Tomato receptor-like cytoplasmic kinase TPK09 mediates plant response to both disease and light stress.

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The ability to recognize and quickly respond to diverse environmental cues allows plants to cope with biotic and abiotic stressors. This process requires highly regulated plant response signaling involving a complex hierarchy of genetic regulators. Plant receptor-like cytoplasmic kinases (RLCKs) have been studied for their signaling function in the control of biotic stress response. However, their role in responding to abiotic stressors such as light quality and quantity is poorly understood in model and crop plants. Here, we determined the function of Tomato Protein Kinase 09 (TPK09) in mediating response to pathogen infection and light stress. We found that CRISPR-cas9-generated tomato TPK09 mutants are more susceptible to the fungal pathogen Botrytis cinerea. Consistently, the mutants had impaired defense gene expression and reduced accumulation of reactive oxygen species in response to chitin and flg22 that are potent immune elicitors. TPK09 expression is induced by Botrytis infection, and various plant hormones. Interestingly, the TPK09 mutants also exhibited an elongated hypocotyl, which is indicative of impaired responses to light. The mutant plants exhibited progressive cell death under light-emitting diode lights (LED) and showed reduced total chlorophyll content. However, the chlorophyll a/b ratio was comparable to the wild type, suggesting an overall reduction in the activities of both PSII and PSI. This impaired response to light stress in the mutant is demonstrated by a decrease in the effective photochemical quantum yield of PSII and electron transport rate. These observations suggest that TPK09 is required to restrict damage from both pathogen attack and light stress.