Assessing the potential maintenance of TYLCV-betasatellite associations

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Betasatellite-associated begomoviruses (family *Geminiviridae*) are reported from Asia and Africa but not from most of Mediterranean countries. The begomovirus/ betasatellite association in natural conditions may not necessarily depend on an extended co-adaptation but merely on coinfection opportunities. Indeed, although the Mediterranean IL and Mld strains of Tomato yellow leaf curl virus (TYLCV) have never been reported in association with betasatellites in natural conditions, they readily transreplicate betasatellite of Asian and African origin in experimental conditions and always with a dramatic increase of symptom severity.

Given the importance of tomato production and the prevalence of TYLCV viruses in the Mediterranean basin, the introduction of a betasatellite may have severe economic consequences. Because the probability of this scenario mainly depends on the putative maintenance of TYLCV-betasatellite association over time, we have studied various factors potentially determining this maintenance in tomato plants using a clone of Cotton leaf curl Gezira betasatellite (CLCuGB): (i) the relative intra-plant accumulation of the DNAs of TYLCV and CLCuGB, (ii) their intra-cellular co-occurrence and (iii) their co- transmission efficiency by the vector *Bemisia tabaci.*

Using real time PCR we have shown that the DNA of CLCuGB accumulated at a similar or higher level than that of TYLCV, and that CLCuGB was efficiently co-transmitted with TYLCV by its whitefly vector. Consistently, at least 70% of the infected plant cells were detected positive by FISH for both TYLCV and CLCuGB. Very unexpectedly up to 25% of the infected cells were positive for CLCuGB only, which indicates at the least that CLCuGB can rely on a very low concentration of helper virus to persist within a cell, and further supports its potential maintenance with TYLCV.

Hence, the risk of an association of TYLCV with a betasatellite cannot be ignored, all the more so as we showed that CLCuGB induce tolerance-breaking of tomato plants bearing the popular Ty-1 gene.