

FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

Lecture 3

Symptomatology of important plant viral diseases

Symptoms on plants may be local on the inoculated leaves and/or systemic on spread to other parts of the plant from inoculated leaves.

A. Local Symptoms

Localized lesions that develop near the site of entry on leaves are not usually of any economic significance but are important for biological assay.

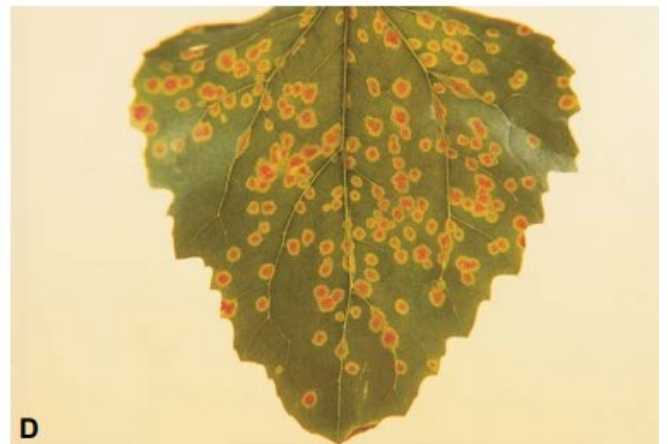
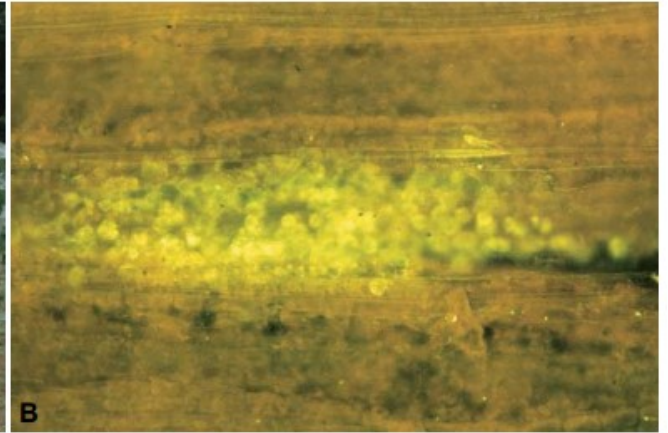
Three types of local response to infection can result:

Necrotic local lesions in which the infected cells die and that vary from small pinpoint to large irregular spreading necrotic patches;

Chlorotic local lesions in which the infected cells lose chlorophyll and other pigments;

Ring spot lesions that typically consist of a central group of dead cells beyond which develop one or more superficial concentric rings of necrotic or chlorotic cells with normal green tissue between them.

Some viruses in certain hosts show no visible local lesions in the intact leaf, but when the leaf is cleared in ethanol and stained with iodine, “starch lesions” may become apparent.



Types of local lesion symptoms. (A) Mechanical inoculation of corn seedlings with sugarcane mosaic virus (SCMV) — infected sap. (B) Early lesion of SCMV infection detected by immunofluorescent microscopy. (C) Local lesions caused by SCMV on sorghum leaf. (D) Local

lesions on Chenopodium leaf caused by potato virus Y. Local lesions on cowpea leaves caused by alfalfa mosaic virus (AMV) (E) and on tobacco leaves caused by tomato ring spot virus (F).

B. Systemic Symptoms

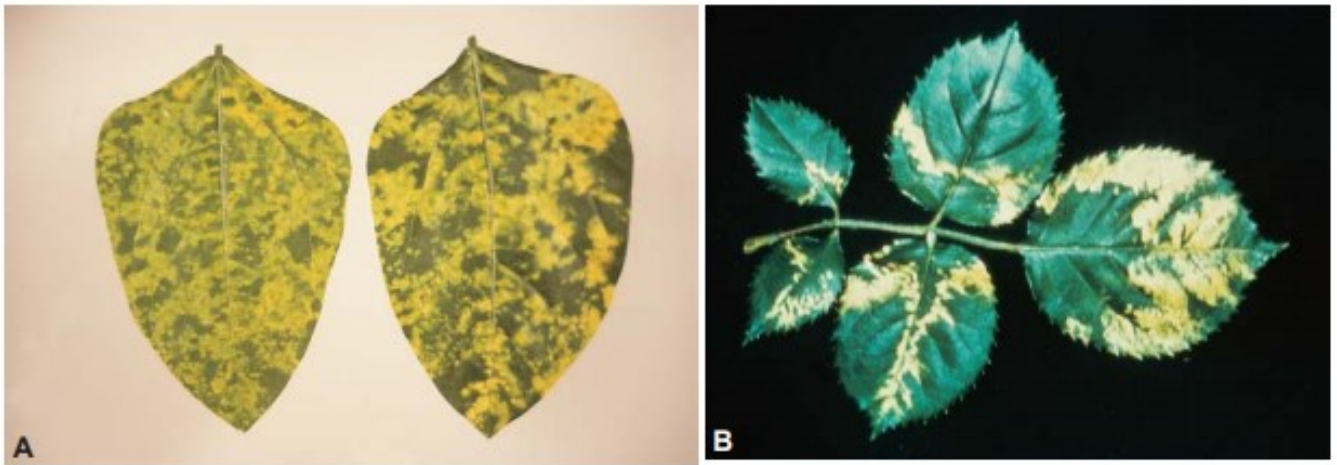
Various symptoms often appear in combination in particular diseases, and the pattern of disease development for a particular host-virus combination often involves a sequential development of different kinds of symptoms.

