Plant virus Symptoms

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Plant virus symptoms

- Important for virus identification
- Used to name the disease
- Solely cannot be used to characterize the virus as affected by many factors
- Environment, virus strain/mixed infections, host varieties, nutrition, age, stage of infection
Types of Symptoms

- Macroscopic symptoms
- Microscopic/ Histological changes
Macroscopic Symptoms

- **Macroscopic Symptoms**
- **Local symptoms**
  - Develops near the site of entry of the virus,
  - *Important in biological assay*
  - Size vary from small pinpoint spots to large necrotic areas
  - *Generally produced in mechanical inoculations*
    - Chlorotic lesions
    - Necrotic lesions
    - Ring spots
Local symptoms

local lesions: necrotic, chlorotic

Local lesions BCMNV
Systemic symptoms

Systemic: cell → cell → tissue → leaf → whole plant

Plasmodesmata  →  veins  →  vascular system
Systemic symptoms

- Appear in different patterns depending upon virus-host combinations
- Appear in sequential patterns and
- May comprise of different symptoms
Plant virus Symptoms

1. Mosaic
2. Mottle
3. Yellowing
4. Chlorosis
5. Vein clearing
6. Vein banding
   - Green vein banding
   - Yellow vein banding
7. Leaf roll
8. Leaf curl
9. Streak
10. Blistering
11. Phyllody
12. Enation
13. Witches broom
14. Proliferations
15. Stunting
16. Ringspot
17. Wilt
18. Tumors/ galls
19. Necrosis
1. Effect on plant size

- **Stunting**
  - Occurs due to reduction in leaf size and inter-nodal length of the infected plant
  - Depend upon stage of infection of the host. And severity of the symptoms
  - Stunting may affect all parts of plants
  - Type of host e.g. in perennial plants – takes more time; in vegetative plants effects are evident over years
2. Mosaic patterns and related symptoms

- Most common effect of virus infection in the form of colour patterns on leaves
- Various colour patterns like green & dark green; green & yellow and green & golden etc.
- Generally depends on different host-virus combinations
- Borders between green and dark green areas may be distinct or diffused
- the patterns appears in systematic sequences
- Mosaic appears at very early stages or some time chlorosis also occurs.
- Other patterns includes
  - vein banding along with vein banding.
  - Stripes
  - Streaks
  - Variegation or breaking in petal color (consist of flecks, streaks, or diff. colors segments. In petals generally due to loss of anthocyanin
- Patterns on fruits e.g cucumber – CMV (mottle)
Mosaic patterns
- Common mosaic
- Yellow mosaic
- Golden mosaic

Mosaic BCMV

yellow mosaic
MYMV

Golden mosaic CpGMV
KATTE DISEASE of cardamom
Mosaic on infected fruits: CMV
Green Vein banding
Tulip variegation
Variegation
**Chlorosis:**

The loss of chlorophyll from the tissues of a plant, resulting from microbial infection, e.g. viral infection, the action of certain phytotoxins, the lack of light, to magnesium or iron deficiency, etc.
3. Yellows

- Induced by some viruses e.g. sugarbeeet, peach yellow,
- May be sight or severe; covers whole leaf or some times sectors of yellow and normal colour are formed

**Yellowing**: A symptom characterized by the turning yellow of plant tissues that were once green
Yellow vein mosaic Okra
4. Leaf rolling

Downward leaf roll & leaf malformation

BCMV
Typical Leaf roll of lower leaves
Blistering
BCMV

Leaf Blistering by BCMV
Leaf Crinkle- Urdbean (ULCV)
Enations: Pea enation mosaic virus (PEMV)
Leaf curl of tomato
5. Ring spot diseases

Vein clearing BCMV

Chlorotic ringspot BCMV
Tomato ring spot virus
6. Necrotic diseases
Local lesions
BCMNV

Veinal necrosis and local lesion
BCMNV
Veinal necrosis
BCMV
7. Abnormalities of plants

- Galls
- Tumors
- Leaf deformation
- Shoe stringing
- Stem pitting
- w
Crown gall/tumor
Stem pitting
Shoe string of tomato
BANANA BUNCHY TOP
Witches’ broom

An abnormal form of plant growth characterized by profuse outgrowth of lateral buds to give a broom-like appearance.

Potato witches’ broom

Groundnut witches’ broom
Rosette:
An abnormal condition in which the leaves form a radial cluster on the stem.

Groundnut rosette caused by: *Groundnut rosette umbravirus*
8. Wilting
Microscopic/ Histological changes

- Expressed as anatomical and histological changes in the affected plants.
- Generally as necrosis, hypoplasia and hyperplasia
- Formation of inclusion bodies
INTERNAL SYMPTOMS

- Expressed as anatomical and histological changes in the affected plants.
- Generally as necrosis, hypoplasia and hyperplasia.
- In mosaic infected plants, generally hypoplasia in the yellow or light green areas is noticed.

Cytological changes
- Virus infection affect various cell organelles like nucleus, chloroplasts, and mitochondria etc.
- **Nucleus:** induces formation of nuclear inclusions, affect nucleolus
  - Nucleus becomes granular, chromatins may be reduced, disintegrated
- Chloroplasts show disintegration, swelling or clumping etc.
- **Mitochondria show aggregation in virus infected cells, formation of vesicles**
- Cell wall show thickening, deposition of electron dense material between cell wall and plasma membrane, callus deposition
Formation of inclusion bodies

- These are intracellular structures formed due to the virus infection
- Major cytological effect of virus infection
- Some may be seen with ordinary microscope
- May contain virus particles, virus-related material or degenerate conditions
- May be nuclear or cytoplasmic
- These may be amorphous, crystalline or pin-wheel
Inclusion Bodies

- Inclusions are found
  - in the epidermis (TMV)
  - in the vascular tissue like Citrus tristeza virus.
  - in the nucleus e.g. geminiviruses and rhabdoviruses.

- Two stains
  - Azure A (AA) which stains RNA pink (top left and right) and DNA blue. Used in looking for viral inclusions.
  - Orange-green stain (OG-bottom right) which stains protein
Crystalline bodies

- These are in the form of virus aggregates arranged in orderly fashion giving three dimensional appearance
- Mostly accumulates in cell cytoplasm
- Commonly seen in the epidermal and hair cells in the cytoplasm
- May be in the form of rods, helical, icosahedral or crystalline array of infected cells.
Pinwheel inclusions

- Characteristic of infection by *Potyviridae* family of viruses
- PVY, BCMV, and *Soybean mosaic virus*.
- Others are scrolls, laminated aggregates etc.
Nuclear inclusions

- Nuclear inclusions are considered to be a main characteristic of geminiviruses.
- These inclusions are aggregates of virus particles.
- Because geminivirus are DNA viruses the inclusions stain bluish to purplish in Azure A stain.
- Blue-stained nuclear inclusions in the phloem tissues of an infected plant can help to diagnose a geminivirus infection.
I gratefully acknowledge the use of some very important contents of the text book “Matthew’s Plant Virology” by Roger Hull.

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