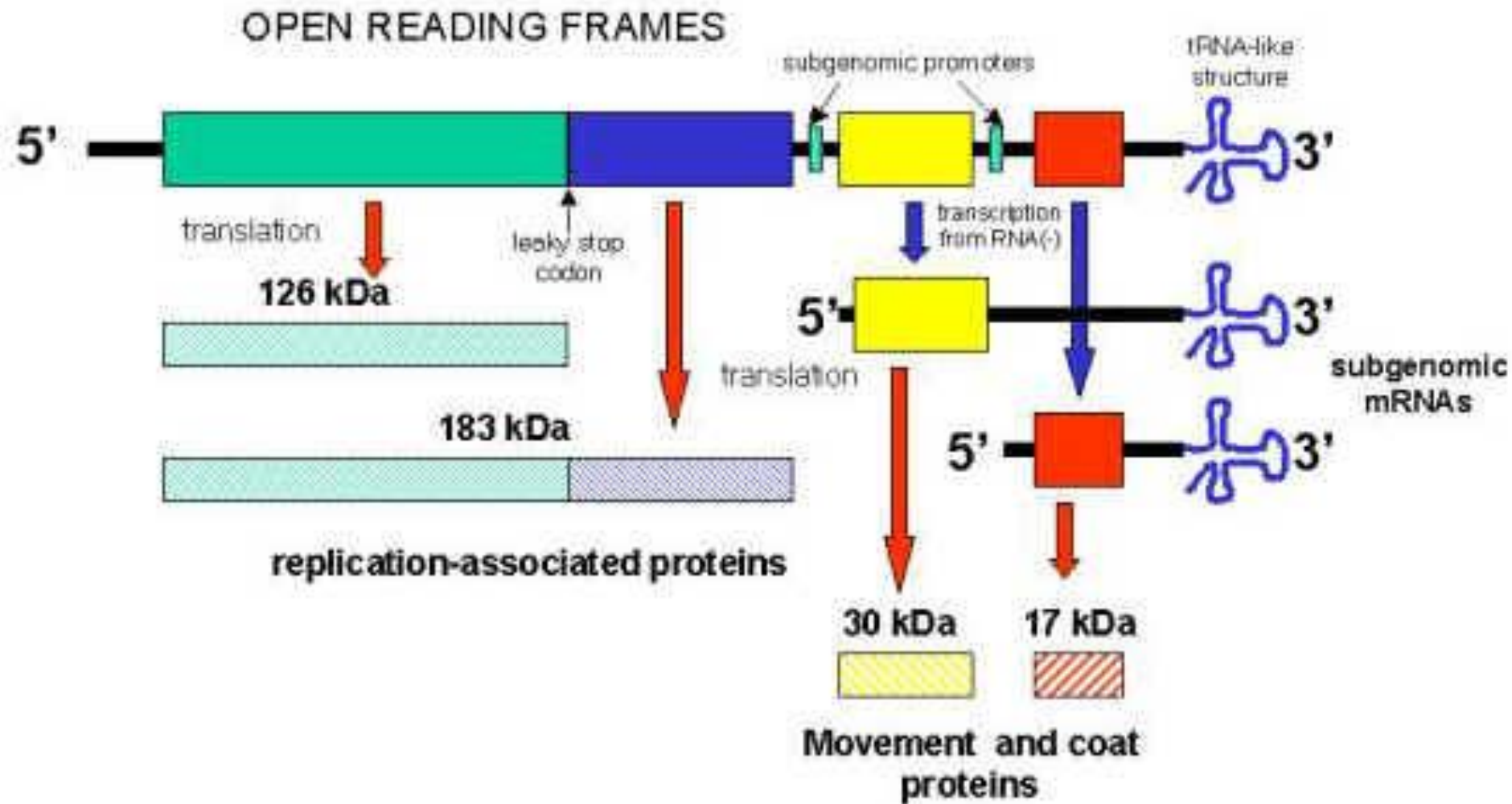
Images: P. Sforza, 2001

www.ppws.vt.edu/~sforza/tmv/tmv.html

TMV genome organization



Tobacco mosaic virus is a typical positive-sense RNA plant virus with a 6.4 kilobase genome

