

Tobacco Mosaic Virus (TMV)

Introduction

Tobacco mosaic virus (TMV) is a plant virus that belongs to the genus *Tobamovirus* that infects a wide range of plants. This disease affects more than 150 genera of primarily herbaceous, dicotyledonous plants including many vegetables such as potatoes, tomatoes and other members of the Solanaceae family. It is named so because it majorly infects tobacco plants. The infection creates a mosaic like pattern, mottling and discoloration of the leaves. TMV affects plants by damage of leaf, flower and fruit and causes stunting of the plant.

Discovery

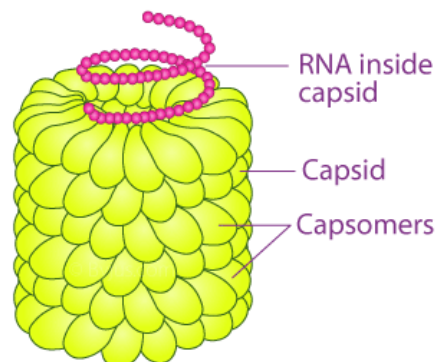
Adolf Mayer, a German chemist first started studying the diseases in tobacco plants in 1879. By 1886 he was able to describe how leaf mottling disease was able to transfer from infected plants to healthy plants by rubbing infected plant juice over the healthy one, similar to bacterial infection.

Dmitri Ivanowsky, a Russian microbiologist, started investigating the tobacco mosaic disease between 1887 and 1890. He came to the conclusion that the causal organism could pass through the porcelain filter that was fine enough to hold the bacterial organisms and thus he believed that it was a non-bacterial infectious agency.

Later, Martinus Beijerinck replicated Ivanowsky's work independently and showed that the causative agent was able to replicate and multiply in the tobacco plant host cell. Thus he coined the term 'virus' to show the non-bacterial nature of the tobacco mosaic disease.

Structure

- The tobacco mosaic virus (TMV) has a rod-like appearance that is 300 nm long with a diameter of 18 nm.
- It is covered by a protein shell called capsid that encloses the virus's genetic material.
- The genetic material is a single-stranded RNA molecule.
- The capsid is made up of 2130 protein subunits that assemble in a rod-like helical structure possessing 16.3 proteins per helix turn.
- The RNA is found in a coiled manner inside the capsid coat and is made up of approximately 6400 nucleotides.



Symptoms

The symptoms include various degrees of chlorosis, curling, mottling, dwarfing, distortion and blistering of leaves, dwarfing of entire plant, dwarfing, distortion and discoloration of flowers and in some plants even development of necrotic areas on leaf.

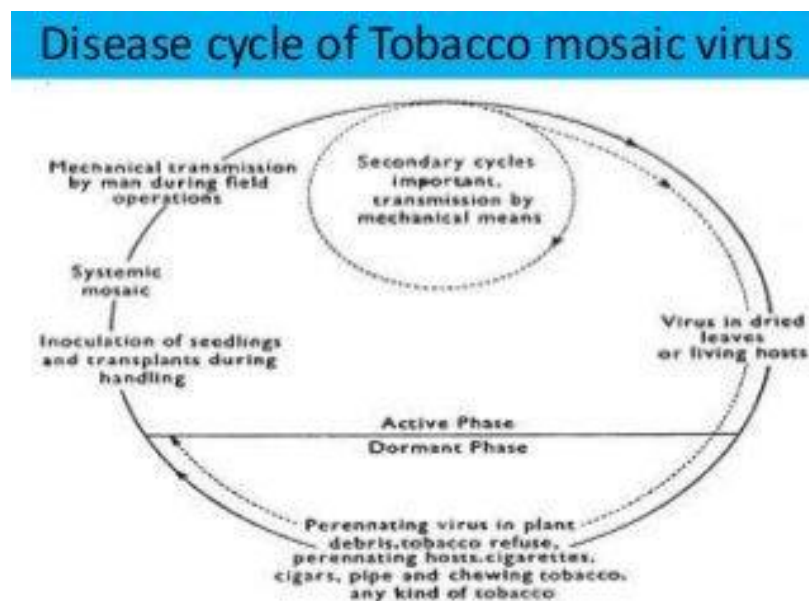
The most common symptom on tobacco is the appearance of mottled dark green and light green areas on leaves. The dark green areas are thicker and appear somewhat elevated in a blisterlike manner over the thinner, chlorotic, light green areas. Stunting of young plants is common and is accompanied by a slight downward curling and distortion of leaves that may become narrow and elongated rather than normal oval shape. Old leaves may not show symptoms, young ones develop typical symptoms.

Disease Cycle

The virus gets inside the plant host cells via vectors such as aphids, flies and other insects. After entering the host cell the virus starts to multiply and spreads to the nearby cells via plasmodesmata.

The virus can be transmitted to other healthy plants by coming in direct contact with the infected plants. For replication and multiplication inside the host cell, the viral particle releases its genomic material. The ssRNA then translates multiple mRNAs that can replicate the viral genome and the capsid proteins. All these proteins assemble to form a newly synthesised cell of tobacco mosaic virus that is ready to infect another cell.

TMV survives in infected leaves and stalks in the soil, on the surfaces of contaminated seeds and on contaminated seed bed cloth and in natural leaf and manufactured tobacco including cigarettes, cigars etc. The virus initially infects wounded tissues of tobacco seedlings in seedbed or of transplants in the field. Then it spreads in the field throughout the season. TMV in all plants produces systemic infections, invading all parenchyma cells of plant. The virus moves from cell to cell through plasmodesmata, multiplies and infects each cell, and, when it reaches the phloem, travels systemically through it infecting the whole plant. In the cytoplasm of cell TMV appears as crystalline aggregates and as amorphous bodies.



Disease management

Sanitation and use of resistant varieties are most effective methods. Crop should not be grown at least for two years in seedbeds or fields where diseased crop was grown. Removal of diseased plants and of some solanaceous weeds harboring the virus early in the season helps in reduction and elimination of subsequent spread of the virus. Chewing and smoking of tobacco during handling of tobacco and other susceptible plants should be avoided. Workers in the field must wash hands with 3% trisodium phosphate or soap. Equipment and instruments used in plantations must be sterilised. TMV-resistant varieties of tobacco must be grown, though these may be of low quality.