Transcript for the Plant Virology course, week 2

2.1. (00:10 00:21) Welcome to the second lecture of the "Plant Virology" course concerning pathogenesis of plant virus diseases

2.2. (00:21 00:33) Plant viruses are placed directly into cells of plants by their vectors or mechanically with "the crude sap" but delivery into cell requires a wound in external surface of plant organs

2.3. (00:33 00:52) The replication cycle of +ssRNA viruses is presented using the example of Tobacco mosaic virus according to Scholthof K.-B.G.2000.

2.4. (00:52 01:55) TMV enters a wounded plant cell to begin the replication cycle **[1].** As the capsid protein (CP) molecules are stripped away from the RNA **[2]**, host ribosomes begin to translate the two replicase-associated proteins. The replicase proteins (RP) are used to generate a negative - sense (-sense) RNA template from the virus RNA **[3].** This (-) sense RNA is, in turn, used to generate both full-length positive-sense (+ sense) TMV RNA **[4]** and the (+) sense subgenomic RNAs (sgRNAs) **[5]** that are used to express the movement protein (MP) and CP. The (+) sense TMV RNA is either encapsidated by the CP to form new TMV particles **[6]** or wrapped with MP **[7]** to allow it to move to an adjacent cell for another round of replication.

2.5. (01:55 02:17) Assembly of viral particles takes place spontaneously. According to Bos, 1999 during this process protein units aggregate to form double protein disc and RNA loop is inserted into the central hole of the disc and intercalating between two layers of spiralizing protein subunits. This results in the formation of helical lockwasher. Both RNA tails protrude from the same end of the rod and……

2.6 (02:17 02:47) ….. the RNA loop on the opposite end of rod interacts with the next incoming disc. Growth of the rod continues in the 5' direction as the loop of RNA receives successive discs. Complete virions often accumulate in large masses in the cells where they were produced.

2.7. (02:47 04:39) In eukaryote protein-synthesizing systems ribosomes are adapted to translate only monocistronic mRNA downstream from its 5' region. Plant viral genomes (+ssRNA) are polycistronic but some mechanisms have been developed to find a way around the mentioned restriction. There are several strategies of expression of plant viral genomes.

According to Matthews, 1991:

Subgenomic RNAs - The synthesis of one or more sgRNA enables the 5'ORF on each such RNA to be translated.

Polyproteins - Here the coding capacity of the RNA for more than one protein, and sometimes for the whole genome, is translated from a single ORF. The polyprotein is then cleaved at specific sites by a viral encode protease.

Multipartite genomes - The 5' gene of each RNA segment can be translated.

Read-through proteins – The termination codon of the 5' gene may be "leaky" and allows proportion of ribosomes to carry on translation to another stop codon downstream from the first, giving rise to a second longer functional polypeptide.

Transframe proteins. Two proteins may commence at the same 5'AUG by a switch of a reading frame near the termination codon of the 5' ORF to give a second longer "transframe" protein.

2.8. (04:39 04:58) During the pathogenesis of viroses, plant viruses use the plant cell energy (ATP) and cell substrates to multiply their own particles and most importantly, they block and deregulate the plant cell translation - ribosomal system.

2.9. (04:58 05:21) There are two routes of virus transport in the plant: short distant virus transport from cell to cell by plasmodesmata and long distant transport by sieves.

2.10. (05:21 05:45) Cell to cell movement of TMV according to Scholthof K.-B.G.2000.
The movement protein (MP) binds to the viral RNA **[1]**. Host proteins and/or other virus-encoded proteins may be included in the MP-complex **[2]**. The MP-complex then moves from cell-to-cell through the plasmodesmata **[3]**. When the complex is localized to a new cell, the MP (and any host proteins) are presumably released from the TMV RNA **[4]**, allowing for translation of the genomic RNA to express the replicase proteins and to initiate a new round of replication **[5].**

2.11. (05:45 06:06) Virus transfer from cell to cell requires plasmodesmata and movement proteins.

2.12. (06:06 06:28) Long distant movement of viruses occurs in phloem tissue (sporadically in xylem).

2. 13. (06:28 06:43) Specific cytological alterations in virus infected plant cells are connected with accumulations of different viral genome products or there are alterations in the cellular membrane system.

2.14. (06:43 06:53) The most obvious products of viral genomes are individual virus particles or aggregates of virions.

2.15. (06:53 07:02) Nonstructural proteins are accumulated in plant cells as inclusion bodies.

2.16. (07:02 07:20) Some of them are very specific e.g. pinwheel structures typical for viruses from the family *Potyviridae.*

2.17. (07:20 07:33) Alterations in the cellular membrane system include proliferations of ER (or other membranes) and accumulations of free vesicles.

2.18. (07:33 07:35) Thank you for your attention.