# Differential Hessian fly (*Mayetiola destructor*) reactions in resistant and susceptible wheat cultivars

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## Abstract

Hessian fly is a serious chronic wheat, barley and rye pest, that causes huge economical damage in the US every year.
The goal of study was to investigate how the Hessian fly resistant wheat differs from the susceptible wheat after the infestation?
Our result showed that the hessian can grow and develop 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.

## Purpose

The purpose of this research was to **determine the quantity and quality of the proteins** were injected by the hessian fly into the resistant and the susceptible wheat.

## Questions, Hypotheses, and Predictions

Question: Why some plants are resistant and others are susceptible to hessian fly infestation?

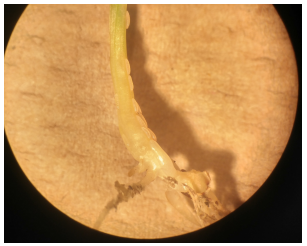
Hypothesis: The hypothesis was that the resistant wheat plants receive significantly less hessian fly saliva proteins because the insect proteins could not get into host cells. The susceptible wheat contains more hessian fly proteins because wheat defense is weaker, and therefore, Hessian fly larvae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

Hessian fly is a serious invasive pest in the United States. It originates from Asia, but it was introduced to the United states by Hessian troops during the American revolution. This invasive pest due to the lack of a natural predator, can cause excessive damage to crops. The hessian fly larvae feeds on the stem of wheat, barley and rye crops. It distracts nutrients from the plant while injecting its saliva into the plant. This way the hessian fly modifies the metabolic pathways of the host plant. There are usually two generations of hessian flies each year. The female fly lays its eggs on the leaf of the crop, after the eggs hatch, the larvae move to the stem where they feed until they reach reproductive maturity.

**Susceptible wheat**
**Karl 92**
**Triticum aestivum 'Karl 92'**



**Resistant wheat**
**Molly H13**
**Triticum aestivum 'Molly H13'**

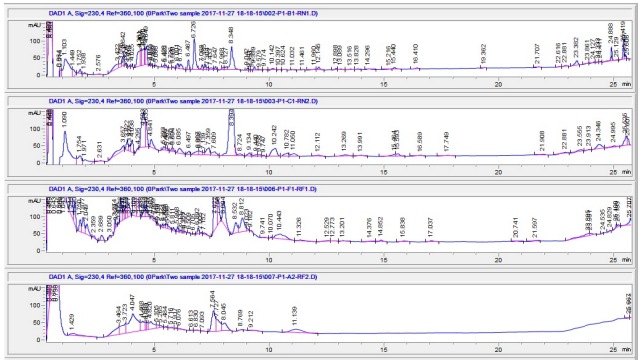
## Methods and Experimental Design

Two different cultivars of wheat were seeded for this experiment. One of them was a resistant 'Molly H13' 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 larva 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 larva were removed from the plants, than 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.

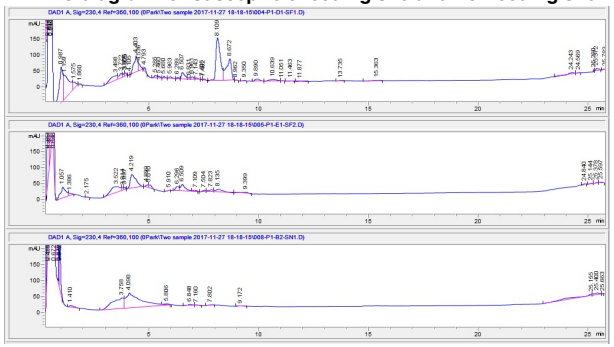
## Appearance

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 11 live hessian fly larvae/pupa in the stem.


## HPLC diagram for resistant feeding site and nonfeeding site



## 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 effected the genetic makeup of the wheat crop, and how the genetic distortion in resistant wheat crop differs from the susceptible one.

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