1. Effects on Plant Size

Reduction in plant size is the most general symptom induced by virus infection. The degree of stunting is generally correlated with the severity of other symptoms, particularly where loss of chlorophyll from the leaves is concerned. Stunting is usually almost entirely due to reduction in leaf size and internode length. Leaf number may be little affected.

2. Mosaic Patterns and Related Symptoms

One of the most common obvious effects of virus infection is the development of a pattern of light and dark green areas, which creates a mosaic effect in infected leaves. The detailed nature of the pattern varies widely for different host-virus combinations. In dicotyledons, the areas that make up the mosaic are generally irregular in outline. For example, only two shades of colour like dark green and a pale or yellow-green may be involved, or there may be many different shades of green, yellow, or even white, as with Turnip yellow mosaic virus (TYMV) in Chinese cabbage.



Some of the types of symptoms caused by viruses on plants. (A) Mosaic or mottle on cowpea leaf. (B) Line pattern or mosaic on rose leaves.

In monocotyledons, a common result of virus infection is the production of stripes or streaks of tissue lighter in colour than the rest of the leaf. The shades of colour vary from pale green to yellow or white, and the more or less angular streaks or stripes run parallel to the length of the leaf.

A variegation or “breaking” in the colour of petals commonly accompanies mosaic or streak symptoms in leaves. The breaking usually consists of flecks, streaks, or sectors of tissue with a colour different from normal (see Box 1.1). The breaking of petal colour is frequently due to loss of anthocyanin pigments.

3. Yellow Diseases

Viruses that cause a general yellowing of the leaves are not as numerous as those that cause mosaic diseases, but some, such as the viruses that cause yellows in sugar beet, are of considerable economic importance. The first sign of infection is usually a clearing or yellowing of the veins in the younger leaves followed by a general yellowing or reddening of the leaves.

4. Leaf Rolling

Virus infection can result in leaf rolling, which is usually upward but occasionally downward. Pronounced epinasty (downward bending of leaves) may sometimes be a prominent feature. Example: Potato leaf roll virus.

5. Ring Spot

Diseases Ring spots are a pattern of concentric rings and irregular lines on the leaves and sometimes also on the fruit. The lines may consist of yellowed tissue or may be due to death of superficial layers of cells, giving an etched appearance. In severe diseases, complete necrosis through the full thickness of the leaf lamina may occur. Ring spot patterns may also occur on other organs, such as bulbs and tubers. Example: Tobacco ring spot virus, Papaya ring spot virus.

6. Necrotic Diseases

The death of tissues, organs, or the whole plant is the main feature of some diseases. Necrotic patterns may follow the veins as the virus moves into the leaf. In some diseases, the entire leaf is killed. Necrosis may extend fairly rapidly throughout the plant. For example, with joint infections of Potato virus X (PVX) and Potato virus Y (PVY) in tomatoes, necrotic streaks appear in the stem. Necrosis spreads rapidly to the growing point, which is killed, and subsequently all leaves may collapse and die. Wilting of the parts that are about to become necrotic often precedes such systemic necrotic disease.

7. Developmental Abnormalities

Besides being generally smaller than normal, virus-infected plants may show a wide range of developmental abnormalities. Such changes may be the major feature of the disease or may accompany other symptoms. For example, uneven growth of the leaf lamina is often found in mosaic diseases. Dark green areas may be raised to give a blistering effect, and the margin of the leaf may be irregular and twisted.

In some diseases, the leaf blade may be more or less completely suppressed—for example, in tomatoes infected with Cucumber mosaic virus (CMV).

Some viruses cause swellings in the stem, which may be substantial in woody plants—for example, in Cocoa swollen shoot virus (CSSV) disease. Another group of growth abnormalities

is known as enations, which are outgrowths from the upper or lower surface of the leaf, usually associated with veins.

Viruses may cause a variety of tumour-like growths. The most studied tumours are those produced by Wound tumor virus (WTV). In a systemically infected plant, external tumours appear on leaves or stems where wounds are made.

Stem deformation such as stem splitting and scarring is caused by some viruses in some woody plants. Virus infection of either the rootstock or scion can cause necrosis and/or failure of the graft union. One of the unusual symptoms of BSV (Banana streak virus) in some *Musa* cultivars is that the fruit bunch emerges from the side of the pseudostem instead of the top of it. This is due to necrosis of the cigar leaf.

8. Wilting

Some virus infections induce wilting of the aerial parts, leading to the death of the whole plant.

E.g. Citrus tristeza virus

9. Genetic Effects

Infection with Barley stripe mosaic virus (BSMV) induces an increase in mutation rate in *Zea mays* and also a genetic abnormality known as an aberrant ratio (AR). This AR effect was observed only when the original pollen parent was infected and showing virus symptoms on the upper leaves. The AR effect is inherited in a stable manner in plants in which the virus can no longer be detected, with a low frequency of reversion to normal ratios.