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Review Article

Chilli Leaf Curl Virus and its Management

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Abstract

Chilli (*Capsicum annuum L.*) is an economically important and widely cultivated crop of India. Chilli leaf curl virus is one of the major limiting factors in chilli production, which is drastically decreases yield. The significant symptoms of chilli leaf curl are curling of leaf margin, reduction in leaf size, vein clearing accompanied by puckering, thickening and swelling of the veins. The maximum leaf curl disease was observed in 19th standard week when the white fly population was highest in the field. The increase or decrease of leaf curl virus disease of chilli was found directly correlated with vector population and vector population was determined by environmental factors. Three cultivars of chilli viz., Surajmukhi, Japani long and Pusa Jwala were showed highly resistant against leaf curl disease. Seed treatment with raw cow milk and *Trichoderma viridae* showed the reducing trends of chilli leaf curl disease incidence. Whereas seed treatment with imidacloprid 70 WS (5 gm/kg) along with two sprays of imidacloprid 17.8 SL (0.24 ml/lit) at 45 and 60 days after planting recorded least number of whiteflies and leaf curl virus per plant with significant increase of growth and yield.

Keywords: Chilli Leaf Curl; *Capsicum annuum L.*

Introduction

Chilli leaf curl locally known as murda is a most destructive disease of chilli in India. It is transmitted by mites (*Polyphagotarsonemus latus* Banks) (Kulkarni, 1924) and thrips (*Scirtothrips dorsalis* Hood). The natural occurrence of tobacco leaf curl virus was observed on chilli in India by Pal and Tandon (1937) and Seth and Dhanraj (1972). Chilli is known to be affected by forty two viruses, twenty two of them reported to occur naturally and twenty viruses infect to chilli through artificial inoculation. Among the twenty two viruses occur naturally on chilli, eleven viruses have been reported from India, viz., cucumber mosaic virus [1], tobacco leaf curl virus [2], Indian chilli mosaic virus [3] potato virus Y [4-6] and Potato virus X [7,8]. Prasada Rao [9] reported tobacco ring spot virus, pepper veinal mottle virus and pepper vein banding virus, Chilli leaf curl virus [10] and Tomato leaf curl New Delhi virus [11,12].

Importance of chilli leaf curl complex disease

Sastry and Singh [13] reported that TLCV infected plants produced very few fruits when infected within 20 days after planting and resulting up to 92.3 per cent yield loss. Plants infected 35 and 50 days after transplanting resulted in 74 and 22.9 per cent yield loss, respectively. The premature death of seedlings was observed when infection was occurred at 2nd and 4th leaf stages, while a considerable reduction in plant height (70.9 cm) and internodal length (5.7 cm) was observed in comparison to healthy plants (127.0 cm and 12.2 cm). The yield reduction at 5th leaf stage was found 94.9 per cent, while it was 65.8 per cent at 10 - 11th leaf stage infection.

Symptomology

Leaf crinkle or leaf curl complex was observed on chillies by Hussain [2]. The vein clearing and leaf malformation was reported by Fernando and Pieries (1967). Curling of leaf margin, reduction in leaf size, vein clearing were observed in India, Sri Lanka and USA [14]. Abaxial curling of the leaves accompanied by puckering, thickening and swelling of the veins were observed by Mishra., *et al.* [15] and Muniyappa and Veeresh [16]. Appearance of most prominent symptoms such as vein clearing followed by veinal distortion, swelling of veins and vein lets on dorsal side were reported by Muniyappa [17] and Ravi [18].

Survey of chilli leaf curl viral complex on chilli in some districts of Uttar Pradesh

Some perennial types with small pungent fruits in Tarai region of Uttar Pradesh were shown to immune against viruses. Selection from crosses between the perennial local types and NP - 46 A was released under the name Pant C - 1, and Pant - 2, which were known to be resistant for leaf curl virus [19]. Wet and dry season are favourable for infection of chilli leaf curl virus on chilli (*Capsicum frutescens* and *C. annuum*), mung bean yellow mosaic virus on mung bean (*Vigna radiata*) and okra yellow vein mosaic virus on okra, all were transmitted by *Bemisia tabaci* (Gennadius) Shivanathan., *et al* (1983). Leaf curl disease of chilli was emerged as a serious problem in Jodhpur district, the major chilli growing area of Rajasthan state. During december, very high disease incidence up to 100% observed in farmer's fields in Narwa and Tinwari villages.

The characteristic field symptoms were upward curling, puckering and reduced size of leaves. Severely affected plants were stunted and produced no fruit. The virus from Narwa village was transmitted by Whitefly (*Bemisia tabaci*), which produced vein clearing, curling and stunting symptoms [10]. Symptoms of tomato leaf curl Jodhpur virus on chilli was a mild yellowing, severe leaf curling, leaf distortion, stunting and blistering observed in the fields of Ludhiana, India (Shih., *et al.* 2006).

