COURSE- B.Sc. PART-II BOTANY HONOURS

PAPER – III

Topic – Ultra structure of TMV, its Replication and Transmission (MICROBIOLOGY)

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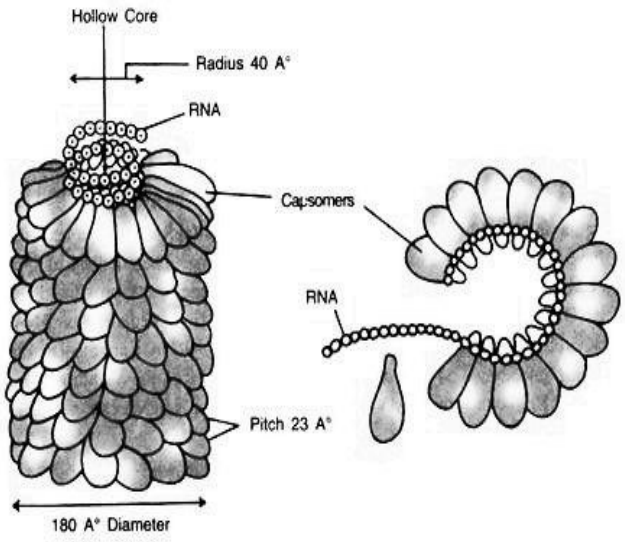
Tobacco mosaic virus (TMV) is a typical plant virus that infects tobacco and other solanaceous plants.

It is a simple rod-shaped helical virus consisting of centrally located single-stranded RNA (ssRNA), which is just 5.6% of the total structure, enveloped by a protein coat (capsid). The viral rod is about 3,000 Å in length and about 180 Å in diameter with 2,130 capsomeres of the capsid in a complete helical rod and 49 capsomeres on every three turns of the helix.

The RNA helix within the capsid is about 80 Å and lies about 50 Å inward from the particle surface. The central core of the rod is about 40 Å in diameter. Each capsomere is composed of about 158 amino acids with a molecular weight of 17,000 dalton.

The ssRNA is about 3300 Å slightly protruding from one end of the rod. The RNA molecule consists of about 7300 nucleotides with the molecular weight of about 25,000 dalton.



Structure of TMV

Life-Cycle (Replication) of Tobacco Mosaic Virus (TMV):

Tobacco mosaic virus enters plant cells only through mechanical wounds which either transiently open the plasma membrane or allow pinocytosis.

It penetrates and enters the host cells completely and their replication completes within the infected host cells. Inside the host cell, the protein coat dissociates and the viral nucleic acid becomes free in the cell cytoplasm. It begins to disassemble within 3 minutes after entry and disassembly of Capsid Proteins from the Capsid is linked with the translation of viral RNA.

Tobacco mosaic virus (TMV) encodes four known functional proteins - the 126 and 183 kDa replication-associated proteins, the movement protein (MP), and the structural capsid or coat protein (CP). In order to have a successful infection, these four multifunctional proteins cooperate with many host components. The host membrane and cytoskeleton are sub-cellular structures important for TMV infection. TMV-induced granules or inclusion bodies that contain membranes also contain host proteins.

For TMV to establish a systemic infection, the virus or its components must move within a cell to establish an infection site, multiply and finally position for the movement to the next cell.

The granules of vRNA that form on initial infection, the VRCs that form during infection and the 126 kDa protein- and MP/vRNA-containing inclusions observed during ectopic expression all move within the cell.

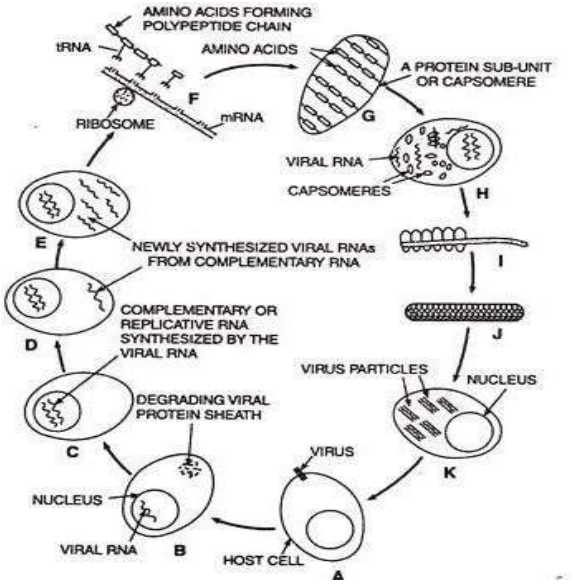
The viral-RNA first induces the formation of specific enzymes called RNA polymerases. The single-stranded viral-RNA synthesizes an additional RNA strand called replicative RNA.

Tobacco mosaic virus and the very closely related *Tomato mosaic virus* (ToMV) use their parental genomes to synthesize complementary negative strands which serve as templates for the synthesis of the progeny full-length positive strands and subgenomic mRNAs containing MP and CP open reading frames (ORFs).

The synthesized RNA strand is complementary to the viral genome and serves as the template for producing new RNA single strands - 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). Each mRNA associates with ribosomes and t-RNA of

the host cell and directs the synthesis of protein subunits.



Once the protein capsomeres are produced in sufficient number, the new viral nucleic acid molecules organize the protein subunits around them resulting in the formation of complete virions.

The host ells remain alive and viruses move from one cell to the another causing systemic infection. When transmitted by suitable means, the viruses infect other healthy plants.

Transmission

Viral particles spread through phloem within the plant. From one plant to another, they are transmitted by direct contact, or indirect contact and human handling.

The dissemination of virus infection throughout a host is the consequence of multiple processes that include replication of viral nucleic acids, protein synthesis and targeting, and cell–cell spread of infectious entities. Plant viruses encode movement proteins (MPs) that are essential for intercellular transport of viral genomes through plasmodesmata, the cytoplasmic bridges that connect adjacent cells. The nature of the infectious entity that moves from cell to cell is different for different viruses. In some Plant virus cases, virions are involved but that by tobacco mosaic virus (TMV) does not involve formation of virus particles required for cell–cell spread of infection.