The Chemical and Structural Effects of Wildfire Smoke on Triticum aestivum Oryza sativa, and Brassica oleracea var. italica: A Multimodal Microscopy and Germination Matrix Analysis

Thogerson, Anders (School: Joel E. Ferris High School)
Osborne, Teddy (School: Joel E. Ferris High School)

Wildfire smoke increasingly impacts agricultural land, specifically in the PNW, yet the effects of seed exposure to smoke remain poorly understood. This study investigated the effects on plant growth triggered by seed exposure to wildfire smoke and explored potential mechanisms involved. In our experiment, we used three seeds from three different species(Oryza sativa, Brassica oleracea var. italica, and Triticum aestivum). Five experimental replicates containing control and experimental groups for all three seeds were conducted: two exposed to simulated 20-day conditions and three exposed to simulated 35-day exposure conditions. Following smoking, a subset of seeds was analyzed using Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM), and the remaining were germinated in Petri dishes for 10 days. Ultimately, we found significantly slower germination and shorter seedling growth in the 35-day simulated smoke exposure groups, with insufficient evidence in the simulated 20-day groups. The FTIR data provided preliminary evidence indicating changes in the amide I protein and carbohydrate/fingerprint regions across all three seed types. The SEM images showed significant particle deposits, as well as substantial seed coat folding and cracking in the experimental groups that weren’t present in the control. These findings suggest potential molecular pathways involved with smoke-induced stress responses. Next steps would likely include further researching the MSR and suberin biosynthesis pathways, as many of our results give promising evidence suggesting those two as targets for further investigation.

Awards Won:
Second Award of $2,400