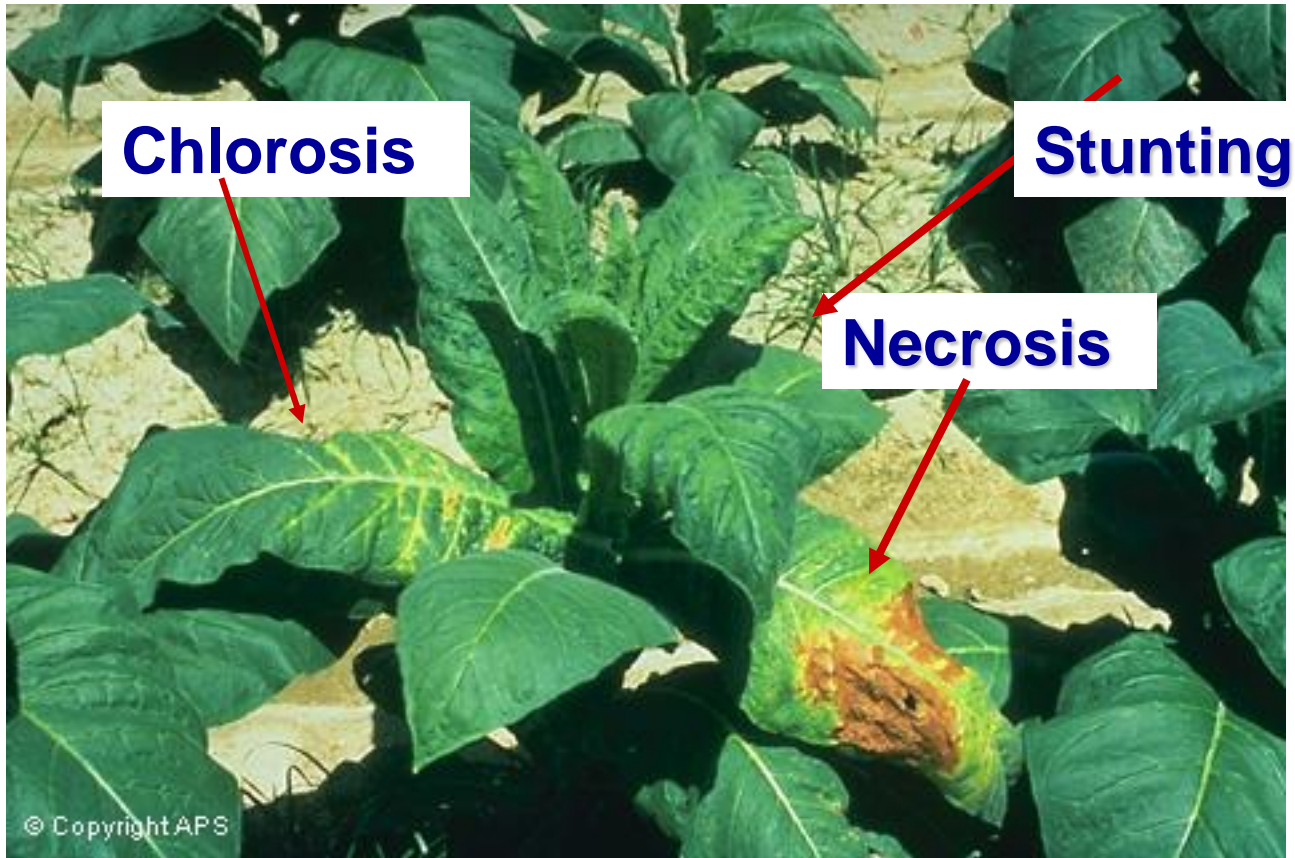


Disease: Mosaic (calico)





