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The Dynamics of Prophages/Phages FP1 and FP2 of '*Candidatus* Liberibacter asiaticus' in Response to Stress Conditions

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'*Candidatus* Liberibacter asiaticus' (Las), the prevalent bacterial pathogen associated with citrus huanglongbing (HLB), harbors at least two prophages, named FP1 and FP2. Due to the fastidious nature of Las, little is known about the prophage's response to stress conditions. In this study, we used real time PCR to investigate the potential conversion of the FP1 and FP2 prophages under stress conditions by comparing the 16S rDNA copy number in HLB-affected periwinkle and citrus. When HLB-affected periwinkle was exposed to heat stress for 4.0 hours, more FP1 and FP2 phage particles were released at 42℃ and 45℃ than at 37℃. A temperature increase from 23℃ to 37℃ caused the relative copy numbers of FP1 and FP2 to increase six folds, while a shift from 23℃ to 42℃ or 45℃ caused the relative copy numbers of FP1 and FP2 to increase between 7.5 and 15-folds compared to the initial samples. Meanwhile, similar results were found when HLB-affected citrus scions were treated with tetracycline at concentrations of 500 ppm to 2000 ppm by soaking for three days. When treated with tetracycline for 7 to 9 hours, the relative copy numbers of FP1 and FP2 reached their highest levels with an increase of 6 to 11.1-folds compared to the initial samples. The results indicate that stress causes the prophages in Las to convert from the lysogenic to lytic cycle. Furthermore, transmission electron microscopy (TEM) provided direct evidence that an upward temperature shift is accompanied by the lysogenic to lytic conversion. This conversion from the lysogenic to lytic cycle may have applications in terms of modulating HLB populations in naturally occurring infections. The study gives new insight into the interaction of prophages and HLB, which may play a potentially important role in the control of HLB.