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# Chilli leaf curl virus disease: Cause and control

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**Abstract**

Chilli pepper or hot pepper is an important spice and vegetable crop of family Solanaceae. Chilli is susceptible to various pathogens involving viruses, which cause heavy production losses. So far 65 viruses have been reported, including chilli leaf curl virus (ChiLCV) infecting chilli throughout the world. The viruses belonging to the family Geminiviridae are among the major limitations that causes huge losses to chilli production. ChiLCV is the most destructive virus in terms of incidence and yield loss. The disease can be identified by typical upward leaf curling, crinkling, puckering and reduction of leaf area along with stunting of whole plants. It is transmitted by whitefly. Although a number of insecticides had been effectively used to manage this pest in the past but it is able to develop resistance very rapidly. Conventional plant breeding techniques remains the major antiviral strategy so far for the development of resistant chilli varieties.

Chilli pepper or hot pepper is an important spice and vegetable crop. Chilli is susceptible to various pathogens involving viruses, which cause heavy production losses. So far 65 viruses have been reported, including chilli leaf curl virus infecting chilli throughout the world (Nigam *et al.*, 2015). In tropical and subtropical parts of India, chilli leaf curl virus disease has been a major problem to chilli. Chilli leaf curl virus is the most destructive virus in terms of incidence and yield loss. In severe cases, 100 per cent losses of marketable fruit have been reported (Senanayake *et al.*, 2012). The typical symptoms consisting of leaf curling, rolling and puckering; blistering of interveinous areas, thickening and swelling of the veins, shortening of internodes and petioles, crowding of leaves and stunting of whole plant. ChiLCV is transmitted by whitefly *Bemisia tabaci*. A single whitefly is able to transmit the virus and eight or more whiteflies per plant resulted in 100% transmission. Virus diseases are commonly seen in agriculture crops and have a major impact on their cultivation. Evasive measures, such as pesticide sprays to control vectors, removal of diseased plants and agronomic interventions have been tried without much success. Development of host plant resistance is effective, economical, ecologically safe and durable approach of disease management, especially the ones caused by viruses.

**Symptoms and disease incidence :** The symptoms consist of abaxial and adaxial curling of the leaves accompanied by puckering and blistering of interveinous areas and thickening and swelling of the veins. In advanced stages of the disease axillary buds produce clusters of leaves which get reduced in size. The whole plant gives a bushy appearance and stunted growth. The diseased plant bear fewer flowers and fruits and those that are formed are much reduced in size. In other type of symptoms the affected plants became erect and bushy and the leaves are dark-green. The leaf tips curled downwards, the shape of the leaves became oval to round with no upward rolling of the edges followed by severe puckering and leatheriness of the leaves. There is pronounced vein-thickening and leafy outgrowths or enations on the undersurface of the leaves. A very high disease incidence was observed (up to 100% of plants during December 2004) in farmer's fields in Narwa and Tinwari villages at Jodhpur Distt. Rajasthan (Senanayake *et al.*, 2007). A disease incidence upto 100% was reported during December 2008 in Vellanad region of Kerala. Incidence of the disease varied from field to field and village to village (14–100%). The incidence was greater in Tiwari, where 100% of the plants of chilli variety Haripur Raipur showed severe leaf curl. A survey was carried out in major pepper growing areas in Punjab and a maximum leaf curl incidence was observed in Ludhiana (79.4 %) followed by Tarn Taran (77 %), Sangrur (72.2%), Sangrur (72.2 %), Patiala (68.6%) and Ferozepur (57.5%) (Kaur *et al.*, 2016). Some of the recently developed resistant varieties have been given in Table 1.

