A Summary of the Tobacco Mosaic Virus Replication Cycle

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Viruses are acellular, and hence obligate 'parasites'. It is impossible for them to survive outside of a cell. While their genome carries ORFs coding for some functional proteins, they do not have the ability to synthesize any of those. Hence, translation of viral proteins is solely dependent on the host translation systems. The viral replication cycle thus goes through the following steps:

1. Entry
2. Uncoating/disassembly
3. Translation of viral replicase
4. Replication of viral RNA, and synthesis of subgenomic RNA
5. Synthesis of 54 kDa protein, movement protein, and coat protein
6. Assembly

Subsequent to entry into the cell, the Tobacco mosaic tobamovirus (TMV) undergoes uncoating, thus releasing its genomic RNA. The TMV RNA is (+)sense single stranded that has special conformations at the two ends, called the 5'-Untranslated Region (5'-UTR) and the 3'-UTR. The 5'-UTR has the 5' cap and a translational enhancer **Ω**. The 3'-UTR on the other hand has pseudoknots and a tRNA-like structure (TLS).

The first ORFs to be translated directly are the ORFs 1 and 2 that share the start codon, to yield the two forms of the viral replicase. The replicase then copies the (+) sense into the complementary (-) sense, that is yet again replicated to give the (+) sense that will form the TMV genome. At the same time, three subgenomic RNAs, are also produced as follows:

sgRNA I_1, translated into the 54 kDa protein (ORF 3)
sgRNA I_2, translated into the 30 kDa MP (ORF 4)
CP sgRNA, translated into the 17.5 kDa CP (ORF 5)

Once the full length genomic RNA is available in the host cell, along with the CP, self-assembly takes place. Approximately 2130 CP subunits encapsidate one molecule of RNA to complete the TMV particle.

References:

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2. Hull, R, 2014, Plant Virology, 5th Ed., Academic Press, 1118 pp.
3. Verma, HN, 2003, Basics of Plant Virology, Oxford and IBH, 228 pp.