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" (Fig. 1). 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. Our goal is to develop a machine that can operate over rough terrain, under muddy conditions, and before and after the peanut canopy closes. The machine will need enough ground-clearance to drive over peanut plants in the field throughout the growing season, but low enough for high resolution imaging. The robot will navigate autonomously through the field or with a controller.

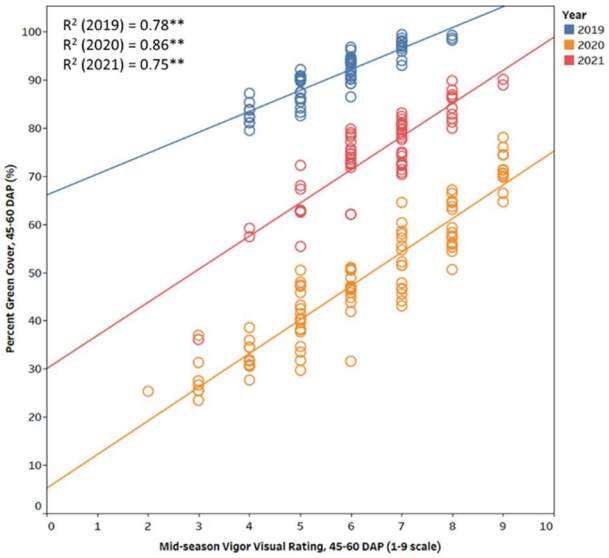

Figure 1. Comparison of mid-season vigor visual ratings with UAS-derived percentage of plot area covered by green pixels (leaves).

It will take highly detailed measurements using red-green-blue (RGB) cameras, multi-spectral sensors, and other devices. The proposed machine, which is currently in prototype form and is being lab-tested in Charlie Li's lab in Athens, will have the size and weight capacity to carry a suite of sensors. Additionally, it could be customized to carry any number of payload devices for automated HTP, disease, insect, or weed scouting, automated cultural practices such as mechanical weed control, spot-spraying, or any number of applications.

Our intent is to first deploy the robot in breeding trials, herbicide trials and others to be determined. We hope to test the device against human and UAS-based evaluations in 2022 as we start to deploy this exciting new tool into the peanut research field. This machine has a great deal of potential for growers and researchers.