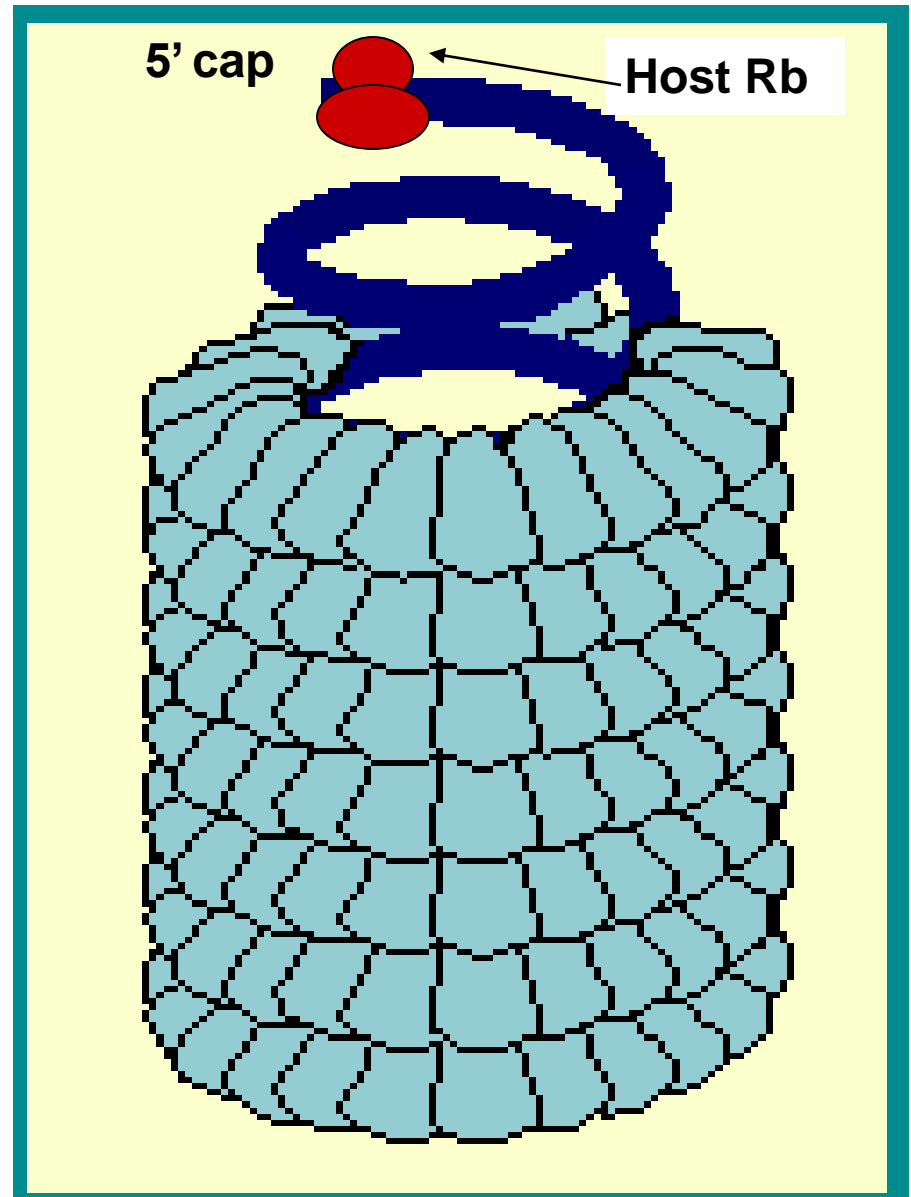
Mosaic disease on Tobacco leaf



Mosaic disease: significant losses in yield & \$ value

TMV Life cycle

- a) Virus entry through abrasions on plant tissue. Inside cell associates with ER
- b) spontaneous release of few capsid (CP) subunits 5' end of genome is uncovered
- c) Host ribosome attaches to viral RNA, moves down displacing more CP units .../....

