Wheat Stem Sawfly Detection

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Digital-Based Research

Vibration Sensor using an accelerometer in its 3D printed mount to maintain consistent orientation and for better stability (Left). Light Absorption Sensor using an LDR (Light Dependent Resistor) and Laser diode in 3D printed device to maintain consistent distance and orientation between LDR and laser diode (Middle). Capacitive Sensor Using an Arduino (Right)

Results

Capacitive/Impedance sensor performed so poorly that that portion of the digital project was not tested on infested wheat due the fact that measuring minor changes in capacitance is almost impossible.

Goal: To design and test multiple new non-invasive techniques of detecting wheat stem sawfly larvae inside wheat stems

The following three hypotheses were evaluated this year:

- Wheat stem sawfly are insect pests which are non-native to Colorado. They destroy wheat crops and force a lower yield.
- No non-invasive testing methods have been found.
- Statistical analysis has been used to determine field infestation rate

Future Work:

- Research accuracy and viability of Arduino and accelerometer circuit in sawfly detection in fields
- Develop a device that looks for sharp changes in absorption along a wheat stem (from presence of frass) with high resolution

Light Absorption

Absorption can be measured very easily along a wheat stem; our circuit performs this task well (the data has corresponding peaks and troughs with the different colors).

- Green and red light pass through wheat stems most
- Absorption along a wheat stem varies with many factors (thickness of stalk, thickness of wheat stem walls, presence of nodes)

Absorption Conclusions

- Absorption along a wheat stem increases due to sawfly larvae excrement
- Absorption is high along a wheat stem and fairly low on frass
- Absorption must be measured in the field to ensure detection

Background and Summary

- Wheat stem sawflies are able to detect a difference between infested/clear stems, but it does so with no precision

Analog-Based Research

Impedance/LCR

- Commercial LCR meter was used to measure impedance across wheat stems
- Data was noisy, inconsistent, and irreproducible
- Test was overall inconclusive; comparing impedances along a stem may work someday, but we are pessimistic. The difference in impedances of wheat stems and sawfly larvae likely are not different enough to detect easily

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Analog transmitter and receiver circuits were designed and built to test the light absorption method. The receiver output was measured by a handheld voltmeter. The AC voltage was proportional to how much light passed through the wheat stem (ranging from 13mVAC to >2.5VAC).