

Cotton Leaf Curl Disease (CLCuD)

Description:

A major (in terms of qualitative and quantitative losses) and devastating (huge economic losses and social impact) disease of cotton in Asia and Africa in general and Pakistan in specific.

History and Importance:

1st reported in 1967 from Multan.

In 1993-95 appeared in epidemic form in Pakistan.

80% yield losses.

In 2001: During the growing season, symptoms of CLCuD were observed on all resistant varieties at Burewala, District Vehari

In 2002: disease symptoms were seen throughout the district.

11 million bales lost due to CLCuV.

All resistant varieties became susceptible in 2002 to a new strain of virus known as Burewala strain. So far no resistant variety is available against this strain.

Strain: A genetic variant (alteration in DNA nucleotide sequence) of virus.

Etiology:

Causal Organism: Cotton Leaf Curl Virus (CLCuV)

Genome: ssDNA

Genus: Begomovirus

Family: Geminiviridae

Symptoms:

1. Infected plants bear leaf-like enations on the underside along with vein thickening.
2. Upward and downward curling of leaves.
3. Thickening of small as well as main veins on leaves, more obvious on underside.
4. If a diseased leaf is viewed from beneath against the light, thickened vein found darker green and opaque than the normal.
5. The newly produced leaves are small, excessively crinkled and curled at the edge.
6. Bolls remained small in size and failed to open.
7. All parts of badly hit plants are very brittle and ready broken.
8. Twisted (Bent) leaf petioles.

Transmission:

CLCuV is transmitted by whitefly *Bemisia tabaci*.

Order: Hemiptera

Family: Aleyrodidae

Whitefly transmits virus during phloem feeding of the plant.

Whitefly has 53 host species.

Latent Period (Inoculation to infection): 24 hours.

Incubation period (Inoculation to symptoms appearance): 7-10 days.

Inoculation feeding period: 30 mins.

Inoculation access period: 5-7 hours.

Retention period (Time period for which virus retains in the body of vector): throughout life.

Disease cycle:

The purpose of studying the disease cycle is to find out the possible disease development ways. After knowing the disease cycle one could be able to disrupt the cycle and disease may be avoided.

Primary source: Overwinters on alternate host (Tomato, okra, eggplant, datura).

Acquired by the whitefly during phloem feeding.

Acquisition access period: 7-10 hours.

Acquisition feeding period: 30 mins.

Transmitted to healthy cotton plants during whitefly feeding.

Secondary source: Symptomatic plants again may be the source of virus acquisition.

Epidemiology:

Study of disease development events in relation to environmental factors.

Minimum temperature: 25-30°C

Maximum temperature: 33-45°C

Optimum temperature: 32°C

Relative humidity: 48-60%

Management

1. Cultivation of disease resistant variety is only safe measure (NIBGE-2, NIAB-884, PB-899, FH-900, FH-1000, VH-148, CIM-446)
2. Proper use of irrigation and chemical fertilizers improves the disease resistant power in cotton plants.
3. Plants must be nourished with micronutrients to boost up their defense system against CLCuV and whitefly (Zn and Boron solution).
4. Whitefly transmits CLCuV from diseased plant to healthy one, hence whitefly must be controlled.
 - a. Imidacloprid@5ml/liter

- b. Acetamiprid@5ml/liter
 - c. Plant extracts (Neem extract, Eucalyptus extract@5ml/liter)
5. Lady's finger (okra), beans, tomatoes, tobacco, chilies, soybean, eggplant, holly hock (gul-e-khera), zinnia, sesame, Ak (*Calotropis*), shesham, citrus species etc. are recorded as alternate host plants of cotton leaf curl virus as well as whitefly. Therefore, they all must be eradicated before and during cotton cropping season.

Potato Leaf Roll Disease (PLRD)

Description:

Emerging and resurging disease.

Emerging (have recently appeared within a population or whose incidence or geographic range is rapidly increasing or threatens to increase in the near future).