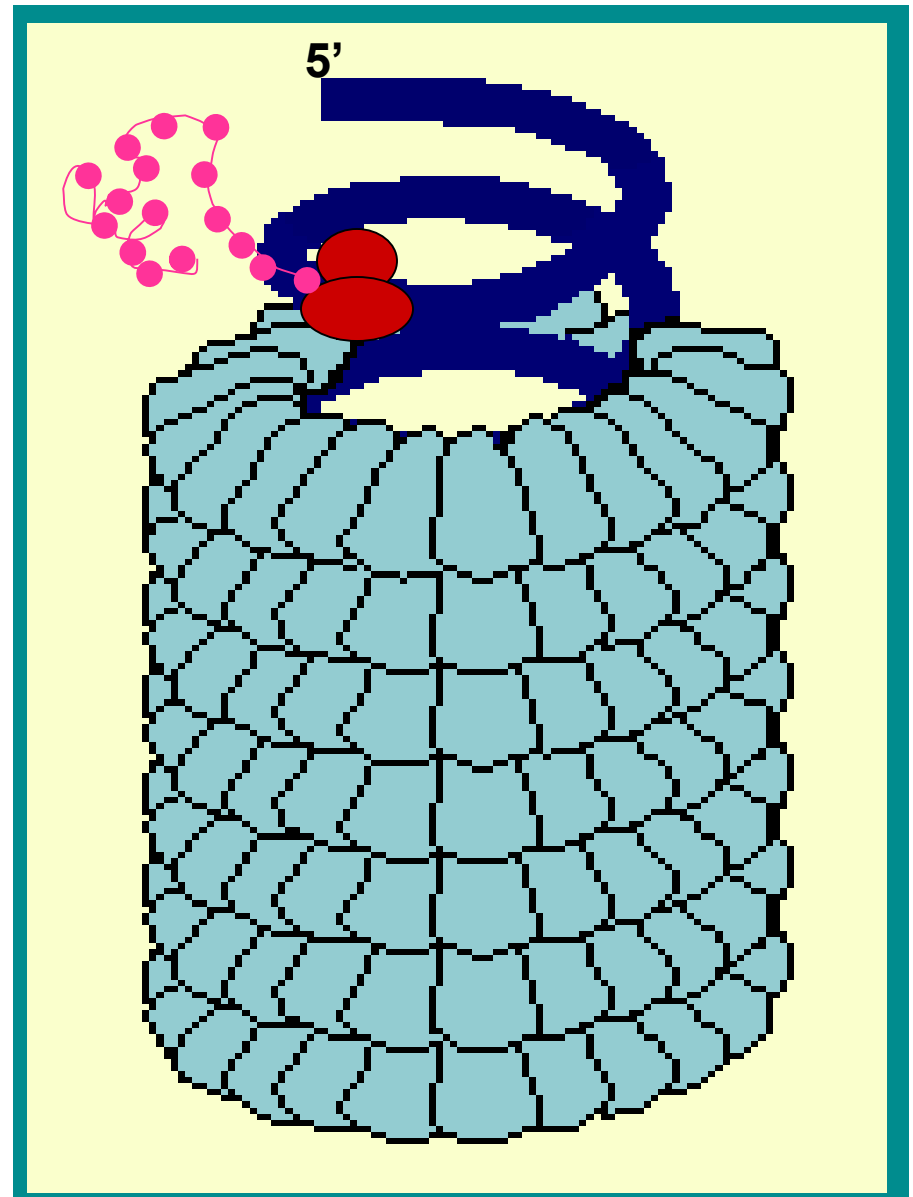


TMV Life cycle

(cont.)

d) Ribosome meets start codon, translates first two proteins (126K ,183 K) while uncoating continues
“co-translational disassembly”

e) 126 K (MET-Hel) & 183 K (RdRp) use viral RNA as template to make full length complementary neg. strand RNA
RNA .../....

