

HISTORY OF PLANT PATHOLOGY (ROLE OF OTHER PLANT PATHOGENS)

Aim: To acquaint the students with history of Plant Pathology (Role of other Plant Pathogens)

Bacteria as Plant Pathogens

- In 1882, T.J. Burrill of USA for the first time reported that a plant disease (fire blight of apple and pear) was caused by a bacterium (now known as *Erwinia amylovora*).
- Wakker (1883) showed that yellows disease of hyacinth was also caused by a bacterium.
- E.E. Smith of USA is regarded the most outstanding and main contributor to the discovery of most of plant diseases due to bacteria since 1895. He is considered Father of Phytobacteriology for his discoveries and methodologies.
- Smith's name is still remembered as he resolved the controversy with the German scientist A. Fischer (1897, 99) who did not agree that bacteria were the causes of diseases in plants.
- Smith was also among the first to notice and study the crown gall disease (1893, 1894). He considered crown gall similar to cancerous tumors of humans and animals.
- Later in 1977, it was demonstrated by Chilton and his team that the crown gall bacterium, *Agrobacterium tumefaciens* transforms the normal plant cells in tumour cells by introducing into them a part of plasmid which becomes inserted into the plant cell chromosome DNA.

Viruses

- Virus diseases of plants have a long history. Among many diseases of unknown cause, potato leaf roll, as „leaf curl“ gave concern in the 2nd half of 18th century and broken tulips were illustrated by painters 200 years before that.
- There were many methods of transmission of leaf mottling of jasmine and passion flower by grafting.
- In 1886, Adolf Mayer, a German Director of Agricultural Experiment Station at Wageningen, Netherland, introduced the term „mosaic“ and showed that the mosaic was infectious and the juice from infected plants if applied to the healthy plants could reproduce the disease.
- In 1891, Smith showed that the peach yellows was contagious disease and could be bud transmitted.
- In 1892, Dimitri Ivanowski proved that the causal agent of tobacco mosaic disease could pass through bacteria proof filters.
- In 1898, Beijerinck, (Father of Plant Virology) a distinguished Dutch microbiologist, demonstrated that the causal agent of tobacco mosaic could diffuse through an agar- agar membrane and concluded that the tobacco mosaic was caused by a non-corpuscular “contagium vivum fluidum” (or contagious living fluid) and called founder of virology and it's a virus.

- Stanley (1935) obtained a crystalline protein by treating the juice of the tobacco mosaic infected leaves with ammonium sulphate, which when placed on the healthy leaves could produce the disease symptoms. It was the first major contribution regarding the nature of the viruses and was awarded Noble Prize for it.
- In 1936, Bawden and Pirie discovered the real nature of the Tobacco mosaic virus and demonstrated that the crystalline preparations of the virus actually consisted of not only proteins but also small amount of nucleic acid (RNA).
- In 1939, Kausche et al. viewed first Tobacco mosaic virus particles under electron microscope.
- Finally in 1956, Gierrer and Schramm showed that the nucleic acid fraction of the virus is actually required for infection and multiplication in the host and protein coat provided the protective covering to it.

Viroids

- In 1971, Diener and Raymer reported that the potato spindle tuber disease was caused by a small (250-400 base pair long), single stranded circular molecule of infectious RNA, which he called a viroid.
- Viroids seem to be the smallest nucleic acid molecules to infect plants but no viroid has so far been found in animals.
- Since then a dozen more viroids have been reported.
- In 1982, a circular single stranded viroid-like RNA (300-400 base pairs long) was found encapsidated together with the single stranded linear RNA (about 4500 base pairs long) of velvet tobacco mottle virus. This small circular RNA was called Virusoid which seems to form an obligatory association with the viral RNA in many plant viruses.

Phytoplasma and Rickettsia like Organisms

- Doi et al. (1967) and Ishiie et al. (1967) independently observed Mycoplasma Like Organisms (MLOs) now called as phytoplasma in the phloem of plants exhibiting yellows and witches' broom symptoms (earlier thought to be caused by viruses).
- The number of plant diseases of phytoplasma etiology is large. Some examples are aster yellows, mulberry dwarf, potato witches' broom and sandal spike.
- These organisms resembling mycoplasma could not be isolated and cultivated on artificial cell free media and they have shown more relatedness to acholeplasma than the mycoplasma, and are called phytoplasma.
- Later in 1973, some of the mycoplasmas such as the causal agent of citrus stubborn and corn stunt diseases could be grown in cell free media, and were helical in morphology and had motile stages and were named as spiroplasma. The agent Spiroplasma citri causing citrus stubborn is the type species of the genus and *S. kunkelli* causes corn stunt.

Fastidious Vascular Bacteria

- Some organisms were also observed in grapevines infected with Pierce's disease, in peach infected with phony peach and others.

- More recently such diseases have been reported to be caused by fastidious vascular xylem limited bacteria *Xylella fastidiosa*, and phloem limited bacteria *Candidatus liberobacter*.
- Examples of xylem inhabiting fastidious bacteria causing diseases: Pierce's disease of grapevine, citrus variegated chlorosis, almond leaf scorch.
- Examples of phloem inhabiting fastidious bacteria are: Club leaf of clover, citrus greening, yellow vine disease of watermelon, bunchy top of papaya.

Flagellate Protozoa

- In 1909, Lafont observed flagellate protozoa in the latex bearing cells of laticiferous plants of Euphorbiaceae family without causing any harm to their hosts.
- However, in 1931, Stahel found the flagellates infecting phloem of coffee plants and causing abnormal phloem formation and wilting of trees.
- Vermeulen in 1963 presented additional and more convincing evidence of the pathogenicity of flagellates to coffee trees and in 1976, flagellates were also found in the phloem of coconut palm trees infected with the heart rot disease.