Transcript for the Plant Virology course, week 1

1.1. (00:10-00:16) Welcome to the first lecture of the "Plant Virology" course.

1.2. (00:17-00:29) I would like to present the plant viruses as infectious agents that cause diseases of plants, called viroses.

1.3. (00:30-01:33) A virus is an infectious, submicroscopic (i.e. light-microscopically invisible), and filterable, non-cellular agent that multiplies only in living cells and often causes disease; it is an intracellular obligate parasite with no energy-producing metabolism of its own. Its particles (the virions or infectious units) consist of a core of nucleic acid (composed of one or more molecules of either RNA or DNA), usually surrounded by a protective coat (composed of one or a few proteins and sometimes an extra lipoprotein envelope). [Bos 1999]. A virus is an elementary biosystem that possesses some of the properties of living systems such as having genome and being able to adapt to changing environments. However, viruses cannot capture and store free energy and they are not functionally active outside their host cells. [van Regenmortel et al. 2000]

1.4. (01:34-01:59) Hypothesis of the origin of plant viruses: degenerated microorganisms, predecessors of microorganisms or autonomous fragments of host nucleic acid.

1.5. (02:00-02:12) Examples of economic losses in the production of various plant crops (in £ or $)

1.6. (02:13-02:35) Based on a survey among 250 plant virologists from the international community (mainly associated with Molecular Plant Pathology) the Top 10 plant virus list was generated. Viruses were nominated based on their scientific/economic importance.

1.7. (02:36-03:12) Explanation of some of the main terms used in plant virology:

Virus genome - a type of nucleic acid

Capsid – protein coat

Capsomer – protein subunit

Nucleocapsid – capsid + nucleic acid

Virion – virus particle, infectious unit of the virus

1.8. (03:13-03:32) Virus particle (virion) is composed of the virus genome (nucleic acid: either RNA or DNA) and the capsid (protein coat, shell) - sometimes with an extra lipoprotein envelope.

1.9. (03:33-03:49) Schematic model of Tomato mosaic virus. The TMV particle resembles of a tower built of bricks and RNA resembles a spiral staircase leading to the top.

1.10. (03:50-04:20) Genomes of plant viruses may be in the form of

ssRNA - single stranded RNA: + sense (can act directly as mRNA) or - sense (must first be transcribed into +strand)

dsRNA –double stranded

as well as ssDNA or dsDNA.

1.11. (04:21-04:56) The molecules of nucleic acids of plant viruses consist of 3 - 20 thousands of nucleotides, it is 3 - 20 base pairs (kbp). For example TMV genome is 6,400 bases long.

Viral genome constitute 3 - 40% of particle weight.

Plant viral genome content - minimum 2 up to 12 ORF (Open Reading Frames), cistrons, but most of +ssRNA genomes code for about 4 to 7 proteins.

1.12. (04:57-05:25) TMV capsid is made of 2,130 molecules of coat protein and each protein monomer consists of 158 amino acids.

Isometric particles are constructed from identical protein subunits arranged with cubic (icosahedral) symmetry on the surface of sphere. Capsomers could form clusters of 5 (pentamers) or 6 (hexamers) structural subunits. Inside the sphere is packed a nucleic acid.

1.13. (05:26-05:46) Morphology of virus particles typical for (+) ssRNA viruses of plants:

Rod-shaped, elongated, rigid particles with size 12-18 x 300nm where 1 nm=10^{-9}m or 10^{-6}mm

1.14. (05:47-05:55) Elongated, flexuous particles with size 12-15 x 600 – 2000 nm

1.15. (05:56-06:10) Isometric (icosaedral) or spherical particles with size 25-30 nm diameter

1.16. (06:11-06:26) Among plant viruses, with the genome other type than (+)ss RNA, also differently shaped virus particles exist such as bacilliform particles with rounded ends, 40-80 x 120-180 nm. It is worthy to mention that some plant viruses have an additional lipoprotein envelope (*Rhabdoviridae, Bunyaviridae: Tospovirus*).

1.17. (06:27-06:46) There are viruses with two isometric particles forming double structures called geminiviruses and there are also capsid-less RNA viruses as in *genera Tenuivirus* and *Umbravirus*.