

MOLECULAR BASIS OF HOST DEFENSE AGAINST GREEN PEACH APHID

Vijay Singh¹; Joe Louis¹; Hossain Ali Mondal¹; Vamsi Nalam¹; Brian Ayre¹; John Reese²; Jyoti Shah¹.

¹*Department of Biological Sciences, University of North Texas, Denton, TX 76210, USA; shah@unt.edu*

²*Department of Entomology, Kansas State University, Manhattan, KS 66502, USA.*

Aphids are phloem-feeding insects that are important pests of a wide variety of plants. Aphid feeding results in the removal of phloem sap and alterations in source-sink patterns, both of which limit plant productivity. In addition, several aphids also vector viral diseases. *Myzus persicae* (Sulzer), commonly known as the green peach aphid (GPA), is a polyphagous insect with a wide-host range that includes the model plant *Arabidopsis thaliana*. *Arabidopsis* utilizes antibiotic and antixenotic mechanisms to curtail GPA infestation. We have exploited this interaction between *Arabidopsis thaliana* and GPA to characterize the molecular basis of host defense against GPA. Our studies indicate that the *PAD4* (*PHYTOALEXIN-DEFICIENT4*) gene, which encodes a protein that is homologous to eukaryotic α/β fold hydrolases, is an important modulator of *Arabidopsis* defense against GPA. *PAD4* is required for deterring insect settling on the plant, and for limiting insect feeding from sieve elements and fecundity. In addition, *PAD4* is required for the activation of premature leaf-senescence that is activated in response to the infestation. *PAD4* expression is induced in response to GPA infestation. This increase in *PAD4* expression is modulated by the *TPS11* gene, which encodes an enzyme that synthesizes trehalose, a non-reducing disaccharide. Our studies are suggestive of a regulatory function for *TPS11* and trehalose metabolism in promoting defense against GPA. In addition to modulating *PAD4* expression, recent studies indicate that *TPS11* promoted reallocation of carbon into starch at the expense of sucrose, which is the primary plant-derived carbon and energy source for GPA, contributes to host defense against the insect. *Arabidopsis* also utilizes an additional antibiosis mechanism that involves the *MPL1* (*MYZUS PERSICAE-INDUCED LIPASE1*)-encoded lipase. This mechanism parallels the *PAD4*-dependent mechanism. Genes similar to *PAD4*, *TPS11* and *MPL1* exist in other plants, suggesting that their function in defense against GPA is likely conserved beyond *Arabidopsis*.