ISRC Project Update

Project updates should include what steps have been/will be taken and where the researcher is at in the process.

1) Tell us about your project
    - Project Title: Low-cost Multimodal Sensor Arrays for Early Detection of Soybean Diseases
    - Lead PI: Liang Dong
        - Co-PIs: Steve Whitham
    - Projects year(s): 2021-2023
    - Total amount of funding: $60,000
    - Leveraged/Additional Funding, including federal or private organizations: N/A

2) Project Summary
    - Objectives: The project is to develop sensors for low-cost monitoring of several key fungal, viral, and bacterial diseases. The goal is early detection of diseases at a stage when there are often no symptoms, to reduce the risk of disease spreading. The sensor will enable real-time disease monitoring during the growing season that can help farmers to make important management decisions for protecting yield potential.
    - Deliverables: We will deliver an array of non-invasive or minimally invasive electrochemical sensing elements specific to multiple critical biomarkers in the plant. The sensor will be designed, manufactured, and tested towards high detection specificity and sensitivity with low cost.
    - Benefit to Soybean Farmers: This research will provide soybean farmers with a solution to early detection of soybean diseases in their fields. This project will build new measurement capacities needed to tackle challenges in state-wide and nation-wide crop disease prediction and prevention in the future.

3) Progress Update (what steps have been taken/initial set up or early findings)
    - We have developed a low-cost sensor capable of detecting bean pod mottle virus (BPMV) in soybean plants. The sensor utilizes virus-specific nanocavities to recognize BPMV. The sensor uses a differential pulse voltammetry technique for accurate and rapid detection of BPMV in soybean leaves. The sensor has demonstrated a high sensitivity of 100 $\mu A\ ng^{-1}\ mL\ cm^{-2}$ over a linear range of concentration from 0.01 to 100,000 $ng\ mL^{-1}$ with a limit of detection of 10 $pg\ mL^{-1}$. The intra-assay coefficient of variation is <10% for standard samples and <15% for real samples from leaves.

- We have developed a low-cost sensor that can detect salicylic acid of soybean plants under various stresses. The sensor is formed with an array of microscale needles that can be attached to the leaf of soybean. The sensor uses gold nanoparticles as catalysts on the surface of the needles to support redox reactions with salicylic acid. The sensor has demonstrated its ability to detect the target molecules in the soybean leaf with a sub-ppm resolution.
- We are currently writing papers to document this effort.

4) Supporting attachments:

- Photos/graphs/other graphics

(Unpublished photos)

- Supporting documents