**Measures of control :** The control of this vector is mainly done by pesticides and physical barriers. Conventional chemical management of the whitefly is very difficult to achieve because the immature forms are found primarily on the underside of leaves with older larvae and

**Table 1 : Recently developed varieties resistant to chilli leaf curl virus disease**

| Sr. No. | Name of variety | Reference |
|---|---|---|
| 1. | Surajmukhi, Japani loungi, Pant chilli-1, Pusa Jwala and PBC-473 | Awasthi and Kumar (2008) |
| 2. | Punjab Sindhuri and Punjab Tej | Dhaliwal *et al.* (2013) |
| 3. | CH-27 -$F_1$ hybrid | Dhaliwal *et al.* (2015) |
| 4. | Saurian 2010, Perennial and Japani Loungi | Ahmad *et al.* (2016) |


**Fig. (a-i) : Different symptoms of chilli leaf curl virus disease**

pupae located lower in the plant canopy. Although a number of insecticides had been effectively used to manage this pest in the past but it is able to develop resistance very rapidly. Thus, the current dependence on chemical control must be considered a short-term measure, pending the development of a satisfactory integrated pest management program. Following methods can be used:

**Cultural control:**

- Use seeds from healthy plants of previous season.
- Growing of nursery in protected structures.

– Removal of infected seedlings and weed hosts from nursery as soon as seen.

– Treatment of seedlings with proper systemic fungicides to control vector.

– Use of yellow sticky traps above the plants to control insect vectors.

– Destroying previous year susceptible crops, particularly solanaceous weeds and volunteer plants.

– Good weed control in the crop that may be alternative host to virus and vectors.

– Transplanting dates should be adjusted to avoid peak season of vector population.

– Use of reflective (silver color) plastic mulch.

– Use of live mulches, border crops, or hedges more attractive to the vectors than pepper crop.

**Biological control of vector :**

– Predators- *Coccinella septempunctata, Clitostethus arcuatus, Orius* spp, *Chrysoperla carnea, Chrysopa* spp., *Sinea confusa*

– Parasitoids - *Eretmocerus emiratus, Eretmocerus eremicus, Encarsia accenta, Encarsia adusta etc*

– Pathogens (Fungi)- *Verticillium lecanii* and *Paecilomyces fumosoroseus, Paecilomyces farinosus*

– Mycoinsecticides- BotaniGard, Bea-Sin, Boveril PM, Mycotal, Ago Biocontrol Verticillium, Pae-Sin

**Chemical control of vector using Synthetic insecticides:**

– Difenthiuron 50 WP @ 0.75 g per l

– Spraying diazinon, malathion, metasystox at 10 days interval

– 0.07% monocrotophos with 0.25% wettable sulphur

– Imidachloprid 17.8 SL (0.003%)

– Imidacloprid (0.05%), Acephate (0.1%) and Malathion (0.05%)

**Control of vector using natural extracts :**

– *Neem* oil, neem guard, repellin and biosol

– Raw cow milk and *Trichoderma*

– *Neem* seed kernel extract (5%)

– Seed extract of *Sapindus trifoliatus* and *Solanum trilobatum*

– *Clerodendrum aculeatum* (leaf extract), *Terminalia arjuna* (bark extract)

**Conclusion:** Due to the tropical climate of India, large number of begomoviruses have been reported from India which causes serious diseases in many crop plants. The destructive outbreaks caused by the emergence and re-emergence of new strains of geminiviruses causing various diseases have threaten sustainable crop production and are of serious concern to world agriculture. By Studying the evolution of geminiviruses and their associated satellite molecules, different strategies can be developed that may control the speed of their development. The emergence of a new vector biotype (B biotype of *B. tabaci*) and increasing vector population are mainly responsible for the appearance of geminivirus disease problems.

Well-characterized resistance genes hold a lot of promise in controlling begomoviruses and there is need to introgress these genes into popular varieties. Hence, more work needs to be done to search for natural begomovirus-resistant wild varieties of crop plants, against begomoviruses. The exciting developments on plant–virus interactions, promise many more avenues of begomovirus control opening up in the near future. These need to be urgently deployed to assure crop protection against the huge losses incurred due to begomoviral infections in India.

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