Characterization of chilli leaf curl virus

Electron Microscopy

Laird and Dickson (1964) reported that PVY consisted of flexuous rod shaped particles measuring 694 nm, whereas Prasada Rao [9] reported the presence of flexuous rod shaped PVY measuring 776 nm x 13 nm. Similarly, Bidari (1982) also reported that PVY consisted of flexuous rod shaped particles measuring 681 x 12.5 nm. Immunosorbent electron microscopy (ISEM) using antibody coated carbon film grids was employed to detect several whitefly transmitted Gemini viruses in the crude sap. Sequeria and Harrison (1982) observed that 38 fold more in number of Cassava latent virus (CLV) particles were trapped in CLV antibody coated grids than those coated with normal serum. Roberts., *et al.* [20] used homologous and heterologous antibody coated carbon film grids in ISEM and found strong relationship existed among five whitefly transmitted Gemini viruses viz., ACMV, BGMV, EVMV (Euphorbia mosaic virus), SLCV and TomGMV. Mathew [21] used ISEM successfully to detect ICMV particles in the leaf extracts of *N. benthamiana* and cassava infected with ICMV –H and ICMV-14 using ICMV-H antibody coated grids. He also found that ICMV-14 antiserum could also detected HyMV in infected french bean and ToBLCV in infected *N. tobaccum.* Mandal [22] used successfully to detect CYVMV particles in the leaf extracts of croton infected with CYVMV using Indian cassava mosaic antibody coated grids. Harrison., *et al.* [23] also used ISEM technique to detect seven different whitefly transmitted Gemini viruses from India. Tomato leaf curl Gemini virus was detected using ISEM technique by Muniyappa., *et al* [24]. Typical geminate particles were detected in the leaf extract of cotton leaf curl infected cotton by using squash leaf curl virus antiserum (Nateshan, 1992).

Management

Bodhade., *et al.* (1985) observed insecticides for the control of *Aphis gossypii*, unspecified thrips and mites cause direct damage to Capsicum annuum which transmit chilli leaf curl virus [tobacco leaf curl virus]. All the treatments significantly reduced the incidence of pests and disease in chilli. Mariappan and Samual [25] studied the effects of neem oil on the survival of *Aphis craccivora* Koch and *Myzus persicae* Sulzer and transmission of chilli mosaic virus. Neem oil both 3% and 5% concentrations reduced the virus transmission by aphids and highest mortality of aphids. Similarly, neem derivatives viz., neem oil, comnhex comnol Nekhex, Repelin Margocide proved their superiority by recording least per cent virus transmission and highest per cent aphid mortality. Sobithadevi and Reddy (1995) reported that the neem formulations, Indiara and Neemark reduced the pepper vein banding virus and cucumber mosaic virus on chilli transmitted by aphid. Chandrasekharan and Veeravel (1998) registered that Achook 1.5% recorded 72.9 per cent reduction of thrips population followed by mixture of Achook 1.5% and neem oil 5%. Tested plant products were found inferior to the chemical check (monocrotophos 0.05 per cent) which recorded 82.9 per cent reduction of mites. Borah (1995) reported that foliar application of cypermethrin (0.01, 0.015%), deltamethrin (0.0028, 0.0042%) and dimethoate (0.03, 0.045%) was effective in reducing the white fly incidence in green gram field. Borah and Nath (1995) reported that spray of 0.03 per cent dimethoate at 15 and 30 days after germination was highly effective in reducing the white fly transmitting yellow vein mosaic virus disease in okra. Panickar and Patel (2001) tested seven insecticides and found triazophos 0.04 per cent was the most effective for managing populations of *Scirtothrips dorsalis* and preventing incidence of chilli leaf curl virus. Salam (2005) reported that mung bean crop can be protected to whiteflies by seed treatment with imidacloprid 70 WS (5 gm/kg) along with two sprays of imidacloprid 17.8 SL (0.24 ml/lit) at 45 and 60 days after planting. Anjaneya Reddy [26] reported the management of the ToLCV disease with application of imidacloprid (0.005%), imidacloprid (0.005%) + Adjavent (APSAR) and sequential application of imidacloprid (0.005%) - Triazophos (0.15%) – Econeem (0.5%) on the basis of low disease incidence, better yield and good net returns compared to all other treatments.

