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Molecular Analysis of *Citrus tristeza* Virus (CTV) and Citrus- viroids from the Sudan

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Abstract

In the Sudan the mostly grown Citrus species are grapefruit (*Citrus paradisi*, Macfad.) cv. ‘Foster pink’ and ‘march seedless’, small fruited acid lime (*C. aurantifolia*, Swingle) cv. ‘Baladi’ (local), sweet orange (*C. sinensis*, Osbeck), mandarins (*C. reticulata*, Blanco) and lemons (*C. limon*, L.). These are grafted predominantly onto sour orange (*C. aurantium* L.) and also on ‘Baladi’ lime, which are suitable rootstocks for the arid climate and the high salinity of irrigated soils in the north-eastern region of the Sudan, where Citriculture is most abundant. Certain viroids as well as *Citrus tristeza* virus (CTV) are long suspected to be responsible for many different graft transmissible diseases of Citrus in the arid and semi arid region of the Sudan creating shortage in food supply and also economic problems. Especially *Citrus spp.* grown on sour orange rootstocks yields a highly susceptible combination for CTV. Infected trees are often showing stem pitting and quick decline or die back. On the other hand, Citrus exocortis viroid (CEVd) and Hop stunt viroid (HSTVd) infections of Citrus species are often symptomless on sour orange rootstocks. Exceptions are HSTVd infected mandarins, who are chlorotic, stunted and exhibit typical pegs and gumming of the bark. Serological and molecular techniques were applied and CTV was detected in oranges, mandarins, grapefruit and lime in nine orchards located in Northern State, River Nile and Khartoum. Consecutively it was shown by RT-PCR with viroid specific primers, that some mandarins and orange trees were additionally infected with Citrus isolates of HSVd and CEVd. Full length viroid genomes were cloned and sequences determined. Secondary structure analysis of different viroid-isolates revealed a characteristic genome-organisation of CEVd belonging to Genus Pospiviroid and established Sudanese HSTVd isolates as members of the Genus Hostuviroid. Furthermore the presence of Cachexia inducing isolates of HSTVd in the Sudan was proved by molecular methods.

Keywords: Cachexia, citrus exocortis viroid, Hop stunt viroid, sequencing, viroid secondary structure