DNA and RNA viruses

DNA Viruses

- As their name implies, DNA viruses use DNA as their genetic material.
- Some common examples of DNA viruses are parvovirus, papillomavirus, and herpesvirus. DNA viruses can affect both humans and animals and can range from causing benign symptoms to posing a very serious health risk.
- DNA viruses enter a host cell, usually when the membrane of the virus fuses with the cell's membrane.
- The contents of the virus enter the cell, travel to the nucleus and take over the cell's biochemical machinery for DNA replication and transcription into RNA.
- The RNA controls the formation of proteins needed by the virus to coat the viral DNA.
- This coating of viral DNA is known as a capsid.
- The capsids accumulate inside the cell until the cell reaches capacity and bursts open, releasing the newly formed viruses to infect new host cells.

RNA Viruses

- RNA viruses, also known as retroviruses, have RNA as their genetic material.
- Some examples of retroviruses are hepatitis viruses and HIV.
- When these viruses enter a host cell, they must first convert their RNA into DNA.
- This process, called reverse transcription, enables the virus to inject its genetic material into the host cell and use the host's biochemical machinery, similar to a DNA virus.
- Often, retroviruses use an enzyme, called integrase, to insert the retroviral DNA into the genome of the host cell.
- The ability of retroviruses to integrate this DNA into the host cell's DNA increases the chances of causing cancer or other diseases.
- For example, if the retroviral DNA is inserted into the middle of one of the host cell's genes, that gene may no longer be functional, leading to disease.

Tobacco Mosaic Virus: symptoms, transmission and management

Tobacco mosaic virus (TMV) can infect a wide range of hosts, and losses of up to 20% have been reported in infected tomatoes. Phillip Mphuthi of the Agricultural Research Council's (ARC) Industrial Crops unit in Rustenburg discusses TMV detection, prevention and management.

A typical mosaic pattern on flue-cured tobacco leaves infected with tobacco mosaic virus.

Tobacco mosaic virus (TMV) was the first virus discovered in 1889, Martinus Beijerinck, found that 'tobacco mosaic disease' was caused by a pathogen able to reproduce and multiply in the host cells of the plant. He called it 'virus' (from the Latin virus, meaning poison) to differentiate this form of disease from those caused by bacteria.

Tobacco yield losses due to TMV are currently estimated at only 1%, because resistant tobacco varieties are routinely grown. However, TMV affects other crops, and losses of up to 20% have been reported in tomatoes.

TMV can be a major problem because, unlike most other viruses, it does not die when the host plant dies and can withstand high temperatures. Thus, the virus can survive on implements, trellis wires, stakes, greenhouse benches, containers and contaminated clothing for many months. It can also survive in crop debris on the soil surface and infect a new crop planted on contaminated land.

Tobacco products, particularly those containing air-cured tobacco, may carry TMV too. The virus cannot be transmitted in the smoke of burning tobacco, but smokers, especially those who roll their own cigarettes, could possibly carry the virus on their hands and transmit it to healthy plants.

Sap-feeding insects such as aphids cannot transmit TMV. However, chewing insects such as grasshoppers and caterpillars do occasionally transmit the virus. They are not considered important vectors, however.

Transmission

Tobacco mosaic virus is usually spread from plant to plant via 'mechanical' wounds caused by contaminated hands, clothing or tools such as pruning shears and hoes. This is because TMV occurs in very high concentrations in most plant cells. When plants are handled, the tiny leaf hairs and some outer cells are inevitably damaged and leak sap onto hands, tools and clothing.

Seeds from infected plants can also carry the virus on their seed coats. The earlier the age at which the mother plant is infected, the more likely it is that the virus will contaminate the seed coat during seed harvesting. When the seed germinates, the virus may enter the seedling through small cuts caused by transplanting and handling, or during the germination/emergence process.

Once inside the plant, the virus releases its genetic code (RNA). The plant mistakes this for its own RNA, and starts to produce viral proteins.

The virus then spreads to neighbouring cells through microscopic channels in the cell walls (plasmodesmata), and eventually enters the translocation system of the plant (xylem and phloem). From here, it spreads to the entire plant.

Signs and symptoms

Symptoms first appear about 10 days after infection. The plants do not usually die, but growth can be seriously stunted. In the case of tomatoes, certain TMV strains can cause deformed fruit, non-uniform fruit colour and delay ripening.

Specific symptoms depend on the host plant, age of the infected plant, environmental conditions, the virus strain and the genetic background of the host plant.

However, common signs include mosaic-like patches (mottling) on the leaves, curling of leaves and the yellowing of plant tissues.

Managing the virus

No chemicals can cure a plant infected with a virus, and TMV is no exception. As mentioned before, however, resistant plant varieties are available.

You will need to consider adaptability, potential yield and resistance to other important diseases when selecting varieties.