038
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Developing an AI-based System for Analysis of Pollen Thermotolerance.

Pollination and fertilization are critical for fruit set in tomatoes. This study aims to develop a reliable and efficient method for screening pollen thermotolerance. In viable pollen grains, fluorescein diacetate (FDA) is converted to fluorescein by cytoplasmic esterase activity and propidium iodide (PI) labels pectin in cell walls. Dead pollen grains become permeable to PI, therefore displaying PI fluorescence inside pollen grains. Images acquired under a fluorescent microscope have viable pollen in green and dead pollen in red. A head-tail structure characterizes germinated pollen grains. In this project, we have developed an AI-based method for automatically counting viable and dead pollen grains and germinated.
pollen from microscopic imaging. FDA/PI double-stained pollen and germinated pollen stained with aniline blue were imaged under a ZEISS microscope. A novel computer vision framework is developed for fully automatic processing and analysis of raw microscopic image tiles to detect and count the presence of viable, dead, and germinated pollen. The computer vision framework applies a series of morphological techniques to the input image to first detect and then count the viable pollen by rendering contour across each pollen with an identification number. Viable pollen grains are masked upon counting to facilitate unambiguous detection and counting of dead pollen in the second phase of the AI framework. The same framework was customized to detect and differentiate germinated and non-germinated pollen based on the presence of the tail structure. The developed system enables fast and accurate quantitative analysis of thousands of microscopic images for pollen thermotolerance research.