

Technical fact sheet

Cotton leaf curl disease

What is it?

Cotton leaf curl disease (CLCuD) is caused by a pathogen complex rather than a single entity. The pathogen complex is comprised of a virus and a DNA beta satellite (DNA- β) molecule. As the DNA- β is responsible for the development of typical CLCuD symptoms and can alter the host range of the begomovirus, it is considered to be the main pathogenicity factor of the complex. Symptoms can be absent or mild when the DNA- β is absent and there is only infection of the virus. The DNA- β relies on the begomovirus for multiplication and transmission, it can not do either alone.

There are many different virus species which can be involved in this complex, all belonging to the Begomovirus genus of the Geminiviridae family. These include in addition to Cotton leaf curl Rajasthan virus (CLCuRV) and Papaya leaf curl virus (PaLCuV), several strains of Cotton leaf curl Alabad virus (CLCuAV), Cotton leaf curl Kokhran virus (CLCuKV), Cotton leaf curl Multan virus (CLCuMV), Cotton leaf curl Gezira virus (CLCuGV) and Tomato leaf curl Bangalore virus. Similarly there are many different DNA- β satellites shown to be associated with CLCuD. In many countries these viruses and DNA- β satellites are constantly evolving and new species are frequently being described but their pathogenicity to cotton is largely unknown.

This disease is a major constraint to cotton production where it occurs. For example, it devastated the Pakistan cotton industry in the 1990's where it caused an estimated loss of US\$5 billion between 1992 and 1997. CLCuD continues to be a significant problem to the Pakistani cotton industry.

What do the symptoms look like?

The initial symptoms of CLCuD are described as a swelling and darkening of the veins, followed by a deep downward cupping of the youngest leaves then either upward or downward curling of the leaf margins (Figure 1). One or more growths (enations) extending from the leaf veins can also occur. These enations are typically found on the lower side of the leaf and in some cotton varieties this can appear as cup-shaped leaf-like structures (Figure 2). Virus-infected plants exhibit very mild symptoms or can appear symptomless unless infected with the DNA- β as well. Plants can be stunted as a result of early infection (Figure 3).

There is some evidence for differences in susceptibility to CLCuD between different *Gossypium* species and cotton varieties. In one disease outbreak on the Indian subcontinent the *G. hirsutum* varieties were more susceptible than those of *G. arboreum*. *G. barbadense* appears to be resistant, at least to the pathogens present in Pakistan and India. Components of known CLCuD-complexes have been detected in two non-cultivated *Gossypium* species, *G. davidsonii* and *G. punctatum*, in Pakistani studies.



Figure 1. Upward cupping of leaf margins and thickening of leaf veins



Figure 2. Thickened veins and leaf-like growths (black arrows) emerging from a vein on the underside of the leaf



Figure 3. A CLCuD-affected plant on the right showing the typical stunting symptoms, growing next to a healthy plant



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Breeding programs have developed resistance to individual pathogen complexes; however, this resistance has not been stable when changes have occurred in the pathogen complex. The change arises due to introduction of a different begomovirus and/or DNA- β satellite.

What should I look for?

CLCuD can be detected by visual examination of unhealthy looking plants. Plants which are stunted and/or have deformed leaves, particularly with an upward or downward cupping, should be selected for closer evaluation. Holding suspect leaves up to the light can help in identifying disease symptoms (Figure 2). These symptoms include:

- Thickening and darkening of the leaf veins
- Presence of abnormal growths (enations) emerging from leaf veins

If any of these symptoms are observed please collect a sample for diagnosis.

How does it spread?

The CLCuD pathogen complex cannot move independently between plants, instead they rely on the whitefly, *Bemisia tabaci* as a vector for dispersal. Biotype-B of *B. tabaci*, the silverleaf whitefly, is the major known vector of the CLCuD agents but other biotypes such as Q are also suspected to be vectors. The pathogen complex is taken up by whiteflies during feeding and remain within the insect for anywhere from a few hours, to a few weeks and can be deposited into other plants when the insect feeds again. As an aerial vector is involved, the disease can spread quickly within a crop and readily over large distances with the movement of pathogen-laden whiteflies. Even small numbers of whiteflies can result in significant disease incidences. In Pakistani experimental studies, a single whitefly was shown to be sufficient for transmission of the pathogen complex from disease-affected cotton to healthy cotton.

Okra, cowpea, radish, tobacco, tomato, French bean, chilli, Hibiscus species and papaya are considered alternative hosts that may act as reservoirs for the disease agents during and between cotton crops. These plant species are also hosts of the whitefly vector.

CLCuD can be graft transmitted but is not mechanically or seed-transmitted. Symptoms become mild or absent in cooler weather particularly in some of the alternative hosts such as hibiscus.

Where is it now?

CLCuD has been reported from Pakistan, India, Egypt, Nigeria, Tanzania and Sudan but the begomoviruses and DNA-satellite molecules associated with the disease in each of these areas are quite different and it is thought the disease has developed locally rather than through the long-distance distribution of infected planting material or pathogen-laden whiteflies. Many Begomovirus species and DNA- β satellites have been reported from south-east Asia, some of which may cause disease in cotton. Neither the viruses nor the satellites are known to occur in Australia.

How can I protect my farm from Cotton leaf curl disease?

Check your farm frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common cotton pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline on 1800 084 881

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