

The Flavonol synthesis in the pistil increases tomato reproductive success

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Global increases in ambient temperature pose a significant threat to crop productivity through disruption of the highly sensitive process of sexual reproduction. In tomato (*Solanum lycopersicum*), heat stress severely impairs pollen viability, and pollen tube elongation, primarily through the accumulation of reactive oxygen species (ROS). Flavonols, specialized metabolites with potent antioxidant capacity, increase reproductive success under heat stress. Using a genetic approach, we used three tomato genotypes, a wild-type (VF36), flavonol-deficient (the *anthocyanin reduced*, *are*) mutant with a point mutation in *FLAVONONE 3-HYDROXYLASE* (*F3H*), and transgenic lines overexpressing *F3H* (VF36-T3). Our results indicated that pollen of the *are* mutant exhibits heightened thermosensitivity, while the VF36-T3 line, characterized by higher levels of flavonols, maintains thermotolerance. To move beyond pollen, I am examining flavonols and ROS levels in tomato pistils of these three lines. Using live cell imaging, with the flavonol-specific dye DPBA (diphenylboric acid 2-aminoethyl ester), and the H₂O₂ sensor Peroxy Orange 1, we established that these genotypes have flavonols levels in pistils that parallel those in pollen and ROS accumulation in the pistil is inversely proportional to endogenous flavonol concentrations. Reciprocal crosses under both optimal and elevated temperature conditions, suggest that the genotype of the maternal pistil tissue is a critical determinant of pollen tube growth. Under heat stress, VF36-T3 pistils supported more pollen tube elongation even when pollinated by the thermosensitive *are* mutant. On the other hand, *are* pistils had reduced germination and growth, an effect partially rescued by flavonol rich VF36-T3 pollen. We are currently employing targeted liquid chromatography-tandem mass spectrometry to quantify specific flavonol profiles prior to and following pollen tube penetration under both control (28/21°C) and heat stress (34/28°C) conditions. These findings suggest that flavonols function as essential redox buffers within the pistil, facilitating successful fertilization by neutralizing heat induced ROS. By characterizing the metabolic requirements for pollen-pistil successful interaction under heat stress, we will identify the key metabolic markers necessary for the development of heat resilient tomato cultivars. (*This work is supported by USDA-NIFA 2026-67013-45819*) -).