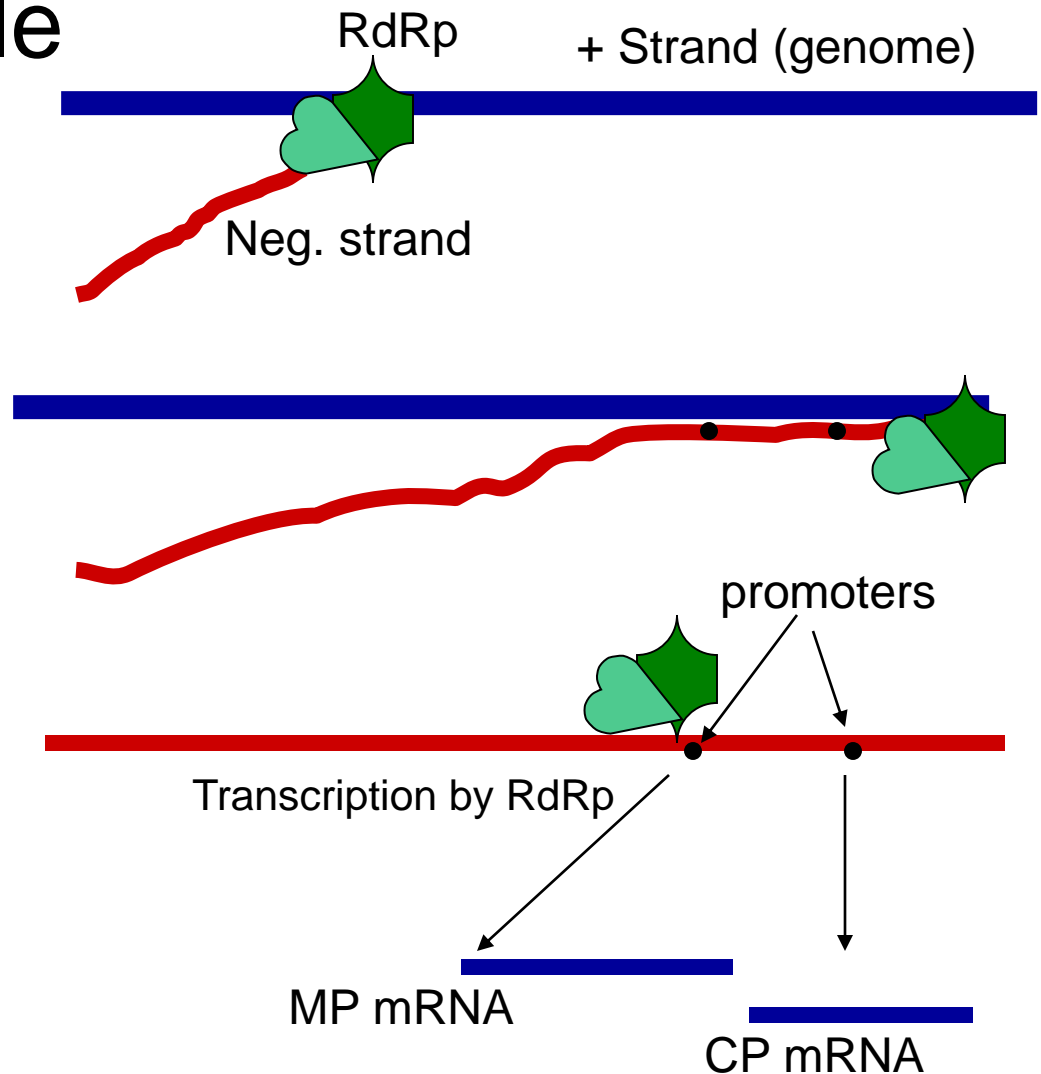


TMV Life cycle

(cont.)

f) Neg. RNA strand used by viral replicase (RdRp/MET-Hel) as template for +RNA

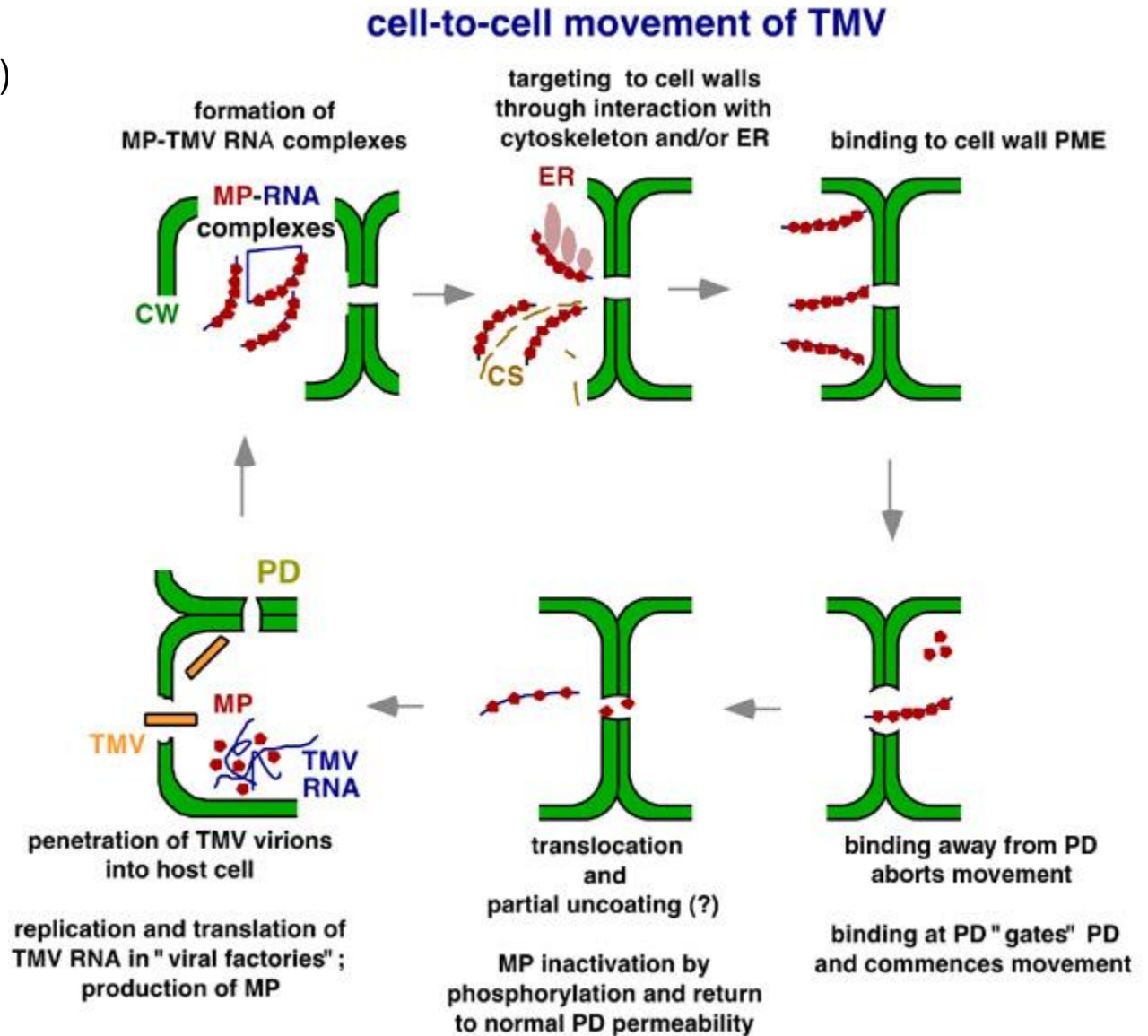
g) Also, neg. RNA strand has internal promoters used by replicase to make mRNA for 30K protein (MP) and 17.5 K (CP)



TMV Life cycle

(cont.)

