Functional analysis of the *MMS19* gene in *Carica papaya*

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Abstract

All terrestrial organisms face DNA-damaging radiation in the form of UV-B light and have evolved mechanisms to avoid, repair or undo damage directly. DNA repair genes exist within all of eukaryotes and play important roles in organismal physiology. Plants being mostly stationary organisms must cope with damaging UV-B rays in a molecular fashion and so have developed many forms of resistance to DNA-damaging agents. *MMS19* is implicated in DNA repair indirectly as a nuclear encoded gene that delivers Fe-S clusters to the enzymes that maintain genome integrity. A naturally occurring mutant within the transgenic SunUp variety of *Carica papaya* has a large deletion for this gene and presents a dwarfed/reduced phenotype under normal growth conditions. The role of *MMS19* mutants in previous studies indicates a strong sensitivity to alkylating agents and UV-B radiation. It is hypothesized that deficient DNA repair mechanisms will shunt cells out of the natural cell cycle and reduce cell proliferation and differentiation. In this study the MMS19-deletion mutant phenotype was characterized using transmission electron microscopy, fluorescent microscopy, and qrt-pcr to quantify gene expression profiles. We observed that mutant cells within leaf tissues were smaller in size and showed increased autolytic activity through vacuolar mediated autophagy when compared to wild type. Analysis of mRNA expression levels confirmed that the mutant type down regulated WEE-1 kinase, a gene important in halting cell cycle progression during DNA-integrity checkpoints. This supports the hypothesis that the MMS19 mutant lacks sufficient DNA repair to undergo normal cell cycle progression. We conclude here that MMS19 is necessary for maintaining normal growth and development of the tropical fruit tree papaya in the face of naturally occurring genotoxic stress.