Excellence in Research: Phytohormones and Heat-Induced Loss of Wheat Resistance to Hessian Fly

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Abstract of the project
Heat stress can compromise plant resistance to insects, but the mechanism of the heat stress-induced loss of host plants remains largely unknown. Overwhelming evidence have indicated that phytohormones salicylic acid (SA), jasmonic acid (JA), 12-oxo-phytodienoic acid (OPDA), and auxin play critical roles in plants' response to biotic and abiotic stresses. This proposal aims to understand the role of phytohormones in resistance (R)-gene-medicated host plant resistance to insects under heat stress using wheat (Triticum aestivum)-Hessian fly (Mayetiola destructor) interaction as a model. Our overall hypothesis is that phytohormones JA, SA, OPDA, and Auxin affect OPDA metabolism in wheat plants and influence wheat resistance to Hessian fly under heat stress. To test this hypothesis, Molly, a Hessian fly resistant cultivar containing the R-gene H13 and its susceptible near-isogenic line Newton will be infested by an avirulent biotype GP Hessian fly. The infested plants will be subjected to heat stress, and the combination of heat stress and external application of phytohormones SA, JA, OPDA, and/or Auxin, respectively. We will deploy a combination of phenotyping, biochemical and molecular analyses, and metabolomics approaches to analyze the roles of phytohormones in sensitivity of plant insect resistance to temperature changes. The objectives of our research are 1) to determine the impact of phytohormones on wheat resistance phenotype to Hessian fly under heat conditions, 2) to demonstrate the impact of phytohormones on OPDA metabolism in wheat plants under heat stress, 3) to examine the impact of phytohormones on transcript expression of wheat genes potentially contributing to wheat resistance/susceptibility to Hessian fly under heat stress, 4) to determine the impact of phytohormones on lipid and fatty acid metabolisms at Hessian fly feeding sites in wheat plants under heat stress. We anticipate that our results will depict the role of phytohormones in affecting wheat resistance expression and reveal the importance of OPDA metabolism in heat-induced loss of wheat resistance to Hessian fly infestation.

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