Resurging (That was almost finished previously but again increasing).

History and Importance:

Potato grown from infected seeds results in 88% yield losses.

Global annual yield reduction is 20×10^6 tones.

1st reported in Pakistan in 1978.

Etiology:

Causal organism: Potato leaf roll virus (PLRV)

Genome: ssRNA

Genus: Polerovirus

Family: Luteoviridae

Symptoms:

1. Mostly appears on lower leaves
2. Leaves roll upward
3. Margins and tips of leaves become yellow.
4. Leaves become leathery (having a tough and hard texture like leather) and brittle (hard but liable to break easily).
5. Stunted growth (arrested growth) and upright appearance (Straight upwards).
6. Necrosis (death of tissues) in tubers.

Transmission:

Aphid *Myzus persicae*

Persistent (requires long time to be disseminated to new host), circulative (virus completes a trip of the insect body) and non-propagative manner (does not replicate in insect vector).

Disease cycle:

Aphids acquire from phloem feeding of diseased plants and weed hosts.

Aphid transmits the PLRV to healthy plants during feeding. Virus moves from phloem to tuber, cause necrosis and reduces size.

Solanaceous crops (Tomato, Eggplant and Chili) are also host for the virus.

Infected tubers are secondary source.

Epidemiology:

Temperature: 15-20°C

Relative humidity: 40-65%

Management:

1. Thermotherapy of tubers (37°C for various intervals).
2. Hot water treatment (50-52°C for 17-20 mins).
3. Use of insecticide (Metasystox or Rogor @6ml/L, Aldicarb, Carbofuran).
4. Resistant varieties (FD-48-4, FD-49-62, FD-7-2, Astrix, Mirrato, Oceania, Hermes, Orla, Safreen).

Banana Bunchy Top Disease (BBTD)**Description:**

Once established difficult to eradicate*. Severely infected plants produce no fruits.

*Eradication (Complete destruction of inoculum)

History and Importance:

Occur in all banana growing countries (Fiji, Indonesia, Malaysia, Australia, Sri-Lanka, Pakistan and India). Serious threat to banana industry in Pakistan. (due to quantitative and qualitative losses industry will be badly affected. Demolish of industry will affect all type of associated stake holders).

First reported in Fiji in 1989.

Etiology:

Causal organism: Banana Bunchy Top Virus (BBTV)

Genome: ssDNA

Genus: Babuvirus

Family: Nanoviridae

Symptoms:

1. Dark green streaks on petioles and veins of new leaves looking against light (Morse code streak).
2. Leaves arise in clusters.

3. Top of plant give upright and bunchy appearance.
4. The leaf lamina has thickened ridges (Green J-Hooks) and infected leaves are brittle and tear easily.

Transmission:

Black Banana Aphid (*Pentalonia nigronervosa*)

Propagative materials (Rhizomes, Suckers)

Rhizomes (also known as rootstocks) is a type of plant stem situated either at the soil surface or underground that contains nodes from which roots and shoots originate).

Sucker (Grows from the base of the root of the plant at a certain distance from the plant).

Transmitted in a persistent, circulative and non-propagative manner.

Acquisition Access Period: 17 hours

Incubation period: 20-50 days

Disease cycle:

Aphid acquire BBTV by feeding on diseased plants and alternative hosts.

Virus is inoculated into the phloem of the healthy plants during aphid feeding. After entry into the phloem virus disturbs the cells functions resulting in abnormal increase in cell size and number. Adjacent to the infected phloem cells abnormally large sized chloroplasts results in macroscopic dark green streaks. Symptomatic leaves serve as the source of further spread through aphid feeding.

Suckers and rhizomes from diseased plants act as source of secondary spread.

Epidemiology:

Temperature: 18-20°C

Relative humidity: 41-84%

Management:

1. Virus free propagative material (Certified points that make sure about the virus free material).
2. Resistant variety (Gross Micheal).
3. Insecticidal soap (Prentox, Diazinon AG500).
4. Spray the plants with insecticide to kill the aphids (malathion or pyrethrin).

