Resistant wheat rebuilds cell walls when attacked by Hessian flies

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(PhysOrg.com) -- Wheat plants found to be resistant to Hessian fly larvae may be calling in reinforcements to build up rigid defenses.

Christie Williams, a research scientist with the U.S. Department of Agriculture's Agricultural Research Service and a Purdue University associate professor of entomology, found that resistant plants under attack by Hessian fly larvae increased production of surface waxes and cutin, a molecule responsible for rigidity and integrity of epidermal cells. In plants susceptible to the fly larvae, the genes thought to be responsible for cutin production were turned off - likely by the attacking larvae.

"The fly larvae seem to hijack the regulation of certain plant genes and cause the plant to turn off defenses that would keep it from becoming susceptible," said Williams, whose results were published in the early online version of The *Plant Journal*. "If we could find a way to block the larvae from affecting genes that are responsible for cutin production or find a way to keep that cutin from degrading, the plants might be more resistant."

Hessian fly larvae deposit saliva on wheat at their feeding site, and that ultimately makes the leaf surface permeable. The larvae then lap up the liquid that flows out of the plant's cells.

"We believe that the susceptible plants are becoming permeable because cutin is being degraded and not replenished," Williams said.

The changes in waxes and cutin production were measured through gas chromatography, in which samples from feeding sites were carried by a gas through a liquid column to separate the chemicals.

Jill Nemacheck, a USDA/ARS biological sciences technician at Purdue, said susceptible plants had large decreases in cutin. Resistant plants had slight increases in cutin and large increases in the wax found in the cuticle, or surface layer, of wheat plants.

Williams and Nemacheck also observed that expression of the genes thought to be responsible for cutin and wax production was affected by the fly larvae.

Nemacheck said real-time polymerase chain reactions were used to quantify gene expression. The process uses an enzyme and other reagents to amplify target sequences from the gene of interest to levels that are detectable in order to determine the levels of messenger RNA in the tissue samples. Comparing the amount of messenger RNA in different plant samples is important because messenger RNA carries instructions that tell cells which proteins to produce, such as those responsible for generating cutin or wax. Less messenger RNA in the original tissue samples would indicate lower levels of gene expression, which ultimately determines cutin or wax production.

"The change in gene expression reflected what we observed," Nemacheck said. "In resistant plants, expression of the genes that control wax and cutin production was increased. Susceptible plants had a decrease in the expression of those genes."

Plants were determined to have become permeable through staining the tissue with a red dye that was placed on the larvae feeding sites. Resistant plants that were observed to have increased cutin production had slight red spotting along the leaves from the dye. But those that were

susceptible absorbed the dye because cutin was lacking and the dye was able to seep into the plant's cells.

More information: Changes in Properties of Wheat Leaf Cuticle During Interactions with Hessian Fly, The *Plant Journal*, online May 2010.

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