CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1908

Project Title

Sucrose and Proton Electrochemical Gradients Mediated by Transporters in Phloem Loading as Crucial Aids for B. tabaci

Abstract

Objectives/Goals

Bemisia tabaci is responsible for transmitting East African pandemics of cassava mosaic disease (CMD) and cassava brown streak disease (CBSD). Since the 1990s, there has been an unprecedented rise of cassava whitefly in the cassava-growing regions, increasing the spread of CMD and CBSD. However, expensive insecticides can cause insecticidal resistance and Hemipteran resistance genes are not common in plants.

1. By investigating whether B. tabaci reaches the phloem through the help of the sugar gradient secreted by SWEET sucrose transporter proteins, the proton electrochemical gradient generated by H+-ATPase plasma membrane proton pump, or SUC sucrose transporters, I hoped to gain understanding of the feeding strategies of whiteflies.
2. I needed to determine which sucrose transporter mutant whiteflies had the most difficulty on.
3. If the whiteflies on a mutant showed difficulty in reaching the phloem, I needed to analyze to what degree it deviated from expected data.
4. To obtain the most data, I had to design new cages and staining and clearing protocols.

Methods/Materials

I infested Col-0, atsweet11, atsweet12, atsut1,atsut2, and ataha3 with whiteflies. Whiteflies were then counted and removed, and leaves stained with McBride's to track stylet pathways. I documented the number of stylets, bifurcations, and its locations, and compared the results. I also developed a new whitefly cage and tested various parameters to improve staining and clearing protocols.

Results

After analyzing stylet destination, directionality, and individual successes of feeding in the mutants and Col-0 using linear regression and chi-square goodness-of-fit tests, I clearly determined that whiteflies on atsweet12 had the most difficulty and least success in reaching the phloem. Agar dish infestations cleared up data and clearing stained leaves in an oven at 90°C for 36 hours before mounting produced best results. The electrochemical gradient and SUC mutants are currently being tested.

Conclusions/Discussion

By inducing the gene expression of SWEET12 proteins, whiteflies had an extremely difficult time feeding. Signs of difficulty in the absence of SUC transporters and AHA3 may provide further evidence of phloem loading's role during whitefly feeding and indicate other gradients whiteflies exploit. This new knowledge of the feeding mechanisms of whiteflies is crucial to improving plant defenses. Publication is under way.

Summary Statement

I have determined that by directly suppressing SWEET12 and possibly SUC and H+-ATPase gene expression, successful whitefly feeding was greatly reduced.

Help Received

I give a tremendous amount of gratitude to Dr. Walling and Mr. Thomas for mentoring me through this project and allowing me to use UCR's whitefly colony and facilities. Mr. Thomas assisted me during the experiments and infestation, but the analysis and conclusions reached were conducted by myself.