CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

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Project Number

S1999

Project Title

DNA-Binding Protein in Xcv Bacteria Alters Plant bHLH Gene to Promote Pathogen Growth during Infection: A Genetic Study

Abstract

Objectives/Goals

Xanthomonas, the causal agent of Bacterial Spot Disease in plants, releases 30 effector proteins, including XopD, into the plant host cell during infection. This research is aimed at elucidating the genetic role of pathogen-released DNA-Binding protein XopD in promoting bacteria growth during tomato plant pathogenesis.

Methods/Materials

Initially, a DNA microarray assaying over 22,800 tomato plant genes was conducted to identify gene levels most affected by XopD. bHLH gene levels were unusually high, indicating that this gene may be critical in promoting the growth of Xanthomonas bacteria. Then, Arabidopsis model plants were engineered with the inserted bHLH gene using Agrobacterium-mediated transformation and the floral dipping method. Both engineered and wildtype plants were inoculated with Xanthomonas and bacterial growth was recorded to determine the function of bHLH in bacteria-plant pathogenesis.

Results

I observed that 70% more bacterial colonies grew in engineered plants than in wildtype plants. A 2-sample statistical T-test reported a p-value of 0.022, indicating that 97.8% of the time, the higher bacteria colony counts in plants with bHLH compared to plants without bHLH was due to the effect of the gene alone.

Conclusions/Discussion

The results conclude that XopD protein promotes pathogen growth by stimulating the overexpression of a critical bHLH gene in tomato plants. In the future, scientists can engineer plants without the bHLH gene to develop resistant crop varieties. There are currently no effective bactericides or agricultural practices to control Bacterial Spot Disease, a disease which costs the United States 480 million dollars per year - a number that can easily decrease if such transgenic resistant crop varieties are successful.

Summary Statement

Using a DNA Microarray, Agrobacterium-Plant Transformation, and Bacterial Assays, I discovered the specific genetic role of pathogen-released protein XopD to propose a novel way of controlling the epidemic Bacterial Spot Disease in plants.

Help Received

Dr. Jung-Gun Kim, research associate, taught me critical lab techniques and procedures. I used equipment in the Department of Biology, Stanford University, under the supervision of Dr. Marybeth Mudgett, primary investigator. My science teacher, Mr. Chan, supported me and fed my curiosity.