

**B.Sc. Botany**  
**Part-I (2019-21)**  
**Paper-II: Microbiology Fungi and Plant Diseases**  
**GROUP-A**

**TOBACCO MOSAIC VIRUS**  
**(TMV)**

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## TOBACCO MOSAIC VIRUS (TMV)

*Tobacco mosaic virus* (TMV) is a positive-sense single-stranded RNA virus species in the genus *Tobamovirus* that infects a wide range of plants, especially tobacco and other members of the family Solanaceae. The infection causes characteristic patterns, such as "mosaic"-like mottling and discoloration on the leaves (hence the name). TMV was the first virus to be discovered.



### Structure of Tobacco Mosaic Virus (TMV):

1. TMV is a simple rod-shaped helical virus consisting of centrally located single-stranded RNA (5.6%) enveloped by a protein coat (94.4%). The rod is considered to be 3,000 Å in length and about 180 Å in diameter.
2. The protein coat is technically called 'capsid'. R. Franklin estimated 2,130 sub-units, namely, capsomeres in a complete helical rod and 49 capsomeres on every three turns of the helix; thus there would be about 130 turns per rod of TMV.
3. The diameter of RNA helix is about 80 Å and the RNA molecule lies about 50 Å inward from the outer-most surface of the rod. The central core of the rod is about 40 Å in diameter. Each capsomere is a grape like structure containing about 158 amino acids and having a molecular weight of 17,000 dalton as determined by Knight.

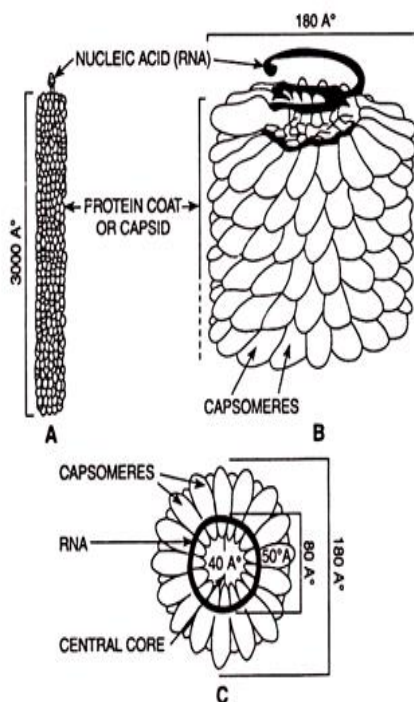
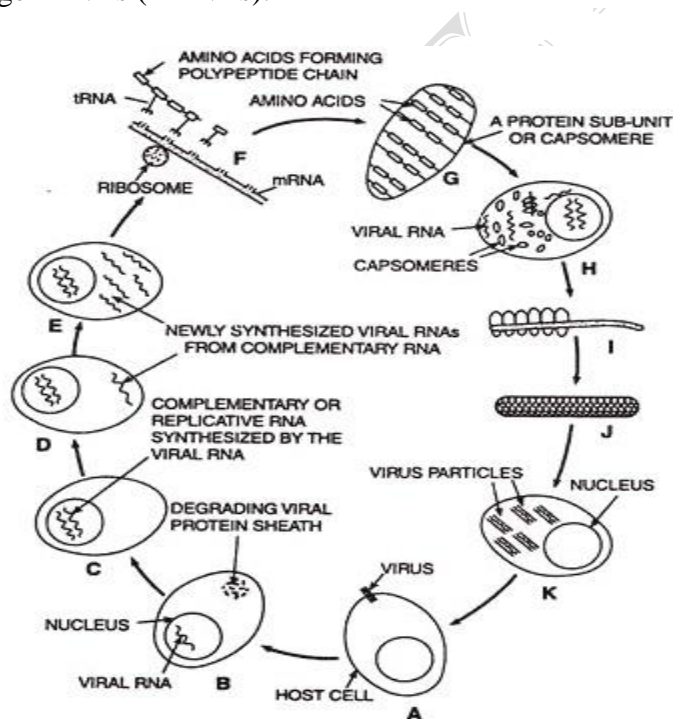


FIG. 13.20. Tobacco mosaic virus (TMV). A. surface view; B. an enlarged portion showing RNA-capsomere arrangement; C. view in section.

4. The ssRNA is little more in length (about 3300 Å) slightly protruding from one end of the rod. The RNA molecule consists of about 7300 nucleotides; the molecular weight of the RNA molecule being about 25,000 dalton.

### Replication of Tobacco Mosaic Virus (TMV)

1. Plant viruses usually enter the host through an abrasion or wound on the plant; biting insects are often involved in transmission of the virus.
2. Following entry into its host, the TMV RNA genome is not immediately transcribed and translated, even though their plus-strand genomes can serve as mRNA. Rather mRNA is generated by a mechanism that is not well understood.
3. The single-stranded viral-RNA synthesizes an additional RNA strand called replicative RNA. This RNA strand is complementary to the viral genome and serves as 'template' for producing new RNA single strands which are the copies of the parental viral-RNA. The new viral-RNAs are released from the nucleus into the cytoplasm and serve as messenger-RNAs (mRNAs).



**FIG. 13.21.** Replication of TMV (diagrammatic). A. Virus particle entering inside the cell of the host plant; B. & C. Viral RNA enters inside the nucleus and synthesizes its complementary copy; D. & E. Complementary RNA synthesizes new viral RNA that comes in the cytoplasm; F. Polypeptide chain synthesis; G., H. & I. Arrangement of capsomeres around viral-RNA; J. Complete virus particle; K. Host cell containing many virus particles.

4. The resulting mRNAs encode several proteins, including the coat protein and an RNA-dependent RNA polymerase.
5. After the coat protein and RNA genome of TMV have been synthesized, they spontaneously assemble into complete TMV virions in a highly organized process.
6. Multiplication of plant viruses within their host depends on the virus's ability to spread throughout the plant. Viruses can move long distances through the plant vasculature; usually they travel in the phloem. The spread of plant viruses in nonvascular tissue is hindered by the presence of tough cell walls. TMV thus spreads slowly, about 1 mm per day or less, moving from cell to cell through the plasmodesmata.

Viral infections of plants often produce microscopically visible intracellular inclusions, usually composed of virion aggregates. Hexagonal crystals of almost pure TMV virions sometimes develop in TMV-infected cells. In addition, the host cell chloroplasts become abnormal and often degenerate, while new chloroplast synthesis is inhibited.