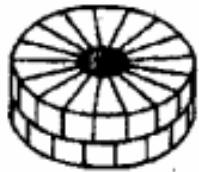
h) MP combines with viral +RNA to move it into new plant cells through plasmodesmata



TMV Life cycle

(cont.)

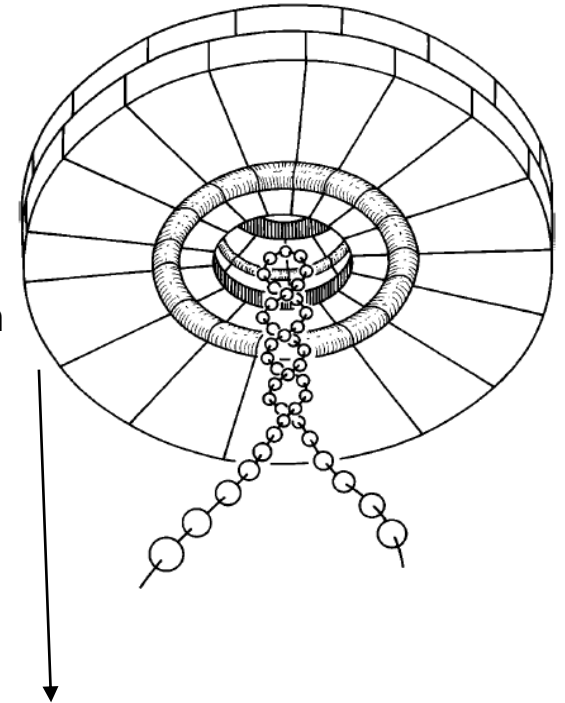
i) Accumulation of +RNA & CP proteins stimulates assembly of progeny virions



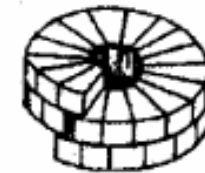
disc

CP units self assemble into discs

Viral RNA interacts with discs



Electrostatic interaction stabilizes structure into helix

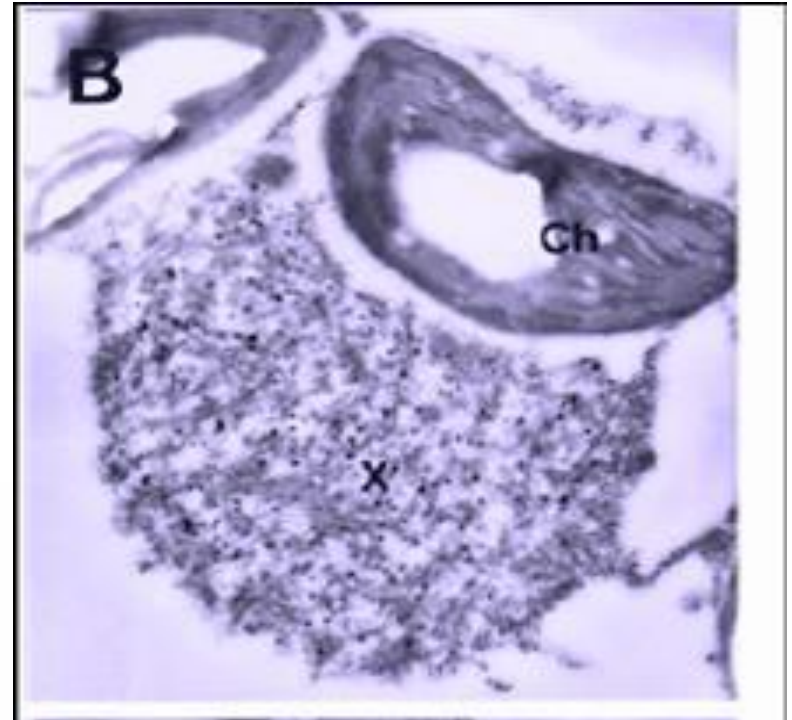
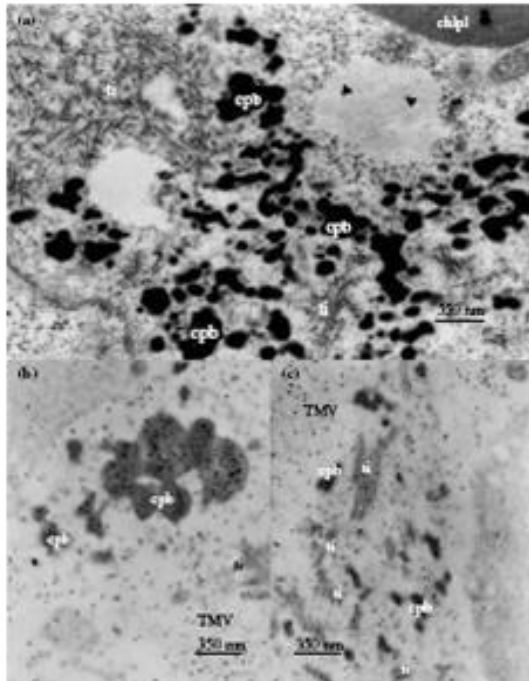


helix

TMV Life cycle

(cont.)