Tobacco Mosaic Disease (TMD)**Description:**

1st reported plant virus. Interesting fact about TMV is that due to its cylindrical nature it can be incorporated into battery electrodes. It is the most stable virus with wide survival range.

History and Importance:

In 1886 Adolph Meyer described that mosaic disease can be transferred between plants.

In 1992 Ivanovsky reported about its filterable nature.

In Martinus Beijerinck named this as Tobacco mosaic virus (TMV).

It infects tobacco, tomato, cucumber and many greenhouse crops.

It is thermostable virus (can survive at high temperature).

Yield losses upto 55%.

Deteriorated quality leads to low market price.

Etiology:

Causal organism: Tobacco mosaic virus (TMV)

Genus: Tobamovirus

Genome: ssRNA

Symptoms:

1. Foliage show mosaic (alternate green and yellow patches) symptoms.
2. Leaves fern like with pointed appearance.
3. Dark green areas of the mottle appear elevated looking like blister like.
4. Leaves give distorted and chlorotic appearance.
5. Shoe string appearance on leaves.
6. Leaves show wrinkle*, crinkle* and twist*.

*wrinkle: slight line on surface. Crinkle: many lines/streaks on a particular area leading to a slight fold. Twist: a bent on leaf surface.

Transmission:

Mechanical means.

Human handling.

Disease cycle:

TMV preserved in nature in herbaceous (does not have wood) and woody plants.

Overwinters in plant stacks, plant debris, soil, seed surface, seed beds, clothes, manufactured tobacco like cigarette and Cigar.

Enters through wounded tissues. Systemically spread through plasmodesmata.

Epidemiology:

Temperature: 28-32°C

Relative humidity: 44-56%

Management:

1. Use clean and healthy seed (Because infected seeds lead to systemic movement of TMV during whole life cycle of the plant).
2. Uncontaminated soil for seed production (Soil should be properly sanitized to rule out all the hidden points of the virus).
3. Crop rotation with maize and wheat (This will help in reducing the virus inoculums by breaking its life cycle due to non-availability of the host plants).
4. Spray skimmed milk.
5. Field sanitation and Rouging.
6. Avoid contamination of hands while working in the fields.

Citrus Tristeza Disease (CTD)

Description:

Responsible for death of million of trees and as many become unproductive.

In 1930s this disease devastated the citrus orchards in Brazil and South American regions.

That's why farmers refer it as "Tristeza" means sadness (in Portuguese and Spanish).

History and Importance:

Largest threat to citrus industry round the globe.

Most destructive (yield reduction, reduced quality of produce) among all virus diseases of plants.

In 1981 total world loss due to this disease was destruction of 50 million trees.

1st reported from Argentina in 1930.

Infects all type of citrus.

Prevalent (widespread in a particular area and time) in all citrus growing regions.

Shortened life span of citrus upto 10-15 years.

Etiology:

Causal organism: Citrus Tristeza Virus (CTV)

Genome: ssRNA

Genus: Closterovirus

Family: Closteroviridae

Symptoms:

1. Stem pitting-Honey combing below bud union or on branches.
2. Vein clearing
3. Seedling Yellows
4. Decline (Due to blockage of phloem at bud union).

Transmission:

Brown Citrus Aphid (*Toxoptera citricida*)

Semi-persistent manner

Acquisition access period 30-60 mins.

Retention period: 24 hours.

Grafting is also the mean of virus transmission if rootstock or scion is affected.

Disease cycle:

Acquired by the aphid from infected source and transmitted to healthy one.

Phloem limited virus, disturbs the physiology of plant.

Infected rootstock or scion are also the sources of spread.

Management:

1. Rootstocks that offer resistance to tristeza decline include the citranges (C-35, Carrizo, Troyer), citrumelos (Swingle), mandarins (Cleopatra).
2. Use of insecticides to control aphid population (Imidacloprid).
3. Neem oil with the addition of soap.