CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

J1829

Project Title

Plant Electrophysiology: How Does the Stimulation of Trigger Hairs Affect Action Potential Generation in Venus Flytraps?

Abstract

Objectives/Goals

This study examined the effect of trigger hair stimulation on the generation of action potentials and their relationship to trap closure in a B52 Venus Flytrap (Dionea Muscipula). I wanted to confirm that one stimulation of a trigger hair resulted in the generation of one action potential. Additionally, two action potentials must reach the midrib within a certain period of time to initiate trap closure, but different scientists claim different durations ranging from 20 to 40 seconds, and I wanted to narrow down that range. Finally, I wanted to see what affect multiple, almost simultaneous, stimulations had upon action potential generation and trap closure.

Methods/Materials

B52 Venus Flytraps were germinated from seed and grown for two years. Each trap was connected via electrode gel to an Arduino board with a Plant SpikerShield, which was connected to a computer. Action potentials were gathered and recorded in the Processing 2 programming language using a plant processing sketch. Trigger hair stimulation was controlled using a linear actuator. The experiment was recorded with 3 cameras, (one running at 240fps) in order to verify and calculate results.

Results

It was found that one trigger hair stimulation resulted in one action potential. However, it was discovered that when two stimulations occurred within 0.229 seconds of each other, only one action potential was generated. Additionally, it was confirmed that two action potentials within 20 seconds of each other closed a trap, except in the special case noted above. Traps also closed intermittently up to 42 seconds between action potentials, suggesting that a trap begins to lose its charge after 20 seconds, and loses its charge completely after 42 seconds.

Conclusions/Discussion

For the next step, a better knowledge of calculus and chemistry would be required to investigate the decisive moment just before trap closure, in which there occurs a myriad of chemical and physical events that are beyond my skill set to evaluate. However, I would like to investigate how the flytrap uses its properties as an electrical storage "battery". In biotechnology, this knowledge could help scientists create a similar "battery" or operate a microcontroller in plants. Understanding how all plants use electricity could pave the way for manipulation of electrical memory in agricultural products and open new forms of electronic communication and real time feedback from crops.

Summary Statement

This study examined the effect of trigger hair stimulation on the generation of action potentials and their relationship to trap closure in a B52 Venus Flytrap.

Help Received

Doug Foster from LA Biohackers answered questions about modifying the SpikerShield circuitry and Timothy Marzullo from Backyard Brains answered questions about software and hardware.