



# Environmental Systems

## Ph.D. Dissertation Defense

### Association Genetics of Drought Tolerance in Ponderosa Pine (*Pinus ponderosa*)

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Environmental Systems

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**Date:**

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**Time:**

2:00 - 3:00 pm

**Location:**

[Zoom Link](#)

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**Abstract:**

Drought stress is a major cause of tree mortality in Mediterranean coniferous forests. Despite the high economic and ecological importance of ponderosa pine (*Pinus ponderosa*) in the western United States, no previous study has investigated the genetics of drought tolerance in this species. This study combines genotype-to-environment (G2E) and genotype-to-phenotype (G2P) association genetics to identify both the genetic loci and phenotypic traits that may influence variation in *P. ponderosa* drought tolerance. I made use of genotyping-by-sequencing (GBS), which is a robust and cost-effective genotyping method, and compared four GBS bioinformatics pipelines to obtain the Single Nucleotide Polymorphism (SNP) markers. The Stacks reference-based pipeline identified 4 million SNPs in 223 ponderosa pine individuals across the Sierra Nevada mountains. In the G2E analysis with these SNPs and five chosen climatic variables, thousands of associations representing a range of different protein functions were identified, including ubiquitination, the abscisic acid signaling pathway, cell division or growth of roots or shoots, cell wall organization, and seed dormancy. For the G2P analysis, I conducted a greenhouse experiment to identify drought-responsive traits in seedlings from 48 maternal families. I then ran a G2P association with the previously identified genotypes and these traits. There was considerable overlap in protein functions associated with both environmental variables and drought-responsive traits. Potentially, future studies can develop molecular tools based on the associated genetic markers to assist breeders and gene resource managers in developing and managing adapted populations.

**Biography:**

Mengjun Shu received a B.S. in Geography in 2013 from Sun Yat-sen University and joined the Environmental Systems Graduate Group in 2015 at UC Merced. She was awarded ES summer fellowship in 2017 and 2018, as well as Graduate Student Opportunity Program Fellowship in 2018 and 2019. Her research interests include using genetic techniques to understand how trees respond to the changing climate.

