

A divergent isolate of *Tomato yellow leaf curl virus* from Oman with an associated DNA β satellite: an evolutionary link between Asian and the Middle Eastern virus–satellite complexes

Akhtar Jamal Khan · Ali M. Idris · Nadiya Abubaker Al-Saady · Madleen Said Al-Mahruki · Ali Masoud Al-Subhi · J. K. Brown

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Abstract Tomato is cultivated in the coastal region of Al-Batinah, in the Sultanate of Oman, during the winter season, to meet the high demand for fresh produce in the domestic market. In order to identify the causal agent of a widespread disease associated with infestations of the whitefly *Bemisia tabaci* (Genn.) leaves were collected from tomato plants showing symptoms characteristic of the disease in Al-Batinah during 2004 and 2005. Total nucleic acids were isolated from the tomato leaves and used as the template for Φ 29 DNA polymerase amplification of begomoviral circular DNA. Putative full unit length begomoviral DNA multimers were digested with *Nco* I and cloned into the plasmid vector pGEM7Zf+. The complete nucleotide (nt) sequence was determined as 2,765 bases, indicative of a monopartite begomoviral genome. A comparison of the genome sequence for the seven field isolates examined, indicated that they shared 99% nt identity. The virus from Oman was most closely related to TYLCV-IR at 91% nt identity, a monopartite begomoviral species described previously from Iran. Based on the guidelines of the ICTV the Oman isolate has been designated TYLCV-Om and is considered an isolate of TYLCV-IR. A satellite DNA (satDNA β), was amplified by polymerase chain reaction using degenerate primers and cloned, and the DNA sequence was determined. Analysis of the complete

nt sequence of 1,371 bases indicated that the satDNA shared 88.5% similarity with its closest relatives, which are DNA β molecules from tomato in Pakistan. This is the first report of a satDNA β associated with the TYLCV species. The TYLCV-Om and associated satDNA, thus represent a begomovirus-complex at the Asian-Middle East crossroads that quietly share geographical and genetic hallmarks of both.

Keywords *Begomovirus* · Bridge species · DNA satellite · Evolution · *Geminiviridae* · Tomato

Introduction

The Tomato yellow leaf curl diseases (TYLCD) are caused by a group of whitefly-transmitted geminivirus (family: *Geminiviridae*, genus: *Begomovirus*) that are a problem to tomato (*Lycopersicon esculentum* Mill.) production throughout the world [1]. Tomato plants infected in early growth stages are severely stunted, have erect terminal and axillary shoots, and leaflets are reduced in size and they are abnormally shaped. Leaves that develop, shortly after infection are cupped downward, whereas leaves developing later are prominently chlorotic and deformed, with leaf margins rolled upward and curling between the veins. The