

Plant Virology

introduction

Plant Virology- An Introduction

- Field of plant pathology that deal with the study of viruses & virus like pathogens and diseases caused by
- Employs all the principles and practices of plant pathology
- Until past century majority of the plant diseases believed to be caused by microbes(i.e. microscopically visible form of life) and some unknown entities of infectious origin, later named virus and virus like pathogens.

- Earliest reference of viral disease was that of Tulip colour breaking by Carolus Clusius (1576).
- 1886- Adolf Mayer: Tobacco mosaic
- 1892- Iwanowski: Tobacco mosaic agent could pass bacterial proof filter
- 1898- E.J. Beijerinck: *Contagium vivum fluidum*- Virus (filterable virus)

What is virus

- **Viruses are submicroscopic entities capable of being introduced into specific living cells and reproduce inside such cells**
 - **Mandahar defined virus as bits of infectious heredity in search of a chromosomes**



- **Too small to be seen with ordinary microscope**
- **Cannot complete their life cycle independently**
- **Transmitted by insects, infected plants, fungi, nematodes, etc.**
- **No pesticides available to control viruses; control by using disease-free or resistant plants and cultural methods**

- The understanding of definition of a virus, first require comparison between various organisms
- Viral nucleic acid – ranges from monocistronic mRNA in STNV to a genome largest than the smallest cell

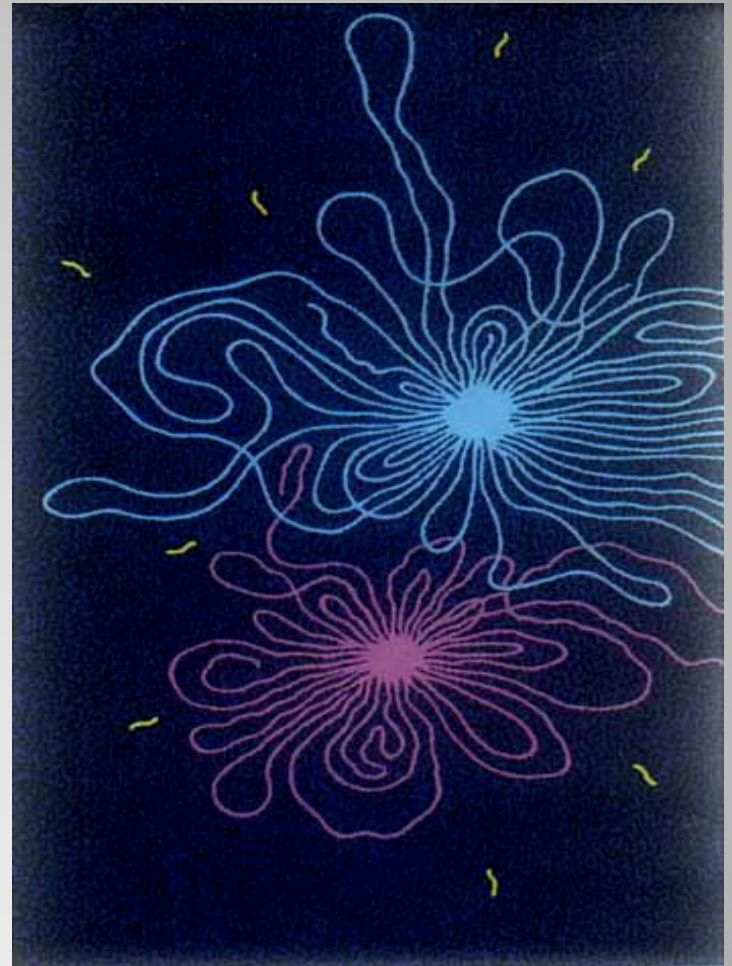
- **Mycoplasma (Phytoplasma):** Doi et al. (1970) are submicroscopic, measuring 150-300 nm in diameter having ribosomes and DNA strands enclosed by a bilayer membrane but not the cell wall, replicate by binary fission, can be cultured artificially *in vitro* on specific medium and are sensitive to certain antibiotics (tetracycline not to penicillin).
 - E.g. Little leaf of brinjal, Peach yellow Spiroplasm citri (Fudt Allh et al. 1571) Citrus stubbesh.

• **Viroids**

(T.O. Diener, 1971):

are small, low mol wt. RNA units (250-370 bp.), lack protein coat, replicate themselves and cause disease

Example: Potato spindle tuber viroid, coconut codang-cadang.



