**AWARD ABSTRACT**

**Proposal 1546625**

**RESEARCH-PGR: Leveraging natural variation in tomato to identify, characterize, and deploy new sources of disease resistance**

Greg Martin, PI Boyce Thompson Institute for Plant Research

Susan Strickler Boyce Thompson Institute for Plant Research

Zhangjun Fei Boyce Thompson Institute for Plant Research

Alan Collmer Cornell University

Magdalen Lindeberg Cornell University

Sam Hutton University of Florida

Dilip Panthee North Carolina State University

**Non-Technical Paragraph (248 words)**

Nearly 30 years of intensive research on the molecular basis of the plant immune system and pathogen infection processes has generated a broad understanding of their underlying mechanisms in certain model plant species. The field is now positioned to use this knowledge to explore the natural genetic variation that contributes to plant immunity and to apply it to crop improvement. This project takes advantage of the interaction of tomato with a pathogen that causes bacterial speck, an economically important disease that decreases the marketability and yield of fresh-market and processing tomatoes. This interaction is a powerful system for understanding disease resistance because both the plant and the pathogen are experimentally tractable. In addition, a vast source of natural genetic variation exists in wild relatives of tomato, all of which can be crossed to cultivated tomato. Our goal is to leverage this natural variation to identify genes that play a role in plant immunity, characterize these genes using molecular methods, and introduce them into fresh-market breeding lines that are important parents in two public tomato improvement programs. An important aspect of the project is the improvement and promotion of a game to entertain and teach high school students and the broader public about the science and importance of plant-pathogen interactions. The enhancement of disease resistance in fresh-market and processing tomatoes could lead to decreased use of pesticides thus saving growers money, reducing the impact of disease control on the environment and providing food for consumers with fewer pesticide residues.

**Technical Paragraph (238 words)**

Diseases of crop plants have major economic and environmental impacts because they decrease yields and require extensive pesticide applications. The overarching goal of this project is to take advantage of the natural variation present in tomato and its wild relatives along with the extensive genome sequence data available to discover new genes/loci that contribute to pattern-triggered immunity (PTI). The molecular functions of these genes will be investigated by using CRISPR-mediated mutations and other approaches and selected genes/loci will be introgressed into two foundational fresh-market tomato breeding lines. Specifically, we will: 1) Screen 200 tomato heirlooms, breeding lines, and wild species accessions for natural variation for PTI using pathogen elicitors and engineered *P. syringae* strains with different effector repertoires; 2) Identify novel PTI-associated loci/genes and develop DNA markers for use in two tomato breeding programs; 3) Develop 150 tomato lines with CRISPR-mediated alterations in candidate immunity-associated genes and characterize them for PTI responses; 4) Introduce novel sources of disease resistance into two fresh-market tomato breeding lines and investigate the molecular functions of PTI-associated loci/genes; and 5) Enhance VEGEVADERS, a game based on plant-microbe interactions, expand functional genomics web resources, develop a plant breeding workshop, and promote educational outreach. Undergraduates, graduate students, and postdocs will be trained in bioinformatics, plant breeding, plant pathology, and functional genomics. Knowledge generated in the project will both enhance our understanding of the plant immune system and lead to tomato varieties with improved disease resistance.