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ORIGINAL ARTICLE

Molecular detection of resistance-breaking strain *Cucumber mosaic virus* (rbCMV) (Cucumovirus; Bromoviridae) on resistant commercial pepper cultivars in Turkey

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Abstract

The cultivation of pepper (*Capsicum annuum*), a significant crop worldwide, is severely affected by a number of viral agents. In Antalya province, it was observed that pepper varieties possessing the *cmr1* allele that provides resistance against CMV-P0 isolate of CMV were affected in 2019 and 2020. Typical symptoms of CMV are emerging at an alarming rate in resistant pepper plants. Afterward, virus mechanical inoculation was carried out under controlled conditions on the five commercial resistant and susceptible varieties. The success of the inoculation studies was determined by RT-PCR using CMV CPG-specific primers. All commercial varieties carrying the resistance *cmr1* gene showed disease symptoms. For complete genome analysis, RNA from a pepper plant carrying the *cmr1* gene was sequenced using Illumina-HiSeq 2000. BLAST analyses of the obtained complete genome sequence were carried out. The breaking (CMV-P1) and non-breaking isolates (CMV-P0), which were previously described in conducted studies, were analysed and aligned for SNPs. SNP mutations in these nucleotide regions were similar to resistance-breaking and completely different from non-breaking isolates. Our study results revealed that the CMV-P1 isolate obtained from pepper samples carrying cmr1 resistance has been shown to be able to overcome both field and laboratory conditions. To our knowledge, this is the first report of resistance-breaking CMV-P1 strain on pepper varieties in Turkey.

KEYWORDS
Capsicum annuum, Cmr1, CMV, NGS

1 | INTRODUCTION

Pepper (*Capsicum annuum*) is among the most significant crops for human nutrition. In 2019, peppers were produced on about 586.078 ha around the world, and 60.7% of which are grown in Asia (FAOSTAT, 2018). In Turkey, the Mediterranean region accounts for 28% of the total pepper production (Güvenç, 2020). Similar to other cultivated plants, pathogenic and non-pathogenic diseases affect the yield and quality of peppers. Peppers are reported to be naturally infected by more than 10 plant viruses (Kenyon et al., 2014). *Patato virus Y* (PVY), *Cucumber mosaic virus* (CMV), *Pepper mild mottle virus* (PMMoV), *Cucumber mosaic virus* (CMV) *Tomato spotted wilt virus* (TSWV), and *Alfalfa mosaic virus* (AMV) are the most widespread viruses (Almási et al., 2020; Bandjo-Oreshkovikj et al., 2017; Kitajima et al., 2018; Li et al., 2020; Moury et al., 2017). Symptoms such as mosaic, yellowing, fruit deformations, green mottling, vein clearing, leaf distortion, and leathery leaf appearance are linked to viral agents. In the last 2 years, an increase in the prevalence of *Cucumber mosaic virus* (CMV) in pepper-growing areas have been reported by farmers and commercial firms. The pathogen is one of the

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