Rickettsiae: **(Windsor and Black, 1972)**

- are non-motile bacteria measuring about 200 - 300 nm in dia., have cell wall, plasma membrane and cytoplasm containing ribosomes & DNA strands; and are obligate:
 1. Multiply by binary fission
 2. Contain enzyme for ATP production
e.g. club leaf of clover, Phoney peach, pierce's disease grape vine

- **Chlamydiae:** are obligate parasites and lack an energy generating system. Have two phases in their life cycle.
 - Outside the host cell they exist as infectious elementary bodies measuring about 300 nm in diameter, have dense contents, no cell wall and are specialized for extracellular survival.
 - Elementary bodies enter the host cell by phagocytosis and within 8 hours, it is converted into a much longer non-infectious reticulate body bounded by a bilayer membrane derived from the host cell. The reticulate body divides by binary fission within this membrane and give rise to thousands of progeny within 40-60 hours. These reticulate bodies are converted into elementary bodies and are released when the host cell lyses.
 - E.g. These cause psittacosis.

Virusoids: Keese & Simon 1986

- A circular, single stranded viroid like satellite RNA measuring 300-400 base long, encapsidated with single stranded linear RNA (450 bp) of velvet tobacco mottle virus.

Lwoff & Tournier (1966): listed five characteristics present in all the viruses and absent in non viral pathogens:

- Viruses possess only one type of nucleic acid (DNA or RNA)
- Reproduce from their sole nucleic acid
- Cannot grow and are unable to divide by binary fission
- Do not have any system to generate energy of high potential and
- Make use of their host ribosomes to carry out their reproduction, strictly intracellular.

- **Luria and Darnell (1967)** defined virus as entities whose genome is an element of nucleic acid (DNA or RNA), reproduce inside living cells by using their synthetic machinery and transfer their nucleic acid to other cells through virions.
- **Gibbs & Harrison (1976)** defined virus as transmissible parasites whose nucleic acid is less than 3×10^8 dalton, that needs ribosome and other cell components of their host cell for multiplication

- **Matthews (1982; 2005)** defined virus as a set of nucleic acid template molecules (either DNA or RNA), encased with in protective coat or coats of protein or lipoprotein, replicate with in suitable host cell an with in such cells the virus production is dependent upon:
 - **Host protein synthesizing machinery**
 - **Composed from a pool of components rather than by binary fission**
 - **Located at sites that are not separated from the host cell contents by a lipoprotein or bilayer membrane**
 - **Continually giving rise to variants through various changes in the viral nucleic acid.**

- **Kassanis (1984)** defined virus as a parasitic nucleic acid which uses their own template molecule to replicate with in living cell alone or with the help of other virus.

- **Plasmids:** these are extra chromosomal genetic elements found in many kind of bacteria and consist of closed circular DNA. Some can become integrated into host chromosome; and replicate with it.
- Some of viruses infecting chromosomes have properties like those of plasmids particularly of integration with host chromosome.

Prions: Prusiner (1982);

(in 1960's GTikvah Alper and John Stanley Griffith)

- **Prion** is an infectious agent composed of protein in a misfolded form. This is in contrast to all other known infectious agents, which must contain nucleic acids (either DNA, RNA, or both) along with protein components.
- The word **prion**, coined in 1982 by Dr. Stanley B. Prusiner, is a portmanteau derived from the words *protein* and *infection*.
- Prions are responsible for the transmissible spongiform encephalopathies in a variety of mammals, including bovine spongiform encephalopathy (BSE, also known as "mad cow disease") in cattle and Creutzfeldt-Jakob disease (CJD) in humans.
- All known prion diseases affect the structure of the brain or other neural tissue and all are currently untreatable and universally fatal.

Prions: Prusiner (1982)

- **Stanley B. Prusiner** of the University of California, San Francisco announced in 1982 that his team had purified the hypothetical infectious prion, and that the infectious agent consisted mainly of a specific protein – though they did not manage to isolate the protein until two years after Prusiner's announcement.
- **Prusiner** coined the word "prion" as a name for the infectious agent. However, the specific protein of prion is also known as the **Prion Protein (PrP)**, though this protein may occur both in infectious and non-infectious forms.
- Prusiner was awarded the Nobel Prize in Physiology or Medicine in 1997 for his research into prions.

Economic Importance of Viruses

- Causes important diseases in different plants
- Experimental studies on various aspects of life sciences. Losses caused by virus diseases
 - Rice tungro-in SE Asia $\$1.5 \times 10^9$ /year
 - Barley yellow dwarf in wheat-In UK- $\pounds 5 \times 10^6$
 - PVY
 - PUX
 - PLRV
- Citrus tristeza world wide $\pounds 9-24 \times 10^6$
- African Cassava mosaic Africa $\pounds 2 \times 10^9$
- Losses depends upon type of crop, stage
- Plant once infected leads to degeneracy.