First report of *Amaranthus* sp. as a natural host of capsicum chlorosis virus in India

Anshul Sharma · Saurabh Kulshrestha

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Abstract Capsicum chlorosis virus (CaCV) is emerging as economically important tospovirus, being a recently identified virus its complete host range was still not completely known. Virus infected leaves of amaranth plants grown in the vicinity of *Capsicum* fields showing characteristic symptoms of tospoviruses were collected, confirmed by tospovirus group specific antibody for the presence of a tospovirus and then the presence of CaCV was confirmed by virus specific antibodies. Nucleocapsid protein (NP) specific primer were used for amplification of NP gene and amplified cDNA products were confirmed by sequencing that the virus infecting amaranth was an isolate of CaCV. A comparison of the NP sequence with other isolate confirmed that it was 100 % similar to the reported Indian isolate of CaCV. To best of our knowledge this is the first report of natural infection of CaCV in *Amaranthus* sp. in India.

Keywords *Amaranthus* · *Capsicum chlorosis virus* · ELISA

Amaranthus sp. are known to be infected with 121 viruses [2]. According to one report, the members of *Amaranthaceae* are susceptible to tomato spotted wilt virus [2]. Tospoviruses have been documented as serious pathogens of different crops worldwide. They are enveloped viruses having tripartite genome containing large (L), medium (M) and small (S) segments. Worldwide more than 20 tospoviruses have been reported [3]. Chillies with five

tospovirus species were reported from India [3]. *Amaranthus* species serve as experimental hosts to a number of viruses, but only a few have been reported to infect them naturally.

During a survey, Amaranth was found in vicinity of infected chillies fields having symptoms of curling and chlorosis of its leaves (Fig. 1a, b). Suspected sample was first checked for the presence of tospovirus using group specific DAS-ELISA kit (Bioreba, New Zealand) and secondly with ELISA kits specific for TSWV and GBNV/CaCV. Positive reaction was only obtained with GBNV/CaCV antibodies which suggested that amaranth plants were infected with CaCV and/or GBNV. Further confirmation was done thrice by RT-PCR using nucleocapsid protein (NP) gene (CP) specific primers of CaCV and GBNV. Amplification product of ~800 bp was only obtained in case of CaCV and no amplification was observed in case of GBNV (Fig. 1c). The amplified product was sequenced using CaCV NP reverse primer and the sequence of 736 bp was obtained. The sequence matches closely with other isolates of CaCV reported from Maharashtra, India (Chilli isolates), Taiwan (orchid isolate) having more than 99 % identity. Phylogenetic analysis of Amaranth isolate with other CaCV and other tospoviruses reported from different parts of the world reconfirms that the tospovirus infecting Amaranth was an isolate of CaCV as it clustered closely with other known (FJ011449; CaCV-Ch-Pan isolate) Indian isolates of CaCV, having 100 % similarity (Fig. 1d). The sequence of amaranth isolate of CaCV was also submitted to EMBL database with accession No. HG917416. CaCV is recognized as an economically important virus reported from different parts of the world [1]. Amaranth is regarded as important natural weed host for thrips transmitted viruses from several parts of the world [4]. Present study confirms the presence of CaCV on

A. Sharma · S. Kulshrestha (✉)
Faculty of Biotechnology, Shoolini University of Biotechnology
and Management Sciences, Bajhol,
Solan 173229, Himachal Pradesh, India
e-mail: saurabh_kul2000@yahoo.co.in

Fig. 1 Capsicum chlorosis virus (CaCV) infection in *Amaranthus* sp. **a** and **b** Showing leaf distortion and chlorosis of Amaranth leaves. **c** Showing amplification of nucleocapsid protein (NP) gene of the associated virus. *i* showing amplification of CaCV CP in positive control; *ii* showing no amplification with groundnut bud necrosis

virus specific primers; *iii* negative control, respectively; *iv* showing CaCV NP gene amplification in *Amaranthus* sp. **d** showing phylogenetic analysis of CaCV NP (Amaranth isolates) with the other tospovirus isolates reported from different parts of the world

Amaranth plant based on visual symptoms, serology and sequence analysis of nucleocapsid protein (NP) with other CaCV reported from different parts of the world. This study provides evidence that Amaranth is a natural host of CaCV from India.

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