

MicroRNAs Are Predicted to Control the Ubiquitin/Proteasome System in *Carica papaya* Plants Infected by the Papaya Meleira Virus Complex [†]

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Abstract: Papaya sticky disease (PSD) is a severe disease that can destroy papaya trees. PSD is associated with a complex formed between a toti-like virus, Papaya meleira virus (PMeV), and an umbra-like virus—Papaya meleira virus 2 (PMeV2). PSD symptoms only appear after flowering, indicating that at the pre-flowering stage, there is a host stress response associated with tolerance to sticky disease symptoms. Transcriptomic and proteomic analyses of symptomatic plants revealed the modulation of protein turnover, suggesting the involvement of the ubiquitin/proteasome system (UPS) in this pathosystem. In parallel, the analysis of microRNAs modulated during the infection showed that microRNAs predicted to target *UPS* genes were specially altered. This study aimed to evaluate the importance of UPS for *C. papaya*–PMeV complex interaction by revisiting transcriptomic and proteomic datasets obtained from infected plants at different developmental phases. In the referred datasets, 1074 transcripts and 80 proteins were related to the UPS pathway. Among the 42 UPS-related genes responsive to PSD, 22 were detected at the transcript level and 21 at the protein level. In addition, the microRNAs predicted to target UPS-related genes were identified, especially those altered during papaya infection by PMeV complex. A total of 106 miRNAs assigned to 33 miRNA families and targeting 146 gene transcripts were found. Among them, 22 miRNAs were predicted to target four genes (U-box domain-containing protein, protein with BTB/POZ domains, 26S proteasome regulatory complex subunit PSMD10, and zinc finger C2H2 type domain) that were observed to be modulated at the transcript level at the pre-flowering stage and one gene (ubiquitin binding domain protein) modulated at the protein level at the post-flowering stage. Experimental evidence supports the idea that key miRNAs were especially relevant in controlling UPS during *C. papaya* response to the PMeV complex. The miRNA expression and the consequent reduction in transcripts levels could result in increased PMeV complex tolerance in *C. papaya*. The results presented here add to the knowledge on UPS involvement during virus infection in plants.

Keywords: Papaya sticky disease; Ubiquitin/proteasome system; microRNA



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