j) massive TMR replication occur in the X-bodies (viroplasmata)



Szececi et al. 1999

Hamacher et al. 2003

Typical RNA-containing plant virus replication cycle

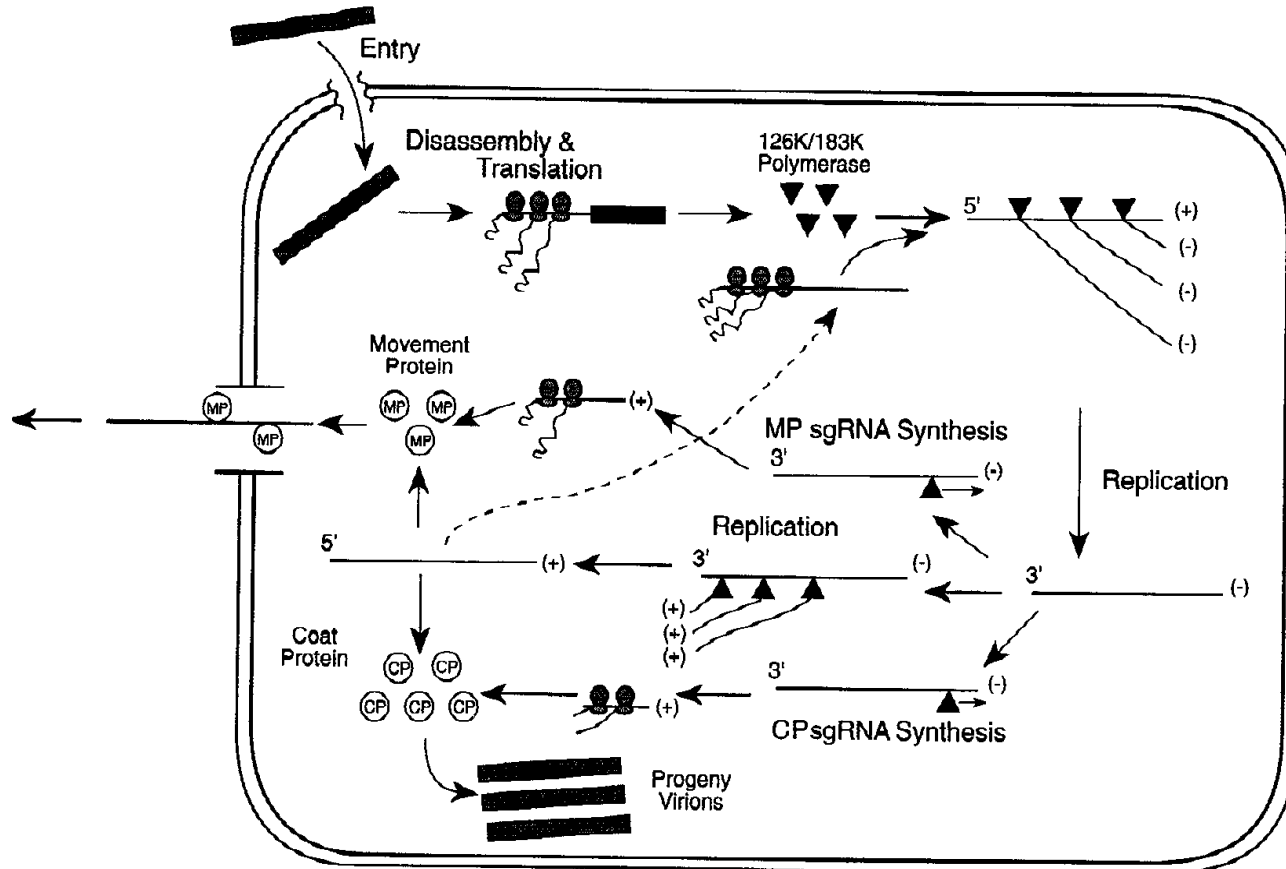
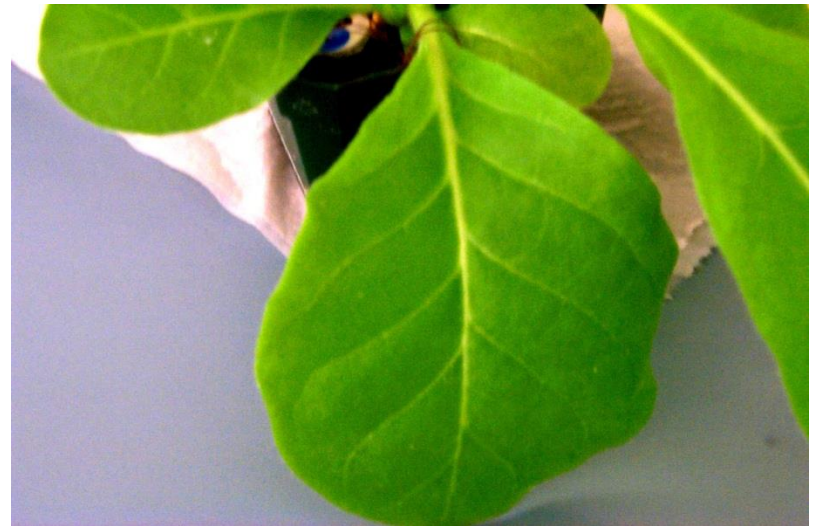
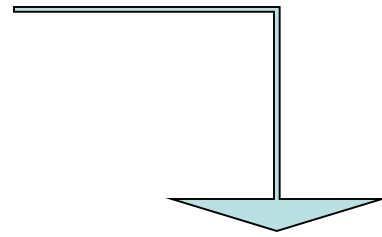


