Defining the genetic basis of reproductive heat tolerance in tomato through high-throughput pollen phenotyping, genome-wide association, and predictive modeling

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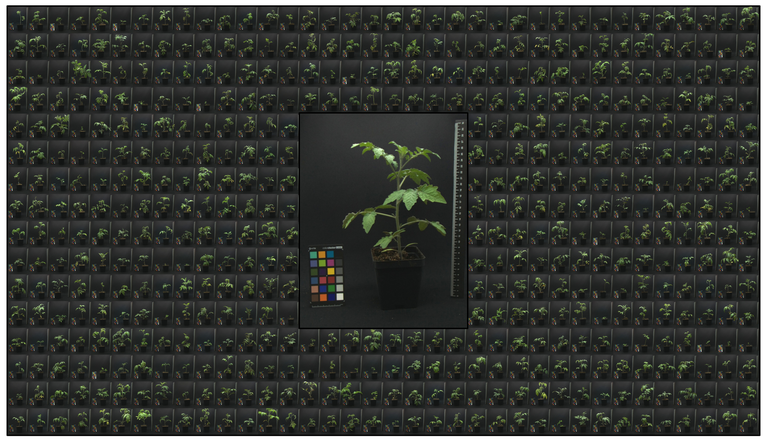
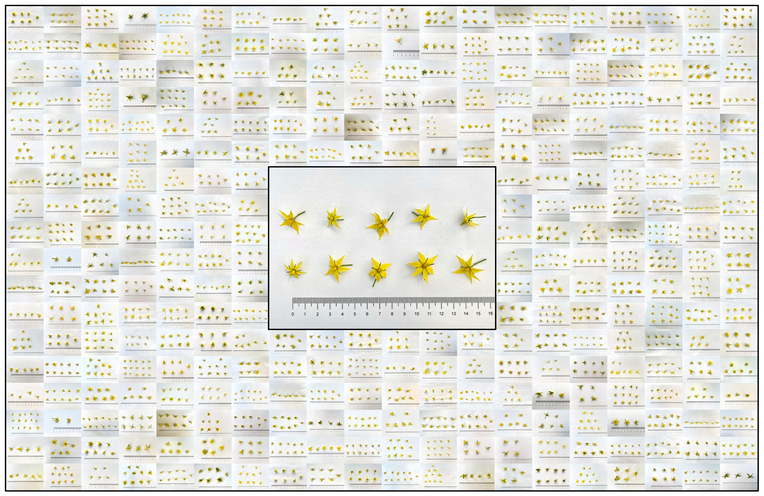
Abstract

Key steps of plant reproduction, including the development and function of pollen, are disrupted after short periods of excess heat, leading to incomplete fertilization and a reduction in seed and fruit yield. This project will survey pollen tube growth phenotypes under heat stress for a wide variety of tomato cultivars and wild relatives (Aim I). Genetic loci associated with variation in these phenotypes will be identified using genome-wide association studies (Aim II). These data will then be used to predict pollen phenotypes under heat stress for ~1000 sequenced tomato cultivars (Aim III). A broader understanding of heat stress during pollen tube growth will guide future breeding efforts to create novel heat tolerant tomato varieties. In addition, methods developed during this project will be readily adaptable to non-model species, accelerating the process of crop improvement for a wide range of climates. As part of this project, high school, undergraduate, and graduate students will be trained in plant biology, quantitative genetics, and computer vision. Research and outreach will take place in the Palanivelu Laboratory at the University of Arizona.

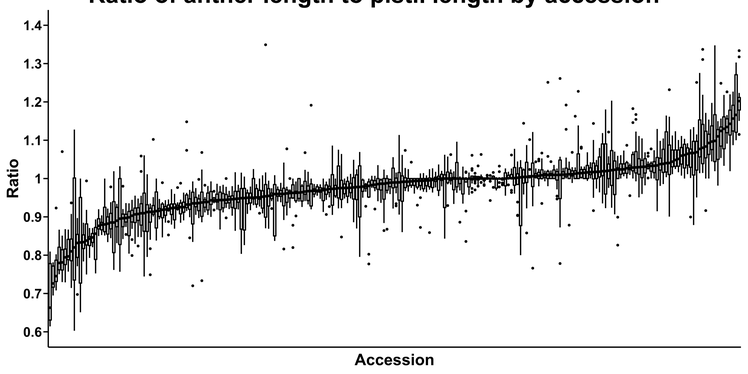
220 accessions were grown to capture genetic diversity of tomato and wild relatives

