GPC Project #: ROBOT

EVALUATION AND DEVELOPMENT OF HIGH-THROUGHPUT PHENOTYPING TECHNOLOGIES FOR PEANUT

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Plant breeding is a numbers game, that is, the more unique progeny a breeding program can evaluate, the higher their chances of identifying breeding lines with significantly improved performance. Equally important to breeding data quantity is data quality. Therefore, it is incumbent on breeders to continually investigate and develop improved methods of phenotyping that are faster, more precise, cheaper, or all of these things.

In 2019, some members of our group began a collaboration to develop high-throughput phenotyping (HTP) methods for peanut breeding research using unmanned aerial systems (UAS), or "drones". Following the positive results from those experiments, in 2021, our group began the planning and design of an automated, ground-based, high-throughput phenotyping robot specifically designed for the conditions found in peanut fields. In 2022, we were able to test the prototype in the field and collect some initial data. There were several set-backs that we encountered during testing last year, including issues with the automated guidance. However, those challenges have been addressed, and we are hopeful that we will be able to collect a large amount of data with the robot in 2023.

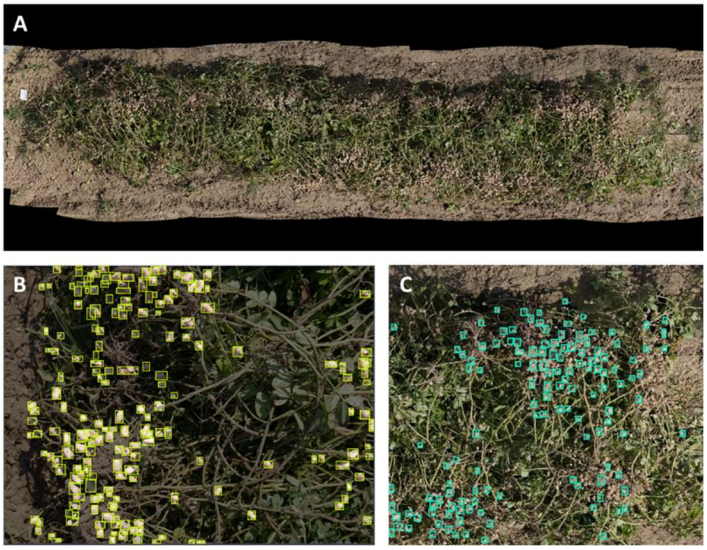

Figure 1. *Images taken by Watson cameras were (A) stitched to form a composite image from approximately 52 individual images taken by three cameras. (B) Peanut pods were manually tagged (yellow boxes) to feed into the AI program to train the model. (C) The model was then executed on new images to test the program's ability autonomously recognize peanut pods in the images (blue boxes).*

We are currently using artificial intelligence systems (AI) to build an algorithm to identify peanut pods in images taken by Watson in 2022 (**Figure 1**). Once the image analysis is complete, we will compare the actual yield and estimated pod counts to the data generated from the robot images. Our goal is to eventually have the computer do this analysis "on the go" in the field without the need for human intervention or for secondary image analysis. There are many other traits that we are interested to measure with the robot in the coming growing season.

We were recently awarded additional funding to support the team that will be in charge of data collection and image analysis, and to cover some of the operational costs associated with large-scale deployment. Our goal is to continue to develop a machine that can operate autonomously over rough terrain, under muddy conditions, and before and after the peanut canopy closes. Our intent is to first deploy the robot in breeding trials, but other research programs will eventually also benefit from this technology. It could even be used some day to scout grower's fields for disease or nutrient issues. This machine has a great deal of potential for growers as well as researchers.