Abstract
Hessian fly is a serious invasive pest that causes millions of dollar damage each year. The goal of this study was to investigate how the Hessian fly resistant wheat differs from the susceptible wheat after the infestation? Our result showed that the resistant plants can develop and grow in susceptible wheat, but die in resistant plants. We found differences in protein profiles in host plants when we compare the feeding site vs non feeding site samples on HPLC. This experiment is important to understand the genetic differences between susceptible and resistant crops and differences in gene expression after the hessian fly injected its saliva. The result of this experiment helps understanding on how the hessian fly manipulates host plants for its benefit.

Methods and Experimental Design

Questions, Hypotheses, and Predictions

Hypothesis: The hypothesis was that the resistant wheat plants receive significantly less hessian fly saliva proteins because the insect proteins could not get into host cells. The susceptible wheat contains more hessian fly proteins because wheat defense is weaker, and therefore, Hessian fly larvae can manipulate and feed in susceptible wheat plants.

Prediction: Hessian fly resistant wheat contains significantly less hessian fly protein than the susceptible wheat.

Study System

The susceptible wheat was ‘Karl 92’ and the resistant wheat was ‘Molly H13’ cultivar. The resistant one is a resistant cultivar and the other one was a susceptible ‘Karl 92’ cultivar. Fourteen days after seeding, the subject plants were exposed to hessian flies. The flies laid their eggs to the leaf blade of the wheat. The eggs hatched and the hessian fly larvae started to feed on the stem of the wheat plants. The plants were kept in the greenhouse for a week so that hessian flies can inject their proteins into the plant. All hessian flies larvae were removed from the plants, then different samples were collected from these plants for further examination. Samples were taken from the feeding site (F) and from the non feeding site (N) resistant plant (R) and same samples were collected from susceptible (S) plant too. Extract was made from these samples, that was later used in a High-performance liquid chromatography (HPLC) to determine the identify, and quantify each component in the extract.

Appearance

The resistant ‘Molly H13’ had a much lighter green color, and it was between 25% to 50% taller compared to the susceptible ‘Karl 92’ cultivar. The difference between the resistant ‘Molly H13’ and susceptible ‘Karl 92’ was that the resistant cultivar had dead Hessian fly larvae on its stem, while susceptible wheat had live Hessian fly larva/pupa in the stem.

HPLC diagram for susceptible feeding site and nonfeeding site

Conclusions
Hessian fly is a serious invasive pest that causes millions of dollar damage each year. This research helped to understand how hessian fly feeds and how the resistant wheat differs from the susceptible. It was interesting to see how hessian altered the wheat plant to improve the efficiency of photosynthesis and made the plant brittle. These data can support development of more new resistant crops, because hessian flies are becoming resistant to the resistant cultivars.

Future Directions
This results should be confirmed on more samples in order to have more consistent results. The large scale study could provide more reliable data to clarify what proteins were exactly injected into the wheat by the hessian fly and how these proteins affected the genetic makeup of the wheat crop, and how the genetic distortion in resistant wheat crop differs from the susceptible one.

References


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I appreciate Dr. Jeremy Marshall and Dr. Ming-shun Chen, for this wonderful research opportunity. I also would like to thank Dr. Younesang Park, for his help with HPLC sampling and Zachary Fleming for the help with my project. I would like to thank Xiaoyan Cheng for the help with making the extracts.

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