Screening of genotypes against leaf curl on chilli

The success of disease resistance breeding solely depends on the reliable evaluation methods employed. It is important to employ most reliable tests of resistance when dealing with destructive diseases. Breeding for resistance to Chilli leaf curl complex disease has been under taken in several states throughout India. Various methods have been employed to screen *Capsicum* germplasm for resistance viz., subjecting the plants to natural epidemics, artificial inoculation, grafting or by white flies. Anand., *et al.* [27] screened 132 varieties of chilli belonging to six different species, varieties Puri Red, Puri orange, Kondiverum and G2 were reported to resistant against mosaic viruses. Cultivars, Puri Red, Puri Orange, G2 and Kondiverum were known to be resistant to mosaic by artificial inoculation [27,28]. Saccardo [29] found eight lines out of 53 of *C. annuum*, ten lines out of 12 of *C. frutescens* and one line of *C. pendulum, C. microcarpum* and *C. chinense* were resistant to CMV and 13 lines of *C. annuum* showed tolerance. Ramanujan., *et al*. [30], studied the inheritance of resistance in chilli; they reported Puri Red as resistant to leaf mosaic. Jeyarajan and

Ramakrishnan [5] reported 15 varieties were resistance out of 22 against PVY. Mayee., *et al.* [31] was tested seedlings of 72 lines of *Capsicum* frutescens which were exposed to infection by cucumber virus, potao x virus, potato y virus, tobacco mosaic virus and chilli leaf curl virus. Some perennial types with small pungent fruits in Tarai region of Uttar Pradesh were shown to be immune against viruses. Selection from crosses between these perennial local types and NP-46A have been released under the name Pant C-1, Pant C-2, which were known to be resistant to leaf curl virus [19]. Anonymous (1990) screened about 291 lines of *C. annuum* for resistance to cucumber mosaic cucumovirus (CMV) from Taiwan, pepper vein mottle virus (PVMV) from England and CVMV (Chilli vein mottle virus) from Taiwan and Japan by artificial inoculation on seedlings. It was found most resistant entries VC 16, HAD 836 and Szechuan to PVMV, VC 35, VC 36, VC 37, VC 40 and VC 41 to CVMV. Singh., *et al.* (1990) out of 148 varieties of Capsicum screened for resistance to mosaic and leaf curl diseases, 122 lines were susceptible while 26 were disease free. The later were further tested and responses to mosaic and leaf curl diseases varied. A few lines were tolerant but only 4 lines were resistant to mosaic disease. Ilyas and Khan [12] reported out of one hundred and fifty nine. Varieties/crosses/selections, Pure red, Cfr-10, LCA-135, LCA-412 and Pant C-1 were found resistant /tolerant to mosaic complex, whereas others showed susceptible reaction. Kumar., *et al.* [32] evaluated 37 chilli (*Capsicum annuum*) genotypes for the incidence of leaf curl virus, 3 were rated resistant (Pusa Jwala, Surya Mukhi and Loungi), 2 moderately resistance, 19 susceptible and 13 highly susceptible. The F1 progenies and BC2 generations of certain crosses were found to be resistant for leaf curl complex. However, the BC1 generation of the cross, (Punjab lal x Pusa sadabahar) x Punjab lal, was found highly resistant with reduced coefficient of infection (Narayana Rishi., *et al.* 1988). Kotreshe (2002) also recorded the fifty genotypes screened against chilli mosaic complex disease under irrigated conditions none of the line were found to be immune. Only four lines were resistant viz., KSDA-210-10, LCA-305, LCA-324 and Hissar Vijay. Most of the lines showed moderately resistant and moderately susceptible reaction and five lines viz., Byadgi Kaddi, Sankeshwar, Paprika, DH-9-66 and DH-9 showed susceptible reaction. Pinaki Acharyya., *et al.* (2003) observed variability and correlation studies for different traits of *Capsicum* were carried out on the F1 and BC2 of cross between Punjab Lal and Pusa Sadabahar under leaf curl infection caused by leaf curl virus. High heritability associated with high genetic advance was recorded for the total fresh yield per plant, ascorbic acid content, number of fruits per plant and total dry yield per plant. Jose., *et al.* (2003) evaluated thirty seven genotypes of chilli against leaf curl virus under natural field conditions in Kerala. It was observed that the genotypes Alampady local-1, Nayyattinkara local, Kottiyan local, Haripuram local, Pant C-1, Chandera local, Mangalapuram local and Kotti Kulam local were tolerant, 27 were susceptible and 2 were highly susceptible to the disease [33-46].

Conclusion

It is concluded that chilli leaf curl virus was found all surveyed field due to growing of susceptible local cultivars prevailing in the districts. The resistant and moderate resistant cultivars should be used by farmers in cultivation under integrated production systems. Whitefly population and leaf curl incidence increased with increasing the temperature as well as relative humidity. Whitefly is a key vector of leaf curl virus, hence seed treatment with imidacloprid 70 WS (5 gm/kg) along with two sprays of imidacloprid 17.8 SL (0.24 ml/lit) at 45 and 60 days after planting should be used for better yield and good net returns from the chilli crop.

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Volume 2 Issue 3 March 2018