New Disease Reports

First report of *Tomato mottle mosaic virus* in tomato crops in Israel

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Received: *17 Sep 2015.* ***Published:*** *07 Jan 2016.* ***Keywords:*** *Solanum lycopersicum, tobamovirus*

Vegetable crops in general, and specifically tomato, are economically very important crops in Israel. In June 2014, 20% of plants from a tomato (*Solanum lycopersicum*) greenhouse in Northern Israel showed severe mosaic symptoms and fern-like leaf deformations that reduced production from infected plants. Two of these plants were sampled and mechanical inoculation was done on *Nicotiana tabacum* cv. White Burley causing local necrotic lesions. Two isolates, each from distinct lesions were deposited in the PLAVIT (Plant Virus of Italy) collection with accession numbers VE493 and VE494. Tomato plants mechanically infected with single local lesions from *N. tabacum* cv. White Burley from isolate VE493 showed strong leaf deformation and their growth was stunted compared to mock-inoculated tomato plants (Fig. 1).

Observation of leaf dip extracts by electron microscopy (Brandes, 1957) showed the presence of abundant viral particles with a rigid rod shape and calculated length of c. 300 nm, consistent with the presence of a possible tobamovirus. RNA was extracted and RT-PCR was done using generic tobamovirus primers Tob-Uni1 and Tob-Uni2 (Heinze *et al*., 2006). The amplified 797 bp PCR product was cloned, and two clones for each sample were sequenced. Consensus sequences were deposited in GenBank with accession numbers KP861747 and KP861748 for VE493 and VE494, respectively. BLAST searches of the GenBank database resulted in an almost perfect match (99% identity at the nucleotide level) to strain MX5 of *Tomato mottle mosaic virus* (ToMMV), a recently described tobamovirus (Li *et al*., 2013). DAS-ELISA using polyclonal antisera for *Tomato mosaic virus* (ToMV) and *Tobacco mosaic virus* (TMV) from the CNR collection (A128 and A25, respectively) detected the ToMMV isolates from Israel. A specific RT-PCR assay was also done using primers ToMMV-F (5′-AAAAGGGCGGTCTAATTTC-3′) and ToMMV-Rev (5′-TAATTTCGTCCTTTATTAC-3′) which were designed to bind to regions of the ToMMV genome which shared limited homology with ToMV, the closest virus species to ToMMV. A band of c. 600 bp was obtained from the ToMMV-infected samples but not from ToMV isolate IFA9 or TMV isolate Ta9 (PLAVIT collection) which were included in the assay. In late 2014, tobamovirus-positive seed extract samples from the same area in Northern Israel were detected by DAS-ELISA using the previously described antisera for ToMV and TMV. Leaf extracts were subsequently inoculated to *N. tabacum* cv. Xanthi NN, and lesions were tested by RT-PCR using the ToMMV-specific primers. Sequences of the amplified segments confirmed the presence of ToMMV.

ToMMV is present in Mexico (Li *et al*., 2013), USA (Webster *et al*., 2014), China (Li *et al*., 2014), Iran and Brazil. The report from Brazil is the first linked to a sequence in the GenBank database corresponding to ToMMV (Moreira *et al*., 2003); the sequences from Iran corresponding to ToMMV were deposited in GenBank before the characterisation of the virus as a new tobamovirus species. To the best of our knowledge this is the first report of ToMMV in Israel.

Acknowledgements

The authors would like to thank Riccardo Lenzi and Caterina Perrone for their excellent technical assistance.

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Figure 1

To cite this report: Turina M, Geraats BPJ, Ciuffo M, 2016. First report of *Tomato mottle mosaic virus* in tomato crops in Israel. *New Disease Reports* **33**, 1. http://dx.doi.org/10.5197/j.2044-0588.2016.033.001

 This report was published on-line at www.ndrs.org.uk where high quality versions of the figures can be found.