FIG. 8. Diagram of stages in TMV infections. All the events shown are presumed to occur in the cytoplasm of infected cells.

TMV Life cycle

(cont.)

k) Virus will remain in plant tissue and sap until delivered to a new plant host usually by mechanical means



TMV diagnosis

- Symptoms
- E.M. & Serology
- RT-PCR & RFLP

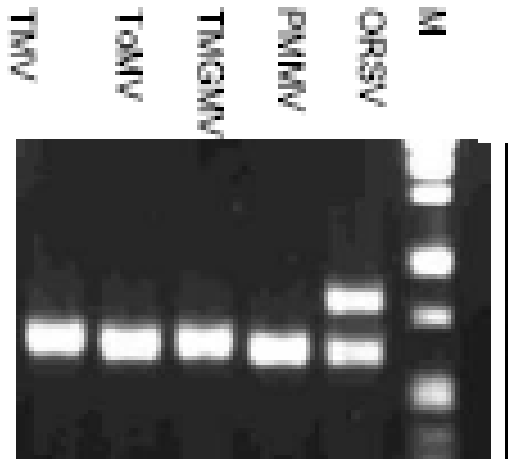
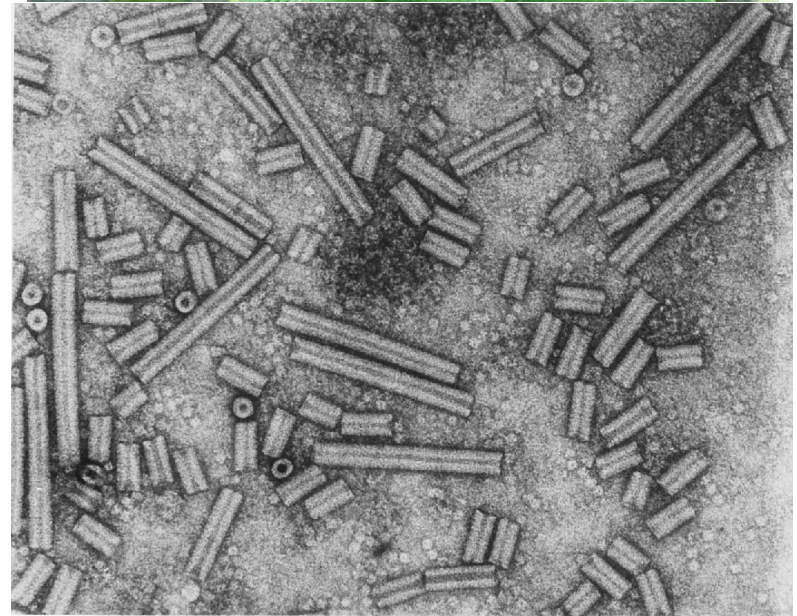


Fig. Tob-Ustil / Tob-Ustil 2



[HTTP://BAKERLAB.BERKELEY.EDU/?IMG=1](http://BAKERLAB.BERKELEY.EDU/?IMG=1)

Current Research on *TMV*

- Improving diagnostic techniques
- Characterization of MP and viral movement through plant
- Characterization of the Helicase & RdRp