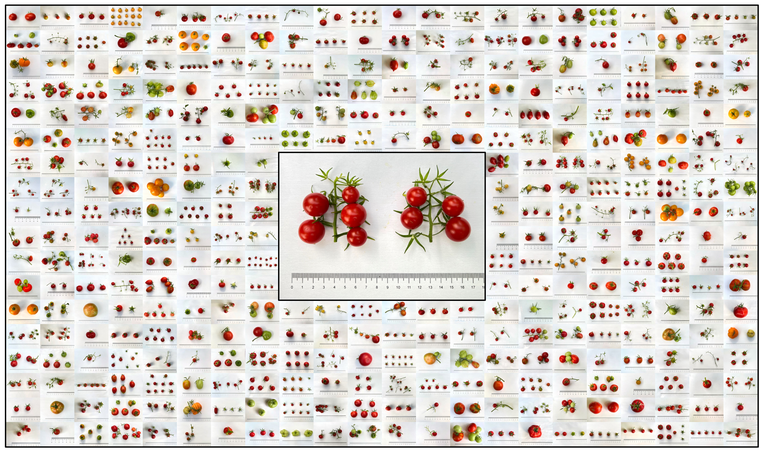


Tomato flowers and fruits have a wide range of phenotypes

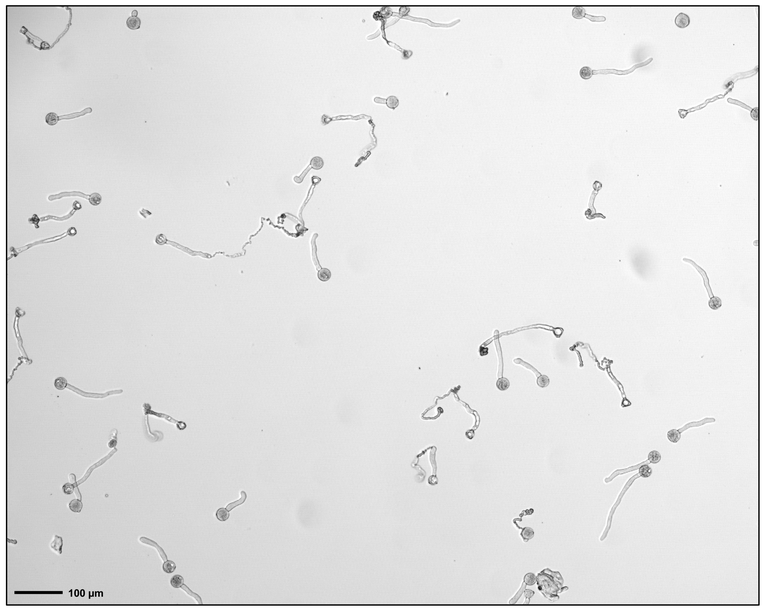


Ratio of anther length to pistil length by accession

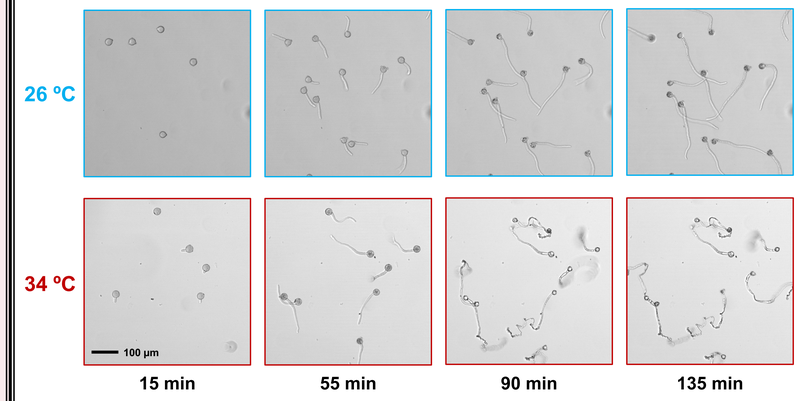




Heat stress affects pollen tube growth



>275,000 time-series images of pollen tube growth



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